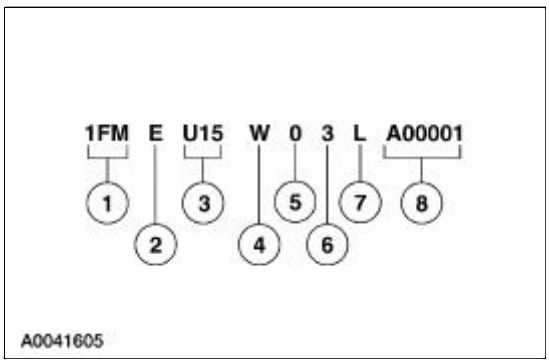
Identification Codes

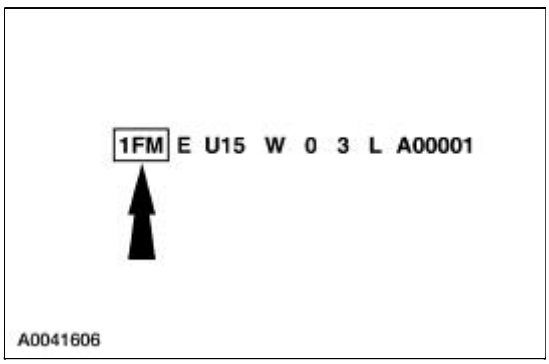
The vehicle identification number (VIN) is a seventeen-digit combination of letters and numbers. The VIN is stamped on a metal tab riveted to the instrument panel, top upper left of the dash. The VIN number is also found on the vehicle certification (VC) label.



Item	Description
1	World manufacturer identifier (WMI)
2	Brake type and gross vehicle weight rating (GVWR)
3	Vehicle line and series
4	Engine type
5	Computer-generated check digit
6	Model year
7	Assembly plant
8	Production sequence number

Vehicle Identification Number (VIN)

World Manufacturer Identifier (WMI)

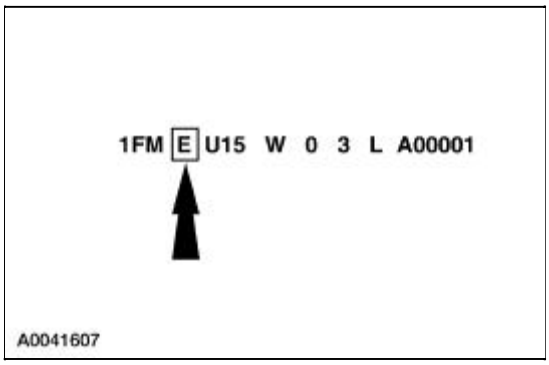


The first three vehicle identification number (VIN) positions are the world manufacturer identifier.

- 1FM — Ford Motor Company, USA, multi-purpose vehicle

- 5LM — Lincoln, USA, multi-purpose vehicle

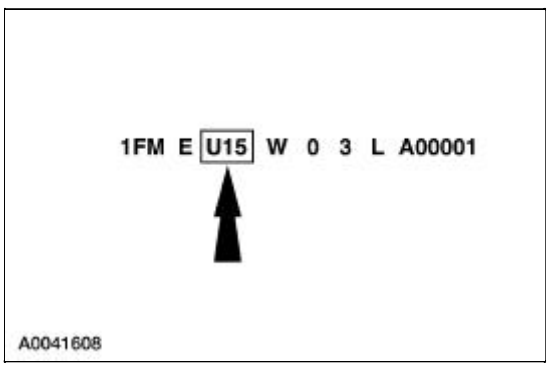
Brake Type and Gross Vehicle Weight Rating (GVWR)



The fourth VIN position is the vehicle brake type and gross vehicle weight rating (GVWR) code. All vehicle use hydraulic brakes.

- E — 6,001-7,000 pounds GVWR with driver and front passenger air bags and driver and front passenger side impact air curtains
- F — 7,001-8,000 pounds GVWR with driver and front passenger air bags and driver and front passenger side impact air curtains
- R — 6,001-7,000 pounds GVWR with driver and front passenger air bags
- P — 7,001-8,000 pounds GVWR with driver and front passenger air bags

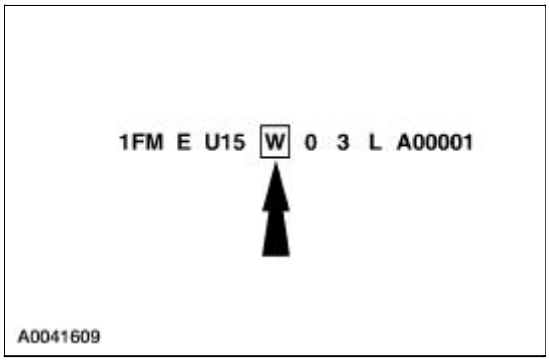
Vehicle Line and Series



Positions 5 through 7 indicate vehicle line and series.

- U15 — Expedition, 4x2, XLT
- U16 — Expedition, 4x4, XLT
- U17 — Expedition, 4x2, Eddie Bauer
- U18 — Expedition, 4x4, Eddie Bauer
- U27 — Navigator, 4x2
- U28 — Navigator, 4x4

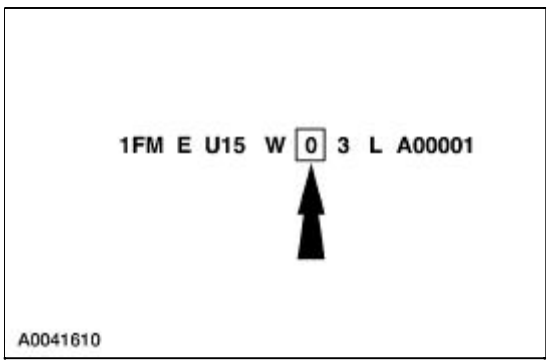
Engine Type



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

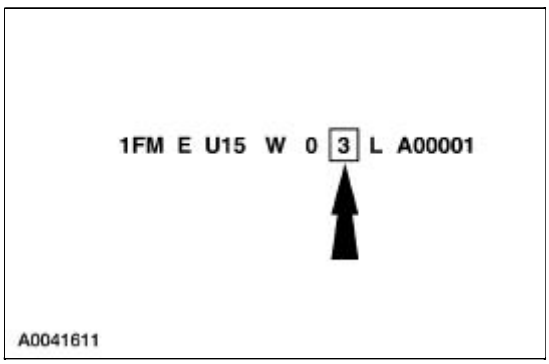
- L — 5.4L, SOHC, EFI, 2V, V-8, gas
- R — 5.4L, DOHC, EFI, 4V, gas
- W — 4.6L, SOHC, EFI, V-8, gas

Computer-Generated Check Digit



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

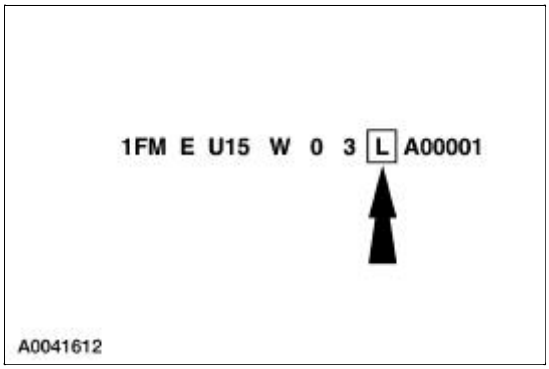
Model Year



The tenth VIN position is the model year code.

- 3 — 2003

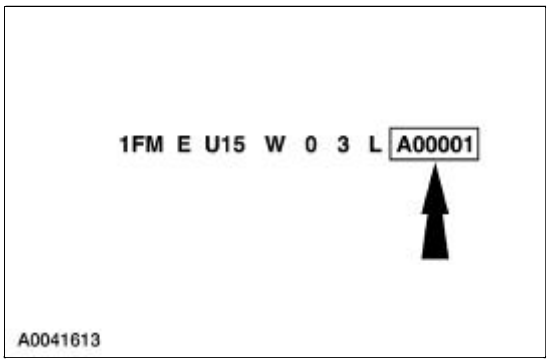
Assembly Plant



The eleventh VIN position is the assembly plant code.

- L — Michigan Truck (Wayne, Michigan)

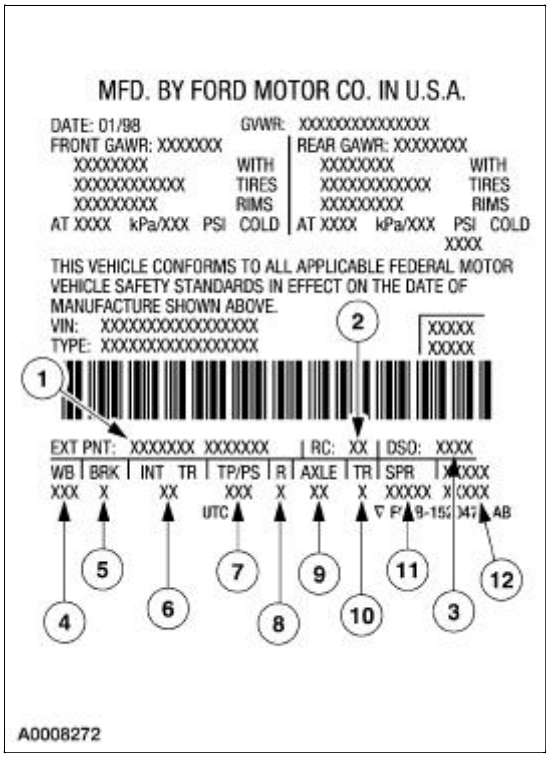
Vehicle Build Sequence



The last six VIN positions are an alphanumeric code for the vehicle build sequence. This is also the vehicle serial and warranty number.

- A00001-C99999 — Ford Division
- J00001-L99999 — Lincoln Division

Vehicle Certification (VC) Label



Item	Description
1	Exterior paint code
2	Region code
3	Domestic special order code
4	Wheelbase code
5	Brake code
6	Interior trim code
7	Tape/paint pinstripe code
8	Radio code
9	Axle code
10	Transmission code
11	Spring code
12	Powertrain calibration information

The vehicle certification (VC) label contains the manufacturer name, the month and year of manufacture, the certification statement, and the VIN. It also includes gross vehicle weight ratings (GVWR).

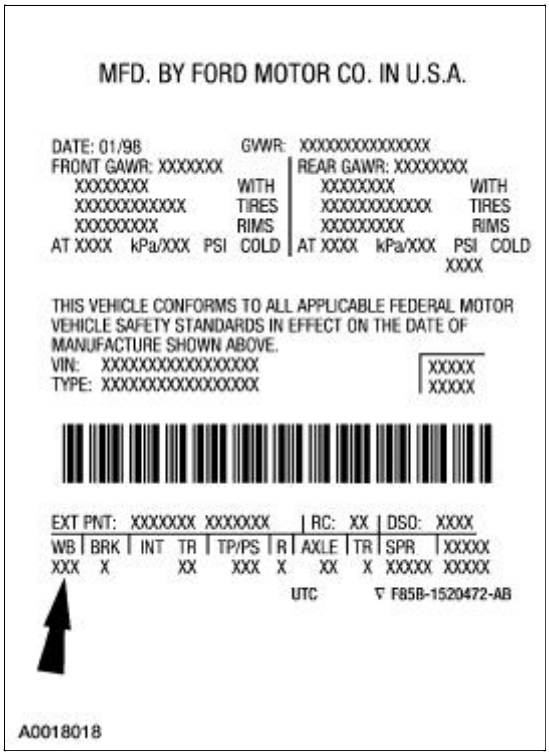
Exterior Paint Code



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

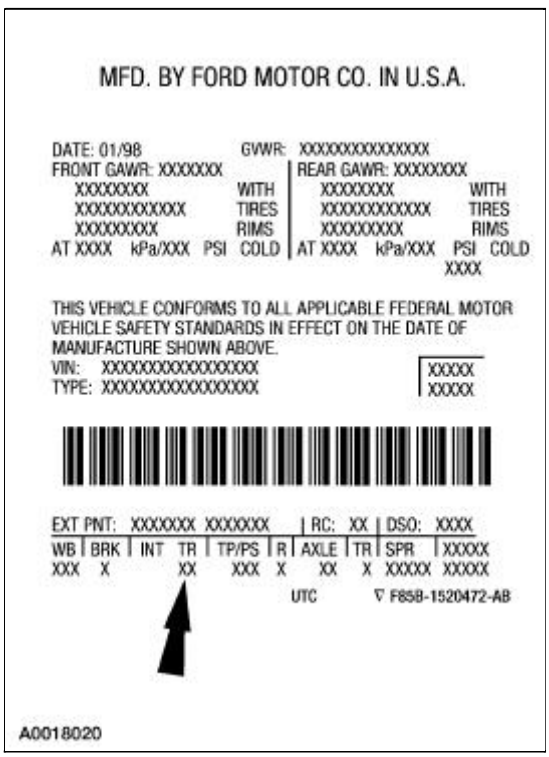
- AQ — Arizona Beige — Expedition
- CX — Dark Shadow Gray — Expedition
- E9 — Laser Red Tint — Expedition
- GT — Autumn Red — Navigator
- JP — Silver Birch Metallic — Expedition/Navigator
- L2 — True Blue — Expedition
- LD — Medium Wedgewood Blue — Expedition/Navigator
- P5 — Aspen Green Metallic — Expedition/Navigator
- ST — Estate Green — Expedition
- TK — Mineral Gray — Navigator
- UA — Ebony — Expedition/Navigator
- YZ — Oxford White — Expedition/Navigator

Wheelbase



- 119 — 119-inch (3,023 mm) wheelbase

Interior Trim



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

Trim Type

- F — Cloth captain's chairs front, Expedition (XLT)

- K — Leather captain's chairs front, Navigator
- 1 — Leather captain's chairs front, Expedition (XLT, Eddie Bauer)
- M — Cloth — 60/40 front, Expedition

Interior Trim Color

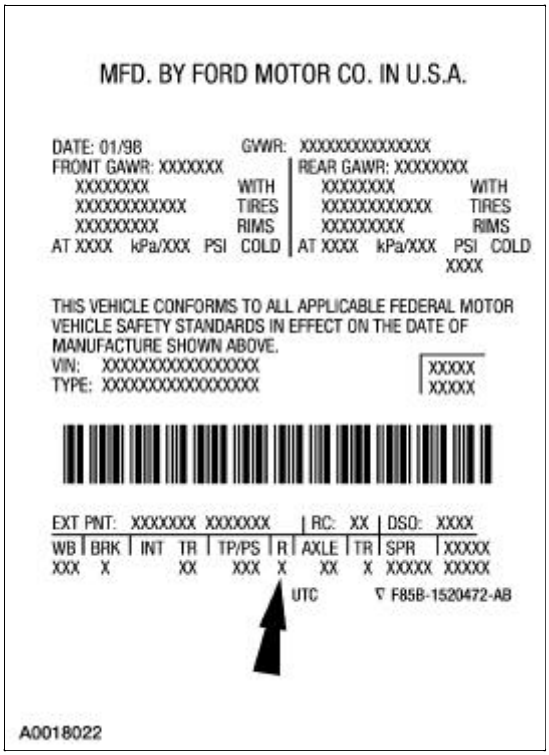
- A — Light Parchment
- B — Black Ink
- G — Dark Flint
- H — Medium Parchment

Tape/Paint Stripe



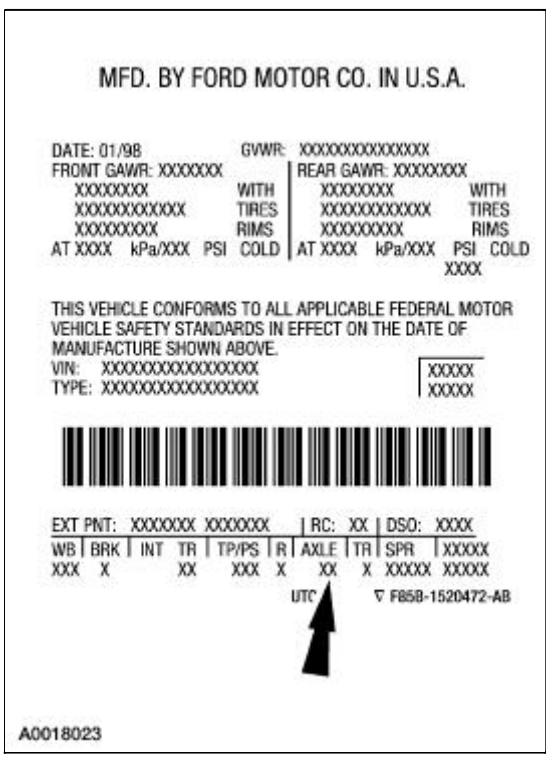
Tape and paint stripe codes do not apply.

Radio Type



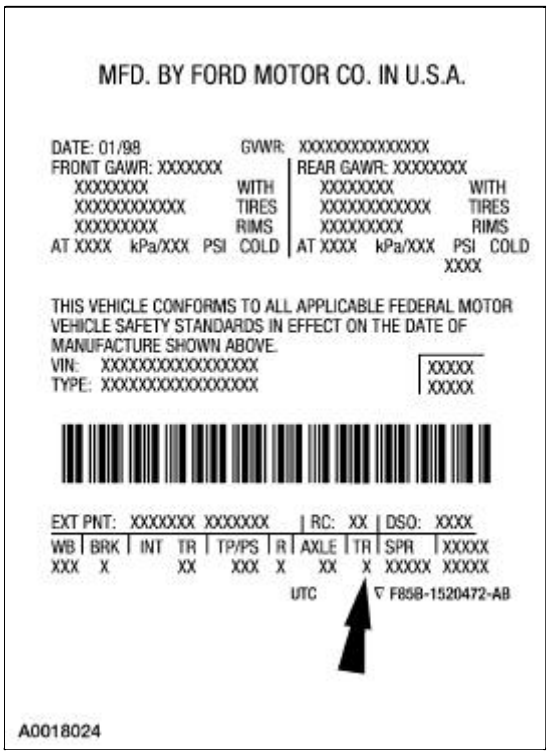
- 1 — AM/FM stereo with six-disc, in-dash compact disc (CD) changer
- F — AM/FM stereo with six-disc, in-dash compact disc (CD) changer and navigation system
- K — Premium electronic AM/FM stereo with compact disc (CD) and cassette player
- T — Premium AM/FM stereo Audiophile with six-disc, in-dash compact disc (CD) changer

Axle Code



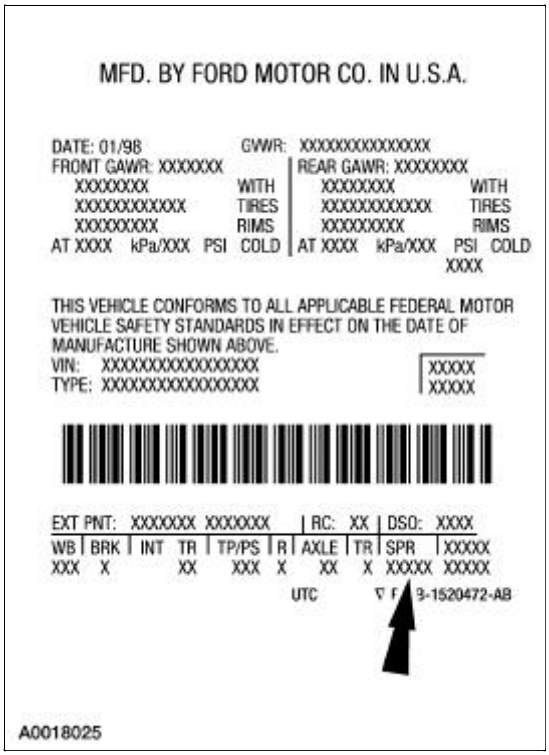
- H6 — 3.73 ratio, limited slip
- 16 — 3.73 ratio, non-limited slip

Transmission Code



- E — Automatic 4R100 (Navigator)
- U — Automatic 4R70W (Expedition)

Spring Codes



Spring codes are listed as a two-part code. The first character listed identifies the front spring. The second code listed identifies the rear spring or load leveling system.

Front Springs

- 6F — 2L14-18B036-F, standard suspension
- 6G — 2L14-18B036-G, standard suspension
- 6H — 2L14-18B036-H, standard suspension
- 6A — 2L1J-18B036-A
- 4A — 2L74-3C098-B, air suspension, right-hand
- 4A — 2L74-3C144-A, air suspension, left-hand
- 4B — 2L74-3C098-C
- 4B — 2L74-3C144-B, air suspension, left-hand

Rear Springs

- JA — 2L1J-18W002-A, standard suspension
- 2B — 2L14-18W002-B, standard suspension
- 1A — 2L74-5A980-A, air suspension, right-hand
- 1A — 2L74-5A981-A, air suspension, left-hand
- 1B — 2L74-5A980-B, air suspension, right-hand
- 1B — 2L74-5A981-B, air suspension, left-hand

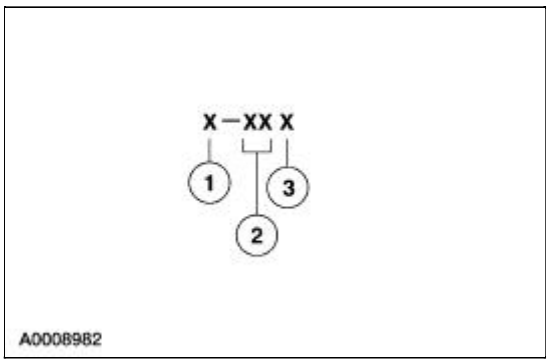
Powertrain Calibration Information



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

Powertrain calibration information is printed in the lower right corner of the Vehicle Certification (VC) Label. Only the base calibration information is printed. Revision levels will not appear, however, they can be found in On Line Automotive Service Information System (OASIS). For the current model year, Ford Motor Company is using three different protocols which describe powertrain base calibration. These protocols are designed to provide worldwide standardization for vehicle calibration. If the electronic calibration strategy has been used since 1998 and carried into the current model year, Protocol 1 will be used. Refer to Protocol 1 below. If the electronic calibration strategy has been used since 1999 and is carried into the current model year, Protocol 2 will be used. Refer to Protocol 2 below. For electronic calibration strategies introduced in the 2000 or later model years, use Protocol 3. Refer to Protocol 3 below.

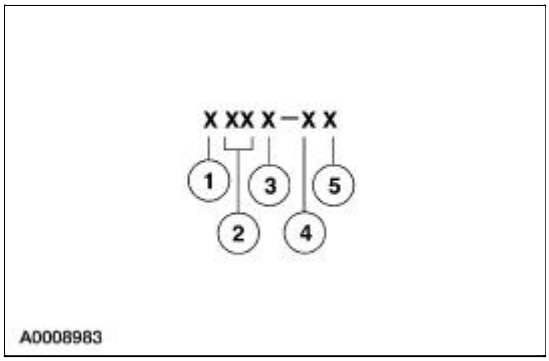
Protocol 1



Item	Description
1	Model year (model year in which calibration strategy was first introduced)
2	Engine code

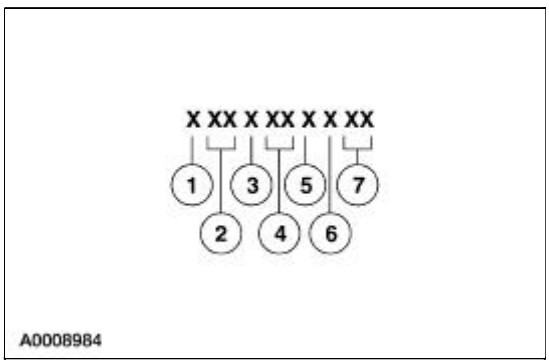
3	Engine revision level

Protocol 2



Item	Description
1	Model year (model year in which calibration strategy was first introduced)
2	Engine code
3	Transmission code
4	Emission standard (designates the specific country emission standard)
5	Design level (design level assigned to the engine)

Protocol 3



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

Protocol 3

The following offers a more detailed explanation of the strategy used in Protocol 3.

Model Year

- 0 — 2000
- 1 — 2001
- 2 — 2002
- 3 — 2003

Vehicle Line

- B3 — Expedition/Navigator

Transmission

- 1 — Automatic transmission

Unique Calibration

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

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

Fleet Code

- 1 — HDGE/Dyno
- 2 — Fast AMA, U.S.
- 3 — ADP, U.S.
- 4 — Not assigned
- 5 — Not assigned
- 6 — Evaporative emissions
- 7 — MACAA
- 8 — On-board diagnostics (OBD)
- 9 — Not assigned

Certification Region

- Where multiple regions are included in one calibration, only the lead region will appear.
- 5 — U.S. fifty states
- A — U.S. Federal, including altitude, may include Canada and/or Mexico
- B — U.S. California Standard, includes U.S. green states
- C — Canada
- D — China
- E — European Community (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and United Kingdom)
- F — Extended European Community (E plus Croatia, Czech Republic, Estonia, Hungary, Norway, Poland, Romania, Russian Federation, Slovakia, Slovenia, Switzerland and Yugoslavia)

- G — Gulf Cooperative Council (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and UAE)
- H — Hong Kong
- J — Japan
- K — Korea
- L — Malaysia
- M — Mexico
- N — New Zealand
- P — Australia
- Q — South America (Brazil)
- S — Singapore
- T — Taiwan
- U — South America (unleaded fuel regions)
- V — Vietnam
- X — ROW (rest of world)
- Y — Military
- Z — Israel

Revision Level (not printed on label)

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

Jacking

WARNING: The electrical power to the air suspension system must be shut down prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the LH rear quarter trim panel area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.

WARNING: Do not run the engine when jacking the vehicle. The wheels contacting the ground could cause the vehicle to move.

WARNING: Support the vehicle prior to carrying out any procedure requiring the vehicle to be jacked off the ground.

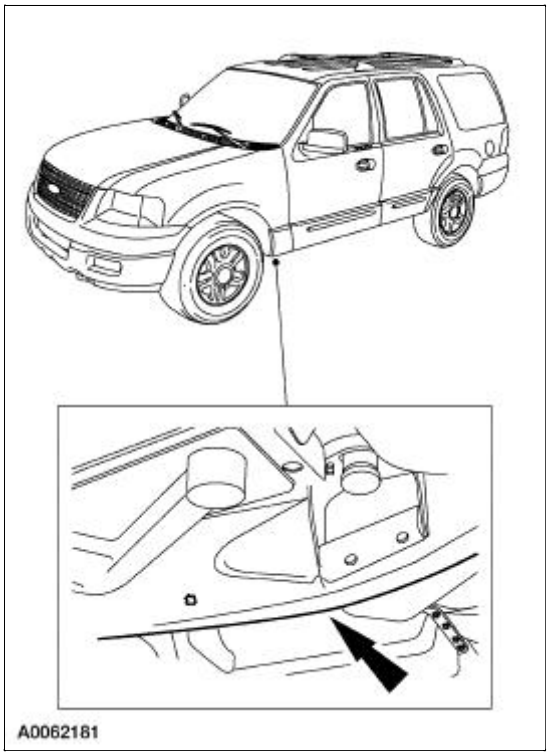
WARNING: Make sure the jack and jack stands are correctly located to prevent the vehicle from falling.

WARNING: Wheel chocks should be used to prevent the vehicle from rolling and falling off the jack.

CAUTION: Never use a halfshaft as a lifting point.

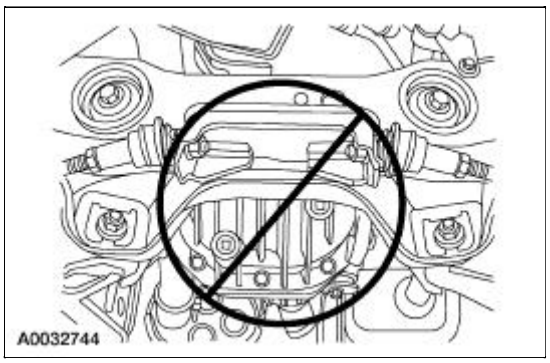
CAUTION: If equipped with retractable running board, disable the system through the instrument cluster controls.

Jacking Points — Front

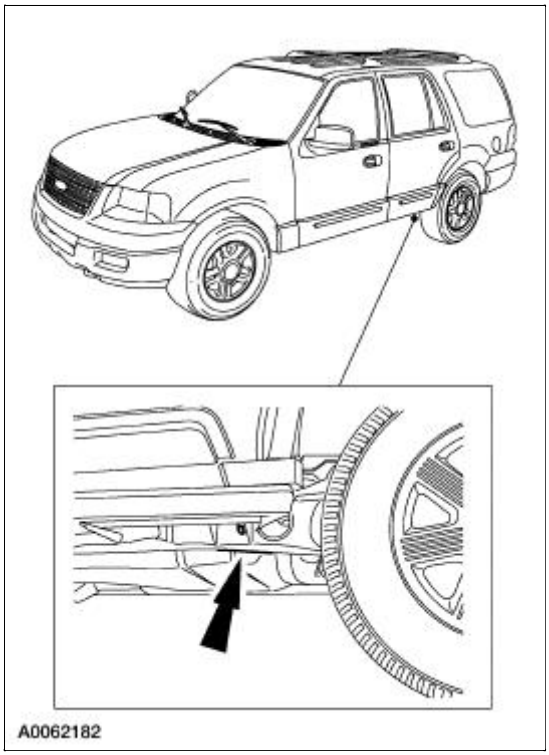


The front jacking point is indicated by an arrow cutout in the frame, located behind the front tire and wheel assembly.

Jacking Points — Rear



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



CAUTION: Do not use the rear control arms as a lifting point.

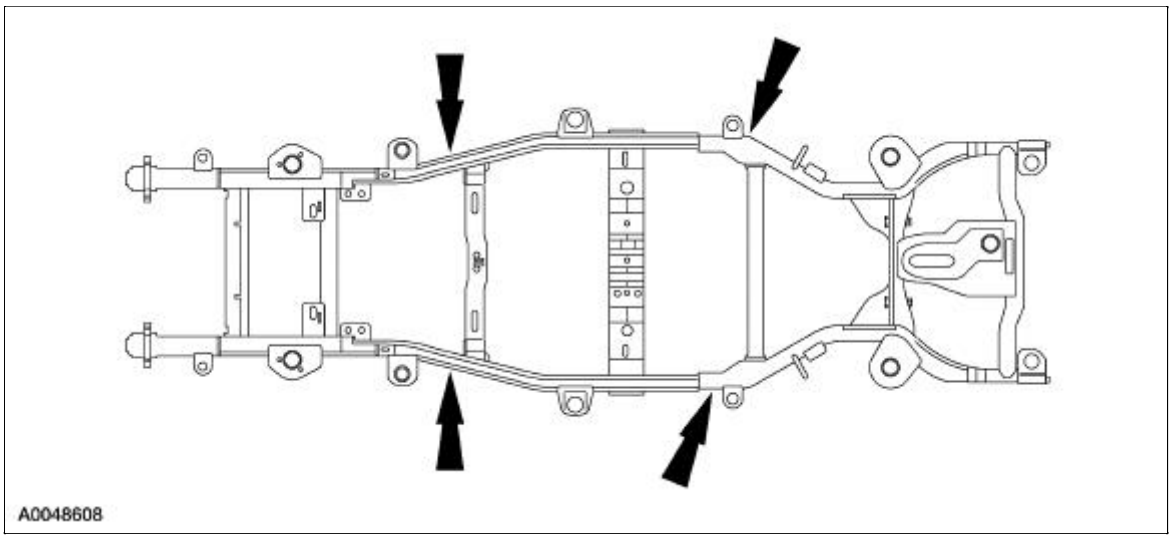
The rear jacking point is indicated by an arrow cutout in the frame, located in front of the rear tire and wheel assembly.

Lifting

WARNING: The electrical power to the air suspension system must be shut down prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the LH rear quarter trim panel area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.

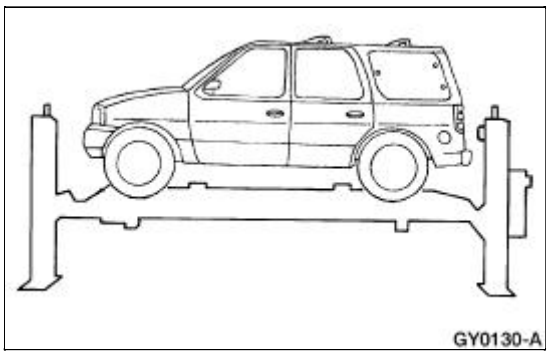
CAUTION: Damage to suspension, exhaust and steering linkage components can occur if care is not exercised when positioning the hoist adapters prior to lifting the vehicle.

Lifting Points — Twin Post Hoist



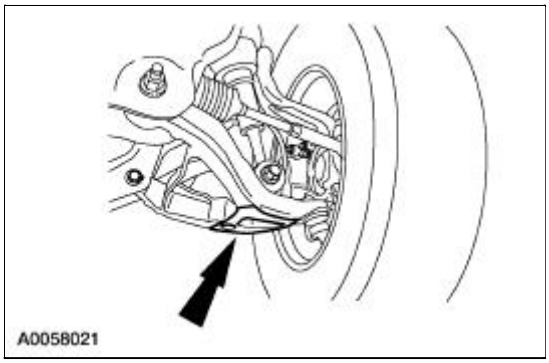
Locate the front hoist adapters and rear hoist adapters (top of frame arc) as indicated.

Lifting Points — Drive On Hoist



The vehicle is supported by tires and suspension components.

Lifting Points — Floor Jack, Front



The front can be lifted using a floor jack under the front control arm directly below the shock.

Maintenance Schedule —Vehicles with Gasoline Engines

The maintenance schedule is designed to protect against major repairs resulting from neglect or inadequate maintenance and to prolong the life of the vehicle.

General Maintenance Information

NOTE: This is a generic maintenance schedule for all Ford, Lincoln and Mercury vehicles. There may be items listed that do not apply to all vehicles.

The Normal Schedule applies to operation of the vehicle under typical, everyday driving conditions. The maintenance frequency in this schedule typifies what the vast majority of vehicles will require. The listed services should be carried out at specified mileage intervals. There are, however, additional services required that only the noted vehicles require.

If the vehicle is operated in one or more of the following special operating conditions, those additional services will be required. The special operating conditions are:

- towing or carrying heavy loads.
- extensive idling and/or driving at low speeds for long distances.
- driving in dusty conditions.
- off-road operation.

There are also exceptions to the Normal Operating Schedule which will require more frequent maintenance for some components. Those exceptions are:

- natural gas and propane vehicles — fuel tank intervals.
- normal vehicle axle — maintenance and lubrication.
- police and taxi vehicles — maintenance and lubrication.
- engine oil and yellow coolant — time and mileage-based interval.

Special Operating Condition Requirements

When towing a trailer or using a camper or car-top carrier:

- Change engine oil and install a new oil filter every 4,800 km (3,000 miles) or 3 months.
- Change transfer case fluid every 96,000 km (60,000 miles).
- Change manual transmission fluid as required.
- Inspect and lubricate U-joints as required.

During extensive idling and/or low speed driving for long distances, as in heavy commercial use such as delivery, taxi, patrol car or livery:

- Change engine oil and install a new oil filter, lube front lower control arm and steering linkage ball joints with zerk fittings (if equipped) every 4,800 km (3,000 miles) or 3 months.
- Inspect brake system and check battery electrolyte level (Patrol cars) every 8,000 km (5,000 miles).
- Install a new fuel filter every 24,000 km (15,000 miles).
- Change automatic transmission fluid, lubricate 4x2 wheel bearings, install new grease seals and adjust bearings every 48,000 km (30,000 miles).
- Install new spark plugs and change transfer case fluid every 96,000 km (60,000 miles).
- Install a new cabin air filter as required.

When operating in dusty conditions such as unpaved or dusty roads:

- Change engine oil and install a new oil filter every 4,800 km (3,000 miles) or 3 months.
- Install a new fuel filter every 24,000 km (15,000 miles).
- Change automatic transmission fluid every 48,000 km (30,000 miles).
- Change transfer case fluid every 96,000 km (60,000 miles).
- Install a new engine air filter as required.
- Install a new cabin air filter as required.

When operating in off-road conditions:

- Change automatic transmission fluid every 48,000 km (30,000 miles).
- Change transfer case fluid every 96,000 km (60,000 miles).
- Install a new cabin air filter as required.
- Inspect and lubricate U-joints.
- Inspect and lubricate steering linkage ball joints with zerk fittings.

Checks and Services

Certain basic maintenance checks and inspections should be carried out at specified intervals. Any recognized adverse condition should be corrected as soon as possible.

Maximum Oil Change Interval (Normal Schedule)

- 8,000 km (5,000 miles) or 6 months, whichever occurs first.

Maximum Oil Change Interval (Special Operating Conditions)

- 4,800 km (3,000 miles) or 3 months.

Monthly Checks

Check each of the following items every month:

- All interior and exterior lights.
- Tires for wear and correct air pressure.

- Engine oil fluid level.
- Windshield washer solvent fluid level.
- Check and drain fuel/water separator.

Six Month Checks

Check each of the following items at least every six months:

- Lap/shoulder belts and seat latches for wear and function.
- Spare tire air pressure.
- Power steering fluid level.
- Parking brake for correct operation.
- Safety warning lamps (brake, ABS, air bag, safety belt) for correct operation.
- Coolant system fluid level and correct strength.
- Battery connections. Clean if necessary.
- Clutch fluid level, if equipped.
- Windshield washer spray, wiper operation, clean all wiper blades.
- Lubricate all hinges, latches and outside locks. Inspect for correct operation.
- Lubricate door rubber weatherstrips. Inspect for excessive wear.
- Clean body and door drain holes. Inspect for clogs and obstructions.

Special Checks (Mustang Only)

Carry out the following check every 8,000 km (5,000 miles):

- Adjust clutch by lifting pedal (manual transmission Mustang only, as described in owner guide).

Normal Schedule

The following checks or procedures should be carried out for all cars, minivans, light trucks, sport utilities, vans, 4x4s, natural gas and propane vehicles.

8,000 Km (5,000 Miles)

- Change engine oil and install a new oil filter.
- Rotate tires and inspect for wear.

16,000 Km (10,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.

24,000 Km (15,000 Miles)

- Change engine oil and install a new oil filter.

- If equipped, inspect automatic transmission fluid level with dipstick.
- Inspect brake pads, shoes, rotors, drums, brake lines, hoses and parking brake system.
- Inspect wheel ends for end play and noise.
- Inspect engine cooling system and hoses.
- Inspect steering linkage, suspension and (if equipped) driveshaft and ball joints.
- Rotate tires and inspect for wear.
- If equipped, install a new cabin air filter.

32,000 Km (20,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.

40,000 Km (25,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.
- Drain coalescent fuel filter and replace filter (NGV).

48,000 Km (30,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect brake pads, shoes, rotors, drums, brake lines, hoses and parking brake system.
- Inspect wheel ends for end play and noise.
- Inspect engine cooling system and hoses.
- Inspect exhaust system and heat shields.
- Inspect steering linkage, suspension and (if equipped) driveshaft and ball joints.
- Rotate tires and inspect for wear.
- Install a new engine air filter.
- Install a new fuel filter. (See ADDITIONAL INFORMATION below.)
- If equipped, install a new cabin air filter.
- Change automatic transmission/transaxle fluid on all vehicles equipped with AX4S, 4F50N, 4R100, 4F27E. Inspect automatic transmission fluid level using dipstick on all other vehicles, if equipped.
- If equipped, install new climate controlled seat filters (Navigator, Lincoln LS and Aviator).

ADDITIONAL INFORMATION: If vehicle is registered in California, the California Air Resources Board (CARB) has determined that failure to install a new fuel filter at this interval will not nullify the emission warranty or limit recall liability prior to completion of the vehicle's useful life. It is, however, recommended that maintenance checks be carried out and recorded at the indicated intervals.

Natural gas and propane vehicles also require checking the fuel tanks and installing a new filter (propane vehicles).

56,000 Km (35,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.

64,000 Km (40,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.

72,000 Km (45,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect automatic transmission fluid level using dipstick, if equipped.
- Inspect brake pads, shoes, rotors, drums, brake lines, hoses and parking brake system.
- Inspect wheel ends for end play and noise.
- Inspect engine cooling system and hoses.
- Inspect steering linkage, suspension and (if equipped) driveshaft and ball joints.
- Rotate tires and inspect for wear.
- If equipped, install a new cabin air filter.
- If filled with green engine coolant, change coolant.

80,000 Km (50,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.
- Drain coalescent fuel filter and replace filter (NGV).

88,000 Km (55,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.

96,000 Km (60,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect brake pads, shoes, rotors, drums, brake lines, hoses and parking brake system.
- Inspect wheel ends for end play and noise.
- Inspect engine cooling system and hoses.
- Inspect steering linkage, suspension and (if equipped) driveshaft and ball joints.
- Rotate tires and inspect for wear.
- Install a new engine air filter.
- Install a new fuel filter. (See ADDITIONAL INFORMATION below.)
- If equipped, install a new cabin air filter.
- Change automatic transmission/transaxle fluid on all vehicles equipped with AX4S, 4F50N, 4R100, 4F27E. Inspect automatic transmission fluid level using dipstick on all other vehicles, if

equipped.

- If equipped, install new climate controlled seat filters (Navigator, Lincoln LS and Aviator).

ADDITIONAL INFORMATION: If vehicle is registered in California, the California Air Resources Board (CARB) has determined that failure to install a new fuel filter at this interval will not nullify the emission warranty or limit recall liability prior to completion of the vehicle's useful life. It is, however, recommended that maintenance checks be carried out and recorded at the indicated intervals.

Additional checks for natural gas and propane vehicles at this interval include inspecting fuel tanks, as well as draining coalescent fuel filter and installing a new filter.

104,000 Km (65,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.

112,000 Km (70,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.

120,000 Km (75,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect automatic transmission fluid level using dipstick.
- Inspect brake pads, shoes, rotors, drums, brake lines, hoses and parking brake system.
- Inspect wheel ends for end play and noise.
- Inspect engine cooling system and hoses.
- Inspect steering linkage, suspension and (if equipped) driveshaft and ball joints.
- Rotate tires and inspect for wear.
- Install a new cabin air filter.
- Drain coalescent fuel filter and replace filter (NGV).
- Change green engine coolant, if equipped.

128,000 Km (80,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.

136,000 Km (85,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.

144,000 Km (90,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect brake pads, shoes, rotors, drums, brake lines, hoses and parking brake system.

- Inspect wheel ends for end play and noise.
- Inspect engine cooling system and hoses.
- Inspect exhaust system and heat shields.
- Inspect steering linkage, suspension and (if equipped) driveshaft and ball joints.
- Rotate tires and inspect for wear.
- Install a new engine air filter.
- Install a new fuel filter.
- If equipped, install a new cabin air filter.
- Change automatic transmission/transaxle fluid on all vehicles equipped with AX4S, 4F50N, 4R100, 4F27E. Inspect automatic transmission fluid level using dipstick on all other vehicles, if equipped.
- If equipped, install new climate controlled seat filters (Navigator, Lincoln LS and Aviator).

Additional services for natural gas and propane vehicles include inspecting fuel tanks, as well as draining coalescent fuel filter bowl and installing a new filter.

152,000 Km (95,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.

160,000 Km (100,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect accessory drive belt(s).
- Rotate tires and inspect for wear.
- Install new spark plugs.
- If filled with yellow coolant, change coolant or at 5 years, whichever comes first.
- Install a new PCV on all cars and light trucks under 6,000 pounds Gross Vehicle Weight (GVW).
- Drain coalescent fuel filter and replace filter (NGV).

168,000 Km (105,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect automatic transmission fluid level if equipped with dipstick.
- Inspect brake pads, shoes, rotors, drums, brake lines, hoses and parking brake system.
- Inspect wheel ends for end play and noise.
- Inspect engine coolant system and hoses.
- Inspect steering linkage, suspension and (if equipped) driveshaft and ball joints.
- Rotate tires and inspect for wear.
- If equipped, install a new cabin air filter.
- If filled with green engine coolant, change coolant.

176,000 Km (110,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.

184,000 Km (115,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.

192,000 Km (120,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect brake pads, shoes, rotors, drums, brake lines, hoses and parking brake system.
- Inspect wheel ends for end play and noise.
- Inspect engine cooling system and hoses.
- Inspect exhaust system and heat shields.
- Inspect steering linkage, suspension and (if equipped) driveshaft and ball joints.
- Rotate tires and inspect for wear.
- Install a new engine air filter.
- Install a new fuel filter. (See ADDITIONAL INFORMATION below.)
- If equipped, install a new cabin air filter.
- Install new accessory drive belt(s) (Escort).
- Install a new PCV valve on all cars and light trucks over 6,000 Gross Vehicle Weight.
- Change automatic transmission/transaxle fluid on all vehicles equipped with AX4S, 4F50N, 4R100, 4F27E. Inspect automatic transmission fluid level using dipstick on all other vehicles, if equipped.
- Install a new camshaft belt on all 2.0L, 4-cylinder engines (Escort, Focus, ZX2 and Escape).
- If equipped, install new climate controlled seat filters (Navigator, Lincoln LS and Aviator).

ADDITIONAL INFORMATION: Additional services for natural gas and propane vehicles include inspecting fuel tanks, as well as draining coalescent fuel filter bowl and installing a new filter.

200,000 Km (125,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.
- Drain coalescent fuel filter and replace filter (NGV).

208,000 Km (130,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.

216,000 Km (135,000 Miles)

- Change engine oil and install a new oil filter.

- If equipped, inspect automatic transmission fluid level with dipstick.
- Inspect brake pads, shoes, rotors, drums, brake lines, hoses and parking brake system.
- Inspect wheel ends for end play and noise.
- Inspect engine cooling system and hoses.
- Inspect steering linkage, suspension and (if equipped) driveshaft and ball joints.
- Rotate tires and inspect for wear.
- Install a new cabin air filter.
- If filled with green engine coolant, change coolant.

224,000 Km (140,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.

232,000 Km (145,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.

240,000 Km (150,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect brake pads, shoes, rotors, drums, brake lines, hoses and parking brake system.
- Inspect wheel ends for end play and noise.
- Inspect engine cooling system and hoses.
- Inspect exhaust system and heat shields.
- Inspect steering linkage, suspension and (if equipped) driveshaft and ball joints.
- Rotate tires and inspect for wear.
- Install a new engine air filter.
- Install a new fuel filter. (See ADDITIONAL INFORMATION below.)
- If equipped, install a new cabin air filter.
- If filled with yellow engine coolant, change coolant or at 8 years, whichever comes first.
- Change automatic transmission/transaxle fluid and filter.
- Change rear axle lubricant on all rear wheel (RWD) vehicles.
- Install a new accessory drive belt(s) (if a new belt has not been installed within the last 100,000 miles).
- If equipped, install new climate controlled seat filters (Navigator, Lincoln LS and Aviator).

ADDITIONAL INFORMATION: If vehicle is registered in California, the California Air Resources Board (CARB) has determined that failure to install a new fuel filter at this interval will not nullify the emission warranty or limit recall liability prior to completion of the vehicle's useful life. It is, however recommended that maintenance checks be carried out and recorded at the indicated intervals.

Additional checks for natural gas and propane vehicles include inspecting fuel tanks, as well as draining and installing a new filter.

Exceptions To Normal Schedule

Yellow Coolant

- Change coolant at 5 years or 160,000 km (100,000 miles) of the vehicle's life, whichever comes first.
- After the initial change, change coolant every 3 years or 80,000 km (50,000 miles) thereafter.

Natural Gas and Propane Vehicles

- Inspect NGV fuel tanks from the date of tank manufacture every 3 years.
- Inspect propane fuel tanks from vehicle build date every 5 years.
- Install new NGV fuel tanks from the date of tank manufacture every 15 years.

Normal Vehicle Axle Maintenance

Rear axles and power take off (PTO) units containing synthetic lubricant and light duty trucks equipped with Ford-design axles are lubricated for life. These lubricants are not to be checked or changed unless service is required, or if a leak is suspected, or the axle assembly has been submerged in water.

The axle and PTO should be changed anytime they have been submerged in water. Non-synthetic rear axle lubricants should be replaced every 4,800 km (3,000 miles) or three months, whichever occurs first, during extended trailer tow operation above 21°C (70°F) ambient and wide open throttle for extended periods above 45 mph.

The 3,000 mile lube change interval may be waived if the axle was filled with 75W140 synthetic gear lubricant meeting Ford specification WSL-M2C192-A, part number F1TZ-19B546-B or equivalent. Add four ounces of additive friction modifier C8AZ-19B546-A (EST-M2C118-A) or equivalent for complete refill of Traction-Lok rear axles.

The axle lubricant should be changed anytime an axle has been submerged in water.

Police and Taxi Vehicle Axle Maintenance

Replace rear axle lubricant every 160,000 km (100,000 miles). Rear axle lubricant change may be waived if the axle was filled with 75W140 synthetic gear lubricant meeting Ford specification WSL-M2C192-A, part number FITZ-19580-B or equivalent. Add four ounces of additive friction modifier C8AZ-19B546-A (EST-M2C118-A) or equivalent for complete refill of Traction-Lok rear axles.

The axle lubricant should be changed anytime an axle has been submerged in water.

Noise, Vibration And Harshness (NVH)

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

Acceptable Noise, Vibration and Harshness

All internal combustion engines and drivelines produce some noise and vibration; operating in a real world environment adds noise that is not subject to control. Vibration isolators, mufflers and dampers reduce these to acceptable levels. A driver who is unfamiliar with a vehicle can think that some sounds are abnormal when actually the sounds are normal for the vehicle type. For example, Traction-Lok® differentials produce a slight noise on slow turns after extended highway driving. This is acceptable and has no detrimental effect on the locking axle function. As a technician, it is very important to be familiar with vehicle features and know how they relate to NVH concerns and their diagnosis. For example, if the vehicle has automatic overdrive, it is important to test drive the vehicle both in and out of overdrive mode.

Diagnostic Theory

The shortest route to an accurate diagnosis results from:

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

The diagnosis and correction of noise, vibration and harshness concerns requires:

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

Glossary of Terms

Acceleration-Light

An increase in speed at less than half throttle.

Acceleration-Medium

An increase in speed at half to nearly full throttle, such as 0-97 km/h (0-60 mph) in approximately 30 seconds.

Acceleration-Heavy

An increase in speed at one-half to full throttle, such as 0-97 km/h (0-60 mph) in approximately 20 seconds.

Ambient Temperature

The surrounding or prevailing temperature.

Amplitude

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

Backlash

Gear teeth clearance.

Boom

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

Bound Up

An overstressed isolation (rubber) mount that transmits vibration/noise instead of absorbing it.

Brakes Applied

When the service brakes are applied with enough force to hold the vehicle against movement with the transmission in gear.

Buffet/Buffeting

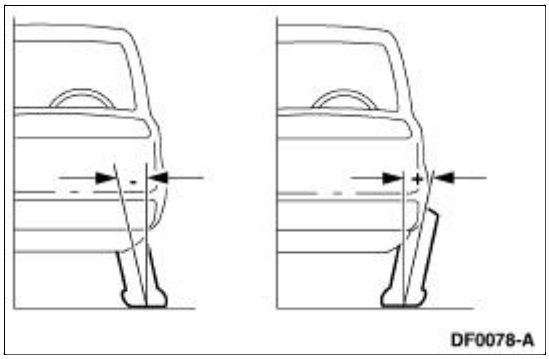
Strong noise fluctuations (less than 1000 Hz) caused by gusting winds. An example would be wind gusts against the side glass.

Buzz

A low-pitched sound like (200-5000 Hz) that from a bee. Often a metallic or hard plastic humming sound. Also describes a high frequency (200-800 Hz) vibration. Vibration feels similar to an electric razor.

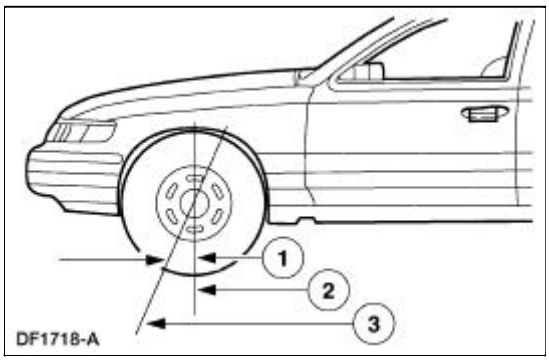
Camber

The angle of the wheel in relation to the true vertical as measured looking from the front of the vehicle. Camber is positive when the wheel angle is offset so that the top of the wheel is positioned away from the vehicle.



Caster

The angle of the steering knuckle in relation to the true vertical as measured looking from the side of the vehicle.



Item	Description
1	Positive caster
2	True vertical
3	Steering axis

Chatter

A pronounced series of rapidly repeating rattling or clicking sounds.

Chirp

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

Chuckle

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

Click

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

Clonk

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

Clunk/Driveline Clunk

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

Coast/Deceleration

Releasing the accelerator pedal at cruise, allowing the engine to reduce vehicle speed without applying the brakes.

Coast/Neutral Coast

Placing the transmission range selector in NEUTRAL (N) or depressing the clutch pedal while at cruise.

Constant Velocity (CV) Joint

A joint used to absorb vibrations caused by driving power being transmitted at an angle.

Controlled Rear Suspension Height

The height at which a designated vehicle element must be when driveline angle measurements are made.

Coupling Shaft

The shaft between the transfer case and the front drive axle or, in a two-piece rear driveshaft, the front section.

CPS

Cycles per second. Same as hertz (Hz).

Cracks

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

Creak

A metallic squeak.

Cruise

Constant speed on level ground; neither accelerating nor decelerating.

Cycle

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

starting point.

Decibel

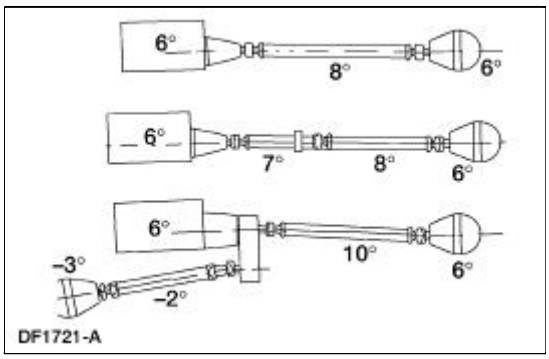
A unit of measurement, referring to sound pressure level, abbreviated dB.

Drive Engine Run-Up (DERU) Test

The operation of the engine through the normal rpm range with the vehicle standing still, the brakes applied and the transmission engaged. This test is used for noise and vibration checks.

Driveline Angles

The differences of alignment between the transmission output shaft, the driveshaft, and the rear axle pinion centerline.



Driveshaft

The shaft that transmits power to the rear axle input shaft (pinion shaft). In a two-piece driveshaft, it is the rearmost shaft.

Drivetrain

All power transmitting components from the engine to the wheels; includes the clutch or torque converter, the transmission, the transfer case, the driveshaft, and the front or rear drive axle.

Drivetrain Damper

A weight attached to the engine, the transmission, the transfer case, or the axle. It is tuned by weight and placement to absorb vibration.

Drone

A low frequency (100-200 Hz) steady sound, like a freezer compressor. Also described as a moan.

Drumming

A cycling, low-frequency (20-100 Hz), rhythmic noise often accompanied by a sensation of pressure on the ear drums. Also described as a low rumble, boom, or rolling thunder.

Dynamic Balance

The equal distribution of weight on each side of the centerline, so that when the wheel and tire assembly spins, there is no tendency for the assembly to move from side-to-side (wobble). Dynamically unbalanced wheel and tire assemblies can cause wheel shimmy.

Engine Imbalance

A condition in which an engine's center mass is not concentric to the rotation center, causing excessive motion.

Engine Misfire

When combustion in one or more cylinders does not occur or occurs at the wrong time.

Engine Shake

An exaggerated engine movement or vibration that directly increases in frequency as the engine speed increases. It is caused by non-equal distribution of mass in the rotating or reciprocating components.

Flexible Coupling

A flexible joint.

Float

A drive mode on the dividing line between cruise and coast where the throttle setting matches the engine speed with the road speed.

Flutter

Mid to high (100-2000 Hz) intermittent sound due to air flow. Similar to a flag flapping in the wind.

Frequency

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

Gravelly Feel

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

Grind

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

Hiss

Steady high frequency (200-800 Hz) noise. Vacuum leak sound.

Hoot

A steady low frequency tone (50-500 Hz), sounds like blowing over a long neck bottle.

Howl

A mid-range frequency (200-800 Hz) noise between drumming and whine. Also described as a hum.

Hum

Mid-frequency (200-800 Hz) steady sound, like a small fan motor. Also described as a howl.

Hz

Hertz; a frequency measured in cycles per second.

Imbalance

Out of balance; heavier on one side than the other. In a rotating component, imbalance often causes vibration.

Inboard

Toward the centerline of the vehicle.

Intensity

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

Isolate

To separate the influence of one component to another.

Knock

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

Moan

A constant, low-frequency (100-200 Hz) tone. Also described as a hum.

Neutral Engine Run-Up (NERU) Test

The operation of the engine through the normal rpm range with the vehicle standing still and the transmission disengaged. This test is used to identify engine related vibrations.

Neutralize/Normalize

To return to an unstressed position. Used to describe mounts. Refer to Bound Up.

Outboard

Away from the centerline of the vehicle.

Ping

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

Pinion Shaft

The input shaft in a driving axle that is usually a part of the smaller driving or input hypoid gear of a ring and pinion gearset.

Pitch

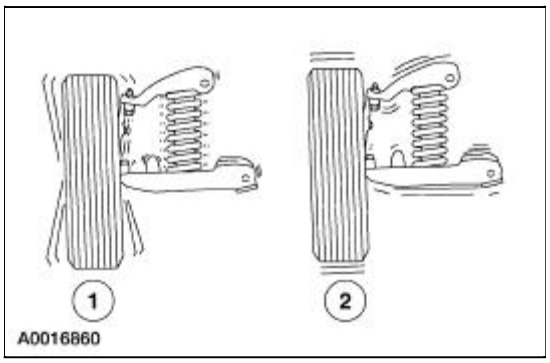
The physical quality of sound that relates to its frequency. Pitch increases as frequency increases and vice versa.

Pumping Feel

A slow, pulsing movement.

Radial/Lateral

Radial is in the plane of rotation; lateral is at 90 degrees to the plane of rotation.



Item	Description
1	Lateral runout
2	Radial runout

Rattle

A random and momentary or short duration noise.

Ring Gear

The large, circular, driven gear in a ring and pinion gearset.

Road Test

The operation of the vehicle under conditions intended to produce the concern under investigation.

Roughness

A medium-frequency vibration. A slightly higher frequency (20 to 50 Hz) than a shake. This type of vibration is usually related to drivetrain components.

Runout

Lateral runout means measuring the movement or "wobble" of a wheel or tire at the sidewall. Radial runout means measuring the out-of-round at the tread surface.

Rustling

Intermittent sound of varying frequency (100-2000 Hz), sounds similar to shuffling through leaves.

Shake

A low-frequency vibration (5-20 Hz), usually with visible component movement. Usually relates to tires, wheels, brake drums or brake discs if it is vehicle speed sensitive, or engine if it is engine speed sensitive. Also referred to as a shimmy or wobble.

Shimmy

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

Shudder

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

Slap

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

Slip Yoke/Slip Spline

The driveshaft coupling that allows length changes to occur while the suspension articulates and while the driveshaft rotates.

Squeak

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

Squeal

A long-duration, high-pitched noise.

Static Balance

The equal distribution of weight around the wheel. Statically unbalanced wheel and tire assemblies can cause a bouncing action called wheel tramp. This condition will eventually cause uneven tire wear.

Tap

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

Thump

A dull beat caused by two items striking together.

Tick

A rhythmic tap, similar to a clock noise.

Tip-In Moan

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

TIR

The acronym for total indicated runout is TIR.

Tire Deflection

The change in tire diameter in the area where the tire contacts the ground.

Tire Flat Spots

A condition commonly caused by letting the vehicle stand while the tires cool off. This condition can be corrected by driving the vehicle until the tires are warm. Also, irregular tire wear patterns in the tire tread resulting from wheel-locked skids.

Tire Force Vibration

A tire vibration caused by variations in the construction of the tire that is noticeable when the tire rotates against the pavement. This condition can be present on perfectly round tires because of variations in the inner tire construction. This condition can occur at wheel rotation frequency or twice rotation frequency.

Transient

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

Two-Plane Balance

Radial and lateral balance.

Vibration

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

Whine

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

Whistle

High-pitched noise (above 500 Hz) with a very narrow frequency band. Examples of whistle noises are a turbocharger or airflow around an antenna.

Wind Noise

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

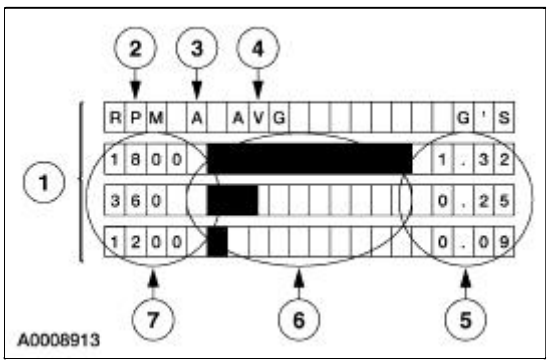
WOT

The acronym for wide open throttle is WOT.

Tools and Techniques

Electronic Vibration Analyzer (EVA)

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



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

The EVA allows for a systematic collection of information that is necessary to accurately diagnose and repair NVH problems. For the best results, carry out the test as follows:

a. Test drive the vehicle with the vibration sensor inside the vehicle.
b. Place the sensor in the vehicle according to feel.
    - If the condition is felt through the steering wheel, the source is most likely in the front of the vehicle.
    - A vibration that is felt in the seat or floor only will most likely be found in the driveline, drive axle or rear wheels and tires.
c. Record the readings. Also note when the condition begins, when it reaches maximum intensity, and if it tends to diminish above/below a certain speed.
    - Frequencies should be read in the "average" mode.

    - Frequencies have a range of plus or minus 2. A reading of 10 Hz can be displayed as an 8 Hz through 12 Hz.
d. Place the vibration sensor on or near the suspect area outside the vehicle.
e. Continue the road test, driving the vehicle at the speed the symptom occurs, and take another reading.
f. Compare the readings.
    - A match in frequency indicates the problem component or area.
    - An unmatched test could indicate the concern is caused by the engine, torque converter, or engine accessory. Use the EVA in the rpm mode and check if concern is rpm related.
    - Example: A vibration is felt in the seat. Place the sensor on the console. Record the readings. Place the vibration sensor on the rear axle. Compare the readings. If the frequencies are the same, the axle is the problem component.

Vibrate Software®

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

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

Combination EngineEAR/ChassisEAR

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

EngineEAR Basic Unit

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

Ultrasonic Leak Detector

The Ultrasonic Leak Detector is used to detect wind noises caused by leaks and gaps in areas where there is weather-stripping or other sealing material. It is also used to identify A/C leaks, vacuum leaks

and evaporative emission noises. The Ultrasonic Leak Detector includes a multi-directional transmitter (operating in the ultrasonic range) and a hand-held detector. The transmitter is placed inside the vehicle. On the outside of the vehicle, the hand-held detector is used to sweep the area of the suspected leak. As the source of the leak is approached, a beeping sound is produced which increases in both speed and frequency.

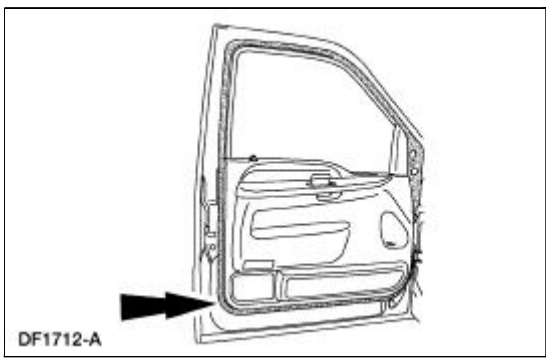
Squeak and Rattle Repair Kit

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

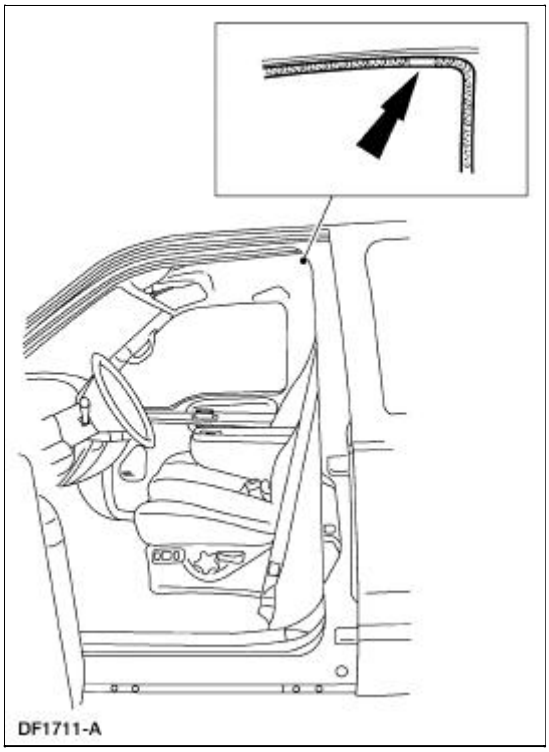
- PVC (soft foam) tape
- Urethane (hard foam) tape
- Flocked (black fuzzy) tape
- UHMW (frosted) tape
- Squeak and rattle oil tube
- Squeak and rattle grease tube

Tracing Powder

Tracing powder is used to check both the uniformity of contact and the tension of a seal against its sealing surface. These tests are usually done when a suspected air leak/noise appears to originate from the seal area or during the alignment and adjustment of a component to a weatherstrip. Tracing powder can be ordered from Crest Industries as ATR Leak Trace. Carry out the tracing powder test as follows:

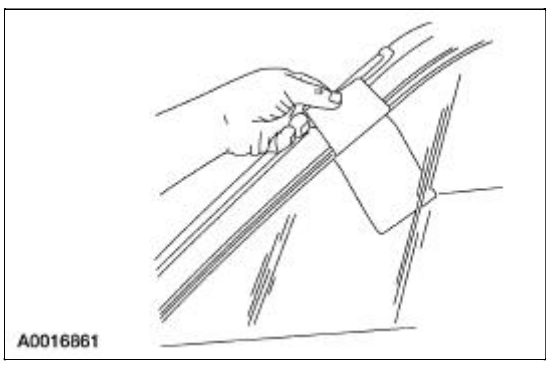


a. Clean the weatherstrip.
b. Spray the tracing powder on the mating surface only.
c. Close the door completely. Do not slam the door.
d. Open the door. An imprint is made where the weatherstrip contacted the mating surface seal. Gaps or a faint imprint will show where there is poor contact with the weatherstrip.



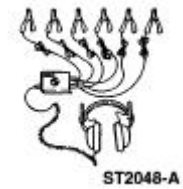
Index Card

Place an index card or a piece of paper between the weatherstrip and the sealing surface, then close the door. Slowly withdraw the index card or paper after the door is closed and check the amount of pressure on the weatherstrip. There should be a medium amount of resistance as it is withdrawn. Continue around the entire seal area. If there is little or no resistance, this indicates insufficient contact to form a good seal. At these points, the door, the glass, or the weatherstrip is out of alignment.



Noise, Vibration And Harshness (NVH)

Special Tool(s)

 ST2048-A	ChassisEAR 107-R2102 or Equivalent
 ST2311-A	Vibration Analyzer 100-F027 (014-00344) or Equivalent
 ST2312-A	EngineEAR 107-R2100 or Equivalent
 ST2314-A	Ultrasonic Leak Detector 134-R0135 or Equivalent

To assist the service advisor and the technician, a Write-up Job Aid and an NVH Diagnostic Guide are included with this material. The Write-up Job Aid serves as a place to record all important symptom information. The NVH Diagnostic Guide serves as a place to record information reported on the Write-up Job Aid as well as data from the testing to be carried out.

To begin a successful diagnosis, fill out the NVH Diagnostic Guide, record the reported findings, then proceed to each of the numbered process steps to complete the diagnosis.

"WRITE-UP" JOB AID

REPAIR ORDER #_____

CUSTOMER CONCERN #_____

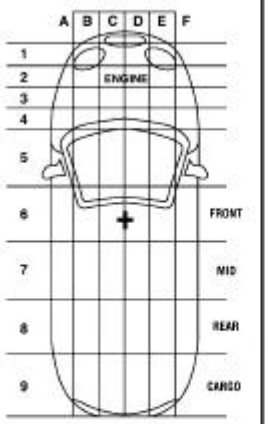
SPECIFIC SENSE IDENTIFICATION AND LOCATION ON VEHICLE OF CUSTOMER SYMPTOM(S)

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

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

SEE YES ☐ | FEEL YES ☐

HEAR YES ☐ | SMELL YES ☐



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

DEALER VERIFICATION

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

WHAT THE CUSTOMER SAID

OASIS SYMPTOM CODE(S)

VIN NUMBER

A0017007

NVH DIAGNOSTIC GUIDE

Dealer: _____ Date: _____

P.A. Code: _____ Order No. _____ Technician: _____

Owner's Name: _____ Address: _____

Phone No. Home: _____ Work: _____

Vehicle Make: _____ Model: _____ Year: _____

VIN: _____ Mileage: _____ Engine: _____ Trans: _____ Axle: _____

OWNER'S DESCRIPTION OF COMPLAINT:

Did Condition Exist When Vehicle Was New? **Yes / No** (circle one)

How Did Condition Begin? Gradually ☐ Suddenly ☐

At What Mileage Did It Occur Or Begin Occuring? _____

Which Driving Conditions Affect The Vehicle?

Light Accel	☐	Closed Throttle Decel	☐	Brakes Applied/Released	☐
Medium Accel	☐	Coast (Float)	☐	Driving The Vehicle: Straight	☐
Heavy Accel	☐	Constant Speed	☐	Cornering	☐

Is Vibration Noticed? If So, Where:

Seat ☐ Steering Wheel ☐ Instrument Panel ☐ Floor ☐ Body Panels ☐ Ft/Rr of Vehicle ☐

Is There Sound Or Sensation Of Sound? **Yes / No** (circle one)

If So, Describe The Sound :

Boom ☐	Hum ☐	Whine ☐	Growl ☐	Other: _____
Drone ☐	Tip-In-Moan ☐	Squeak ☐	Rattle ☐	

PREDRIVE CHECKS

Tire Condition/Pressure: _____

Vehicle Body Damage? _____

Other: _____

ROAD TEST:

Vibration/Noise Occurs:

Vehicle Speed _____ Accel _____ Vibration Frequency _____ Hz/RPM

Gear Range _____ Decel/Coast _____ Engine Speed _____ RPM

ENGINE RUN-UP TESTS

Neutral Engine Run-Up (NERU)	**Yes / No**	Engine RPM _____	Vibration/Frequency _____	Hz/RPM
Drive Engine Run-Up (DERU)	**Yes / No**	Engine RPM _____	Vibration/Frequency _____	Hz/RPM
Drivetrain Run-Up (DTRU)	**Yes / No**	Engine RPM _____	Vibration/Frequency _____	Hz/RPM

Indicate Suspected Area of Concern:

Tire/Wheel/Brakes	☐	Engine/Accessory	☐	Rear	☐
Driveline/Axle	☐	Susp/Steering	☐	Right	☐
Body	☐	Front	☐	Left	☐

Other _____

Equipment Used:

Reed Tachometer	☐	Electronic Noise Detector	☐	Tape	☐
Engine Tachometer	☐	Ultrasonic Leak Detector	☐	Other _____	

DF1688-A

WHEEL/TIRE/BRAKES CHECK:

Balance Check **Yes / No**

Maximum Runout Allowed:

Wheel:	Radial _____	Lateral _____					
Tire:	Radial _____	Lateral _____					

Measured Runout:

Tire/Wheel	Radial:	LF _____	LR _____	RF _____	RR _____
	Lateral:	LF _____	LR _____	RF _____	RR _____
Wheel Only	Radial:	LF _____	LR _____	RF _____	RR _____
	Lateral:	LF _____	LR _____	RF _____	RR _____

SUSPENSION INSPECTION:

Can Cause:	Shimmy ☐	Clunk ☐	Squeak ☐	Harshness ☐
Suspension Bushings:	Loose ☐	Worn ☐	Missing ☐	OK ☐

Front Upper Control Arm ☐	Stabilizer (sway bar) ☐	Rear Lower Control Arm ☐
Front Lower Control Arm ☐	Rear Upper Control Arm ☐	Rear Upper Control Arm ☐

Other _____

Suspension/Steering Components:	Loose	Worn	Missing	OK
Ball Joints	☐	Idler Arm	☐	Pitman Arm ☐
Shock Absorbers F/R	☐	Center Link	☐	Steering Gear ☐
Springs F/R	☐	Tie Rod Ends/Sleeve	☐	Steering Coupler ☐

DRIVESHAFT CONDITION: Noise ☐ Vibration ☐

Balance Weights Missing/Other Visual Defects? **Yes / No**

Maximum Allowable Runout: _____

Actual Runout:	Front _____	Middle _____	Rear _____
Two-Piece Driveshaft Runout:	Front _____	Rear _____
Middle Support Bearing:	Loose ☐	Damaged ☐	Worn ☐	Other _____

Suspect Driveshaft Balanced? **Yes / No**

Pinion Angle:	Engine Height:	Specification _____	Actual _____
	Pinion Angle:	Specification _____	Actual _____
Driveline Angle - Truck:		Specification _____	Actual _____

ENGINE/ACCESSORY CHECK:

Visual Inspection for Damage or Grounded Condition:

Powertrain Mounts ☐	Fuel Lines ☐	A/C Lines ☐	Power Steering/Cooler Lines ☐
Air Intake ☐	Accessories ☐	Exhaust ☐	Radiator/Condensor ☐

BODY (NOISE/RATTLE)

Indicate Suspected Area of Concern: Doors ☐ Windows ☐ Dash Panel ☐ Other _____

Tests Used to Isolate

NVH Concern: Vacuum/Leak Detector ☐ Ultrasonic Leak Detector ☐ Tracing Powder ☐

Electronic Noise Detector ☐ Other _____

ROAD/ENGINE RUN-UP TESTS: Improved? **Yes / No** Vehicle Acceptable? **Yes / No**

Comments: _____

A0008914

1: Customer Interview

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

- When was it first noticed?
- Did it appear suddenly or gradually?

- Did any abnormal occurrence coincide with or proceed its appearance?

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

2: Pre-Drive Check

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

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

3: Preparing for the Road Test

Observe the following when preparing for the road test:

- Review the information recorded on the NVH Diagnostic Guide. It is important to know the specific concern the customer has with the vehicle.
- Do not be misled by the reported location of the noise/vibration. The cause can actually be some distance away.
- Remember that the vibrating source component (originator) may only generate a small vibration. This small vibration can in turn cause a larger vibration/noise to emanate from another receiving component (reactor), due to contact with other components (transfer path).
- Conduct the road test on a quiet street where it is safe to duplicate the vibration/noise. The ideal testing route is an open, low-traffic area where it is possible to operate the vehicle at the speed in which the condition occurs.
- If possible, lower the radio antenna in order to minimize turbulence. Identify anything that could potentially make noise or be a source of wind noise. Inspect the vehicle for add-on items that create vibration/noise. Turn off the radio and the heating and cooling system blower.
- The engine speed is an important factor in arriving at a final conclusion. Therefore, connect an accurate tachometer to the engine, even if the vehicle has a tachometer. Use a tachometer that has clearly defined increments of less than 50 rpm. This ensures an exact engine speed reading.

4: Verify the Customer Concern

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

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

5: Road Test

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

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

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

Slow Acceleration Test

To carry out this test, proceed as follows:

- Slowly accelerate to the speed where the reported concern occurs. Note the vehicle speed, the engine rpm and, if possible, determine the vibration frequency.
- Attempt to identify from what part of the vehicle the concern is coming.
- Attempt to identify the source of the concern.
- Proceed as necessary.

Heavy Acceleration Test

To carry out this test, proceed as follows:

- Accelerate hard from 0-64 km/h (0-40 mph).

- Decelerate in a lower gear.
- The concern is torque related if duplicated while carrying out this test.
- Proceed as necessary.

Neutral Coast Down Speed Test

To carry out this test, proceed as follows:

- Drive at a higher rate of speed than where the concern occurred when carrying out the Slow Acceleration Test.
- Place the transmission in NEUTRAL and coast down past the speed where the concern occurs.
- The concern is vehicle speed-related if duplicated while carrying out this test. This eliminates the engine and the torque converter as sources.
- If the concern was not duplicated while carrying out this test, carry out the Downshift Speed Test to verify if the concern is engine speed related.
- Proceed as necessary.

Downshift Speed Test

To carry out this test, proceed as follows:

- Shift into a lower gear than the gear used when carrying out the Slow Acceleration Test.
- Drive at the engine rpm where the concern occurs.
- The concern is engine speed related if duplicated while carrying out this test. This eliminates the tires, wheels, brakes and the suspension components as sources.
- If necessary, repeat this test using other gears and NEUTRAL to verify the results.
- Proceed as necessary.

Steering Input Test

To carry out this test, proceed as follows:

- Drive at the speed where the concern occurs, while making sweeping turns in both directions.
- If the concern goes away or gets worse, the wheel bearings, hubs, U-joints (contained in the axles of 4WD applications), and tire tread wear are all possible sources.
- Proceed as necessary.

Brake Test

To carry out this test, proceed as follows:

- Warm the brakes by slowing the vehicle a few times from 80–32 km/h (50–20 mph) using light braking applications. At highway speeds of 89–97 km/h (50–60 mph), apply the brake using a light pedal force.
- Accelerate to 89–97 km/h (55–60 mph).
- Lightly apply the brakes and slow the vehicle to 30 km/h (20 mph).
- A brake vibration noise can be felt in the steering wheel, seat or brake pedal. A brake noise can be heard upon brake application and diminish when the brake is released.

Road Test Over Bumps

To carry out this test, proceed as follows:

- Drive the vehicle over a bump or rough surface one wheel at a time to determine if the noise is coming from the front or the back and the left or the right side of the vehicle.
- Proceed as necessary.

Neutral Engine Run-Up (NERU) Test

To carry out this test, proceed as follows:

- Install a tachometer.
- Increase the engine rpm up from an idle to approximately 4000 rpm while in PARK on front wheel drive vehicles with automatic transmissions, or NEUTRAL for all other vehicles. Note the engine rpm and, if possible, determine the vibration frequency.
- Attempt to identify what part of the vehicle the concern is coming from.
- Attempt to identify the source of the concern.
- Proceed as necessary.

Drive Engine Run-Up (DERU) Load Test

To carry out this test, proceed as follows:

- **WARNING: Block the front and rear wheels, and apply the parking brake and the service brake, or injury to personnel can result.**

  CAUTION: Do not carry out the Engine Load Test for more than five seconds or damage to the transmission or transaxle can result.

  Block the front and rear wheels.
- Apply the parking brake and the service brake.
- Install a tachometer.
- Shift the transmission into DRIVE, and increase and decrease the engine rpm between an idle to approximately 2000 rpm. Note the engine rpm and, if possible, determine the vibration frequency.

- Repeat the test in REVERSE.
- If the vibration/noise is duplicated when carrying out this test, inspect the engine and transmission or transaxle mounts.
- If the concern is definitely engine speed-related, carry out the Engine Accessory Test to narrow down the source.
- Proceed as necessary.

Engine Accessory Test

To carry out this test, proceed as follows:

- **WARNING: Block the front and rear wheels, and apply the parking brake and the service brake, or injury to personnel can result.**

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

  NOTE: A serpentine drive belt decreases the usefulness of this test. In these cases, use a vibration analyzer (VA), to pinpoint accessory vibrations. An electronic listening device, such as an EngineEAR, will also help to identify noises from specific accessories.

  Remove the accessory drive belts.
- Increase the engine rpm to where the concern occurs.
- If the vibration/noise is duplicated when carrying out this test, the belts and accessories are not sources.
- If the vibration/noise was not duplicated when carrying out this test, install each accessory belt, one at a time, to locate the source.

Vehicle Cold Soak Procedure

To carry out this procedure, proceed as follows:

- Test preparations include matching customer conditions (if known). If not known, document the test conditions: gear selection and engine rpm. Monitor the vibration/noise duration with a watch for up to three minutes.
- Park the vehicle where testing will occur. The vehicle must remain at or below the concern temperature (if known) for 6-8 hours.
- Before starting the engine, conduct a visual inspection under the hood.
- Turn the key on, but do not start the engine. Listen for the fuel pump, anti-lock brake system (ABS) and air suspension system noises.
- Start the engine.
- **CAUTION: Never probe moving parts.**

  Isolate the vibration/noise by carefully listening. Move around the vehicle while listening to find the general location of the vibration/noise. Then, search for a more precise location by using a stethoscope or EngineEAR.

- Refer to Idle Noise/Vibration in the Symptom Chart to assist with the diagnosis.

6: Check OASIS/TSBs/Repair History

After verifying the customer concern, check for OASIS reports, TSBs and the vehicle repair history for related concerns. If information relating to a diagnosis/repair is found, carry out the procedure(s) specified in that information.

If no information is available from these sources, carry out the vehicle preliminary inspection to eliminate any obvious faults.

7: Diagnostic Procedure

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

- Verify the "symptom".
- Determine which "system(s)" can cause the "symptom".
  - If a vibration concern is vehicle speed related, the tire and wheel rpm/frequency or driveshaft frequency should be calculated.
  - If a vibration concern is engine speed related, the engine, engine accessory or engine firing frequencies should be calculated.
- After determining the "system", use the diagnostic tools to identify the worn or damaged "components".
- After identifying the "components", try to find the "cause" of the failure.

Once the concern is narrowed down to a symptom/condition, proceed to NVH Condition and Symptom Categories.

NVH Condition and Symptom Categories

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

- Identify the operating condition that the vehicle is exhibiting.
- Match the operating condition to the symptom.
- Verify the symptom.
- Identify which category or system could cause the symptom.
- Refer to the diagnostic symptom chart that is referred to.

Operating Condition—Vehicle is Not Moving

1. Static operation
   - Noise occurs during component/system functioning. GO to Symptom Chart — Squeak and Rattle .

2. While cranking
    1. Grinding or whine, differential ring gear or starter motor pinion noise. GO to Symptom Chart — Engine Noise/Vibration .
    2. Rattle. Exhaust hanger, exhaust heat shield or A/C line noise. GO to Symptom Chart — Squeak and Rattle .
    3. Vibration. Acceptable condition.

3. At idle
    - Idle noise. GO to Symptom Chart — Idle Noise/Vibration .
    - Idle vibration or shake. GO to Symptom Chart — Idle Noise/Vibration .

4. During Gear Selection
    1. Vehicle parked on a steep incline. Acceptable noise.
    2. Vehicle parked on a flat surface. GO to Symptom Chart — Driveline Noise/Vibration .
    3. Vehicle with a manual transmission. GO to Symptom Chart — Transmission (Manual) and Transfer Case Noise/Vibration .

Operating Condition—Vehicle is Moving

1. Depends more on how the vehicle is operated
    1. Speed related
        - Related to vehicle speed
            - Pitch increases with vehicle speed. GO to Symptom Chart — Tire Noise/Vibration .
            - Noise occurs at specific vehicle speed. A high-pitched noise (whine). GO to Symptom Chart — Driveline Noise/Vibration .
            - Loudness proportional to vehicle speed. Low-frequency noise at high speeds, noise and loudness increase with speed. GO to Symptom Chart — Driveline Noise/Vibration .
            - A low-pitched noise (drumming). GO to Symptom Chart — Engine Noise/Vibration .
            - Vibration occurs at a particular speed (mph) regardless of acceleration or deceleration. GO to Symptom Chart — Tire Noise/Vibration .
            - Noise varies with wind/vehicle speed and direction. GO to Symptom Chart — Air Leak and Wind Noise .
        - Related to engine speed.
            - Noise varies with engine rpm. GO to Symptom Chart — Engine Noise/Vibration .
            - Vibration occurs at a particular speed (mph) regardless of engine speed (rpm).
    2. Acceleration
        - Wide open throttle (WOT)
            - Engine induced contact between components. Inspect and repair as necessary.
            - Noise is continuous throughout WOT. Exhaust system or engine ground out. GO to Symptom Chart — Engine Noise/Vibration .
        - Light/moderate acceleration
            - Tip-in moan. Engine/exhaust noise. GO to Symptom Chart — Engine Noise/Vibration .
            - Knock-type noise. GO to Symptom Chart — Engine Noise/Vibration .
            - Driveline shudder. GO to Symptom Chart — Driveline Noise/Vibration .

- Engine vibration. GO to Symptom Chart — Engine Noise/Vibration .

3. Turning noise. GO to Symptom Chart —Steering Noise/Vibration .
4. Braking
   - Clicking sound is signaling ABS is active. Acceptable ABS sound.
   - A continuous grinding/squeal. GO to Symptom Chart — Brake Noise/Vibration .
   - Brake vibration/shudder. GO to Symptom Chart — Brake Noise/Vibration .
5. Clutching
   - A noise occurring during clutch operation. GO to Symptom Chart — Transmission (Manual) and Transfer Case Noise/Vibration .
   - Vibration. GO to Symptom Chart — Transmission (Manual) and Transfer Case Noise/Vibration .
6. Shifting
   - Noise or vibration condition related to the transmission (automatic). GO to Symptom Chart — Transmission (Automatic) Noise/Vibration .
   - Noise or vibration related to the transmission (manual). GO to Symptom Chart — Transmission (Manual) and Transfer Case Noise/Vibration .
7. Engaged in four-wheel drive. GO to Symptom Chart — Transmission (Manual) and Transfer Case Noise/Vibration .
8. Cruising speeds
   - Accelerator pedal vibration. GO to Symptom Chart — Engine Noise/Vibration .
   - Driveline vibration. GO to Symptom Chart — Driveline Noise/Vibration .
   - A shimmy or shake. GO to Symptom Chart — Tire Noise/Vibration .
9. Driving at low/medium speeds
   - A wobble or shudder. GO to Symptom Chart — Tire Noise/Vibration .

2. Depends more on where the vehicle is operated
   1. Bump/pothole, rough road or smooth road. GO to Symptom Chart — Suspension Noise/Vibration y.
      - Noise is random or intermittent occurring from road irregularities. GO to Symptom Chart — Squeak and Rattle .
      - Noise or vibration changes from one road surface to another. Normal sound changes.
      - Noise or vibration associated with a hard/firm ride. GO to Symptom Chart — Suspension Noise/Vibration .

Symptom Charts

Symptom Chart — Air Leak and Wind Noise

Condition	Possible Sources	Action
• Air leak around door perimeter	• Loose fit seal.	• PINCH the seal carrier to improve retention on the seal flange.
	• Seal installed incorrectly.	• REINSTALL the seal.
	• Door misaligned.	• REALIGN the door. CHECK door gaps and fit in the door opening and ADJUST as necessary.

	• Scuff plate installed incorrectly. • Seal or seal push pins damaged.	• REINSTALL the scuff plate. • INSTALL a new seal.
• Air leak around glass run	• Door glass misaligned. • Glass run installed incorrectly. • Leak path behind glass run. • Glass run channel spread wide. • Blow-out clip bent or contacting door glass. • Glass run damaged.	• ADJUST the door glass. • ADJUST the glass run. INSERT foam in the glass run carrier. • INSTALL foam rope behind the glass run. • PINCH the glass run channel to reduce the size of the opening. • ADJUST the blow-out clip or INSTALL a new glass run/blow-out clip molding assembly. • INSTALL a new glass run.
• Air leak at inner belt line	• Belt line seal installed incorrectly on flange. • Belt line seal integrated with door trim installed incorrectly (no glass contact). • No contact with side glass. • No contact with glass runs at both ends of belt line seal. • Belt line seal damaged.	• ADJUST the seal. (Do not bend the flange.) • REINSTALL the door trim. • ADJUST the door glass. • ADJUST the belt line seal or ADD foam at the seal ends. • INSTALL a new seal.
• Air leak at outer belt line	• Belt line seal installed incorrectly on flange (no glass contact). • Belt line seal does not contact the glass. • No contact with glass runs at both ends of belt line seal. • Belt line seal damaged.	• ADJUST the seal. • ADJUST the door glass. • ADJUST the belt line seal/ADD foam at the seal ends. • INSTALL a new seal.
• Draft at inner door handle/speaker opening	• Hole in watershield. • Watershield misaligned. • Exterior door handle seal misaligned/damaged.	• SEAL the hole with a suitable tape. • REALIGN the watershield. INSTALL a new watershield if the pressure sensitive adhesive fails. • REALIGN or INSTALL a new seal as necessary.
• Wind noise from side view mirror	• Outside mirror housing misaligned.	• REALIGN with the edges shingled correctly and no gaps.

	• Mirror sail gasket folded/misaligned.	• REINSTALL with the gasket unfolded and aligned correctly.
	• Mirror housing trim cap installed incorrectly.	• REINSTALL with the edges shingled to the air flow.
	• Air leak through mirror housing hinge.	• Fully ENGAGE the mirror into its operating position/USE foam to block the air path through the hinge.
	• Inner sail trim installed incorrectly.	• REINSTALL the sail trim/ADJUST the door trim.
	• Inner sail gasket/barrier installed incorrectly.	• REINSTALL the trim cover with the gasket/barrier aligned correctly.
	• Air path through wiring bundle/fastener access holes.	• BLOCK the air path(s) with foam/tape.
	• Exposed fastener access hole on mirror housing/sail.	• INSTALL a new cap if it is missing.
• Air leak around perimeter of fixed glass	• Gaps in the sealant bead.	• APPLY approved sealant.
	• Air traveling up windshield molding along A-pillar.	• INSTALL foam rope the full length of the A-pillar.
	• Windshield/backlite misaligned or not installed correctly.	• REINSTALL the windshield/backlite.
	• Rear hood seal at base of windshield misaligned/damaged.	• REALIGN or INSTALL a new seal as necessary.
• Air leak at cowl	• Cowl gasket misaligned/damaged.	• REALIGN or INSTALL a new seal as necessary.
• Air leak around liftgate perimeter	• Loose fit seal.	• PINCH the seal carrier to improve retention on the seal flange or INSERT foam in the carrier.
	• Seal misaligned.	• REINSTALL the seal.
	• Liftgate misaligned.	• REALIGN the liftgate. CHECK the liftgate fit in the body opening and ADJUST as necessary.
	• Scuff plate misaligned.	• REINSTALL the scuff plate.
	• Seal or seal push pins damaged.	• INSTALL a new seal.
• Air leak around the liftgate flip window perimeter	• Loose fit seal.	• PINCH the seal carrier to improve the retention to the seal flange.

	• Seal misaligned. • Glass misaligned. • Seal damaged.	• REINSTALL the seal. • REALIGN the glass. • INSTALL a new seal.
• Wind noise from antenna	• Shape of antenna. • Air leak around antenna cable access hole.	• INSTALL an antenna boot or a spiral antenna. • INSPECT the antenna access hole grommet. REPAIR as necessary.
• Air leak from closed roof opening panel	• Seal installed incorrectly. • Roof opening panel glass/door misaligned. • Roof opening panel damaged.	• REINSTALL the seal. • REALIGN the roof opening panel glass/door. • INSTALL a new roof opening panel.
• Buffeting from an open roof opening panel	• Wind deflector inoperative/damaged. • Wind deflector height incorrect.	• REPAIR or INSTALL a new wind deflector as necessary. • ADJUST the wind deflector higher.
• Wind noise created by airflow over or behind body panels	• Fender splash shield misaligned. • Body panel misaligned (exposed edge). • Hood misaligned (front margin). • Front grille edge noise.	• REALIGN the fender splash shield. • REALIGN the appropriate body panel. • CHECK hood gaps and fit. ADJUST the hood as necessary. • APPLY foam in the hollow areas behind the louvers.
• Wind noise created by grille opening panel	• Grille relationship to leading edge on hood. • Sharp edges due to material imperfections.	• ADJUST the grille opening panel forward to eliminate wind noise. • REMOVE the sharp edges (no damage to visible surface).
• Wind noise from air extractor	• Air extractor housing seated incorrectly. • Air extractor housing or flaps damaged.	• REINSTALL the air extractor housing. • INSTALL a new air extractor.
• Air leak at top of A-pillar — vehicles with a convertible top	• Seal at windshield header installed incorrectly. • Seal pinched. • Gap between side rail and header seal at A-pillar.	• REINSTALL the seal. • FILL the seal with foam to reshape it. • ADJUST the J-hook/vinyl top.
• Air leak at rear quarter glass (division bar) —	• No contact between front side glass and quarter glass division	• ADJUST the front side glass regulator and the rear quarter glass

vehicles with a convertible top	bar.	regulator.
• Air leak or wind noise from top of side glass — vehicles with a convertible top	• Gap between side rail and vinyl top.	• ADD additional foam tape to seal between the side rail and the vinyl top.
	• Seal at windshield header installed incorrectly.	• REINSTALL the seal.
	• Seal damaged between side rail and vinyl top.	• INSTALL a new seal.
	• Vinyl top damaged.	• INSPECT the vinyl top. INSTALL a new vinyl top as necessary.
• Air leak or wind noise at windshield header — vehicles with a convertible top	• Vinyl top not flush with header.	• ADJUST the J-hook to lower the top to achieve a flush condition.
	• Seal at windshield header installed incorrectly.	• REINSTALL the seal.
	• Header seal not flush with header.	• REINSTALL the seal.
• Convertible top flapping with the top up	• Vinyl top contacting interior headliner.	• Working from front to back, INSTALL a 6.35 mm (0.25 in) foam sheet between the headliner and the vinyl top at the suspected area. Allow a clearance of 50 mm (2 in) - 75 mm (3 in) away from the roof bows and the side rails.
• Noise from roof rack	• Roof rack rails or crossbars loose.	• TIGHTEN the fasteners.
	• Roof rack fasteners missing.	• INSTALL the approved fasteners.
	• Roof rack crossbars installed backward.	• REINSTALL the crossbars.
	• Roof rack rub strips partially lifting from roof.	• REAPPLY adhesive or fasteners or INSTALL new rub strips as necessary.
	• Roof rack gaskets loose or misaligned.	• REINSTALL the gasket.
• Wind noise from bug shield/exterior windshield sun visor	• Turbulence created by location and shape.	• REMOVE per customer direction if it is a dealer installed option.

Symptom Chart—Brake Noise/Vibration

Condition	Possible Sources	Action

• Rattling noise	• Caliper mounting bolts loose.	• CHECK the caliper bolts. TIGHTEN to specifications. REFER to Section 206-03 for the front disc brakes or Section 206-04 for the rear disc brakes.
	• Damaged or worn caliper pins or retainers.	• CHECK the caliper pins and retainers for lubrication and correct fit. LUBRICATE or INSTALL new components as necessary. REFER to Section 206-03 for the front disc brakes or Section 206-04 for the rear disc brakes.
	• Missing or damaged anti-rattle clips or springs.	• CHECK the brake pads for missing clips or broken springs. INSTALL new components as necessary. REFER to Section 206-03 for the front disc brakes or Section 206-04 for the rear disc brakes.
	• Loose brake disc shield.	• TIGHTEN the brake disc shield bolts to specification. REFER to Section 206-03 .
• Clicking noise—with brakes applied with ABS brakes	• ABS hydraulic control unit.	• Acceptable condition.
• Squealing noise—occurs on first (morning) brake application	• Disc brake pads.	• Acceptable condition. Caused by humidity and low disc brake pad temperature.
• Squealing noise—a continuous squeal	• Disc brake pads or linings worn below minimum thickness.	• INSTALL new disc brake pads. REFER to Section 206-03 for the front disc brakes or Section 206-04 for the rear disc brakes.
• Squealing noise—an intermittent squeal brought on by cold, heat, water, mud or snow	• Disc brake pad.	• Acceptable condition.
• Groaning noise—occurs at low speeds with brake lightly applied (creeping)	• Disc brake pads.	• Acceptable condition.
• Grinding noise—continuous	• Disc brake pads or linings worn below minimum thickness.	• INSPECT the disc brake pads, brake discs/drums and attaching hardware for damage. REPAIR or INSTALL new components as necessary. REFER to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes.
• Moaning noise	• Brake linings contaminated	• INSPECT the brake pads and shoes for

	with grease or oil.	contamination. REPAIR or INSTALL new components as necessary.
• Brake vibration/shudder—occurs when brakes are applied	• Uneven disc or drum wear. • Uneven disc brake pad or lining transfer. • Suspension components.	• Go To Pinpoint Test A .
• Brake vibration/shudder—occurs when the brake pedal is released	• Brake drag.	• INSPECT the disc brake pads or linings for premature wear. REPAIR or INSTALL a new caliper or wheel cylinder as necessary. REFER to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes.

Symptom Chart—Driveline Noise/Vibration

Condition	Possible Sources	Action
• Axle howling or whine—front or rear axle	• Axle lubricant low.	• CHECK the lubricant level. FILL the axle to specification.
	• Axle housing damage.	• INSPECT the axle housing for damage. REPAIR or INSTALL a new axle as necessary. REFER to Section 205-02A for Ford 8.8 rear axles, Section 205-02B for Ford 9.75 rear axles or Section 205-03 for the front axle.
	• Damaged or worn wheel bearings or axle bearings.	• CHECK for abnormal wheel bearing play or roughness. Refer to Wheel Bearing Check in this section. ADJUST or INSTALL new wheel bearings as necessary.
	• Damaged or worn differential ring and pinion.	• INSPECT the ring and pinion ring for abnormal wear patterns or broken teeth. INSTALL a new ring and pinion as necessary. REFER to Section 205-02A for Ford 8.8 rear axles, Section 205-02B for Ford 9.75 rear axles or Section 205-03 for the front axle.
	• Damaged or worn differential side or pinion bearings.	• CHECK for abnormal bearing play or roughness. INSTALL new bearings as necessary. REFER to Section 205-02A for Ford 8.8 rear axles, Section 205-02B for Ford 9.75 rear axles or Section 205-03 for the front

		axle.
	• Damaged or worn differential side gears and pinion gears.	• DISASSEMBLE the differential carrier. INSPECT the side and pinion gears for abnormal wear patterns or broken teeth. INSTALL new gears as necessary. REFER to Section 205-02A for Ford 8.8 rear axles, Section 205-02B for Ford 9.75 rear axles or Section 205-03 for the front axle.
• Driveline clunk—loud clunk when shifting from reverse to drive	• Incorrect axle lubricant level.	• CHECK the lubricant level. FILL the axle to specification.
	• Excessive backlash in the axle or transmission.	• CARRY OUT a total backlash check. REFER to Section 205-00 .
	• Damaged or worn pinion bearings.	• CHECK for abnormal bearing play or roughness. INSTALL new bearings as necessary
	• Damaged or worn universal joints (U-joints).	• INSPECT the U-joints for wear or damage. INSTALL new U-joints as necessary. REFER to Section 205-01 .
	• Loose suspension components.	• INSPECT the suspension for damage or wear. REPAIR or INSTALL new components as necessary.
	• Broken powertrain mounts.	• INSPECT the powertrain mounts. REFER to Section 303-01A for 4.6L and 5.4L (2V) engines or Section 303-01B for 5.4L (4V) engines. INSTALL new mounts as necessary.
	• Idle speed too high.	• CHECK for the correct idle speed.
• Driveline clunk—occurs as the vehicle starts to move forward following a stop	• Worn or galled driveshaft slip-yoke splines.	• CLEAN and INSPECT the splines of the yoke for a worn or galled condition. INSTALL a new yoke as necessary. REFER to Section 205-01 .
	• Worn or galled driveshaft and coupling shaft splines.	• CLEAN and INSPECT the splines of the driveshaft and coupling shaft for a worn or galled condition. INSTALL a new driveshaft assembly as necessary. REFER to Section 205-01 .
	• Loose rear leaf spring U-bolts.	• CHECK the U-bolts for loose nuts. TIGHTEN to specification. REFER to Section 204-02 .
• Driveline clunk (FWD	• Damaged or	• INSPECT the inboard CV

vehicles)—occurs during acceleration or from cruise to coast/deceleration	worn inboard constant velocity (CV) joint.	joint and boot. REPAIR or INSTALL a new CV joint as necessary.
• Driveline clunk (4WD vehicles)—occurs during shift-on-the-fly engagement	• Clutch relay. • Shift motor. • Transfer case. • GEM.	• CHECK the 4WD engagement system. REPAIR or INSTALL new components as necessary. REFER to Section 308-07A and Section 308-07B .
• Clicking, popping or grinding—occurs while vehicle is turning	• Inadequate or contaminated lubrication in the (CV) joints.	• CHECK the CV boots and joints for wear or damage. REPAIR or INSTALL new components as necessary. REFER to Section 205-04 .
	• Another component contacting the halfshaft.	• CHECK the halfshafts and the area around the halfshafts. REPAIR as necessary.
	• Brake components.	• INSPECT the front brakes for wear or damage. REPAIR as necessary. REFER to Section 206-03 .
	• Steering components.	• INSPECT the drag link, inner and outer tie-rods or idler arm for wear or damage. REPAIR as necessary.
	• Suspension components.	• INSPECT the upper and lower ball joints for wear or damage. REPAIR as necessary. REFER to Section 204-01A for 2-wheel drive vehicles or Section 204-01B for 4-wheel drive vehicles.
	• Damaged or worn wheel bearings.	• CHECK for abnormal wheel bearing play or roughness. Refer to Wheel Bearing Check in this section. ADJUST or INSTALL new wheel bearings as necessary.
• Clicking or snapping—occurs when accelerating around a corner	• Damaged or worn outboard CV joint.	• INSPECT the outboard CV joint and boot. REPAIR or INSTALL a new CV joint as necessary. REFER to Section 205-04 .
• High pitched chattering—noise from the rear axle when the vehicle is turning	• Incorrect or contaminated lubricant.	• CHECK the vehicle by driving in tight circles (5 clockwise, 5 counterclockwise). FLUSH and REFILL with the specified rear axle lubricant and friction modifier as necessary.
	• Damaged or worn differential (differential side gears and	• DISASSEMBLE the differential assembly. INSPECT the differential case, pin and gears for wear

	pinion gears).	or damage. REPAIR or INSTALL a new differential as necessary. REFER to Section 205-02A for Ford 8.8 rear axles or Section 205-02B for Ford 9.75 rear axles.
• Buzz—buzzing noise is the same at cruise or coast/deceleration	• Damaged or worn tires. • Incorrect driveline angles.	• CHECK for abnormal tire wear or damage. INSTALL new tire(s) as necessary. REFER to Section 204-04 . • CHECK for correct driveline angles. REPAIR as necessary. REFER to Section 205-00 .
• Rumble or boom—noise occurs at coast/deceleration, usually driveshaft speed related and noticeable over a wide range of speeds	• Driveshaft is out-of-balance. • U-joints binding or seized. • Excessive pinion flange runout.	• CHECK the driveshaft for damage, missing balance weights or undercoating. CHECK the driveshaft balance. CARRY OUT a driveline vibration test. REFER to Section 205-00 . • ROTATE the driveshaft and CHECK for rough operation or seized U-joints. INSTALL new U-joints as necessary. REFER to Section 205-01 . • CARRY OUT a runout check. REPAIR as necessary. REFER to Section 205-00 .
• Grunting—normally associated with a shudder experienced during acceleration from a dead stop	• Driveshaft slip yoke binding. • Loose rear spring U-bolts.	• CLEAN and LUBRICATE the male and female splines. • INSPECT the rear suspension. TIGHTEN the U-bolt nuts to specification. REFER to Section 204-02 .
• Howl—can occur at various speeds and driving conditions. Affected by acceleration and deceleration	• Incorrect ring and pinion contact, incorrect bearing preload or gear damage.	• CHECK the ring and pinion and bearings for damage. INSPECT the ring and pinion wear pattern. REFER to Checking Tooth Contact Pattern and Condition of the Ring and Pinion component test in this section. ADJUST or INSTALL new components as necessary. REFER to Section 205-02A for Ford 8.8 rear axles, Section 205-02B for Ford 9.75 rear axles or Section 205-03 for the front axle.
• Chuckle—heard at coast/deceleration. Also described as a knock	• Incorrect ring and pinion contact or by damaged teeth on the coast	• CHECK the ring and pinion for damage. INSPECT the ring and pinion wear pattern. REFER to Checking Tooth Contact Pattern and

	side of the ring and pinion.	Condition of the Ring and Pinion component test in this section. ADJUST or INSTALL new components as necessary. REFER to Section 205-02A for Ford 8.8 rear axles, Section 205-02B for Ford 9.75 rear axles or Section 205-03 for the front axle.
• Knock—noise occurs at various speeds. Not affected by acceleration or deceleration	• Gear tooth damage to the drive side of the ring and pinion.	• CHECK the differential case and ring and pinion for damage. INSTALL new components as necessary. REFER to Section 205-02A for Ford 8.8 rear axles, Section 205-02B for Ford 9.75 rear axles or Section 205-03 for the front axle.
	• Excessive axle shaft end play. (Vehicles with integral axles).	• CHECK the axle end play using a dial indicator. INSTALL a new axle shaft or side gears as necessary. REFER to Section 205-02A for Ford 8.8 rear axles, Section 205-02B for Ford 9.75 rear axles or Section 205-03 for the front axle.
• Scraping noise—a continuous low pitched noise starting at low speeds	• Worn or damaged pinion bearings.	• CHECK the pinion bearings. INSTALL new pinion bearings as necessary. REFER to Section 205-02A for Ford 8.8 rear axles, Section 205-02B for Ford 9.75 rear axles or Section 205-03 for the front axle.
• Driveline shudder—occurs during acceleration from a slow speed or stop	• Rear drive axle assembly mispositioned.	• CHECK the axle mounts and the rear suspension for damage or wear. REPAIR as necessary.
	• Loose rear spring U-bolts.	• INSPECT the U-bolts. TIGHTEN the U-bolt nuts to specification. REFER to Section 204-02 .
	• Incorrect or high CV joint operating angle.	• CHECK vehicle ride height is within limits. REPAIR as necessary.
	• Damaged or worn front suspension components.	• CHECK for a loose stabilizer bar, damaged or loose strut/strut bushings or loose or worn ball joints. INSPECT the steering linkage for wear or damage. REPAIR or INSTALL new components as necessary. REFER to the appropriate section for the service procedure.
	• Driveline angles out of specification.	• CHECK for correct driveline angles. REPAIR as necessary. REFER to

		Section 205-00 .
	• U-joints binding or seized.	• ROTATE the driveshaft and CHECK for rough operation or seized U-joints. INSTALL new U-joints as necessary. REFER to Section 205-01 .
	• Binding, damaged or galled splines on the driveshaft slip-yoke.	• CLEAN and INSPECT the splines of the slip-yoke, driveshaft and coupling shaft for a worn, damaged or galled condition. INSTALL a new slip-yoke or driveshaft assembly as necessary. REPAIR as necessary. REFER to Section 205-01 .
• Driveline vibration—occurs at cruising speeds	• U-joints are worn.	• CHECK for wear or incorrect seating. INSTALL new U-joints as necessary. REFER to Section 205-01 .
	• Worn or damaged driveshaft center bearing support.	• CHECK the insulator for damage or wear. ROTATE the driveshaft and CHECK for rough operation. INSTALL a new center bearing support as necessary. REFER to Section 205-01 .
	• Loose axle pinion flange bolts.	• INSPECT the axle pinion flange. TIGHTEN the pinion flange bolts to specification. REFER to Section 205-01 .
	• Excessive axle pinion flange runout.	• CARRY OUT a Runout Check. REPAIR as necessary. REFER to Section 205-01 .
	• Driveshaft is out-of-balance.	• CHECK the driveshaft for damage, missing balance weights or undercoating. CHECK driveshaft balance. CARRY OUT a driveline vibration test. REFER to Section 205-00 . REPAIR as necessary.
	• Binding or damaged splines on the driveshaft slip-yoke.	• CLEAN and INSPECT the splines of the slip-yoke, driveshaft and coupling shaft for wear or damage. INSTALL a new slip-yoke or driveshaft assembly as necessary. REFER to Section 205-01 . REPAIR as necessary.
	• Driveshaft runout.	• CARRY OUT a Runout Check. REFER to Section 205-00 . REPAIR as necessary.
	• Incorrect lateral and radial tire/wheel	• INSPECT the tire and wheels. MEASURE tire runouts. REPAIR or

	runout.	INSTALL new components as necessary. REFER to Section 204-04 .
	• Driveline angles out of specification.	• CHECK for correct driveline angles. REPAIR as necessary. REFER to Section 205-00 .
	• Incorrectly seated CV joint in the front wheel hub.	• CHECK the outer CV joint for correct seating into the hub. REPAIR as necessary. REFER to Section 205-04 .

Symptom Chart — Engine Noise/Vibration

Condition	Possible Sources	Action
• Grinding noise—occurs during engine cranking	• Incorrect starter motor mounting.	• INSPECT the starter motor for correct mounting. REPAIR as necessary. REFER to Section 303-06 .
	• Starter motor.	• CHECK the starter motor. REPAIR or INSTALL a new starter motor as necessary. REFER to Section 303-06 .
	• Incorrect starter motor drive engagement.	• INSPECT the starter motor drive and flexplate/flywheel for wear or damage. INSTALL a new starter motor drive or flexplate/flywheel as necessary. REFER to Section 303-06 .
• Engine ticking noise	• Fuel injector. • Fuel line. • Oil pump. • Valve lifter. • Belt tensioner. • Water pump. • Obstruction of cooling fan.	• Go To Pinpoint Test B .
• Engine drumming noise—normally accompanied by vibration	• Powertrain mount.	• CARRY OUT Powertrain/Drivetrain Mount Neutralizing in this section.
	• Damaged or misaligned exhaust system.	• INSPECT the exhaust system for loose or broken clamps and brackets. CARRY OUT Exhaust System Neutralizing in this section.
• Whistling noise—normally accompanied with poor idle condition	• Air intake system.	• CHECK the air intake ducts, air cleaner, throttle body and vacuum hoses for leaks and correct fit. REPAIR or ADJUST as necessary. REFER to Section 303-12 .
• Clunking noise	• Water pump has excessive end play or	• CHECK the water pump for excessive end play.

	imbalance.	INSPECT the water pump with the drive belt off for imbalance. INSTALL a new water pump as necessary. REFER to Section 303-03 .
	• Generator has excessive end play.	• CHECK the generator for excessive end play. REPAIR or INSTALL a new generator. REFER to Section 414-02 .
• Pinging noise	• Exhaust system leak.	• INSPECT the exhaust system for leaks. REPAIR as necessary.
	• Gasoline octane too low.	• VERIFY with customer the type of gasoline used. CORRECT as necessary.
	• Knock sensor operation.	• CHECK the knock sensor. INSTALL a new knock sensor as necessary. REFER to Section 303-14 .
	• Incorrect spark timing.	• CHECK the spark timing. REPAIR as necessary.
	• High operating temperature.	• INSPECT cooling system for leaks. CHECK the coolant level. REFILL as necessary. CHECK the coolant for the correct mix ratio. DRAIN and REFILL as needed. CHECK engine operating temperature is within specifications. REPAIR as necessary.
	• Foul-out spark plug.	• CHECK the spark plugs. REPAIR or INSTALL new spark plugs as necessary.
	• Catalytic converter.	• Acceptable noise.
• Knocking noise—light knocking noise, also described as piston slap. Noise is most noticeable when engine is cold with light to medium acceleration. Noise disappears as engine warms	• Excessive clearance between the piston and the cylinder wall.	• Engine cold and at high idle. Using an EngineEAR, pull a spark plug or fuel injector connector until the noise goes away. CARRY OUT a cylinder bore clearance to piston check. INSTALL a new piston. REFER to Section 303-01A for 4.6L and 5.4L (2V) engines or Section 303-01B for 5.4L (4V) engines.
• Knocking noise—light double knock or sharp rap sound. Occurs mostly with warm engine at idle or low speeds in DRIVE. Increases in	• Excessive clearance between the piston and the piston pin.	• INSTALL a new piston or piston pin. REFER to Section 303-01A for 4.6L and 5.4L (2V) engines or Section 303-01B for 5.4L (4V) engines.

relation to engine load. Associated with poor lubrication history		
• Knocking noise—light knocking noise is most noticeable when engine is warm. Noise tends to decrease when vehicle is coasting or in neutral	• Excessive clearance between the connecting rod bearings and the crankshaft.	• Engine warm and at idle. Using an EngineEAR, PULL a spark plug or fuel injector connector until the noise goes away. INSTALL new bearings. REFER to Section 303-01A for 4.6L and 5.4L (2V) engines or Section 303-01B for 5.4L (4V) engines.
• Knocking—deep knocking noise. Noise is most noticeable when engine is warm, at lower rpm and under a light load and then at float	• Worn or damaged crankshaft main bearings.	• CARRY OUT Drive Engine Run-Up (DERU) Test. CHECK for noise with vehicle at operating temperature, during medium to heavy acceleration. CHECK at idle with injector disconnected, noise does not change. INSTALL new main bearings. REFER to Section 303-01A for 4.6L and 5.4L (2V) engines or Section 303-01B for 5.4L (4V) engines.
• Knocking noise—occurs mostly with warm engine at light/medium acceleration	• Spark plugs. • Carbon accumulation in combustion chamber.	• CHECK the spark plug for damage or wear. INSTALL new spark plugs as necessary. • REMOVE carbon from combustion chamber.
• Whine or moaning noise	• Air intake system. • Generator electrical field or bearings.	• CHECK the air cleaner and ducts for correct fit. INSPECT the air intake system for leaks or damage. REPAIR as necessary. • CARRY OUT generator load test. REPAIR or INSTALL a new generator as necessary. REFER to Section 414-02 .
• Drone type noise	• Exhaust system. • A/C compressor.	• CARRY OUT Exhaust System Neutralizing in this section. REPAIR as necessary. • CHECK for noise with vehicle at constant speeds. CYCLE the compressor on and off and listen for a change in pitch. REPAIR as necessary. REFER to Section 412-03A .

	• Powertrain mounts.	• CARRY OUT Powertrain/Drivetrain Mount Neutralizing in this section.
• Sputter type noise—noise worse when cold, lessens or disappears when vehicle is at operating temperature	• Damaged or worn exhaust system components.	• INSPECT the exhaust system for leaks or damage. REPAIR as necessary. REFER to Section 309-00 .
• Rattling noise—noise from the upper engine (valve train). Worse when engine is cold	• Low oil level.	• CHECK oil level. FILL as necessary.
	• Thin or diluted oil.	• INSPECT the oil for contamination. If oil is contaminated, CHECK for the source. REPAIR as necessary. CHANGE the oil and filter.
	• Low oil pressure.	• CARRY OUT an oil pressure test. If not within specifications, REPAIR as necessary. REFER to Section 303-00 .
	• Worn rocker arms/fulcrums or followers.	• CARRY OUT a valve train analysis. INSTALL new valve train components as necessary. REFER to Section 303-01A for 4.6L and 5.4L (2V) engines or Section 303-01B for 5.4L (4V) engines.
	• Worn valve guides.	• CARRY OUT a valve train analysis. INSTALL new valve guides as necessary. REFER to Section 303-01A for 4.6L and 5.4L (2V) engines or Section 303-01B for 5.4L (4V) engines.
	• Excessive runout of valve seats on the valve face.	• CARRY OUT a valve seat runout test. INSPECT the valve face and seat. INSTALL new valves as necessary. REFER to Section 303-01A for 4.6L and 5.4L (2V) engines or Section 303-01B for 5.4L (4V) engines.
• Rattling noise—from the bottom of the vehicle	• Loose muffler shields or catalytic converter shields.	• CHECK the exhaust system for loose exhaust shields. REPAIR as necessary.
• Thumping noise—from the bottom of the vehicle, worse at	• Exhaust pipe/muffler grounded to chassis.	• CHECK the exhaust system to chassis clearance. CHECK the exhaust system hangers for damage.

acceleration		REPAIR as necessary. REFER to Section 309-00 .
• Whoosh—occurs during light vehicle acceleration. Heard inside the vehicle	• Throttling late, creating turbulence transmitted through the plastic manifold.	• CHECK for leaks or missing seal in the dash panel.
• Engine vibration—increases intensity as engine rpm is increased	• Engine out-of-balance.	• CARRY OUT Neutral Engine Run-Up (NERU) Test. ROTATE the torque converter, 120° for 3 bolt and 180° for 4 bolt. INSPECT the torque converter pilot outer diameter to crankshaft pilot inner diameter. REPAIR as necessary. REFER to Section 307-01B for 4R70W transmissions or Section 307-01A for 4R100 transmissions.
• Engine vibration—is felt with increases and decreases in engine rpm	• Strain on exhaust mounts. • Damaged or worn powertrain/drivetrain mounts. • Engine or transmission grounded to chassis.	• CARRY OUT Exhaust System Neutralizing in this section. REPAIR as necessary. • CHECK the powertrain/drivetrain mounts for damage. CARRY OUT the Powertrain/Drivetrain Mount Neutralizing in this section. REPAIR as necessary. • INSPECT the powertrain/drivetrain for correct clearances. REPAIR as necessary.
• Engine vibration—vibration felt at all times	• Excessive engine pulley runout. • Damaged or worn accessory component.	• CARRY OUT Engine Accessory Test. INSTALL a new engine pulley as necessary. REFER to Section 303-01A for 4.2L and 5.4L (2V) engines or Section 303-01B for 5.4L (4V) engines. • CARRY OUT Engine Accessory Test. REPAIR or INSTALL a new component as necessary.
• Accelerator pedal vibration—felt through the pedal as a buzz	• Throttle cable loose or misrouted.	• INSPECT the throttle cable. REPAIR as necessary. REFER to Section 310-02 .
• Engine vibration—mostly at coast/neutral coast. Condition improves with	• Combustion instability.	• CHECK the ignition system. INSTALL new components as necessary.

vehicle accelerating		
● Engine vibration or shudder—occurs with light to medium acceleration above 56 km/h (35 mph)	● Worn or damaged spark plugs.	● INSPECT the spark plugs for cracks, high resistance or broken insulator. INSTALL a new spark plug (s) as necessary.
	● Plugged fuel injector.	● REPAIR or INSTALL a new injector as necessary.
	● Damaged spark plug wire.	● INSPECT the spark plug wires for damage. INSTALL a new spark plug wire(s) as necessary.
	● Contaminated fuel.	● INSPECT the fuel for contamination. DRAIN the fuel system and refill.
	● Worn or damaged torque converter.	● CHECK the torque converter. INSTALL a new torque converter as necessary. REFER to Section 307-01B for 4R70W transmissions. REFER to Section 307-01A for 4R100 transmissions.

Symptom Chart—Idle Noise/Vibration

Condition	Possible Sources	Action
● Idle air control (IAC) valve moan — occurs on throttle tip-out	● IAC valve is contaminated with oil.	● GO to Component Tests in this section.
● Accessory drive belt chirp — occurs at idle or high idle, cold or hot. Most common occurrence is during humid weather	● Accessory drive belt worn, or pulley is misaligned or loose.	● INSPECT for loose or misaligned pulleys. CHECK the drive belt for wear or damage. INSTALL new pulley(s)/accessory drive component or drive belt, as necessary. REFER to Section 303-05 .
● Accessory drive bearing hoot — occurs at idle or high idle in cold temperatures of approximately +4°C (+40°F) or colder at first start of the day	● Accessory drive idler or tensioner pulley bearing is experiencing stick/slip between ball bearings and bearing race.	● Go To Pinpoint Test C .
● Power steering moan — occurs at high idle and possibly at idle during the first cold start of the day in temperatures of approximately -18°C (0°F) or colder. Noise can even be a severe	● High fluid viscosity, or plugged reservoir screen in power steering reservoir starves pump causing	● Go To Pinpoint Test D .

screech for less than one minute in very cold temperatures of approximately -29°C (-20°F) or colder	cavitation.	
• Generator whine — during high electrical loads at idle or high idle, a high pitch whine or moan is emitted from the generator	• Generator electrical field noise.	• Using an EngineEAR, PROBE near the generator housing. LISTEN for changes in the noise level while changing electrical loads (such as rear defrost, headlamps, etc.). CARRY OUT a generator load test. If the system passes the load test, the noise is from the generator bearings, INSTALL new bearings. If the system fails the load test, INSTALL a new generator. REFER to Section 414-02 .
• Engine-driven cooling fan moan — occurs during the first start of the day. It is most objectionable near idle speeds up to 2000 rpm. The noise increases with rpm	• The viscous cooling fan clutch engages until the fluid in the clutch reaches normal operating temperature, causing the fan to fully engage.	• Go To Pinpoint Test E .
• Drumming noise — occurs inside the vehicle during idle or high idle, hot or cold. Very low-frequency drumming is very rpm dependent	• Exhaust system vibration excites the body resonances inducing interior noise. • Engine vibration excites the body resonances inducing interior noise.	• Go To Pinpoint Test F .
• Hissing noise — occurs during idle or high idle that is apparent with the hood open	• Vacuum leak or idle air control (IAC) valve flow noise. • Vehicles with a plastic intake manifold.	• Use the Ultrasonic Leak Detector/EngineEAR to locate the source. Scan the air intake system from the inlet to each cylinder intake port. DISCARD the leaking parts, and INSTALL a new component. • Acceptable condition. Some plastic manifolds exhibit this noise, which is the effect of the plastic manifold.
• Automatic transmission buzz or hiss	• Incorrect driveline angles. • Worn or	• CHECK for correct driveline angles. REPAIR as necessary. REFER to Section 205-00 . • Using a transmission tester,

	damaged main control solenoids or valves.	activate the solenoids to duplicate sound. INSTALL new components as necessary. REFER to Section 307-01B for 4R70W transmissions. REFER to Section 307-01A for 4R100 transmissions.
• Manual Transmission Clutch throw-out bearing whine. A change in noise pitch or loudness while depressing the clutch pedal	• Worn throw-out bearing.	• INSTALL a new throw-out bearing.
• Heating, vacuum and air conditioning (HVAC) system chirp — most audible inside the vehicle. Listen for a change in noise pitch or loudness while changing the HVAC system blower speed	• Damaged or worn HVAC blower bearing.	• INSTALL a new blower motor. REFER to Section 412-02 .
• Air conditioning (A/C) clutch ticking — occurs when the compressor clutch engages	• Acceptable noise. • Incorrect air gap.	• LISTEN to the clutch to determine if the noise occurs with clutch engagement. A small amount of noise is acceptable. If the noise is excessive, CHECK the A/C clutch air gap. INSPECT the A/C clutch for wear or damage. INSTALL a new clutch as necessary. REFER to Section 412-03A .
• Intermittent rattle, or scraping/rubbing noise	• Loose exhaust heat shield(s). • Wiring, hose or other part interfering with accessory drive belt or pulley.	• INSPECT the exhaust system for loose parts using a glove or clamps to verify cause. REPAIR as necessary. REFER to Section 309-00 . • INSPECT accessory drive system closely verifying there is adequate clearance to all rotating components. REPAIR as necessary.
• Engine ticking or knocking noise — occurs during idle or high idle during the first cold start of the day	• Piston noise or valvetrain noise (bled down lifter/lash adjuster).	• Go To Pinpoint Test G .
• A continuous, speed-dependent rattle from the engine — occurs during idle or high idle during the first cold start of the day and disappears as the	• Piston noise or valvetrain noise (bled down lifter/lash adjuster).	• Go To Pinpoint Test G .

engine warms up		
• Idle vibration—a low-frequency vibration (5-20 Hz) or mild shake that is felt through the seat/floorpan	• Cylinder misfire.	• Using a scan tool, CHECK the ignition system. CARRY OUT a cylinder power test. REFER to Section 303-00 .
	• Engine or torque converter out of balance.	• VERIFY the torque converter to crankshaft pilot clearance is correct, REPAIR as necessary. RE-INDEX the torque converter on the flex plate by 120° on a 3 bolt converter or 180° for a 4 bolt converter. REFER to Section 307-01B for 4R70W transmissions. REFER to Section 307-01A for 4R100 transmissions. RETEST the vehicle.
• Idle vibration—a high-frequency vibration (20–80 Hz) or buzz, that is felt through the steering wheel or seat	• Exhaust system mounts bound up.	• VERIFY concern occurs at engine firing frequency. CHECK that the exhaust system vibrates at the same frequency as the engine. ADD 9–14 km (20–30 lb.) to the tail pipe to test, CARRY OUT Exhaust System Neutralizing in this section.
	• Body mounts loose.	• INSPECT the body mounts. CARRY OUT a Neutral Engine Run-Up (NERU) Test. REPAIR as necessary
	• Power steering lines grounded out.	• INSPECT that the power steering lines are not contacting the chassis or each other. REPAIR as necessary.

Symptom Chart—Squeak and Rattle

Condition	Possible Sources	Action
• Squeak—heard inside the vehicle when closing/opening the door	• Insufficient lubrication on the door hinge or check strap.	• LUBRICATE the hinge or check strap.
	• Internal door components loose, rubbing or misaligned.	• CHECK the inside of the door. TIGHTEN or ALIGN as necessary. USE the Rotunda Squeak and Rattle Kit to isolate any rubbing components.
• Squeak—heard inside the vehicle when closing/opening the window	• Worn or damaged glass run/channel.	• REPAIR or INSTALL a new glass run/channel. REFER to Section 501-11 .
• Squeak—heard outside of vehicle when	• Exhaust shield rubbing against the chassis or	• CHECK the exhaust system. REPAIR as necessary. Section 309-00 .

closing/opening the door	exhaust pipe.	
• Squeak—occurs with initial brake pedal application	• Disc brake pads.	• Under certain conditions, asbestos free pads can generate a squeak noise. This noise is normal and does not indicate a concern.
• Squeak—a constant noise that occurs with brake pedal applications	• Damaged or worn disc brake pads.	• INSPECT the pads for oil, grease or brake fluid contamination. CHECK for glazed linings. A brake disc with hard spots will also cause a squeak type noise. REPAIR or INSTALL new pads as necessary. REFER to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes.
• Squeak—noise occurs over bumps or when turning	• Worn control arm bushings. • Worn or damaged shock absorber/strut.	• INSPECT the control arm bushings. Spray with lubricant and CARRY OUT a "bounce test" to determine which bushing. REPAIR as necessary. REFER to Section 204-01A for 2-wheel drive vehicles or Section 204-01B for 4-wheel drive vehicles. • INSPECT the shock absorber for damage. CARRY OUT a "bounce test" to isolate the noise. INSTALL a new shock absorber/strut as necessary. REFER to Section 204-01A for 2-wheel drive vehicles and Section 204-01B for 4-wheel drive vehicles for the front shock absorber/strut or Section 204-02 for the rear shock absorber/strut.
• Rattle—heard when closing/opening the door or window	• Loose internal door mechanism, bracket or attachment.	• REPEAT the motion or CARRY OUT a "tap test" to duplicate the noise. INSPECT the door for loose components. TIGHTEN loose components or USE the Rotunda Squeak and Rattle Kit to isolate any rattling components.
• Squeak or rattle—heard inside the vehicle over rough roads/bumps	• Misaligned glove compartment door/hinge. • Instrument panel trim loose or misaligned. • Loose interior component or trim.	• ALIGN the glove compartment door. • INSPECT the instrument panel trim for missing or loose clips or screws. REPAIR as necessary. • CARRY OUT a "touch test". ELIMINATE the noise by pressing or pulling on interior trim and components. USE the Rotunda Squeak and Rattle Kit

		to isolate any rattling/squeaking components.
• Squeak or rattle—noise with a vibration concern	• Damaged or worn body mounts.	• INSPECT the upper and lower absorbers and washers for damage or wear. CHECK the body mount brackets for damage. CHECK the nuts and bolts are tightened to specifications. TIGHTEN as necessary.
	• Damaged or worn sub-frame mounts.	• INSPECT the upper and lower absorbers for damage or wear. CHECK the sub-frame for damage. CHECK the nuts and bolts are tightened to specifications. TIGHTEN as necessary.

Symptom Chart—Steering Noise/Vibration

Condition	Possible Sources	Action
• Steering grunt or shudder — occurs when turning into or out of a turn at low speeds (temperature sensitive)	• Steering gear or power steering hoses.	• GO to Steering Gear Grunt/Shudder Test component test in this section.
• Steering System clonk—hydraulic knocking sound	• Air in the steering hydraulic system.	• CHECK for leaks in the system. PURGE the air from the system. REFER to Section 211-00 .
• Power steering pump moan — loud humming noise occurs when the steering wheel is rotated to the stop position. Produces a 120-600 Hz frequency that changes with rpm	• Power steering hose grounded out to chassis.	• INSPECT the power steering hoses. REPAIR as necessary.
	• Aerated fluid.	• PURGE the air from the system. REFER to Section 211-00 . CHECK for leaks in the system.
	• Steering gear isolators.	• INSPECT the isolators for wear or damage. REPAIR as necessary.
	• Low fluid.	• CHECK the fluid level. REFILL as necessary.
	• Power steering pump brackets loose or misaligned.	• CHECK bolts, brackets and bracket alignment. TIGHTEN bolts to specification. REPAIR or INSTALL new brackets as necessary. REFER to Section 211-02 .

• Steering gear clunk — occurs only while cornering over a bump (can be temperature sensitive)	• Steering gear.	• INSPECT the steering gear for loose mounting bolts. TIGHTEN as necessary. REFER to Section 211-02 .
• Feedback (rattle, chuckle or knocking noise in the steering gear) — a condition where roughness is felt in the steering wheel when the vehicle is driven over rough surfaces	• Column intermediate/flexible shaft joints damaged or worn.	• INSTALL a new intermediate/flexible shaft. REFER to Section 211-04 .
	• Loose, damaged or worn tie-rod ends.	• TIGHTEN the nuts to specification or INSTALL new tie-rod ends as necessary.
	• Steering gear insulators or mounting bolts loose or damaged.	• TIGHTEN the bolts or INSTALL new bolts as necessary. REFER to Section 211-02 .
	• Steering column intermediate shaft bolts are loose.	• TIGHTEN the bolts to specification. REFER to Section 211-04 .
	• Steering column damaged or worn.	• REPAIR or INSTALL a new steering column as necessary. REFER to Section 211-04 .
	• Loose suspension bushings, bolts or ball joints.	• INSPECT the suspension system. TIGHTEN or INSTALL new components as necessary. REFER to Section 204-01A for 2-wheel drive vehicles or Section 204-01B for 4-wheel drive vehicles.
• Feedback (nibble at the steering wheel) — a condition where slight rotational movement is felt in the steering wheel when the vehicle is driven over rough or grooved surfaces	• Lateral runout in the tire or wheel.	• Go To Pinpoint Test H .
	• Yoke spring in the steering gear.	• CHECK TSBs for revised yoke spring for applicable vehicles.
• Accessory drive belt squeal/chirp—when rotating the	• Loose or worn accessory drive belt.	• ADJUST or INSTALL a new accessory drive belt as necessary. REFER to

steering wheel from stop to stop		Section 303-05 .
• Power steering gear hiss	• Steering column intermediate/flexible shaft-to-steering gear is binding or misaligned. • Grounded or loose steering column boot at the dash panel. • Damaged or worn steering gear input shaft and valve.	• REPAIR or INSTALL a new intermediate/flexible shaft as necessary. REFER to Section 211-04 . • REPAIR as necessary. • REPAIR or INSTALL a new steering gear as necessary. REFER to Section 211-02 .
• Steering column rattle	• Loose bolts or attaching brackets. • Loose, worn or insufficiently lubricated column bearings. • Steering shaft insulators damaged or worn. • Intermediate/flexible shaft compressed or extended.	• TIGHTEN the bolts to specifications. • LUBRICATE or INSTALL new steering column bearings as necessary. REFER to Section 211-04 . • INSTALL new insulators. REFER to Section 211-04 . • INSPECT the rubber spider coupling for damage. INSTALL a new intermediate/flexible shaft. REFER to Section 211-04 .
• Steering column squeak or cracks	• Insufficient lubricated steering shaft bushings. • Loose or misaligned steering column shrouds. • Steering wheel rubbing against steering column shrouds. • Insufficient lubricated speed control slip ring. • Upper or lower bearing sleeve out of position.	• LUBRICATE the steering shaft and shaft tube seals. • TIGHTEN or ALIGN the steering column shrouds. • REPOSITION the steering column shrouds. • LUBRICATE the speed control slip ring. • REPOSITION the bearing sleeves.
• Power steering pump noisy	• Incorrect assembly of components. • Imperfections on the outside diameter or end surface of the power steering pump rotor. • Damaged or worn power steering pump rotor splines. • A crack on the inner surface of the power steering pump cam. • Interference between	• REPAIR or INSTALL a new power steering pump as necessary. REFER to Section 211-02 .

	the power steering pump rotor and cam. ● Damaged or worn power steering pump rotor and pressure plates.	
● Power steering pump swish noise	● Power steering fluid flow into the bypass valve of the pump valve housing with fluid temperature below 54° C (130°F).	● Acceptable condition.
● Power steering pump whine noise	● Aerated fluid. ● Damaged power steering pump cam. ● Damaged valve cover O-ring seal.	● CHECK for a leak in the system. PURGE the air from the system. REFER to Section 211-00 . ● REPAIR or INSTALL a new power steering pump as necessary. REFER to Section 211-02 . ● REPAIR or INSTALL a new power steering pump as necessary. REFER to Section 211-02 .
● Power steering pump clicking (mechanical) noise	● Power steering pump rotor slippers too long, excessive rotor slipper-to-slot clearance or damaged or worn rotor assembly.	● REPAIR or INSTALL a new power steering pump as necessary. REFER to Section 211-02 .
● Power steering pump clatter noise	● Damaged corners on the outside diameter or the power steering rotor or distorted rotor slipper ring.	● REPAIR or INSTALL a new power steering pump as necessary. REFER to Section 211-02 .

Symptom Chart—Suspension Noise/Vibration

Condition	Possible Sources	Action
● Squeak or grunt—noise from the front suspension, occurs more in cold ambient temperatures. More noticeable over rough roads or when turning	● Front stabilizer bar insulators.	● Under these conditions, the noise is acceptable. CHECK TSBs for applicable vehicle.
● Clunk—noise from the front suspension, occurs in and out of turns	● Loose front struts or shocks.	● INSPECT for loose nuts or bolts. TIGHTEN to specifications. REFER to Section 204-01A for 2-wheel drive vehicles or Section 204-01B for 4-wheel drive vehicles.
● Clunk—noise from the rear suspension, occurs when shifting from	● Loose rear suspension components.	● INSPECT for loose or damaged rear suspension components.

reverse to drive		REPAIR or INSTALL new components as necessary. REFER to Section 204-02 .
• Click or pop—noise from the front suspension. More noticeable over rough roads or over bumps	• Worn or damaged ball joints.	• CARRY OUT a ball joint inspection. INSTALL new ball joints or control arms as necessary. REFER to Section 204-01A for 2-wheel drive vehicles or Section 204-01B for 4-wheel drive vehicles.
• Click or pop (FWD vehicles)—noise occurs when vehicle is turning	• Worn or damaged ball joints.	• CARRY OUT a ball joint inspection. INSTALL new ball joints or control arms as necessary.
• Click or snap—occurs when accelerating around a corner	• Damaged or worn outboard CV joint.	• INSPECT the outboard CV joint and boot. REPAIR or INSTALL a new CV joint as necessary. REFER to Section 205-04 .
• Front suspension noise—a squeak, creak or rattle noise. Occurs mostly over bumps or rough roads	• Steering components. • Loose or bent front struts or shock absorbers. • Damaged spring or spring mounts. • Damaged or worn control/radius arm bushings. • Worn or damaged stabilizer bar bushings or links.	• Go To Pinpoint Test H .
• Rear suspension noise—a squeak, creak or rattle noise. Occurs mostly over bumps or rough roads	• Loose or bent rear shock absorbers. • Damaged spring or spring mounts. • Damaged or worn control arm bushings. • Worn or damaged stabilizer bar bushings or links.	• Go To Pinpoint Test I .
• Shudder—occurs during acceleration from a slow speed or stop	• Rear drive axle assembly mispositioned. • Incorrect or high	• CHECK the axle mounts and the rear suspension for damage or wear. REPAIR as necessary. • CHECK vehicle ride

	CV joint operating angle. ● Damaged or worn front suspension components.	height is within limits. REPAIR as necessary. ● CHECK for a loose stabilizer bar, damaged or loose strut/strut bushings or loose or worn ball joints. INSPECT the steering linkage for wear or damage. REPAIR or INSTALL new components as necessary.
● Shimmy—most noticeable on coast/deceleration. Also hard steering condition	● Excessive positive caster.	● CHECK the caster alignment angle. CORRECT as necessary. REFER to Section 204-00 .

Symptom Chart—Tire Noise/Vibration

Condition	Possible Sources	Action
● Tire noise—hum/moan at constant speeds	● Abnormal wear patterns.	● SPIN the tire and CHECK for tire wear. INSTALL a new tire as necessary. INSPECT for damaged/worn suspension components. CARRY OUT wheel alignment.
● Tire noise—noise tone lowers as the vehicle speed is lowered	● Out-of-balance tire.	● BALANCE the tire and road test. INSTALL a new tire as necessary. REFER to Section 204-04 .
● Tire noise — ticking noise, changes with speed	● Nail puncture or stone in tire tread.	● INSPECT the tire. REPAIR as necessary.
● Wheel and tire—vibration and noise concern is directly related to vehicle speed and is not affected by acceleration, coasting or decelerating	● Damaged or worn tire.	● Go To Pinpoint Test J .
● Tire wobble or shudder — occurs at lower speeds	● Damaged wheel bearings.	● SPIN the tire and CHECK for abnormal wheel bearing play or roughness. ADJUST or INSTALL new wheel bearings as necessary. REFER to Section 204-01A for 2-wheel drive vehicles or Section 204-01B for 4-wheel drive vehicles.
	● Damaged wheel.	● INSPECT the wheel for damage. INSTALL a new wheel as necessary. REFER to Section 204-04 .
	● Damaged or worn suspension	● INSPECT the suspension components for wear or

	components. • Loose wheel nuts. • Damaged or uneven tire wear.	damage. REPAIR as necessary. • CHECK the wheel nuts. TIGHTEN to specification. REFER to Section 204-04 . • SPIN the tire and CHECK for abnormal tire wear or damage. INSTALL a new tire as necessary. REFER to Section 204-04 .
• Tire shimmy or shake— occurs at lower speeds	• Wheel/tire out of balance. • Uneven tire wear. • Excessive radial runout of wheel or tire. • Worn or damaged wheel studs or elongated stud holes. • Excessive lateral runout of the wheel or tire. • Foreign material between the brake disc and hub or in the brake disc fins.	• BALANCE the wheel/tire assembly. • CHECK for abnormal tire wear. INSTALL a new tire as necessary. REFER to Section 204-04 . • CARRY OUT a radial runout test of the wheel and tire. INSTALL a new tire as necessary. REFER to Section 204-04 . • INSPECT the wheel studs and wheels. INSTALL new components as necessary. REFER to Section 204-01A , 2-wheel drive vehicles or Section 204-01B , 4-wheel drive vehicles for the front wheels or Section 204-02 for the rear wheels. • CARRY OUT a lateral runout test of the wheel and tire. REFER to Section 204-04 . CHECK the wheel, tire and hub. REPAIR or INSTALL new components as necessary. • CLEAN the mounting surfaces of the brake disc and hub. CHECK the brake disc fins for material.
• High speed shake or shimmy—occurs at high speeds	• Excessive wheel hub runout. • Damaged or worn tires. • Damaged or worn wheel bearings. • Worn or damaged suspension or steering linkage components. • Brake disc or drum imbalance.	• Go To Pinpoint Test K .

Symptom Chart—Transmission (Manual) and Transfer Case Noise/Vibration

Condition	Possible Sources	Action
• Clutch rattling noise—occurs with clutch engaged, noise changes/disappears with clutch pedal depressed	• Flywheel bolts, clutch housing bolts or clutch pressure plate bolts loose.	• TIGHTEN the bolts to specifications. CHECK the bolts for damage.
• Clutch squeaking noise—noise is heard when the clutch is operated. Vehicle moves slowly or creeps when the clutch is disengaged. Can also be difficult to shift into first and reverse gear	• Pilot bearing seized or damaged.	• INSTALL a new pilot bearing.
• Clutch squeaking noise—occurs with clutch pedal depressed/released	• Worn clutch pedal shaft or bushings.	• INSPECT the clutch pedal for wear or damage. REPAIR as necessary.
• Clutch whirring/rattle noise—occurs when clutch pedal is depressed	• Worn, damaged or misaligned clutch release bearing.	• INSTALL a new clutch release bearing.
• Clutch grating/grinding noise—occurs when clutch pedal is depressed	• Clutch pressure plate fingers bent or worn. • Contact surface of clutch release bearing worn or damaged.	• INSPECT the clutch pressure plate release fingers. INSTALL a new pressure plate as necessary. • INSTALL a new clutch release bearing.
• Clutch chatter—a small amount of noise when clutch pedal is released at initial take-off	• Clutch engagement.	• Acceptable operating condition.
• Clutch chatter/grabs—in some cases a shudder is felt. Occurs with clutch pedal depressed/released	• Damaged or worn powertrain/driveline mounts. • Binding or dragging plunger of the clutch master cylinder or slave cylinder. • Grease or oil on the clutch disc facing.	• INSPECT the powertrain/drivetrain mounts. CARRY OUT Powertrain/Drivetrain Mount Neutralizing in this section. INSTALL new mounts as necessary. • CHECK the master and slave cylinder operation. INSPECT the components for damage or wear. INSTALL a new master or slave cylinder as necessary. • CHECK the input shaft seal and rear main oil seal. REPAIR as

		necessary. INSTALL a new clutch disc.
	• Clutch disc surface glazed or damaged.	• INSPECT the clutch disc surface for a glazed, hardened or damaged condition. CARRY OUT a disc check. INSTALL a new clutch disc as necessary.
	• Damaged or worn clutch pressure plate.	• INSPECT the clutch pressure plate for wear or damage. INSTALL a new clutch pressure plate as necessary.
	• Flywheel surface damaged or glazed.	• INSPECT the flywheel for damage or wear. CARRY OUT a flywheel runout check. INSTALL a new flywheel as necessary.
• Clutch chatter noise—noise when clutch pedal is released at initial take-off. Clutch is hard to engage and disengage	• Pilot bearing worn, damaged or not correctly aligned in bore.	• INSPECT the clutch pressure plate release fingers for uneven wear, clutch components burnt or a seized pilot bearing. INSTALL a new pilot bearing as necessary.
• Clutch vibration	• Loose flywheel bolts. • Damaged or loose clutch pressure plate. • Excessive flywheel runout.	• Go To Pinpoint Test L .
• Transmission rattling/clattering noise—noise at idle or on light acceleration from a stop. Gear selection difficult	• Gearshift lever joint worn or damaged.	• INSTALL a new gearshift lever.
	• Gearshift lever loose.	• TIGHTEN the bolts to specification.
	• Gearshift linkage rods worn or damaged.	• CHECK the linkage bushings for wear. INSTALL new linkage rods as necessary.
• Transmission rattling/clattering noise—occurs in neutral or in gear, at idle	• Incorrect fluid level or fluid quality.	• CHECK that the transmission is filled to the correct level and with the specified fluid.
• Transmission rattling/clattering noise—noise at idle in neutral	• Worn or rough reverse idler gear.	• CHECK the reverse idler gear. REPAIR as necessary.
	• Rough running	• CHECK the ignition

	engine, cylinder misfire. ● Excessive backlash in gears. ● Worn countershaft gears.	system. CARRY OUT a cylinder power test. ● CHECK the gear backlash. ADJUST as necessary. ● REPAIR as necessary.
● Transmission whine—a mild whine at extreme speeds or high rpm	● Rotating gears/geartrain.	● Acceptable noise.
● Transmission whine—a high pitched whine, also described as a squeal	● Transmission gears are worn (high mileage vehicle). ● Mismatched gear sets. ● Damaged or worn transmission bearing.	● Result of normal gear wear. REPAIR as necessary. ● INSPECT the gear sets for an uneven wear pattern on the face of the gear teeth. REPAIR as necessary. ● INSPECT the transmission bearings. INSTALL new bearings as necessary.
● Transmission growling/humming—noise occurs in the forward gears. The noise is more prominent when the gear is loaded. The problem gear can be located as the noise occurs in a specific gear position	● Gear is cracked, chipped or rough.	● INSPECT the transmission gears for damage or wear. INSTALL new gears as necessary.
● Transmission hissing—noise in neutral or in forward gears. As bearings wear or break up, the noise changes to a thumping noise	● Damaged or worn bearings.	● INSPECT the transmission bearings. INSTALL new bearings as necessary.
● Transmission knocking/thudding—noise at low speeds in forward gears	● Bearings with damaged balls or rollers or with pitted and spalled races.	● INSPECT the transmission bearings. INSTALL new bearings as necessary.
● Transmission rumble/growl—noise at higher speeds in forward gears, more pronounced in a coast/deceleration condition	● Incorrect driveline angle. ● Driveshaft out of balance or damaged.	● CHECK the driveline angle. REPAIR as necessary. ● CHECK the driveshaft for damage, missing balance weights or undercoating. Using a vibration analyzer (VA),

		CHECK the driveshaft balance. CARRY OUT a driveline vibration test. REPAIR as necessary.
• Transmission rumble/growl—noise at all speeds in forward gears, more pronounced in a heavy acceleration condition	• Damaged or worn transmission bearing or gears (high mileage vehicles).	• CHECK transmission fluid for excessive metal particles. REPAIR as necessary.
• Transfer case whine—noise at all ranges	• Incorrect fluid level or fluid quality. • Worn oil pump. • Under-inflated or oversized tires.	• CHECK that the transfer case is filled to the correct level and with the specified fluid. REFER to Section 308-07B . • DISASSEMBLE the transfer case. CHECK the oil pump for wear or damage. REPAIR as necessary. REFER to Section 308-07B . • CONFIRM that the tires and wheels are correct for the vehicle. CHECK that the tire inflation pressures are correct.
• Transfer case growl/rumble—noise at all ranges (A small amount of planetary noise can be heard when the transfer case is operated in low range.)	• Damaged or worn bearings or planetary gear.	• DISASSEMBLE the transfer case. CHECK the bearings or planetary gear for wear or damage. REPAIR as necessary. REFER to Section 308-07B .
• Transfer case scraping/grating—noise at all ranges	• Excessively stretched drive chain hitting the case.	• DISASSEMBLE the transfer case. CHECK the drive chain for wear or damage. REPAIR as necessary. REFER to Section 308-07B .
• Transfer case howl/hum—noise at all ranges or high range only	• Worn or damaged sun (input) gear, clutch pack (intermediate) gear or output shaft gear.	• DISASSEMBLE the transfer case. CHECK the gears for wear or damage. REPAIR as necessary. REFER to Section 308-07B .
• Transfer case howl/hum—noise at low range only	• Worn or damaged intermediate gear and sliding gears (clutch pack).	• DISASSEMBLE the transfer case. CHECK the gears for wear or damage. REPAIR as necessary. REFER to Section 308-07B .
• Transfer case vibration—vibration felt with vehicle in 4WD	• Transfer case mounting. • Driveshaft out of balance. • Excessive pinion	• Go To Pinpoint Test M .

	flange runout.	

Symptom Chart—Transmission (Automatic) Noise/Vibration

Condition	Possible Sources	Action
• Rattle—occurs at idle or at light acceleration from a stop	• Damaged engine or transmission mounts.	• CHECK the powertrain/drivetrain mounts for damage. REFER to Section 303-01A for 4.2L and 5.4L (2V) engines or Section 303-01B for 5.4L (4V) engines.
	• A loose front exhaust pipe heat shield.	• REPAIR or INSTALL a new heat shield as necessary.
	• Loose inspection plate or dust cover plate.	• CHECK for loose bolts. TIGHTEN to specifications. REFER to Section 307-01B for 4R70W transmissions or Section 307-01A for 4R100 transmissions.
	• Loose flexplate to converter nuts.	• CHECK for loose nuts. TIGHTEN to specifications. REFER to Section 307-01B for 4R70W transmissions or Section 307-01A for 4R100 transmissions.
• Whine—pitch increases with vehicle speed. Starts in first and second gear, decreases or goes away at higher gears	• Damaged or worn low one-way clutch. • Damaged or worn intermediate one-way clutch. • Friction elements. • Damaged or worn planetary or sun gear.	• INSPECT the transmission for wear or damage. REPAIR or INSTALL new components as necessary. REFER to Section 307-01B for 4R70W transmissions or Section 307-01A for 4R100 transmissions.
• Whine—the pitch changes with engine speed	• A worn or damaged accessory drive component.	• CARRY OUT the Engine Accessory Test. REPAIR or INSTALL new components as necessary.
	• Incorrect fluid level.	• CHECK that the transmission is filled to the correct level. ADD fluid as necessary. REFER to Section 307-01B for 4R70W transmissions or Section 307-01A for 4R100 transmissions.
	• Partially blocked filter.	• INSPECT the filter. CLEAN or INSTALL a new filter as necessary. REFER to Section 307-01B for 4R70W transmissions or Section 307-01A for 4R100 transmissions.
	• Worn or damaged torque converter.	• CARRY OUT the torque converter service and replacement check. REFER to Section 307-01B for 4R70W transmissions or Section 307-01A for 4R100 transmissions.

	• Worn or damaged front pump.	• INSPECT the front pump. INSTALL a new front pump as necessary. REFER to Section 307-01B for 4R70W transmissions or Section 307-01A for 4R100 transmissions.
• Whine—pitch changes with vehicle speed	• Speedometer cable or gears.	• REPAIR or INSTALL new cables or gears as necessary.
• Whine/moan type noise—pitch increases or changes with vehicle speed	• Damaged engine or transmission mount.	• CHECK the powertrain/drivetrain mounts for damage. REFER to Section 303-01A for 4.2L and 5.4L (2V) engines or Section 303-01B for 5.4L (4V) engines.
	• U-joints worn or damaged.	• INSPECT the U-joints for wear or damage. INSTALL new U-joints as necessary. REFER to Section 205-01 .
	• Damaged or worn differential ring and pinion.	• INSPECT the differential ring and pinion for damage. CARRY OUT the Checking Tooth Contact Pattern and Condition of the Ring and Pinion component test in this section. REPAIR or INSTALL a new differential ring and pinion as necessary. REFER to Section 205-02A for Ford 8.8 rear axles, Section 205-02B for Ford 9.75 rear axles or Section 205-03 for the front axle.
	• Planetary gears nicked or chipped.	• CHECK the planetary gears for damage. INSTALL new components as necessary. REFER to Section 307-01B for 4R70W transmissions or Section 307-01A for 4R100 transmissions.
• Whistle—noise is high pitched, constant. Changes in pitch with throttle position	• Hydraulic pressure in the main control.	• INSPECT the main control. REPAIR or INSTALL new components as necessary. REFER to Section 307-01B for 4R70W transmissions or Section 307-01A for 4R100 transmissions.
	• Incorrect band/clutch apply pressure.	• CARRY OUT the line pressure tests. REPAIR or INSTALL components as necessary. REFER to Section 307-01B for 4R70W transmissions or Section 307-01A for 4R100 transmissions.
	• Worn or damaged torque converter.	• CARRY OUT the torque converter service and replacement check. REFER to Section 307-01B for 4R70W transmissions or

		Section 307-01A for 4R100 transmissions.
• Clunk—occurs when shifting from PARK to a drive or reverse position	• Damaged powertrain mounts.	• INSPECT the powertrain mounts for damage. INSTALL new mounts as necessary. REFER to Section 307-01B for 4R70W transmissions or Section 307-01A for 4R100 transmissions.
	• Damaged or worn pinion bearings.	• CHECK for abnormal bearing play or roughness. INSTALL new bearings as necessary. REFER to Section 205-02A for Ford 8.8 rear axles, Section 205-02B for Ford 9.75 rear axles or Section 205-03 for the front axle.
	• Worn or galled driveshaft slip yoke splines.	• CLEAN and INSPECT the splines of the yoke. INSTALL a new slip yoke as necessary. REFER to Section 205-01 .
	• Worn friction elements or excessive clutch pack end plate play.	• INSPECT the transmission for wear. CHECK that all end play and clearances are within specification. REPAIR or INSTALL new components as necessary. REFER to Section 307-01B for 4R70W transmissions or Section 307-01A for 4R100 transmissions.
• Bump—occurs when shifting from PARK to a drive or reverse position. Similar to Clunk but with no sound	• Initial gear engagement.	• Acceptable condition.
• Buzz or hiss	• Incorrect driveline angles.	• CHECK for correct driveline angles. REPAIR as necessary. REFER to Section 205-00 .
	• Worn or damaged main control solenoids or valves.	• Using a transmission tester, ACTIVATE the solenoids to duplicate sound. INSTALL new components as necessary. REFER to Section 307-01B for 4R70W transmissions or Section 307-01A for 4R100 transmissions.
• Vibration—a high frequency (20–80 Hz) that is felt through the seat or gear shifter. Changes with	• Transmission cooler lines grounded out.	• CHECK the transmission cooler lines. REPAIR as necessary.

engine speed	● Flexplate to torque converter nuts loose. ● Fluid filler tube grounded out. ● Shift cable incorrectly routed, grounded out or loose.	● CHECK the flexplate nuts. TIGHTEN to specification. REFER to Section 307-01B for 4R70W transmissions or Section 307-01A for 4R100 transmissions. ● CHECK the fluid filler tube. REPAIR as necessary. ● CHECK the shift cable. REPAIR as necessary. REFER to Section 307-05 .
● Shutter or chatter—occurs with light to medium acceleration from low speeds or a stop	● Electrical inputs/outputs. ● Vehicle wiring harness. ● Incorrect inputs/outputs from the powertrain control module (PCM), digital transmission range (TR) sensor, brake pedal position (BPP) sensor, throttle position (TP) sensor, transmission speed sensor (TSS), output speed shaft (OSS) sensor or the torque converter clutch (TCC).	● CARRY OUT a Torque Converter Clutch Operation Test. RUN on-board diagnostics or self-test. REFER to Section 307-01B for 4R70W transmissions or Section 307-01A for 4R100 transmissions. CLEAR the DTC's, road test and rerun on-board diagnostics or self–test.

Pinpoint Tests

The pinpoint tests are a step-by-step diagnostic process designed to determine the cause of a condition. It may not always be necessary to follow a pinpoint test to its conclusion. Carry out only the steps necessary to correct the condition. Then, test the system for normal operation. Sometimes, it is necessary to remove various vehicle components to gain access to the component requiring testing. For additional information, REFER to the appropriate Workshop Manual section for removal and installation procedures. Reinstall all components after verifying system operation is normal.

PINPOINT TEST A: BRAKE VIBRATION/SHUDDER

Test Step	Result / Action to Take
A1 ROAD TEST THE VEHICLE—LIGHT BRAKING	
● Check that the wheel and tires are correct for the vehicle. Inspect the tires for abnormal wear patterns. ● Road test the vehicle. Warm the brakes by slowing the vehicle a few times from 80–32 km/h (50 to 20 mph) using light braking applications. At highway speeds of 89–97 km/h (55-60 mph), apply the brake using a light pedal force. ● **Is there a vibration/shudder felt in the steering wheel, seat or brake pedal?**	**Yes** GO to A4 . **No** GO to A2 .

A2 ROAD TEST THE VEHICLE—MODERATE TO HEAVY BRAKING	
• Road test the vehicle. At highway speeds of 89–97 km/h (55-60 mph), apply the brake using a moderate to heavy pedal force. • **Is there a vibration/shudder?**	**Yes** For vehicles with ABS, GO to A3 . For vehicles with standard brakes, GO to A4 . **No** Vehicle is OK. VERIFY condition with customer. TEST the vehicle for normal operation.
A3 NORMAL ACTUATION OF THE ABS SYSTEM DIAGNOSIS	
• During moderate to heavy braking, noise from the hydraulic control unit (HCU) and pulsation in the brake pedal can be observed. Pedal pulsation coupled with noise during heavy braking or on loose gravel, bumps, wet or snowy surfaces is acceptable and indicates correct functioning of the ABS system. Pedal pulsation or steering wheel nibble (frequency is proportioned to the vehicle speed) indicates a concern with a brake or suspension component. • **Is the vibration/shudder vehicle speed sensitive?**	**Yes** GO to A5 . **No** The brake system is operating correctly.
A4 APPLICATION OF THE PARKING BRAKE	
• **NOTE:** Begin at the front of the vehicle unless the vibration or shudder has been isolated to the rear. • This test is not applicable to vehicles with drum-in-hat type parking brakes. For vehicles with drum-in-hat parking brakes, proceed to the next test. For all other vehicles, apply the parking brake to identify if the problem is in the front or rear brake. At highway speeds of 89–97 km/h (55-60 mph), lightly apply the parking brake until the vehicle slows down. Release the parking brake immediately after the test. • **Is there a vibration/shudder?**	**Yes** GO to A7 . **No** GO to A5 .
A5 CHECK THE FRONT WHEEL BEARINGS	
• Check the front wheel bearings. Refer to Wheel Bearing Check in this section. • **Are the wheel bearings OK?**	**Yes** GO to A6 . **No** INSPECT the wheel bearings. ADJUST or REPAIR as necessary. TEST the system for normal operation.
A6 CHECK THE FRONT SUSPENSION	
• Check the front suspension for: • Broken or loose bolts. • Damaged springs. • Worn or damaged upper and lower control arm bushings. • Loose or rough front bearings. • Uneven tire wear. • **Are all the suspension components in satisfactory condition?**	**Yes** GO to A7 . **No** REPAIR or INSTALL new components as necessary. TEST the system for normal operation.
A7 RESURFACE THE FRONT BRAKE DISCS	
• **CAUTION: Do not use a bench lathe to machine brake discs.**	**Yes** GO to A8 .

• **NOTE:** Follow the manufacturer's instructions to machine the brake discs. After machining, make sure the brake disc meets the thickness specification. • Resurface the front brake discs. Refer to Brake Disc Machining in this section. Road test the vehicle. • **Is the vibration/shudder present?**	**No** Vehicle is OK.
A8 CHECK THE REAR SUSPENSION	
• Check the rear suspension for: • Broken or loose bolts. • Damaged or worn springs or spring bushings. • Worn or damaged upper and lower control arm bushings. • Worn or damaged trailing arms. • Loose or rough rear bearings. • Uneven tire wear. • **Are all the suspension components in satisfactory condition?**	**Yes** GO to A9 . **No** REPAIR or INSTALL new components as necessary. TEST the system for normal operation.
A9 RESURFACE THE REAR BRAKE DISC OR DRUM	
• **CAUTION: Do not use a bench lathe to machine brake discs.** • **NOTE:** Follow the manufacturers instructions to machine the brake discs. After machining, make sure the brake disc meets the thickness specification. • Resurface the rear brake discs or drums. Refer to Brake Disc Machining in this section. Road test the vehicle. • **Is the vibration/shudder present?**	**Yes** Check the front suspension for wear or damage, resurface the front brake discs. Test the system for normal operation. **No** Vehicle is OK.

PINPOINT TEST B: ENGINE TICKING NOISE

Test Step	Result / Action to Take
B1 CHECK FOR TICKING NOISE AT THE FUEL RAIL	
• Disconnect the first fuel line clip. • **Is the ticking noise gone?**	**Yes** CHECK for TSB for applicable vehicle. REPAIR as necessary. TEST the system for normal operation. **No** GO to B2 .
B2 CHECK FOR TICKING NOISE AT THE FUEL INJECTOR	
• Using an EngineEAR, listen at the fuel injectors by placing a probe on each injector. To isolate the faulty injector, disconnect the injector electrical connector and listen for the noise. • **Is the fuel injector the source of the ticking noise?**	**Yes** INSTALL a new fuel injector. REFER to Section 303-04A for 4.6L and 5.4L (2V) engines or Section 303-04B for 5.4L (4V) engines. TEST the system for normal operation. **No** GO to B3 .
B3 CHECK THE BELT TENSIONER FOR TICKING NOISE	
• Inspect the accessory drive. Check for the belt tensioner bottoming at end of travel or	**Yes** INSTALL a new belt tensioner. TEST the

not at end of stroke. ● Using an EngineEAR, listen at the belt tensioner. ● **Is the belt tensioner the source of the noise?**	system for normal operation. **No** GO to B4 .
B4 CHECK THE WATER PUMP FOR TICKING NOISE	
● Using an EngineEAR, listen at the water pump for ticking noise. ● **Is the water pump the source of the noise?**	**Yes** INSTALL a new water pump. REFER to Section 303-03 . TEST the system for normal operation. **No** GO to B5 .
B5 CHECK FOR AN OBSTRUCTION OF THE COOLING FAN	
● Inspect the cooling fan for obstructions. ● Check the cooling fan and shroud for wear or damage. ● **Was there an obstruction or does the cooling fan show signs of damage?**	**Yes** REPAIR or INSTALL a new cooling fan. TEST the system for normal operation. REFER to Section 303-03 . **No** GO to B6 .
B6 CHECK THE OIL PUMP FOR TICKING NOISE	
● Check the oil pump using EngineEARs and probe at the oil filter adapter to verify the oil pump as a source. ● **Is the oil pump the source of the noise?**	**Yes** INSTALL a new oil pump. REFER to Section 303-01A for 4.6L and 5.4L (2V) engines or Section 303-01B for 5.4L (4V) engines. TEST the system for normal operation. **No** GO to B7 .
B7 CHECK VALVE LIFTERS OR LASH ADJUSTERS FOR CORRECT OPERATION	
● Check valve lifter/lash adjuster for correct operation, using EngineEARs. ● **Are the valve lifters/lash adjusters operating correctly?**	**Yes** VERIFY customer concern. CONDUCT a diagnosis of other suspect components. **No** INSTALL a new valve lifter/lash adjuster(s). REFER to Section 303-01A for 4.6L and 5.4L (2V) engines or Section 303-01B for 5.4L (4V) engines. TEST the system for normal operation.

PINPOINT TEST C: ACCESSORY DRIVE BEARING HOOT

Test Step	Result / Action to Take
C1 CHECK THE ACCESSORY DRIVE IDLER AND TENSIONER PULLEY BEARINGS	
● Carry out the Vehicle Cold Soak Procedure in this section. ● Key in START position. ● Place an EngineEAR probe directly on the	**Yes** INSTALL a new pulley/idler. CARRY OUT the Vehicle Cold Soak Procedure and TEST the system for normal operation.

pulley center post or bolt to verify which bearing is making the noise. ● Key in OFF position. ● **Is either bearing making the noise?**	**No** CONDUCT a diagnosis on other suspect accessory drive components.

PINPOINT TEST D: POWER STEERING MOAN

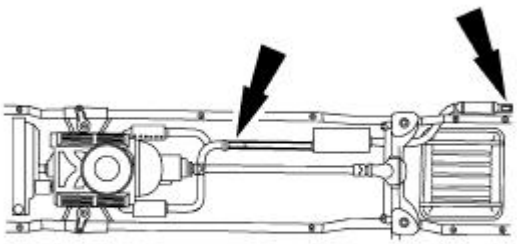
Test Step	Result / Action to Take
D1 CHECK THE POWER STEERING SYSTEM	
● Carry out the Vehicle Cold Soak Procedure in this section. ● Key in START position. ● Turn the steering wheel while the noise is occurring and listen for changes in sound pitch or loudness. ● Key in OFF position. ● **Does the sound pitch or loudness change while turning the steering wheel?**	**Yes** GO to D2 . **No** CONDUCT a diagnosis on other suspect accessory drive components.
D2 VERIFY THE SOURCE	
● Key in START position. ● Place an EngineEAR probe near the power steering pump/reservoir while the noise is occurring. While an assistant turns the steering wheel, listen for changes in sound pitch or loudness. ● Key in OFF position. ● **Does the sound pitch or loudness change while turning the steering wheel?**	**Yes** VERIFY that the supply tube to the pump is unobstructed. CHECK the fluid condition and level. DRAIN the fluid and REFILL. REFER to Section 211-02 . CARRY OUT the Vehicle Cold Soak Procedure and TEST the system for normal operation. **No** Normal system operation.

PINPOINT TEST E: ENGINE DRIVEN COOLING FAN MOAN

Test Step	Result / Action to Take
E1 CHECK THE ENGINE DRIVEN COOLING FAN AFTER A COLD SOAK	
● Carry out the Vehicle Cold Soak Procedure in this section. ● Key in START position. ● Assess the airflow. ● Raise the engine speed to 1500 rpm while listening for the moan to increase in proportion to the airflow. ● Key in OFF position. ● **Does the moan increase in proportion to the airflow?**	**Yes** TEST the fan for normal operation. If the fan tests normal, GO to E2 . Otherwise, REPAIR as necessary. **No** Normal system operation.
E2 CHECK THE ENGINE DRIVEN COOLING FAN AT NORMAL OPERATING TEMPERATURE	
● Key in START position. ● Run the engine to normal operating temperature while listening for the moan to stop. ● Key in OFF position.	**Yes** Normal clutch operation. **No** INSTALL a new fan clutch. TEST the

• **Does the moan stop?**	system for normal operation.

PINPOINT TEST F: DRUMMING NOISE

Test Step	Result / Action to Take
F1 CHECK THE EXHAUST SYSTEM	
• Key in START position. • Increase the engine rpm until the noise is the loudest. Note the engine rpm. • Key in OFF position. • Add approximately 9 kg (20 lb) of weight to the exhaust system. First place the weight at the tail pipe and test, then at the front pipe.  DF1768-A • Key in START position. • Increase the engine rpm and listen for the drumming noise. Note the engine rpm if the noise occurs. • Key in OFF position. • Using a vibration analyzer (VA), determine the amount of vibration that occurs with the drumming noise. • **Is the noise/vibration reduced or eliminated, or does the noise/vibration occur at a different rpm?**	**Yes** CARRY OUT Exhaust System Neutralizing in this section. TEST the system for normal operation. **No** GO to F2.
F2 POWERTRAIN/DRIVETRAIN MOUNT NEUTRALIZING	
• Carry out Powertrain/Drivetrain Mount Neutralizing in this section. Test the system for normal operation. • **Is the noise reduced or eliminated?**	**Yes** Vehicle OK. TEST the system for normal operation. **No** CONDUCT diagnosis of other suspect components.

PINPOINT TEST G: ENGINE TICKING, KNOCKING OR CONTINUOUS RATTLE

Test Step	Result / Action to Take
G1 CHECK FOR NOISE AT THE VALVE COVERS AND THE FRONT COVERS (OHC ENGINES)	
• Carry out the Vehicle Cold Soak Procedure in this section. • Key in START position. • **NOTE:** For a short-duration ticking noise, multiple engine starts may be necessary.	**Yes** REMOVE the appropriate cover and INSPECT for loose, worn/broken components. REPAIR as necessary. TEST the system for normal operation.

• Using an EngineEAR, listen closely at the valve covers and the front covers (OHC engines) by placing the probe near the surface of the valve cover and then on the surface front cover. • Key in OFF position. • **Is the noise source apparent?**	**No** GO to G2 .
G2 CHECK FOR NOISE AT THE CYLINDER BLOCK	
• Key in START position. • Using an EngineEAR, listen closely at the cylinder block by placing a probe on or near each freeze plug. • Key in OFF position. • **Is the noise source apparent?**	**Yes** REPAIR or INSTALL new components as necessary. **No** GO to G3 .
G3 CHECK FOR NOISE WHILE DISCONNECTING EACH FUEL INJECTOR ELECTRICAL CONNECTOR, ONE AT A TIME	
• Key in START position. • Disconnect each fuel injector electrical connector, one at a time, to decrease piston force and listen for the noise. • Key in OFF position. • **Is the noise reduced or eliminated?**	**Yes** INSTALL a new fuel injector. TEST the system for normal operation. **No** INSPECT accessory drive or the transmission as a possible source.

PINPOINT TEST H: FRONT SUSPENSION NOISE

Test Step	Result / Action to Take
H1 ROAD TEST THE VEHICLE	
• Test drive the vehicle. • **NOTE:** An assistant will be needed for this road test. • During the road test, drive the vehicle over a rough road. Using ChassisEARs, determine from which area/component the noise is originating. • **Is there a squeak, creak or rattle noise?**	**Yes** GO to H2 . **No** The suspension system is OK. CONDUCT a diagnosis on other suspect systems.
H2 INSPECT THE STEERING SYSTEM	
• **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.** • Raise and support the vehicle. • Check the steering system for wear or damage. Carry out a steering linkage test. Refer Section 211-00 . • Inspect the tire wear pattern. Refer to Tire Wear Patterns chart in this section. • **Are the steering components worn or damaged?**	**Yes** REPAIR the steering system. INSTALL new components as necessary. TEST the system for normal operation. **No** GO to H3 .
H3 FRONT SHOCK ABSORBER/STRUT CHECK	
• Check the front shock absorber/strut mounts for loose bolts or nuts. • Check the front shock absorbers/struts for wear or damage.	**Yes** TIGHTEN to specifications if loose. INSTALL new front

Carry out a "bounce test". ● **Are the front shock absorbers/struts loose or damaged?**	shock absorbers/struts if damaged. TEST the system for normal operation. **No** GO to H4.
H4 CHECK THE FRONT SPRINGS	
● Check the front spring and front spring mounts/brackets for wear or damage. ● **Are the front springs or spring mounts/brackets worn or damaged?**	**Yes** REPAIR or INSTALL new components as necessary. TEST the system for normal operation. **No** GO to H5.
H5 CHECK THE CONTROL ARMS/RADIUS ARMS	
● Inspect the control arm bushings for wear or damage. ● Inspect for twisted or bent control arm/radius arm. ● **Are the control arms/radius arms damaged or worn?**	**Yes** REPAIR or INSTALL new components as necessary. TEST the system for normal operation. **No** GO to H6.
H6 CHECK THE STABILIZER BAR/TRACK BAR	
● Check the stabilizer bar/track bar bushings and links for damage or wear. ● Check the stabilizer bar/track bar for damage. ● Check for loose or damaged stabilizer bar isolators or brackets. ● **Are the stabilizer bar/track bar components loose, worn or damaged?**	**Yes** REPAIR or INSTALL new components as necessary. TEST the system for normal operation. **No** Suspension system OK. CONDUCT diagnosis on other suspect systems.

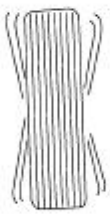
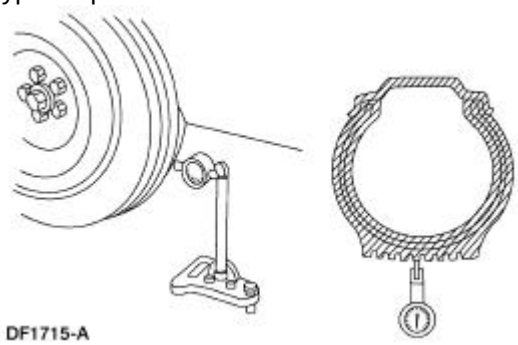
PINPOINT TEST I: REAR SUSPENSION NOISE

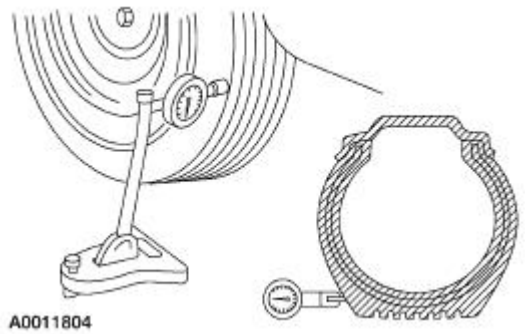
Test Step	Result / Action to Take
I1 ROAD TEST THE VEHICLE	
● Test drive the vehicle. ● **NOTE:** An assistant will be needed for this road test. ● During the road test, drive the vehicle over a rough road. Using ChassisEARs, determine from which area/component the noise is originating. ● **Is there a squeak, creak or rattle noise?**	**Yes** GO to I2. **No** The suspension system is OK. CONDUCT a diagnosis on other suspect systems.
I2 REAR SHOCK ABSORBER/STRUT CHECK	
● **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**	**Yes** TIGHTEN to specifications if loose. INSTALL new rear shock absorbers/struts if damaged. TEST the system for normal operation. **No**

• Raise and support the vehicle. • Check the rear shock absorber/strut mounts for loose bolts or nuts. • Check the rear shock absorbers/struts for damage. Carry out a shock absorber check. • **Are the rear shock absorbers/struts loose or damaged?**	GO to I3.
I3 CHECK THE REAR SPRINGS	
• Check the rear springs and rear spring mounts/brackets for wear or damage. • **Are the rear springs or spring mounts/brackets worn or damaged?**	**Yes** REPAIR or INSTALL new components as necessary. TEST the system for normal operation. **No** GO to I4.
I4 CHECK THE CONTROL ARMS/TRAILING ARMS	
• Inspect the control arm/trailing arm bushings for wear or damage. Check for loose control arm /trailing arm bolts. • Inspect for twisted or bent control arms/trailing arms. • **Are the control arms/trailing arms loose, damaged or worn?**	**Yes** REPAIR or INSTALL new components as necessary. TEST the system for normal operation. **No** GO to I5.
I5 CHECK THE STABILIZER BAR/TRACK BAR	
• Check the stabilizer bar/track bar bushings and links for damage or wear. • Check the stabilizer bar/track bar for damage. • Check for loose or damaged stabilizer bar isolators or brackets. • **Are the stabilizer bar/track bar components loose, worn or damaged?**	**Yes** REPAIR or INSTALL new components as necessary. Test the system for normal operation. **No** Suspension system OK. CONDUCT diagnosis on other suspect systems.

PINPOINT TEST J: WHEEL AND TIRE

Test Step	Result / Action to Take
J1 ROAD TEST THE VEHICLE	
• **NOTE:** Wheel or tire vibrations felt in the steering wheel are most likely related to the front wheel or tire. Vibration felt through the seat are most likely related to the rear wheel or tire. This may not always be true, but it can help to isolate the problem to the front or rear of the vehicle. • Test drive the vehicle at different speed ranges. • During the road test, if the vibration can be eliminated by placing the vehicle in neutral or is affected by the speed of the engine, the cause is not the wheels or tires. • **Is there a vibration and noise?**	**Yes** GO to J2. **No** The wheel and tires are OK. CONDUCT a diagnosis on other suspect systems.
J2 CHECK THE FRONT WHEEL BEARINGS	
• Check the front wheel bearings. Refer to Wheel Bearing Check in this section. • **Are the wheel bearings OK?**	**Yes** GO to J3. **No**

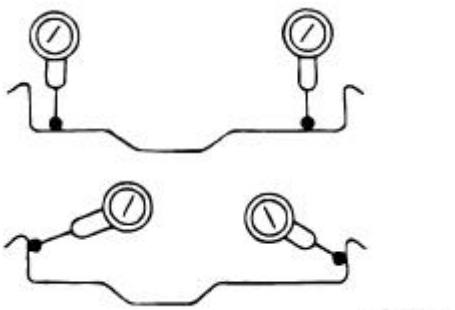
	INSPECT the wheel bearings. ADJUST or REPAIR as necessary. TEST the system for normal operation.
J3 INSPECT THE TIRES • Check the tires for missing weights. • Check the wheels for damage. • Inspect the tire wear pattern. Refer to the Tire Wear Patterns chart in this section. • **Do the tires have an abnormal wear pattern?**	**Yes** CORRECT the condition that caused the abnormal wear. INSTALL new tire (s). TEST the system for normal operation. **No** GO to J4 .
J4 TIRE ROTATION DIAGNOSIS • Spin the tires slowly and watch for signs of lateral runout.  DF1713-A • Spin the tires slowly and watch for signs of radial runout.  DF1714-A • **Are there signs of visual runout?**	**Yes** GO to J5 . **No** CHECK the wheel and tire balance. CORRECT as necessary. TEST the system for normal operation.
J5 RADIAL RUNOUT CHECK ON THE TIRE • Measure the radial runout of the wheel and tire assembly. A typical specification for total radial runout is 0.045 inch.  DF1715-A • **Is the radial runout within specifications?**	**Yes** GO to J8 . **No** GO to J6 .
J6 RADIAL RUNOUT CHECK ON THE WHEEL	

• Measure the radial runout of the wheel. A typical specification for total radial runout is 0.045 inch. • **Is the radial runout within specifications?**	**Yes** INSTALL a new tire. TEST the system for normal operation. **No** GO to J7 .
J7 CHECK THE HUB/BRAKE DISC OR DRUM PILOT RUNOUT OR BOLT CIRCLE RUNOUT	
• Measure the pilot or bolt circle runout. A typical specification for radial runout is: • Pilot runout— less than 0.15 mm (0.006 inch). • Bolt circle runout— less than 0.38 mm (0.015 inch). • **Is the radial runout within specifications?**	**Yes** INSTALL a new wheel. TEST the system for normal operation. **No** REPAIR or INSTALL new components as necessary. REFER to Section 204-01A , 2-wheel drive vehicles and Section 204-01B , 4-wheel drive vehicles for the front wheels or Section 204-02 for the rear wheels.
J8 LATERAL RUNOUT CHECK ON THE TIRE	
• Measure the lateral runout of the wheel and tire assembly. A typical specification for total lateral runout is 1.14 mm (0.045 inch).  A0011804 • **Is the lateral runout within specifications?**	**Yes** Wheel and tires OK. CONDUCT diagnosis on other suspect systems. **No** GO to J9 .
J9 LATERAL RUNOUT CHECK ON THE WHEEL	
• Measure the lateral runout of the wheel. A typical specification for total radial runout is 1.14mm (0.045 inch. • **Is the lateral runout within specifications?**	**Yes** INSTALL a new tire. TEST the system for normal operation. **No** GO to J10 .
J10 CHECK THE FLANGE FACE LATERAL RUNOUT	
• Measure the flange face lateral runout. A typical specification for lateral runout is: • Hub/brake disc— less than 0.13 mm (0.005 inch). • Axle shaft— less than 0.25 mm (0.010 inch). • **Is the lateral runout within specifications?**	**Yes** INSTALL a new wheel. TEST the system for normal operation. **No** REPAIR or INSTALL new components as

	necessary. REFER to Section 204-01A , 2-wheel drive vehicles and Section 204-01B , 4-wheel drive vehicles for the front wheels or Section 204-02 for the rear wheels.

PINPOINT TEST K: HIGH SPEED SHAKE OR SHIMMY

Test Step	Result / Action to Take
K1 CHECK FOR FRONT WHEEL BEARING ROUGHNESS	
• Chock the rear wheels. • Raise and support the front end of the vehicle so that the front wheel and tire assemblies can spin. • Spin the front tires by hand. Refer to Wheel Bearing Check in this section. • **Do the wheel bearings feel rough?**	**Yes** INSPECT the wheel bearings. REPAIR as necessary. TEST the system for normal operation. **No** GO to K2 .
K2 CHECK THE END PLAY OF THE FRONT WHEEL BEARINGS	
• Check the end play of the front wheel bearings. Refer to Section 204-00 . • **Is the end play OK?**	**Yes** GO to K3 . **No** ADJUST or REPAIR as necessary. TEST the system for normal operation.
K3 MEASURE THE LATERAL RUNOUT AND THE RADIAL RUNOUT OF THE FRONT WHEELS ON THE VEHICLE	
• Measure the lateral runout and the radial runout of the front wheels on the vehicle. Refer to Pinpoint Test J. • **Are the measurements within specifications?**	**Yes** GO to K4 . **No** INSTALL new wheels as necessary and BALANCE the assembly. TEST the system for normal operation.
K4 MEASURE THE LATERAL RUNOUT OF THE FRONT TIRES ON THE VEHICLE	
• Measure the lateral runout of the front tires on the vehicle. Refer to Pinpoint Test J. • **Is the runout within specifications?**	**Yes** GO to K5 . **No** INSTALL new tires as necessary and BALANCE the assembly. TEST the system for normal operation.
K5 MEASURE THE RADIAL RUNOUT OF THE FRONT TIRES ON THE VEHICLE	
	Yes

• Measure the radial runout of the front tires on the vehicle. Refer to Pinpoint Test J. • **Is the runout within specifications?**	BALANCE the front wheel and tire assemblies. If any tire cannot be balanced, INSTALL a new tire. TEST the system for normal operation. **No** GO to K6 .
K6 MATCH MOUNT THE TIRE AND WHEEL ASSEMBLY	
• Mark the high runout location on the tire and also on the wheel. Break the assembly down and rotate the tire 180 degrees (halfway around) on the wheel. Inflate the tire and measure the radial runout. • **Is the runout within specifications?**	**Yes** BALANCE the assembly. TEST the system for normal operation. **No** If the high spot is not within 101.6 mm (4 inches) of the first high spot on the tire, GO to K7 .
K7 MEASURE THE WHEEL FLANGE RUNOUT	
• Dismount the tire and mount the wheel on a wheel balancer. Measure the runout on both wheel flanges. Refer to Section 204-04 .  DG0199-A • **Is the runout within specifications?**	**Yes** LOCATE and MARK the low spot on the wheel. INSTALL the tire, matching the high spot on the tire with the low spot on the wheel. BALANCE the assembly. TEST the system for normal operation. If the condition persists,GO to K8 . **No** INSTALL a new wheel. CHECK the runout on the new wheel. If the new wheel is within limits, LOCATE and MARK the low spot. INSTALL the tire, matching the high spot on the tire with the low spot on the wheel. BALANCE the assembly. TEST the system for normal operation. If the condition persists, GO to K8 .
K8 CHECK FOR VIBRATION FROM THE FRONT OF THE VEHICLE	
WARNING: If only one drive wheel is allowed to rotate, speed must be limited to 55 km/h (34 mph) using the speedometer reading, since actual wheel speed will be twice that indicated on the speedometer. Exceeding a speed of 55 km/h (34 mph) or allowing the drive wheel to hang unsupported can result in tire disintegration or differential failure, which can cause serious personal injury and extensive vehicle damage.	**Yes** SUBSTITUTE known good wheel and tire assemblies as necessary. TEST the system for normal operation. **No** GO to K9 .

• Spin the front wheel and tire assemblies with a wheel balancer while the vehicle is raised on a hoist. Feel for vibration in the front fender or while seated in the vehicle. • **Is the vibration present?**	
K9 CHECK FOR VIBRATION FROM THE REAR OF THE VEHICLE	
WARNING: If only one drive wheel is allowed to rotate, speed must be limited to 55 km/h (34 mph) using the speedometer reading, since actual wheel speed will be twice that indicated on the speedometer. Exceeding a speed of 55 km/h (34 mph) or allowing the drive wheel to hang unsupported can result in tire disintegration or differential failure, which can cause serious personal injury and extensive vehicle damage. • Chock the front wheels. • Raise and support the rear end of the vehicle so that the rear wheel and tire assemblies can spin. • Engage the drivetrain and carefully accelerate the drive wheels while checking for vibration. • **Is the vibration present?**	**Yes** GO to K10 . **No** TEST the system for normal operation.
K10 CHECK THE DRIVETRAIN	
WARNING: If only one drive wheel is allowed to rotate, speed must be limited to 55 km/h (34 mph) using the speedometer reading, since actual wheel speed will be twice that indicated on the speedometer. Exceeding a speed of 55 km/h (34 mph) or allowing the drive wheel to hang unsupported can result in tire disintegration or differential failure, which can cause serious personal injury and extensive vehicle damage. • Remove the rear wheel and tire assemblies. Refer to Section 204-04 . • Secure the brake drums (if so equipped), by installing wheel hub bolt nuts, reversed. • Carefully accelerate the drivetrain while checking for vibration. • **Is the vibration present?**	**Yes** CHECK/TEST the drivetrain and driveline components. TEST the system for normal operation. **No** SUBSTITUTE known good wheel and tire assemblies as necessary. TEST the system for normal operation.

PINPOINT TEST L: CLUTCH VIBRATION

Test Step	Result / Action to Take
L1 CHECK ENGINE COMPONENTS FOR GROUNDING	
• **NOTE:** Make sure the clutch is the cause of the vibration concern. The vibration should occur during clutch operation. The clutch can also be difficult to engage or disengage. Eliminate all related systems before checking the clutch components. • **NOTE:** Check the driveline angles and driveshaft runout before disassembling the clutch system. Refer to Section 205-00 . • Check the powertrain/drivetrain mounts, exhaust manifolds or other engine components for grounding on the chassis. • **Are any mounts or engine components grounded?**	**Yes** REPAIR as necessary. TEST the system for normal operation. **No** GO to L2
L2 CHECK THE ACCESSORY DRIVE BELT	
• Remove the accessory drive belt. • **Does the vibration stop with the accessory drive belt**	**Yes** DIAGNOSE the accessory drive components.

removed?	**No** GO to L3 .
L3 CHECK FOR LOOSE CLUTCH PRESSURE PLATE BOLTS	
• Check for loose clutch pressure plate bolts. Inspect the clutch pressure plate for damage or for material between the pressure plate and flywheel. • **Are there any loose bolts or damage?**	**Yes** TIGHTEN the bolts to specifications or if damaged, INSTALL a new clutch pressure plate. **No** GO to L4 .
L4 CHECK THE CLUTCH DISC SPRINGS	
• Check for worn, broken or loose clutch disc springs. • **Are the clutch springs worn, broken or loose?**	**Yes** INSTALL a new clutch disc. TEST the system for normal operation. **No** GO to L5 .
L5 CHECK THE CLUTCH DISC SPLINES	
• Inspect the clutch disc splines for damage or wear. • **Is there damage or wear?**	**Yes** INSTALL a new clutch disc. TEST the system for normal operation. **No** GO to L6 .
L6 CHECK THE FLYWHEEL BOLTS	
• Check for loose flywheel bolts. • **Are the bolts loose?**	**Yes** TIGHTEN the bolts to specifications. TEST the system for normal operation. **No** GO to L7 .
L7 CHECK THE FLYWHEEL SURFACE	
• Inspect the flywheel surface for wear or damage. Check the flywheel runout. • **Is there any damage or excessive wear?**	**Yes** INSTALL a new flywheel. TEST the system for normal operation. **No** Clutch system normal. CONDUCT a diagnosis on other suspect systems.

PINPOINT TEST M: TRANSFER CASE VIBRATION

Test Step	Result / Action to Take
M1 INSPECT THE TRANSFER CASE	
• **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing**	**Yes** TIGHTEN to specifications or

an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations. ● Inspect the transfer case for loose or missing mounting bolts. Check for fluid seepage between the transfer case and the transmission. ● **Are the mounting bolts missing or loose?**	INSTALL new bolts as necessary. TEST the system for normal operation. **No** GO to M2 .
M2 INSPECT THE REAR DRIVESHAFT	
● **NOTE:** Verify that the driveshaft and pinion flange index marks are aligned. ● Inspect the driveshaft for missing weights, damage or undercoating. ● Inspect the U-joints for freedom of movement. ● Check driveshaft runout and, if necessary, check the pinion flange runout. ● **Is the driveshaft or U-joints worn or damaged or misaligned?**	**Yes** REPAIR or INSTALL a new driveshaft as necessary. TEST the system for normal operation. **No** GO to M3 .
M3 CHECK THE DRIVELINE ANGLES	
● Measure the rear driveshaft and pinion angles. Refer to Section 205-00 . ● Measure the front driveshaft and pinion angles. Refer to the appropriate workshop manual for the service procedures. ● **Are the driveline angles incorrect?**	**Yes** REPAIR as necessary. TEST the system for normal operation. **No** GO to M4 .
M4 INSPECT THE FRONT DRIVESHAFT	
● **NOTE:** Verify that the driveshaft and pinion flange index marks are aligned. ● Inspect the front driveshaft for missing weights, damage or undercoating. ● Inspect the U-joints and slip yoke for freedom of movement. ● Check driveshaft runout and, if necessary, check the pinion flange runout. Refer to Section 206-00 . ● **Is the driveshaft or U-joints worn or damaged?**	**Yes** REPAIR or INSTALL a new driveshaft as necessary. TEST the system for normal operation. **No** GO to M5 .
M5 ROAD TEST WITH THE FRONT DRIVESHAFT ONLY	
● **NOTE:** Index mark the driveshaft to the pinion flange and to the output shaft before removal. ● Remove the rear driveshaft. ● Plug the transfer case with an output shaft seal plug. ● **NOTE:** Shift the transfer case into 4WD high so the vehicle is driven by the front driveshaft only. ● Test drive the vehicle. ● **Is the vibration gone?**	**Yes** INSTALL and BALANCE the rear driveshaft. TEST the system for normal operation. **No** GO to M6 .
M6 ROAD TEST WITH THE REAR DRIVESHAFT ONLY	
● **NOTE:** Index mark the front driveshaft to the pinion flange. ● Remove the front driveshaft. ● Test drive the vehicle. ● **Is the vibration gone?**	**Yes** INSTALL and BALANCE the front driveshaft. TEST the system for normal operation. **No** GO to M7 .
M7 TRANSFER CASE TAIL SHAFT INSPECTION	
● Inspect the splines of the output shaft for wear or damage.	**Yes**

• Inspect the splines of the driveshaft slip yoke for wear or damage. • **Are the splines worn or damaged?**	REPAIR or INSTALL new components as necessary. TEST the system for normal operation. **No** The transfer case is OK. CONDUCT a diagnosis on other suspect systems.

Component Tests

Idle Air Control (IAC) Valve

1. Open the hood.
2. **NOTE:** Key symptom is elevated idle speed while noise is occurring.

   NOTE: "Snapping" the throttle can induce the noise.

   Verify the condition by operating the vehicle for a short time.
3. Inspect the IAC valve. If physical evidence of contamination exists, install a new IAC valve.
4. While the noise is occurring, either place an EngineEAR probe near the IAC valve and the inlet tube, or create a 6.35 mm (0.25 in)-12.7 mm (0.50 in) air gap between the inlet tube and the clean air tube. If the IAC valve is making the noise, install a new IAC valve.
5. Test the vehicle for normal operation.

Steering Gear Grunt/Shudder Test

1. Start and run the vehicle to operating temperature.
2. Set engine idle speed to 1200 rpm.
3.  **CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump will occur.**

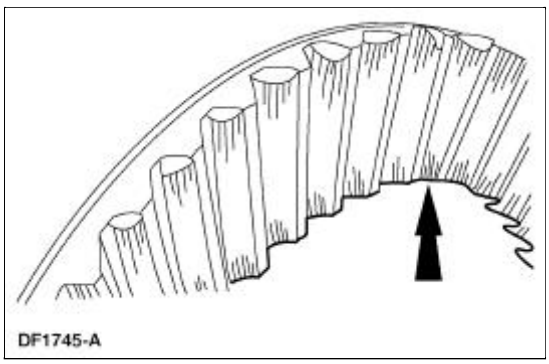
   Rotate the steering wheel to the RH stop, then turn the steering wheel 90° back from that position. Turn the steering wheel slowly in a 15° to 30° arc.
4. Turn the steering wheel another 90°. Turn the steering wheel slowly in a 15° to 30° arc.
5. Repeat the test with power steering fluid at different temperatures.
6. If a light grunt is heard or a low (50-200 Hz) shudder is present, this is a normal steering system condition.
7. If a loud grunt is heard or a strong shudder is felt, fill and purge the power steering system.

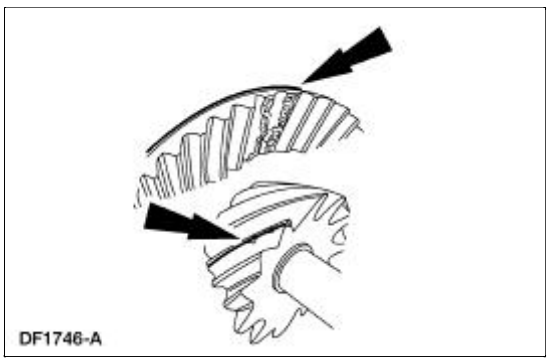
Checking Tooth Contact Pattern and Condition of the Ring and Pinion

There are two basic types of conditions that will produce ring and pinion noise. The first type is a howl

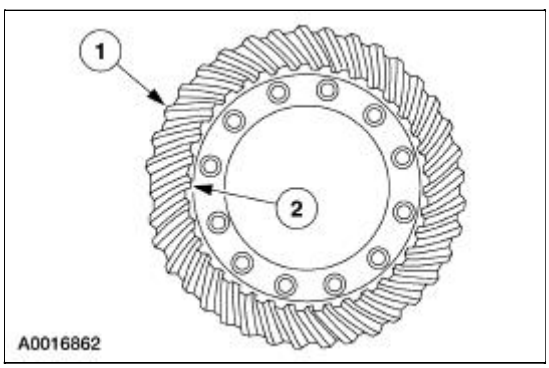
or chuckle produced by broken, cracked, chipped, scored or forcibly damaged gear teeth and is usually quite audible over the entire speed range. The second type of ring and pinion noise pertains to the mesh pattern of the gear pattern. This gear noise can be recognized as it produces a cycling pitch or whine. Ring and pinion noise tends to peak in a narrow speed range or ranges, and will tend to remain constant in pitch.

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Drain the axle lubricant. REFER to Section 205-02A for Ford 8.8 rear axles, Section 205-02B for Ford 9.75 rear axles or Section 205-03 for the front axle.
3. Remove the carrier assembly or the axle housing cover depending on the axle type. Refer to Section 205-02A for Ford 8.8 rear axles, Section 205-02B for Ford 9.75 rear axles or Section 205-03 for the front axle.
4. Inspect the gear set for scoring or damage.





5. In the following steps, the movement of the contact pattern along the length is indicated as toward the" heel" or "toe" of the differential ring gear.



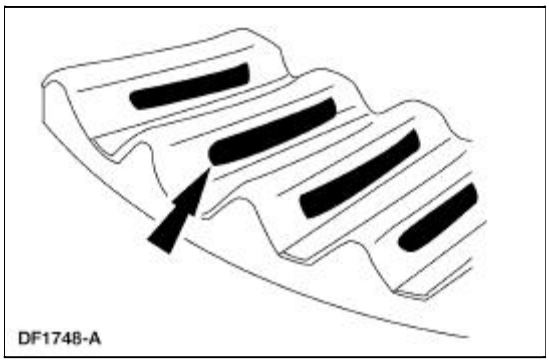
Item	Description

1	Heel
2	Toe

6. Apply a marking compound to a third of the gear teeth on the differential ring gear. Rotate the differential ring gear several complete turns in both directions until a good, clear tooth pattern is obtained. Inspect the contact patterns on the ring gear teeth.

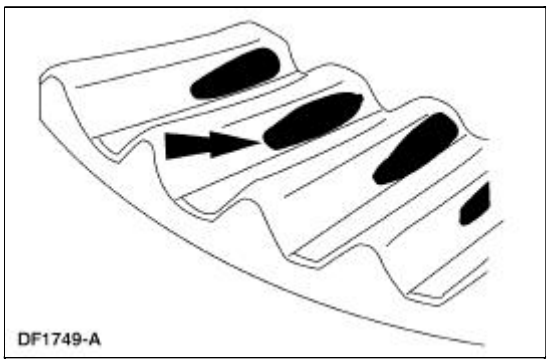
7. A good contact pattern should be centered on the tooth. It can also be slightly toward the toe. There should always be some clearance between the contact pattern and the top of the tooth.

- Tooth contact pattern shown on the drive side of the gear teeth.



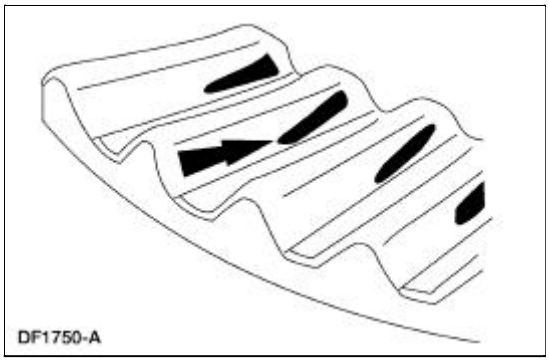
8. A high, thick contact pattern that is worn more toward the toe.

- Tooth contact pattern shown on the drive side of the gear teeth.
- The high contact pattern indicates that the drive pinion is not installed deep enough into the carrier.
- The differential ring gear backlash is correct, a thinner drive pinion shim is needed. A decrease will move the drive pinion toward the differential ring gear.



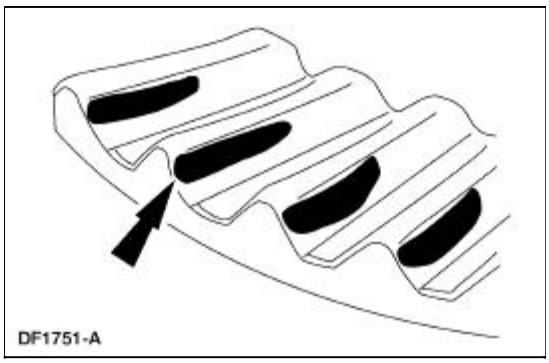
9. A high, thin contact pattern that is worn toward the toe.

- Tooth contact pattern shown on the drive side of the gear teeth.
- The drive pinion depth is correct. Increase the differential ring gear backlash.



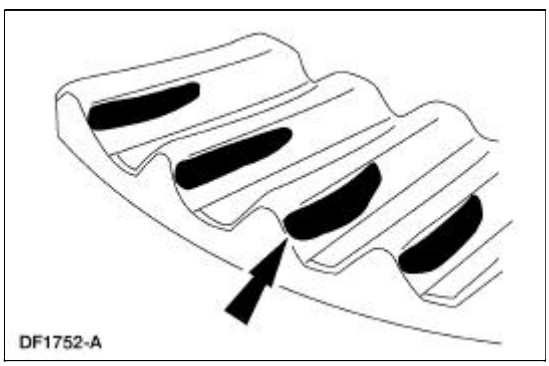
10. A contact pattern that is worn in the center of the differential ring gear tooth toward the heel.

- Tooth contact pattern shown on the drive side of the gear teeth.
- The low contact pattern indicates that the drive pinion is installed too deep into the carrier.
- The differential ring gear backlash is correct. A thicker drive pinion shim is needed.



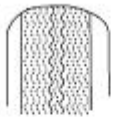
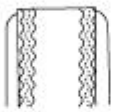
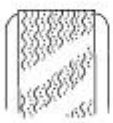
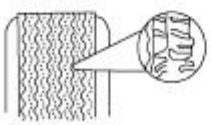
11. A contact pattern that is worn at the top of the differential ring gear tooth toward the heel.

- Tooth contact pattern shown on the drive side of the gear teeth.
- The pinion gear depth is correct. Decrease the differential ring gear backlash.



Tire Wear Patterns and frequency calculations

Tire Wear Chart

TIRE WEAR	CONDITION	POSSIBLE CAUSES
	• Rapid wear at both shoulders.	• Tires underinflated. • Worn suspension components. • Excessive cornering speeds. • Lack of rotation.
	• Rapid wear at the center.	• Tires overinflated. • Lack of rotation. • Excessive toe on drive wheels. • Heavy acceleration on drive wheels.
	• Wear at one shoulder.	• Toe adjustment out of specification. • Camber out of specification. • Damaged strut. • Damaged lower control arm.
	• Feather edges.	• Toe adjustment out of specification. • Damaged or worn tie rods. • Damaged spindle or knuckle.
	• Bald spots or cupping.	• Unbalanced wheel. • Excessive radial runout. • Worn strut or shock absorber.
	• Tire scalloped.	• Toe adjustment out of specification. • Camber out of specification. • Worn or damaged suspension components.
	• Wear pattern - FWD vehicles.	• Excessive toe on non-drive wheels. • Lack of rotation.
	• Wear pattern - FWD vehicles. Edge of thread blocks worn.	• Excessive toe on non-drive wheels. • Lack of rotation.

DF1717-A

Wheel and tire NVH concerns are directly related to vehicle speed and are not generally affected by acceleration, coasting or decelerating. Also, out-of-balance wheel and tires can vibrate at more than one speed. A vibration that is affected by the engine rpm, or is eliminated by placing the transmission in NEUTRAL is not related to the tire and wheel. As a general rule, tire and wheel vibrations felt in the steering wheel are related to the front tire and wheel assemblies. Vibrations felt in the seat or floor are related to the rear tire and wheel assemblies. This can initially isolate a concern to the front or rear.

Careful attention must be paid to the tire and wheels. There are several symptoms that can be caused by damaged or worn tire and wheels. Carry out a careful visual inspection of the tires and wheel assemblies. Spin the tires slowly and watch for signs of lateral or radial runout. Refer to the tire wear chart to determine the tire wear conditions and actions.

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

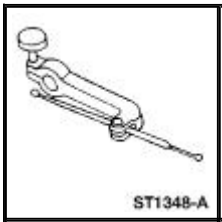
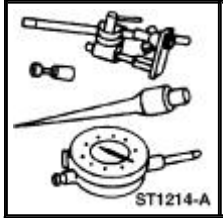
- Measure the diameter of the tire.
- Record the speed at which the vibration occurs.
- Obtain the corresponding tire and wheel rpm and frequency from the Tire Speed and Frequency Chart.
    - If the vehicle speed is not listed, divide the vehicle speed at which the vibration occurs by 16 km/h (10 mph). Multiply that number by 16 km/h (10 mph) tire rpm listed for that tire diameter in the chart. Then divide that number by 60. For example: a 40 mph vibration with 835 mm (33 in) tires. 40 ÷10 = 4. Multiply 4 by 105 = 420 rpm. Divide 420 rpm by 60 seconds = 7 Hz at 40 mph.

Tire Speed and Frequency Chart

Tire Diameter	Tire RPM/Hz	Tire RPM/Hz	Tire RPM/Hz	Tire RPM/Hz
mm (inch)	@ 16 km/h (10 mph)	@ 80 km/h (50 mph)	@ 97 km/h (60 mph)	@ 113 km/h (70 mph)
483 (19)	182	910/15	1092/18	1274/21
508 (20)	173	865/14	1038/17	1211/20
533 (21)	165	825/14	990/16	1155/19
560 (22)	158	790/13	948/16	1106/18
585 (23)	151	755/13	906/15	1057/18
610 (24)	145	725/12	870/14	1015/17
635 (25)	139	695/12	834/14	973/16
660 (26)	134	670/11	804/13	938/16
685 (27)	129	645/11	774/13	903/15
710 (28)	124	620/10	744/12	868/14
735 (29)	119	595/10	714/12	833/14
760 (30)	115	575/10	690/11	805/13
785 (31)	111	555/9	666/11	777/13
810 (32)	108	540/9	648/11	756/13
835 (33)	105	525/9	630/10	735/12
864 (34)	102	510/8	612/10	714/12

Brake Disc Machining

Special Tool(s)

 ST1348-A	Gauge, Clutch Housing 308-021 (T75L-4201-A)
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent

Material

Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
High Temperature Nickel Anti-Seize Lubricant F6AZ-9L494-AA or equivalent	ESE-M12A4-A

WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.

CAUTION: Do not install brake discs that are less than the minimum thickness specified. Do not machine a brake disc below the minimum thickness specification.

1. Check wheel bearing end-play and correct as necessary.
2. **NOTE:** Begin at the front of the vehicle unless the vibration has been isolated to the rear.

   Remove the tire and wheel assembly.
3. Remove the brake caliper and the brake caliper anchor plate. Refer to the appropriate section in Group 206 for the procedure.
4. Inspect the brake linings. Install new brake linings if below specification. For additional information, refer to the appropriate brake section.
5. Measure and record the brake disc thickness. Install a new brake disc if the thickness after machining will be at or below specification. The specification is molded into the brake disc.
   - Do not machine a new brake disc.

6. For vehicles with a two-piece hub and brake disc assembly:
   - Match-mark before disassembly.
   - Remove the brake disc.
   - Clean the hub and brake disc mounting surfaces with metal surface cleaner.
   - Using a die grinder with a mild abrasive (Scotch Brite® type), remove any rust or corrosion from the hub and brake disc mounting surfaces.
   - Align the match-marks and reinstall the brake disc on the hub.

7. **CAUTION: Do not use a bench lathe to machine brake discs.**

   NOTE: The depth of cut must be between 0.10 and 0.20 mm (0.004 and 0.008 inch). Lighter cuts will cause heat and wear. Heavier cuts will cause poor brake disc surface finish.

   Using an on-car brake lathe, machine the brake discs. Follow the manufacturer's instructions. After machining, make sure the brake disc still meets the thickness specification.

8. Using the special tools, verify that the brake disc lateral runout is now within specification. For additional information, refer to Section 206-00 .

9. Remove the special tool hub adapter.

10. Remove any remaining metal chips from the machining operation.

11. For vehicles with a two-piece hub and brake disc assembly:
    - Remove the brake disc from the hub.
    - Remove any remaining metal chips from hub and brake disc mounting surfaces and from the ABS sensor.
    - Apply a liberal amount of lubricant to the hub flange, pilot area and to the brake disc-to-hub mounting surface.
    - Using the match marks, mount the brake disc on the hub.

12. Install the brake caliper anchor plate and the brake caliper.

13. Install the tire and wheel assembly.

14. Test the system for normal operation.

Powertrain/Drivetrain Mount Neutralizing

WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.

1. Raise and support the vehicle.
2. Loosen, but do not remove, the powertrain/drivetrain mount fasteners.
3. Lower the vehicle.
4. **CAUTION: Do not twist or strain the powertrain/drivetrain mounts.**

   Move the vehicle in forward and reverse 0.6-1.2 meters (2-4 ft).
5. Raise and support the vehicle.
6. Tighten the powertrain/drivetrain mount fasteners.
7. Lower the vehicle.
8. Test the system for normal operation.

Exhaust System Neutralizing

WARNING: Exhaust gases contain carbon monoxide, which is harmful to health and potentially lethal. Repair exhaust system leaks immediately. Never operate the engine in an enclosed area.

WARNING: Exhaust system components are hot.

NOTE: Neutralize the exhaust system to relieve strain on mounts which can be sufficiently bound up to transmit vibration as if grounded.

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

   CAUTION: Make sure the system is warmed up to normal operating temperature, as thermal expansion can be the cause of a strain problem.

   Raise and support the vehicle.

2. Loosen all exhaust hanger attachments and reposition the hangers until they hang free and straight.

3. Loosen all exhaust flange joints.

4. Place a stand to support the muffler parallel to the vehicle frame with the muffler pipe bracket free of stress.

5. Tighten the muffler connection.

6. Tighten all the exhaust hanger clamps and flanges (tighten the exhaust manifold flange joint last).
   - Verify there is adequate clearance to prevent grounding at any point in the system. Make sure that the catalytic converter and heat shield do not contact the frame rails.
   - After neutralization, the rubber in the exhaust hangers should show some flexibility when movement is applied to the exhaust system.
   - With the exhaust system installed securely and cooled, the rear hanger should be angled forward.

7. Lower the vehicle.

8. Test the exhaust system for normal operation.

Wheel Bearing Check

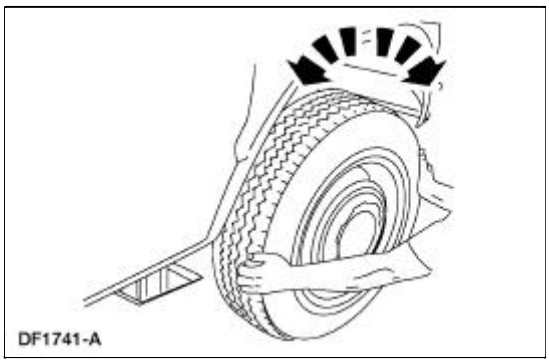
1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

   Raise the vehicle until the front tires are off the floor.

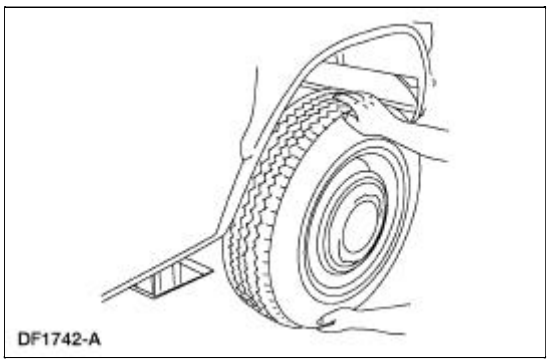
   - Make sure the wheels are in a straight forward position.

2. **NOTE:** Make sure the wheel rotates freely and that the brake pads are retraced sufficiently to allow free movement of the tire and wheel assembly.

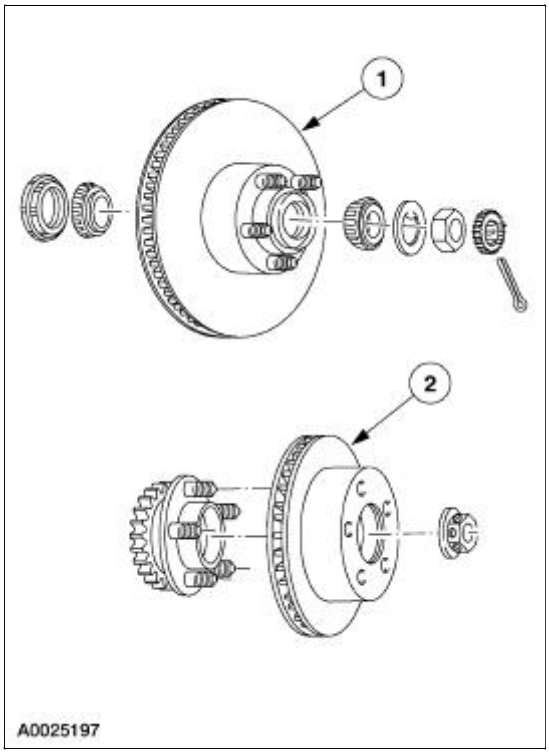
   Spin the tire by hand to check the wheel bearings for roughness.



3. Grip each front tire at the top and bottom and move the wheel inward and outward while lifting the weight of the tire off the front wheel bearing.



4. If the tire and wheel (hub) is loose on the spindle, does not rotate freely, or has a rough feeling when spun, carry out one of the following:
   1. On vehicles with inner and outer bearings, inspect the bearings and cups for wear or damage. Adjust or install new bearings and cups as necessary.
   2. On vehicles with one sealed bearing, install a new wheel hub.


1
2
A0025197

Alignment Specifications

Item	LH	RH	Total/ Split
Front (Expedition)			
Camber	-0.3° ± 0.75°	-0.3° ± 0.75°	0° ± 0.75°
Caster	5.3° ± 1.0°	5.3° ± 1.0°	0° ± 1.0°
Toe @ curb ride height (positive value is toe-in, negative value is toe-out)	—	—	0.20° ± 0.20°
Front (Navigator)			
Camber	-0.6° ± 0.75°	-0.6° ± 0.75°	0° ± 0.75°
Caster	5.5° ± 1.0°	5.5° ± 1.0°	0° ± 1.0°
Toe @ trim ride height (positive value is toe-in, negative value is toe-out)	—	—	0.14° ± 0.20°
Rear (Expedition)			
Camber	-0.9° ± 0.75°	-0.9° ± 0.75°	0° ± 0.75°
Toe @ curb ride height (positive value is toe-in, negative value is toe-out)	—	—	0.24° ± 0.20°
Rear (Navigator)			
Camber	-1.0° ± 0.75°	-1.0° ± 0.75°	0° ± 0.75°
Toe @ trim ride height (positive value is toe-in, negative value is toe-out)	—	—	0.20° ± 0.20°

General Specifications

Item	Specification
Front Ride Height	
Expedition	105 mm (4.2 in) ± 7.0 mm (0.28 in)
Navigator	85 mm (3.4 in) ± 7.0 mm (0.28 in)
Rear Ride Height	
Expedition	119 mm (4.76 in) ± 7.0 mm (0.28 in)
Navigator	112 mm (4.48 in) ± 7.0 mm (0.28 in)
Vehicle Lean (Side-to-Side Differences)	
Front ride height—maximum	7 mm (0.28 in)

Rear ride height—maximum	8 mm (0.32 in)
Wheel Track	
Wheel track	0.6 mm (0.02 in)
Dogtracking	
Dogtracking—maximum (centerline of front tires compared to centerline of rear tires)	30 mm (1.18 in)
Ball Joint End Play	
Lower ball joint (front)—maximum vertical	0.8 mm (0.03 in)
Upper ball joint—maximum vertical	0.8 mm (0.03 in)

Torque Specifications

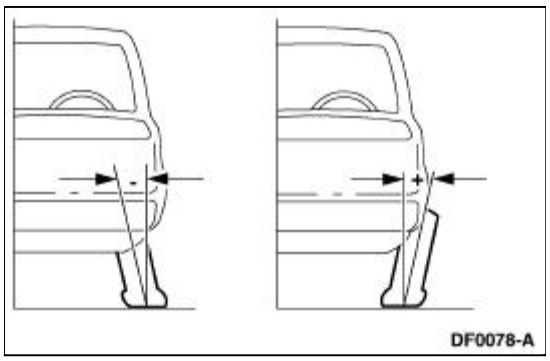
Description	Nm	lb-ft
Front lower arm-to-frame nuts	270	200
Toe set jam nuts (front)	103	76
Rear upper arm-to-wheel knuckle bolt and nut	150	111
Toe set jam nuts (rear)	115	85
Forward cam bolt plate-to-crossmember bolts (M6)	15	11
Rearward cam bolt plate-to-crossmember bolts (M8)	40	30

Wheel Alignment Angles

The front caster and camber are adjusted by removing the lower arm-to-frame mounting bolts and installing adjuster kits to allow the arm to be adjusted in the frame slots. Front toe is adjusted by the use of the front wheel spindle tie-rod. The rear camber is adjusted by removing the upper arm-to-wheel knuckle mounting bolt and installing an adjuster kit to allow the wheel knuckle to be adjusted in the arm slot. The rear toe is adjusted by the use of the rear toe link.

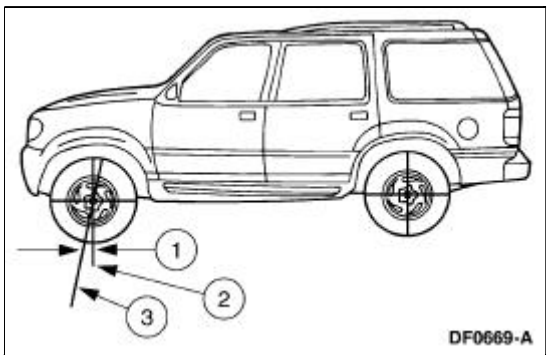
Camber

Negative and Positive Camber



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

Caster



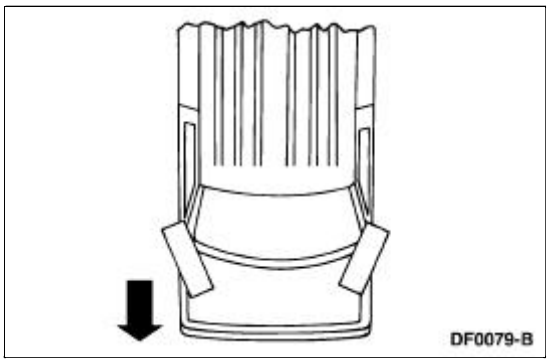
Item	Part Number	Description
1	—	Positive caster
2	—	True vertical
3	—	Steering axis

Caster is the deviation from vertical of an imaginary line drawn through the ball joints when viewed from the side. The caster specifications in this section will give the vehicle the best directional stability

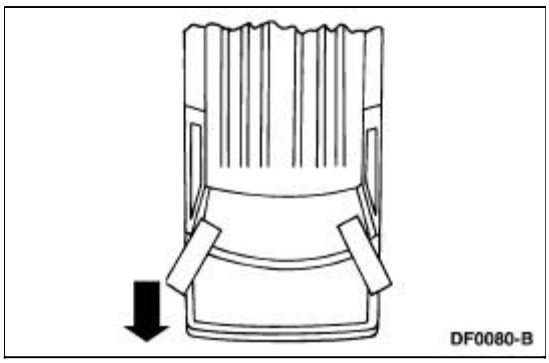
characteristics when loaded and driven. The caster setting is not related to tire wear.

Toe

Positive Toe (Toe In)



Negative Toe (Toe Out)



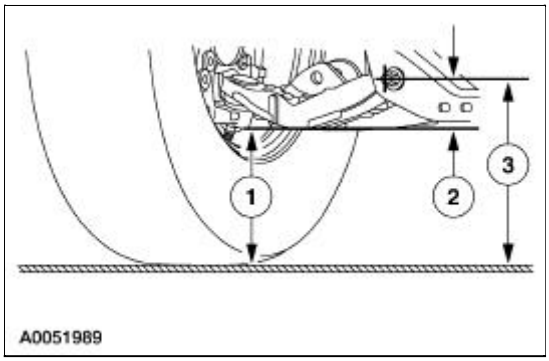
The vehicle toe setting:

- affects tire wear and directional stability.
- must be checked after adding aftermarket equipment, such as a snowplow or body.

Ride Height

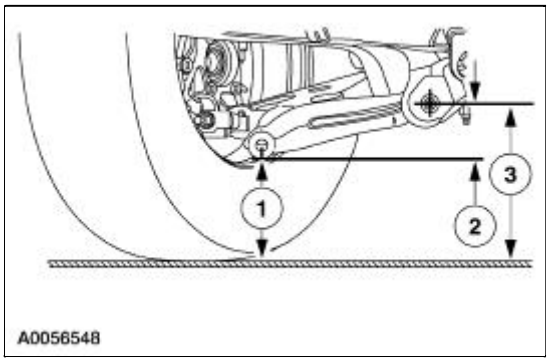
NOTE: Air suspension vehicles must be at trim prior to measuring the vehicle ride height. For additional information, refer to Section 204-05 .

Front Ride Height Measurement



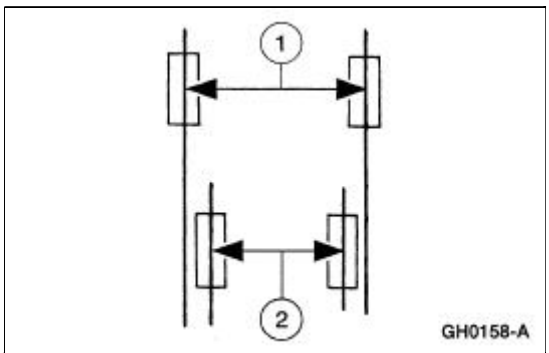
Item	Description
1	Distance between the ground and the lower knuckle surface near the ball joint.
2	Ride height = 3-1
3	Distance between the ground and the center of the lower arm rearward mounting bolt

Rear Ride Height Measurement



Item	Description
1	Distance between the ground and lower edge of arm below the shock absorber mounting bolt
2	Ride height = 3-1
3	Distance between the ground and the center of the lower arm mounting bolt

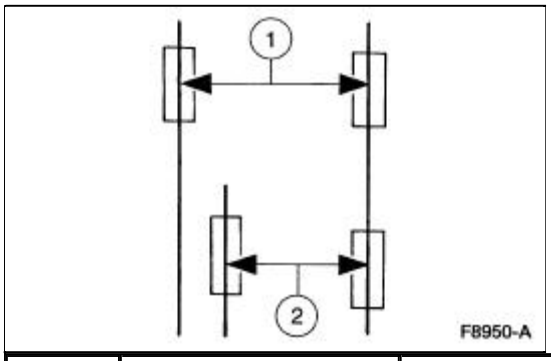
Wheel Track



Item	Part Number	Description

1	—	Front track
2	—	Rear track

Dogtracking



Item	Part Number	Description
1	—	Front track
2	—	Rear track dogtracking

Dogtracking is the condition in which the rear axle is not square to the chassis. Heavily crowned roads can give the illusion of dogtracking.

Wander

Wander is the tendency of the vehicle to require frequent, random left and right steering wheel (3600) corrections to maintain a straight path down a level road.

Shimmy

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

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

Nibble

Sometimes confused with shimmy, nibble is a condition resulting from tire interaction with various road surfaces or tire imbalance. This condition is observed by the driver as small rotational oscillations of the steering wheel.

Poor Returnability/Sticky Steering

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

Drift/Pull

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

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

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

Poor Groove Feel

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

- Under 20 degrees of turn, most of the turning effort that builds up comes from the mesh of gear teeth in the steering gear (3504). In this range, the steering wheel is not yet turned enough to feel the effort from the self-aligning forces at the road wheel or tire patch.
- In the diagnosis of a roadability problem, it is important to understand the difference between wander and poor groove feel.

Suspension System

Inspection and Verification

1. Road test.
   - Verify the customer's concern by performing a road test on a smooth road. If any vibrations are apparent, refer to Section 100-04 .
2. Inspect tires.
   - Check the tire pressure with all normal loads in the vehicle and the tires cold. Refer to the vehicle certification (VC) label.
   - Verify that all tires are sized to specification. Refer to Section 204-04 .
   - Inspect the tires for incorrect wear and damage. Refer to Section 204-04 .
3. Inspect chassis and underbody.
   - Remove any excessive accumulation of mud, dirt or road deposits from the chassis and underbody.
4. Inspect for aftermarket equipment.
   - Check for aftermarket changes to the steering, suspension, wheel and tire components (such as competition, heavy duty, etc.) The specifications shown in this manual do not apply to vehicles equipped with aftermarket equipment.

Visual Inspection Chart

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

5. If an obvious cause for an observed or reported condition is found, correct the cause (if possible) before proceeding to the next step.
6. If the fault is not visually evident, determine the symptom and proceed to the following symptom chart.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• Dogtracking	• Excessive rear thrust angle.	• ADJUST as necessary.
	• Front or rear suspension components.	• INSPECT the front and rear suspension system. REPAIR or INSTALL new suspension components as necessary. REFER to Section 204-01A , Section 204-01B or Section 204-02 .
• Drift/pull	• Unequal tire pressure.	• ADJUST tire pressure.
	• Caster total split is not within specification.	• CHECK the wheel alignment. ADJUST as necessary.
	• Camber total split is not within specification.	• CHECK the wheel alignment. ADJUST as necessary.
	• Tire forces.	• CROSS ROTATE tires front to rear.
	• Unevenly loaded or overloaded vehicle.	• NOTIFY the customer of incorrect vehicle loading.
	• Steering components.	• REFER to Section 211-00 .
	• Brake drag.	• REFER to Section 206-00 .
• Front bottoming or riding low	• Spring(s).	• INSTALL new spring(s) as necessary. REFER to Section 204-01A (4x2 and 4x4).
	• Incorrect Spring(s)	• INSTALL new spring(s) as necessary. REFER to Section 204-01A (4x2 and 4x4).
	• Front shock absorber(s).	• INSTALL new shock absorber (s) as necessary. REFER to Section 204-01A (4x2 and 4x4).
• Incorrect tire wear	• Incorrect tire pressure (rapid center rib or inner and outer edge wear).	• ADJUST tire pressure.
	• Excessive front or rear toe (rapid inner or outer edge wear).	• CHECK the wheel alignment. ADJUST as necessary.
	• Excessive negative or positive camber (rapid inner or outer edge wear).	• CHECK the wheel alignment. ADJUST as necessary.
	• Front or rear suspension components.	• INSPECT the front and rear suspension system. REPAIR or INSTALL new suspension components as necessary. REFER to Section 204-01A , Section 204-01B or Section

		204-02 . ● Tires out of balance (tires cupped or dished).	● BALANCE tires.
● Rough ride	● High tire pressure. ● Shock absorber(s). ● Spring(s).	● ADJUST tire pressure. ● INSTALL new shock absorbers as necessary. REFER to Section 204-01A and Section 204-02 . ● INSTALL new spring(s) as necessary. REFER to Section 204-01A and Section 204-02 .
● Shimmy or wheel tramp	● Loose wheel nut (s). ● Loose front suspension fasteners. ● Front wheel bearing. ● Wheel or tire concerns. ● Shock absorber(s). ● Loose, worn or damaged ball joint (s). ● Loose, worn or damaged steering components. ● Front wheel alignment.	● TIGHTEN to specification. REFER to Section 204-04 . ● TIGHTEN to specification. REFER to Section 204-01A (4x2) or Section 204-01B (4x4). ● REFER to Wheel Bearing Inspection in this section. ● REFER to Section 204-04 . ● INSTALL new shock absorber (s) as necessary. REFER to Section 204-01A (front) or Section 204-02 (rear). ● GO to the Ball Joint Inspection component test in this section. ● REFER to Section 211-00 . ● CHECK the wheel alignment. ADJUST as necessary.
● Sticky steering, poor returnability	● Ball joints. ● Steering components. ● Caster out of specification.	● GO to the Ball Joint Inspection component test in this section. ● REFER to Section 211-00 . ● CHECK the wheel alignment. ADJUST as necessary.
● Steering wheel off-center	● Unequal front or rear toe settings (side-to-side). ● Steering components.	● CHECK the wheel alignment. ADJUST as necessary. ● REFER to Section 211-00 .
● Sway or roll	● Overloaded, unevenly or incorrectly loaded vehicle. ● Loose wheel nut (s). ● Shock absorber(s).	● NOTIFY the customer of incorrect vehicle loading. ● TIGHTEN to specification. REFER to Section 204-04 . ● INSTALL new shock absorbers as necessary. REFER to Section 204-01A or Section

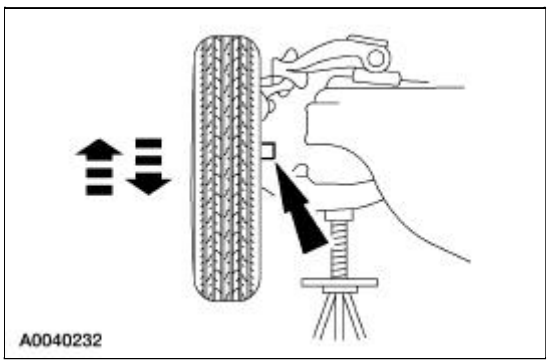
		204-02 .
	• Loose stabilizer assembly.	• TIGHTEN to specification. REFER to Section 204-01A (4x2), Section 204-01B (4x4) or Section 204-02 .
	• Worn stabilizer assembly bushing (s) or link(s).	• INSTALL new stabilizer assembly bushings as necessary. REFER to Section 204-01A (4x2), Section 204-01B (4x4) or Section 204-02 .
	• Worn spring(s).	• INSTALL new as necessary. REFER to Section 204-01A (front) or Section 204-02 (rear).
• Vehicle leans to one side	• Unevenly loaded or overloaded vehicle.	• NOTIFY the customer of incorrect vehicle loading.
	• Front or rear suspension components.	• INSPECT the front and rear suspension systems. REPAIR or INSTALL new suspension components as necessary. REFER to Section 204-01A (4x2), Section 204-01B (4x4) or Section 204-02 .
	• Spring(s).	• INSTALL new spring(s) as necessary. REFER to Section 204-01A (front) or Section 204-02 (rear).
	• Incorrect drive axle (s) ride height. Lateral tilt out of specification.	• INSPECT the front and rear suspension systems. ADJUST, REPAIR or INSTALL new suspension components as necessary. REFER to Section 204-01B (4x4) or Section 204-02 .
• Vibration/noise	• Tire and wheel concerns. • Wheel bearings. • Wheel hubs. • Brake components. • Suspension components. • Steering components.	• REFER to Section 100-04 .
• Wander	• Unevenly loaded or overloaded vehicle.	• NOTIFY the customer of incorrect vehicle loading.
	• Ball joint(s).	• GO to the Ball Joint Inspection component test in this section.
	• Loose, worn or damaged front wheel bearing(s).	• REFER to Wheel Bearing Inspection in this section.
	• Loose, worn or damaged suspension component(s).	• INSTALL new suspension components as necessary. REFER to Section 204-01A (4x2) or Section 204-01B (4x4).
	• Loose suspension fasteners.	• TIGHTEN to specification. REFER to Section 204-01A

	• Steering components. • Wheel alignment (excessive total front toe out).	(4x2) or Section 204-01B (4x4). • REFER to Section 211-00 . • ADJUST as necessary.

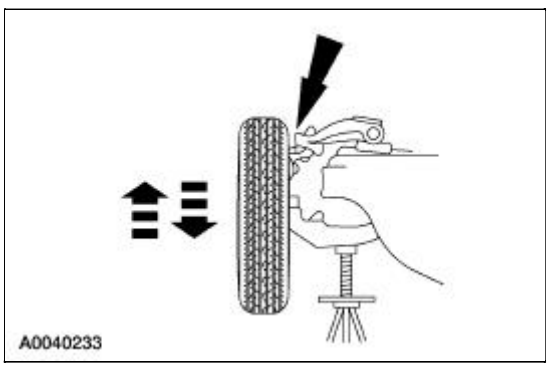
Component Tests

Ball Joint Inspection

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Prior to performing any inspection of the ball joints, inspect the front wheel bearings (1216).
3. Position a safety stand beneath the front suspension lower arm (3079) to be tested.



4. While an assistant pries upward on the bottom of the tire, measure the relative movement between the lower spindle arm and the front suspension lower arm ball joint. Any movement at or exceeding the specification indicates a worn or damaged lower ball joint. Install a new ball joint as necessary. For additional information, refer to Section 204-01A or Section 204-01B .



5. While an assistant pries upward on the bottom of the tire, measure the relative movement between the upper spindle arm and the front suspension upper ball joint. Movement at or exceeding the specification indicates a worn or damaged upper ball joint. Install a new upper ball joint as necessary. For additional information, refer to Section 204-01A or Section 204-01B .

Wheel Bearing Inspection

1. Raise the vehicle until the tire is off the floor. For additional information, refer to Section 100-02 .

2. **NOTE:** Make sure the wheel rotates freely and the brake pads are retracted sufficiently to allow movement of the tire and wheel assembly.

   Grasp each front tire at the top and bottom and move the wheel inward and outward while lifting the weight of the tire off the front wheel bearing.

3. If the wheel (hub) is loose or does not rotate freely, install a new wheel hub. For additional information, refer to Section 204-01A (4x2) or Section 204-01B (4x4).

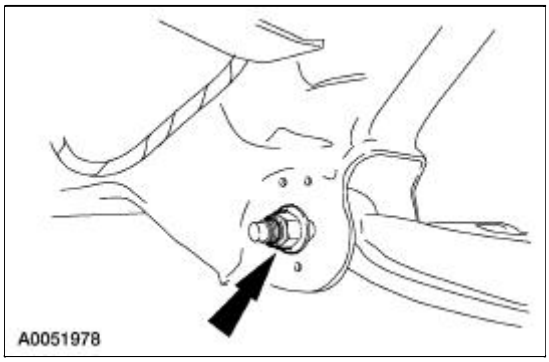
Camber and Caster Adjustment —Front

NOTE: Air suspension vehicles must be at trim ride height prior to measuring or adjusting the caster, camber or toe. For additional information, refer to Section 204-05 .

1. **NOTE:** New lower arm-to-frame mounting bolts must be installed with cam bolt kits (2L1Z-3B236-AC for forward bushing; and 2L1Z-3B236-AD for rearward bushing), to allow for adjustment of the arm in the frame slot. The vehicle should be supported by the frame to ease movement of the lower arm in the slot.

   Remove the nuts and bolts.

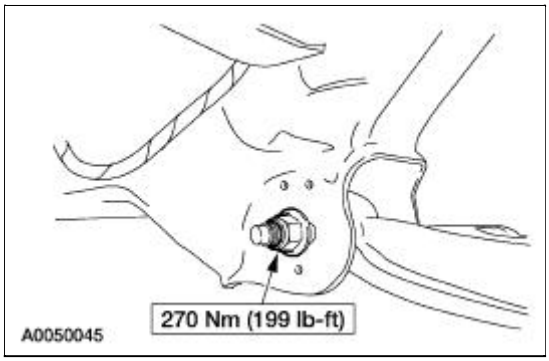
   - Discard the nuts and bolts.
   - Install the cam bolt kit(s) and snug the nut(s).



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

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

3. While holding the cam bolt, tighten the nut(s).



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

Front Toe Adjustment

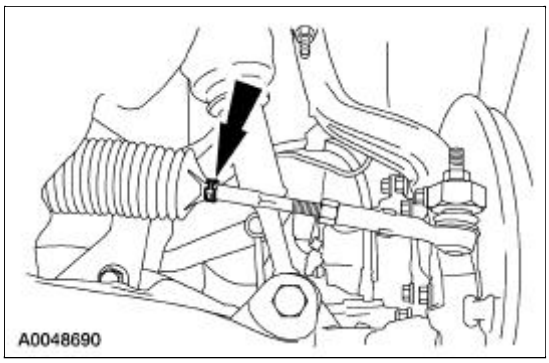
NOTE: Air suspension vehicles must be at trim ride height prior to measuring or adjusting the caster, camber or toe. For additional information, refer to Section 204-05 .

1. Start the engine and center the steering wheel.

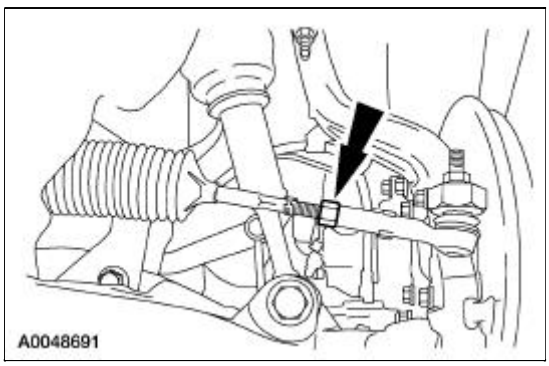
2. Turn the engine off, and hold the steering wheel in the "straight forward" position using a suitable holding device.

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

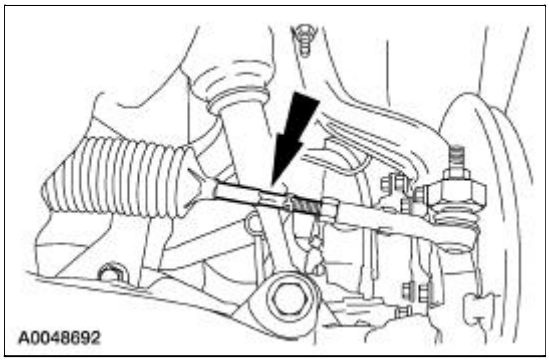
   Remove the clamp(s).



4. Loosen the nut(s).
   - Clean and lubricate the nut(s) and spindle tie-rod threads.



5. Rotate the spindle tie-rod(s).

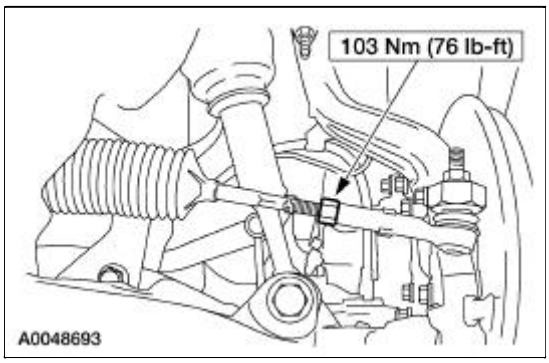


6. Start the engine and center the steering wheel.
   - Recheck the toe settings and adjust if necessary.

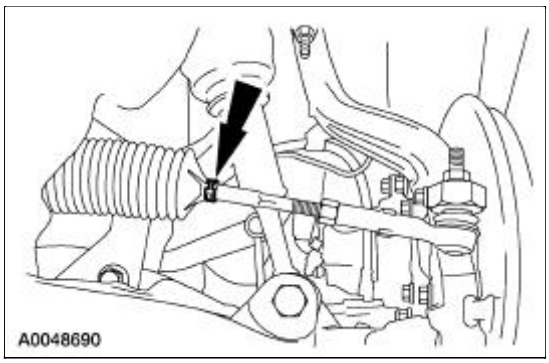
7. **CAUTION: Make sure to hold the tie-rod end stationary while tightening the nut or damage to the boot can occur.**

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

   Tighten the nut(s).



8. Install the clamp(s).



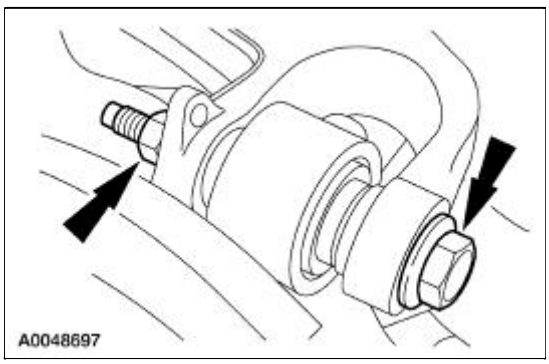
Camber Adjustment —Rear

NOTE: Air suspension vehicles must be at trim ride height prior to measuring or adjusting the rear camber or toe. For additional information, refer to Section 204-05 .

1. **NOTE:** The upper arm-to-wheel knuckle bolt and nut must be removed and replaced with a cam bolt kit (2L14-5K750-AA/2L1Z-5K751-AA) to allow for the adjustment of the arm in the frame slot. The vehicle should be supported by the lower arm to ease movement of the wheel knuckle in the slot.

   Remove the nut and bolt.

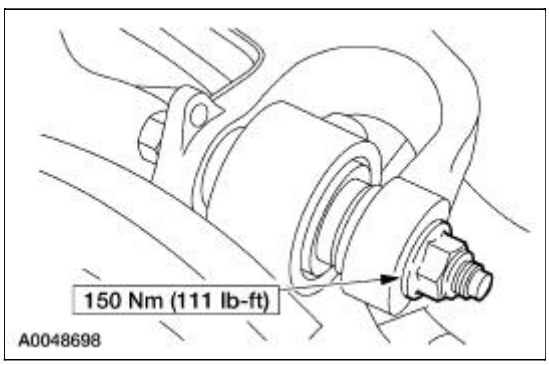
   - Discard the nut and bolt.
     - Install the cam bolt kit and snug the nut.



2. **NOTE:** To decrease the camber, rotate the cam bolt to move the wheel knuckle inward.To increase the camber, rotate the cam bolt to move the the wheel knuckle outward.

   Rotate the cam bolt.

3. While holding the cam-bolt, tighten the nut.



4. Check and if necessary adjust the rear toe. For additional information, refer Rear Toe Adjustment in this section.

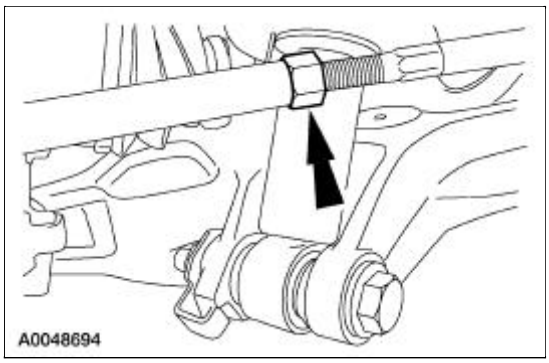
Rear Toe Adjustment

NOTE: Air suspension vehicles must be at trim ride height prior to measuring or adjusting the rear toe. For additional information, refer to Section 204-05 .

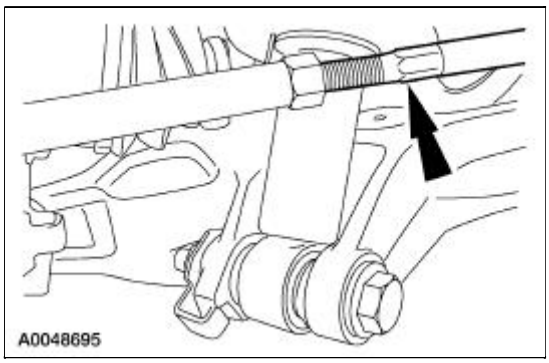
1. Start the engine and center the steering wheel.

2. Turn the engine off, and hold the steering wheel in the "straight forward" position using a suitable holding device.

3. Loosen the nuts(s).
   - Clean and lubricate the nut(s) and rear toe link threads.

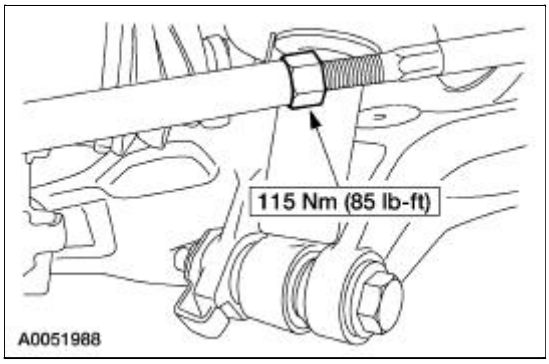


4. Rotate the spindle tie rod.



5. **NOTE:** Make sure the toe settings are not disturbed while tightening the nuts.

   Tighten the nut(s).

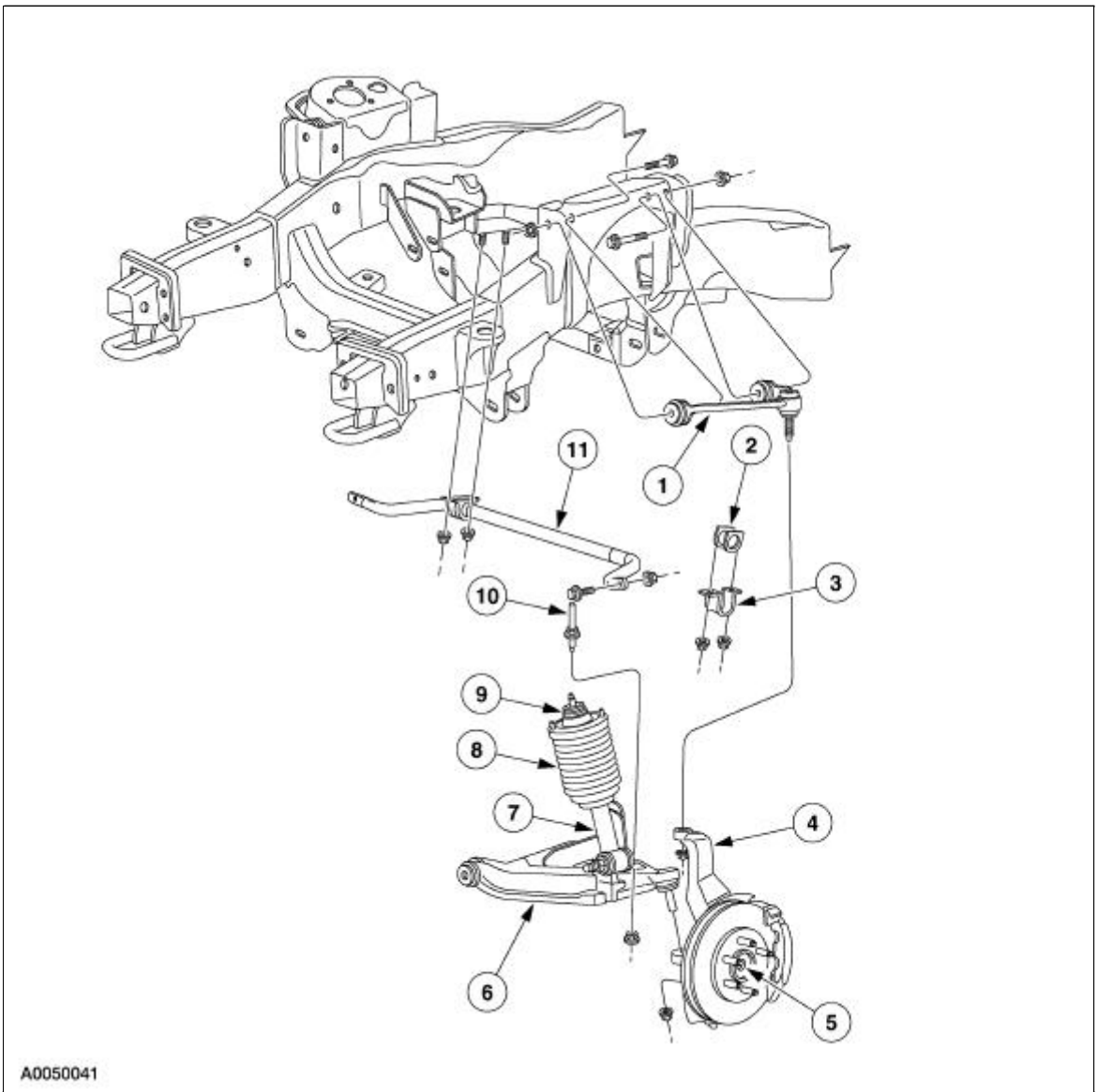

115 Nm (85 lb-ft)
A0051988

Torque Specifications

Description	Nm	lb-ft
Wheel bearing-to-knuckle bolts	200	148
Tie-rod end nut	150	111
Upper ball joint nut	150	111
Upper arm-to-frame nuts and bolts	150	111
Lower ball joint nut	200	148
Lower arm-to-frame nuts and bolts	270	199
Shock absorber-to-frame upper mounting nuts	35	26
Shock absorber-to-lower arm bolt and nut	400	295
Shock absorber-to-upper mounting plate nut	30	22
Stabilizer bar bracket-to-frame nuts	55	41
Stabilizer bar link-to-control-arm nuts	90	66
Stabilizer bar link-to-bar nuts	133	98
Wheel speed sensor wiring retainer bolt	12	9
Brake caliper anchor plate bolts	200	148

Front Suspension

Front Suspension Components



A0050041

Item	Part Number	Description
1	3084/3091	Upper arm RH/LH
2	5493	Stabilizer bar bushing
3	5487	Stabilizer bar bracket
4	3K184/3K185	Wheel knuckle RH/LH
5	1104	Wheel bearing and hub
6	3042/3051	Lower arm RH/LH
7	18124	Shock absorber
8	5310	Coil spring

9	18183	Shock absorber upper mount
10	5K483	Stabilizer bar link
11	5482	Stabilizer bar

Front Suspension

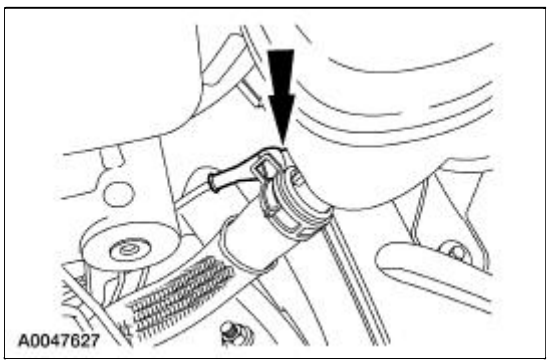
Refer to Section 204-00 .

Wheel Hub

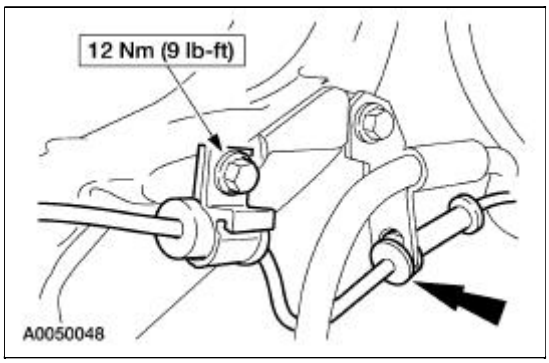
Removal and Installation

WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the LH rear quarter trim panel. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.

1. If equipped, turn the air suspension switch to the OFF position.
2. Disconnect the wheel speed sensor connector.

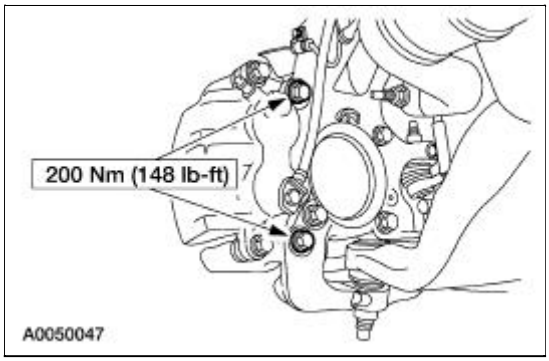


3. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .
4. Remove the bolt and detach the retainers.

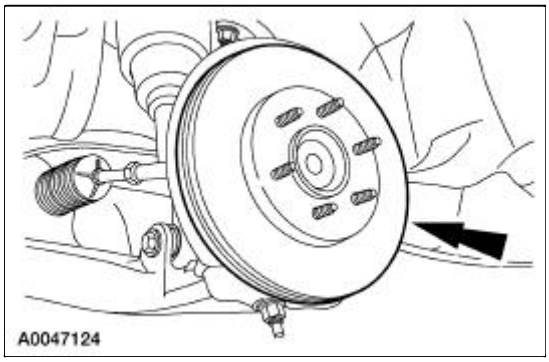


5. **CAUTION: Do not allow the caliper to hang from the brake hose or damage to the hose can result.**

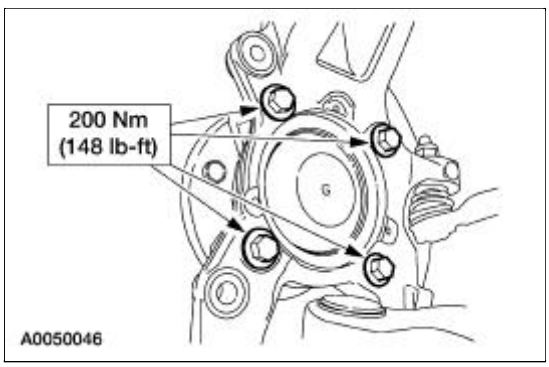
   Remove the bolts, and position the caliper, pads and anchor place aside.



6. Remove the brake disc.



7. Remove the bolts and the wheel bearing and hub assembly.



8. **CAUTION: If the original wheel bearing and hub is being reinstalled, make sure to install a new O-ring.**

   To install, reverse the removal procedure.

Wheel Studs

Special Tool(s)

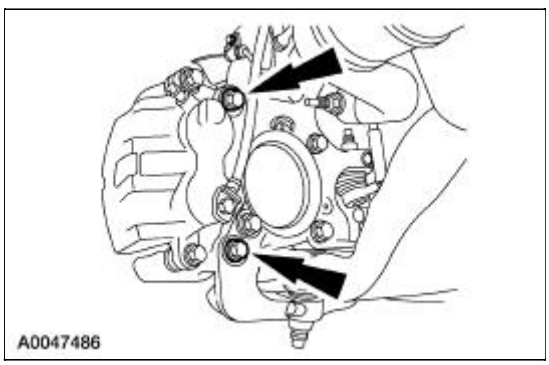
 ST1494-A	C-Frame and Screw Assembly 211-023 (T74P-3044-A1)

Removal

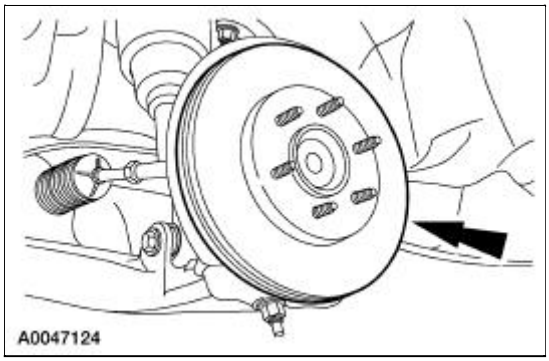
WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the LH rear quarter trim panel. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.

1. If equipped, turn the air suspension switch to the OFF position.
2. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .
3. **CAUTION: Do not allow the caliper to hang from the brake hose or damage to the brake hose can result.**

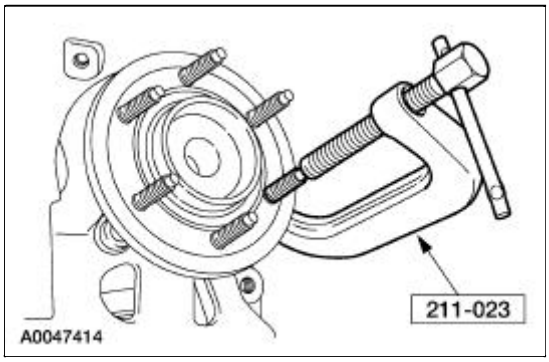
   Remove the bolts and position the caliper, pads and anchor plate aside.



4. Remove the brake disc.

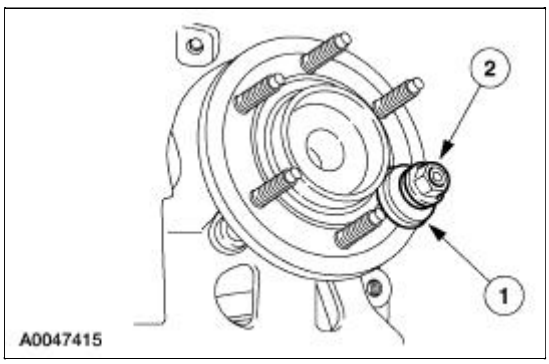


5. Using the special tool, remove the wheel stud.



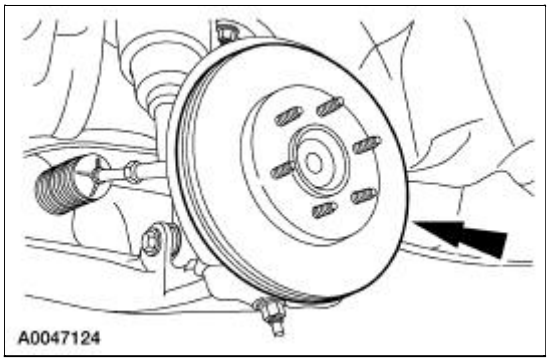
Installation

1. Install the wheel stud.
    1. Install four washers onto the wheel stud.
    2. Install the wheel nut. Tighten the wheel nut until the wheel stud seats fully onto the wheel hub flange.

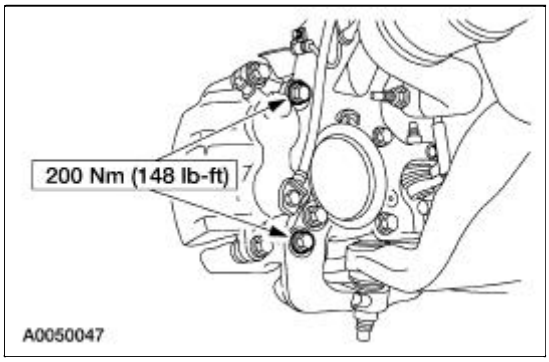


2. Remove the wheel nut and washers.

3. Install the brake disc.



4. Position the caliper, pads and anchor plate and install the bolts.



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

6. If equipped, turn the air suspension switch to the ON position.

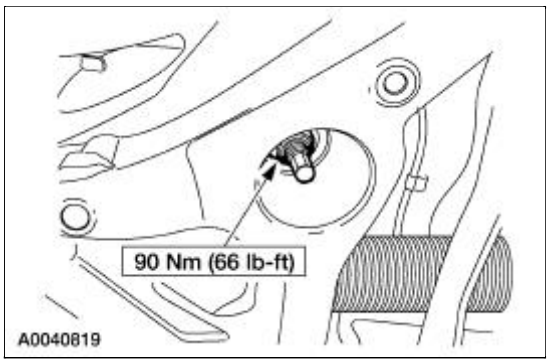
Lower Arm

Removal and Installation

WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the LH rear quarter trim panel. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.

1. If equipped, turn the air suspension switch to the OFF position.
2. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .
3. **NOTE:** Use the hex holding feature to prevent the stud from turning while removing the nut.

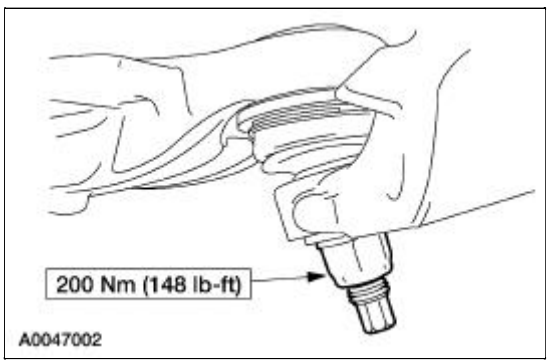
   Remove and discard the nut.



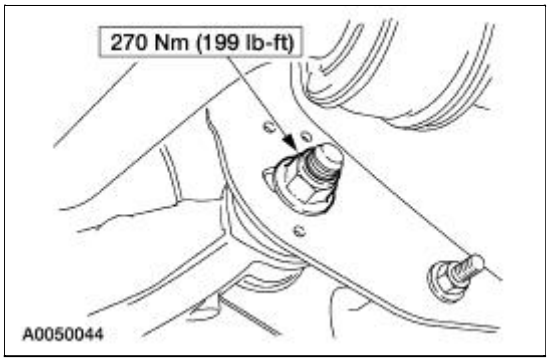
4. **NOTE:** Use the hex holding feature to prevent the stud from turning while removing the nut.

   NOTE: If necessary, tap on the end of the stud to separate the stud from the knuckle.

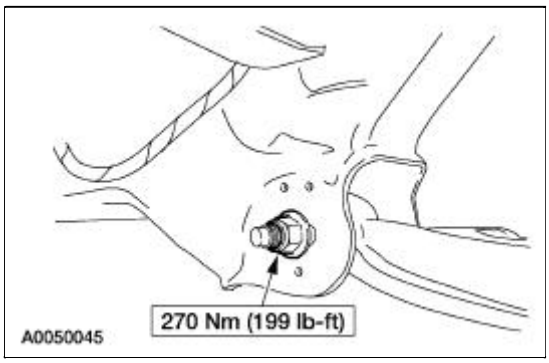
   Remove and discard the nut.



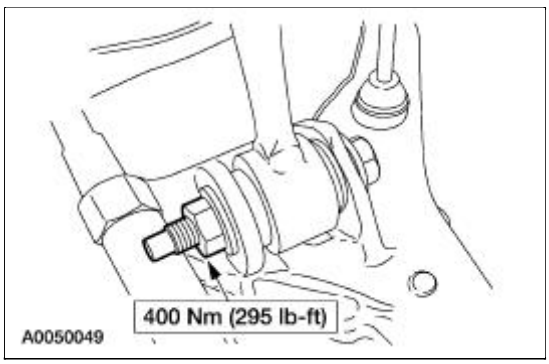
5. Remove the nut and bolt.
   - Discard the nut.



6. Remove the nut and bolt.
    - Discard the nut.



7. Remove the nut, bolt and the lower arm.
    - Discard the nut.



8. **NOTE:** Assemble the lower arm pivot nuts and bolts. Do not tighten until the installation procedure is complete and the weight of the vehicle is resting on the wheel and tire assemblies.

    To install, reverse the removal procedure.

9. Check and, if necessary, align the front end. For additional information, refer to Section 204-00 .

Upper Arm

Removal and Installation

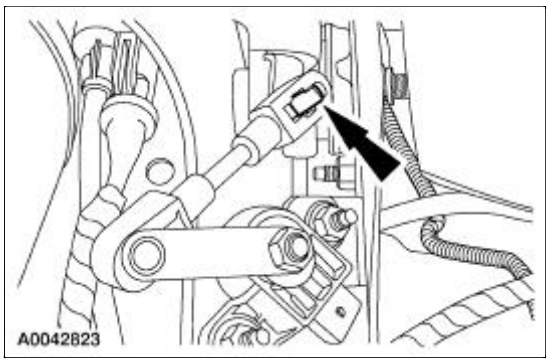
Vehicles with coil spring suspension

1. Remove the shock absorber and spring assembly. For additional information, refer to Shock Absorber and Spring Assembly in this section.

Vehicles with air suspension

2. Remove the air shock absorber assembly. For additional information, refer to Section 204-05 .

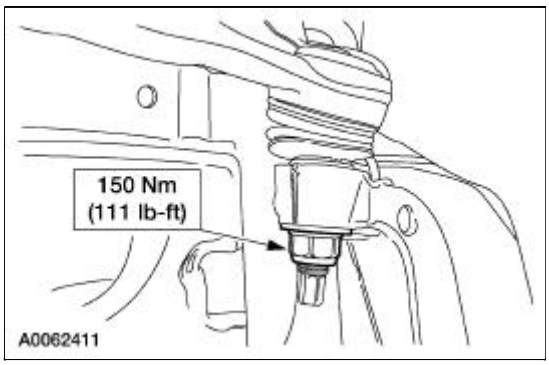
3. Detach the height sensor from the upper arm.



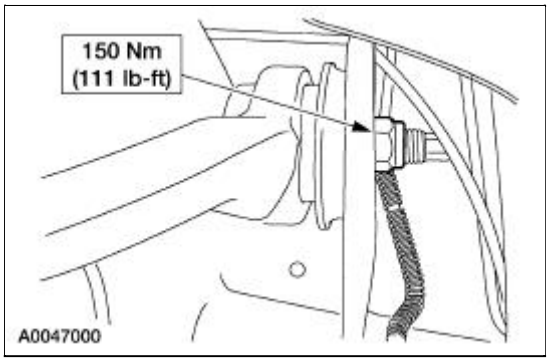
All vehicles

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

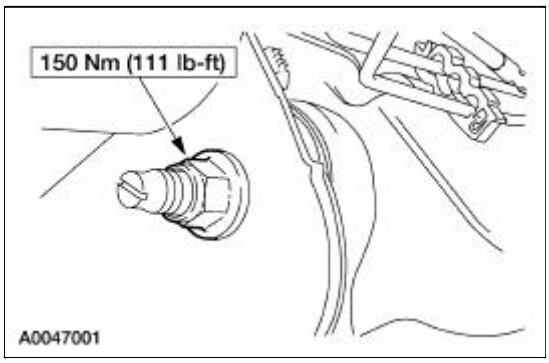
   Remove and discard the nut.



5. Remove the nut and bolt.
   - Discard the nut.



6. Remove the nut, bolt and the upper arm.
    - Discard the nut.



7. **NOTE:** Assemble the upper arm pivot nuts and bolts. Do not tighten until the installation procedure is complete and the weight of the vehicle is resting on the wheel and tire assemblies.

   To install, reverse the removal procedure.

8. Check and, if necessary, align the front end. For additional information, refer to Section 204-00 .

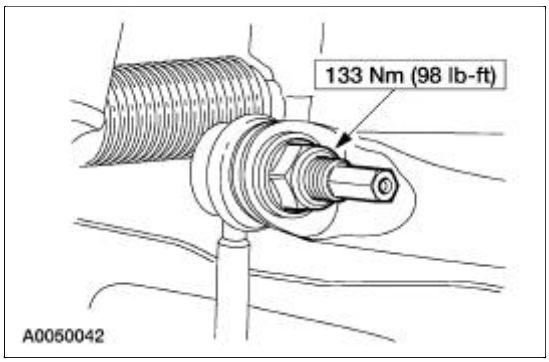
Stabilizer Bar and Link

Removal and Installation

WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the LH rear quarter trim panel. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.

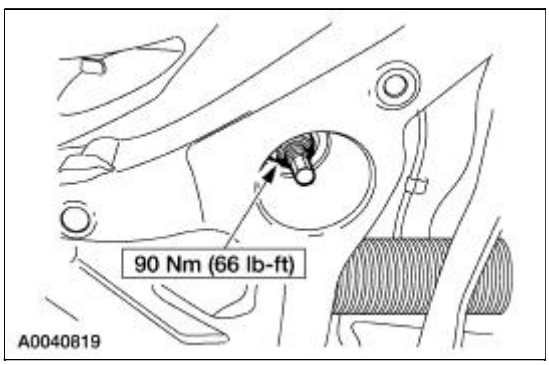
1. If equipped, turn the air suspension switch to the OFF position.
2. Raise and support the vehicle. For additional information, refer to Section 204-04 .
3. **NOTE:** The hex holding feature can be used to prevent turning of the stud while removing the nut.

   Remove and discard the two nuts.

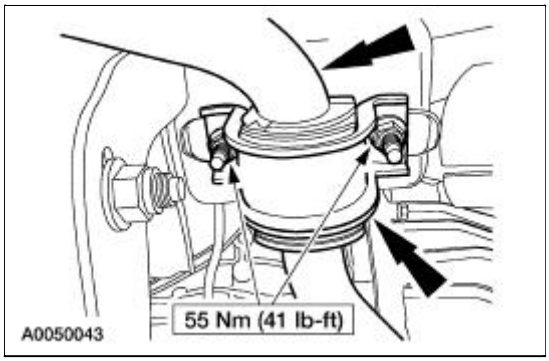


4. **NOTE:** Use the hex holding feature to prevent the stud from turning while removing the nut.

   Remove the two nuts and the stabilizer bar links.
   - Discard the nuts.



5. Remove the four nuts, brackets, bushings and the stabilizer bar.
   - Discard the nuts.



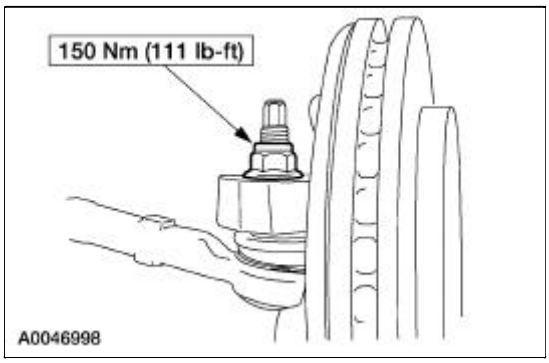
6. Inspect and, if necessary, install new stabilizer bar bushings.
7. To install, reverse the removal procedure.

Wheel Knuckle

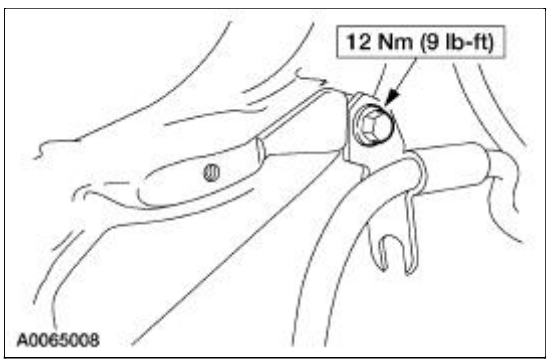
Removal and Installation

1. Remove the wheel hub. For additional information, refer to Wheel Hub in this section.
2. **NOTE:** Use the hex holding feature to prevent the stud from turning while removing the nut.

   Remove the nut and detach the tie-rod from the wheel knuckle.
   - Discard the nut.

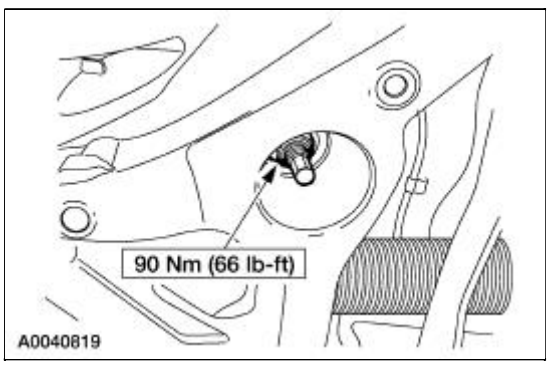


3. Remove the bolt and position the brake hose aside.

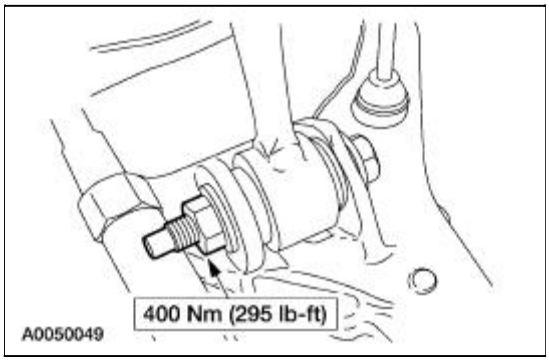


4. **NOTE:** Use the hex holding feature to prevent the stud from turning while removing the nut.

   Remove and discard the nut.



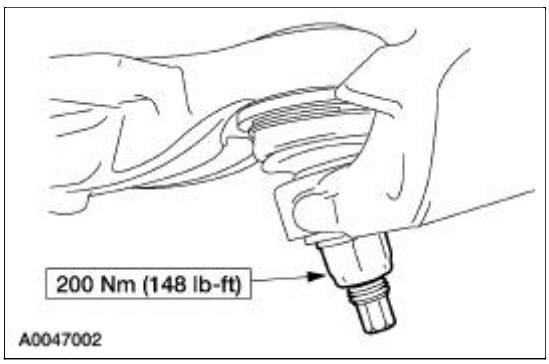
5. Remove the nut and bolt.
    - Discard the nut.



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

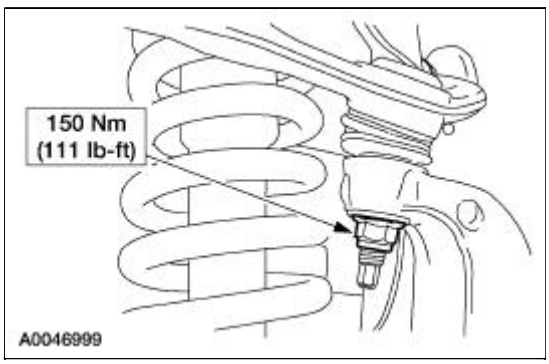
   NOTE: To separate the ball joint from the wheel knuckle, loosely install the nut and then tap on the end of the stud.

   Remove the nut and separate the ball joint from the knuckle.
    - Discard the nut.



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

   Remove the nut and the wheel knuckle.
    - Discard the nut.

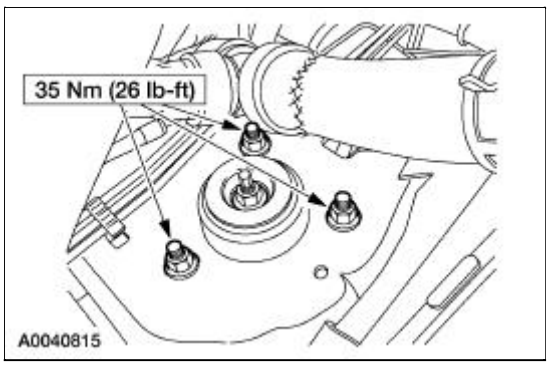


8. To install, reverse the removal procedure.

9. Check and, if necessary, align the front end. For additional information, refer to Section 204-00 .

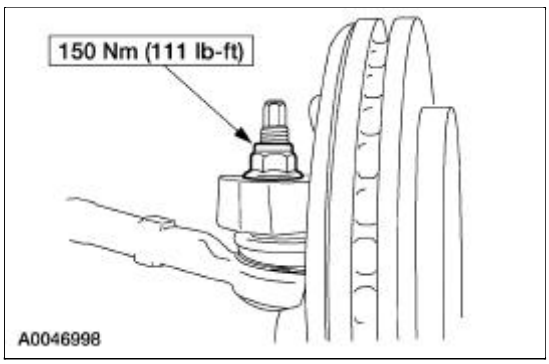
Shock Absorber and Spring Assembly

1. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .
2. Remove and discard the nuts.

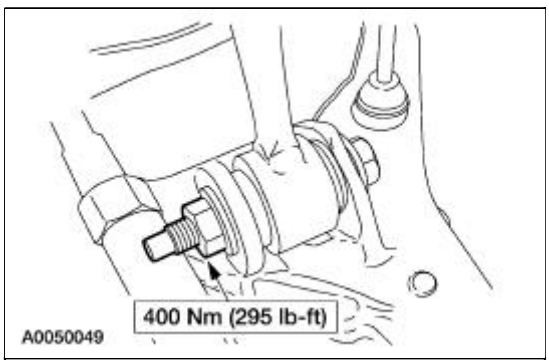


3. **NOTE:** Use the hex holding feature to prevent the stud from turning while removing the nut.

   Remove the nut and detach the tie-rod from the wheel knuckle.
   - Discard the nut.

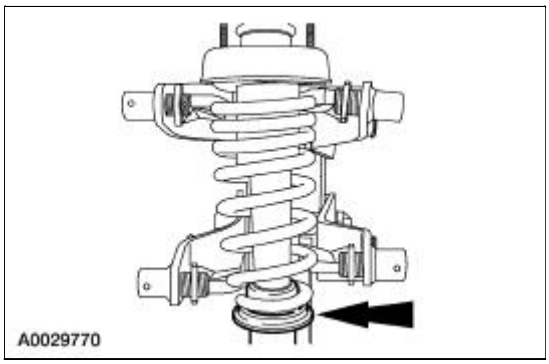


4. Remove the nut, bolt and the shock absorber and spring assembly.
   - Discard the nut.

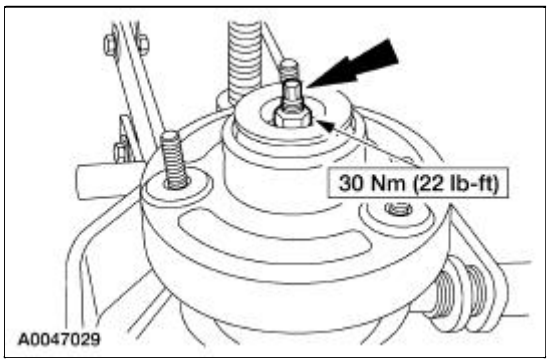


5. **NOTE:** For reference during assembly, index the upper mount, spring and shock absorber.

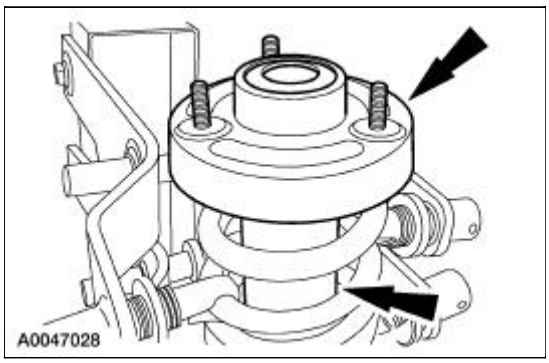
Using a suitable spring compressor, compress the spring until the tension is released from the shock absorber.



6. While holding the shock rod, remove the nut and washer.
   - Remove the shock absorber.
   - Discard the nut.



7. Remove the upper mount, dust shield and insulator.



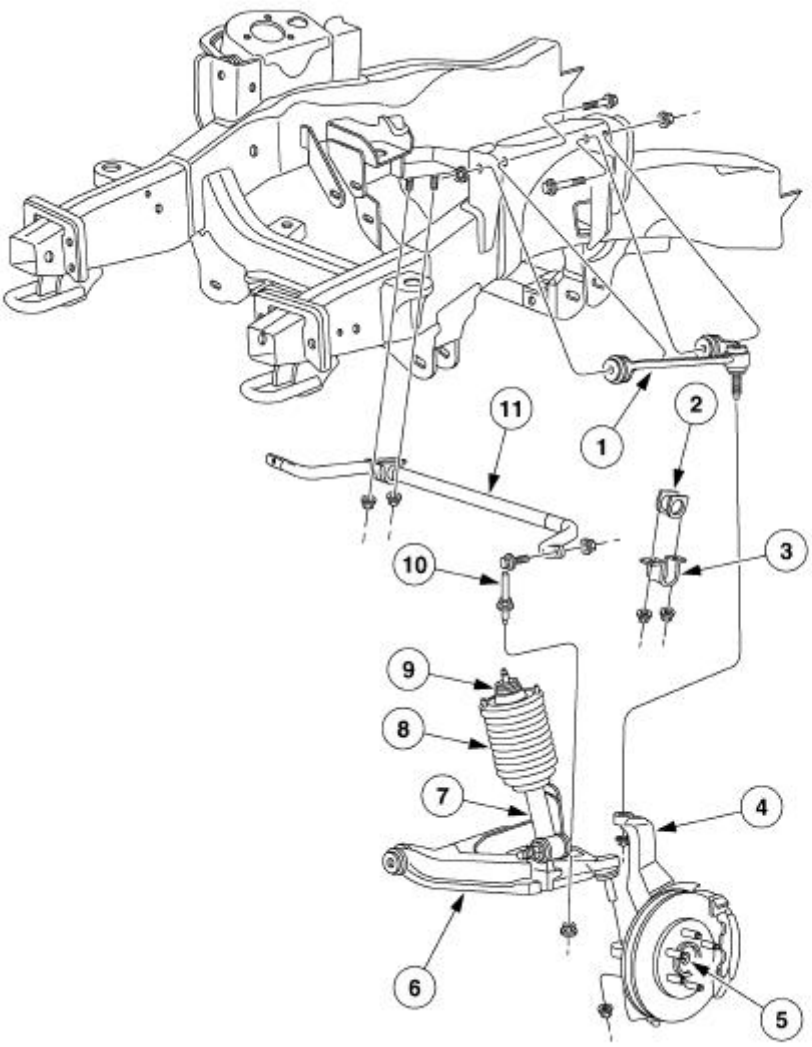
8. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-ft
Wheel hub-to-knuckle bolts	150	111
Axle-to-wheel hub nut	27	20
Wheel end actuator-to-wheel knuckle bolts	15	11
Tie-rod end nut	150	111
Upper ball joint nut	150	111
Upper arm-to-frame nuts and bolts	150	111
Lower ball joint nut	200	148
Lower arm-to-frame nuts and bolts	270	199
Shock absorber-to-frame upper mounting nuts	35	26
Shock absorber-to-lower arm bolt and nut	400	295
Shock absorber-to-upper mounting plate nut	30	22
Stabilizer bar bracket-to-frame nuts	55	41
Stabilizer bar link-to-lower arm nuts	90	66
Wheel speed sensor wiring retainer bolt	12	9
Brake caliper anchor plate bolts	32	24
Stabilizer bar link-to-stabilizer bar nuts	133	98

Front Suspension

Front Suspension Components



A0050041

Item	Part Number	Description
1	3084/3091	Upper arm RH/LH
2	5493	Stabilizer bar bushing
3	5486	Stabilizer bar bracket
4	3K184/3K185	Wheel knuckle RH/LH
5	1104	Wheel bearing and hub
6	3042/3051	Lower arm RH/LH
7	18124	Shock absorber
8	5310	Coil spring

9	18183	Shock absorber upper mount
10	5K483	Stabilizer bar link
11	5482	Stabilizer bar

Front Suspension

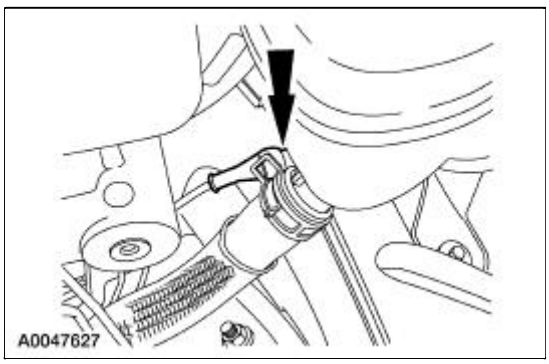
Refer to Section 204-00 .

Wheel Hub

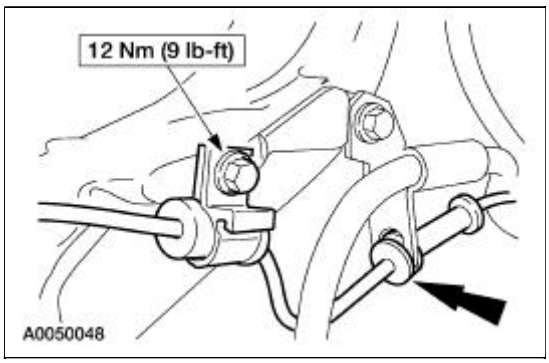
Removal and Installation

WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the LH rear quarter trim panel. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.

1. If equipped, turn the air suspension switch to the OFF position.
2. Disconnect the wheel speed sensor electrical connector.

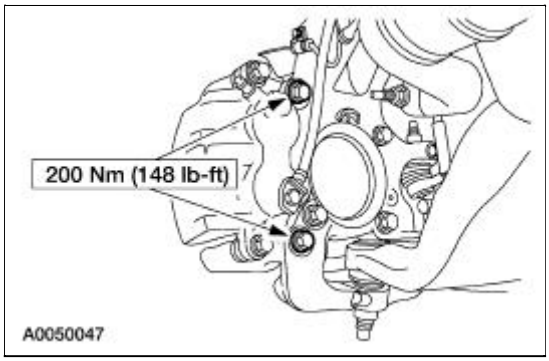


3. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .
4. Remove the bolt and detach the retainers.

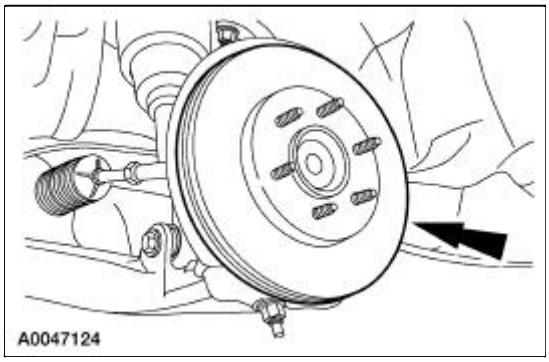


5. **CAUTION: Do not allow the caliper to hang from the brake hose or damage to the hose can result.**

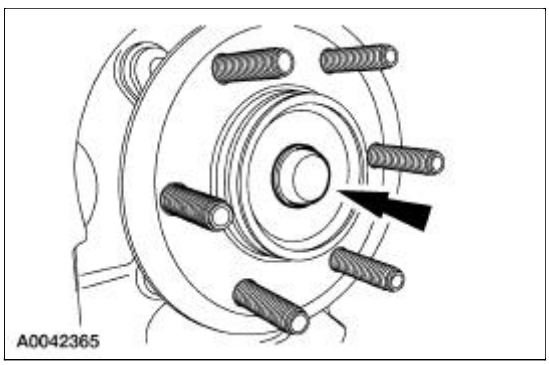
   Remove the bolts, and position the caliper, pads and anchor plate aside.



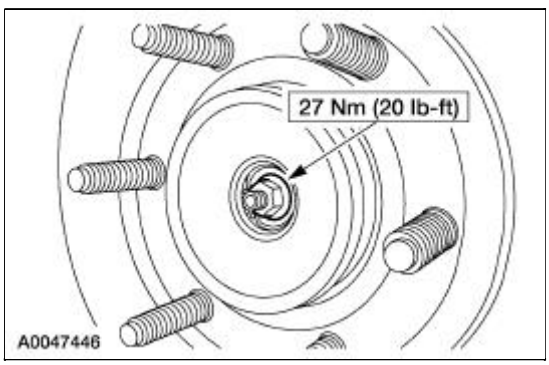
6. Remove the brake disc.



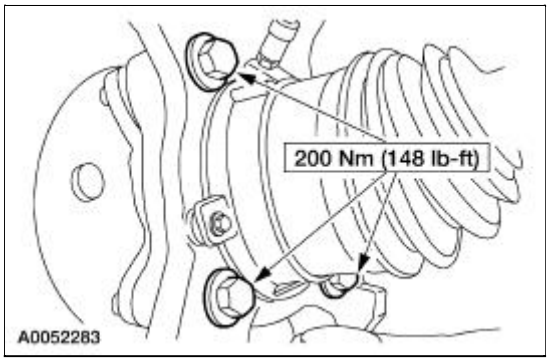
7. Remove the dust cap.



8. Remove and discard the nut.



9. Remove the bolts and the wheel bearing and hub assembly.



10. **CAUTION: If the original wheel bearing and hub is being reinstalled, make sure to install a new O-ring.**

    To install, reverse the removal procedure.

Wheel Studs

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

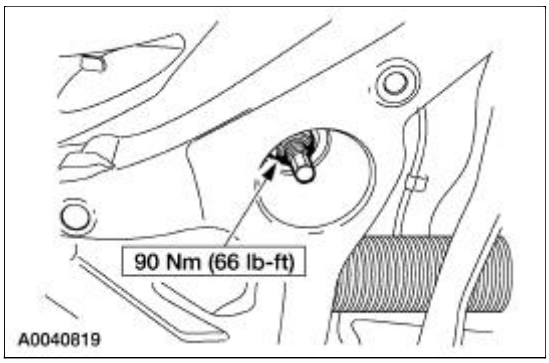
Lower Arm

Removal and Installation

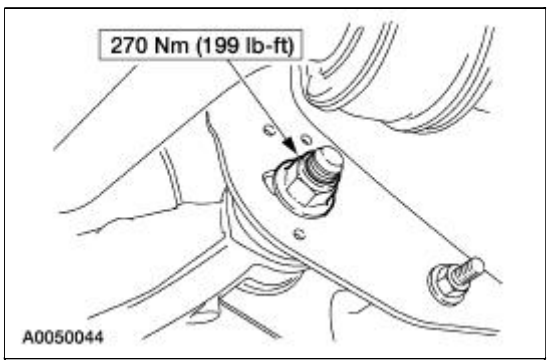
WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the LH rear quarter trim panel. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.

1. If equipped, turn the air suspension switch to the OFF position.
2. Remove the wheel knuckle. For additional information, refer to Wheel Knuckle in this section.
3. **NOTE:** Use the hex holding feature to prevent the stud from turning while removing the nut.

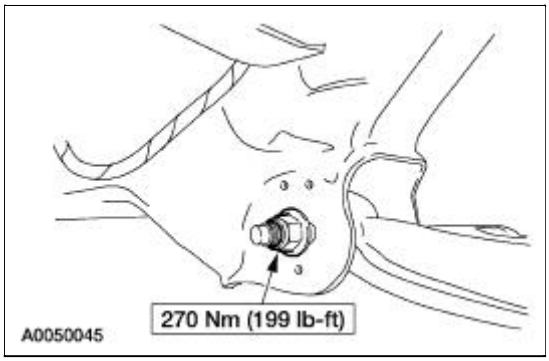
   Remove and discard the nut.



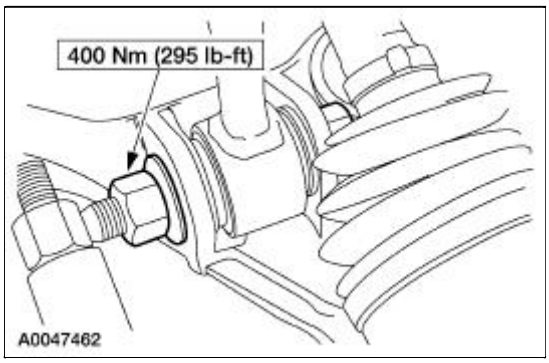
4. Remove the nut and bolt.
   - Discard the nut.



5. Remove the nut and bolt.
   - Discard the nut.



6. Remove the nut, bolt and the lower arm.
   - Discard the nut.



7. **NOTE:** Assemble the lower arm pivot nuts and bolts. Do not tighten until the installation procedure is complete and the weight of the vehicle is resting on the wheel and tire assemblies.

   To install, reverse the removal procedure.

8. Check and, if necessary, align the front end. For additional information, refer to Section 204-00 .

Upper Arm

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

Stabilizer Bar and Link

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

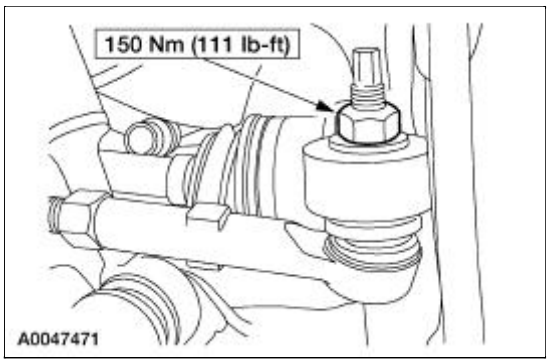
Wheel Knuckle

Removal and Installation

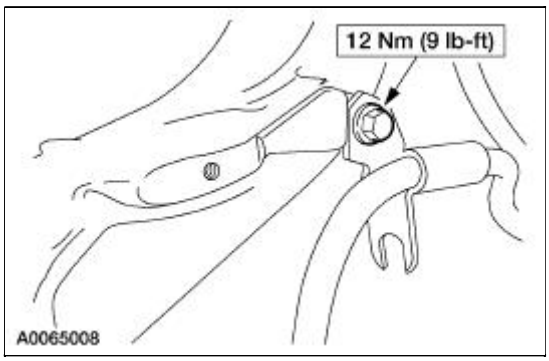
WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the LH rear quarter trim panel. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.

1. If equipped, turn the air suspension to the OFF position.
2. Remove the wheel hub. For additional information, refer to Wheel Hub in this section.
3. **NOTE:** Use the hex holding feature to prevent the stud from turning while removing the nut.

   Remove and discard the nut.

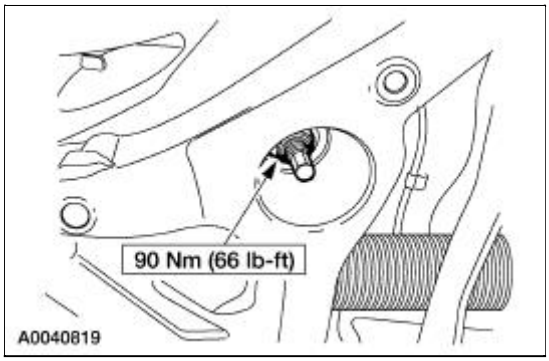


4. Remove the bolt and position the brake hose aside.

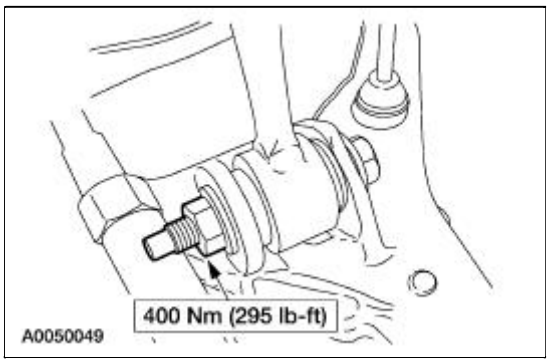


5. **NOTE:** Use the hex holding feature to prevent the stud from turning while removing the nut.

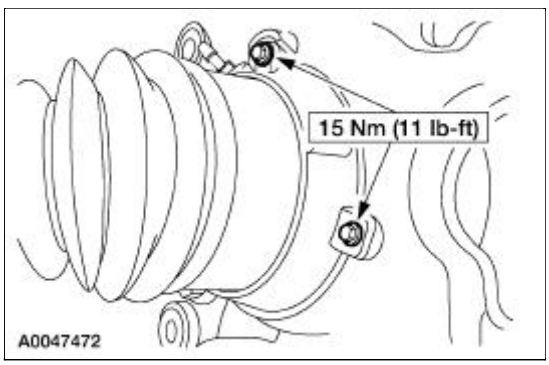
   Remove and discard the nut.



6. Remove the nut and bolt.
    - Discard the nut.

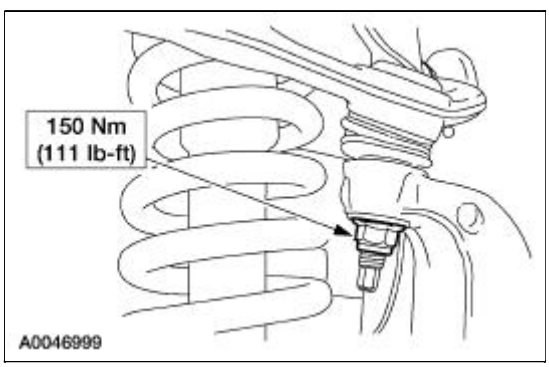


7. Remove the three bolts.



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

    Remove and discard the nut.

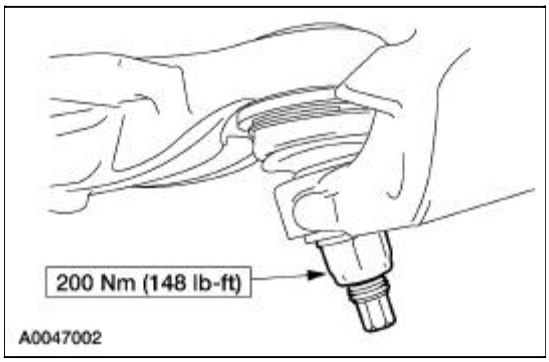


9. **NOTE:** Use the hex holding feature to prevent the stud from turning while removing the nut.

NOTE: To separate the ball joint from the wheel knuckle, loosely install the nut and then tap on the end of the stud.

Remove the nut and the wheel knuckle.

- Discard the nut.



10. To install, reverse the removal procedure.

11. Check and, if necessary, align the front end. For additional information, refer to Section 204-00 .

Shock Absorber and Spring Assembly

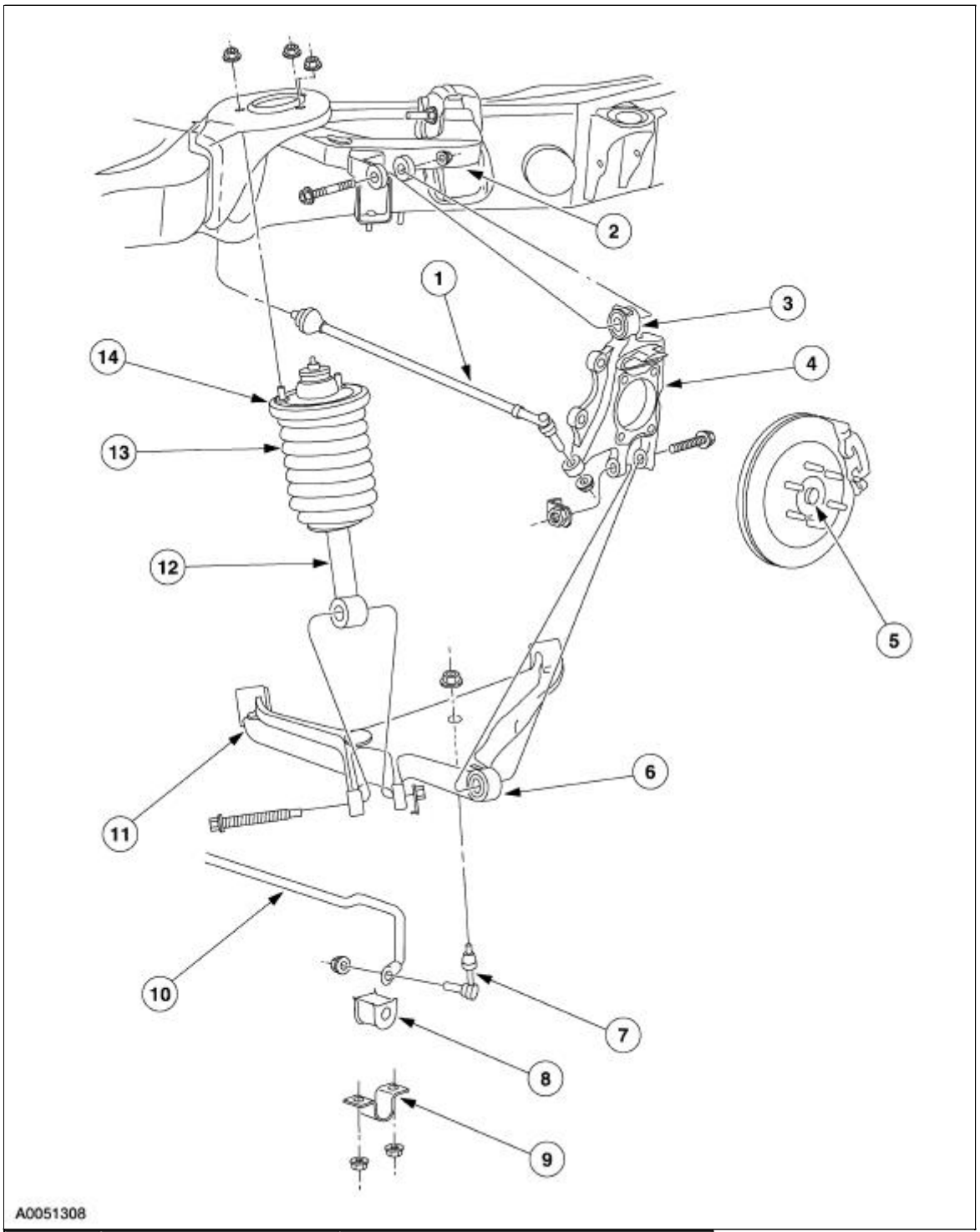
For additional information, refer to Section 204-01A .

Torque Specifications

Description	Nm	lb-ft
Upper ball joint-to-wheel knuckle bolt and nut	150	111
Forward upper arm-to-frame bolt and nut	150	111
Rearward upper arm-to-frame bolt and nut	250	184
Lower arm-to-frame flag bolts and nuts	250	184
Lower arm-to-wheel knuckle bolt and flag nut	400	295
Axle-to-wheel hub retainer nut	300	221
Wheel bearing and hub assembly-to-wheel knuckle bolts	185	136
Stabilizer bar link nuts	90	66
Stabilizer bar bracket-to-frame nuts	40	30
Shock absorber upper mounting plate-to-frame nuts	35	26
Shock absorber-to-lower arm bolt and flag nut	475	332
Shock absorber-to-upper mounting plate nut	30	22
Toe link-to-frame nut	80	59
Toe link-to-wheel knuckle nut	55	41
Toe link adjustment lock nut	115	85
Brake caliper anchor plate-to-wheel knuckle bolts	190	140

Rear Suspension

Rear Suspension Components



Item	Part Number	Description
1	5A972	Toe link
2	5K742/5K743	Upper arm RH/LH

3	3C270	Upper ball joint
4	—	Wheel knuckle RH/LH
5	—	Wheel bearing
6	3C270	Lower ball joint
7	5E494	Stabilizer bar link
8	4A037	Stabilizer bar bushing
9	5B491	Stabilizer bar bracket
10	5A772	Stabilizer bar
11	5B530/5B531	Lower arm RH/LH
12	18125	Shock absorber
13	5560	Coil spring
14	18192	Mounting plate

Rear Suspension

Refer to Section 204-00 .

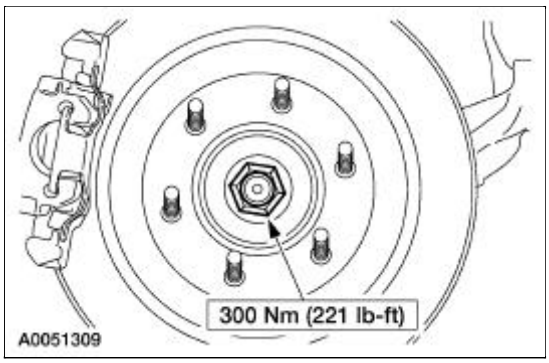
Wheel Bearing and Wheel Hub

Removal and Installation

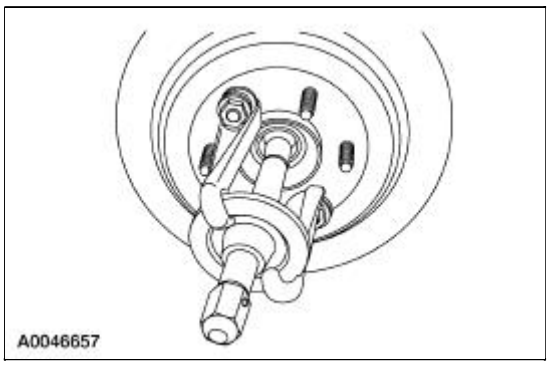
WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the LH rear quarter trim panel. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.

1. If equipped, turn the air suspension switch to the OFF position.
2. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .
3. **NOTE:** Have an assistant press the brake pedal to keep the axle from rotating.

   Remove and discard the rear axle wheel hub retainer and the washer.

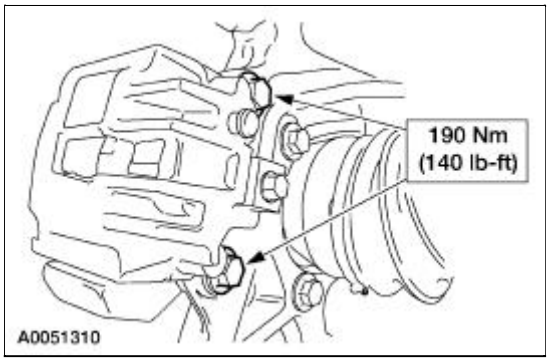


4. Using a suitable hub puller, separate the outboard CV joint from the wheel hub.

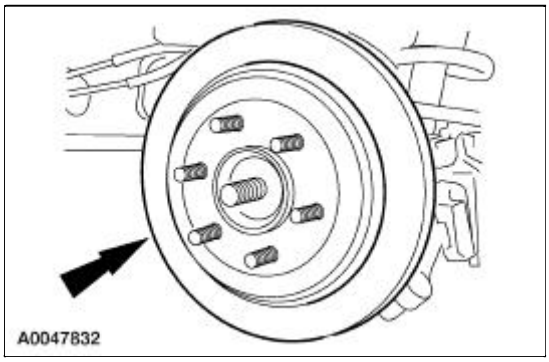


5. **CAUTION: Do not allow the caliper to hang from the brake hose or damage to the hose can result.**

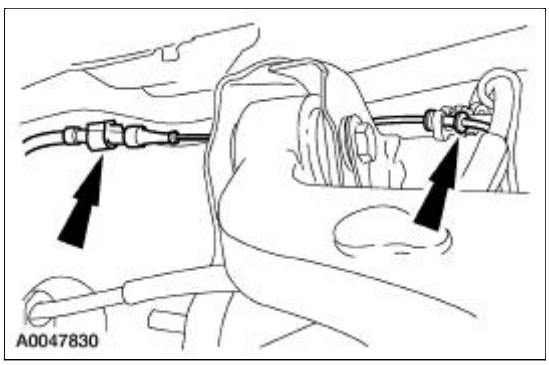
   Remove the bolts, and position the caliper, pads and anchor plate aside.



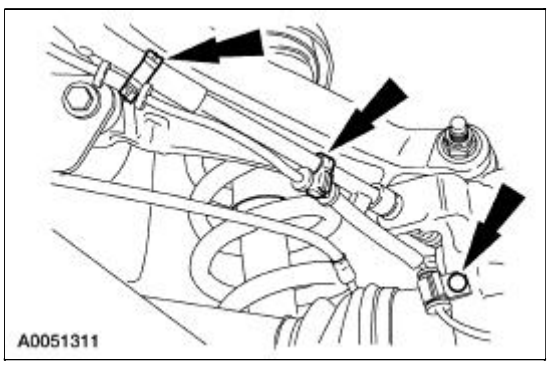
6. Remove the brake disc.



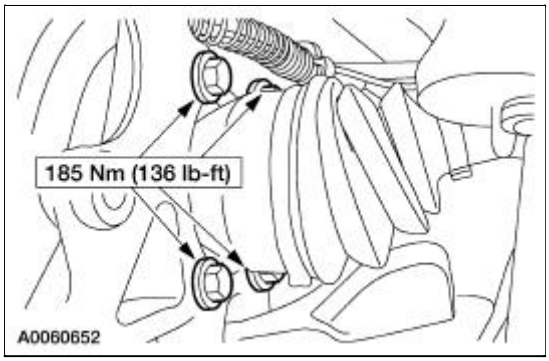
7. Disconnect the wheel speed sensor electrical connector and detach the retainer.



8. Remove the bolt and detach the retainers.



9. Remove the bolts, the wheel bearing and the wheel speed sensor as an assembly.
    - Route the sensor wiring through the access hole in the brake shield.
    - Discard the bolts.



10. To install, reverse the removal procedure.

Wheel Studs

Special Tool(s)

 ST1494-A	C-Frame and Screw 211-023 (T74P-3044-A1)

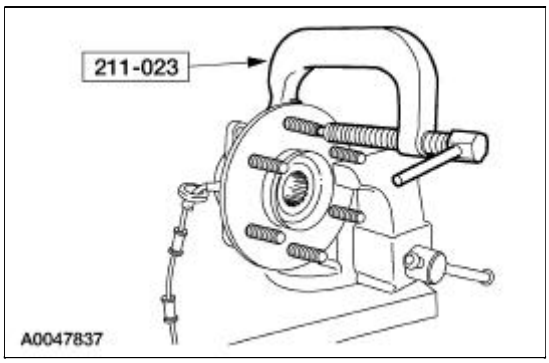
Removal

WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the LH rear quarter trim panel. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.

1. Remove the wheel bearing. For additional information, refer to Wheel Bearing and Wheel Hub in this section.

2. **CAUTION: Never use a hammer to remove a wheel stud. Damage to the wheel hub can result.**

   Place the wheel hub in a soft jawed vice and using the special tool, remove the wheel stud.



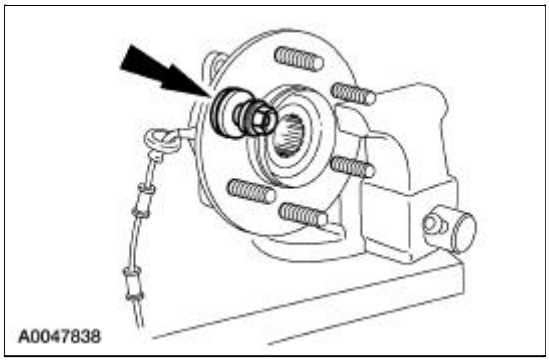
Installation

1. **CAUTION: Do not use power tools to install the wheel stud. The serrations on the flange can be stripped.**

   NOTE: Do not use the wheel nut that came with the vehicle.

   Install the washers and wheel nut on the wheel stud and tighten the wheel nut until the stud seats against the flange.

   - Discard the wheel nut.



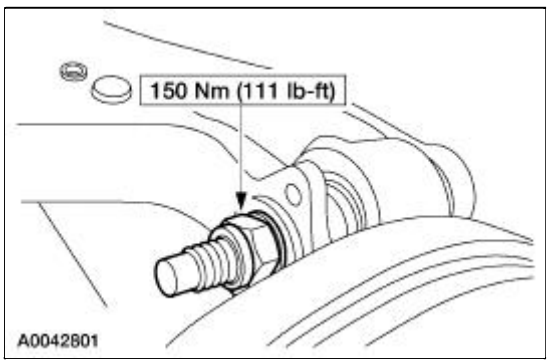
2. Install the wheel bearing. For additional information, refer to Wheel Bearing and Wheel Hub in this section.

Upper Arm

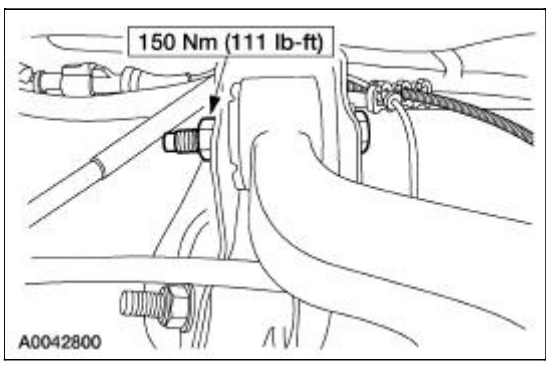
Removal and Installation

WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the LH rear quarter trim panel. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.

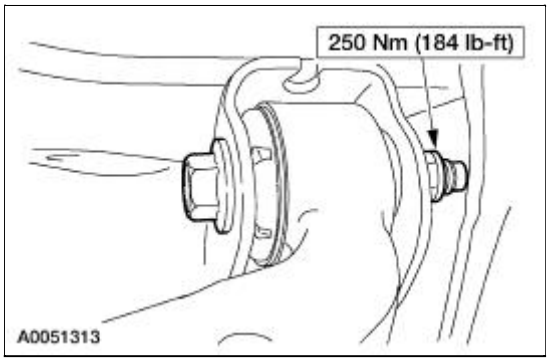
1. If equipped, turn the air suspension switch to the OFF position.
2. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .
3. Remove the nut and bolt.
   - Discard the nut.



4. Remove the nut and bolt.
   - Discard the nut.



5. Remove the nut, bolt and the upper arm.
   - Discard the nut.



6. To install, reverse the removal procedure.

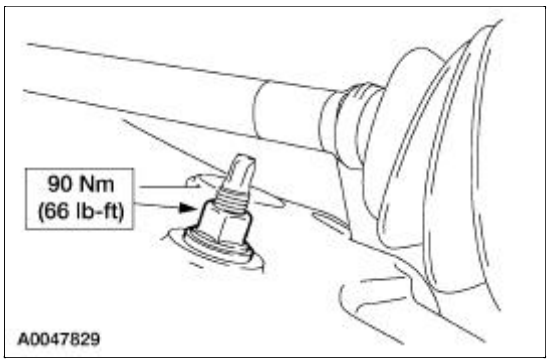
7. Check and, if necessary, adjust the rear alignment. For additional information, refer to Section 204-00 .

Lower Arm

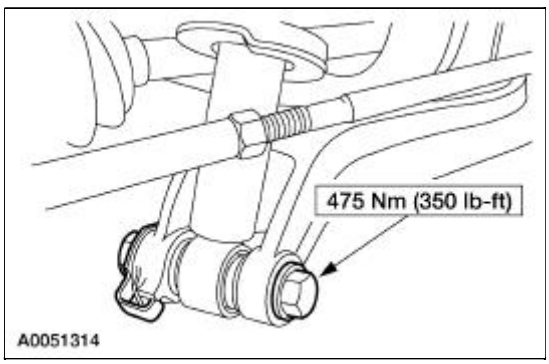
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1. If equipped, turn the air suspension switch to the OFF position.
2. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .
3. **NOTE:** Use the hex holding feature to prevent the stud from turning while removing the nut.

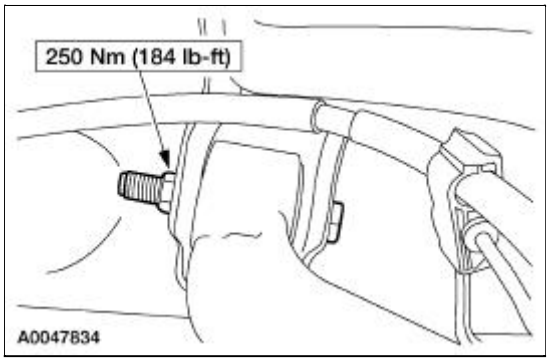
   Remove and discard the nut.



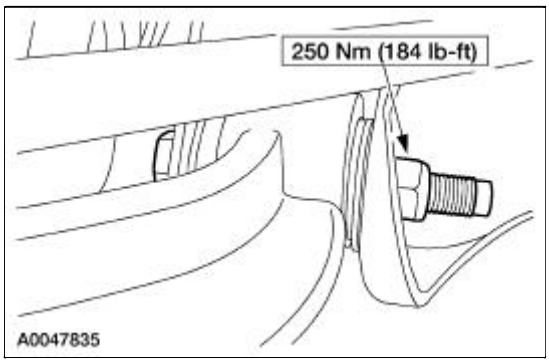
4. Remove the bolt and flag nut.
   - Discard the flag nut.



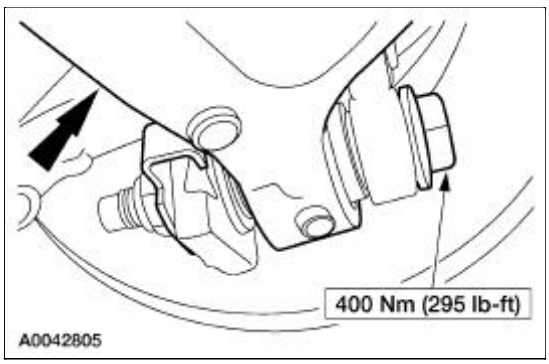
5. Remove the nut and bolt.
   - Discard the nut.



6. Remove the nut and bolt.
    - Discard the nut.



7. Remove the bolt, flag nut and the lower arm.
    - Discard the flag nut.



8. If necessary, using a suitable press and adapters, remove the lower ball joint.

9. **NOTE:** Snug the lower arm-to-frame pivot nuts and bolts. Do not tighten to specification until installation procedure is complete and the vehicle is at curb ride height.

    To install, reverse the removal procedure.
    - Check and, if necessary, adjust the rear alignment. For additional information, refer to Section 204-00 .

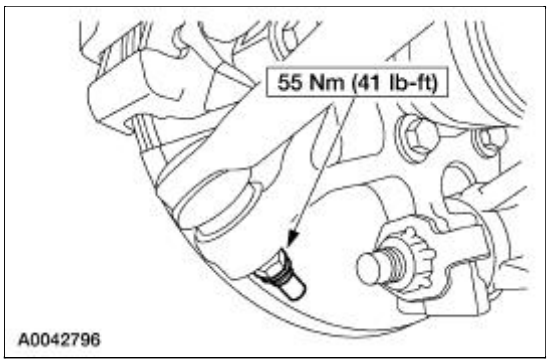
Toe Link

Removal and Installation

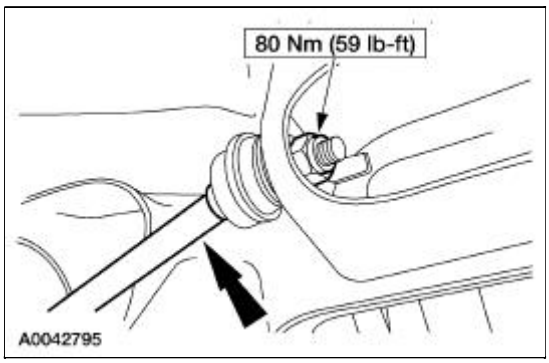
WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the LH rear quarter trim panel. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.

1. If equipped, turn the air suspension switch to the OFF position.
2. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .
3. **NOTE:** Use the hex holding feature to prevent the stud from turning while removing the nut.

   Remove the nut and separate the toe link from the wheel knuckle.



4. Remove the nut and the toe link.



5. To install, reverse the removal procedure.
6. Check and, if necessary, adjust the rear toe. For additional information, refer to Section 204-00 .

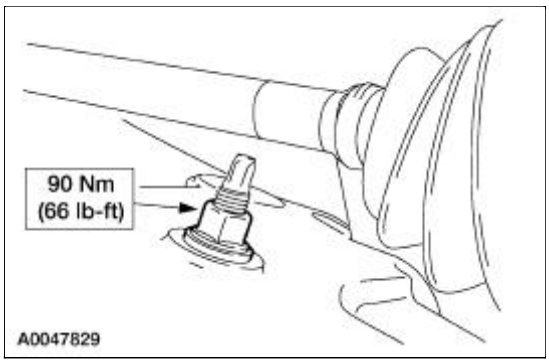
Stabilizer Bar and Link

Removal and Installation

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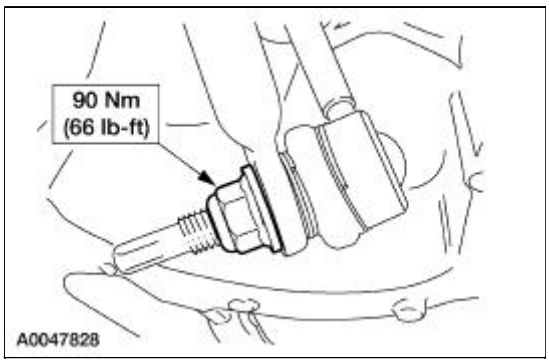
1. If equipped, turn the air suspension switch to the OFF position.
2. Remove the wheel and tire assemblies. For additional information, refer to Section 204-04 .
3. **NOTE:** Use the hex holding feature to prevent the stud from turning while removing the nut.

   Remove the two nuts.
   - Discard the nuts.

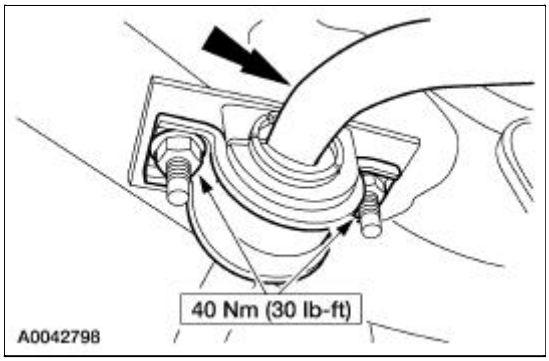


4. **NOTE:** Use the hex holding feature to prevent the stud from turning while removing the nut.

   Remove the two nuts and the stabilizer bar links.
   - Discard the nuts.



5. Remove the four nuts, brackets and the stabilizer bar.



6. **NOTE:** Inspect and, if necessary, install new bushings.

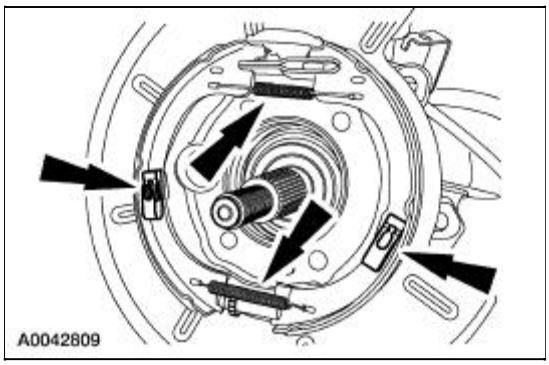
   To install, reverse the removal procedure.

Wheel Knuckle

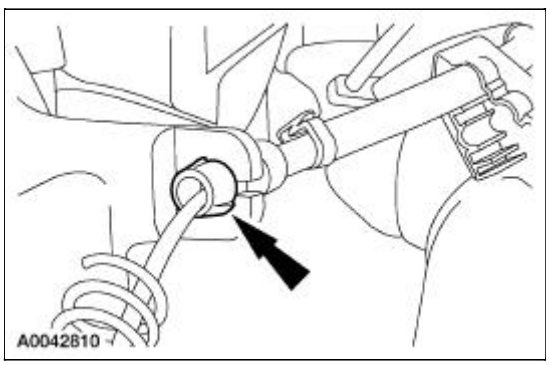
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1. Remove the wheel bearing. For additional information, refer to Wheel Bearing and Wheel Hub in this section.

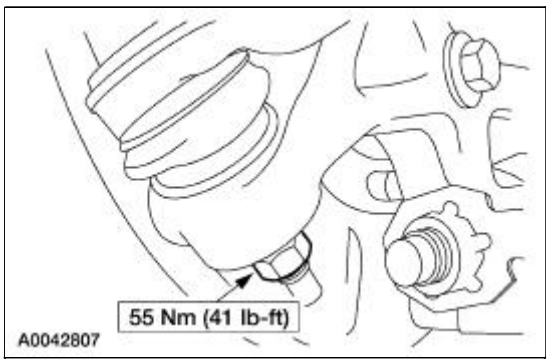
2. Remove the springs, adjuster and the parking brake shoes.



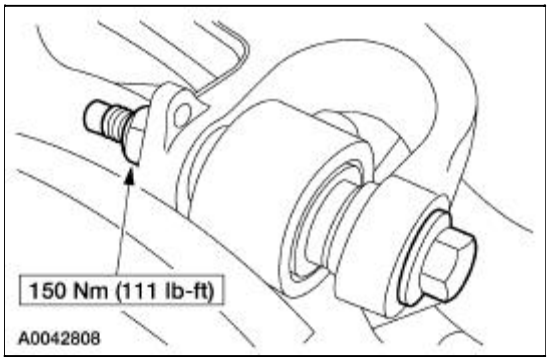
3. Depress the tabs and detach the parking brake cable from the wheel knuckle.



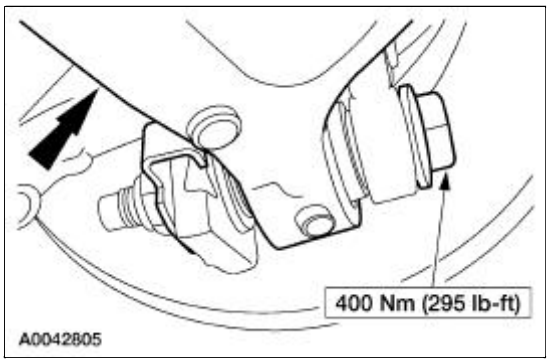
4. Remove the nut and detach the toe link from the wheel knuckle.
   - Discard the nut.



5. Remove the nut and bolt.
    - Discard the nut.



6. Remove the bolt, flag nut and the wheel knuckle.
    - Discard the flag nut.



7. If necessary, using a suitable press and adapters, remove the upper ball joint.

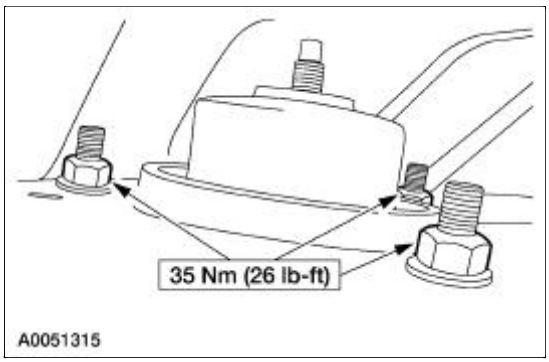
8. To install, reverse the removal procedure.
    - Check and, if necessary, adjust the rear alignment. For additional information, refer to Section 204-00 .

Shock Absorber and Spring Assembly

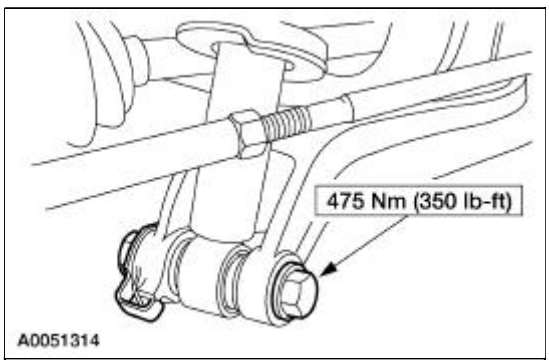
Removal and Installation

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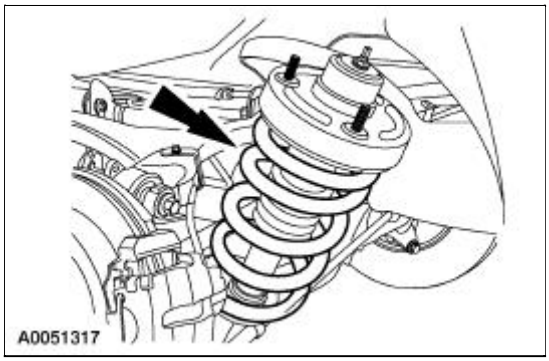
1. If equipped, turn the air suspension switch to the OFF position.
2. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .
3. Remove and discard the nuts.



4. Remove the bolt and flag nut.
   - Discard the flag nut.

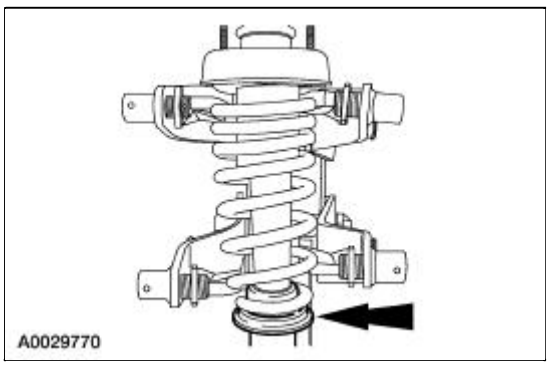


5. Remove the shock absorber and spring assembly.

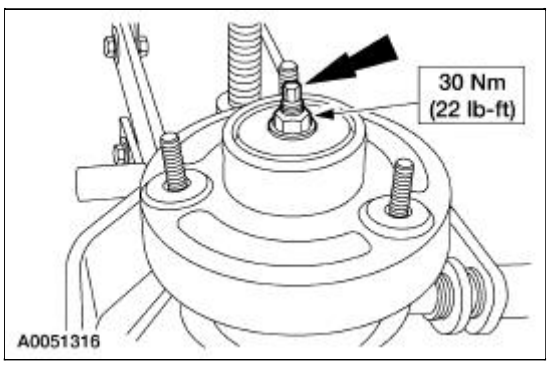


6. **NOTE:** For reference during assembly, index the upper mount, spring and shock absorber.

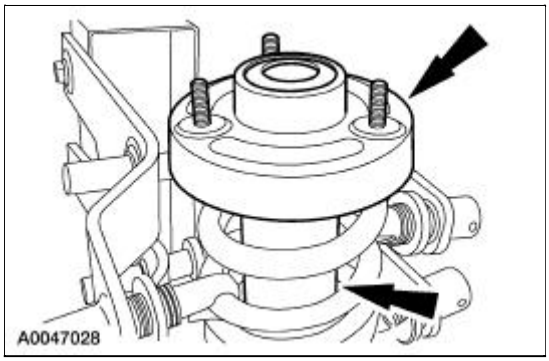
   Using a suitable spring compressor, compress the spring until the tension is released from the shock absorber.



7. While holding the shock rod, remove the nut and washer.
   - Remove the shock absorber.
   - Discard the nut.



8. Remove the upper mount, dust shield and insulator.



9. To install, reverse the removal procedure.

General Specifications

Item	Specification
Wheel Balance Weight	
Maximum balance weight (total of inner and outer wheel flanges)	170 g (6 oz)
Wheel rim runout (maximum radial or lateral)	1.12 mm (0.044 in.)
Tire Inflation	
Tires	See safety certification sticker located on driver door jamb.

Torque Specifications

Description	Nm	lb-ft	lb-in
Wheel nuts	204	150	—
Tire pressure monitoring sensor valve stem nut	7	—	62
Tire pressure monitoring system module screws	8	—	71

Wheels And Tires

 **WARNING: Do not mix different types of tires, such as radial, bias, or bias-belted, on the same vehicle except in emergencies (temporary spare usage). Vehicle handling can be seriously affected and can result in loss of control.**

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

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

Replacement tires should follow the recommended:

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

Use of any other tire size or type may seriously affect:

- ride.
- handling.
- speedometer/odometer calibration.
- vehicle ground clearance.
- tire clearance between the body and chassis.
- wheel bearing life.
- brake cooling.

New wheels need to be installed when:

- bent.
- dented.
- heavily rusted.
- leaking.
- they have elongated wheel hub bolt holes.
- they have excessive lateral or radial runout.

The vehicle uses a one-piece cone wheel nut.

Wheel and tire assemblies are attached by six noncentering wheel nuts.

The spare tire is mounted under the frame. The valve stem should be on the top side of the tire to reduce the possibility of accidental valve stem air leakage.

To equalize tire wear, rotate the tires periodically.

Safety Precautions

 **WARNING: Never run the engine with one wheel off the ground, for example, when changing a tire. The wheel resting on the ground could cause the vehicle to move.**

 **WARNING: The tire and wheel must always be correctly matched. It is very important to determine the size of each component before any assembly operations commence. Failure to adhere to these instructions can result in an explosive separation and cause serious bodily injury or death.**

 **WARNING: Aftermarket aerosol tire sealants are extremely flammable. Always question the customer to make sure these products have not been used.**

 **WARNING: Use only wheels and wheel nuts that have been designed for current model year Ford trucks. Aftermarket wheels or wheel nuts may not fit or function correctly, and can cause personal injury or damage the vehicle.**

 **WARNING: Always wear safety goggles or a face shield when carrying out any work with tire and wheel assemblies.**

 **WARNING: Retighten the wheel nuts at 800 km (500 miles) after any wheel change or any time the wheel nuts are loosened.**

 **WARNING: Failure to retighten wheel nuts at the mileage specified can allow wheels to come off while the vehicle is in motion, possibly causing loss of vehicle control and collision.**

 **CAUTION: Do not clean aluminum wheels with steel wool, abrasive-type cleaners or strong detergents. Use Custom Bright Metal Cleaner 8A-19522-A or equivalent meeting Ford specification ESR-M5B194-B.**

 **CAUTION: Reduce the air pressure as much as possible by pushing the valve core plunger in prior to removing the valve core.**

When carrying out any inspection or repair procedures on wheels and tires, follow the preceding safety precautions.

Wheels And Tires

Inspection and Verification

WARNING: A vehicle equipped with a Traction-Lok® differential will always have both wheels driving. If, while the vehicle is being serviced, only one wheel is raised off the ground and the rear axle is driven by the engine, the wheel on the ground could drive the vehicle off the stand or jack. Be sure both rear wheels are off the ground.

WARNING: Never run the engine with one wheel off the ground, for example, when changing a tire. The wheel(s) resting on the ground could cause the vehicle to move.

WARNING: Do not balance the wheels and tires while they are mounted on the vehicle. Possible tire disintegration or differential failure could result, causing personal injury and extensive component damage. Use off-vehicle wheel and tire balancer only.

Be sure to follow the warnings when carrying out inspection and verification.

Road Test

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

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

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

Replacement tires must follow the recommended:

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

Use of any other tire size or type can seriously affect:

- ride.
- handling.
- speedometer/odometer calibration.
- vehicle ground clearance.
- tire clearance between the body and chassis.

- wheel bearing life.
- brake cooling.

New wheels need to be installed when vehicle's wheels:

- are bent.
- are cracked.
- are dented.
- are heavily corroded.
- are leaking.
- have elongated wheel hub bolt holes.
- have excessive lateral or radial runout.

Wheel and tire assemblies are attached by six wheel nuts.

It is mandatory to use only the tire sizes recommended on the tire chart attached to the vehicle. Larger or smaller tires can damage the vehicle, affect durability, and require changing the speedometer calibration. Make sure wheel size and offsets match those recommended for the tire in use.

1. Inspect for signs of uneven wear that may indicate a need for balancing, rotation, front suspension alignment, damaged tie-rod, or steering components.

2. Check tires for:
   - cuts.
   - stone bruises.
   - abrasions
   - blisters.
   - embedded objects.

3. Tread wear indicators are molded into the bottom of the tread grooves. Install a new tire when the indicator bands become visible.

Symptom Chart

Symptom Chart

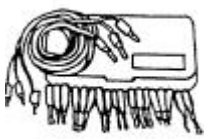
Condition	Possible Sources	Action
• Tires show excess wear on edge of tread	• Underinflated tires.	• ADJUST air pressure in tires.
	• Vehicle overloaded.	• RETURN vehicle. NOTIFY customer of overload condition.
	• High-speed cornering.	• RETURN vehicle. NOTIFY customer of cause of condition.
	• Incorrect ride height.	• SET ride height.
	• Incorrect wheel alignment.	• SET alignment to specification. REFER

		to Section 204-00 . ● ADVISE customer of condition. ROTATE tires.
● Tires show excess wear in center of tread	● Tires overinflated.	● ADJUST air pressure.
● Other excessive tire wear problems	● Incorrect tire rotation intervals. ● Incorrect tire pressure. ● Loose or leaking shock absorbers. ● Incorrect wheel alignment. ● Loose, worn or damaged suspension components. ● Wheel and tire assembly out of balance. ● Excessive lateral or radial runout of wheel.	● ADVISE customer of condition. ROTATE tires. ● ADJUST pressure. ● TIGHTEN or INSTALL new shock absorbers as necessary. ● SET alignment to specification. REFER to Section 204-00 . ● REFER to Section 204-00 . ● BALANCE wheel and tire assembly. ● REFER to Section 100-04 .
● Wobble or shimmy	● Damaged wheel bearings. ● Loose or damaged suspension components. ● Bent wheel. ● Damaged tire. ● Loose wheel nuts.	● REFER to Section 204-00 . ● REFER to Section 204-00 . ● INSTALL a new wheel as necessary. ● INSTALL a new tire as necessary. ● TIGHTEN to specification.
● High-speed shake	● Wheel hub face/pilot/bolt circle runout. ● Tires/wheels. ● Wheel bearings. ● Suspension/steering linkage. ● Engine. ● Transmission. ● Brake discs/imbalance.	● REFER to Section 100-04 .
● Vehicle vibration	● Driveline — engine. ● Tires.	● REFER to Section 100-04 .

Tire Pressure Monitoring System

Refer to Wiring Diagrams Cell 118 for schematic and connector information.

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WAS) 418-F224 New Generation STAR (NOS) Tester 418-F052 or equivalent scan tool
 ST1177-A	Rotunda 88 Digital Multimeter or equivalent 105-R0053
 ST1138-A	Flex Probe Kit 418-F090 (105-R025B)
 ST2735-A	Activation Tool, Tire Pressure Monitor 204-324

Principles of Operation

The tire pressure monitoring system (TPMS) has the ability to monitor the air pressure of all five tires. The tire-mounted pressure sensors transmit signals to the TPMS module by using the valve stem as an antenna. These transmissions are sent approximately every 60 seconds when the vehicle speed exceeds 32 km/h (20 mph). The TPMS module compares each tire pressure sensor transmission against low and high pressure limits. If the TPMS module determines that the tire pressure has exceeded the limit, the TPMS module communicates on the SCP network to the vehicle message center, which then displays a warning message. The system is not affected by wheel and tire rotation.

Vehicle Message Center TPMS Messages

The vehicle message center sometimes displays messages that cannot be resolved by the customer. Treat these messages as TPMS system faults that must be serviced. Refer to the symptom chart for the following messages:

Warning—Tire Very Low

Displayed when one or more tires have very low pressure. When this warning message is displayed, a warning chime will sound reminding you to stop the vehicle as soon as safely possible and check the tires for correct pressure, leaks and damage.

Check Tire Pressure

Displayed when any of the tire pressures are high or low.

Check Spare Tire Pressure

Displayed when the spare tire pressure is high or low.

Tire Pressure Sensor Fault

Displayed when a tire pressure sensor is malfunctioning.

If the customer requests that the TPMS be turned off, it can be done by configuring the message center through the instrument cluster (IC), using the scan tool. Refer to Section 413-01 .

Inspection and Verification

1. Verify the customer concern by inspecting the vehicle and observing the message center.
2. Inspect to determine if one of the following mechanical or electrical concerns apply:

Visual Inspection Chart

Mechanical	Electrical
● Tire pressure ● Tire size or mismatched tires ● TPMS sensor missing	● Blown fuse(s) ● Battery junction box (BJB): ■ fuse(s) 1 (10A), 21 (15A) ● Connectors or connections ● Ground integrity ● Harness routing ● Wire chafing ● Circuitry open/shorted ● TPMS module missing or damaged

3. If the inspection reveals an obvious concern(s) that can be readily identified, repair as required.
4. If the concern remains after the inspection, connect the scan tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the scan tool menu. If the scan tool does not communicate with the vehicle:
   - check the connections to the vehicle.
   - check the ignition switch position.
   - verify that the battery voltage is between 10 and 16 volts. Refer to Section 414-00 .
5. If the scan tool still does not communicate with the vehicle, refer to the scan tool manual.
6. Carry out the DATA LINK DIAGNOSTIC TEST. If the scan tool responds with:
   - CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-

00 .

- SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs, and carry out self-test diagnostics for the TPMS module.

7. If the DTCs retrieved are related to the concern, refer to Tire Pressure Monitor Module Diagnostic Trouble Code (DTC) Index to continue diagnostics.

8. If no DTCs related to the concern are retrieved, GO to Symptom Chart to continue diagnostics.

Tire Pressure Monitor System (TPMS) Module Diagnostic Trouble Code (DTC) Index

Tire Pressure Monitor System (TPMS) Module Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1342	ECU is Defective	TPMS Module	INSTALL a new tire pressure monitor module. REFER to Tire Pressure Monitoring System Module .
B2477	Module Configuration Failure / Mismatch	TPMS Module	REFER to Section 418-01 .
B2849	Horn Output Relay Circuit Open	TPMS Module	Go To Pinpoint Test D .
B2872	Tire Pressure Sensor Fault	TPMS Module	Go To Pinpoint Test E .
B2885	Spare Tire Pressure Sensor Fault	TPMS Sensor	Go To Pinpoint Test E .
C2780	ECU in Manufacturing Mode	TPMS Module	INSTALL a new tire pressure monitor module. REFER to Tire Pressure Monitoring System Module .
U1014	SCP Invalid or Missing Data for Vehicle Speed	SCP	REFER to Section 418-00 .
U1262	SCP Communication Bus Fault	SCP	REFER to Section 418-00 .

Symptom Chart

NOTE: The tire pressure monitoring system is not affected by wheel and tire rotation.

Failure of a tire pressure monitor system component may not cause the message center to display a system fault message or a DTC to be stored. The Symptom Chart is a starting point to begin diagnosis of these concerns.

Symptom Chart

Condition	Possible Sources	Action
• No communication with the TPMS module	• Fuse(s). • Circuitry. • Module.	• Go To Pinpoint Test A .
• Unable to enter self-test	• Module. • Scan tool.	• Go To Pinpoint Test A .

• TPMS will not enter sensor training mode	• TPMS sensor. • Message center. • TPMS module. • BOO switch. • ABS/TC/IVD module.	• Go To Pinpoint Test B . • REFER to Section 206-09A or Section 206-09B .
• Message center displays "WARNING TPMS SYSTEM FAULT"	• TPMS module. • Four TPMS sensors (excluding spare tire) failed, missing, or incorrectly trained. • Message center misconfigured.	• Go To Pinpoint Test C . • REFER to Section 413-01 .
• Message center displays "WARNING — TIRE VERY LOW"	• TPMS module. • TPMS sensor.	• Go To Pinpoint Test C .
• Message center displays "CHECK TIRE PRESSURE"	• TPMS module. • TPMS sensor.	• Go To Pinpoint Test C .
• Message center displays "CHECK SPARE TIRE PRESSURE"	• TPMS module. • TPMS sensor.	• Go To Pinpoint Test C .

Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE TPMS MODULE / UNABLE TO ENTER SELF-TEST

Test Step	Result / Action to Take
CAUTION: The Flex Probe Kit must be used for all test connections. Use of standard multimeter probes may damage wiring terminals.	
A1 CHECK CIRCUITS 1002 (BK/PK) and 3049 (BK/LG) FOR AN OPEN	
• Disconnect: TPMS Module C3183. • Key in ON position. • Measure the voltage between TPMS module connector C3183 pin 5, circuit 1002 (BK/PK) harness side and ground and between pin 3 circuit 3049 (BK/LG) harness side and ground. • **Are the voltages greater than 10 volts?**	**Yes** GO to A2 . **No** REPAIR circuit 1002 (BK/PK) or circuit 3049 (BK/LG). TEST the system for normal operation.
A2 CHECK CIRCUIT 57 (BK) FOR OPEN	
• Measure the resistance between TPMS module harness connector C3183 pin 6, circuit 57 (BK) and ground. • **Is the resistance greater than 5 ohms?**	**Yes** REPAIR circuit 57 (BK). TEST the system for normal operation.

	No REFER to Section 418-00 .

PINPOINT TEST B: TPMS WILL NOT ENTER SENSOR TRAINING MODE

Test Step	Result / Action to Take
CAUTION: The Flex Probe Kit must be used for all test connections. Use of standard multimeter probes may damage wiring terminals.	
B1 CHECK THE BRAKE PEDAL POSITION BRAKE ON/OFF SWITCH ● Using the scan tool menu, monitor the brake pedal position switch PID. ● Press and release the brake pedal while monitoring the PID. ● **Do the brake pedal PID values match the brake pedal positions?**	**Yes** GO to B2 . **No** REFER to Section 206-09A and Section 206-09B .
B2 CHECK THE INSTRUMENT CLUSTER ● Using the scan tool menu, monitor the instrument cluster ignition switch status PID. ● Cycle the ignition switch to the ON and OFF position while monitoring the PID. ● **Does the ignition switch status PID values match the ignition switch positions?**	**Yes** INSTALL a new TPMS module. REFER to Tire Pressure Monitoring System Module . TEST the system for normal operation. **No** REFER to Section 413-01 .

PINPOINT TEST C: MESSAGE CENTER DISPLAYS TPMS SYSTEM FAULT

Test Step	Result / Action to Take
C1 CHECK FOR DTCS ● Connect the scan tool. ● Retrieve and document the continuous DTCs. ● **Are DTCs obtained?**	**Yes** REFER to TPMS module Diagnostic Trouble Code (DTC) Index. If DTC B2872 is retrieved, TRAIN the TPMS sensors. REFER to Sensor Training component test in this section. CLEAR the message center. **No** GO to C2 .
C2 CHECK THE SYSTEM COMPONENTS ● Carry out the sensor training procedure. Refer to Sensor Training component test. ● Using the scan tool menu, enter the TPMS module function test for tire pressure status. ● Compare the recorded tire	**Yes** INSTALL a new TPMS module. REFER to Tire Pressure Monitoring System Module in this section. TEST the system for normal operation. **No** INSTALL new tire pressure sensors for those with discrepancies. REFER to Tire Pressure Sensor in this

pressure values to the tire status values obtained by the function test. ● **Do the compared tire pressure values match within ±3 psi?**	section. TEST the system for normal operation.

PINPOINT TEST D: DTC B2849 HORN OUTPUT RELAY CIRCUIT OPEN

Test Step	Result / Action to Take
CAUTION: The Flex Probe Kit must be used for all test connections. Use of standard multimeter probes may damage wiring terminals.	
D1 CHECK MANUAL HORN OPERATION	
● Confirm horn operation. ● **Does the horn sound?**	**Yes** GO to D2 . **No** REPAIR the horn. REFER to Section 413-06 . TEST the system for normal operation.
D2 CHECK HORN OPERATION USING ACTIVE COMMAND	
● Using the scan tool active command menu, actuate the horn. ● **Does the horn sound?**	**Yes** CHECK the TPMS module connector C3183 for corroded, damaged or backed out pins. If no faults are found, INSTALL a new TPMS module. REFER to Tire Pressure Monitoring System Module in this section. CLEAR the DTC. TEST the system for normal operation. **No** GO to D3 .
D3 CHECK CIRCUIT 490 (DB) FOR AN OPEN	
● Disconnect the battery ground cable. Refer to Section 414-01 . ● Disconnect: TPMS Module C3183. ● Disconnect: Battery Junction Box (BJB) Horn Relay. ● Measure the resistance between TPMS module C3183 pin 4 circuit 490 (DB) harness side and ground. ● **Is the resistance greater than 5 ohms?**	**Yes** INSTALL a new TPMS module. REFER to Tire Pressure Monitoring System Module in this section. CLEAR the DTC. TEST the system for normal operation. **No** REPAIR circuit 490 (DB). TEST the system for normal operation.

PINPOINT TEST E: DTC B2872, B2885— TIRE PRESSURE SENSOR FAULT

Test Step	Result / Action to Take

E1 CHECK FOR FAULT REPEATABILITY	
• Connect the scan tool. • Carry out the tire pressure sensor training procedure using the scan tool. • **Does the tire training procedure initiate?**	**Yes** GO to E2 . **No** CHECK the message center. REFER to Section 413-08 .
E2 CHECK TIRE PRESSURE SENSOR TRANSMITTING ABILITY	
• Train the tire pressure sensors. Refer to the Sensor Training component test. • **Do all of the tire pressure sensors transmit correctly or does the horn sound when each tire pressure sensor transmits to the TPMS module?**	**Yes** GO to E3 . **No** INSTALL a new tire pressure sensor. REFER to Tire Pressure Sensor . CLEAR the DTC(s). REPEAT the self-test.
E3 CHECK THE TPMS MODULE	
• Review the continuous and on-demand self-test DTCs. • **Was DTC B1342 retrieved?**	**Yes** INSTALL a new TPMS module. REFER to Tire Pressure Monitoring System Module . CLEAR the DTCs. REPEAT the self-test. **No** The system is functioning normally. CLEAR the DTCs. If other DTCs are retrieved, REFER to the DTC index.

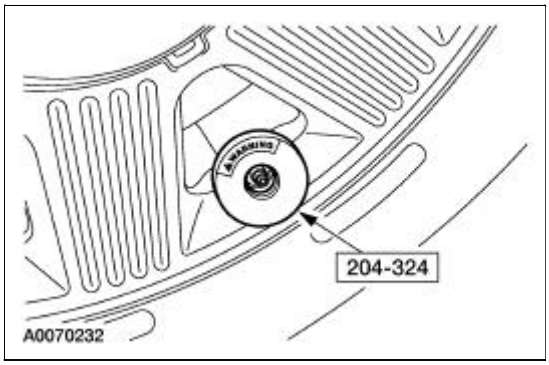
Sensor Training

NOTE: The tire pressure monitoring system is not affected by wheel and tire rotation.

NOTE: The tire pressure sensor training procedure must be done on a single vehicle, in an area without radio frequency (RF) noise.

RF noise is generated by electrical motor and appliance operation, cellular telephones, and remote transmitters.

1. Turn the ignition switch to the OFF position.
2. Turn the ignition switch from the OFF position to the RUN position three times, ending in the RUN position. Do not wait more than two minutes between each key cycle.
3. Press and release the brake pedal.
4. Turn the ignition switch to the OFF position.
5. Turn the ignition switch from the OFF position to the RUN position three times, ending in the RUN position. Do not wait more than two minutes between each key cycle.



6. When the message center displays "TRAIN LEFT FRONT TIRE", place the magnet on the valve stem of the LF tire pressure sensor. The horn will sound briefly to indicate that the tire pressure sensor has been recognized by the TPMS module.

7. Within two minutes after the horn sounds, place the magnet on the valve stem of the RF tire pressure sensor.

NOTE: If the TPMS module does not recognize any one of the five tire pressure sensors during the tire training procedure, the horn will sound twice and the message center will display "TIRE TRAINING MODE INCOMPLETE" and the procedure must be repeated.

8. Repeat Step 7 for the RR, LR, and spare tires.
   When the tire training procedure is complete, the horn will sound once and the message center will display "TIRE TRAINING MODE COMPLETE".

Wheel and Tire

Material

Item	Specification
Anti-Seize Lubricant XG-3	ESE-M12A4-A

Removal

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the LH rear quarter trim panel. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

   If equipped, turn the air suspension switch to the OFF position.

2. **NOTE:** To avoid damage or scratching to the center cap, place facing up when removed.

   Remove the center cap.

3. **CAUTION: Do not use heat to loosen a seized wheel nut. Heat can damage the wheel and wheel bearings.**

   With the weight of the vehicle on the wheels, loosen the wheel nuts.

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

5. Remove the wheel nuts and the wheel and tire assembly.

Installation

1. **WARNING: When a wheel is installed, always remove any corrosion, dirt or foreign material present on the mounting surfaces of the wheel or the surface of the wheel hub, brake drum or brake disc that contacts the wheel. Installing wheels without correct metal-to-metal contact at the wheel mounting surfaces can cause the wheel nuts to loosen and the wheel to come off while the vehicle is in motion, causing loss of control.**

   WARNING: Retighten at 800 km (500 miles) after any wheel change or any time the wheel nuts are loosened.

   WARNING: Failure to retighten wheel nuts at the mileage specified could allow wheels to come off while the vehicle is in motion, possibly causing loss of vehicle control and collision.

   Clean the wheel hub mounting surface.

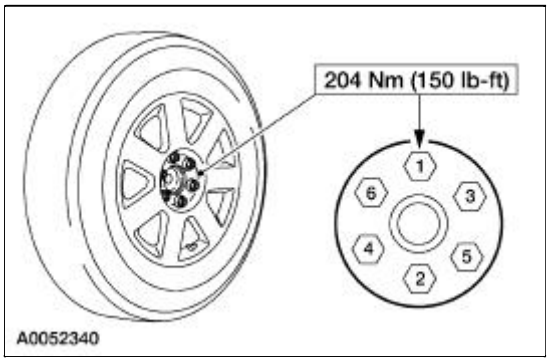
2. **CAUTION: Make sure to apply a thin coat of anti-seize lubricant to the hub pilot surface only. Do not allow the lubricant to make contact with the wheel studs, brake pads or brake disc.**

   Apply a thin coat of anti-seize lubricant to the wheel hub pilot surface.

3. Install the tire and wheel assembly.
   - Position the tire and wheel assembly.
   - Install the wheel nuts, hand-tight, then lower the vehicle.

4. **CAUTION: Failure to tighten the wheel nuts in a star pattern can result in high brake disc runout, which will speed up the development of brake roughness, shudder and vibration.**

   Tighten the wheel nuts in sequence.



5. Install the center cap.

6. If equipped, turn the air suspension switch to the OFF position.

Tire Pressure Sensor

Removal

CAUTION: Make sure to install a new sensor grommet or an air leak can occur.

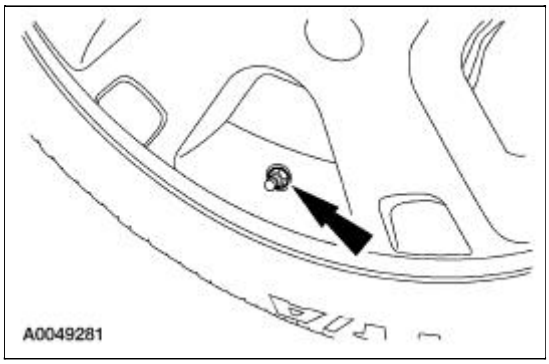
NOTE: Do not remove the valve stem core to relieve the tire pressure.

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

2. **CAUTION: If the valve stem core has been removed from the valve stem, a new nickel-plated core must be installed. Failure to use a nickel-plated core will result in corrosion and the possible loss of tire pressure.**

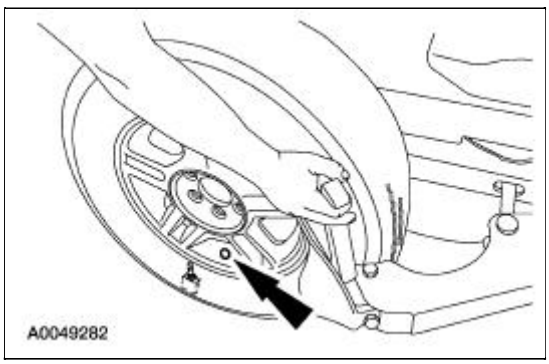
   NOTE: Release the tire pressure by removing the sensor retaining nut.

   With the valve stem at the 6 o'clock position, remove the sensor retaining nut and allow the sensor to fall into the tire.



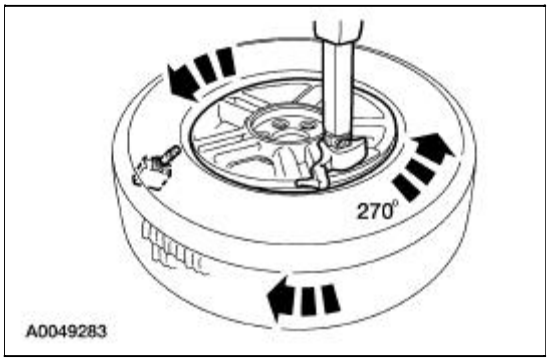
3. **CAUTION: Make sure that the valve stem mounting hole remains in the 6 o'clock position while separating the beads of the tire.**

   Using a suitable tire machine, separate both beads of the tire from the wheel.

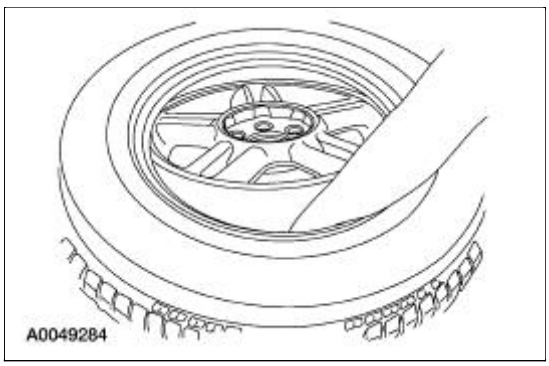


4. Place the wheel and tire on the turntable of the tire machine so that the valve stem hole is positioned 270 degrees from the mounting/dismounting fixture.

- Index-mark the valve stem and wheel weight positions.
- Lubricate the bead of the tire.
- Dismount the outside bead of the tire from the rim.

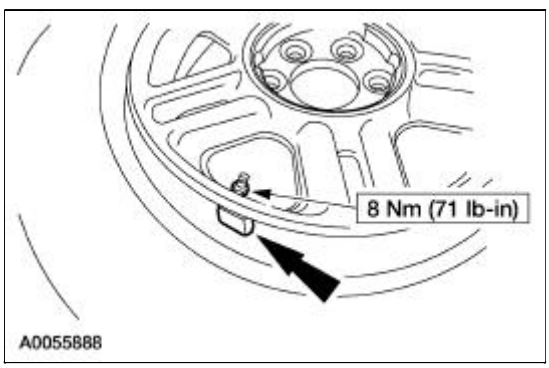


5. Remove the tire pressure sensor.
    - Discard the grommet.



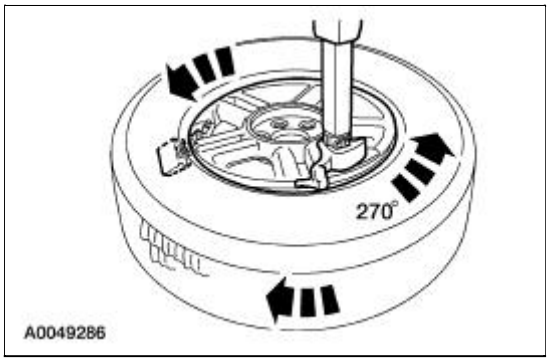
Installation

1. Install the sensor and tighten the retainer nut.



2. **NOTE:** Do not allow the tire to rotate relative to the rim while mounting the tire.

   Lubricate and mount the outside bead of the tire to the rim.



3. Inflate the tire to the pressure specified on the safety certification sticker located on the driver door jamb.

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

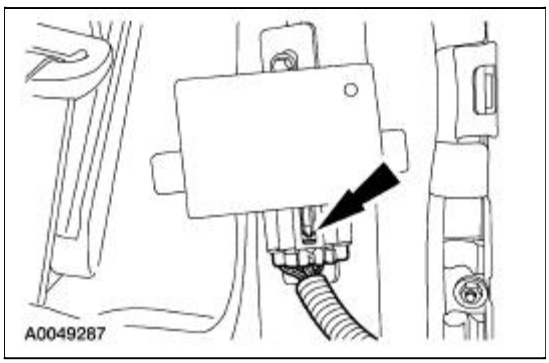
5. Train the tire pressure sensors. For additional information, refer to Sensor Training component test in this section.

Tire Pressure Monitoring System Module

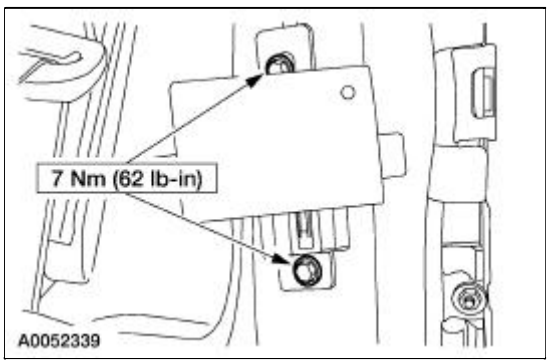
Removal and Installation

CAUTION: Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage can result.

1. Disconnect the battery ground cable.
2. Remove the LH C-pillar trim panel. For additional information, refer to Section 501-05 .
3. Disconnect the electrical connector.



4. Remove the bolts and the module.



5. To install, reverse the removal procedure.
6. Train the tire pressure sensors. For additional information, refer to Sensor Training component test in this section.
7. Reconfigure the TPMS module. For additional information, refer to Section 418-01 .

General Specifications

Item	Specification
Lubricants	
Multi-Purpose Grease XG-4	ESR-M1C159-A
Silicone Brake Caliper Grease and Dielectric Compound XG-3	ESE-M1C171-A

Torque Specifications

Description	Nm	lb-ft	lb-in
Shock absorber-to-lower arm bolt and nut (front)	400	295	—
Shock absorber-to-lower arm bolt and flag nut (rear)	475	350	—
Air spring upper mount-to-frame nuts	35	26	—
Shock absorber-to-upper mount nut	30	22	—
Compressor bracket bolts	9	—	80
Control module bracket nuts	9	—	80
Height sensor (upper) bracket bolts	30	22	—
Height sensor (lower) bracket nuts	33	17	—

Vehicle Dynamic Suspension

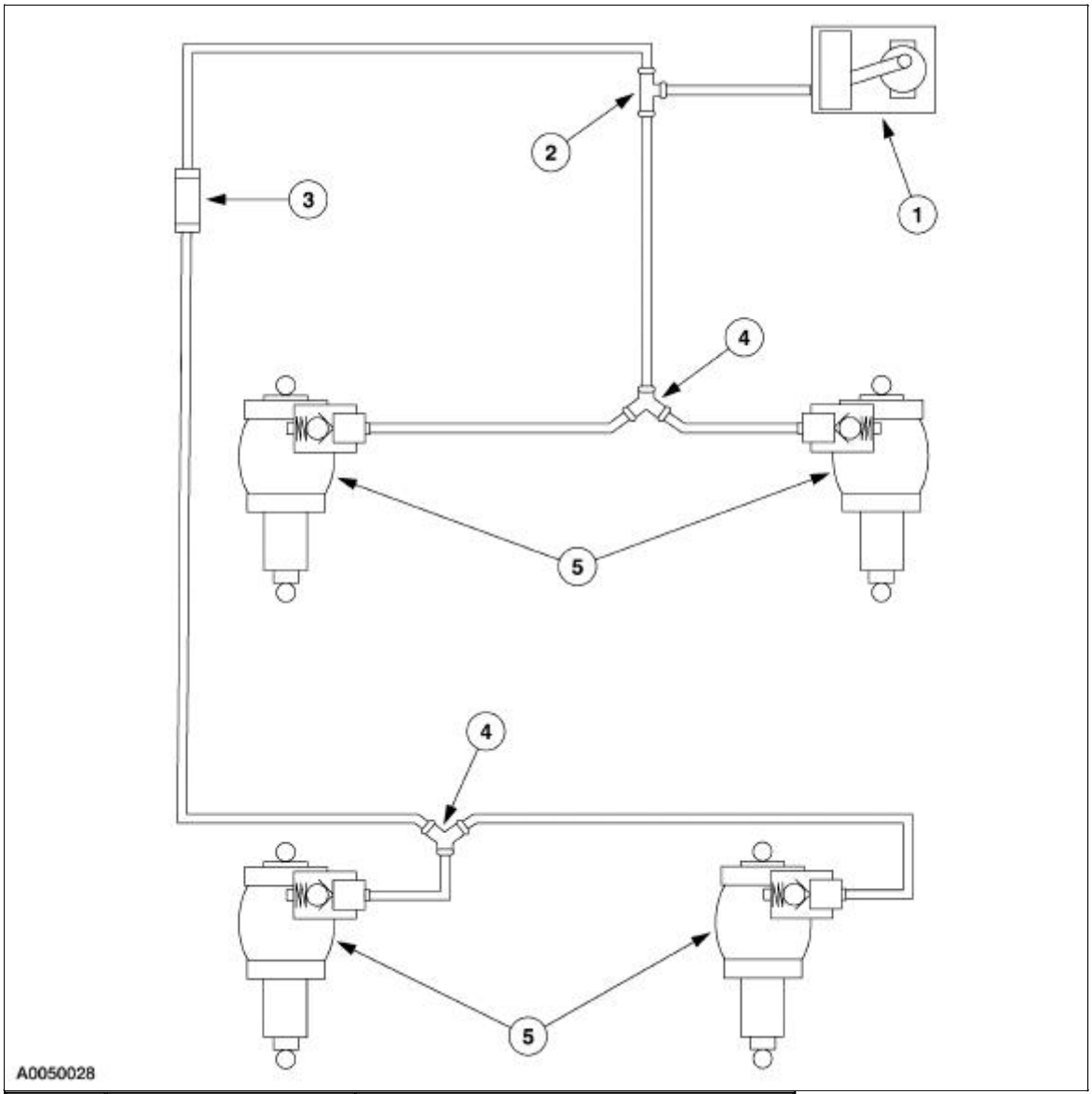
The four wheel air suspension system is comprised of the following components:

- service switch
- control module
- two front height sensors
- one rear height sensor
- compressor and drier assembly (includes vent solenoid)
- air lines
- front and rear air spring and shock absorber assemblies
- four air spring solenoids
- compressor relay

WARNING: The service switch for the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the jack storage area in the rear of the passenger compartment. Failure to do so may result in unexpected inflation or deflation of the air springs which may result in shifting of the vehicle during these operations.

WARNING: Do not remove an air spring under any circumstances when there is pressure in the air spring. Do not remove any components supporting an air spring without either exhausting the air or providing support for the air spring to prevent vehicle damage or personal injury.

Air Suspension Pneumatic Diagram



Item	Part Number	Description
1	5319	Air compressor and drier
2	5B322	Air line T-fitting
3	5B321	Air line union
4	—	Air line Y-fitting
5	18945/5311	Air spring and solenoid

Vehicle Dynamic Suspension —4-Wheel Air Suspension

Refer to Wiring Diagrams Cell 41 , Programmable Ride Control for schematic and connector information.

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052 or equivalent scan tool
 ST1176-A	Vacuum Tester or equivalent 014-R1054
 ST1137-A	73 Digital Multimeter or equivalent 105-R0051

Principles of Operation

The 4-wheel air suspension (4WAS) module commands changes in vehicle height that are necessary for both the load leveling and the vertical height adjustment features.

The 4WAS load leveling feature automatically makes adjustments in vehicle height so that the vehicle is always at target height, and that constant front-to-rear vehicle attitudes are maintained over the load range of the vehicle. Adjustments in height that are necessary to correct height differences between the vehicle left and right sides for the 4WAS system are restricted to what can be reliably achieved with three height sensors.

The height adjustment feature has three vehicle target heights within a two-inch span:

Kneel height — improves the ease of entering and exiting by lowering the vehicle one inch below the trim height in the front and rear when the vehicle ignition is in the OFF or LOCK positions and the vehicle is stationary.

Trim height — normal vehicle ride position; vehicle moves to trim position when the ignition is ON, when the transmission is initially shifted to DRIVE or REVERSE mode, when all doors are closed or when speed of more than 24 km/h (15 mph) is detected.

Off-road height — improves ground clearance by raising the vehicle one inch above trim height in the front and rear when the vehicle is at 4x4 low modes and the vehicle speed is less than 40 km/h (25 mph).

The 4WAS module uses the universal bus protocol, (UBP), module communications network for sending and receiving various signals, information from the three height sensors, and the air suspension service switch. For additional information about UBP, refer to Section 418-00 .

The 4WAS system holds vehicle height when any door or rear hatch is opened. The system stores front and rear vehicle height the moment any door is detected open. The system then maintains this height regardless of the addition or removal of a load. The system returns to its commanded height when all doors are closed or vehicle speed exceeds 24 km/h (15 mph).

The system will remain active for 40 minutes after the ignition is turned off to make limited height adjustments as necessary.

Vehicle Height Modes

Ignition State	Transfer Case Mode	Speed or Speed Range	Resulting Vehicle Height
OFF	4x2, A4WD, 4x4 HI	N/A	Kneel (TRIM - 25 mm)
ON and RUN	4x2, A4WD, 4x4 HI	All speeds	TRIM
ON and RUN	4x4 Low	Below 13 km/h (8 mph)	Off-Road (TRIM + 25 mm)
ON and RUN	4x4 Low	Above 40 km/h (25 mph)	TRIM
OFF	4x4 Low	N/A	Stays at current position (prior to ignition transition)

Air Suspension Service Switch

The air suspension service switch signal is needed to wake up the 4WAS module. Without the module receiving this signal, the 4WAS system is inoperative at speeds below 24 km/h (15 mph) and will not react when the vehicle is raised or lowered. At speeds above 24 km/h (15 mph), the system will be active as if the air suspension service switch is in the ON position.

Vehicles without message center

When the air suspension service switch is in the OFF position and the ignition switch is in the RUN position, a "CHECK SUSP" will appear in the RH corner of the instrument cluster.

Vehicles with message center

When the air suspension service switch is in the OFF position and the ignition switch is in the RUN position, the message center will display "SUSPENSION SWITCHED OFF"

Air Compressor

The air compressor:

- consists of the compressor and vent solenoid; neither are replaceable as individual items.
- is a single cylinder electric motor driven unit that provides pressurized air as required.
- is powered by an electromechanical or solid state relay, which is controlled by the 4WAS module.

- passes pressurized air through the compressor air drier that contains silica gel (a drying agent). Moisture is then removed from the compressor air drier when vented air passes out of the system during vent operation.
- has a single port drier that can be installed separately.

The vent solenoid:

- allows air to escape from the system during venting actions.
- is part of the air compressor cylinder head.
- shares a common electrical connector with the air compressor motor.
- is enclosed in the cylinder head casting, which forms an integral valve housing that allows the valve tip to enter the pressurized side of the system.
- has an O-ring seal that prevents air leakage past the valve tip.
- opens when the 4WAS module determines that lowering is required.
- provides an escape route for pressurized air when system pressures exceed safe operating levels.
- has a 1034 kPa (150 psi) internal relief valve.
- is installed with the air compressor as a unit.

Air Spring

The 4WAS system has front and rear air springs. The air springs provide a varying spring rate proportional to the system's air pressure and volume. The air suspension system regulates the air pressure in each air spring by compressing and venting the system's air. Increasing air pressure (compressing) raises the vehicle; decreasing air pressure (venting) lowers the vehicle. Vehicle height is maintained by the addition and removal of air in each air spring through an air spring solenoid installed in the upper spring cap and energized through the 4WAS module command.

Air Lines and Fittings

NOTE: Apply a soapy water solution to the air lines to verify the location of air leaks. If the air lines are cut, ruptured or leaking, a service repair kit is available.

Nylon air lines with quick connect fittings connect to the air compressor and air spring solenoids. The compressor assembly output line is divided by the use of a fitting to supply the front and rear air springs. Fittings are also used to divide the air supply to the RH and LH air spring solenoids.

Air Suspension Height Sensors

There are two sensors used for the front suspension and one sensor used for the rear suspension. The sensors send a voltage signal to the 4WAS module. The output ranges from approximately 4.50 volts at minimum height (when the vehicle is low or in full jounce) to 0.50 volt at maximum height (when the vehicle is high or in full rebound). The sensors have a usable range of ± 45° compared to total suspension travel of 196 mm (7.84 in) at the front wheels and 240 mm (9.6 in) at the rear wheels. Therefore, the sensors are mounted to the suspension at a point where full suspension travel at the wheel is relative to the travel at the height sensor. The front height sensors are mounted to the frame and the links are attached to the upper arm ball studs. The left and right sensors are not interchangeable. The rear height sensor is mounted to the frame and the link is attached to the rear lower arm ball stud.

When the height sensor indicates that the vehicle is lower than trim under normal driving conditions, the air compressor will turn on and pump compressed air to the system. When the sensor indicates that the vehicle is raised above trim under normal driving conditions, this will cause the air to be vented from the system to lower the vehicle to its trim height level.

Compressor Relay

A (electromechanical or solid state) relay is used in the air suspension system for compressor control. The relay switches high current loads in response to low power signals and is controlled by the logic of the 4WAS module.

The compressor (electromechanical or solid state) relay is energized by the 4WAS module to have high current flow from the battery to the compressor motor.

4-Wheel Air Suspension (4WAS) Module

NOTE: The 4WAS module must receive a ride height adjustment calibration and must pass a pneumatic test when it is installed new or swapped.

The 4-wheel air suspension (4WAS) module controls the air compressor motor (through an electromechanical or solid state relay), all air spring solenoids, and provides power to front and rear height sensors. The 4WAS module also controls vehicle height adjustments by monitoring the three height sensors and other universal bus protocol (UBP) signals. The 4WAS module conducts all fail-safe and diagnostic strategies, and contains self-test and communication software for testing the vehicle and related components.

The 4WAS module monitors and controls the air suspension system through a 26-pin, two-way connector. The 4WAS module is keyed so that it cannot be plugged into an incorrect harness. There are two harness hardshell connectors and each is uniquely colored and keyed to prevent reversed connections.

Air Spring Solenoid

WARNING: Never rotate an air spring solenoid valve to the release slot in the end cap fitting until all pressurized air has escaped from the spring to prevent damage or injury.

The air spring solenoid:

- allows air to enter and exit the air spring during leveling operations.
- is electrically operated and controlled by the 4WAS module.
- is only replaced as a unit (the air spring solenoid is serviced separately from the air spring).

Inspection and Verification

1. Verify the customer concern.

2. **NOTE:** If the door ajar indicator is illuminated when all doors, liftgate, and liftgate glass are closed, the air suspension will not work correctly. Repair door ajar indicator; refer to Section 413-01.

   Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical

• Restricted suspension movement • Excessive vehicle load • Cut, severed, crimped air line(s) • Unmounted height sensor(s) • Damaged front air spring(s) • Damaged rear air spring(s)	• Battery junction box (BJB) fuses 11 (10) (later built vehicles), 20 (30A), fuse 27 (5A), and fuse 111 (50A) • Loose, corroded, or disconnected connectors • Air suspension service switch is in the OFF position • Damaged solenoid valve(s)/height sensor(s)

3. If the inspection reveals an obvious concern that can be readily repaired, correct the concern before continuing with Inspection and Verification.

4. **NOTE:** The 4WAS module is also referred to as the Vehicle Dynamic Module (VDM).

   If the concern remains after the inspection, use the scan tool connected to the data link connector (DLC) to retrieve continuous diagnostic trouble codes (DTCs) and to execute On-Demand Self Test diagnostics for the 4WAS module.
   - If the On-Demand Self Test is passed and no DTCs are retrieved, GO to Symptom Chart to continue diagnostics.
   - If DTCs are retrieved, go to the 4WAS Module Diagnostic Trouble Code (DTC) Index in this section.
   - If the 4WAS module cannot be accessed by the scan tool, Go To Pinpoint Test A .

Pneumatic Test

This test verifies that the air lines are connected and that they are not restricted. It also verifies that the air compressor, air compressor vent solenoid and air spring solenoid valves are functioning properly. Verify that the following conditions are met before running the Pneumatic Test.

- All doors, liftgate, and liftgate glass must be closed.
- Vehicle in PARK.
- The vehicle speed is less the 3 km/h (1.87 mph).
- The air suspension service switch must be in the ON position.
- Test is used to clear DTCs C1990 and C1991.

Trim Height Test (or Accurate Trim Test)

The trim height test is used to make the vehicle level to within 2 mm (0.08 in) of the calibrated trim height. Accurate trim test should be run before setting vehicle alignment.

- All doors, liftgate, and liftgate glass must be closed.
- The transmission is in PARK.
- The vehicle speed is less than 3 km/h (1.87 mph).
- The ignition switch is in the ON position.
- The air suspension service switch is in the ON position.
- Battery voltage greater than 11 volts for duration of test.

1. Fulfill the pre-conditions.

2. Install a battery charger for the Trim Height Test to prevent battery drain.
3. Run the Trim Height Test.

Self-Test

Verify that the following conditions are met before running the On-Demand Self Test.

- All doors, liftgate, and liftgate glass must be closed.
- The transmission is in PARK.
- The vehicle speed is less than 3 km/h (1.87 mph).
- The ignition switch is in the ON position.
- The vehicle is not in 4L mode.

1. Fulfill the pre-conditions.
2. Install a battery charger for the On-Demand Self Test to prevent battery drain.
3. Run the air suspension On-Demand Self Test.
4. Record all listed DTCs.
5. Retrieve stored DTCs.
6. Troubleshoot any On-Demand Self Test DTCs first.
7. Repeat the On-Demand Self Test and clear DTCs after repairs are completed.

4-Wheel Air Suspension (4WAS) Module Diagnostic Trouble Code (DTC) Index

4-Wheel Air Suspension (4WAS) Module Diagnostic Trouble Code (DTC) Index

NOTE: Repair all other DTCs before C1725 and C1726. Repair DTCs C1990 and C1991 last.

DTCs	Description	Source	Action
B1317	Battery voltage high	4WAS module	Go To Pinpoint Test C .
B1318	Battery voltage low	4WAS module	Go To Pinpoint Test C .
B1342	ECU is defective	4WAS module	INSTALL a new 4WAS module. REFER to Air Suspension Control Module . SET the ride height. REFER to Ride Height Adjustments . CARRY OUT the pneumatic test. TEST the system for normal operation.
B1566	Door circuit failure	4WAS module	REFER to the Symptom Chart.
B2477	VAPS II steering assist curve not complete	4WAS module	REFER to Section 211-00 .
C1445	Vehicle speed signal circuit failure	4WAS module	GO to Symptom Chart .
C1724	Air suspension height	4WAS	Go To Pinpoint Test D .

	sensor power circuit failure	module	
C1725	Air suspension front pneumatic failure	4WAS module	Go To Pinpoint Test E .
C1726	Air suspension rear pneumatic failure	4WAS module	Go To Pinpoint Test E .
C1760	Air suspension rear height sensor signal circuit failure	4WAS module	Go To Pinpoint Test F .
C1770	Air suspension vent solenoid output circuit failure	4WAS module	Go To Pinpoint Test G .
C1790	Air suspension LR air spring/shock solenoid output circuit failure	4WAS module	Go To Pinpoint Test H .
C1795	Air suspension RR air spring/shock solenoid output circuit failure	4WAS module	Go To Pinpoint Test H .
C1830	Air suspension compressor relay circuit failure	4WAS module	Go To Pinpoint Test I .
C1840	Air suspension disable switch circuit failure	4WAS module	Go To Pinpoint Test J .
C1873	Air suspension RF air spring solenoid output circuit failure	4WAS module	Go To Pinpoint Test H .
C1877	Air suspension LF air spring solenoid output circuit failure	4WAS module	Go To Pinpoint Test H .
C1881	Air suspension RF height sensor circuit failure	4WAS module	Go To Pinpoint Test F .
C1889	Air suspension LF height sensor circuit failure	4WAS module	Go To Pinpoint Test F .
C1897	Steering VAPS circuit loop failure	4WAS module	REFER to Section 211-00 .
U1950	UBP communication bus fault	4WAS module	REFER to Section 418-00 .
C1964	Air suspension compressor actual run time exceeded allowed run time	4WAS module	Allow the air compressor to cool down. CLEAR the DTC. REPEAT the self-test.
C1990	New control module initialization (requires ride height calibration and pneumatic test pass)	4WAS module	CARRY OUT the ride height resetting procedure. REFER to Ride Height Adjustments in this section. Then, CARRY OUT the pneumatic test. REFER to the Pneumatic Test in this section. RETRIEVE any DTCs. If any DTCs are found, REPAIR as necessary. **Navigator:** If no DTCs are found, REFER to Section 211-00 to download the VAPS information. **Expedition:** If no DTCs are found, procedure is complete.
C1991	Plant ride height setting and/or tests incomplete	4WAS module	CARRY OUT the pneumatic test. REFER to the Pneumatic Test in this section.

			RETRIEVE the DTCs. If DTC C1991 is found, CARRY OUT the ride height resetting procedure. Refer to Ride Height Adjustments in this section. RETRIEVE the DTCs. IF DTC C1991 is found, RUN the On-Demand Self Test. If the self-test yields no faults, procedure is complete. If the self-test yields a fault(s), GO to Symptom Chart. If no DTCs are found, procedure is complete.
U2235	4x4 mode status invalid	4x4 control module	REFER to Section 418-00.
U2306	Transmission PRNDL indicator or vehicle speed signal invalid	Instrument Cluster (IC)	REFER to Section 418-00.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• No communication with the 4WAS module (VDM)	• BJB fuses 20 (30A), 27 (5A), 102 (30A). • Circuitry. • 4WAS module (VDM).	• Go To Pinpoint Test A.
• **NOTE:** Be sure that the ignition switch is in the ON position and the air suspension service switch is in the ON position before determining that the 4WAS module will not enter the self-test. Unable to enter self-test	• Air suspension service switch. • 4WAS module.	• Go To Pinpoint Test B.
• Vehicle raises and/or lowers too slowly	• Front/rear pneumatic failure. • Height sensor. • Air compressor assembly. • Circuitry. • Solenoid. • Air line.	• Go To Pinpoint Test E.
• Uneven vehicle height	• Front/rear pneumatic failure. • Height sensor. • Solenoid. • Air compressor assembly. • Air line. • Circuitry.	• Go To Pinpoint Test E.
• The air compressor continuously cycles with the ignition switch	• Circuitry. • Air suspension relay. • 4WAS module.	• Go To Pinpoint Test K.

in the OFF position and no DTC is set		
• The air suspension system is inoperative without DTCs and vehicle at rest	• UBP network communication fault.	• Go To Pinpoint Test L .
• Air suspension system operates with air suspension service switch in the OFF position	• Circuitry. • Air suspension switch. • 4WAS module.	• Go To Pinpoint Test M .
• Excessive air compressor noise	• Silencer. • Mounting bracket. • Air compressor assembly. • Air compressor assembly in contact with other components.	• Go To Pinpoint Test N .
• The compressor is inoperative	• BJB fuse 111 (50A). • Air compressor assembly. • Circuitry. • Air suspension (electromechanical or solid state) relay.	• Go To Pinpoint Test O .
• DTC B1566: Door circuit failure	• Door(s) or liftgate open during on demand self-test.	• Validate that all doors, liftgate, and liftgate glass are closed. Check the door ajar indicator in the cluster. ▪ If the door ajar indicator is illuminated, REFER to Section 419-10 .
• **NOTE:** Vehicle speed signal is sent through the UBP communication (secondary) network and it is transmitted by hardwire (primary). DTC C1445: Vehicle Speed Signal Circuit Failure	• Circuitry. • PCM. • UBP communication network.	• REFER to Section 418-00 .

Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE 4WAS (VDM) MODULE

Test Step	Result / Action to Take
A1 CHECK CIRCUIT 1524 (DB) FOR POWER	
• Disconnect: 4WAS Module C2131a. • Measure the voltage between 4WAS module C2131a pin 1, circuit 1524 (DB), harness side and ground, and between 4WAS module C2131a pin 15, circuit 1524 (DB), harness side and ground. • **Are the voltages greater than 10 volts?**	**Yes** GO to A2 . **No** REPAIR circuit 1524 (DB). TEST the system for normal operation.
A2 CHECK CIRCUIT 1003 (GY/YE)	
• Key in ON position. • Measure the voltage between 4WAS module C2131b pin 4, circuit 1003 (GY/YE), harness side and ground. • **Is the voltage greater than 10 volts?**	**Yes** GO to A3 . **No** REPAIR circuit 1003 (GY/YE). TEST the system for normal operation.
A3 CHECK CIRCUIT 875 (BK/LG) FOR AN OPEN	
• Key in OFF position. • Measure the resistance between 4WAS module C2131b pin 19, circuit 875 (BK/LG), harness side and ground. • **Is the resistance less than 5 ohms?**	**Yes** CHECK the UBP communication network. REFER to Section 418-00 . **No** REPAIR circuit 875 (BK/LG). TEST the system for normal operation.

PINPOINT TEST B: UNABLE TO ENTER SELF-TEST

Test Step	Result / Action to Take
NOTE: Be sure that the ignition switch is in the ON position and the air suspension service switch is in the ON position before determining that the 4WAS module will not enter the self-test.	
B1 CHECK THE COMMUNICATION TO THE 4WAS MODULE	
• Verify that the following conditions have been met: ▪ ignition switch is in the ON position ▪ air suspension service switch is in the ON position ▪ vehicle speed is less than 3 km/h (2 mph) ▪ transmission selector is in PARK ▪ battery voltage is greater than 10 volts • **Does scan tool communicate with the 4WAS module?**	**Yes** INSTALL a new 4WAS module. REFER to Air Suspension Control Module in this section. REPEAT the self-test. **No** Go To Pinpoint Test A .

PINPOINT TEST C: DTC B1317/B1318 — BATTERY VOLTAGE HIGH/LOW

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>C1 CHECK THE BATTERY VOLTAGE

● Measure the battery voltage between the positive and negative battery posts with the key ON engine OFF (KOEO), and with the engine running.
● Is the battery voltage between 10 and 13 volts with KOEO, and between 11 and 18 volts with the engine running?</td><td>Yes
GO to C2 .

No
REFER to Section 414-00 . TEST the system for normal operation.</td></tr>
<tr><td>C2 CHECK VOLTAGE TO THE 4WAS MODULE

● Key in OFF position.
● Disconnect: 4WAS Module C2131a.
● Key in ON position.
● Measure the voltage between the following 4WAS module C2131a pins, harness side and ground:
<table><tr><th>4WAS Module Connector C2131a Pin No.</th><th>Circuit</th></tr><tr><td>1</td><td>1524 (DB)</td></tr><tr><td>4</td><td>1003 (GY/YE)</td></tr><tr><td>15</td><td>1524 (DB)</td></tr></table>● Is the voltage between 10 and 13 volts with KOEO, and between 11 and 18 volts with the engine running?</td><td>Yes
GO to C3 .

No
REPAIR circuit 1524 (DB) or circuit 1003 (GY/YE). CLEAR the DTCs. REPEAT the self-test.</td></tr>
<tr><td>C3 CHECK CIRCUIT 875 (BK/LG) FOR AN OPEN

● Key in OFF position.
● Measure the resistance between 4WAS module C2131a pin 19 circuit 875 (BK/LG), harness side, and ground.
● Are the resistances less than 5 ohms?</td><td>Yes
INSTALL a new 4WAS module. REFER to Air Suspension Control Module in this section. REPEAT the self-test.

No
REPAIR circuit 875 (BK/LG). CLEAR the DTCs. REPEAT the self-test.</td></tr>
</table>

PINPOINT TEST D: DTC C1724 — AIR SUSPENSION HEIGHT SENSOR POWER CIRCUIT FAILURE

Test Step	Result / Action to Take
D1 CHECK AIR SUSPENSION HEIGHT SENSOR POWER CIRCUITS FOR OPEN ● Disconnect: 4WAS Module C2131a. ● Disconnect: LF Height Sensor C1153. ● Disconnect: RF Height Sensor C1151. ● Disconnect: Rear Height Sensor C4084. ● Measure the resistance between 4WAS module C2131b pin 17, circuit 426 (RD/BK), harness side and between LF height sensor C1153 pin 3, and RF height sensor C1151 pin 3, circuit 426 (RD/BK) and between 4WAS module C2131b pin 8, circuit 429 (PK/LG), harness side and rear height sensor C4084 pin 3, circuit 429 (PK/LG). ● **Is the resistance less than 5 ohms?**	**Yes** GO to D2 . **No** REPAIR circuit 426 (RD/BK) or circuit 429 (PK/LG). CLEAR the DTC. REPEAT the self-test.

D2 CHECK AIR SUSPENSION HEIGHT SENSOR POWER CIRCUITS FOR SHORT TO GROUND	
• Measure the resistance between 4WAS module C2131b pin 17, circuit 426 (RD/BK), harness side and ground, between LF height sensor C1153 pin 3 and ground, between RF height sensor C1151 pin 3, circuit 426 (RD/BK) and ground, and between 4WAS module C2131b pin 8, circuit 429 (PK/LG), harness side and ground and between rear height sensor C4084 pin 3, circuit 429 (PK/LG) and ground. • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to D3 . **No** REPAIR circuit 426 (RD/BK) or circuit 429 (PK/LG). CLEAR the DTC. REPEAT the self-test.
D3 CHECK AIR SUSPENSION HEIGHT SENSOR SIGNAL RETURN CIRCUITS	
• Measure the resistance between 4WAS module C2131b pin 10, circuit 432 (BK/PK), harness side and rear height sensor C4084 pin 1, circuit 432 (BK/PK) and between 4WAS module C2131b pin 20, circuit 432 (BK/PK), harness side and LF and RF height sensor C1151 and C1153 pin 1, circuit 432 (BK/PK). • **Is the resistance less than 5 ohms?**	**Yes** GO to D4 . **No** REPAIR circuit 432 (BK/PK). CLEAR the DTCs. REPEAT the self-test.
D4 CHECK VOLTAGE AT THE LF, RF, AND REAR HEIGHT SENSORS	
• Connect: 4WAS Module C2131b. • Key in ON position. • Measure the voltages at C1153 (LF), C1151 (RF), and C4084 (rear) height sensors between pin 1, circuit 432 (BK/PK) and pin 3, circuit 429 (PK/LG). • **Are the voltages 5 volts?**	**Yes** INSTALL a new height sensor. REFER to Suspension Height Sensor in this section. CLEAR the DTC. REPEAT the self-test. **No** INSTALL a new 4WAS module. REFER to Air Suspension Control Module in this section. CLEAR the DTC. REPEAT the self-test.

PINPOINT TEST E: DTCS C1725/C1726— AIR SUSPENSION FRONT/REAR PNEUMATIC FAILURE

Test Step	Result / Action to Take
NOTE: It may be necessary to vent air from the front air suspension air springs during this pinpoint test.	
E1 CHECK THE AIR SUSPENSION HEIGHT SENSORS	
• Inspect the LF, RF, and rear air suspension height sensor for correct installation at the upper and lower ball stud bracket for damage. • Inspect the air suspension height sensor mounting brackets for damage. • Verify that all air lines are fully seated. • **Are the air suspension height sensors, mounting brackets, and air lines OK?**	**Yes** GO to E2 . **No** REPAIR as necessary. If the height sensor mounting brackets are installed or repaired, RESET front ride height. REFER to Ride Height Adjustments in this section. CLEAR the DTCs. REPEAT the

	self-test.
E2 CHECK THE AIR SUSPENSION HEIGHT SENSOR OPERATION • Turn the air suspension switch to the OFF position. • Disconnect the lower end of the LF and RF, and rear air suspension height sensors. • Connect the diagnostic tool. • Monitor LF, RF, and rear height sensor PIDs. • **NOTE:** The voltage increases as the suspension is compressed. • While monitoring the 4WAS module LF, RF, rear height sensor PID display, slowly move the LF, RF, rear air suspension height sensors up and down its full travel. • **Do the voltages vary between 0.50 volts and 4.50 volts?**	**Yes** RECONNECT air suspension height sensors. GO to E3 . **No** INSTALL a new height sensor. REFER to Suspension Height Sensor in this section. CLEAR the DTC. REPEAT the self-test.
E3 VERIFY THAT THE VEHICLE CAN BE RAISED • **NOTE:** To trigger the OFF active command using the NGS, press "cancel", then press off. • TRIGGER the 4WAS module front and rear suspension fill active commands. • Allow the vehicle to raise for 30 seconds. • Record the voltage levels for the LF, RF, and rear air suspension height sensors at the up and down full travel positions. • **Does the vehicle raise evenly and hold the new height?**	**Yes** TRIGGER the 4WAS module off active command. GO to E4 . **No** TRIGGER the 4WAS module off active command. GO to E5 .
E4 VERIFY THAT THE VEHICLE CAN BE LOWERED • TRIGGER the 4WAS module vent front and rear air suspension active commands. • Allow the front and rear to lower for 30 seconds. • **Does the vehicle lower evenly?**	**Yes** INSTALL a new 4WAS module. REFER to Air Suspension Control Module in this section. REPEAT the self-test. **No** GO to E8 .
E5 CHECK OPERATION OF AIR COMPRESSOR **CAUTION: The 4WAS module limits the air compressor run time. If the air compressor overheats, it will not restart until it cools down. The ignition switch must be in the OFF position to allow the compressor thermal switch to cool.** • TRIGGER the 4WAS module compressor on active command. • **Does the air compressor run (slight buzzing noise from RF fender)?**	**Yes** TRIGGER the 4WAS module compressor off active command. GO to E6 . **No** TRIGGER the 4WAS module compressor off active command. INSTALL a new air compressor. REFER to Air Suspension Compressor . CLEAR the DTCs. REPEAT the self-test.
E6 CHECK AIR COMPRESSOR PRESSURE OUTPUT **CAUTION: The 4WAS module limits the air compressor run time. If the air compressor overheats, it will not restart until it cools down. The ignition switch must be in the OFF position to allow the compressor thermal switch to cool. NOTE:** If fluid is present when disconnecting an air line, clear the air lines; refer to Air Line Fluid Purge procedure in this	**Yes** GO to E8 . **No** GO to E7 .

section. Check the compressor air drier for water or the front air spring for oil. ● Disconnect air line T-fitting at the right front shock tower. ● Connect an air pressure gauge (1,723 kPa [250 psi] maximum reading) with common fittings to the air line going to the compressor air drier. ● TRIGGER the 4WAS module compressor on active command. ● Run the air compressor for 30 seconds. ● Wait five minutes. ● TRIGGER the 4WAS module compressor vent on active command. ● **Did the compressor produce 1,034 kPa (150 psi) within 30 seconds and hold developed pressure during the five minutes?**	
E7 CHECK THE AIR DRIER FOR LEAKS	
CAUTION: The 4WAS module limits the air compressor run time. If the air compressor overheats, it will not restart until it cools down. The ignition switch must be in the OFF position to allow the compressor thermal switch to cool. NOTE: Apply a soap and water solution to the air lines and air line connections when checking for air suspension system leakage. ● TRIGGER the 4WAS module compressor on active command. ● Thoroughly inspect the air drier-to-air compressor connection. ● **Is the air drier leaking at the air compressor?**	**Yes** INSTALL a new air drier. REFER to Air Suspension Compressor Drier in this section. CLEAR the DTCs. REPEAT the self-test. **No** GO to E9.
E8 CHECK AIR LINE FROM AIR DRIER	
CAUTION: The 4WAS module limits the air compressor run time. If the air compressor overheats, it will not restart until it cools down. The ignition switch must be in the OFF position to allow the compressor thermal switch to cool. NOTE: Apply a soap and water solution to the air lines and air line connections when checking for air suspension system leakage. ● TRIGGER the 4WAS module compressor on active command. ● Check for excessive air leaks, kinked or pinched air lines between the air compressor and LF, RF, LR, and RR air spring solenoids and between the air compressor and the air pressure gauge. ● **Are there any excessive leaks, kinks or pinched air lines?**	**Yes** INSTALL new or REPAIR the air line where necessary. CLEAR the DTCs. REPEAT the self-test. **No** GO to E9.
E9 CHECK FOR A PLUGGED AIR DRIER	
● Disconnect the air drier from the air compressor while leaving the air line connected. ● TRIGGER the front and rear suspension vent active commands. ● **Does the vehicle lower at an acceptable rate?**	**Yes** INSTALL new air drier. REFER to Air Suspension Compressor Drier in this section. CLEAR the DTCs. REPEAT the self-test. **No** GO to E10.
E10 CHECK FOR BLOCKAGE IN AIR LINE TO LF OR RF AIR SPRING	

NOTE: If fluid is present when disconnecting an air line, clear the air lines; refer to Air Line Fluid Purge in this section. Check the air compressor air drier for water and check the air springs for oil. ● Disconnect the air line at LF, RF, LR, or RR air spring. ● Disconnect the air line at the air drier. ● Connect the vacuum tester at the suspect air spring air line and try to draw a vacuum. ● **Can a vacuum be drawn and held?**	**Yes** REPAIR the blockage in the affected air line(s). CLEAR the DTCs. REPEAT the self-test. **No** GO to E11 .
E11 CHECK THE SPRINGS FOR CORRECT OPERATION	
NOTE: If fluid is present when disconnecting an air line, clear the air lines; refer to Air Line Fluid Purge in this section. Check the air compressor air drier for water and check the air springs for oil. ● Disconnect the air line at the LF, RF, LR, or RR air spring solenoids. ● TRIGGER the 4WAS module LF, RF, LR, and RR air spring solenoid valve vent active commands. ● **Does each corner of the vehicle lower?**	**Yes** INSTALL a new 4WAS module. REFER to Air Suspension Control Module in this section. REPEAT the self-test. **No** INSTALL a new air spring solenoid valve. REFER to Air Spring Solenoid Valve in this section. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST F: DTC C1760 (REAR), C1881 (RF), C1889 (LF)— AIR SUSPENSION HEIGHT SENSOR SIGNAL CIRCUIT FAILURE

Test Step	Result / Action to Take
F1 VALIDATE DTC ERROR	
● CARRY OUT the 4WAS module On-Demand Self Test. ● **Is the same air suspension height sensor DTC set?**	**Yes** GO to F2 . **No** If no DTC is retrieved, GO to F5 . If a different DTC is retrieved, REFER to the 4WAS Module Diagnostic Trouble Code (DTC) Index.
F2 CHECK SUSPECT AIR SUSPENSION HEIGHT SENSOR SIGNAL RETURN CIRCUIT	
● Key in OFF position. ● Turn the air suspension service switch to the OFF position. ● Disconnect: Air Suspension Service Switch C4169. ● Disconnect: 4WAS Module C2131a. ● Measure the resistance between the suspect height sensor connector pin 1 harness side, circuit 432 (BK/PK) and 4WAS module C2131a pin 20 (front sensors), C2131a pin 10 (rear sensor); harness side.	**Yes** GO to F3 . **No** REPAIR circuit 432 (BK/PK). CLEAR the DTCs. REPEAT the self-test.

Air Suspension Height Sensor	Air Suspension Height Sensor Connector No.
Left Front (LF)	C1153
Right Front (RF)	C1151
Rear	C4084

• **Is the resistance less than 5 ohms?**	
F3 CHECK 4WAS MODULE POWER AND RETURN CIRCUITS	
• Key in OFF position. • Turn the air suspension service switch to the OFF position. • Disconnect: Air Suspension Service Switch C4169. • Key in ON position. • For DTC C1760, measure the voltage between rear height sensor C4084 pin 1, circuit 432 (BK/PK) harness side and pin 3, circuit 426 (RD/BK) harness side. • For DTC's C1881 (RF) or C1889 (LF), measure the voltage between C1151 or C1153 height sensor pin 1, circuit 432 (BK/PK) harness side and pin 3, circuit 429 (PK/LG) harness side. • **Is the voltage approximately 5 volts?**	**Yes** GO to F5 . **No** GO to F4 .
F4 CHECK AIR SUSPENSION HEIGHT SENSOR POWER CIRCUIT	
• Key in OFF position. • Turn the air suspension service switch to the OFF position. • Measure the voltage between suspect height sensor connector pin 3, circuit 429 (PK/LG) harness side and ground. • **Is voltage present?**	**Yes** REPAIR circuit 429 (PK/LG). **No** Go To Pinpoint Test D .
F5 CHECK THE HEIGHT SENSOR OUTPUT	
• Connect: Height Sensor(s). • Turn the air suspension service switch to the OFF position. • Key in ON position. • Disconnect the suspect height sensor ball stud from the height sensor bracket. • Using the scan tool, monitor the suspect height sensor PID(s). • Move the suspect height sensor arm through its full range of motion. • **Does the voltage vary from 0.50 to 4.5 volts?**	**Yes** INSTALL a new 4WAS module. REFER to Air Suspension Control Module in this section. REPEAT the self-test. **No** Go To Pinpoint Test D .

PINPOINT TEST G: DTC C1770 — AIR SUSPENSION VENT SOLENOID OUTPUT CIRCUIT FAILURE

Test Step	Result / Action to Take
G1 VALIDATE DTC C1770	
• Carry out 4WAS module On-Demand Self Test. • **Is the same air suspension DTC set?**	**Yes** GO to G2 . **No** CHECK the 4WAS module and air compressor harness connectors for bent or pushed out pins, corrosion or damage. CARRY OUT the pneumatic test. REPEAT the self-test. If other DTCs are present, REFER to the 4WAS Module Diagnostic Trouble Code (DTC) Index.
G2 CHECK VENT SOLENOID CONNECTOR	

• Key in OFF position. • Turn the air suspension service switch to the OFF position. • Disconnect: Air Compressor Assembly C1179. • Inspect the pins and terminals of the air compressor assembly connector for corrosion, bent or broken pins, moisture, or other damage. • **Is the air compressor assembly C1179 OK?**	**Yes** RECONNECT the air compressor assembly C1179. GO to G3. **No** REPAIR the connector as necessary. CLEAR the DTC. REPEAT the self-test.
G3 CHECK VENT SOLENOID PID	
• Turn the air suspension service switch to the ON position. • Key in ON position. • TRIGGER the 4WAS module vent on and vent off active command. • **Do the letters O, G, or B appear next to the ON/OFF text for the air suspension vent solenoid?**	**Yes** If O appeared, GO to G4. If G appeared, GO to G5. If B appeared, GO to G7. **No** CLEAR the DTCs. REPEAT the self-test.
G4 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
• Measure the resistance between air compressor assembly C1179 pin 2, circuit 57 (BK), harness side and ground. • **Is the resistance less than 5 ohms?**	**Yes** GO to G5. **No** REPAIR circuit 57 (BK). CLEAR the DTCs. REPEAT the self-test.
G5 CHECK THE VENT SOLENOID FOR AN OPEN	
• Disconnect: Air Compressor C1179. • Measure the resistance between air compressor C1179 pin 2 and pin 3, component side. • **Is the resistance between 17 and 22 ohms?**	**Yes** GO to G6. **No** INSTALL a new air compressor. REFER to Air Suspension Compressor in this section. CLEAR the DTCs. REPEAT the self-test.
G6 CHECK CIRCUIT 421 (PK)	
• Disconnect: 4WAS Module C2131b. • Measure the resistance between 4WAS module C2131b pin 5, circuit 421 (PK), harness side and air compressor assembly C1179 pin 3, circuit 421 (PK), harness side. • **Is the resistance less than 5 ohms?**	**Yes** GO to G7. **No** REPAIR circuit 421 (PK). CLEAR the DTCs. REPEAT the self-test.
G7 CHECK CIRCUIT 421 (PK) FOR SHORT TO GROUND	
• Disconnect: 4WAS Module C2131b. • Measure the resistance between 4WAS module C2131b pin 5, circuit 421 (PK), harness side and ground. • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to G8. **No** REPAIR circuit 421 (PK). CLEAR the DTCs. REPEAT the self-test.
G8 CHECK CIRCUIT 421 (PK) FOR	

SHORT TO POWER	
• Key in OFF position. • Turn the air suspension service switch to the OFF position. • Disconnect: 4WAS Module C2131b. • Key in ON position. • Measure the voltage between 4WAS module C2131b pin 5, circuit 421 (PK), harness side and ground. • **Is the voltage at zero?**	**Yes** INSTALL a new 4WAS module. REFER to Air Suspension Control Module in this section. REPEAT the self-test. **No** REPAIR circuit 421 (PK). CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST H: DTC C1790 (LR), C1795 (RR), C1873 (RF), C1877 (LF)— AIR SUSPENSION AIR SPRING SOLENOID OUTPUT CIRCUIT FAILURE

Test Step	Result / Action to Take
H1 VALIDATE DTC	
• Carry out the 4WAS module On-Demand Self Test. • **Is DTC C1790, C1795, C1873, or C1877 set?**	**Yes** GO to H2. **No** If no DTCs are retrieved, GO to H10. If different DTCs are retrieved, REFER to 4WAS Module Diagnostic Trouble Code (DTC) Index.
H2 CHECK AIR SUSPENSION AIR SPRING SOLENOID CONNECTOR(S)	
• Key in OFF position. • Turn the air suspension service switch to the OFF position. • Disconnect: Air Suspension Air Spring Solenoid Connector. • Inspect the pins and terminals of the air suspension air spring solenoid connector (s) for corrosion, bent or broken pins, moisture, or other damage. • **Is the air suspension air spring solenoid connector(s) OK?**	**Yes** RECONNECT the air suspension air spring solenoid connector(s). GO to H3. **No** REPAIR the connector(s) as necessary. CLEAR the DTCs. REPEAT the self-test.
H3 CHECK AIR SPRING SOLENOID PID(S)	
• Turn the air suspension service switch to the ON position. • Key in ON position. • Monitor the air spring solenoid PID. • **Do the letters O, G, or B appear next to the ON/OFF text for the air suspension air spring solenoid?**	**Yes** If O appeared, GO to H4. If G appeared, GO to H7. If B appeared, GO to H9. **No** GO to H10.
H4 CHECK AIR SUSPENSION AIR SPRING SOLENOID COIL(S) FOR OPEN	
• Key in OFF position. • Turn the air suspension service switch to the OFF position. • Disconnect: Air Spring Solenoid connector. • Measure the resistance between the	**Yes** GO to H5. **No** INSTALL a new air spring solenoid. For front

<table>
<tr><td>suspect air spring solenoid(s) pin 1 and pin 2 (component side).
● Is the resistance between 15 and 18 ohms?</td><td>air spring solenoid, REFER to Air Shock Absorber—Front in this section, for rear air spring solenoid, REFER to Air Shock Absorber—Rear in this section. CLEAR the DTC. REPEAT the self-test.</td></tr>
<tr><td>H5 CHECK GROUND CIRCUIT 57 (BK) FOR OPEN</td><td></td></tr>
<tr><td>● Measure the resistance between the suspect air spring solenoid pin 1, circuit 57 (BK), harness side and ground.
● Is the resistance less than 5 ohms?</td><td>Yes
GO to H6 .

No
REPAIR circuit 57 (BK). CLEAR the DTC. REPEAT the self-test.</td></tr>
<tr><td>H6 CHECK AIR SPRING SOLENOID OUTPUT CIRCUIT(S)</td><td></td></tr>
<tr><td>● Disconnect: 4WAS Module C2131b.
● Measure the resistance between the 4WAS module C2131b pin (harness side) and the suspect air suspension air spring solenoid pin 2, (harness side) as follows:
<table><tr><th>4WAS Module C2131B Pin</th><th>Air Suspension Air Spring Solenoid Output Circuit</th></tr><tr><td>(LR) 13</td><td>1114 (BR/PK)</td></tr><tr><td>(RR) 14</td><td>1115 (TN/WH)</td></tr><tr><td>(RF) 2</td><td>414 (OG/RD)</td></tr><tr><td>(LF) 16</td><td>415 (LG/RD)</td></tr></table>● Is the resistance less than 5 ohms?</td><td>Yes
INSTALL a new 4WAS module. REFER to Air Suspension Control Module in this section. REPEAT the self-test.

No
REPAIR the affected circuit(s). CLEAR the DTC(s). REPEAT the self-test.</td></tr>
<tr><td>H7 CHECK AIR SUSPENSION AIR SPRING SOLENOID COIL FOR SHORT</td><td></td></tr>
<tr><td>● Key in OFF position.
● Turn the air suspension service switch to the OFF position.
● Disconnect: Air Suspension Air Spring Solenoid.
● Measure the resistance between the suspect air suspension air spring solenoid pin 1 and pin 2 (component side).
● Is the resistance 15 to 18 ohms?</td><td>Yes
GO to H8 .

No
INSTALL a new air suspension air spring solenoid. REFER to Air Shock Absorber—Front or Air Shock Absorber—Rear in this section.</td></tr>
<tr><td>H8 CHECK OUTPUT CIRCUIT FOR SHORT TO GROUND</td><td></td></tr>
<tr><td>● Disconnect: 4WAS Module C2131b.
● Measure the resistance between 4WAS module pin (harness side) and ground.
<table><tr><th>4WAS Module C2131B Pin</th><th>Air Suspension Air Spring Solenoid Output Circuit</th></tr><tr><td>(LR) 13</td><td>1114 (BR/PK)</td></tr><tr><td>(RR) 14</td><td>1115 (TN/WH)</td></tr><tr><td>(RF) 2</td><td>414 (OG/RD)</td></tr><tr><td></td><td></td></tr></table></td><td>Yes
INSTALL a new 4WAS module. REFER to Air Suspension Control Module in this section. REPEAT the self-test.

No
REPAIR the affected circuit(s). CLEAR the DTC(s). REPEAT the self-test.</td></tr>
</table>

(LF) 16	415 (LG/RD)

- **Is the resistance greater than 10,000 ohms?**

Test Step	Result / Action to Take
H9 CHECK OUTPUT CIRCUIT FOR SHORT TO POWER	
• Key in OFF position. • Disconnect: 4WAS Module C2131b. • Measure the voltage between 4WAS module C2131b pin (harness side) and ground. **4WAS Module C2131B Pin** / **Air Suspension Air Spring Solenoid Output Circuit** (LR) 13 — 1114 (BR/PK) (RR) 14 — 1115 (TN/WH) (RF) 2 — 414 (OG/RD) (LF) 16 — 415 (LG/RD) • **Is voltage present?**	**Yes** REPAIR the affected circuit(s). CLEAR the DTC. REPEAT the self-test. **No** INSTALL a new 4WAS module. REFER to Air Suspension Control Module in this section. REPEAT the self-test.
H10 CHECK AIR SUSPENSION AIR SPRING SOLENOID CONNECTOR FOR DAMAGE	
• Key in OFF position. • Turn the air suspension service switch to the OFF position. • Disconnect: Suspect Air Suspension Air Spring Solenoid. • Inspect the pins and terminals of the air suspension air spring solenoid for corrosion, bent or broken pins, moisture, or other damage; inspect the wiring near the connector for damage. • **Is the air suspension air spring solenoid connector OK?**	**Yes** RECONNECT the air suspension air spring solenoid connector. Turn the air suspension service switch to the ON position. REPEAT the self-test. If no DTCs are retrieved, the system is OK. If a DTC is retrieved, REFER to 4WAS Module Diagnostic Trouble Code (DTC) Index. **No** REPAIR the connector(s) as necessary. CLEAR the DTC. REPEAT the self-test.

PINPOINT TEST I: DTC C1830 — AIR SUSPENSION COMPRESSOR RELAY CIRCUIT FAILURE

Test Step	Result / Action to Take
I1 VALIDATE DTC C1830	
• Carry out the 4WAS module On-Demand Self Test. • **Is the same air suspension DTC set?**	**Yes** GO to I2 . **No** If no DTC is retrieved, GO to I8 . If a different DTC is retrieved, REFER to 4WAS Module Diagnostic Trouble Code (DTC) Index.
I2 CHECK AIR COMPRESSOR RELAY AND CONNECTOR	
• Key in OFF position. • Turn the air suspension service switch to	**Yes** RECONNECT air compressor relay C1300. GO

the OFF position. • Disconnect: Air Compressor Relay C1300. • Inspect the pins and terminals of the air compressor relay for corrosion, bent or broken pins, moisture, or other damage. For vehicles built after 2/03, carry out the Air Compressor Relay Component test. Refer to Cell 149. • **Is the connector OK?**	to I3 . **No** REPAIR as necessary. CLEAR the DTC. REPEAT the self-test.
I3 CHECK THE AIR COMPRESSOR PID	
• Turn the air suspension service switch to the ON position. • Key in ON position. • TRIGGER the 4WAS module compressor on and off active command. • **Do the letters O or B appear next to the ON/OFF text for the air compressor?**	**Yes** If O appeared, GO to I4 . If B appeared, GO to I8 . **No** GO to I9 .
I4 CHECK POWER TO AIR SUSPENSION RELAY COIL	
• Key in OFF position. • Turn the air suspension service switch to the OFF position. • Disconnect: Air Suspension Relay C1300. • Measure the voltage between air compressor relay C1300 pin 1, circuit 833 (PK/LB). • **Is the voltage greater than 10 volts?**	**Yes** GO to I5 . **No** REPAIR the circuit. CLEAR the DTC. REPEAT the self-test.
I5 CHECK POWER TO AIR SUSPENSION RELAY	
• Measure the voltage between air compressor relay C1300 pin 3, circuit 1053 (LB/PK), component side and ground. • **Is the voltage greater than 10 volts?**	**Yes** GO to I6 . **No** REPAIR the circuit. CLEAR the DTC. REPEAT the self-test.
I6 CHECK CIRCUIT 420 (DB/YE) FOR AN OPEN	
• Disconnect: 4WAS Module C2131b. • Measure the resistance between 4WAS module C2131b pin 18, circuit 420 (DB/YE), harness side and air compressor relay C1300 pin 2, circuit 420 (DB/YE), harness side. • **Is the resistance less than 5 ohms?**	**Yes** GO to I7 . **No** REPAIR circuit 420 (DB/YE). CLEAR the DTC. REPEAT the self-test.
I7 CHECK CIRCUIT 420 (DB/YE) FOR SHORT TO GROUND	
• Disconnect: 4WAS Module C2131b. • Measure the resistance between 4WAS module C2131b pin 18, circuit 420 (DB/YE), harness side and ground. • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to I8 . **No** REPAIR circuit 420 (DB/YE). CLEAR the DTC. REPEAT the self-test.
I8 CHECK CIRCUIT 420 (DB/YE) FOR SHORT TO POWER	

• Key in OFF position. • Turn the air suspension service switch to the OFF position. • Disconnect: Air Compressor Relay C1300. • Disconnect: 4WAS Module C2131b. • Turn the air suspension service switch to the ON position. • Key in ON position. • Measure the voltage between 4WAS module C2131b pin 18, circuit 420 (DB/YE), harness side and ground. • **Is the voltage greater than zero volts?**	**Yes** REPAIR the circuit. CLEAR the DTC. REPEAT the self-test. **No** INSTALL a new 4WAS module. REFER to Air Suspension Control Module in this section. REPEAT the self-test.
I9 CHECK AIR COMPRESSOR RELAY CONNECTOR	
• Key in OFF position. • Turn the air suspension service switch to the OFF position. • Disconnect: Air Compressor Relay C1300. • Inspect the pins and terminals of the air compressor relay for corrosion, bent or broken pins, moisture, or other damage; inspect the wiring near the connector for damage. • **Is the connector OK?**	**Yes** RECONNECT air compressor relay. PLACE the air suspension service switch in the ON position. TEST the system for normal operation. If no DTCs are retrieved, the system is OK. If a DTC is retrieved, REFER to 4WAS Module Diagnostic Trouble Code (DTC) Index. **No** REPAIR as necessary. CLEAR the DTC. REPEAT the self-test.

PINPOINT TEST J: DTC C1840 — AIR SUSPENSION SERVICE SWITCH CIRCUIT FAILURE

Test Step	Result / Action to Take
J1 CHECK POSITION OF AIR SUSPENSION SERVICE SWITCH	
• Verify that the air suspension service switch is in the ON position. • **Is the air suspension service switch ON?**	**Yes** GO to J2 . **No** Turn ON the air suspension service switch. CLEAR the DTC. REPEAT the self-test. If DTC C1840 is retrieved, GO to J2 .
J2 CHECK THE AIR SUSPENSION SERVICE SWITCH	
• Turn the air suspension service switch to the OFF position. • Disconnect: Air Suspension Service Switch C4169. • Press the air suspension service switch ON and measure the resistance between pin 1 and 2. • **Is the resistance less than 5 ohms?**	**Yes** GO to J3 . **No** INSTALL a new air suspension service switch. CLEAR the DTC. REPEAT the self-test.
J3 CHECK CIRCUIT 418 (PK/LG) FOR OPEN	
• Key in OFF position. • Disconnect: 4WAS Module C2131b. • Measure the resistance between the air suspension service switch C4169 pin 2, circuit 418 (PK/LG)	**Yes** GO to J4 . **No**

(harness side), and 4WAS module C2131b pin 25 (harness side), circuit 418 (PK/LG). ● **Is the resistance less than 5 ohms?**	REPAIR circuit 418 (PK/LG). CLEAR the DTC. REPEAT the self-test.
J4 CHECK CIRCUIT 418 (PK/LG) FOR SHORT TO GROUND	
● Measure the resistance between the air suspension service switch C4169 pin 2 (harness side), circuit 418 (PK/LG) and ground. ● **Is the resistance greater than 10,000 ohms?**	**Yes** GO to J5 . **No** REPAIR circuit 418 (PK/LG). CLEAR the DTC. REPEAT the self-test.
J5 CHECK CIRCUIT 429 (PK/LG) FOR VOLTAGE	
● Connect: 4WAS Module C2131b. ● Key in ON position. ● Measure the voltage between the air suspension service switch C4169 pin 1 (harness side), circuit 429 (PK/LG) and ground. ● **Is the voltage 5 volts?**	**Yes** INSTALL a new 4WAS module. REFER to Air Suspension Control Module in this section. REPEAT the self-test. **No** REPAIR circuit 429 (PK/LG). CLEAR the DTC. REPEAT the self-test.

PINPOINT TEST K: THE AIR COMPRESSOR CONTINUOUSLY CYCLES WITH THE IGNITION SWITCH IN THE OFF POSITION AND NO DTC IS SET

Test Step	Result / Action to Take
K1 CHECK FOR MODULE ACTIVITY	
NOTE: The 4WAS module is powered for 40 minutes after the ignition is turned OFF. During this time, the air suspension system is still active and may activate system components. ● Key in OFF position. ● Check to see if the air compressor still cycles 50 minutes after the ignition is turned OFF. ● **Does the air compressor still cycle after the module goes to sleep?**	**Yes** GO to K2 . **No** The system is OK. INFORM the owner of system operations.
K2 CHECK THE 4WAS MODULE	
● Turn the air suspension service switch to the OFF position. ● Disconnect: 4WAS Module C2131b. ● **Does the air compressor still cycle?**	**Yes** GO to K3 . **No** INSTALL a new 4WAS module. REFER to Air Suspension Control Module in this section. REPEAT the self-test.
K3 CHECK THE AIR COMPRESSOR RELAY	
● Disconnect: Air Compressor Relay C1000. ● **Does the air compressor still cycle?**	**Yes** REPAIR circuit 538 (GY/RD). TEST the system for normal operation. **No** GO to K4 .

K4 CHECK CIRCUIT 420 (DB/YE) FOR SHORT TO GROUND	
• Measure the resistance between the air compressor relay C1000 pin D and ground. • **Is the resistance less than 10,000 ohms?**	**Yes** INSTALL a new air suspension relay. TEST the system for normal operation. **No** REPAIR circuit 420 (DB/YE). TEST the system for normal operation.

PINPOINT TEST L: AIR SUSPENSION SYSTEM INOPERATIVE WITHOUT DTCS AND VEHICLE AT REST

Test Step	Result / Action to Take
L1 CHECK 4WAS MODULE FOR IGNITION SWITCH ON INPUT	
• Enter the following diagnostic mode on the diagnostic tool: Scan Tool. • Monitor 4WAS module ignition switch position PID. • **Does the PID indicate that the ignition switch is in the ON position?**	**Yes** GO to L2 . **No** REPAIR circuit 1003 (GY/YE). TEST the system for normal operation.
L2 CHECK 4WAS MODULE FOR IGNITION SWITCH OFF INPUT	
NOTE: The ignition switch must initially be in the ON position for this test step to be valid. • Key in OFF position. • **Does the PID indicate that the ignition switch is in the ON position?**	**Yes** GO to L3 . **No** REPAIR circuit 1003 (GY/YE). TEST the system for normal operation.
L3 CHECK 4WAS MODULE FOR DOOR AJAR INPUT	
• Monitor 4WAS module door position status PID. • Close all doors, liftgate, and liftgate glass. • While observing the scan tool, open and close one door. • **Does the door status PID change between CLOSED and AJAR states?**	**Yes** GO to L4 . **No** CHECK for a UBP network fault. REFER to Section 418-00 .
L4 CHECK 4WAS MODULE FOR 4X4 STATE INPUT	
• Monitor 4WAS module PID 4WDLOW. • **NOTE:** The 4x4 light on the instrument panel will turn off when the system is in 2H mode. • Place the mode switch into 2H mode. • Place the mode switch into 4L mode. • Select NEUTRAL. • Press the brake pedal. • **Did PID 4WDLOW show OFF in 2H and ON in 4L, and did the cluster indicators agree with PID 4WDLOW?**	**Yes** GO to L5 . **No** CHECK for a UBP network fault. REFER to Section 418-00 .
L5 CHECK 4WAS MODULE FOR VSS INPUT	

• Monitor 4WAS module VSS PID. • Test drive the vehicle at different speeds. • **Does VSS PID track the speedometer within 8 km/h (5 mph)?**	**Yes** GO to L6 . **No** REPAIR circuit 679 (GY/BK). TEST the system for normal operation.
L6 CHECK PARK/NEUTRAL INPUT TO 4WAS MODULE	
• Monitor 4WAS module Park/Neutral switch PID. • Select DRIVE. • Select PARK. • **Does Park/Neutral switch PID show OFF with the vehicle in Drive and ON with the vehicle in Park?**	**Yes** RETRIEVE all DTCs and REFER to the 4WAS Module Diagnostic Trouble Code (DTC) Index and Symptom Chart for further diagnostics. **No** CHECK for a UBP network fault. REFER to Section 418-00 .

PINPOINT TEST M: AIR SUSPENSION SYSTEM OPERATES WITH AIR SUSPENSION SERVICE SWITCH IN THE OFF POSITION

Test Step	Result / Action to Take
NOTE: The air suspension system will operate at speeds greater that 24 km/h (15 mph) with the air suspension service switch in the OFF position.	
M1 CHECK AIR SUSPENSION SWITCH	
• Key in OFF position. • Turn the air suspension service switch to the OFF position. • Disconnect: Air Suspension Service Switch C4169. • Measure the resistance between air suspension service switch terminals. • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to M2 . **No** INSTALL a new air suspension service switch. TEST the system for normal operation.
M2 CHECK CIRCUIT 418 (DG/YE) FOR VOLTAGE	
• Disconnect: Air Suspension Service Switch C4169. • Key in ON position. • Measure the voltage between air suspension service switch C4169 pin 2, circuit 418 (DG/YE), harness side and ground. • **Is the voltage approximately 0 volts?**	**Yes** INSTALL a new 4WAS module. REFER to Air Suspension Control Module in this section. REPEAT the self-test. **No** REPAIR circuit 418 (DG/YE). TEST the system for normal operation.

PINPOINT TEST N: EXCESSIVE AIR COMPRESSOR NOISE

Test Step	Result / Action to Take
N1 CHECK FOR AIR COMPRESSOR AND/OR AIR COMPRESSOR WIRING CONTACTING OTHER COMPONENTS	
• Check the air compressor wiring to see if it is contacting other components inside the engine compartment at any place other than the mounting points.	**Yes** ADJUST air compressor wiring harness so that it does not contact non-mounting components or FASTEN/REMOVE objects so

• Check for anything contacting the air compressor (other wire harnesses, air lines, hoses, loose fasteners, stones or other foreign objects). • **Is the air compressor wiring contacting non-mounting components or is anything contacting the compressor assembly besides the mounts?**	they no longer contact the air compressor assembly. TEST the system for normal operation. **No** GO to N2 .
N2 CHECK FOR BENT AIR COMPRESSOR BRACKET	
• Check the air compressor bracket for any damage/bends that may contact other components within the engine compartment. • **Is the air compressor bracket making contact with other components?**	**Yes** REPAIR the air compressor and bracket assembly or other components as necessary. REFER to Air Suspension Compressor in this section. TEST the system for normal operation. **No** GO to N3 .
N3 CHECK AIR COMPRESSOR MOUNTS FOR DAMAGE	
• Check the air compressor mounts for signs of cracks or breaking away of insulation material. • **Are any faults in the mounts present?**	**Yes** INSTALL a new air compressor and bracket assembly. REFER to Air Suspension Compressor in this section. TEST the system for normal operation. **No** GO to N4 .
N4 CHECK AIR COMPRESSOR FOR NOISE	
CAUTION: Do not run the air compressor for more than three minutes. The air compressor can overheat and stop operating due to an internal temperature sensitive thermal breaker. • Remove the air compressor assembly, but leave it connected electrically. • Connect the diagnostic tool. • TRIGGER the 4WAS module compressor on active command. • **Is the air compressor noisy?**	**Yes** INSTALL a new air compressor assembly. REFER to Air Suspension Compressor in this section. TEST the system for normal operation. **No** RECHECK the mountings and bracket for damage. If damaged, INSTALL a new air compressor assembly. REFER to Air Suspension Compressor in this section. TEST the system for normal operation.

PINPOINT TEST O: THE COMPRESSOR IS INOPERATIVE

Test Step	Result / Action to Take
NOTE: This test is for the harness side of the relay circuitry. Refer to Wiring Diagrams Cell 149 , relay component for schematic and connector information.	
O1 CHECK AIR COMPRESSOR RELAY CONNECTOR	
• Disconnect: Air Compressor Relay C1000. • Inspect the pins of the air compressor relay connector for corrosion, bent or broken pins,	**Yes** GO to O2 .

moisture, or other damage. • **Is the air compressor relay C1000 OK?**	**No** REPAIR as necessary. TEST the system for normal operation.
O2 CHECK CIRCUIT 1053 (LB/BK) • Measure the voltage between air compressor relay C1000 pin 1, circuit 1053 (LB/BK), harness side and ground. • **Is the voltage greater than 10 volts?**	**Yes** GO to O3 . **No** REPAIR the circuit. TEST the system for normal operation.
O3 CHECK CIRCUIT 538 (GY/RD) • Disconnect: Air Compressor Assembly C194. • Measure the resistance between air compressor relay C1000 pin 5, circuit 538 (GY/RD), harness side and air compressor assembly C194 pin 4, circuit 538 (GY/RD), harness side. • **Is the resistance less than 5 ohms?**	**Yes** GO to O4 . **No** REPAIR the circuit. TEST the system for normal operation.
O4 CHECK CIRCUIT 577 (LG/RD) • Measure the resistance between air compressor assembly C194 pin 1, circuit 577 (LG/RD), harness side and ground. • **Is the resistance less than 5 ohms?**	**Yes** RECONNECT air compressor relay C1000 and air compressor assembly C194. GO to O5 . **No** REPAIR the circuit. TEST the system for normal operation.
O5 CHECK AIR COMPRESSOR AFTER COOL DOWN PERIOD • Turn the air suspension service switch to the OFF position. Allow the vehicle to sit for 60 minutes to give the air compressor assembly time to cool off. • Turn the air suspension service switch to the ON position. • Key in ON position. • TRIGGER the 4WAS module vent on active command. • TRIGGER the 4WAS module compressor on active command. • **Does the air compressor assembly run?**	**Yes** GO to O8 . **No** GO to O6 .
O6 CHECK AIR COMPRESSOR RELAY POWER • Disconnect: Air Compressor Relay C1000. • Measure the voltage between air compressor relay C1000 pin 2 circuit 577 (PK/LB), harness side and ground. • **Is the voltage less than 10 volts?**	**Yes** GO to O7 . **No** REPAIR circuit 577 (PK/LB). TEST the system for normal operation.
O7 CHECK AIR COMPRESSOR RELAY • Key in OFF position. • Connect a fused (50A) jumper wire (10 gauge) between air compressor relay C1000 pin 3, circuit 1053 (LB/BK), harness side and air compressor relay C1000 pin 5, circuit 538 (GY/RD), harness side. • **Does the air compressor run?**	**Yes** DISCONNECT the jumper wire. INSTALL a new air compressor relay. TEST the system for normal operation. **No** DISCONNECT the jumper wire. INSTALL a new air compressor. REFER to Air

	Suspension Compressor in this section. TEST the system for normal operation.
O8 CHECK AIR COMPRESSOR THERMAL BREAKER	
• TRIGGER the 4WAS module LR and RR air spring solenoid valve open active commands. • Run the air compressor assembly for 60 seconds. • **Did the air compressor assembly run for 60 seconds?**	**Yes** The thermal breaker was overheated. RETEST to validate the system is OK. **No** INSTALL a new air compressor assembly. REFER to Air Suspension Compressor in this section. TEST the system for normal operation.

Component Test

Relay

Refer to Wiring Diagrams Cell 149 for schematic and connector information.

Ride Height Adjustments

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052 or equivalent scan tool

Inflation and Deflation of the Air Suspension System

1. **NOTE:** Make sure that the air suspension switch is in the ON position

   NOTE: Make sure that a battery voltage of at least 11 volts is maintained while carrying out this procedure.

   Turn the ignition switch to the ON position.

2. Connect scan tool to the data link connector (DLC).

3. Select Air Suspension Control Module under Active Command Mode:
   - VENT FRNT to deflate the front down.
   - LIFT FRNT to inflate the front up.
   - VENT REAR to deflate the rear down.
   - LIFT REAR to inflate the rear up.

Calibration

Ride Height Resetting

1. **NOTE:** Make sure that the air suspension switch is in the ON position.

   NOTE: Make sure that a battery voltage of at least 11 volts is maintained while carrying out this procedure.

   Turn the ignition to the ON position.
   - Exit the vehicle, close all doors and allow the system to vent the vehicle down to kneel height (approximately 45 seconds).

2. With the ignition remaining in the ON position, shift the vehicle into DRIVE and then back to PARK.

- Exit the vehicle, close all doors and allow the vehicle to pump to trim (approximately 45 seconds).

3. Measure the ride height. For additional information, refer to Section 204-00 .
4. Open the LF door.
5. Connect scan tool to the data link connector (DLC).
6. While outside of the vehicle, select the proper vehicle year, model and engine type.
7. Select 4WAS module.
8. Using the active command mode, vent or lift the vehicle to achieve the correct ride height.
9. Select the "Save Calibration Values (Store Ride Height)" scan tool command to calibrate the 4WAS module.

Air Leaks

1. Apply a soapy water solution to the air lines, air line fittings, air springs and the air compressor.

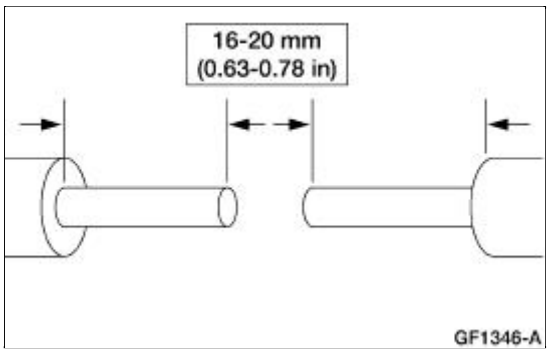
2. **NOTE:** If a leak is detected within the air compressor, install a new compressor. If a leak is detected in a line, carry out the air line repair procedure.

   Verify the location of air leak(s) and repair or install new components as necessary.

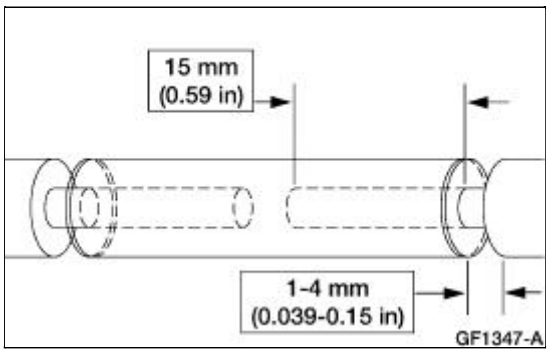
Air Line Repair

3. Cut the line at the damaged area.

4. Trim the sleeve material from both ends of the damaged line.



5. Install the repair filling.



6. **NOTE:** Check system for leaks.

   Inflate the air suspension system. For additional information, refer to Ride Height Adjustments in this section.

Air Line Fluid Purge

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052 or equivalent scan tool

1. **NOTE:** If oil is present in the air lines, remove the air spring solenoids and inspect the solenoid filters. If oil is present in a filter, replace the solenoid and the shock absorber.

   Disconnect the air line at the air compressor drier that is connected to the front fill solenoid inlet.

2. Disconnect the air line at the RF and LF air spring solenoids.

3. Connect shop air line to the disconnected air line (drier end) and blow out any fluid.

4. **NOTE:** When installing air lines, make sure the white air line is fully inserted into the fitting for correct installation.

   Reconnect the air line at the RF air spring solenoid.

5. Disconnect the air line at the RR and LR air spring solenoids.

6. Connect the shop air line (drier end) to the disconnected air line and blow out any fluid.

7. **NOTE:** When installing the air lines, make sure the white air line is fully inserted into the fitting for correct installation.

   Reconnect the air line at the RR and LR air spring solenoids.

8. Replace the air compressor drier. For additional information, refer to Air Suspension Compressor Drier in this section.

9. **NOTE:** When installing the air lines, make sure the white air line is fully inserted into the fitting for correct installation.

   Reconnect the air line to the air compressor drier.

10. **NOTE:** When installing the air lines, make sure the white air line is fully inserted into the fitting for correct installation.

    Reconnect the air line at the rear LH and RH air spring solenoids.

11. Replace the air compressor drier. For additional information, refer to Air Suspension Compressor Drier in this section.

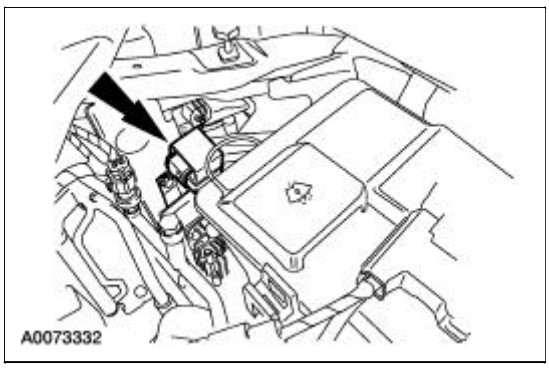
12. **NOTE:** When installing the air lines, make sure the white air line is fully inserted into the fitting for correct installation.

    Reconnect the air line to the air compressor drier.

Air Suspension Compressor

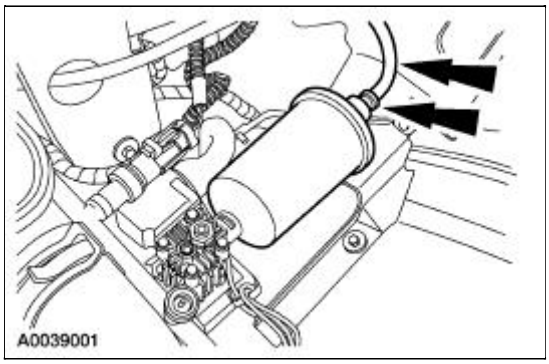
Removal and Installation

1. Remove the air suspension relay from the bracket (if equipped).

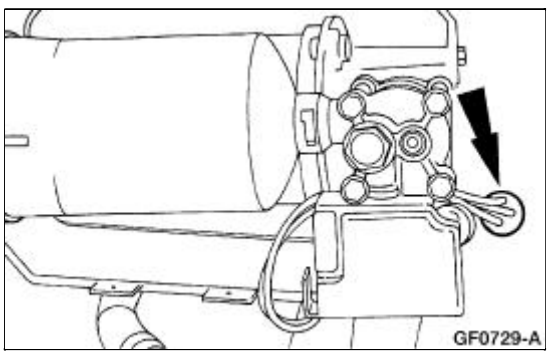


2. Remove the windshield washer pump and reservoir. For additional information, refer to Section 501-16 .

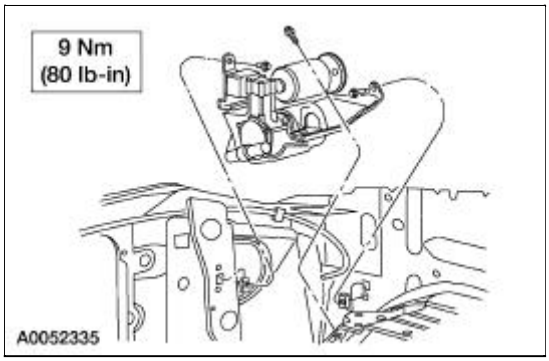
3. Compress the orange quick-connect lock ring inward while pulling outward on the air supply line.



4. Disconnect the air compressor electrical connector.



5. Remove the air compressor bracket bolts and remove the air compressor/drier assembly.



6. **NOTE:** When installing the air lines, make sure the white air line is fully inserted into the fitting for correct installation.

   To install, reverse the removal procedure.

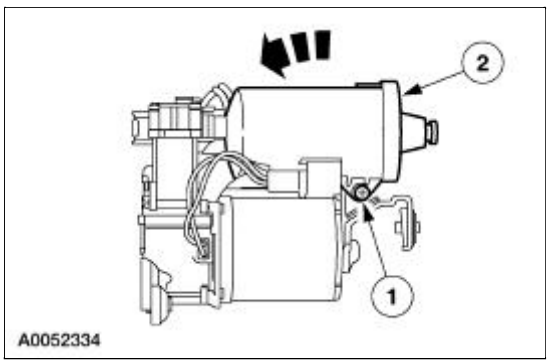
Air Suspension Compressor Drier

Removal

1. Remove the air compressor. For additional information, refer to Air Suspension Compressor in this section.

2. **NOTE:** Make sure that the drier O-ring does not remain inside of the compressor assembly.

   Remove the air compressor drier.
   1. Remove the screw.
   2. Rotate 90 degrees counterclockwise to unlock, then remove the air compressor drier.



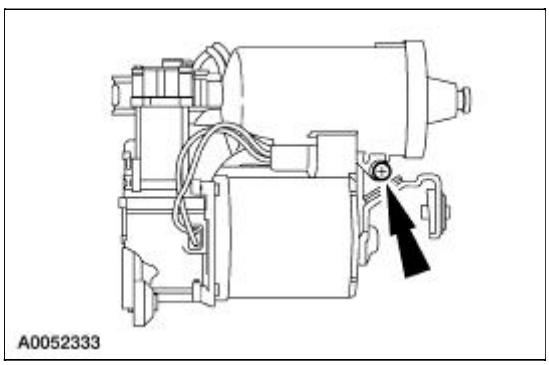
Installation

1. **NOTE:** Inspect the drier O-ring for damage and replace as necessary.

   NOTE: When installing the air lines, make sure the white air line is fully inserted into the fitting for correct installation.

   NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn the strategy.

   To install, reverse the removal procedure.



Air Suspension Control Module

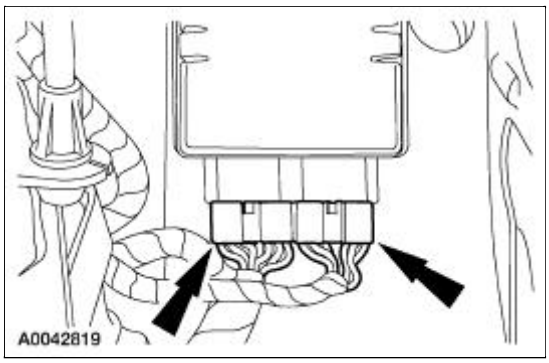
Removal and Installation

1. **CAUTION: Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage may result.**

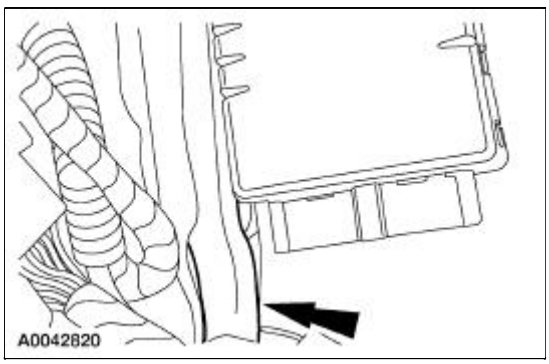
   Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

2. **NOTE:** The air suspension control module is mounted to the lower left side of the dash above the parking brake control.

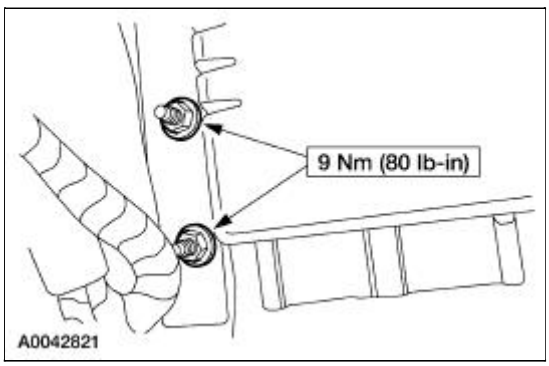
   Disconnect the electrical connectors.



3. Pull back the dash padding to expose the module mounting nuts.



4. Remove the air suspension control module nuts.



5. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

   NOTE: The air suspension control module is calibrated with information from the ride height sensor. A new or exchanged air suspension control module requires that the ride height adjustment calibration and pneumatic test be carried out. For additional information, refer to Calibration Initialize System — Clear C1990 and C1991 DTCs.

   To install, reverse the removal procedure.

Air Shock Absorber —Front

Material

Item	Specification
Multi-Purpose Grease XG-4	ESR-M1C159-A

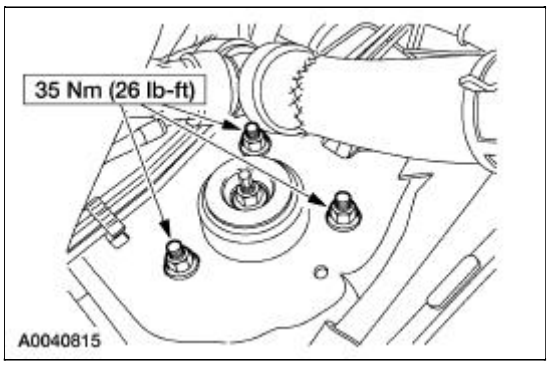
Removal and Installation

WARNING: Do not remove an air spring under any circumstances when there is pressure in the air spring. Do not remove any components supporting an air spring without either exhausting the air or providing support for the air spring to prevent vehicle damage or personal injury.

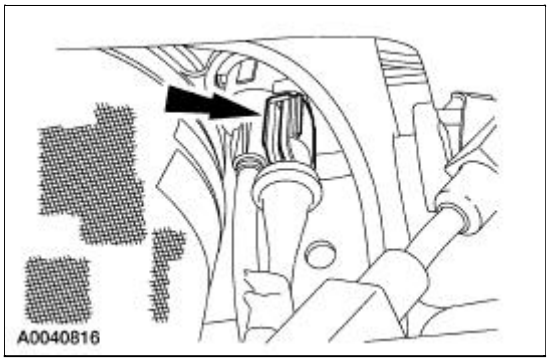
CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be used if installation is necessary. Do not use a new part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

1. Using the scan tool, vent the appropriate air spring(s).
2. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the LH rear quarter trim panel. Failure to do so may result in unexpected inflation or deflation of the air springs which may result in shifting of the vehicle during these operations.**

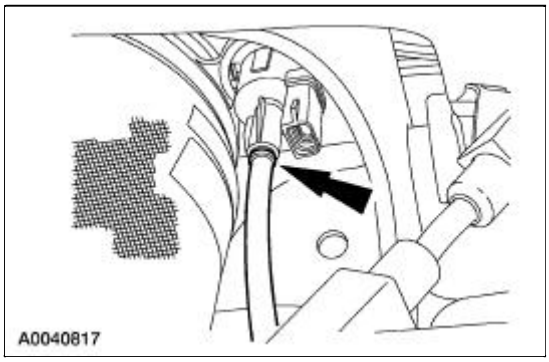
   Turn the air suspension switch to the OFF position.
3. Remove the nuts.
   - Discard the nuts.



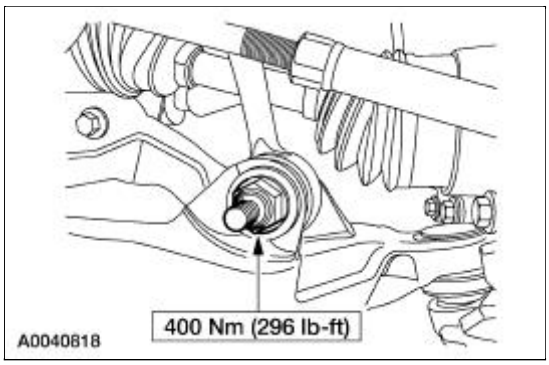
4. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .
5. Disconnect the electrical connector.



6. Compress the orange quick-connect lock ring while pulling outward on the air supply line.

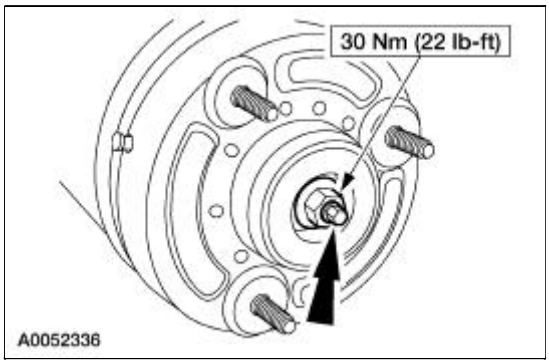


7. Remove the nut, bolt and the air shock absorber.
    - Discard the nut.



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

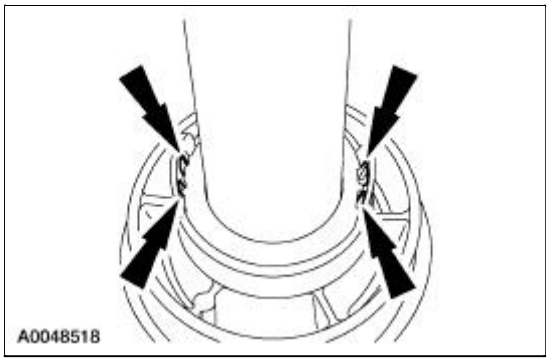
    Remove and discard the nut.



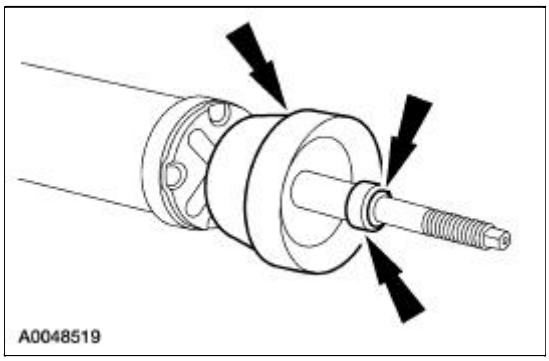
9. **CAUTION: If the retainer tabs are broken, a new air spring must be installed.**

   NOTE: Make an index mark on the air spring and the shock absorber for reference during the installation procedure.

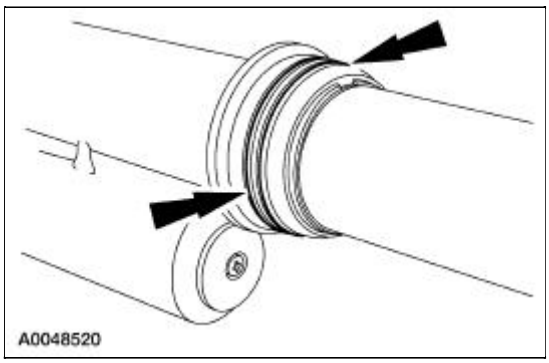
   Depress the retainer tabs and remove the air spring.



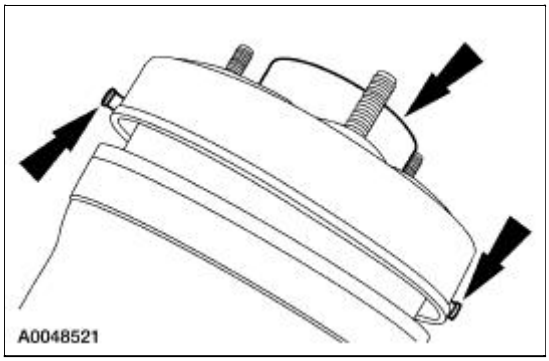
10. Remove the O-ring seal, washer and jounce bumper.
    - Discard the seal and washer.



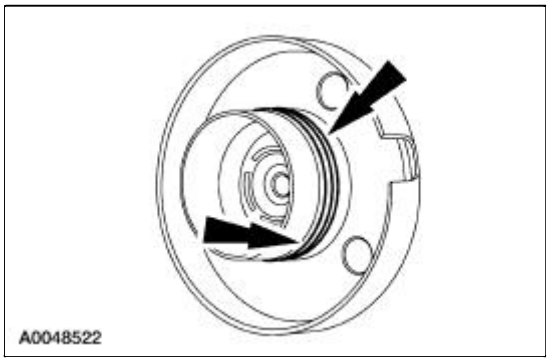
11. Remove and discard the O-ring seals.



12. Remove the retainer pins and the upper mount.
    - Discard the pins.



13. Remove and discard the O-ring seals.



14. **CAUTION: Use a suitable press to install the upper mount retainer pins. Do not use a hammer or damage may occur.**

    NOTE: During installation, use assembly kit 2L74-5B303-AA.

    NOTE: Make sure to apply a thin coat of grease to the new O-ring seals.

    To install, reverse the removal procedure.

Air Shock Absorber —Rear

Material

Item	Specification
Multi-Purpose Grease XG-4	ESR-M1C159-A

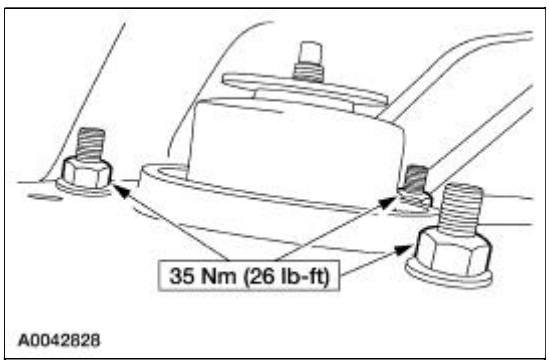
Removal and Installation

WARNING: Do not remove an air spring under any circumstances when there is pressure in the air spring. Do not remove any components supporting an air spring without either exhausting the air or providing support for the air spring to prevent vehicle damage or personal injury.

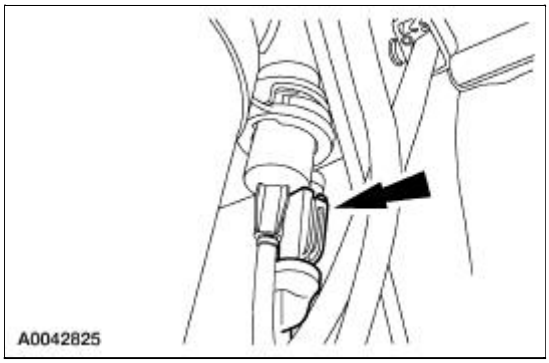
CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be used if installation is necessary. Do not use a new part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

1. Using the scan tool, vent the appropriate air spring.
2. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the LH quarter trim panel. Failure to do so may result in unexpected inflation or deflation of the air springs which may result in shifting of the vehicle during these operations.**

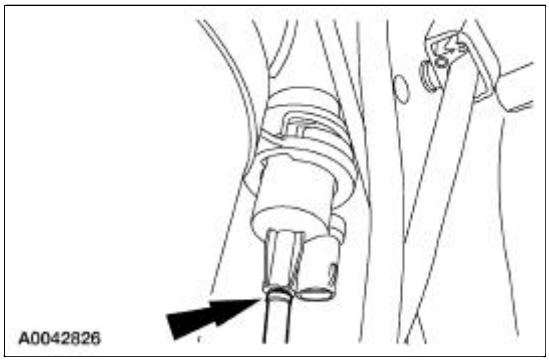
   Turn the air suspension switch to the OFF position.
3. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .
4. Remove the nuts.
   - Discard the nuts.



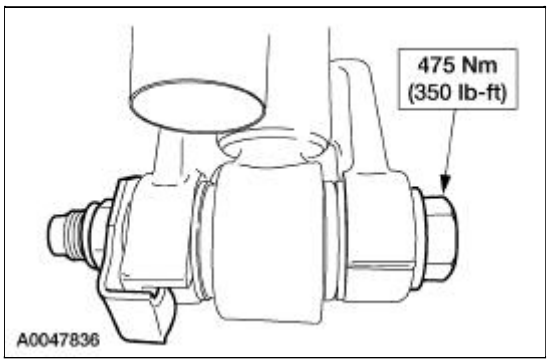
5. Disconnect the electrical connector.



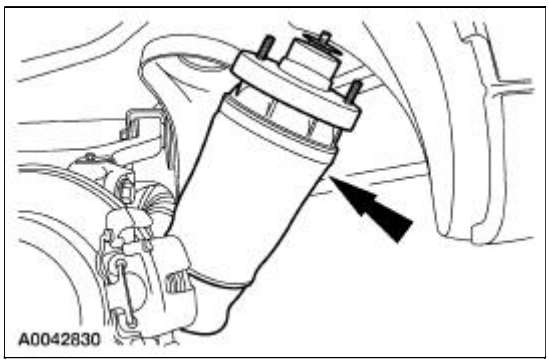
6. Compress the quick connect lock ring while pulling outward on the air supply line.



7. Remove the bolt and flag nut.
    - Discard the flag nut.

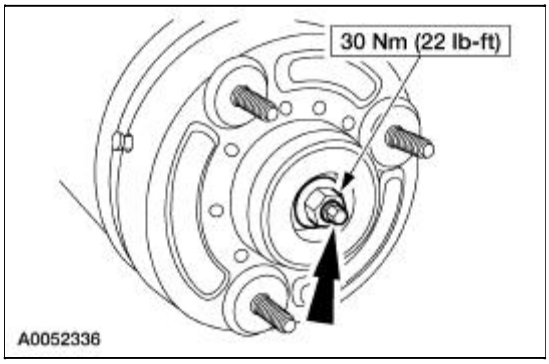


8. Remove the air shock absorber.



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

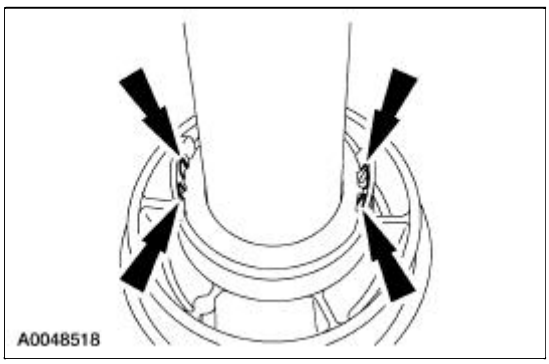
Remove and discard the nut.



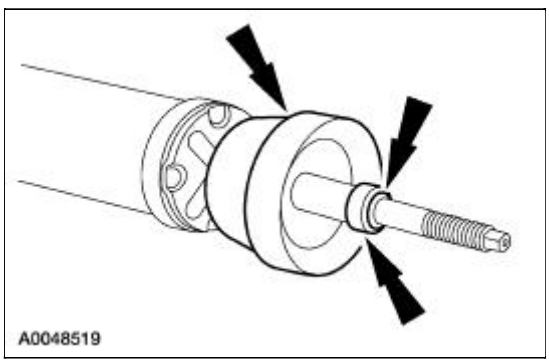
10. **CAUTION: If the retainer tabs are broken, a new air spring must be installed.**

    NOTE: Make an index mark on the air spring and shock absorber for reference during the installation procedure.

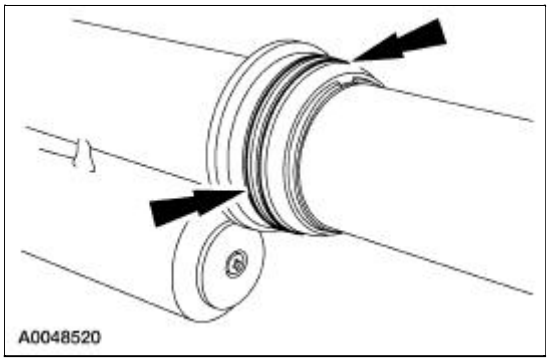
    Depress the retainer tabs and remove the air spring.



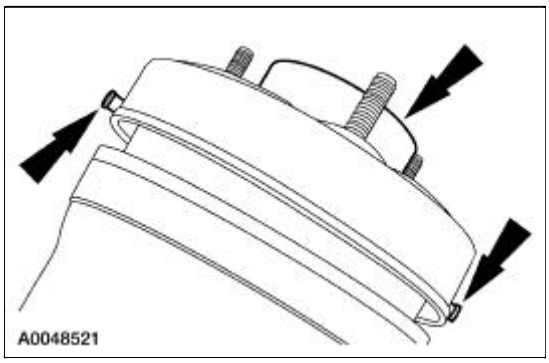
11. Remove the O-ring seal, washer and jounce bumper.
    - Discard the seal and washer.



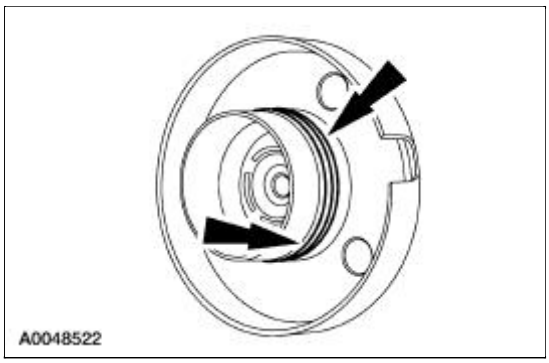
12. Remove and discard the O-ring seals.



13. Remove the retainer pins and the upper mount.
    - Discard the pins.



14. Remove and discard the O-ring seals.



15. **CAUTION: Use a suitable press to install the upper mount retainer pins. Do not use a hammer or damage may occur.**

    NOTE: During installation, use assembly kit 2L74-5B303-AA.

    NOTE: Make sure to apply a thin coat of grease to the new O-ring seals.

    To install, reverse the removal procedure.

Air Spring Solenoid Valve

Material

Item	Specification
Silicone Brake Caliper Grease and Dielectric Compound XG-3	ESE-M1C171-A

Removal and Installation

WARNING: Do not remove an air spring under any circumstances when there is pressure in the air spring. Do not remove any components supporting an air spring without either exhausting the air or providing support for the air spring to prevent vehicle damage or personal injury.

NOTE: Front shown, rear similar

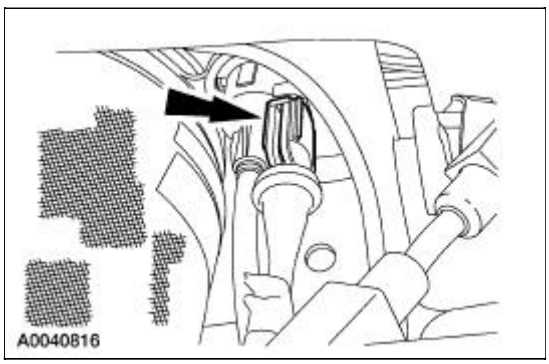
1. If the air spring solenoid valve is functional, use the scan tool to vent the appropriate air spring (s).

2. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the LH quarter trim panel. Failure to do so may result in unexpected inflation or deflation of the air springs which may result in shifting of the vehicle during these operations.**

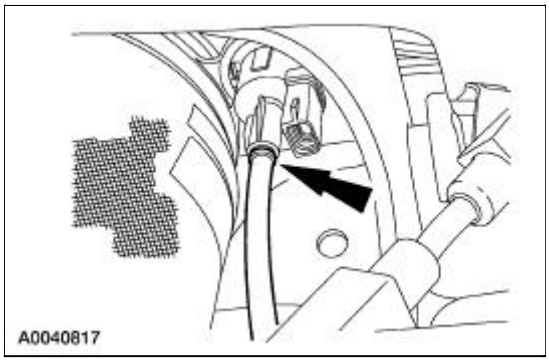
   Turn the air suspension switch to the OFF position.

3. Remove the wheel and tire assembly. For additional information, refer to Section 204-04

4. Disconnect the electrical connector.

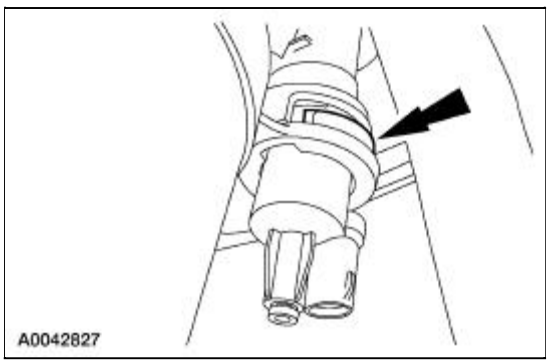


5. Compress the lock ring while pulling down on the air line and disconnect the air line.



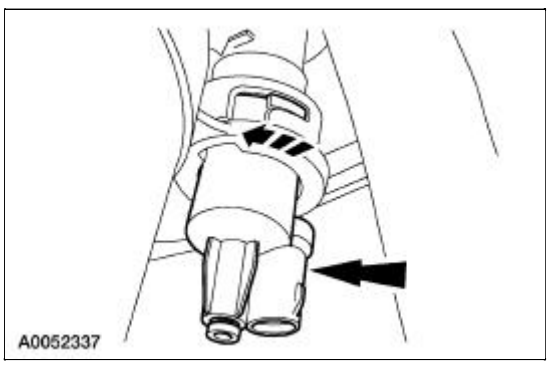
6. **CAUTION: Remove any dirt or other debris from the air spring assembly prior to removing the air spring solenoid valve from the air spring assembly.**

   Remove the air spring solenoid clip.



7. **WARNING: The air spring solenoid valve has a two stage release. When removing a non-functional solenoid and the air spring is inflated, carefully rotate the solenoid counterclockwise until it reaches the first stage to release the air from the air spring. Turn the solenoid to the second stage to remove the solenoid. Failure to follow these instructions when removing a non-functional air spring solenoid can cause personal injury or damage to components as high pressure air is vented uncontrolled.**

   Rotate the air spring solenoid and remove the solenoid.



8. **NOTE:** Inspect the O-ring for damage and install a new O-ring as necessary. Lubricate the solenoid seal area with silicone grease.

   NOTE: After installing the solenoid, it is necessary to inflate the air suspension system. For additional information, refer to Ride Height Adjustments in this section.

   NOTE: When installing the air lines, make sure the white air line is fully inserted into the fitting

for correct installation.

To install, reverse the removal procedure.

Suspension Height Sensor

Removal and Installation

NOTE: Front shown, rear similar

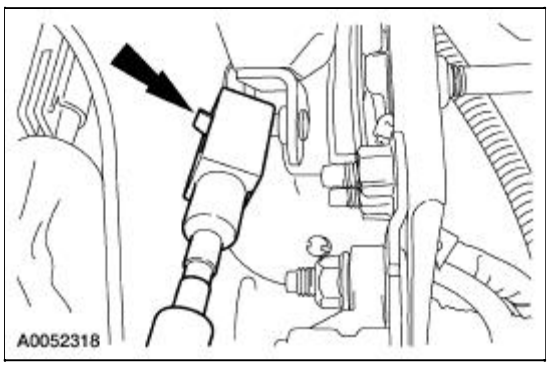
All vehicles

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the LH quarter trim panel. Failure to do so may result in unexpected inflation or deflation of the air springs which may result in shifting of the vehicle during these operations.**

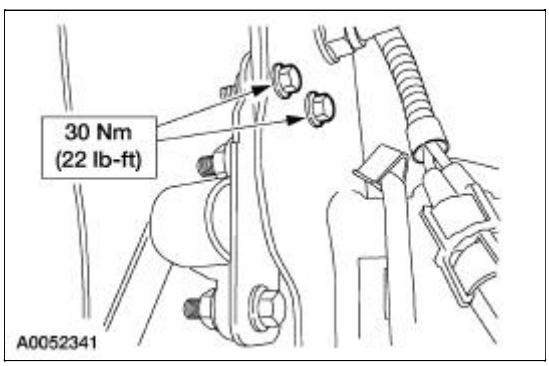
   Raise and support the vehicle. For additional information, refer to Section 100-02 .

Vehicles with bracket mounted sensor

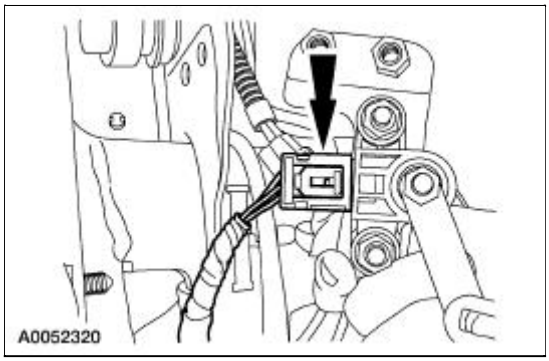
2. Disconnect the sensor arm.



3. Remove the bolts and the sensor.

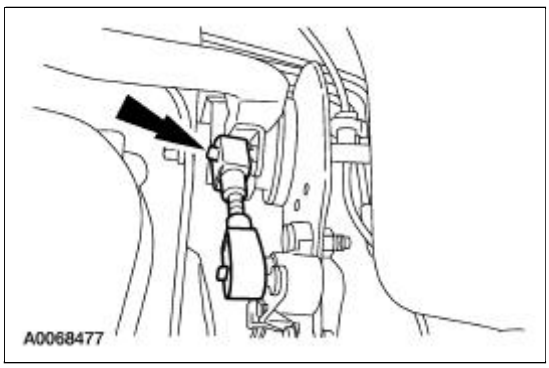


4. Disconnect the electrical connector.

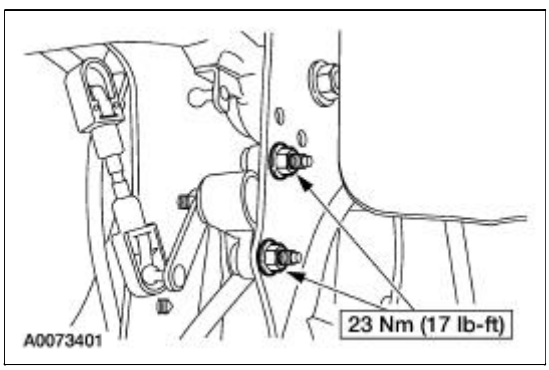


Vehicles with stud mounted sensor

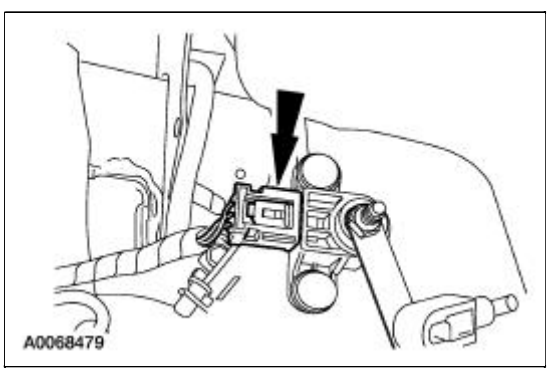
5. Disconnect the sensor arm.



6. Remove and discard the nuts.



7. Disconnect the electrical connector.



All vehicles

8. **NOTE:** The RH (3C112) and LH (3C113) height sensors cannot be used on opposite sides of the vehicle.

   To install, reverse the removal procedure.

General Specifications

Item	Specification
Driveline Angles	
Universal Joint Operating Angle	0.5°-3.0°
Axle Capacities and Lubricant Specifications	
SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL	WSL-M2C192-A
Additive Friction Modifier XL-3	EST-M2C118-A
Premium Long-Life Grease XG-1-C	ESA-M1C75-B
SAE-75W90 XY-75W90-QL	FEHP
Front axle liters (pints)	1.70 (3.6)
Conventional rear axle liters (pints) 8.8 in./9.75 in.	1.9 (4.0)
Traction-Lok® rear axle liters (pints) 8.8 in./9.75 in.	1.77 (3.75)
Traction-Lok® [a] ml (ounces)	118 (4)

[a] Friction Modifier

Driveline System

The source of the drivetrain's power is generated by the engine and delivered to the transmission. The driveline transfers the engine torque through the driveshaft to the axle.

- On 2-wheel drive vehicles, power is transmitted through the transmission to the driveshaft and then to the rear axle.
- On 4-wheel drive vehicles, power is transmitted through the transmission and the transfer case. The transfer case directs the power to the rear driveshaft and then to the rear axle. When engaged, it also transmits power through the front driveshaft to the front axle.

The rear driveshaft is connected to the output shaft of the transmission and to the rear axle. The front driveshaft is connected to the transfer case and to the front axle. Universal joints are used at both ends of the driveshaft to allow for angular motions. Slip yokes are used to allow for any changes to the length of the driveshaft. The engine torque enters the axle through the drive pinion, which rotates the ring gear. The ring gear is mounted to the differential case, which contains the gears that transmit power to the rear axle shafts or front halfshafts. These shafts rotate the drive wheels.

For additional information on the front axle assembly, refer to Section 205-03 .

For additional information on the halfshaft, refer to Section 205-04 .

For additional information on the driveshaft, refer to Section 205-01 .

For additional information on the rear axle, refer to Section 205-02A or to Section 205-02B .

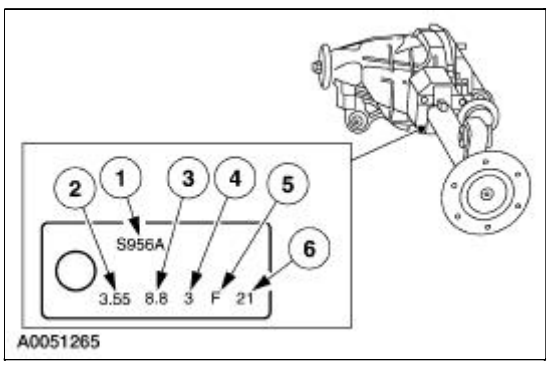
The engine angle is built into the engine mounts. If the engine angle is out of specification, the engine mounts must be inspected for damage. For additional information, refer to Section 303-01A for 4.6L or 5.4L engines.

Vehicle Certification (VC) Label Example



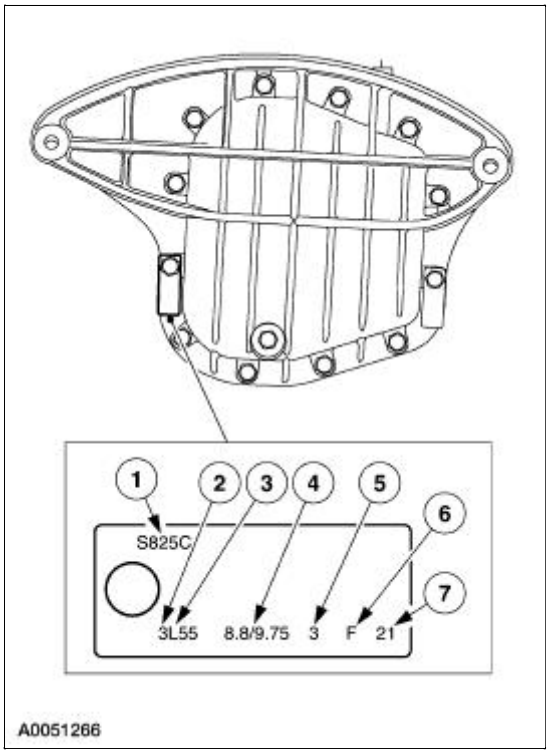
The vehicle certification (VC) label is located in the driver door jamb. The first two digits of the axle code indicate the rear axle and the third digit refers to the front axle, if so equipped. For additional information on the VC label, refer to Section 100-01 .

Front Axle Identification Tag



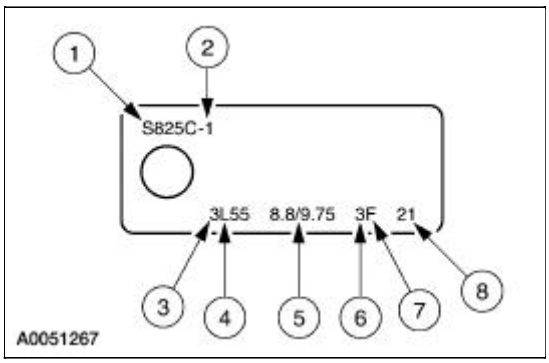
Item	Description
1	Plant code
2	Axle ratio
3	Ring gear diameter (inch)
4	Build year
5	Build month
6	Build day

Rear Axle Identification Tag



Item	Description
1	Plant code
2	Axle ratio
3	Denotes Traction-Lok®
4	Ring gear diameter (inch)
5	Build year
6	Build month
7	Build day

Axle Identification Tag Denoting Interchangeability Affected Internally



Item	Description
1	Plant code
2	Denotes interchangeability affected internally

3	Axle ratio
4	Denotes Traction-Lok®
5	Ring gear diameter (inch)
6	Build year
7	Build month
8	Build day

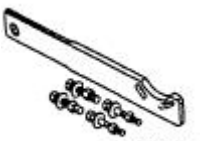
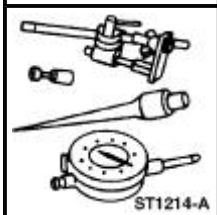
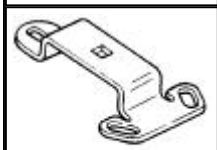
CAUTION: The axle identification tag is the official service identifier. Do not damage the tag. Always reinstall the tag after removing it for axle inspection/repair.

The plant code denotes a particular axle design, a specific ratio, and if it is a conventional or limited slip (Traction-Lok®) type. In addition, the plant code will not change as long as that particular axle assembly never undergoes an external design change. If, however, an internal design change takes place during the production life of the axle and that internal change affects parts interchangeability, a dash and numerical suffix is added to the plant code.

Note that the plant code in the front and rear axle identification tag illustrations is similar, but the illustration denoting interchangeability affected internally shows the addition of the suffix. This means that as an assembly both axles are interchangeable; however, internally they are different. Each axle requires different internal parts at the time of repair.

Driveline System

Special Tool(s)

 ST1268-A	Clamp Plate, Driveshaft 205-320 (T92L-4851-C)
 ST1348-A	Gauge, Clutch Housing 308-021 (T75L-4201-A)
 ST1257-A	Holding Fixture, Drive Pinion Flange 205-126 (T78P-4851-A)
 ST1267-A	Runout Gauge, Drive Pinion Flange 205-319 (T92L-4851-B)
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent
 ST1266-A	Dial Indicator Gauge with Holding Fixture 100-D002 (D78P-4201-B) or equivalent
 ST1863-A	Gauge, Differential (Traction-Lok) 205-385 (T97T-4205-B)

Inspection and Verification

Certain axle noise or vibration symptoms are also common to the engine, transmission, wheel bearings, tires, and other parts of the vehicle. For this reason, be sure that the cause of the trouble is in the axle before disassembling, adjusting or repairing the axle. For additional information, refer to Section 100-04 .

Certain driveshaft vibration symptoms are common to the front engine accessory drive (FEAD), the engine, transmission or tires. Be sure the cause of the concern is the driveshaft before repairing or installing a new driveshaft. For additional information, refer to Section 100-04 .

Certain symptoms may be caused by Traction-Lok® differentials. Check the vehicle certification label and axle identification tag to determine the type of differential. For additional information, refer to Section 100-01 .

Noise Acceptability

NOTE: A gear-driven unit will produce a certain amount of noise. Some noise is acceptable and audible at certain speeds or under various driving conditions such as a newly paved blacktop road. Slight noise is not detrimental to the operation of the axle and is considered normal.

With the Traction-Lok® differential axle, slight chatter noise on slow turns after extended highway driving is considered acceptable and has no detrimental effect on the locking axle function.

Universal Joint (U-Joint) Inspection

WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.

Place the vehicle on a frame hoist and rotate the driveshaft by hand. Check for rough operation or seized U-joint. Install a new U-joint if it shows signs of seizure, excessive wear, or incorrect seating. For additional information, refer to Section 205-01 .

Analysis of Leakage

Clean up the leaking area enough to identify the exact source. An axle leak can be caused by the following:

- Axle lubricant level is too high.
- Worn or damaged axle shaft seals or differential seals.
- Differential housing is cracked.
- Flange yoke seal is worn or damaged.
- Pinion flange is scored or damaged.
- Axle cover is not sealed.
- Vent is plugged.

Repair the axle as necessary. Make sure the axle lubricant is at the correct level. For additional information, refer to Specifications if this section.

Axle Vent

NOTE: If a plugged vent cannot be cleared, install a new one.

A plugged vent will cause excessive seal lip wear due to internal pressure buildup. If a leak occurs, check the vent. Make sure the vent hose is not kinked. Remove the hose from the vent nipple and clear the hose of any foreign material. While the hose is removed, pass a length of mechanics wire or a small diameter Allen wrench in and out of the vent to clean it. Connect the hose when done.

Flange Yoke Seal

Leaks at the axle drive pinion seal originate for the following reasons:

- Seal was not correctly installed.
- Poor quality seal journal surface.

Any damage to the seal bore (dings, dents, gouges, or other imperfections) will distort the seal casing and allow leakage past the outer edge of the axle drive pinion seal.

The axle drive pinion seal can be torn, cut, or gouged if it is not installed carefully. The spring that holds the axle drive pinion seal against the pinion flange may be knocked out and allow leakage past the lip.

The rubber lips can occasionally become hard (like plastic) with cracks at the oil lip contact point. The contact point on the pinion flange may blacken, indicating excessive heat. Marks, nicks, gouges, or rough surface texture on the seal journal of the pinion flange will also cause leaks.

Axle drive pinion seal wear 1.27 mm (0.050 inch) or greater is considered excessive.

A new pinion flange must be installed if any of these conditions exist.

Metal chips or sand trapped at the sealing lip may also cause oil leaks. This can cause a wear groove on the pinion flange and heavy pinion seal wear.

When a seal leak occurs, install a new seal and check the vent and the vent hose to make sure they are clean and free of foreign material.

Axle Shaft Seals

Axle shaft oil seals are susceptible to the same kinds of damage as axle drive pinion seals if incorrectly installed. The seal bore must be clean and the lip handled carefully to avoid cutting or tearing it. Axle shaft journal surface must be free of nicks, gouges, and rough surface texture.

Differential Seals

For additional information on differential seals, refer to Section 205-02A or Section 205-02B for the rear axle or Section 205-03 for the front axle.

Analysis of Vibration

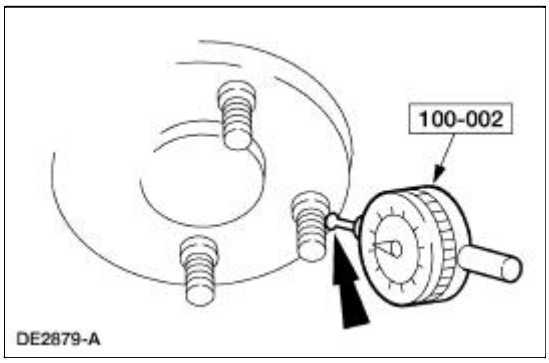
WARNING: A vehicle equipped with a Traction-Lok® differential will always have both wheels driving. If only one wheel is raised off the floor and the rear axle is driven by the engine, the wheel on the floor could drive the vehicle off the stand or jack. Be sure both rear wheels are off the floor.

Few vibration conditions are caused by the front or rear axle. On a vibration concern, follow the diagnosis procedure in Section 100-04 unless there is a good reason to suspect the axle.

Wheel Hub or Axle Flange Bolt Circle Runout

NOTE: The brake discs must be removed to carry out all runout measurements.

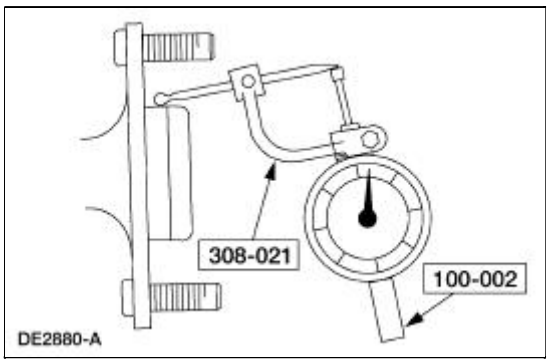
1. Position the special tool perpendicular to the wheel hub or axle flange bolt, as close to the hub or flange face as possible. Zero the indicator to allow the pointer to deflect either way.



2. Rotate the hub or flange until the next bolt is contacted. Record the measurement and continue until each bolt is checked. The difference between the maximum and minimum contact readings will be the total wheel hub or axle flange bolt pattern runout. The runout must not exceed 0.38 mm (0.015 inch).

Pilot Runout

1. Position the special tool as close to the hub or axle flange face as possible. Zero the indicator to allow the pointer to deflect either way.

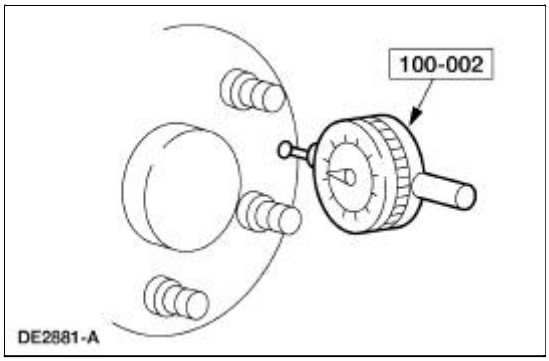


2. Rotate the hub or flange one full turn and note the maximum and minimum readings. The difference between the maximum and minimum readings will be the total pilot runout. Pilot runout must not exceed 0.15 mm (0.006 inch).

Wheel Hub or Axle Flange Face Runout

NOTE: If the axle shaft assembly is removed, check runout of the shaft itself. The forged (unmachined) part of the shaft is allowed to have as much as 3.0 mm (0.120 inch) runout. This alone will not cause a vibration condition.

1. Position the special tools on the wheel hub or axle flange face, as close to the outer edge as possible. Zero the indicator to allow the pointer to deflect either way.



2. Rotate the hub or flange one full turn and note the maximum and minimum readings. The difference between the maximum and minimum readings will be the total face runout. The runout must not exceed 0.254 mm (0.010 inch).

Drive Pinion Stem and Pinion Flange

Check the pinion flange runout when all other checks have failed to show the cause of vibration.

One cause of excessive pinion flange runout is incorrect installation of the axle drive pinion seal. Check to see if the spring on the seal lip has been dislodged before installing a new ring gear and pinion.

Halfshafts

NOTE: New constant velocity (CV) joints must not be installed unless disassembly and inspection reveals unusual wear. For additional information, refer to Section 205-04 or Section 205-05 .

NOTE: Inspect the boots for indentations ("dimples") in the boot convolutions. Indentations must be removed.

- Inspect the boots for evidence of cracks, tears, or splits.
- Inspect the underbody for any indication of grease splatter near the boots outboard and inboard locations. This is an indication of boot/clamp damage.

Axle Noise

NOTE: Before disassembling the axle to diagnose and correct gear noise, eliminate the tires, exhaust, trim items, roof racks, axle shafts and wheel bearings as possible causes. Follow the diagnostic procedures. For additional information, refer to Section 100-04 .

The noises described as follows usually have specific causes that can be diagnosed by observation as the unit is disassembled. The initial clues are the type of noise heard during the road test.

Gear Howl and Whine

Howling or whining of the ring gear and pinion is due to an incorrect gear pattern, gear damage or incorrect bearing preload.

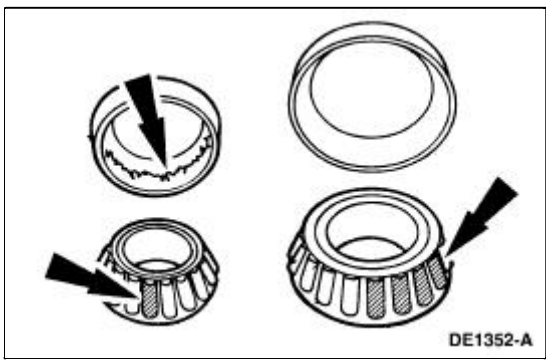
Bearing Whine

Bearing whine is a high-pitched sound similar to a whistle. It is usually caused by worn/damaged pinion bearings, which are operating at driveshaft speed. Bearing noise occurs at all driving speeds. This distinguishes it from gear whine which usually comes and goes as speed changes.

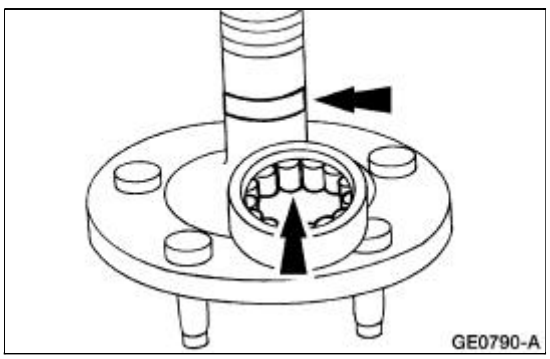
As noted, pinion bearings make a high-pitched, whistling noise, usually at all speeds. If however there is only one pinion bearing that is worn/damaged, the noise may vary in different driving phases. New pinion bearings must not be installed unless scoring or damage is found or there is a specific pinion bearing noise. A worn/damaged bearing will normally be obvious at disassembly. Examine the large end of the rollers for wear. If the pinion bearings original blend radius has worn to a sharp edge, a new pinion bearing must be installed.

NOTE: A low-pitched rumble normally associated with a worn/damaged wheel bearing can be caused by the exterior luggage rack or tires.

A wheel bearing noise can be mistaken for a pinion bearing noise. On 4x2 vehicles, check the wheel bearing for a spalled cup, and spalled/damaged rollers. Install a new wheel bearing if any of these concerns are detected.



If the wheel bearing is damaged, the roller surface on the axle shaft may also be damaged. Install a new axle shaft if any damage is detected.



On 4x4 vehicles, check the wheel bearing for rotating smoothness and end play. Install new wheel bearings as required.

Chuckle

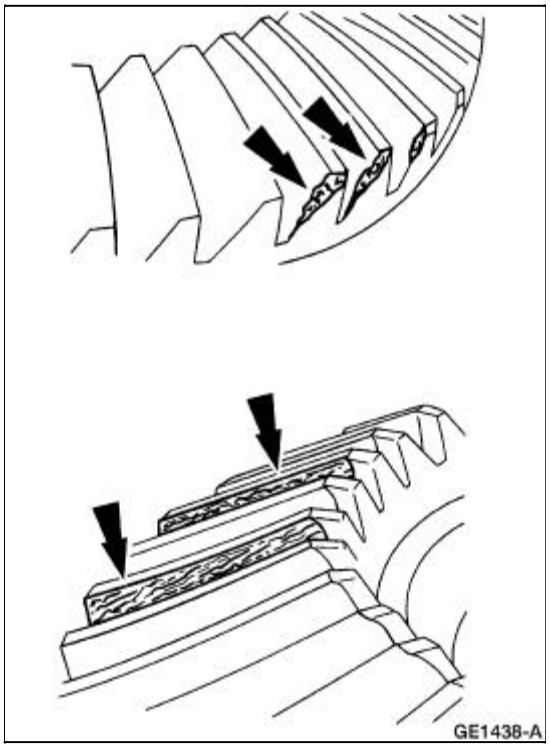
Chuckle that occurs on the coast driving phase is usually caused by excessive clearance between the differential gear hub and the differential case bore.

Damage to a gear tooth on the coast side can cause a noise identical to a chuckle. A very small tooth nick or ridge on the edge of a tooth can cause the noise.

Clean the gear tooth nick or ridge with a small grinding wheel. If the damaged area is larger than 3.2 mm (1/8 inch), install a new gearset.

To check the ring gear and pinion, remove as much lubricant as possible from the gears with clean solvent. Wipe the gears dry or blow them dry with compressed air. Look for scored or damaged teeth. Also look for cracks or other damage.

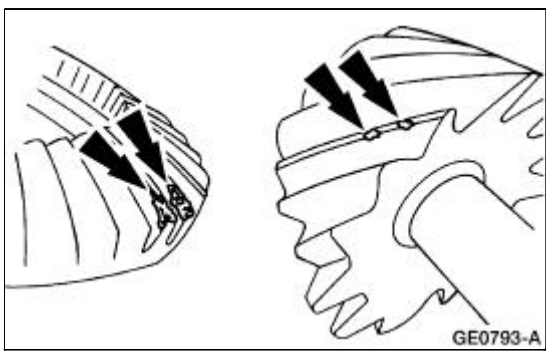
If either gear is scored or damaged badly, a new ring gear and pinion must be installed.



If metal has broken loose, the axle housing must be cleaned to remove particles that will cause damage. At this time if any other damaged parts are found in the axle housing, new parts must also be installed.

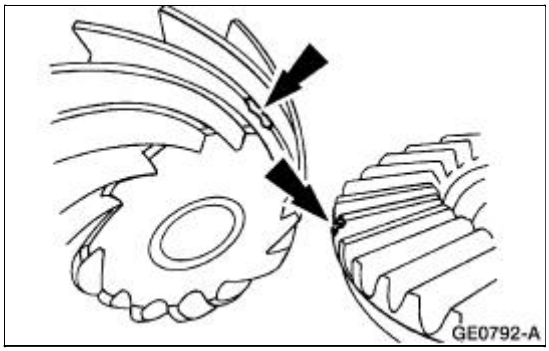
Knock

Knock, which can occur on all driving phases, has several causes including damaged teeth or gearset.



In most cases, one of the following conditions will occur:

1. A gear tooth damaged on the drive side is a common cause of the knock. This can usually be corrected by grinding the damaged area.



2. **NOTE:** Measure the end play with a Dial Indicator Gauge with Holding Fixture and not by feel.

   The knock is also caused by excessive end play in the axle shafts. Up to 0.762 mm (0.030 inch) is allowed in semi-float axles. The frequency of the knock will be less because the axle shaft speed is slower than the driveshaft.

Clunk

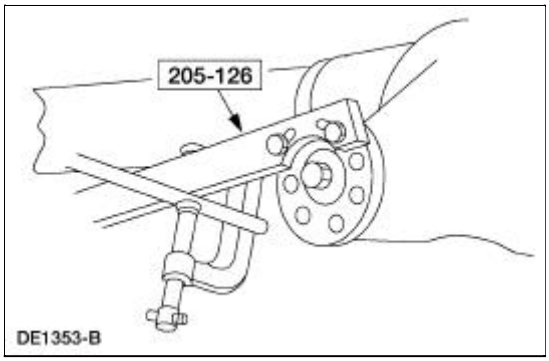
Clunk is a metallic noise heard when the automatic transmission is engaged in REVERSE or DRIVE. The noise may also occur when throttle is applied or released. It is caused by backlash somewhere in the driveline or loose suspension components; it is felt or heard in the axle. Refer to Total Backlash Check in this section.

Additionally, clunk may be heard upon initial drive-away. This occurs as engine torque shifts vehicle weight, forcing changes in driveline angles, preventing the driveshaft slip-yoke from sliding on the output shaft. To correct this condition, lubricate the slip-yoke splines. For additional information, refer to Section 205-01 .

Total Backlash Check

WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Remove the driveshaft. For additional information, refer to Section 205-01 .
3. Install the special tool.
   - Clamp a rigid bar or pipe to the tool. Clamp the other end of the bar or pipe to the frame or a body member in order to prevent movement of the pinion flange.



4. Lower the vehicle so that one rear wheel is resting on a wheel chock to prevent it from turning. The other rear wheel will be used to measure total rear axle backlash.

5. Rotate the free wheel slowly, by hand, until the feeling of driving the rear axle is encountered. Place a mark on the side of the tire, 305 mm (12 inches) from the center of the wheel, with a crayon or chalk.

6. While holding the crayon or chalk against the tire, rotate the wheel slowly in the opposite direction until the feeling of driving the rear axle is encountered again.

7. Measure the length of the crayon or chalk mark on the tire.
    - If the length of the mark is 25.4 mm (1 inch) or less, the rear axle backlash is within allowable limits.
    - If the chalk mark is greater than 25.4 mm (1 inch), check for these conditions:
        - Elongation of the differential pinion shaft and holes in the differential case (4204).
        - Missing differential pinion thrust washer (4230) or differential side gear thrust washer (4228)
        - Galling of the differential pinion shaft (4211) and bore.
        - Excessive ring gear and pinion backlash. Follow the procedure for the type of rear axle to check backlash.

Axle Shaft Bearing Noise

Axle shaft bearing noise is similar to gear noise and differential pinion bearing whine. Axle shaft bearing noise will usually distinguish itself from gear noise by occurring in all driving modes (drive, coast, and float), and will persist with the transmission in NEUTRAL while the vehicle is moving at the speed in which the concern is occurring. If the vehicle makes this noise, remove the suspect axle shaft and install a new bearing and axle seal. Re-evaluate the vehicle for noise before removing any internal components.

Bearing Rumble

Bearing rumble sounds like marbles being tumbled. This condition is usually caused by a worn/damaged wheel bearing. The lower pitch is because the wheel bearing turns at only about one-third of the driveshaft speed. Wheel bearing noise also may be high-pitched, similar to gear noise, but will be evident in all four driving modes.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action

• Traction-Lok® does not work in snow, mud or on ice	• Differential.	• CARRY OUT the Traction-Lok® Differential Operation Check in this section. REPAIR as necessary. REFER to Section 205-02A or Section 205-02B .
• Lubricant leaking from the pinion seal, axle shaft oil seals or support arm to the housing	• Vent. • Damage in the seal contact area or dust slinger on the pinion flange dust shield.	• CLEAN the axle housing vent. • INSTALL a new pinion flange and the pinion seal if damage is found.
• The vehicle does not shift between the different modes correctly	• Mode switch. • Wiring/relays. • Shift motor. • Transfer case. • GEM.	• REFER to Section 308-07A .
• Front axle will not engage	• Switches • Wiring. • GEM. • Shift motor.	• REFER to Section 308-07A .
• Front axle will not disengage	• Switches. • Wiring. • GEM. • Shift motor.	• REFER to Section 308-07A .
• Differential side gears/pinion gears are scored	• Insufficient lubrication. • Incorrect or contaminated lubricant type	• INSTALL new gears. REFER to Section 205-02A , Section 205-02B or Section 205-03 . FILL the axle to specification. • INSTALL new gears. REFER to Section 205-02A , Section 205-02B or Section 205-03 . CLEAN and REFILL the axle to specification.
• Axle overheating	• Lubricant level too low. • Incorrect or contaminated lubrication type. • Bearing preload adjusted too tight. • Excessive gear wear. • Incorrect ring gear backlash	• CHECK the lubricant level. FILL the axle to specification. • INSPECT the axle for damage. REPAIR as necessary. CLEAN and REFILL the axle to specification. • CHECK the ring and pinion for damage. INSPECT the ring and pinion wear pattern. ADJUST the preload as necessary. • INSPECT all the axle gears for wear or damaged. INSTALL new components as necessary. • INSPECT the ring gear for scoring. INSPECT the ring and pinion wear pattern. ADJUST the ring gear backlash as necessary.

• Broken gear teeth on the ring gear or pinion	• Overloading the vehicle.	• INSTALL a new ring and pinion. REFER to Section 205-02A , Section 205-02B or Section 205-03 .
• Axle shaft broken	• Overloading the vehicle. • Misaligned axle shaft tube.	• INSTALL a new axle shaft. REFER to Section 205-02A , Section 205-02B or Section 205-03 . • INSPECT the axle for damage. CHECK axle shaft tube alignment. INSTALL a new axle shaft. REFER to Section 205-02A , Section 205-02B or Section 205-03 .

Component Tests

Driveline Vibration

WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.

Driveline vibration exhibits a higher frequency and lower amplitude than does high-speed shake. Driveline vibration is directly related to the speed of the vehicle and is usually noticed at various speed ranges. Driveline vibration can be perceived as a tremor in the floor pan or is heard as a rumble, hum, or boom. Driveline vibration can exist in all drive modes, but may exhibit different symptoms depending upon whether the vehicle is accelerating, decelerating, floating, or coasting. Check the driveline angles if the vibration is particularly noticeable during acceleration or deceleration, especially at lower speeds. Driveline vibration can be duplicated by supporting the axle upon a hoist or upon jack stands, though the brakes may need to be applied lightly in order to simulate road resistance.

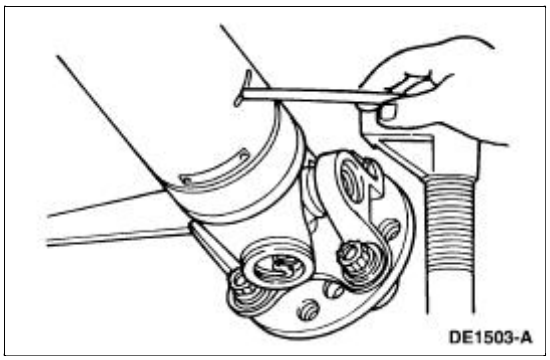
1. Raise the vehicle promptly after road testing. Use twin-post hoist or jack stands to prevent tire flat-spotting. Engage the drivetrain and accelerate to the observed road test speed to verify the presence of the vibration. If the vibration is not evident, check the non-driving wheels with a wheel balancer to rule out imbalance as a possible cause. If required, balance the non-driving wheels and repeat the road test. If the vibration is still evident, proceed to Step 2.

2. Mark the relative position of the drive wheels to the wheel bolts. Remove the wheels. Install all the wheel nuts in the reversed position and repeat the road speed acceleration. If the vibration is gone, refer to the tire and wheel runout procedure in Section 204-04 . If the vibration persists, proceed to Step 3.

3. Inspect the driveshaft(s) for signs of physical damage, missing balance weight, undercoating, incorrect seating, wear and binding universal joints (4635). Clean the driveshaft and install new universal joints or install a new driveshaft if damaged. Check the index marks (paint spots) on the rear of the driveshaft and pinion flange. If these marks are more than one quarter turn apart, disconnect the driveshaft and re-index to align the marks as closely as possible. After any corrections are made, recheck for vibration at the road test speed. If the vibration is gone, reinstall the wheels and road test. If the vibration persists, proceed to Step 4.

4. Raise the vehicle on a hoist and remove the wheels. Rotate the driveshaft by turning the axle and measure the runout at the front, the center, and the rear of the driveshaft with the indicator. If the runout exceeds 0.89 mm (0.035 inch) at the front or center, a new driveshaft must be

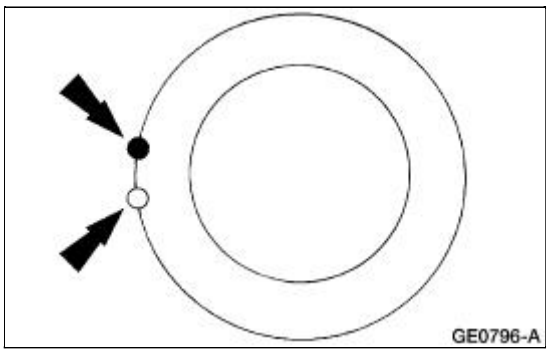
installed. If the front and center are within this limit, but the rear runout is not, mark the rear runout high point and proceed to Step 5. If the runout is within the limits at all points, proceed to Step 7.



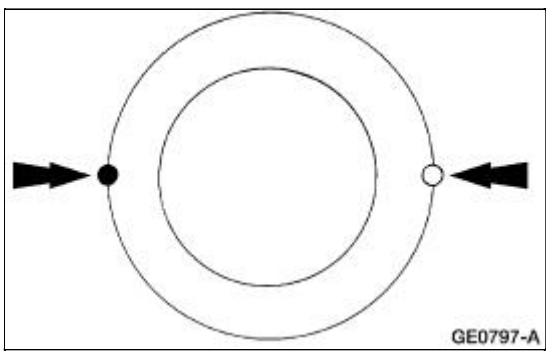
5. **NOTE:** Check the U-joints during re-indexing. If a U-joint feels stiff or gritty, install new U-joints.

   Scribe alignment marks on the driveshaft and the pinion flange. Disconnect the driveshaft, rotate it one half turn, and reconnect it. Circular pinion flanges can be turned in one quarter increments to fine tune the runout condition; half-round pinion flanges are limited to two positions. Check the runout at the rear of the driveshaft. If it is still over 0.89 mm (0.035 inch), mark the high point and proceed to Step 6. If the runout is no longer excessive, check for vibration at the road test speed. If vibration is still present, re-index the driveshaft slip-yoke on the transmission output shaft one half turn and road test the vehicle. If the vibration persists, proceed to Step 7.

6. Excessive driveshaft runout may originate in the driveshaft itself or in the pinion flange. To determine which, compare the two high points marked in Steps 4 and 5. If the marks are close together, within about 25 mm (1 inch), a new driveshaft must be installed and the vehicle road tested.



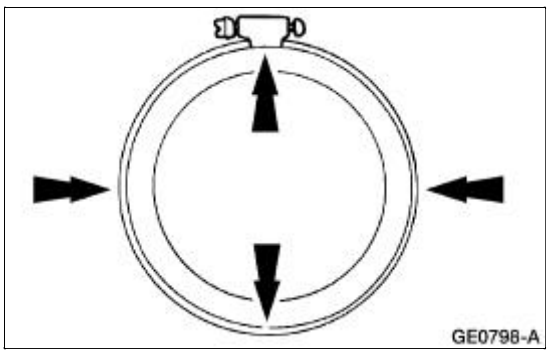
If the marks are on opposite sides of the driveshaft, the yoke or pinion flange is responsible for the vibration.



When installing a new pinion flange, the driveshaft runout must not exceed 0.89 mm (0.035 inch). When runout is within limits, recheck for vibration at road speed. If vibration persists, balance the driveshaft.

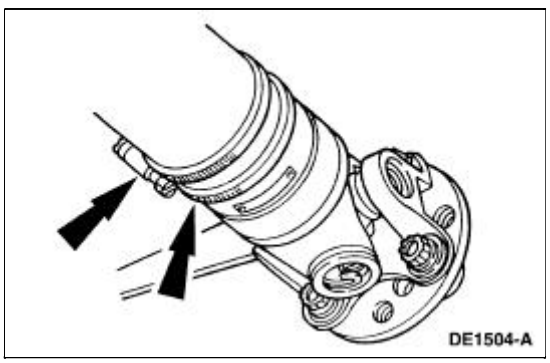
7. To balance the driveshaft, install one or two hose clamps on the driveshaft, near the rear. Position of the hose clamp head(s) can be determined by trial-and-error.

8. Mark the rear of the driveshaft into four approximately equal sectors and number the marks 1 through 4. Install a hose clamp on the driveshaft with its head at position No. 1.

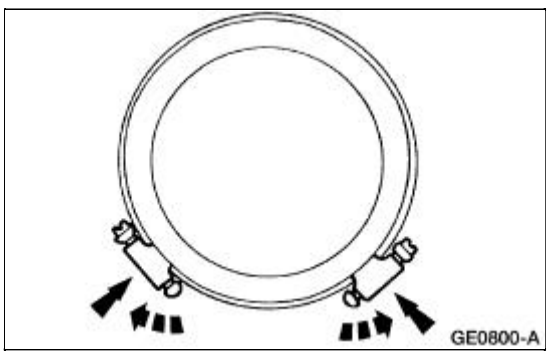


Check for vibration at road speed. Recheck with the clamp at each of the other positions to find the position that shows minimum vibration. If two adjacent positions show equal improvement, position the clamp head between them.

9. If the vibration persists, add a second clamp at the same position and recheck for vibration.



If no improvement is noted, rotate the clamps in opposite directions, equal distances from the best position determined in Step 8. Separate the clamp heads about 13 mm (1/2 inch) and recheck for vibration at the road speed.



Repeat the process with increasing separation until the best combination is found or the vibration is reduced to an acceptable level.

10. Install the wheels and road test (vibration noticeable on the hoist may not be evident during the road test). If the vibration is still not acceptable, install a new axle drive line vibration damper first, if so equipped. If the vibration is still not acceptable, refer to Section 205-02A or Section 205-02B for differential case and ring gear runout checks.

Driveshaft Vibrates

1. Road test the vehicle to determine the critical vibration points. Note the road speed, the engine rpm, and the shift lever positions at which the vibration occurs.

2. Stop the vehicle, place the transmission lever in neutral and run the engine through the critical speed ranges determined in Step 1.

3. If no vibration is felt, balance the driveshaft. Refer to Driveline Vibration in this section.

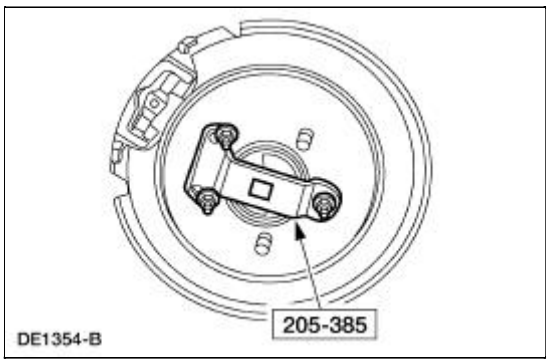
Traction-Lok® Differential Operation Check

A Traction-Lok® differential can be checked for correct operation without removing it from the rear axle housing (4010).

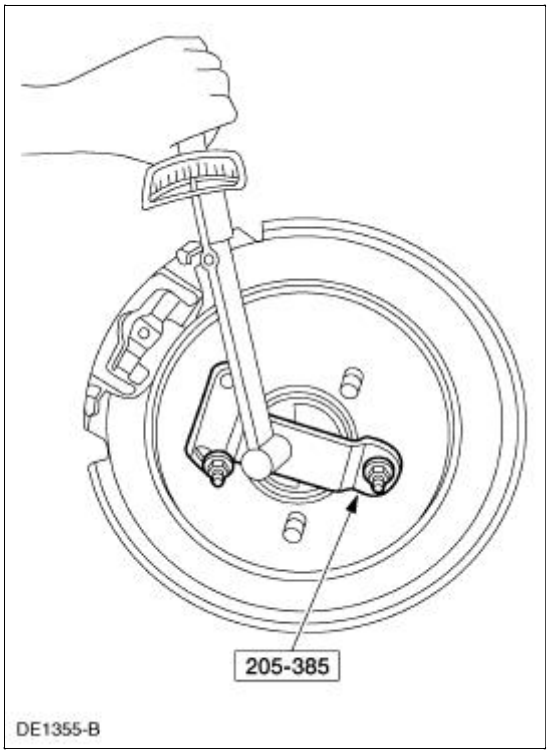
WARNING: A vehicle equipped with a Traction-Lok® differential will always have both wheels driving. If only one wheel is raised off the floor and the rear axle is driven by the engine, the wheel on the floor could drive the vehicle off the stand or jack. Be sure both rear wheels are off the floor.

WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.

Raise and remove only one rear wheel. Install the special tool on the wheel bolts.



Use a torque wrench with the capacity of at least 271 Nm (200 lb-ft) to rotate the axle shaft. Be sure that the transmission is in NEUTRAL, and that one rear wheel is on the floor while the other rear wheel is raised off the floor. The breakaway torque required to start rotation must be at least 27 Nm (20 lb-ft). The initial breakaway torque may be higher than the continuous turning torque.



The axle shaft must turn with even pressure throughout the check without slipping or binding. If the torque reading is less than specified, check the differential case for incorrect assembly.

Traction-Lok® Differential Check Road Test

1. Place one wheel on a dry surface and the other wheel on ice, mud or snow.
2. Gradually open the throttle to obtain maximum traction prior to break away. The ability to move the vehicle demonstrates correct performance of a Traction-Lok® rear axle assembly (4006).
3. When starting with one wheel on an excessively slippery surface, a slight application of the parking brake may be necessary to help energize the Traction-Lok® feature of the differential. Release the brake when traction is established. Use light throttle on starting to provide maximum traction.
4. If, with unequal traction, both wheels slip, the limited slip rear axle has done all it can possibly do.
5. In extreme cases of differences in traction, the wheel with the least traction may spin after the Traction-Lok® has transferred as much torque as possible to the non-slipping wheel.

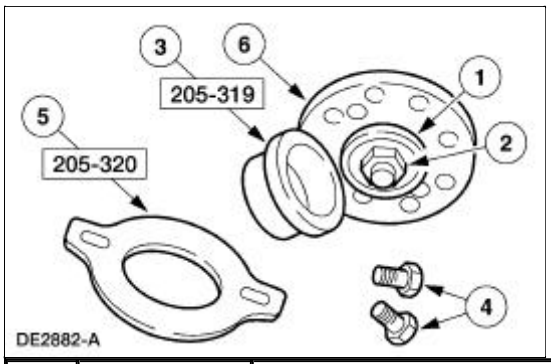
Pinion Flange Runout Check — Circular

WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.

CAUTION: Pinion bearing preload must be reset if the pinion nut has been loosened or

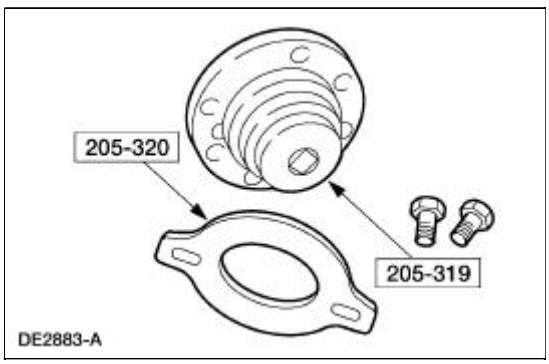
removed for pinion flange reindexing or replacement.

1. Raise the vehicle on a twin-post hoist that supports the rear axle.
2. Remove the driveshaft. For additional information, refer to Section 205-01 .
3. Check the pinion flange for damage.
4. Position special tool on the pinion flange.

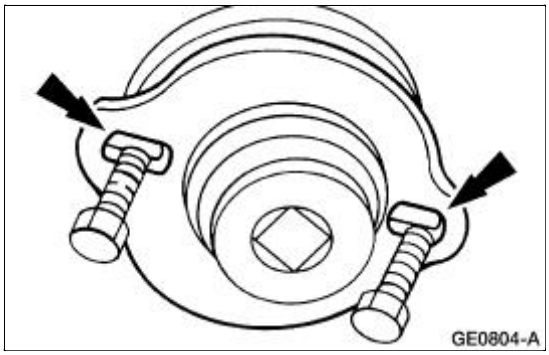


Item	Part Number	Description
1	—	Pilot (part of 205-319) (T92L-4851-B)
2	354845	Pinion nut
3	205-319	Gauge, Companion Flange Runout (T92L-4851-B)
4	—	Bolts (2 req'd) (part of 205-320) (T92L-4851-C)
5	205-320	Plate, Companion Flange (T92L-4851-C)
6	4851	Pinion flange

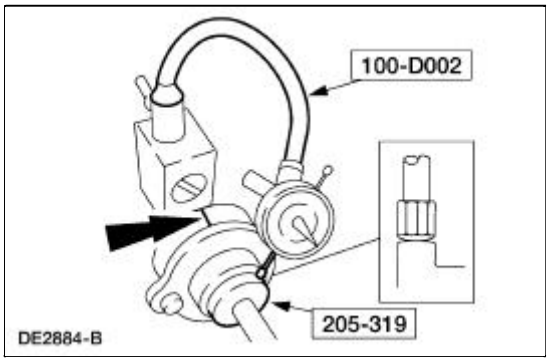
5. Position the special tools onto the pinion flange.



6. Align the holes on the clamp plate with the holes in the pinion flange and install the bolts. Snug the bolts evenly.

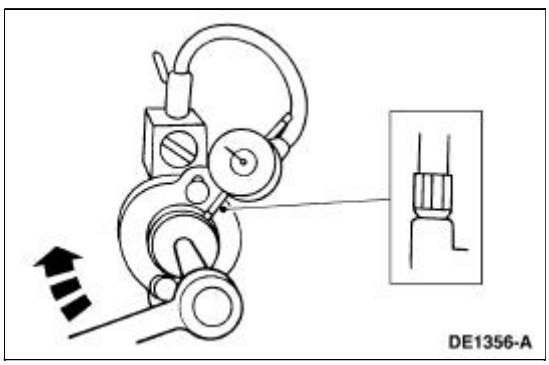


7. Position the special tool as shown. Turn the special tool, and locate and mark the high spot on the pinion flange with yellow paint.



If the flange runout exceeds 0.25 mm (0.010 inch), remove the pinion flange, reindex the flange one-half turn on the pinion, and reinstall it. Refer to Section 205-02A , Section 205-02B or Section 205-03 for the flange removal and installation procedures.

8. Check the runout again. If necessary, rotate the flange until an acceptable runout is obtained. If the flange runout is still more than 0.25 mm (0.010 inch), install a new pinion flange.



9. If excessive runout is still evident after replacement of the pinion flange, install a new ring and pinion. Repeat the above checks until the runout is within specifications.

10. Install the driveshaft. For additional information, refer to Section 205-01 .

Tooth Contact Pattern Check — Gearset

1. To check the gear tooth contact, paint the gear teeth with the special marking compound. A mixture that is too wet will run and smear; a mixture that is too dry cannot be pressed out from between the teeth.

2. Use a box wrench on the ring gear bolts as a lever to rotate the ring gear several complete revolutions in both directions or until a clear tooth contact pattern is obtained.

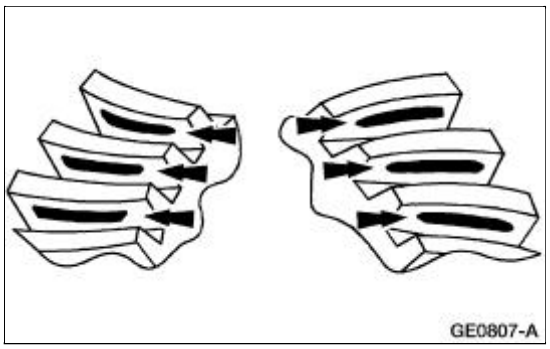
3. Certain types of gear tooth contact patterns on the ring gear indicate incorrect adjustment. Incorrect adjustment can be corrected by readjusting the ring gear or the pinion.

Contact Pattern Location

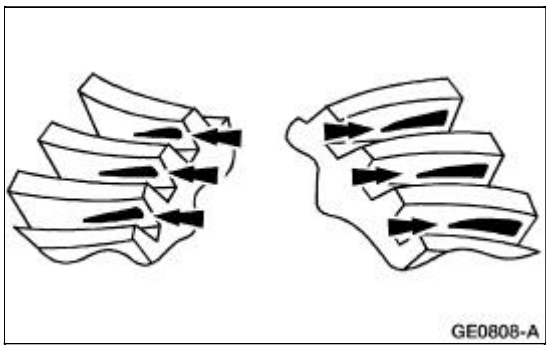
In general, desirable ring gear tooth patterns must have the following characteristics:

- Drive pattern on the drive side ring gear well centered on the tooth.
- Coast pattern on the coast side ring gear well centered on the tooth.
- Clearance between the pattern and the top of the tooth.
- No hard lines where the pressure is high.

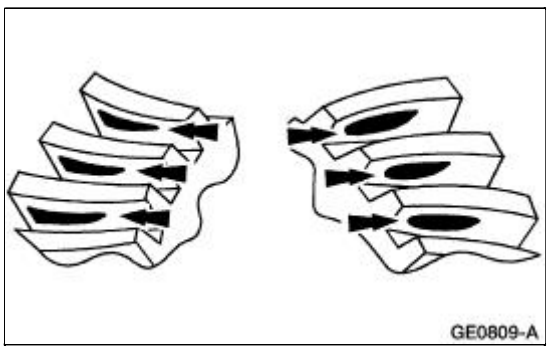
Acceptable ring gear tooth patterns for all axles.



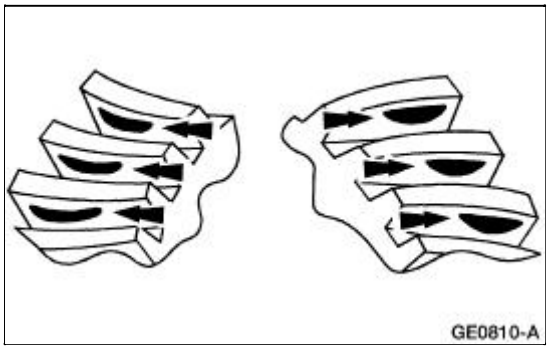
Correct backlash with a thinner pinion position shim required.



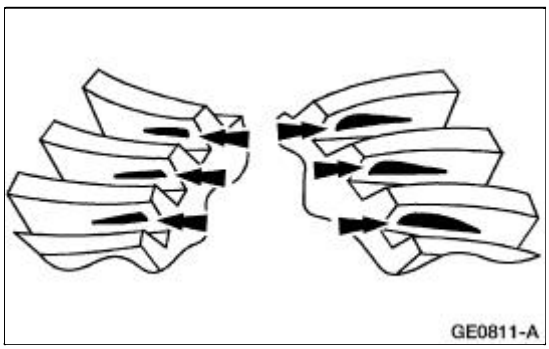
Correct backlash with a thicker pinion position shim required.



Correct pinion position shim that requires a decrease in backlash.



Correct pinion position shim that requires an increase in backlash.



Driveline Angle Inspection

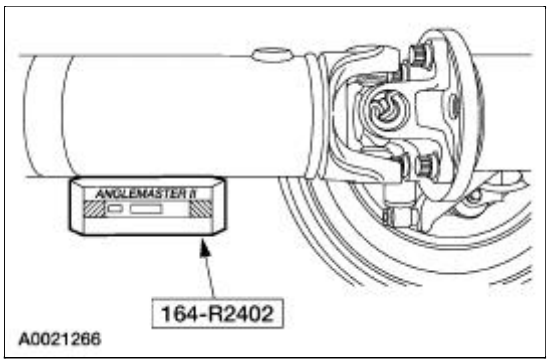
Special Tool(s)

 ST1622-A	Anglemaster II Driveline Inclinometer/Protractor 164-R2402 or equivalent

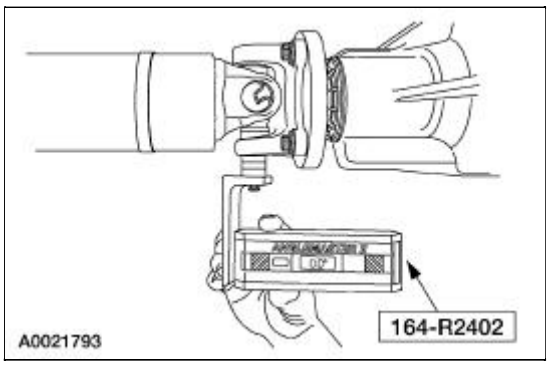
CAUTION: Prior to checking driveline angularity, inspect the U-joints for correct operation.

NOTE: An incorrect driveline angle can cause a vibration or shudder. For additional information, refer to Section 100-04 .

1. For the driveshaft angle reading, place the special tool flush against the bottom of the driveshaft. Press the ALT ZERO button to calibrate the inclinometer.



2. To check the pinion operating angle, rotate the driveshaft so that the rear axle pinion flange yoke ear is parallel to the floor. Remove the U-joint snap ring, then install the special tool. Check and record the pinion operating angle reading.
   - If the angle is not within specifications, repair or adjust to obtain the correct angle . Inspect the rear suspension, rear axle, rear axle mounting or the frame for wear or damage.



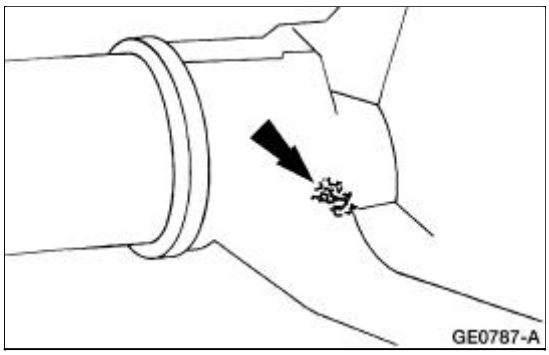
3. Repeat the step, using the front universal joint to record the transmission operating angle.
4. Compare the operating angles. Ideally, the operating angles on each end of the driveshaft must:
    - be equal or within one degree of each other.
    - have a three degree maximum operating angle.
    - have at least one-half degree of operating angle.

Axle Housing Casting Porosity (Holes in Casting) Repair

CAUTION: To keep the axle's sound characteristics, do not disassemble the carrier.

NOTE: Casting porosity is a condition where occasionally gas bubbles will form during the casting process leaving small pockets in the metal that will cause the axle housing to leak.

1. To fill small pockets, peen in a small amount of body lead.



2. Seal the pocket.
   - Use Devcon Aluminum Liquid F2 or equivalent meeting Ford specification M-3D35A(E).

3. To fill large pockets, drill and tap a shallow hole for a small setscrew. Install the setscrew and seal it.
   - Use Devcon Aluminum Liquid F2 or equivalent meeting Ford specification M-3D35A(E).

Axle Housing Weld Leaks Repair

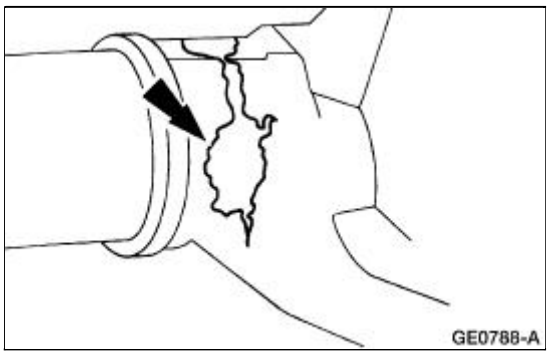
1. **CAUTION: To keep the axle's sound characteristics, do not disassemble the carrier.**

   CAUTION: Rear axle housing straightness is too critical for field repair. Install a new axle housing if a weld is broken.

   NOTE: Most minor weld leaks are repairable. This includes the puddle and fill welds that join the axle shaft tube to the axle housing on integral axles.

   Seal the weld.

   - Use Devcon Aluminum Liquid F2 or equivalent meeting Ford specification M-3D35A(E).

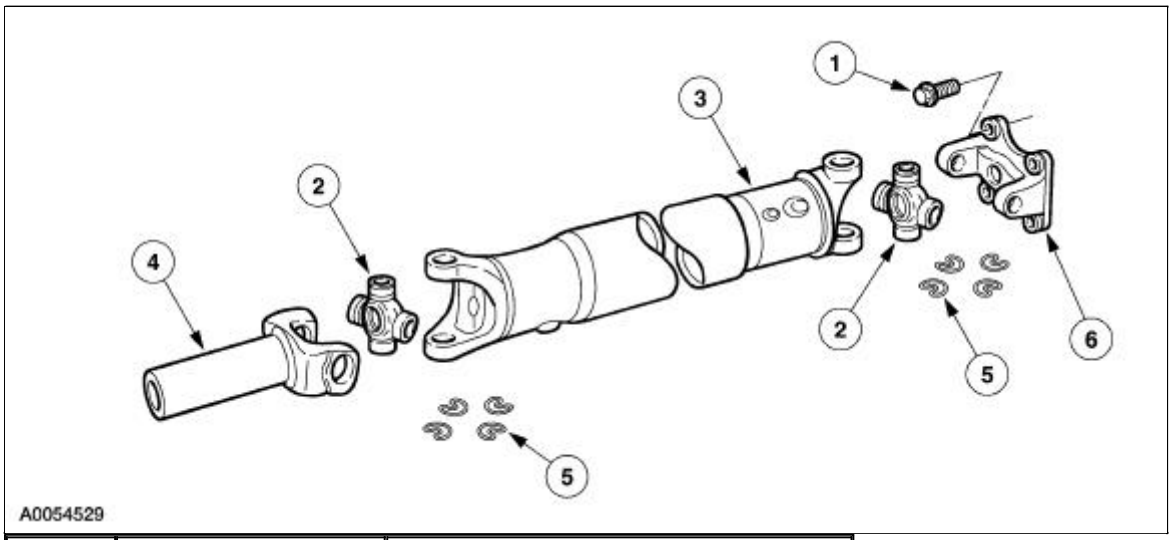


Torque Specifications

Description	Nm	lb-ft
Bolts retaining rear flange to transfer case flange	104	77
Bolts retaining front flange to front drive axle pinion flange	112	83
Nuts retaining front driveshaft shield to transfer case	25	18
Bolts retaining driveshaft flange yoke to rear axle pinion flange	112	83

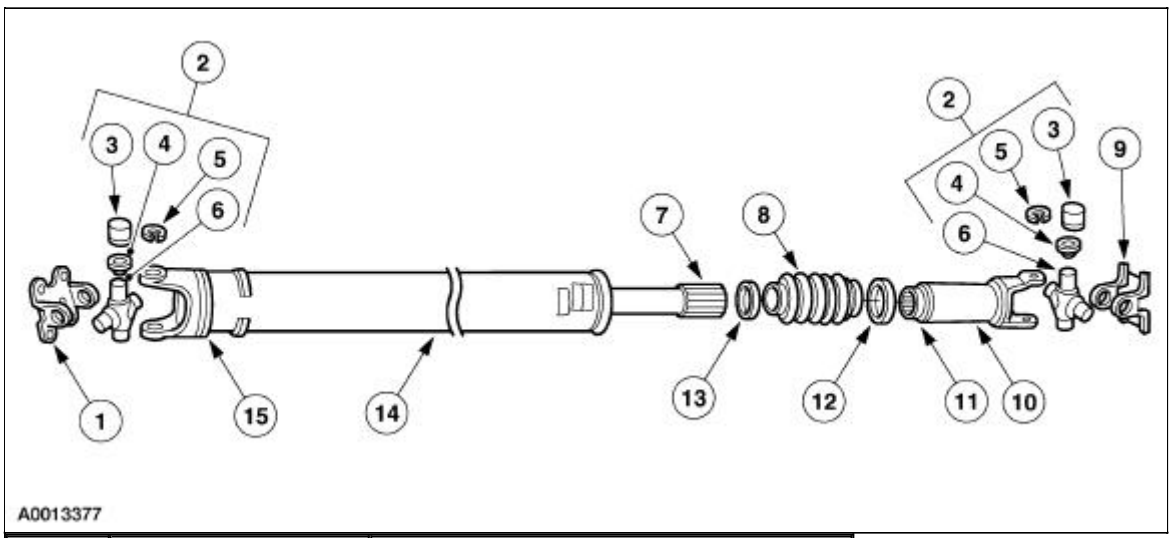
Driveshaft

Rear



Item	Part Number	Description
1	—	Bolt (part of 4A378)
2	4635	Universal joint assembly
3	4602	Driveshaft assembly
4	4A335	Driveshaft slip yoke
5	—	Snap ring (part of 4635)
6	4A378	Driveshaft flange yoke

Front



Item	Part Number	Description
1	4A378	Front flange

2	4635	Universal joint kit
3	—	Bearing (part of 4635)
4	—	Seal (part of 4635)
5	—	Snap ring (part of 4635)
6	—	Spider (part of 4635)
7	—	Splined stud shaft
8	4421	Rubber boot
9	4A378	Rear flange
10	4841	Driveshaft slip yoke
11	—	Boot groove (part of 4841)
12	4K227	Large clamp
13	4K227	Small clamp
14	4A376	Driveshaft assembly
15	—	Front yoke (part of 4602)

CAUTION: All driveshafts are balanced. If undercoating the vehicle, protect the driveshaft and universal joints to prevent overspray of any undercoating material.

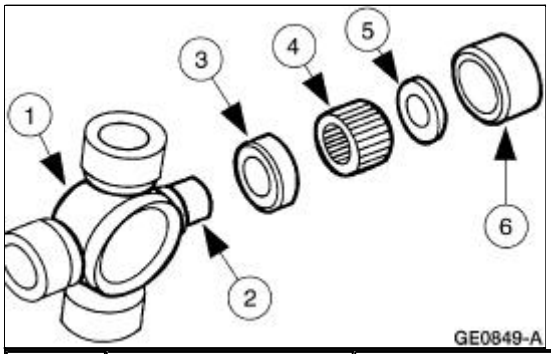
NOTE: Refer to Section 205-00 for driveshaft runout and balance, and indexing procedures.

Driveshafts differ in length, diameter, and type of yoke to accommodate various wheelbase and powertrain combinations.

The front driveshaft uses one universal joint to connect the flange yoke at each end of the driveshaft. Inspect the front driveshaft slip yoke rubber boot for rips and holes. Install new components as necessary.

The rear driveshaft is connected to the pinion flange by the driveshaft flange yoke with four bolts. It is connected to the transmission or transfer case with a driveshaft slip yoke.

Universal Joints



Item	Part Number	Description
1	—	Spider (part of 4635)
2	—	Trunnion (part of 4635)
3	—	Grease seal (part of 4635)
4	—	Needle rollers (part of 4635)
5	—	Thrust washer (part of 4635)
6	—	Bearing cup (part of 4635)

The universal joint (U-joint) connects to the drive axle of the driveshaft and allows for up and down movement of the axle. The U-joint is lubricated for the life of the vehicle.

Driveshaft

Refer to Section 205-00 .

Driveshaft —Front

Material

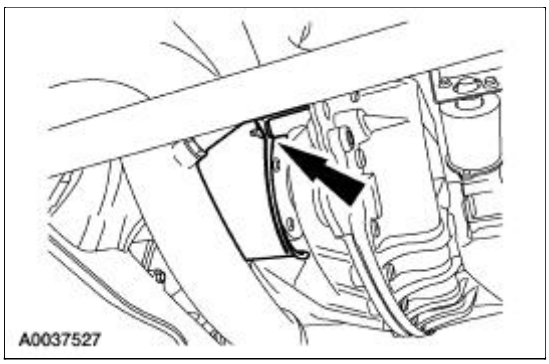
Item	Specification
Threadlock and Sealer E0AZ-19554-AA	WSK-M2G351-A5

Removal and Installation

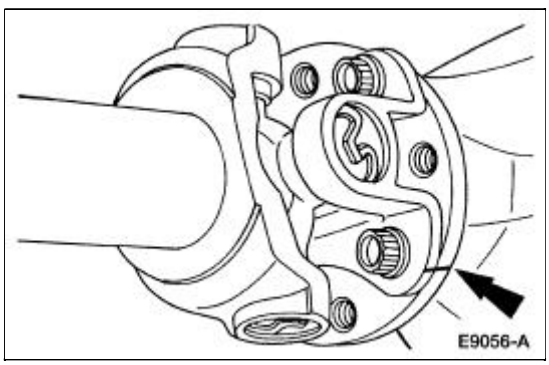
1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations. Failure to follow these instructions may result in personal injury.**

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

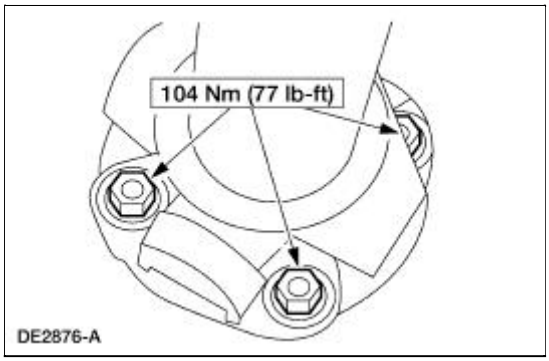
2. Remove the front driveshaft shield.



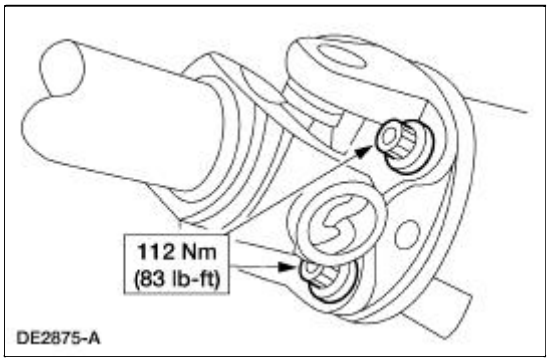
3. Index-mark the front flange and pinion flange.
   - Repeat for the rear flange and transfer case flange.



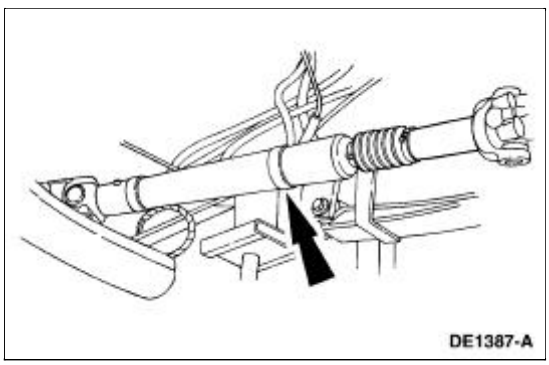
4. Remove the four bolts retaining the rear flange to the transfer case.



5. Remove the four bolts retaining the front flange to the pinion flange.



6. Remove the front driveshaft.



7. **CAUTION: If new bolts to retain the driveshaft to the axle and the driveshaft to the transfer case are not available, coat the threads of the original bolts with threadlock and sealer.**

CAUTION: The front driveshaft must be installed with the boot toward the transfer case to prevent damage to the boot from the exhaust system.

To install, reverse the removal procedure.

Driveshaft —Rear

Material

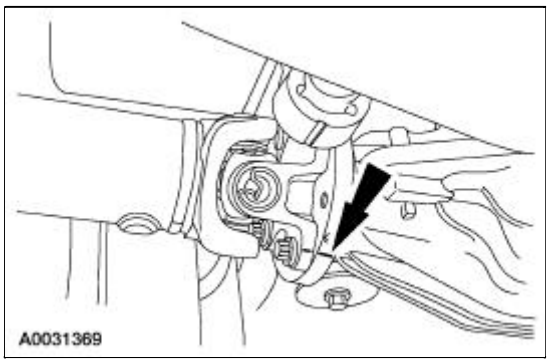
Item	Specification
Threadlock and Sealer E0AZ-19554-AA	WSK-M2G351-A5
Premium Long Life Grease XG-1-C	ESA-M1C75-B

Removal and Installation

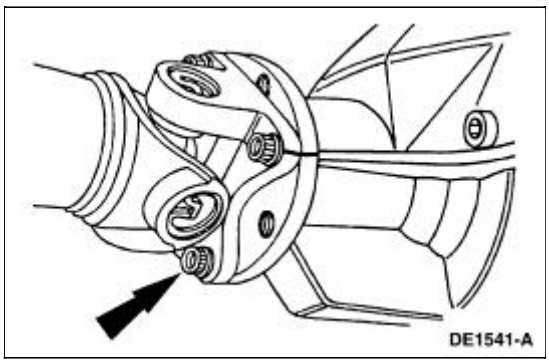
1. **CAUTION: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in the unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations. Failure to follow these instructions may result in personal injury.**

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

2. Index-mark the driveshaft flange and the rear axle pinion flange.

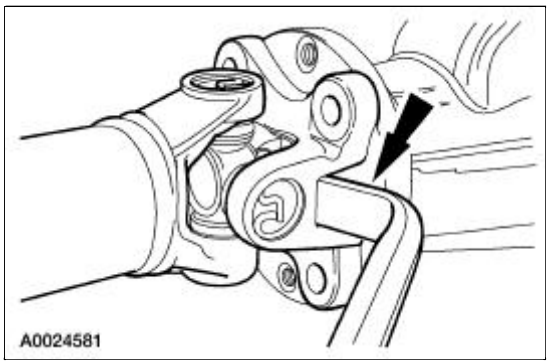


3. Remove the four bolts.



4. **CAUTION: The driveshaft flange fits tightly on the rear axle pinion flange pilot. Never hammer on the driveshaft or any of its components to disconnect the driveshaft from the pinion flange. Pry only in the area shown, with a suitable tool, to disconnect the driveshaft flange from the pinion flange.**

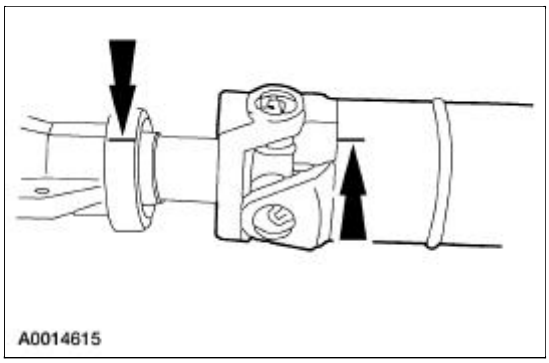
   Using a suitable tool as shown, disconnect the driveshaft flange from the rear axle pinion flange.



5. **NOTE:** Do not rotate the driveshaft when removing the slip yoke from the transmission output shaft.

   Index-mark the driveshaft slip yoke and the transmission extension housing.

   - Mark the transmission output shaft to the transmission extension housing after removing the driveshaft.

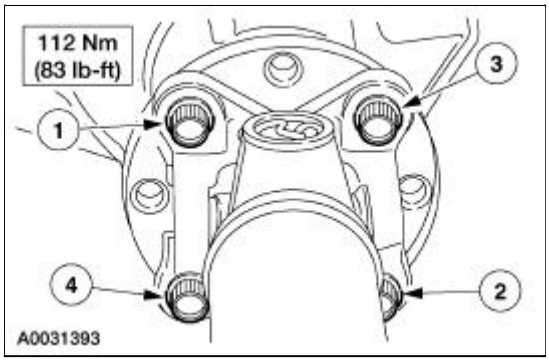


6. **CAUTION: Coat the threads of the original bolts with sealer.**

   CAUTION: The driveshaft flange fits tightly on the rear axle pinion flange pilot. To make sure that the driveshaft flange seats squarely on the pinion flange, tighten the bolts evenly in a cross pattern as shown.

   CAUTION: Make sure all index marks are aligned.

   To install, reverse the removal procedure.


112 Nm
(83 lb-ft)
1
2
3
4
A0031393

Universal Joint —Single Cardan

Special Tool(s)

 ST1172-A	Installer/Remover, C-Frame and Screw 205-086 (T74P-4635-C)

Disassembly

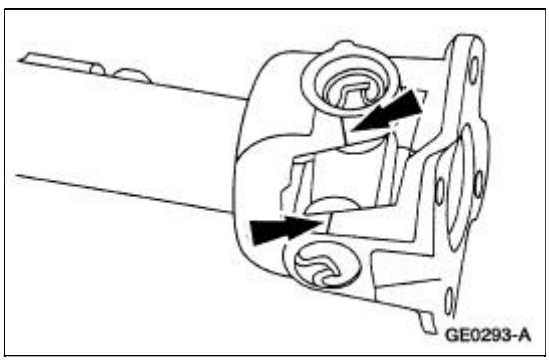
1. Remove the driveshaft. For additional information, refer to Driveshaft—Rear or Driveshaft—Front in this section.

2. **CAUTION: Do not clamp the driveshaft in the jaws of a vise or a similar holding fixture.**

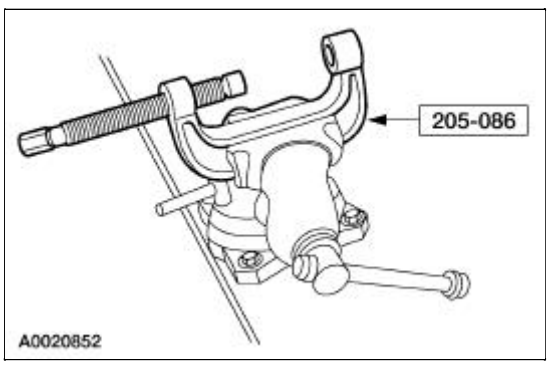
   Carefully place the driveshaft on a suitable workbench.

3. **NOTE:** Index-mark the driveshaft components relative to the driveshaft tube. Make sure all components are reassembled in the same relationship to maintain correct balance.

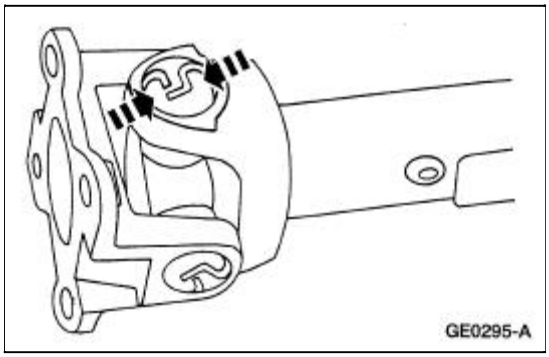
   Index-mark the driveshaft and driveshaft components.



4. Position the special tool in a vise.

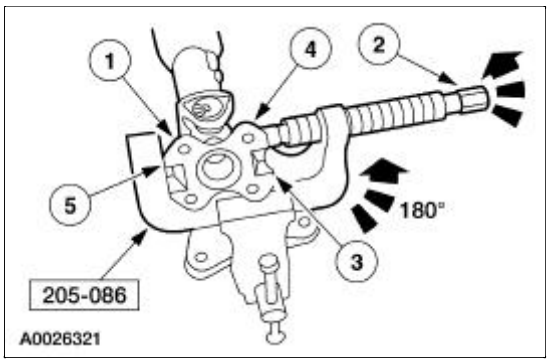


5. Remove the snap rings from the universal joint.



6. **NOTE:** If necessary, use a pair of pliers to remove a bearing cup if it cannot be pressed out all the way.

   Remove the driveshaft flange yoke.
   1. Position the driveshaft flange in the special tool.
   2. Press out the bearing cup.
   3. Rotate the driveshaft flange yoke.
   4. Press on the spider to remove the remaining bearing cup.
   5. Remove the driveshaft flange yoke.



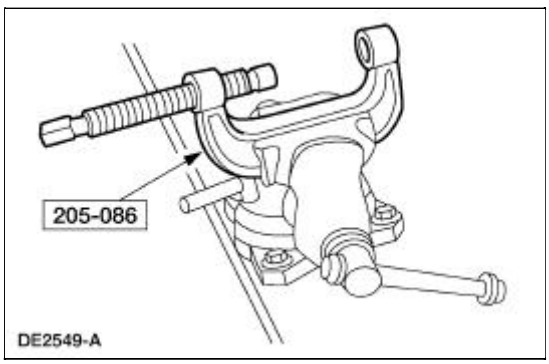
7. Repeat the previous step to remove the remaining bearing cups and spider from the driveshaft.

8. Clean the yoke area at the end of the driveshaft and flange yoke.

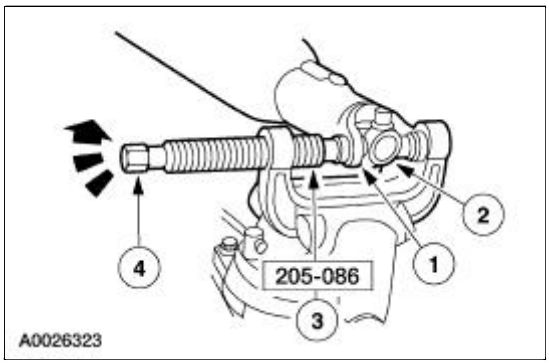
Assembly

NOTE: Universal joint service kits are to be installed as complete assemblies only. Do not use components from other universal joints.

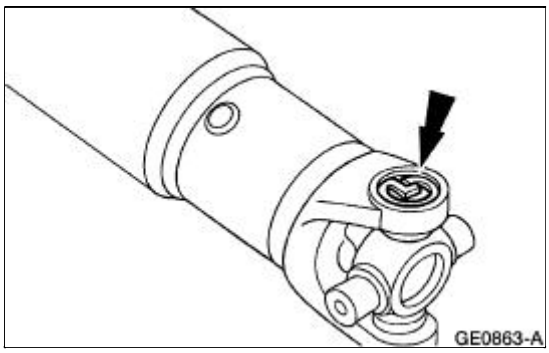
1. Clamp the special tool in a vise.



2. Install a new bearing cup.
    1. Start a new bearing cup into the driveshaft yoke.
    2. Position a new spider in the driveshaft yoke.
    3. Install the driveshaft into the special tool.
    4. Press the bearing cup below the yoke surface.



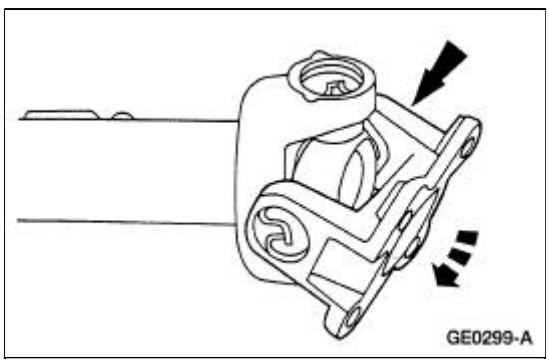
3. Remove the driveshaft from the special tool and install the snap ring.



4. Repeat the previous steps to install the remaining bearing cups.

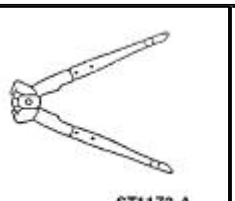
5. **NOTE:** Do not strike the bearings. If binding, strike the yoke with a brass or plastic hammer.

   Check the universal joint for freedom of movement.



Driveshaft Slip Yoke

Special Tool(s)

 ST1173-A	Installer, Keystone Clamp 211-002 (T63P-9171-A)

Material

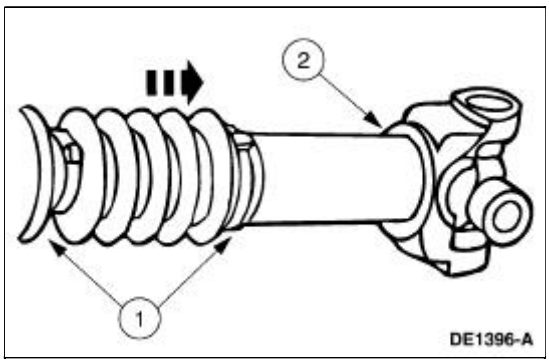
Item	Specification
Premium Long Life Grease XG-1-C	ESA-M1C75-B

Disassembly

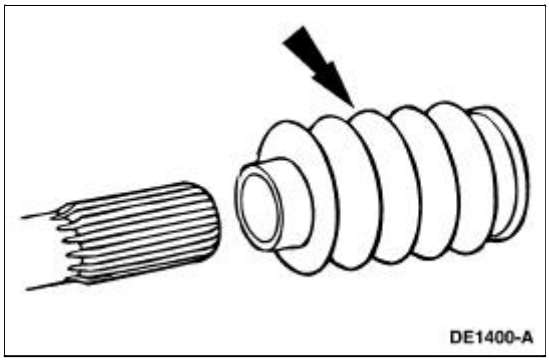
1. **CAUTION: Do not, under any circumstance, clamp the driveshaft in the jaws of a vise or similar holding fixture. Denting or localizing fracture can result, causing driveshaft failure during vehicle operation.**

   Place the driveshaft on a suitable workbench. Do not damage the tubes.

2. Remove the driveshaft slip-yoke from the driveshaft.
   1. Cut and discard the driveshaft slip-yoke boot clamps.
   2. Remove the driveshaft slip-yoke from the driveshaft.



3. Remove the slip-yoke boot from the driveshaft.
   - Inspect the boot for damage. Discard the boot as necessary.

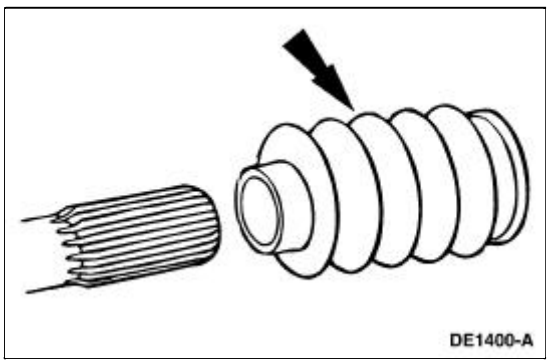


4. Inspect the lubricant on the driveshaft splines and in the driveshaft slip-yoke for contamination. If contaminated, inspect the driveshaft splines and the driveshaft slip-yoke for wear. Install new components as necessary.

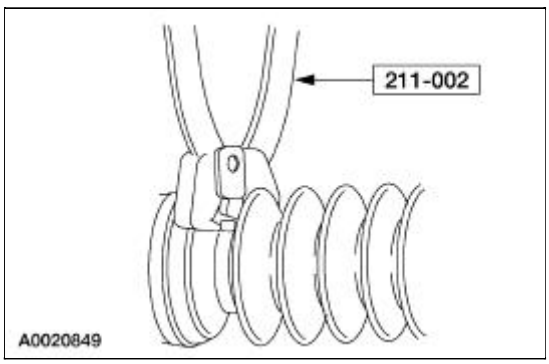
Assembly

1. Position the new small driveshaft slip-yoke boot clamp on the driveshaft stub shaft.

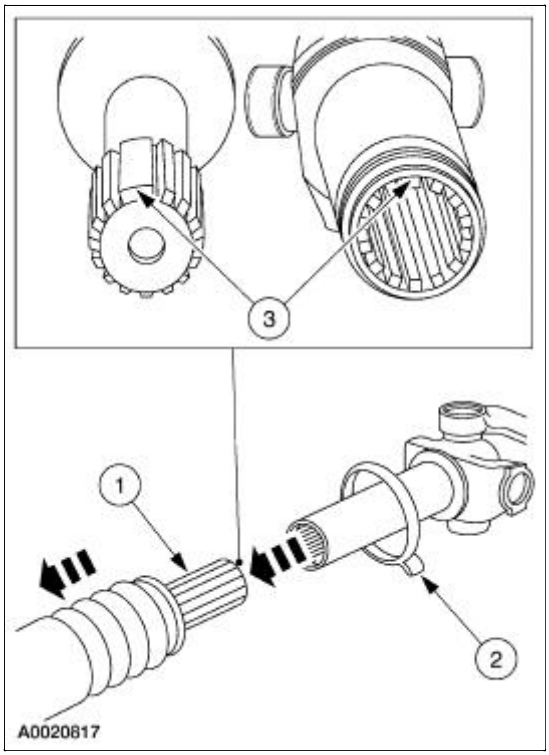
2. Slide the small opening end of the slip-yoke boot on the driveshaft stub shaft, as far as it will travel.



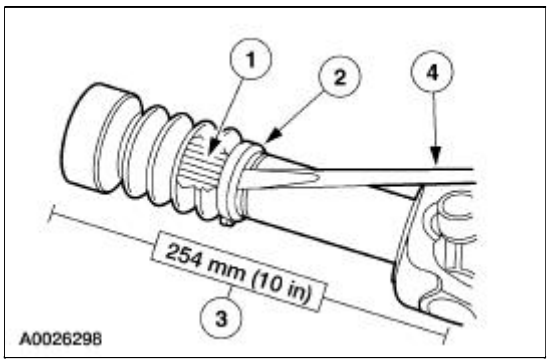
3. Using the special tool, crimp the driveshaft slip-yoke boot clamp.



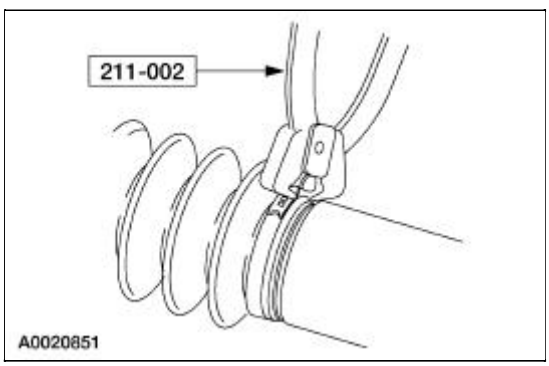
4. Install the driveshaft slip-yoke on the driveshaft.
    1. Pull the slip-yoke boot toward the driveshaft. Lubricate the driveshaft splines with approximately 10 grams (0.24 oz) of grease.
    2. Position the new large slip-yoke boot clamp.
    3. Align the blind splines, and install the driveshaft slip-yoke on the driveshaft.



5. Set the driveshaft assembled length to specification.
    1. Remove any excess grease from the slip-yoke boot and driveshaft slip-yoke surfaces.
    2. Position the slip-yoke boot in the slip-yoke boot groove.
    3. Set the driveshaft assembled length to specification.
        - Measure from the stub shaft weld to the U-joint centerline.
    4. Bleed the air from the slip-yoke boot.



6. Using the special tool, crimp the large driveshaft slip-yoke boot clamp.



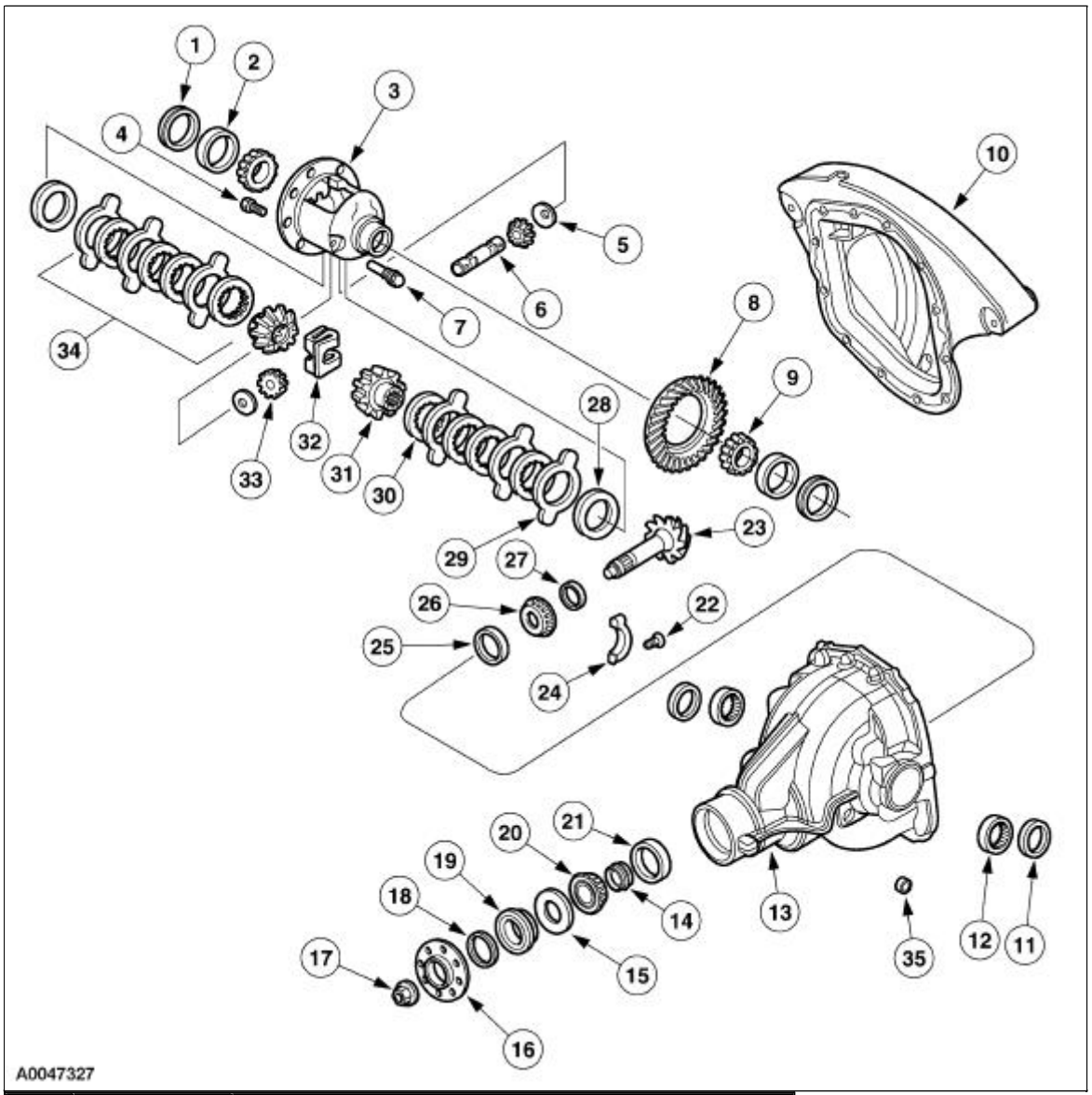
General Specifications

Item	Specification
Lubricants and Sealants	
SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL	WSL-M2C192-A
Additive Friction Modifier XL-3	EST-M2C118-A
SAE 75W-90 FEHP XY-75W90-QFEHP	—
Premium Long-Life Grease XG-1-C	ESA-M1C75-B
Ultra Silicone Sealant F7TZ-19554-AA	WSS-M4G320-A3
Threadlock and Sealer EOAZ-19554-AA	WSK-M2G351-A5
Backlash Specifications	
Differential case maximum runout	0.076 mm (0.003 in)
Backlash between ring gear and pinion teeth	0.254-0.308 mm (0.010-0.012 in)
Ring gear maximum backlash variation between teeth	0.102 mm (0.004 in)
Pinion flange maximum runout	0.254 mm (0.010 in)
Rotational Torque Ranges	
Pinion bearing preload (used pinion bearings)	0.9-1.5 Nm (8-14 Lb-In)
Pinion bearing preload (new pinion bearings)	1.8-3.3 Nm (16-29 Lb-In)
Adapter for 205-S127	2.2 Nm (20 Lb-In)
Initial minimum breakaway torque (Traction-Lok®)	27 Nm (20 Lb-Ft)

Torque Specifications

Description	Nm	lb-ft	lb-in
Differential bearing cap bolt	105	77	—
Differential pinion shaft lock bolt	30	22	—
Oil filler plug	30	22	—
Differential housing cover bolts	32	24	—
Rear driveshaft bolts	112	83	—
Ring gear bolts	105	77	—
Differential clutch gauge nut	6.7	—	60
Torque arm insulator bolt	181	100	
Torque arm-to-rear axle housing bolts	181	100	
Rear axle cover insulator stud nut	100	74	—

Rear Drive Axle and Differential



Item	Part Number	Description
1	4067	Differential bearing shim
2	4222	Differential bearing cup
3	4204	Differential case
4	4216	Differential ring gear case bolt
5	4230	Differential pinion thrust washer
6	4211	Differential pinion shaft
7	4241	Differential pinion shaft lock bolt
8	—	Differential ring gear (part of 4209)
9	4221	Differential bearing

10	4033	Differential housing cover
11	4B416	Inboard CV joint stub shaft pilot bearing housing seal
12	4B413	Inboard CV joint stub shaft pilot bearing
13	4010	Differential housing
14	4662	Differential drive pinion collapsible spacer
15	4670	Rear axle drive pinion shaft oil slinger
16	4851	Rear axle pinion flange
17	389546-S100	Pinion nut
18	4859	Drive pinion oil seal deflector
19	4676	Rear axle drive pinion seal
20	4621	Pinion bearing
21	4616	Differential drive pinion bearing cup
22	56187-S	Bolt
23	—	Drive pinion gear (part of 4209)
24	—	Differential bearing cap (part of 4010)
25	4628	Rear axle pinion bearing cup
26	4630	Pinion bearing
27	4663	Drive pinion bearing adjustment shim
28	4A321	Rear axle differential clutch shim
29	—	Clutch plate (part of 4947)
30	—	Clutch disc (part of 4947)
31	4236	Differential side gear
32	4214	Differential clutch spring
33	4215	Differential pinion gear
34	4947	Differential clutch pack
35	390943-S100	Fill Plug

- The differential housing consists of a cast aluminum housing and a cast aluminum differential housing cover. The differential housing cover uses silicone sealant as a gasket.
- The hypoid-design gearset consists of an 8.8-inch differential ring gear and a drive pinion gear. Two opposed pinion bearings support the drive pinion gear in the differential housing.
- A differential drive pinion collapsible spacer, located on the drive pinion gear shaft, maintains pinion bearing preload. The pinion nut adjusts the preload.
- Differential bearing shims, located between the differential bearing cups and the differential housing, adjust the differential ring gear backlash and the differential bearing preload.
- The differential case is a one-piece design with two openings to allow for assembly of the internal components and lubricant flow. Two opposed differential bearings support the differential case in the differential housing. Removable differential bearing caps retain the differential assembly in the differential housing.
- Inside the differential case, the differential pinion shaft supports two differential pinion gears. The pinion gears engage the differential side gears to which the halfshafts are splined. The differential pinion shaft lock bolt retains the differential pinion shaft in the differential case.

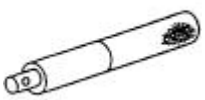
- A circlip, located on the inboard CV joint stub shaft, holds the halfshaft in the differential case. When installed, the circlip engages a groove in the differential side gear.
- The limited slip rear axle requires SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL or equivalent meeting Ford specification WSL-M2C192-A with 4 ounces of Friction Modifier XL-3 or equivalent meeting Ford specification EST-M2C118-A.
- An embossed metal tag, bolted to the differential housing cover, contains rear axle identification. For additional information, refer to Section 205-00 .
- The conventional rear axle requires SAE 75W-90 FEHP XY-75W90-QFEHP or equivalent.

Rear Drive Axle and Differential

Refer to Section 205-00 .

Stub Shaft Pilot Bearing and Seal

Special Tool(s)

 ST1200-A	Remover, Bearing Cup 308-047 (T77F-1102-A)
 ST2258-A	Protector, Halfshaft Seal (Pair) 205-506
 ST1721-A	Installer, Halfshaft Pilot Bearing 205-504
 ST1326-A	Adapter for 303-224 (Handle) 205-153 (T80T-4000-W)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
 ST1721-A	Installer, Halfshaft Seal 205-505

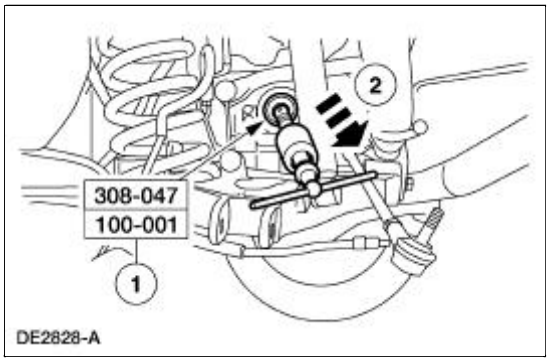
Material

Item	Specification
SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL	WSL-M2C192-A
Premium Long Life Grease	

1. Remove the halfshaft assembly. For additional information, refer to Section 205-05 .

2. **NOTE:** If removing the stub shaft pilot seal only, engage the tangs of the special tool on the seal.

   Using the special tools, remove the stub shaft pilot bearing and seal.
   1. Firmly engage the tangs of the special tool on the stub shaft pilot bearing.
   2. Remove the bearing and seal.

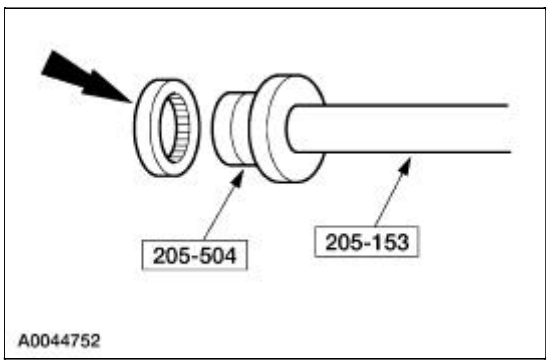


3. Inspect the seal journal for rust, nicks and scratches. Polish the seal journal surface with fine crocus cloth, if necessary.

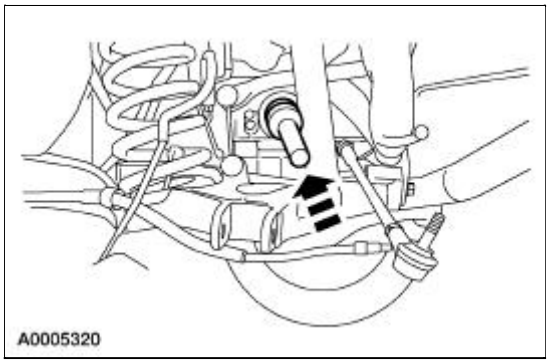
4. Lubricate the new stub shaft pilot bearing with axle lubricant.

5. **CAUTION: Installation of the stub shaft pilot bearing or stub shaft oil seal without the correct tools can result in early bearing or seal failure. If the stub shaft pilot bearing becomes cocked in the bore during installation, remove it and install a new one.**

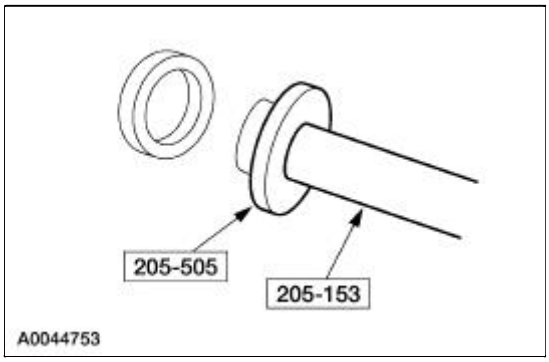
   Place the stub shaft pilot bearing onto the special tools.



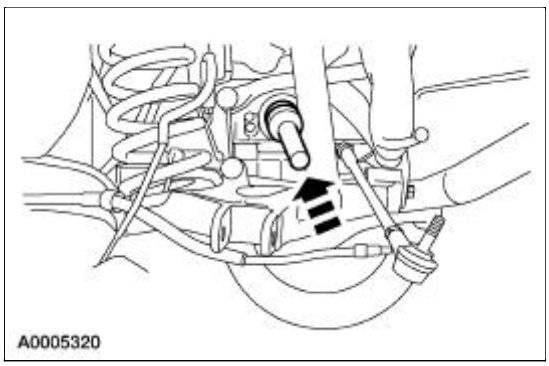
6. Install the stub shaft pilot bearing into the rear axle housing bore.



7. Lubricate the lip of the stub shaft pilot bearing oil seal with grease and install the seal onto the special tools.



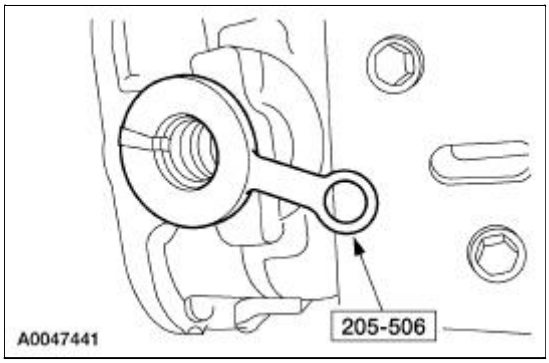
8. Carefully align the stub shaft pilot bearing oil seal with the housing bore and install the stub shaft pilot bearing oil seal.



9. **CAUTION: Use the special tool, 205-506, to avoid damaging the seal with the halfshaft.**

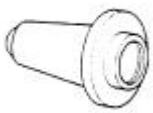
CAUTION: Inspect the stub shaft seal journal for rust, nicks, or scratches prior to installing the halfshaft. Polish the seal journal with fine crocus cloth, if required.

Install the halfshaft. For additional information, refer to Section 205-05 .


205-506
A0047441

Drive Pinion Flange and Drive Pinion Seal

Special Tool(s)

 ST2026-A	2-Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1257-A	Holding Fixture, Drive Pinion Flange 205-126 (T78P-4851-A)
 ST1862-A	Installer, Drive Pinion Flange 205-002 (TOOL-4858-E) or equivalent
 ST1325-A	Installer, Drive Pinion Oil Seal 205-208 (T83T-4676-A)

Material

Item	Specification
Premium Long Life Grease XG-1-C or equivalent	ESA-M1C75-B

Removal

1. Position the vehicle on a hoist. For additional information, refer to Section 100-02 .
2. Remove the rear wheel and tire assemblies. For additional information, refer to Section 204-04 .
3. **CAUTION: Remove the rear brake calipers to prevent drag during the drive pinion bearing preload adjustment.**

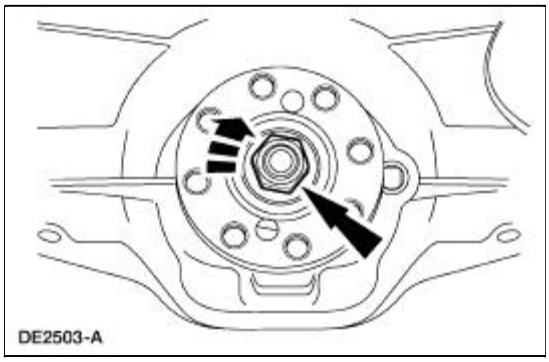
   CAUTION: Do not allow the calipers to hang from the brake hoses.

   Remove the rear brake caliper and support bracket from the knuckle as an assembly. Wire the

caliper and support bracket assembly out of the way. For additional information, refer to Section 206-04 .

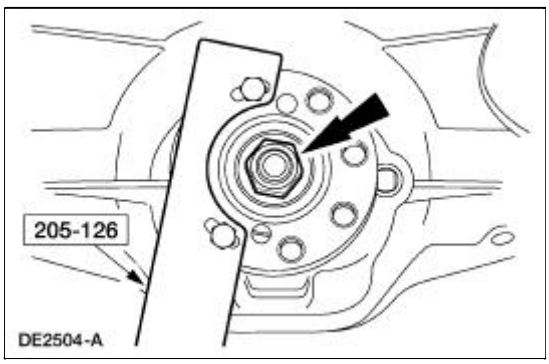
4. Remove the driveshaft assembly. For additional information, refer to Section 205-01 .

5. Install an Nm (inch/pound) torque wrench on the nut and record the torque necessary to maintain rotation of the drive pinion gear through several revolutions.

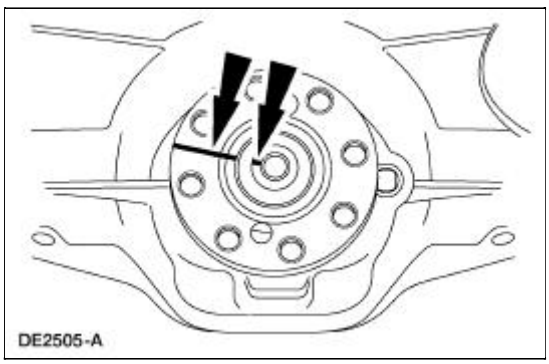


6. **CAUTION: After removing the nut, discard it. Use a new nut for installation.**

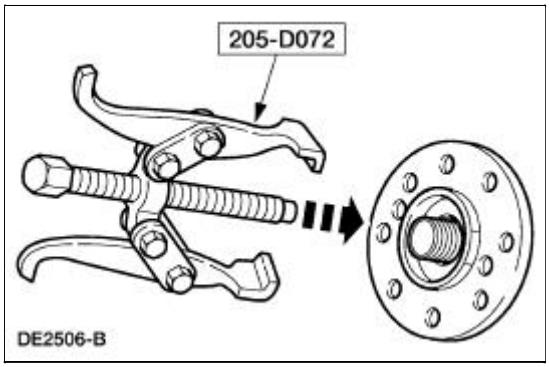
   Use the special tool to hold the rear axle pinion flange while removing the nut.



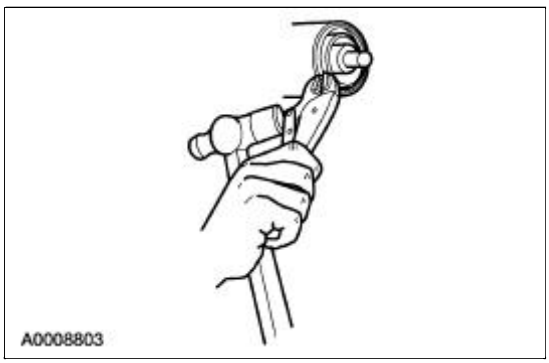
7. Index-mark the rear axle pinion flange and drive pinion gear stem to maintain initial balance during installation.



8. Using the special tool, remove the rear axle pinion flange.



9. Force up on the metal flange of the rear axle drive pinion seal. Install gripping pliers and strike with a hammer until the rear axle drive pinion seal is removed.

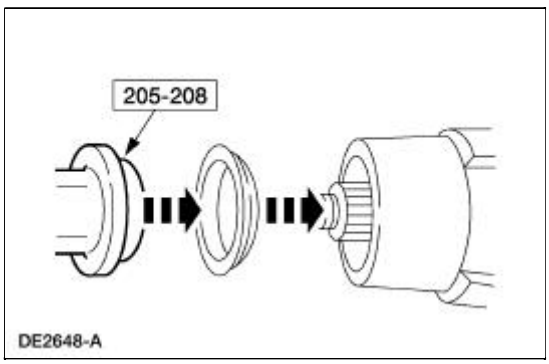


Installation

1. Lubricate the new rear drive pinion seal with grease.

2. **CAUTION: If the rear axle drive pinion seal becomes misaligned during installation, remove the rear axle drive pinion seal and install a new seal.**

   Using the special tool, install the rear axle drive pinion seal.

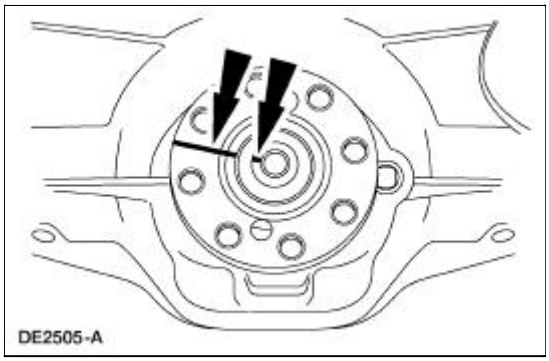


3. Inspect the rear axle pinion flange seal journal for rust, nicks and scratches prior to installing the flange. Polish the seal journal with fine crocus cloth, if necessary.

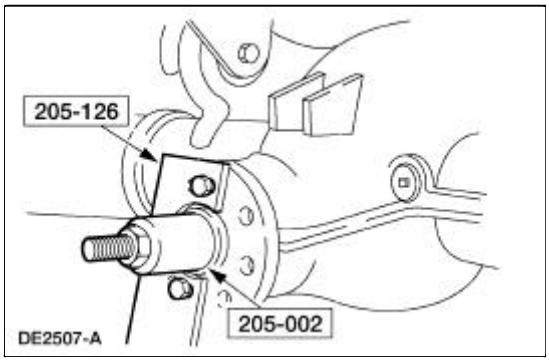
4. Lubricate the rear axle pinion flange splines.

5. **NOTE:** Disregard the index marks if installing a new rear axle pinion flange.

   Position the rear axle pinion flange.



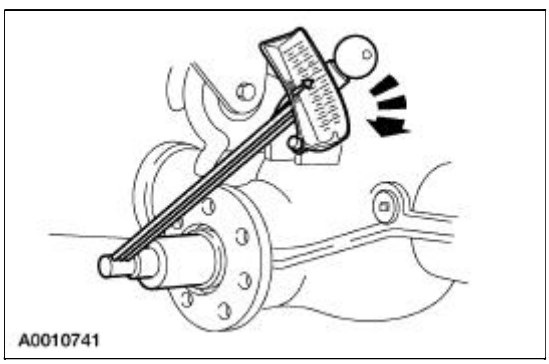
6. Using the special tools, install the rear axle pinion flange.



7. **CAUTION: Do not under any circumstance loosen the nut to reduce preload. If it is necessary to reduce preload, install a new differential drive pinion collapsible spacer and nut.**

   Tighten the nut to set the preload.

   - Rotate the pinion occasionally to make sure the pinion bearings seat correctly. Take frequent pinion bearing torque preload readings by rotating the drive pinion gear with a Nm (inch-pound) torque wrench.
   - If the preload recorded prior to disassembly is lower than the specification for used bearings, tighten the nut to specification. If the preload recorded prior to disassembly is higher than the specification for used bearings, tighten the nut to the original reading as recorded.
   - Refer to the torque specification for used pinion bearings in the Specifications portion of this section.



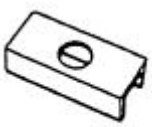
8. Install the driveshaft. For additional information, refer to Section 205-01 .

9. Install the rear brake calipers. For additional information, refer to Section 206-04 .

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

Rear Axle Housing Support Insulator

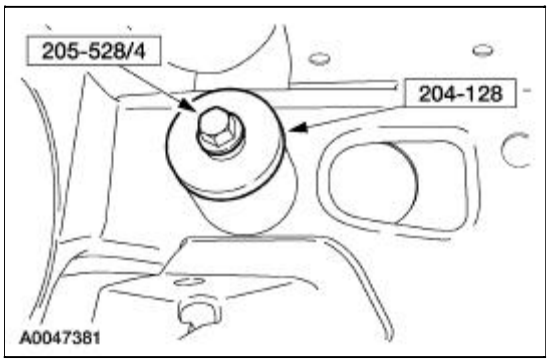
Special Tool(s)

 ST2668-A	Forcing Screw 205-528/4
 ST1970-A	Bushing Installer 205-528/2
 ST2669-A	Bushing Receiving Cup 205-528/3
 ST1965-A	Bushing Remover 205-528/1
 ST1569-A	Adapter for 204-S127 204-128 (T86P-5638-AH1)
 ST1367-A	Installer, Drive Pinion Bearing 205-488
 ST1254-A	Plate, Bearing/Oil Seal 205-09

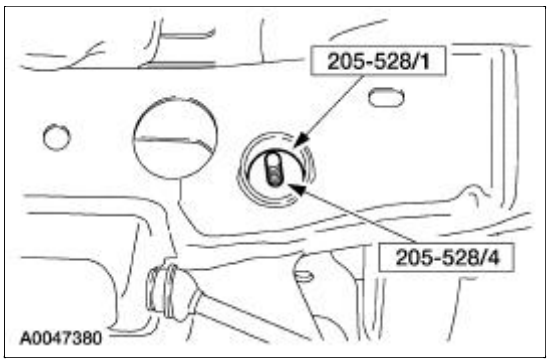
Removal

1. Remove the rear axle assembly. For additional information, refer to Axle Assembly—Air Suspension , or Axle Assembly—Coil Suspension in this section.

2. Insert special tools (205-528/4) through 204-128 and frame support insulator.

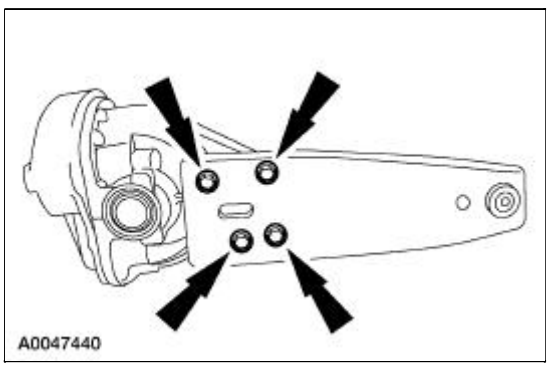


3. Thread bushing remover 205-528/1 on 205-528/4.

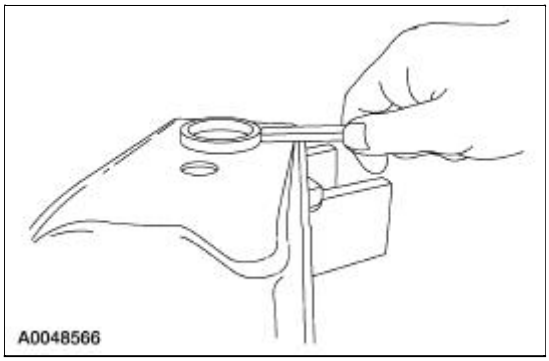


4. Tighten the special tool to remove the frame support insulator.

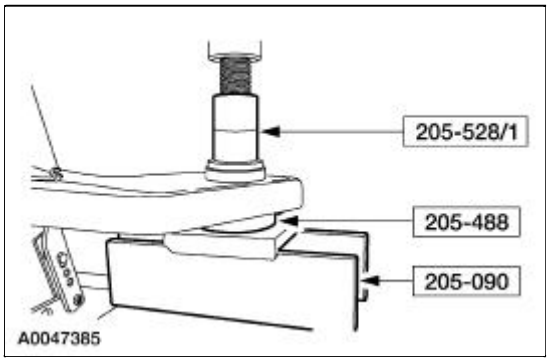
5. Remove the four bolts attaching the torque arm to the axle housing.



6. Measure and record the distance the insulator extends from the face of the torque arm.

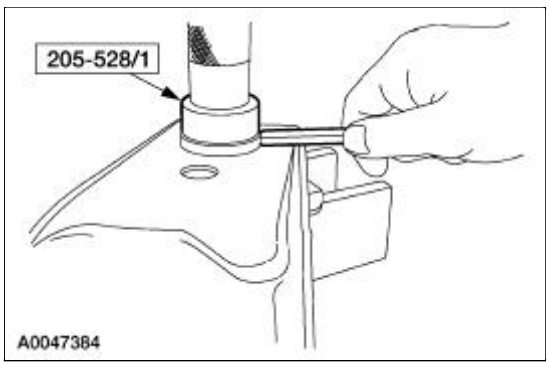


7. Using a shop press and the special tools, remove the torque arm insulator from the torque arm.

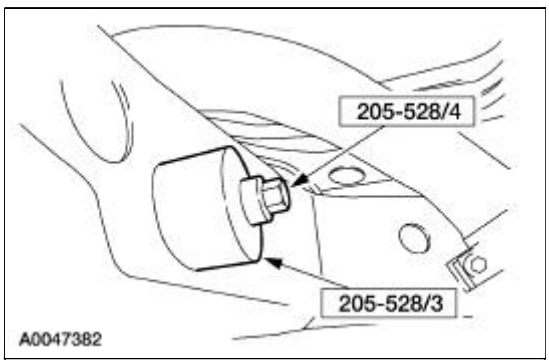


Installation

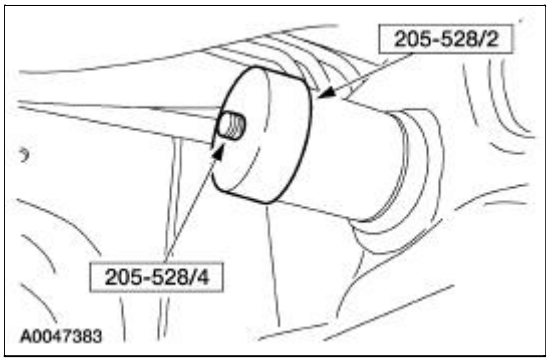
1. Using a shop press and the special tools, install the new torque arm insulator to the previously recorded depth.



2. Position the special tools on the rear of the crossmember.

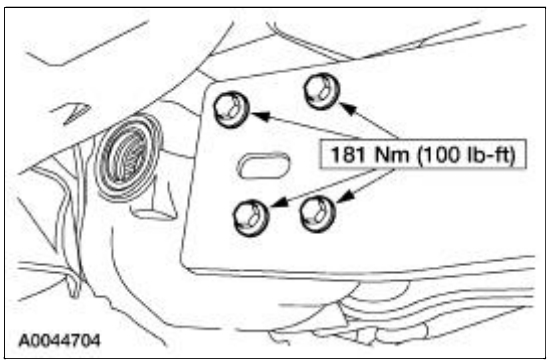


3. Position the new insulator and thread the special tools together.



4. Tighten the drawbolt to seat and position the new insulator.

5. Install the torque arm on the rear axle housing.

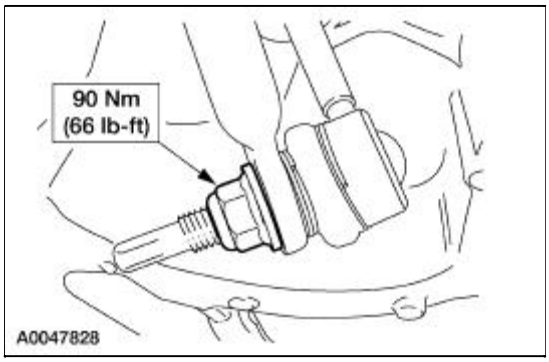


6. Install the rear axle assembly. For additional information, refer to Axle Assembly—Air Suspension , or Axle Assembly—Coil Suspension in this section.

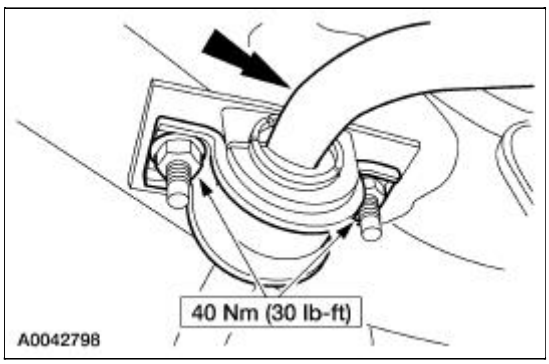
Axle Assembly —Air Suspension

Removal and Installation

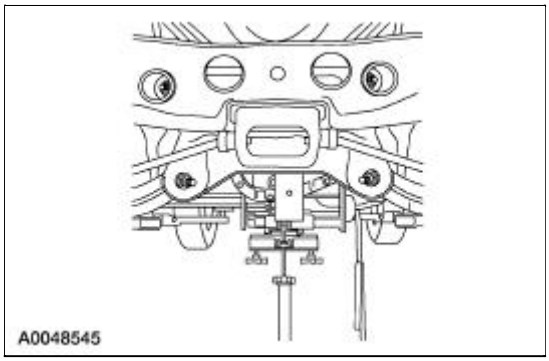
1. Position the vehicle on a hoist. For additional information, refer to Section 100-02 .
2. Deflate the rear air springs. For additional information, refer to Section 204-05 .
3. Remove the rear driveshaft assembly. For additional information, refer to Section 205-01 .
4. Remove the lower rear sway bar links.



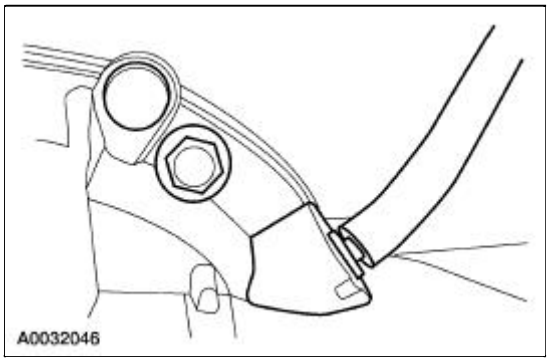
5. Remove the four bracket bolts and remove the rear sway bar.



6. Remove the axle halfshafts. For additional information, refer to Section 205-05 .
7. Support the axle housing.

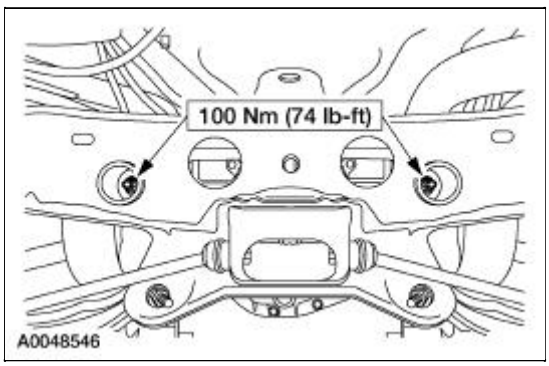


8. Disconnect the axle housing vent tube.

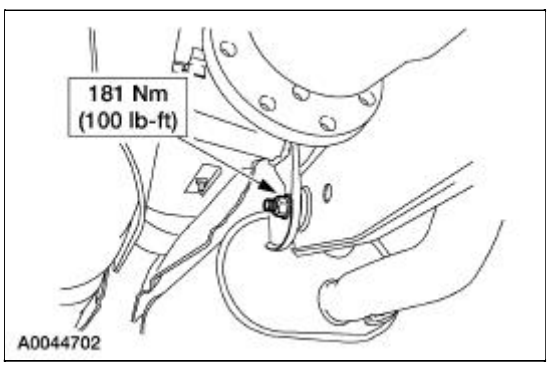


9. **NOTE:** Spare wheel removed for clarity.

   Remove the upper axle housing stud nuts.

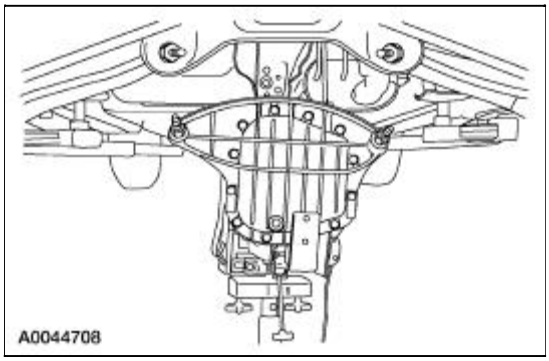


10. Remove the front torque arm bolt.



11. **NOTE:** Move the axle housing forward to clear the rear mounting studs from the bushings.

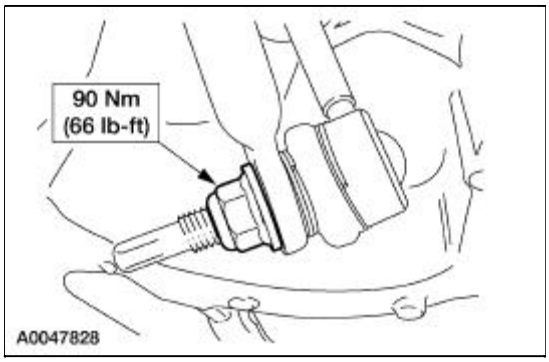
Lower the axle housing from the vehicle.



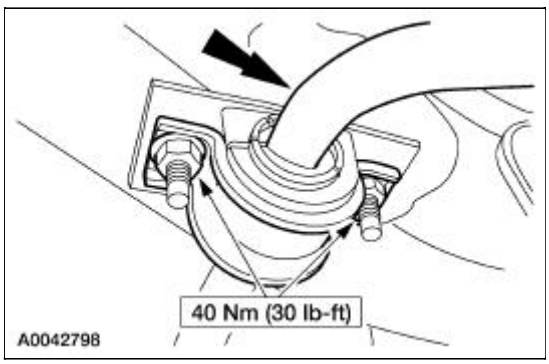
12. To install, reverse the removal procedure.

Axle Assembly —Coil Suspension

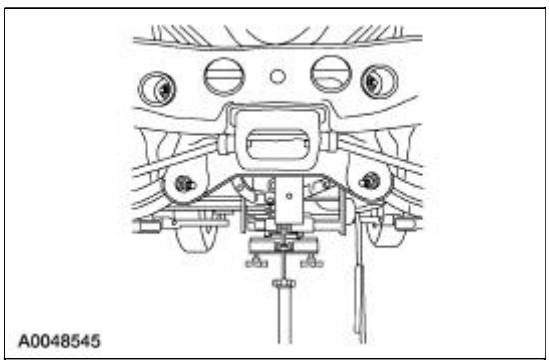
1. Position the vehicle on a hoist. For additional information, refer to Section 100-02 .
2. Remove the rear wheel and tire assemblies. For additional information, refer to Section 204-04 .
3. Remove the rear driveshaft assembly. For additional information, refer to Section 205-01 .
4. Remove the rear halfshafts. For additional information, refer to Section 205-05 .
5. Remove the lower rear sway bar links.



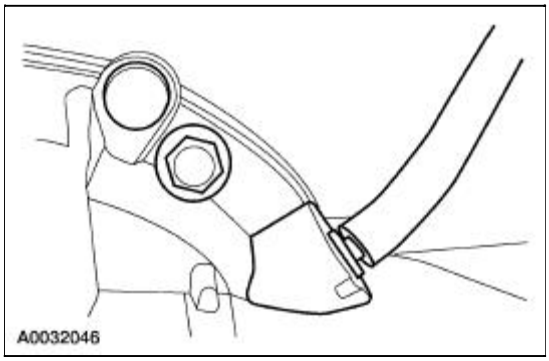
6. Remove the four bracket bolts and remove the rear sway bar.



7. Support the axle housing.

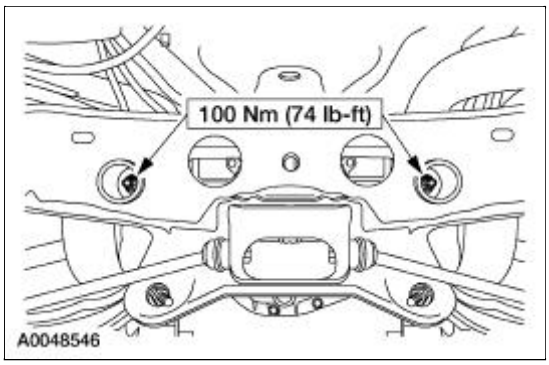


8. Disconnect the axle housing vent tube.

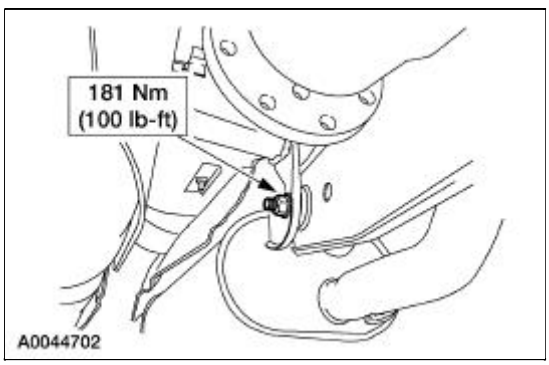


9. **NOTE:** Spare wheel removed for clarity.

   Remove the upper axle housing stud nuts.

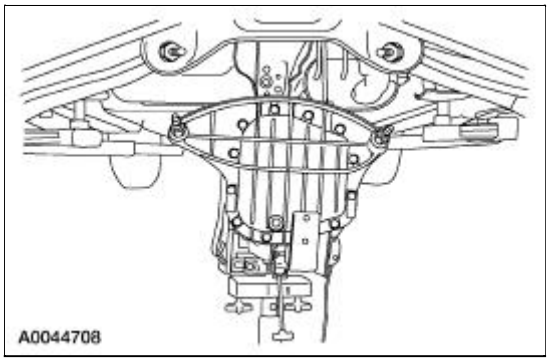


10. Remove the front torque arm bolt.



11. **NOTE:** Move the axle housing forward to clear the rear mounting studs from the bushings.

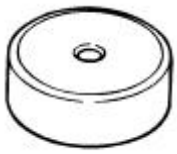
    Lower the axle housing from the vehicle.

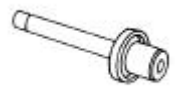
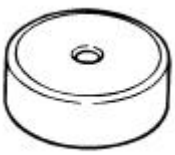
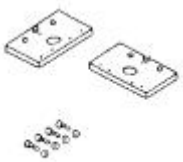
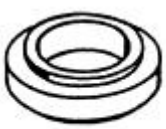


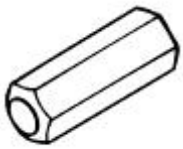
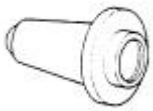
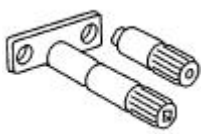
12. To install, reverse the removal procedure.

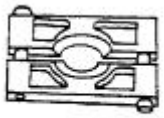
Axle

Special Tool(s)

 ST2026-A	2-Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1743-A	Adapter for 205-S127 205-105 (T76P-4020-A3)
 ST1485-A	Installer, Differential Shim 205-220 (T85L-4067-AH)
 ST1254-A	Plate, Bearing/Oil Seal 205-090 (T75L-1165-B)
 ST1348-A	Gauge, Clutch Housing 308-021 (T75L-4201-A)
 ST1724-A	Installer, Drive Pinion Flange 205-002 (TOOL-4858-E) or equivalent
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent
	Installer, Differential Side Bearing

 ST1375-A	205-010 (T57L-4221-A2)
 ST1431-A	Adapter for 205-S127 205-110 (T76P-4020-A10)
 ST1743-A	Adapter for 205-S127 205-129 (T79P-4020-A18)
 ST1434-A	Gauge Tube, Drive Pinion 205-336 (T93P-4020-A)
 ST1432-A	Adapter for 205-S127 205-111 (T76P-4020-A11)
 ST1344-A	Spreader, Differential Housing (Plate) 205-335 (T93P-4000-A)
 ST1349-A	Gauge, Differential Bearing 205-338 (T93P-4222-A)
 ST1367-A	Installer, Drive Pinion Bearing Cone 205-005 (T53T-4621-C)
	Installer, Drive Pinion Bearing Cup 205-024 (T67P-4616-A)

 ST1678-A	
 ST1744-A	Protector, Drive Pinion Thread 205-460
 ST1325-A	Installer, Drive Pinion Oil Seal 205-133 (T79P-4676-A)
 ST1350-A	Gauge, Differential Bearing 205-339 (T93P-4222-B)
 ST1429-A	Adapter for 205-S127 205-109 (T76P-4020-A9)
 ST1725-A	Step Plate 205-D061 (D83T-4205-C2) or equivalent
 ST1374-A	Gauge, Differential Clutch 205-135 (T80P-4946-A)
 ST1265-A	Gauge, Differential Clutch Torque 205-013 (T59L-4204-A)
	Remover, Bearing 205-055 (T71P-4621-B)

 ST1310-A	
 ST1186-A	Holding Fixture, Transmission 307-003 (T57L-500-B)

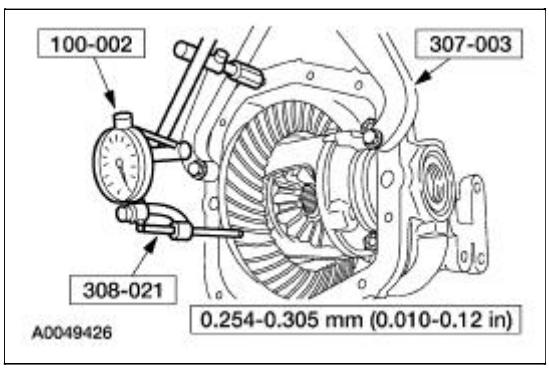
Material

Item	Specification
Premium Long Life Grease XG-1-C or equivalent	ESA-M1C75-B
SAE 75W-90FEHP XY-75W90-QFEHP	—
SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL	WSL-M2C192-A
Additive Friction Modifier XL-3	EST-M2C118-A
Ultra Silicone Sealant F7TZ-19554-AA	WSS-M4G320-A3
Stud and Bearing Mount E0AZ-19554-BA	WSK-M2G349-A1

Disassembly

Initial disassembly

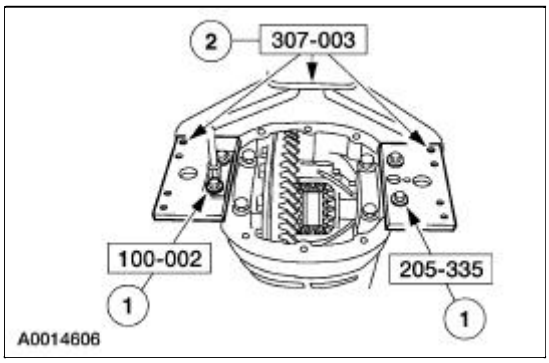
1. Remove the differential housing cover and drain the lubricant into a suitable container.
2. Wipe the lubricant from the internal working parts and inspect the parts for wear and damage.
3. Using the special tool, measure and record the differential ring gear backlash between teeth at four places around the ring gear.
   - Remove the special tool.



4. **CAUTION: Do not damage the aluminum differential housing while carrying out these procedures.**

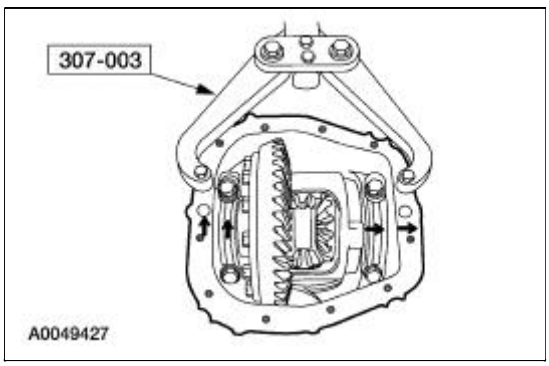
Using the special tools, mount the differential housing to a work bench.

1. Attach the special tools to the differential housing with four bolts that retain the differential housing cover to the differential housing.
2. Attach the special tools together with two 3/8 inch x 1-1/2 inch bolts.



5. **CAUTION: Mark the position and location of the differential bearing caps as the arrows may not be visible. Always install the differential bearing caps in their identical location and position.**

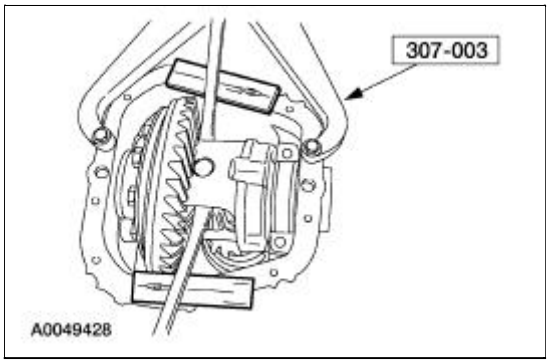
Remove the differential bearing caps.



6. **CAUTION: Use wood blocks to avoid damaging the differential housing.**

Remove the differential assembly.

- Position wood blocks at the top and bottom of the differential case.
- Pry the differential assembly and the differential bearing shims out of the differential housing.

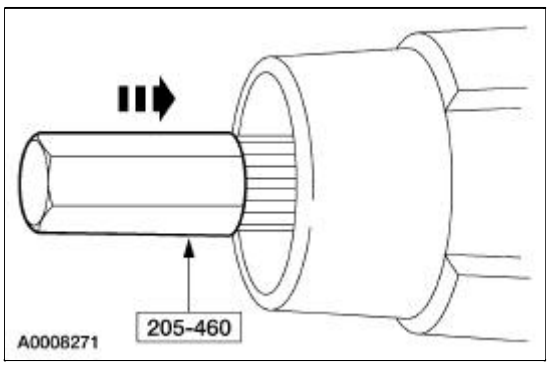


7. **CAUTION: Record the torque necessary to maintain rotation of the drive pinion gear through several revolutions prior to removing the rear axle pinion flange.**

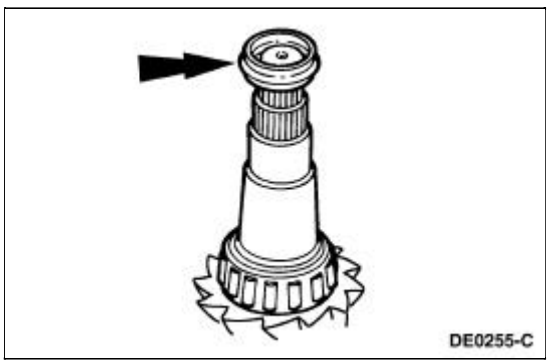
   Remove the rear axle pinion flange and the rear axle drive pinion seal. For additional information, refer to Drive Pinion Flange and Drive Pinion Seal in this section.

8. Remove the rear axle drive pinion shaft oil slinger.

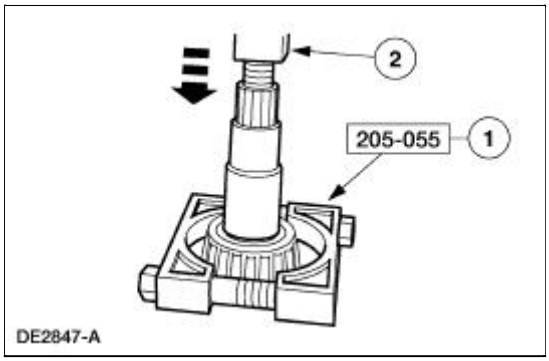
9. Using the special tool and a soft-faced hammer, drive the drive pinion gear out of the front pinion bearing and remove it through the rear of the differential housing.



10. Remove and discard the differential drive pinion collapsible spacer.

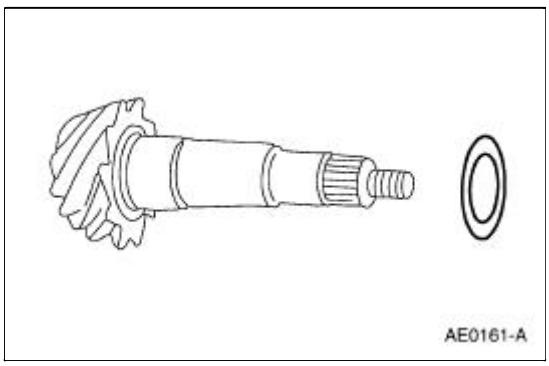


11. Using the special tool and a press, remove the pinion bearing.
    1. Position the special tool under the pinion bearing.
    2. Using a press, remove the pinion bearing.

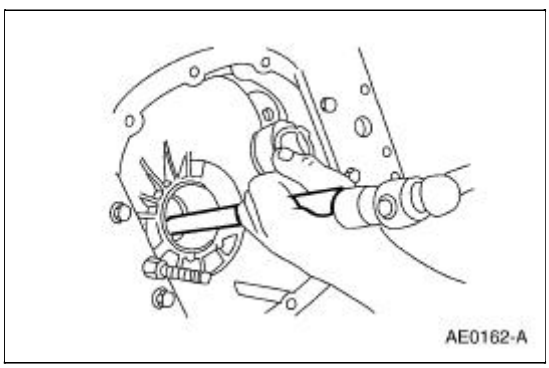


12. **NOTE:** Using a micrometer, measure the drive pinion bearing adjustment shim thickness. Use this measurement as a reference to compare to the shim gauge reading taken prior to installing the pinion bearing.

    Remove the drive pinion bearing adjustment shim.



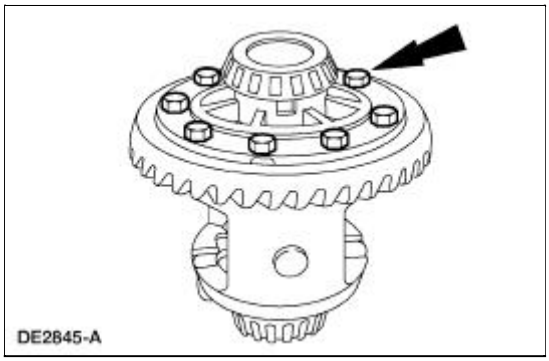
13. Using a brass drift and a hammer, remove any damaged differential drive pinion bearing cup from the differential housing. Tap alternately on each side of the cup to prevent it from cocking in the bore.



14. If the differential ring gear backlash measurement between teeth, taken at the beginning of this procedure, did not exceed the specification, proceed to Final disassembly in this procedure. If the differential ring gear backlash measurement between teeth, taken at the beginning of this procedure, exceeded the specification, the cause may be a warped differential ring gear, a damaged differential case, or loss of differential bearing preload. Proceed to Excessive differential ring gear backlash in this procedure to verify the cause of the excessive runout.

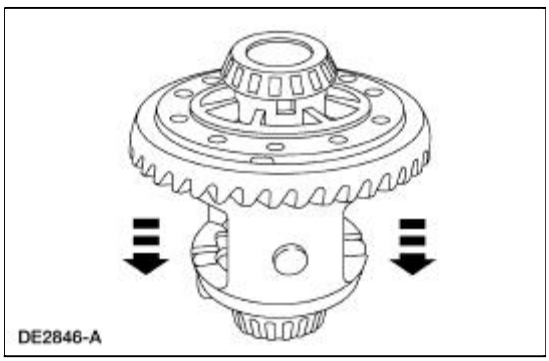
Excessive differential ring gear backlash between teeth

15. Remove the bolts.

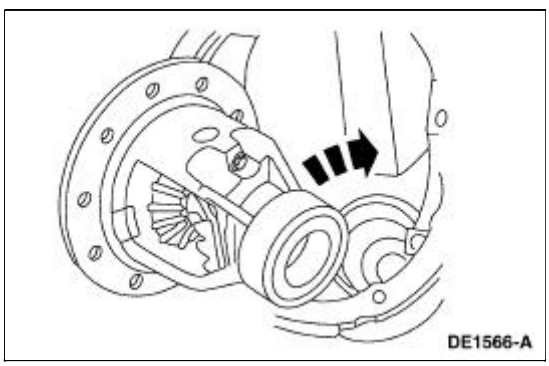


16. **CAUTION: Do not damage the bolt hole threads.**

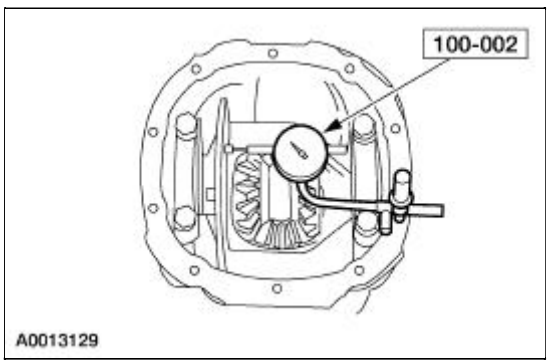
    Insert a punch in the bolt holes and drive off the differential ring gear.



17. Install the differential case, differential bearings, cups and shims in their original location. Rotate the differential case to seat the differential bearings.

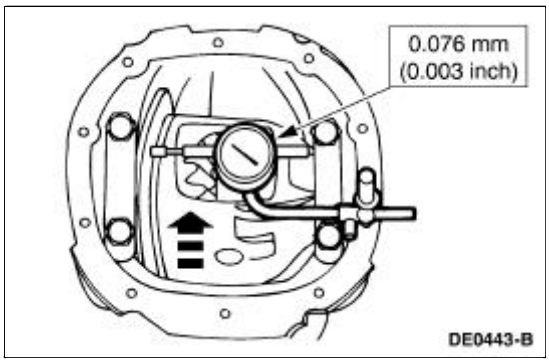


18. Install the special tool.



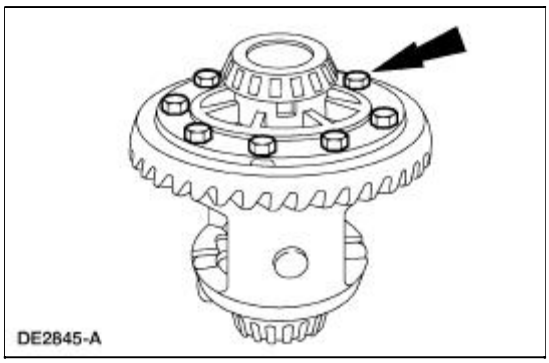
19. Using the special tool, measure the differential case flange runout.

- If the runout does not exceed the specification, the cause of the original excessive runout is the differential ring gear. Remove the differential case. Discard the differential ring gear and the drive pinion gear. Proceed to Final disassembly in this procedure.
- If the runout exceeds the specification, the differential ring gear is true and the concern is due to either differential case or differential bearing damage. Remove the differential case. Discard the differential bearings/differential case. Proceed to Final disassembly in this procedure.
    - Remove the special tool.



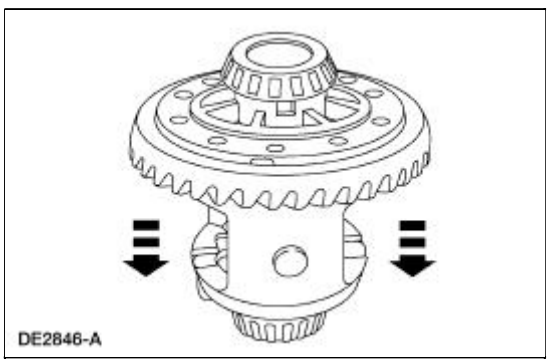
Final disassembly

20. If not done previously, remove the bolts.

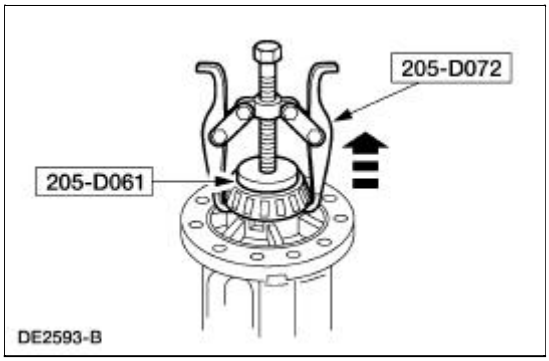


21. **CAUTION: Do not damage the bolt hole threads.**

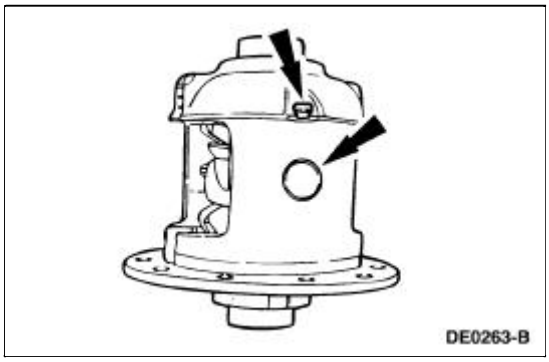
    If not done previously, insert a punch in the bolt holes and drive off the differential ring gear.



22. Using the special tools, remove the differential bearing.
    - Repeat for the other side.

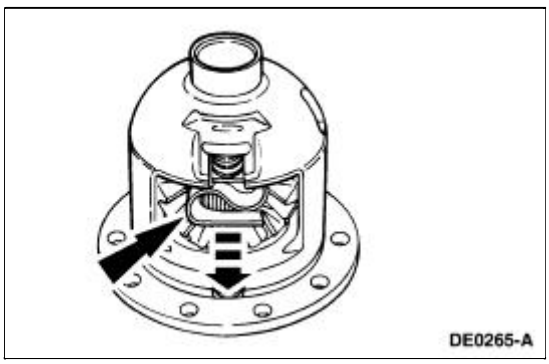


23. Remove the bolt and remove the differential pinion shaft.

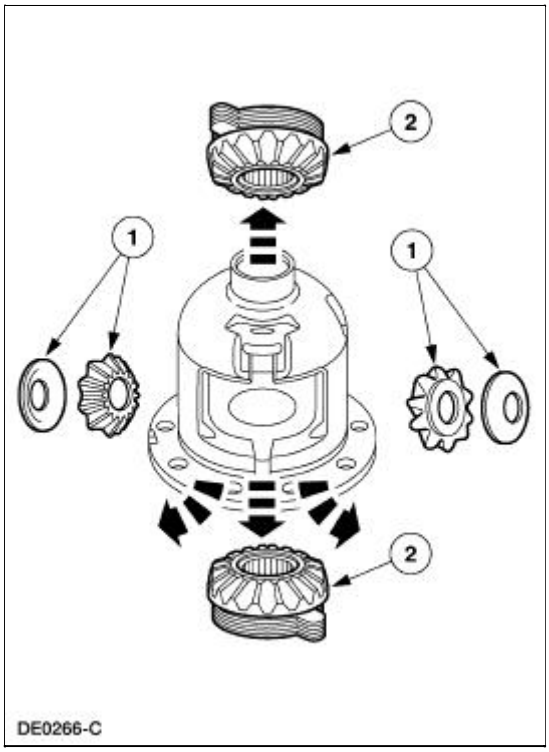


24. **WARNING: The differential clutch spring is under tension. Remove the spring carefully. Failure to follow these instructions may result in personal injury.**

    Remove the differential clutch spring.



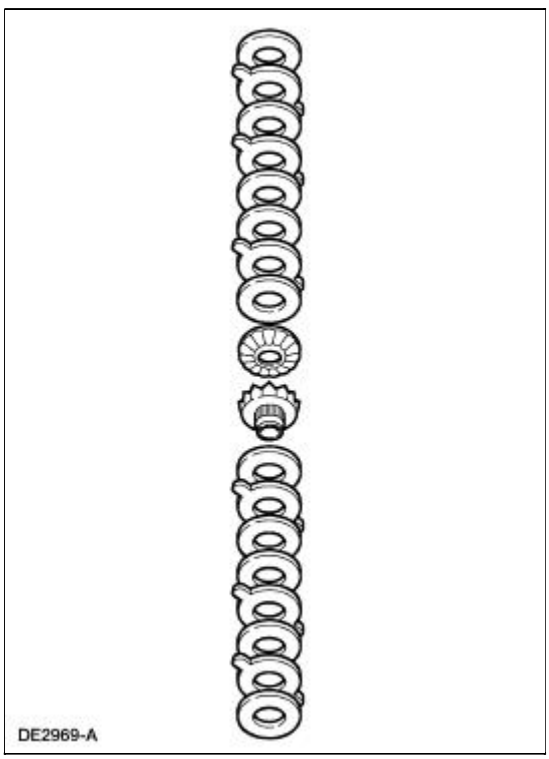
25. Remove the differential gears.
    1. Remove the two differential pinion gears and pinion thrust washers.
    2. Remove the two differential side gears with the clutch packs and the shims and tag them "left" and "right."



26. **CAUTION: Keep the differential clutch packs in order. Do not mix them. Always reassemble them in the same sequence.**

Remove the differential clutch packs and shims from the differential side gears.

- Clean and inspect the remaining differential components for wear and damage. Install new parts as necessary.



27. **CAUTION: Do not use acids or solvents when cleaning the differential clutch packs.**

Wipe the components only with a clean, lint-free cloth.

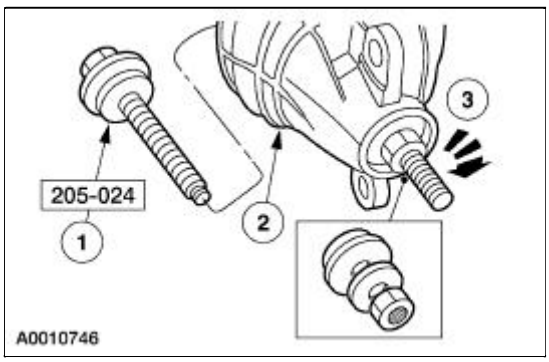
Clean and inspect the differential clutch packs for wear and damage. Install new parts as necessary.

Assembly

Initial assembly

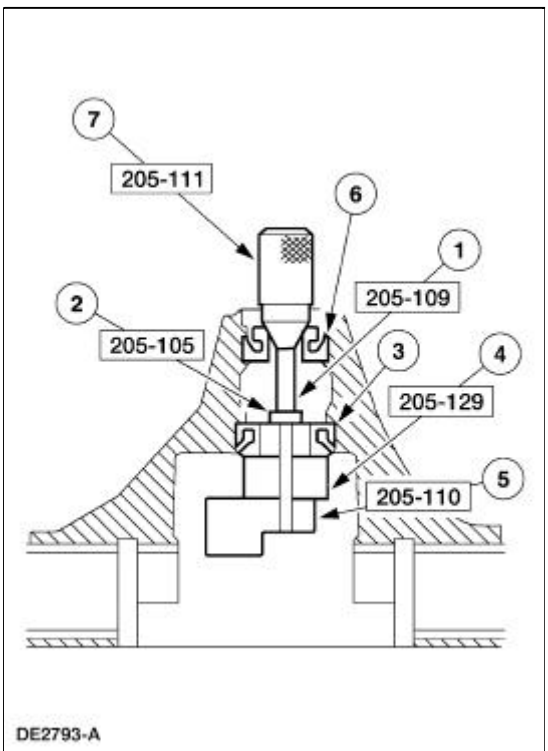
1. Coat the new differential drive pinion bearing cup(s) with lubricant.

2. Using the special tool, install the differential drive pinion bearing cup(s).
    1. Position the bearing cup(s) on the special tool.
    2. Position the special tool and the bearing cup(s) in the differential housing.
    3. Tighten the special tool to fully seat the bearing cup(s) in the bore(s).



3. **NOTE:** Apply a light film of lubricant on the front and rear pinion bearings.

   Install the pinion bearings and special tools as shown.

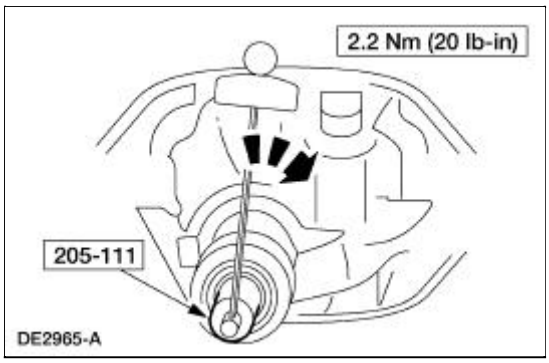


Item	Part Number	Description
1	205-109	Adapter for 205-S127

2	205-105	Adapter for 205-S127
3	4630	Rear (inner) pinion bearing
4	205-129	Adapter for 205-S127
5	205-110	Adapter for 205-S127
6	4621	Front (outer) pinion bearing
7	205-111	Adapter for 205-S127

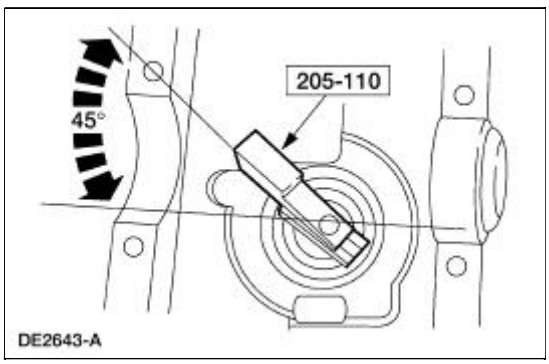
4. **NOTE:** This step duplicates pinion bearing preload.

   Thread the special tool onto the Screw and tighten to the specification shown.

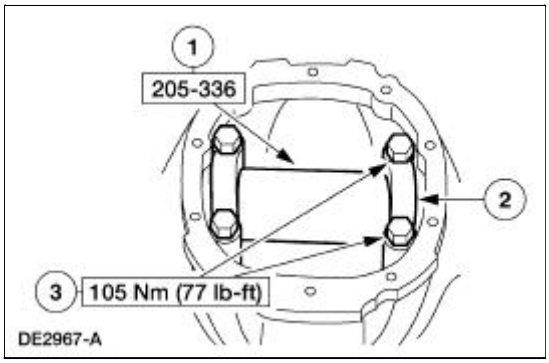


5. **CAUTION: Offset the special tool to obtain an accurate reading.**

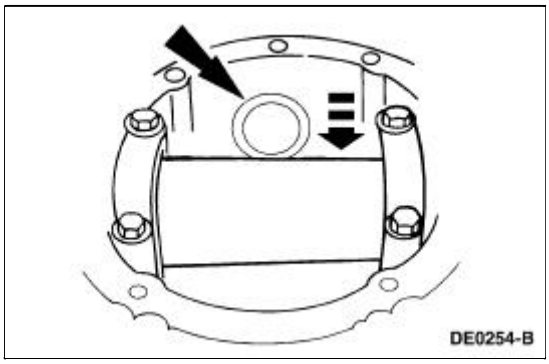
   Rotate the special tool several half turns to seat the pinion bearings. Position the special tool as shown.



6. Install the special tool.
   1. Position the special tool on the differential housing differential bearing seat.
   2. Install the differential bearing caps.
   3. Install the bolts.



7. Use a drive pinion bearing adjustment shim as a gauge for shim selection. Check the drive pinion bearing adjustment shim thickness between the Gauge Block and the Gauge Tube. A slight drag indicates correct shim selection.

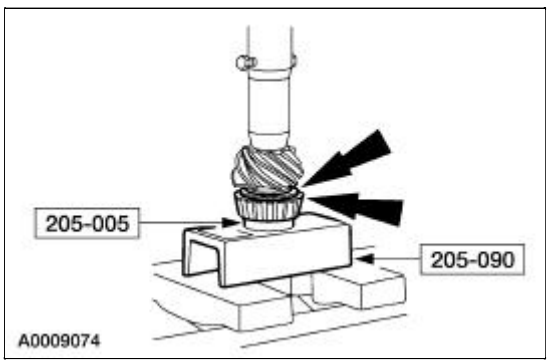


8. Remove all of the special tools.

9. **CAUTION: Use the same pinion bearings and drive pinion bearing adjustment shim from the drive pinion bearing adjustment shim selection procedure for final assembly.**

   Position the drive pinion bearing adjustment shim and the pinion bearing on the drive pinion gear stem.

10. Using the special tools and a suitable press, firmly seat the drive pinion bearing adjustment shim and pinion bearing on the drive pinion gear stem.



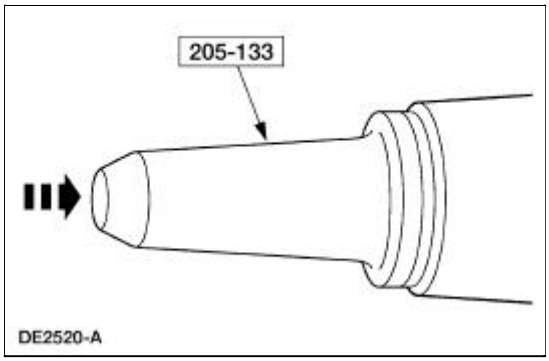
11. Install the front pinion bearing and the rear axle drive pinion shaft oil slinger in the differential housing.

12. **CAUTION: Installation without the correct tool can result in early seal failure.**

CAUTION: If the seal becomes misaligned during installation, remove it and install a new one.

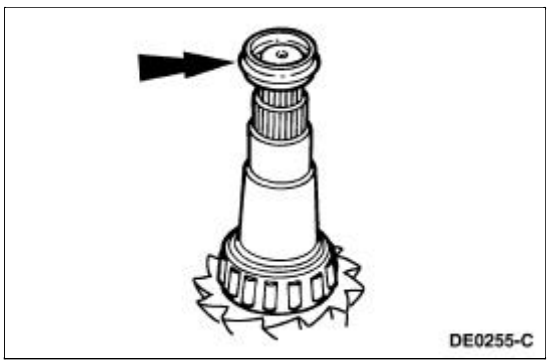
NOTE: Coat the rear axle drive pinion seal lips with grease.

Using the special tool, install the new rear axle drive pinion seal.

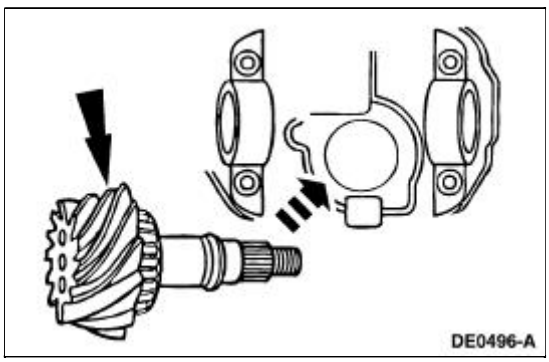


13. **CAUTION: Make sure the splines on the drive pinion gear stem are free of burrs. If burrs are evident, remove them using a fine crocus cloth.**

    Place a new differential drive pinion collapsible spacer on the drive pinion gear stem against the pinion stem shoulder.

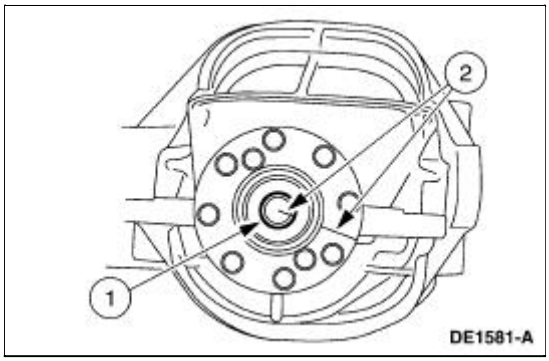


14. Install the drive pinion gear with the differential drive pinion collapsible spacer in the differential housing.

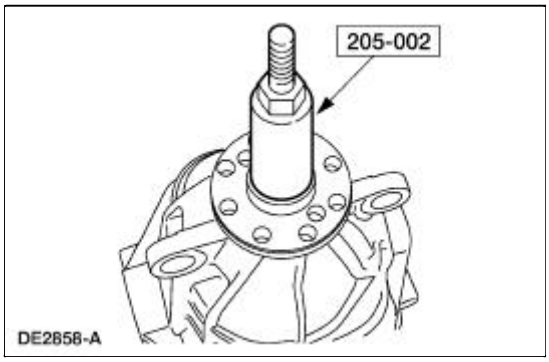


15. **NOTE:** Disregard the index marks if installing a new rear axle pinion flange.

    Position the rear axle pinion flange.
    1. Lubricate the rear axle pinion flange splines.
    2. Position the rear axle pinion flange.



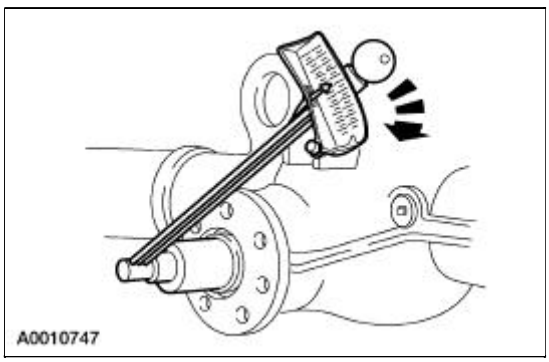
16. Using the special tool, install the rear axle pinion flange.



17. **CAUTION: Do not under any circumstance loosen the nut to reduce preload. If it is necessary to reduce preload, install a new differential drive pinion collapsible spacer and nut.**

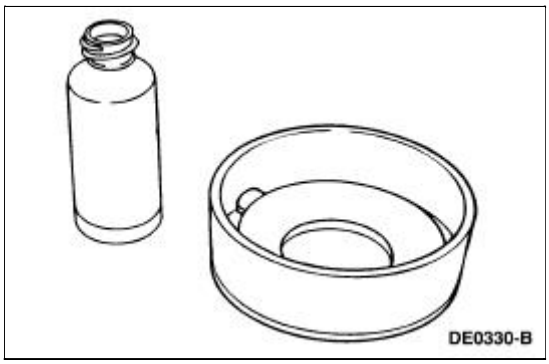
    Tighten the nut to set the preload.

    - Rotate the pinion occasionally to make sure the pinion bearings seat correctly. Take frequent pinion bearing torque preload readings by rotating the drive pinion gear with a Nm (inch/pound) torque wrench.
    - For new pinion bearings, tighten the nut to specification. Refer to torque specifications for new pinion bearings in the Specifications portion of this section.
    - For used pinion bearings, if the preload recorded prior to disassembly is lower than the specification for used bearings, then tighten the nut to specification. Refer to torque specifications for used pinion bearings in the Specifications portion of this section.
    - For used pinion bearings, if the preload recorded prior to disassembly is higher than the specification for used bearings, then tighten the nut to the original reading as recorded.



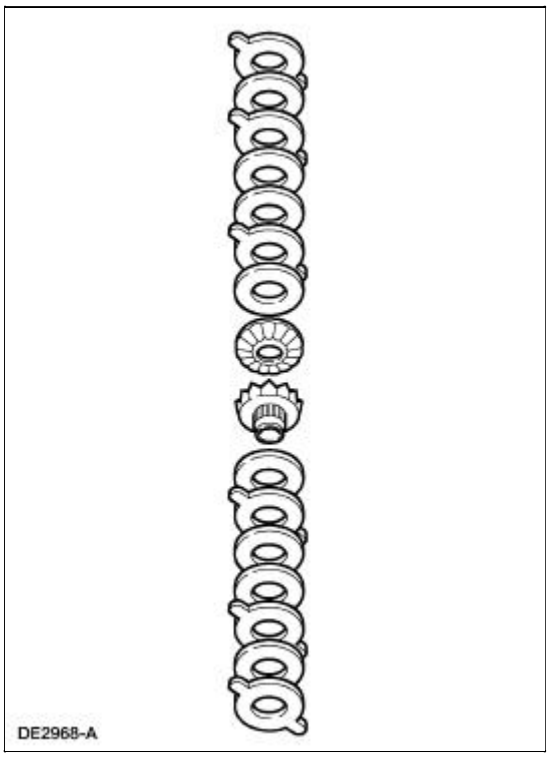
18. **CAUTION: 118 ml (4 oz) of additive friction modifier must be used in the axle.**

Lubricate each steel clutch plate with additive friction modifier and soak all friction plates for no less than 15 minutes.

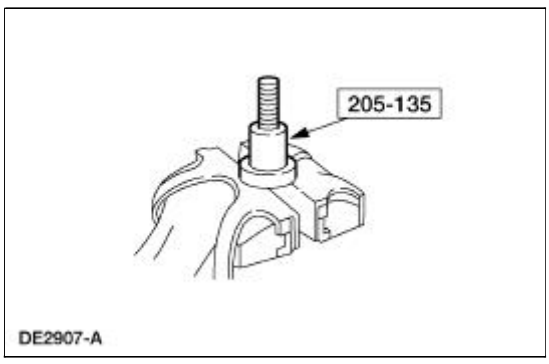


19. **CAUTION: Do not mix the clutch plates, clutch discs or shim from one side with the other.**

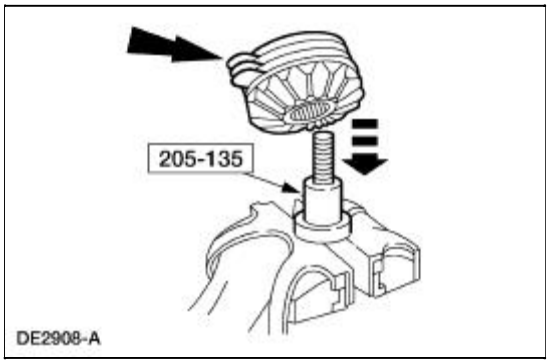
    Assemble the differential clutch packs (without the shims) on their respective differential side gear.



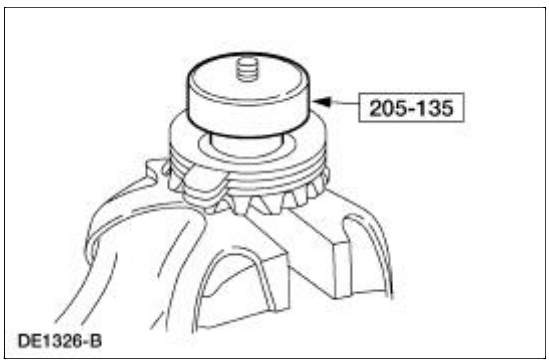
20. Place the base portion of the special tool in a vise.



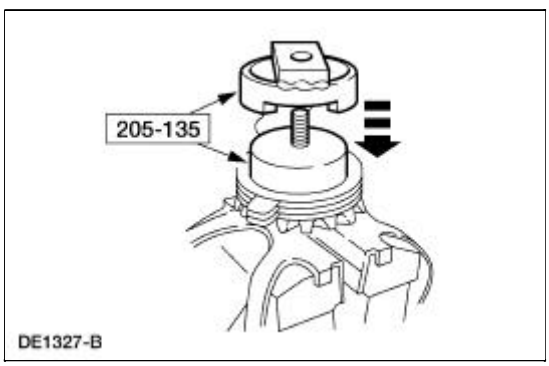
21. Install the differential clutch pack and differential side gear (without the shim) on the special tool.



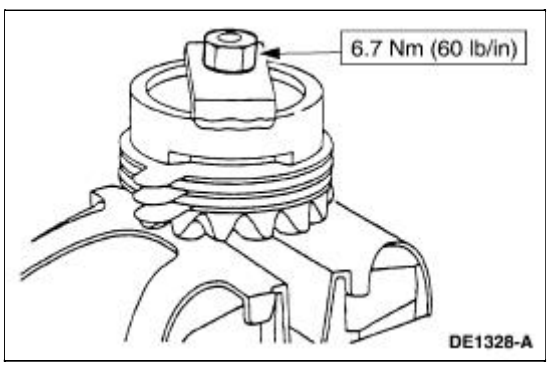
22. Position the special tool hand-tight on top of the differential clutch pack.



23. Install the special tool over the disc and differential clutch pack.



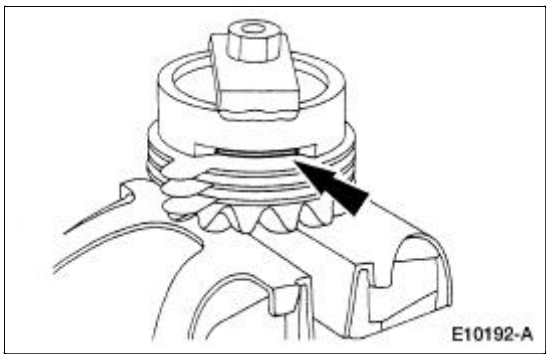
24. Install the nut.



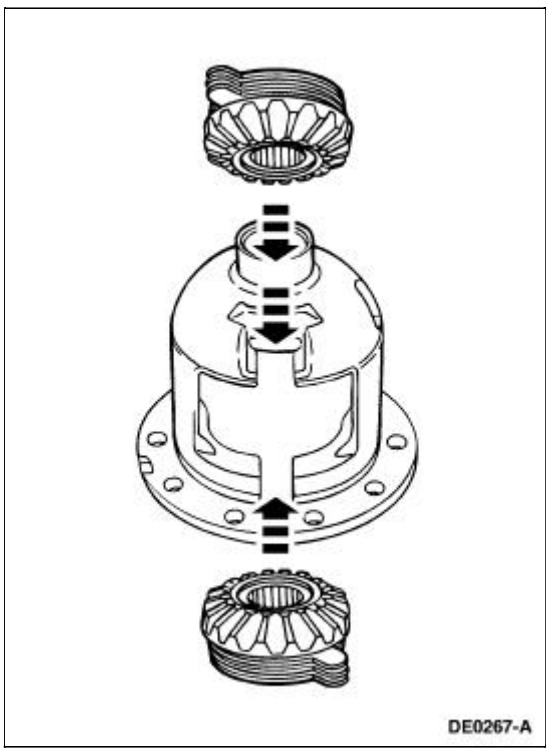
25. Select and insert the thickest feeler gauge blade that will enter between the tool and the differential clutch pack. The reading will be the thickness of the new clutch shim.

Selective Shims

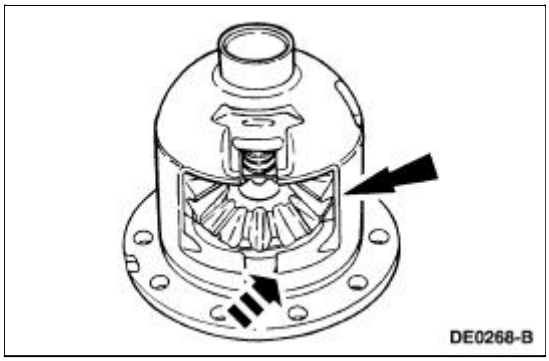
Part Number	Description
E0AZ-4A324-G	0.025 inch
E0AZ-4A324-H	0.030 inch
E0AZ-4A324-C	0.035 inch
E0AZ-4A324-D	0.040 inch
E0AZ-4A324-F	0.045 inch



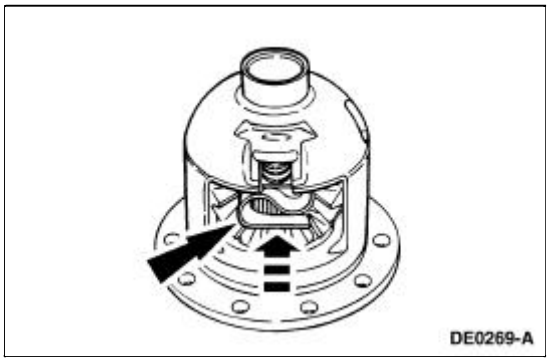
26. Remove the special tool from the differential clutch pack and differential side gear assembly.
27. Install the shim(s) on the differential clutch pack and differential side gear assembly.
28. Install the differential side gear assemblies in the differential case.



29. Install the differential pinion gear and differential pinion thrust washer assemblies in the differential case.

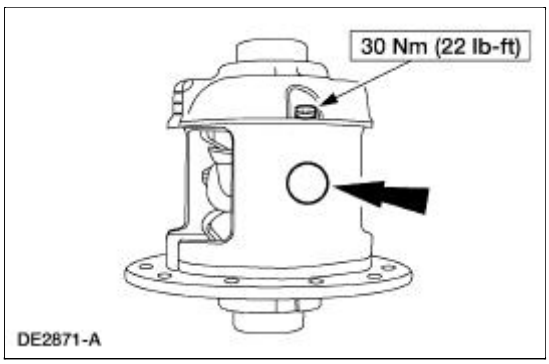


30. Using a soft-faced hammer, install the differential clutch spring.

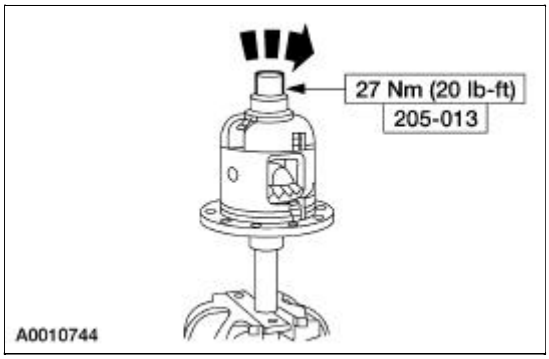


31. **NOTE:** If a new bolt is unavailable, coat the original bolt threads with threadlock and sealer prior to final installation.

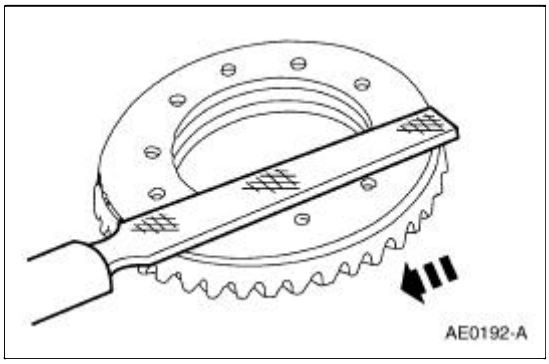
    Install the differential pinion shaft and install a new bolt finger-tight.



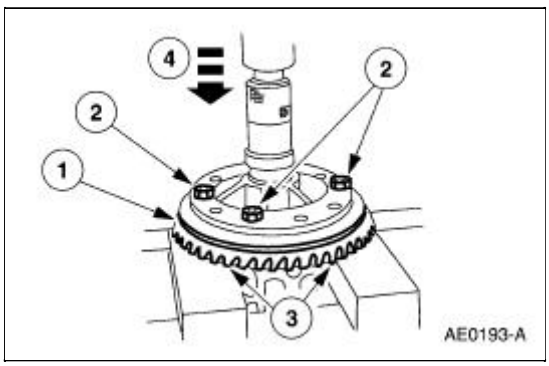
32. Mount the differential case and the special tool in a vise. Using the special tool, check the torque necessary to rotate one differential side gear.
    - If reusing the original clutch plates, the initial minimum break-away torque must be no less than the specification. The minimum rotating torque necessary to keep the differential side gear turning with new clutch plates may vary.



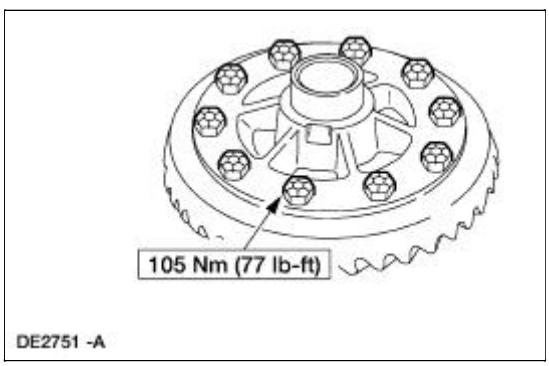
33. Draw-file the differential ring gear mounting surface to remove any nicks or burrs.



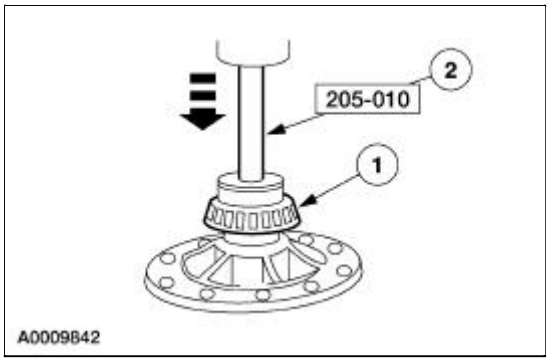
34. Install the differential ring gear.
    1. Place the differential ring gear on the differential case.
    2. Hand start three bolts to align the holes in the differential ring gear and the differential case.
    3. Place the differential case and differential ring gear onto the press bed blocks with the differential ring gear teeth facing downward.
    4. Press the differential ring gear into place.



35. Install the remaining bolts.

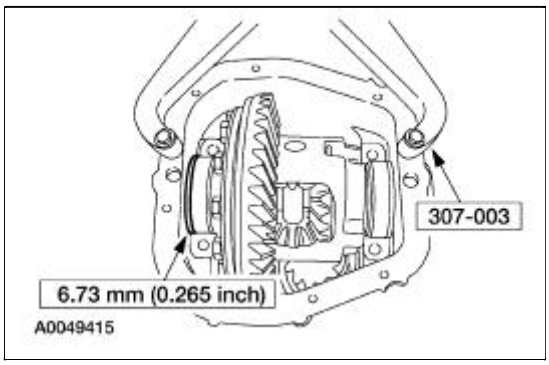


36. Press the left and right differential bearing on the differential case.
    1. Place the bearing on the differential case.
    2. Use the special tool to install the bearing.



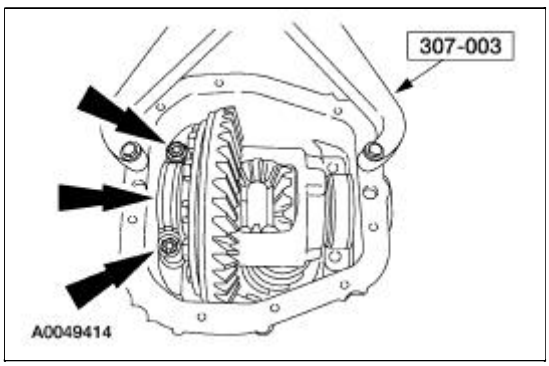
37. With the pinion depth set and the pinion installed, place the differential case in the rear axle housing.

38. Install a shim as shown on the left side.

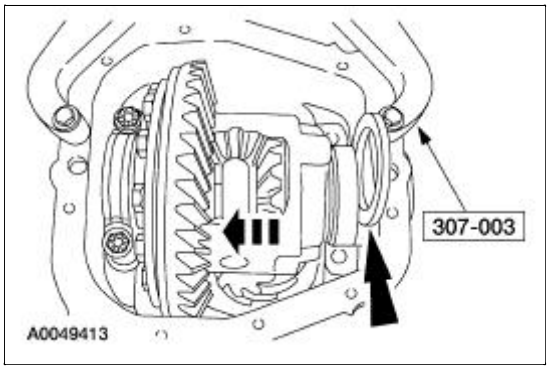


39. **NOTE:** Apply pressure toward the left side to make sure the left bearing cup is seated.

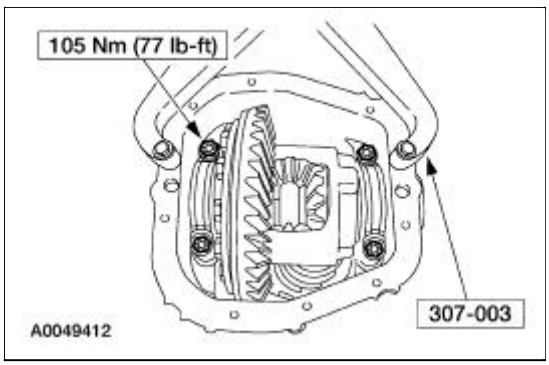
    Install the left bearing cap and loosely install the bearing cap bolts.



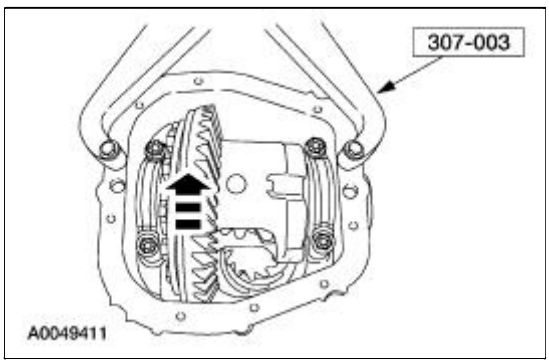
40. Install progressively larger shims on the right side until the largest shim selected can be installed by hand.



41. Install the right side bearing cap and tighten the bolts.



42. Rotate the differential case to make sure it rotates freely.

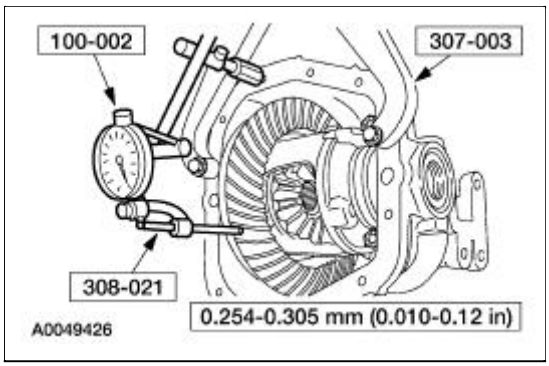


Measuring backlash

43. Using the special tools, measure and note the differential ring gear backlash.
    - If backlash is within the specification, refer to Backlash within specification in this procedure.
    - If a zero backlash condition occurs, refer to Zero backlash in this procedure.
    - If backlash is not within the specification, refer to Backlash not within specification in this procedure.

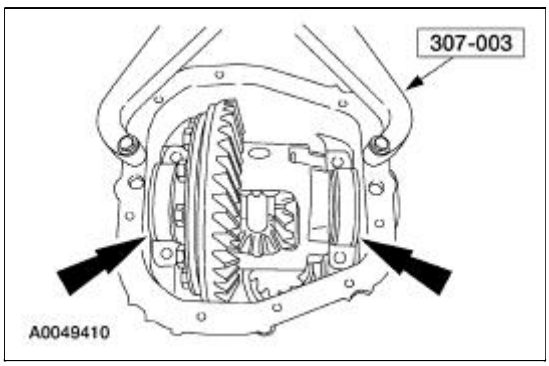
Backlash Change Required		Thickness Change Required	
mm	**Inch**	**mm**	**Inch**
0.025	0.001	0.050	0.002
0.050	0.002	0.050	0.002
0.076	0.003	0.101	0.004

0.101	0.004	0.152	0.006
0.127	0.005	0.152	0.006
0.152	0.006	0.203	0.008
0.177	0.007	0.254	0.010
0.203	0.008	0.254	0.010
0.228	0.009	0.304	0.012
0.254	0.010	0.355	0.014
0.279	0.011	0.355	0.014
0.304	0.012	0.406	0.016
0.330	0.013	0.457	0.018
0.335	0.014	0.457	0.018
0.381	0.015	0.508	0.020



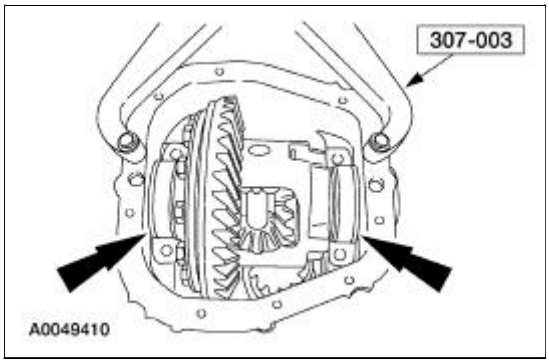
Zero backlash

44. If a zero backlash condition occurs, add 0.51 mm (0.020 inch) to the RH side and subtract 0.51 mm (0.020 inch) from the LH side to allow backlash indication. Measure the backlash. Refer to Measuring backlash in this procedure.

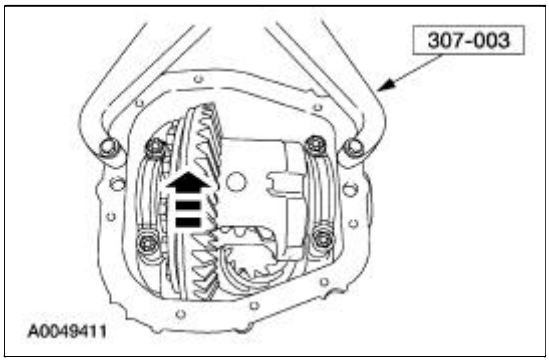


Backlash not within specification

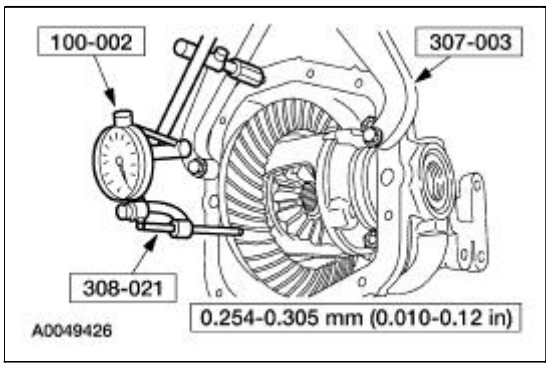
45. To increase or decrease backlash, remove the differential bearing caps and install a thicker shim and a thinner shim accordingly.
    - If backlash is not within the specification, increase the thickness of one differential bearing shim and decrease the thickness of the other differential bearing shim by the same amount.



46. Rotate the differential assembly several times to verify that the differential bearings seated correctly.



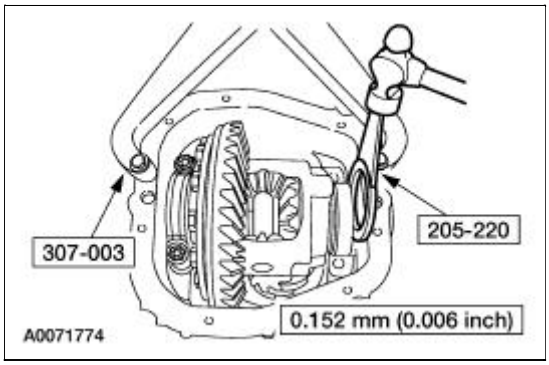
47. Using the special tools, recheck the backlash.
    - If backlash is within the specification, refer to Backlash within specification in this procedure. If backlash is not within the specification, repeat Backlash not within specification in this procedure.



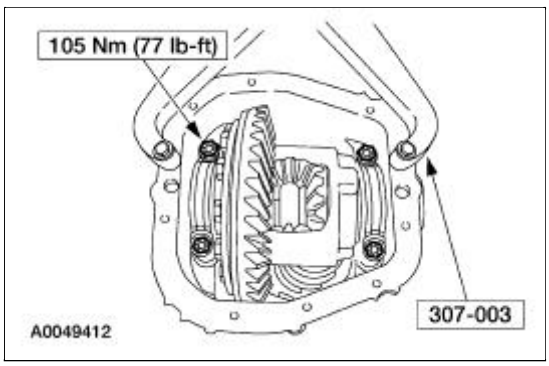
Backlash within specification

48. Remove the bolts and the differential bearing caps.

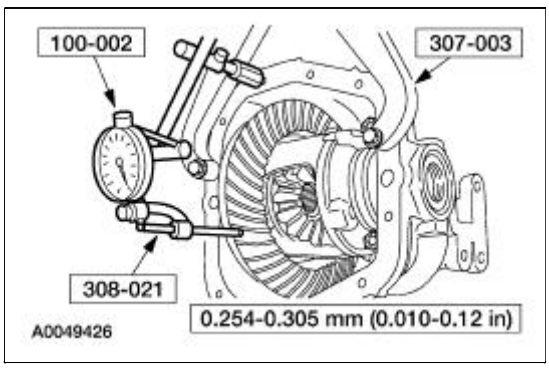
49. To establish differential bearing preload, increase both left and right differential bearing shim sizes by the specification shown.



50. Install the differential bearing caps and bolts.



51. Using the special tools, recheck the backlash.



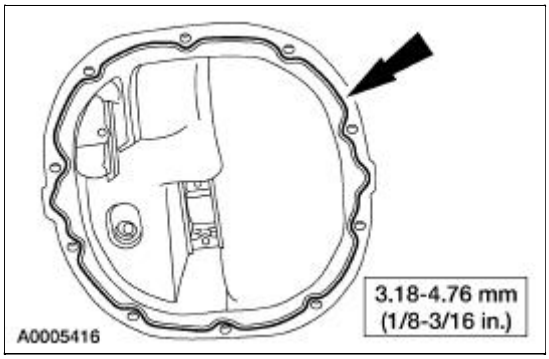
Final assembly

52. **CAUTION: The machined surfaces on the differential housing and the differential housing cover must be clean and free of oil before applying the new silicone sealant. Cover the inside of the axle before cleaning the machined surface to prevent contamination.**

CAUTION: Install the differential housing cover within 15 minutes of applying the silicone material.

CAUTION: Allow the sealant to cure for one hour before filling the axle with lubricant.

Apply a continuous bead of sealant, of the specified thickness, to the differential housing cover mounting surface.



53. Install the differential housing cover.

54. **CAUTION: Place 118 ml (4 oz) of additive friction modifier in the rear axle assembly.**

    Install the rear axle assembly in the vehicle. Fill the axle with the specified lubricant. For additional information, refer to Axle Assembly—Air Suspension or Axle Assembly—Coil Suspension in this section.

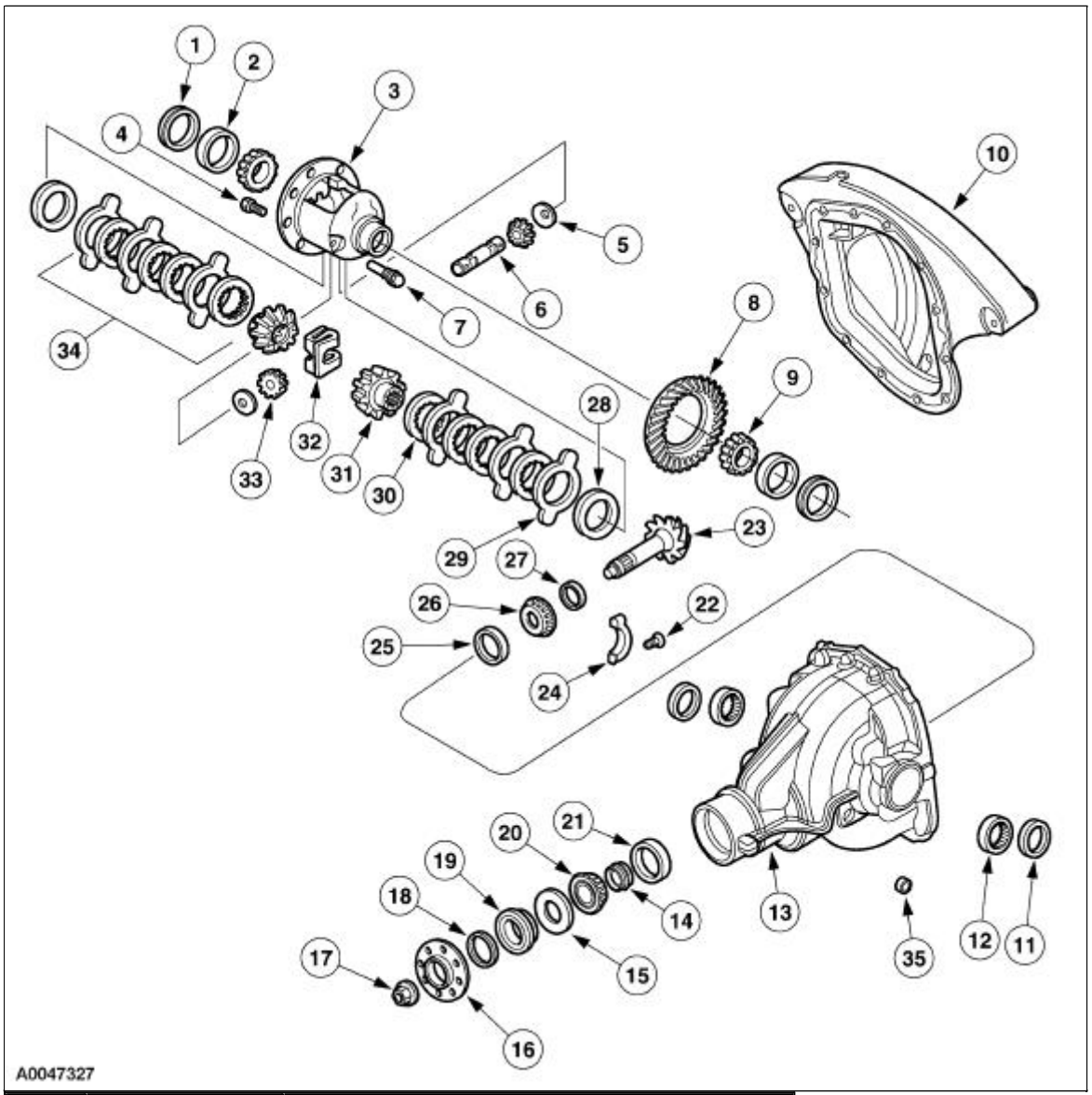
General Specifications

Item	Specification
Lubricants and Sealants	
SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL	WSL-M2C192-A
Additive Friction Modifier XL-3	EST-M2C118-A
Premium Long-Life Grease XG-1-C	ESA-M1C75-B
Ultra Silicone Rubber F7TZ-19554-AA	WSS-M4G320-A3
Threadlock and Sealer E0AZ-19554-AA	WSK-M2G351-A5
Backlash Specifications	
Differential case maximum runout	0.076 (0.003)
Backlash between ring gear and pinion teeth	0.254-0.305 (0.010-0.012)
Ring gear maximum backlash variation between teeth	0.102 (0.004)
Pinion flange maximum radial runout in assembly	0.203 (0.008 T.I.R.)
Rotational Torque Ranges	
Pinion bearing preload (used pinion bearing)	0.9-1.5Nm (8-14 Lb-In)
Pinion bearing preload (new pinion bearing)	1.8-3.3Nm (16-29 Lb-In)
Minimum breakaway torque — (Traction-Lok®)	27Nm (20 Lb-Ft)

Torque Specifications

Description	Nm	lb-ft	lb-in
Differential bearing cap bolt	105	77	—
Differential pinion shaft lock bolt	30	22	—
Oil filler plug	30	22	—
Differential housing cover bolts	32	24	—
Driveshaft bolts	112	83	—
Ring gear bolts	150	111	—
Traction-Lok clutch gauge nut	6.7	—	60
Driver handle	2.2	—	20
Torque arm-to-rear axle housing bolts	181	100	—
Torque arm insulator bolt	181	100	—
Rear axle cover insulator stud nut	100	74	—

Rear Drive Axle and Differential



Item	Part Number	Description
1	4067	Differential bearing shim
2	4222	Differential bearing cup
3	4204	Differential case
4	4216	Differential ring gear case bolt
5	4230	Differential pinion thrust washer
6	4211	Differential pinion shaft
7	4241	Differential pinion shaft lock bolt
8	—	Differential ring gear (part of 4209)
9	4221	Differential bearing

10	4033	Differential housing cover
11	4B416	Stub shaft pilot bearing seal
12	4B413	Stub shaft pilot bearing
13	4010	Differential housing
14	4662	Drive pinion collapsible spacer
15	4670	Drive pinion shaft oil slinger
16	4851	Drive pinion flange
17	389546-S100	Drive pinion nut
18	4859	Drive pinion oil seal deflector
19	4676	Drive pinion seal
20	4621	Drive pinion bearing
21	4616	Drive pinion bearing cup
22	56187-S	Bolt
23	—	Drive pinion gear (part of 4209)
24	—	Differential bearing cap (part of 4010)
25	4628	Drive pinion bearing cup
26	4630	Drive pinion bearing
27	4663	Drive pinion bearing adjustment shim
28	4A321	Differential clutch shim
29	—	Clutch plate (part of 4947)
30	—	Clutch disc (part of 4947)
31	4236	Differential side gear
32	4214	Differential clutch spring
33	4215	Differential pinion gear
34	4947	Differential clutch pack
35	390943 S100	Fill plug

- The differential housing consists of a cast iron housing and a cast aluminum differential housing cover. The differential housing cover uses silicone sealant as a gasket.
- The hypoid-design gearset consists of a 9.75-inch differential ring gear and a drive pinion gear. Two opposed pinion bearings support the drive pinion gear in the differential housing.
- A drive pinion collapsible spacer, located on the drive pinion gear shaft, maintains pinion bearing preload. The pinion nut adjusts the preload.
- Differential bearing shims, located between the differential bearing cups and the differential housing, adjust the differential ring gear backlash and the differential bearing preload.
- The differential case is a one-piece design with two openings to allow for assembly of the internal components and lubricant flow. Two opposed differential bearings support the differential case in the differential housing. Removable differential bearing caps retain the differential assembly in the differential housing.
- Inside the differential case, the differential pinion shaft supports two differential pinion gears. The pinion gears engage the differential side gears, to which the halfshafts are splined. The differential pinion shaft lock bolt retains the differential pinion shaft in the differential case.
- A circlip, located on the stub shaft, holds the halfshaft in the differential case. When installed, the circlip engages a groove in the differential side gear.

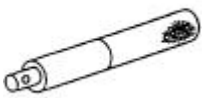
- The rear axle uses SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL or equivalent meeting Ford specification WSL-M2C192-A.
- An embossed metal tag, bolted to the differential housing cover, contains rear axle identification. For additional information, refer to Section 205-00 .

Rear Drive Axle and Differential

Refer to Section 205-00 .

Stub Shaft Pilot Bearing and Seal

Special Tool(s)

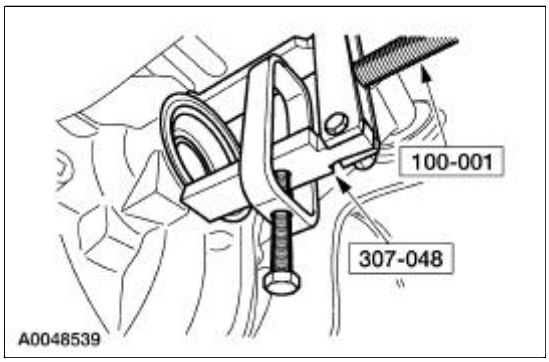
 ST1200-A	Remover, Bearing Cup 308-047 (T77F-1102-A)
 ST2258-A	Protector, Halfshaft Seal (Pair) 205-506
 ST1676-A	Installer, Halfshaft Seal 205-505
 ST1326-A	Adapter for 303-224 (Handle) 205-153 (T80T-4000-W)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
 ST1721-A	Installer, Halfshaft Pilot Bearing 205-504
 ST1192-A	Remover, Transmission Fluid Seal 307-048 (T74P-77248-A)

Material

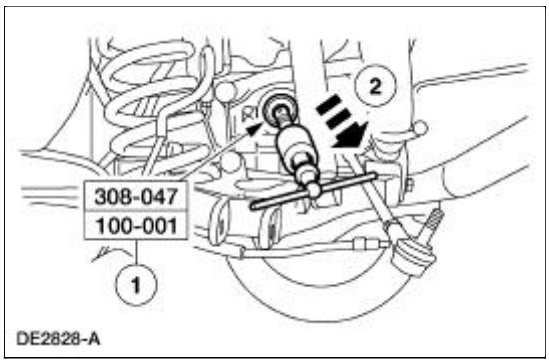
Item	Specification
SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL	WSL-M2C192-A
Premium Long Life Grease XG-1-C	ESA-M1C75-B

1. Remove the halfshaft assembly. For additional information, refer to Section 205-05 .

2. Using the special tools, remove the stub shaft pilot bearing seal.



3. Using the special tools, remove the stub shaft pilot bearing.
    1. Firmly engage the tangs of the special tool on the stub shaft pilot bearing.
    2. Remove the bearing.

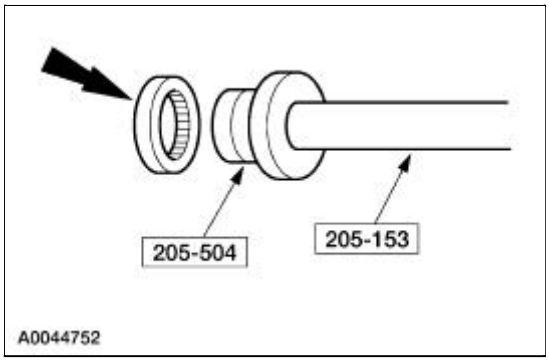


4. Inspect the seal journal for rust, nicks and scratches. Polish the seal journal surface with fine crocus cloth, if necessary.

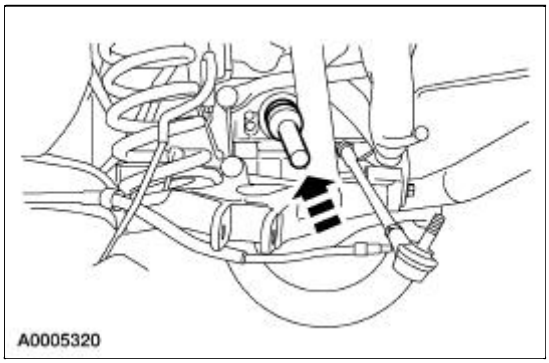
5. Lubricate the new stub shaft pilot bearing with axle lubricant.

6. **CAUTION: Installation of the stub shaft pilot bearing or stub shaft oil seal without the correct tools can result in early bearing or seal failure. If the stub shaft pilot bearing becomes cocked in the bore during installation, remove it and install a new one.**

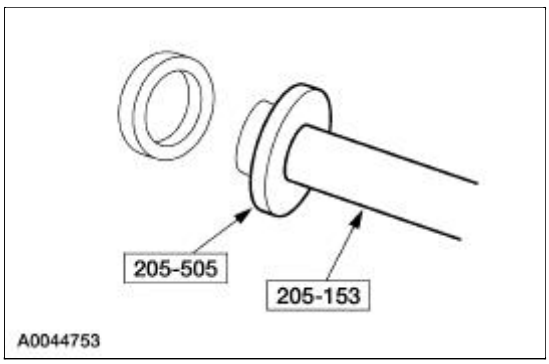
    Place the stub shaft pilot bearing onto the special tools.



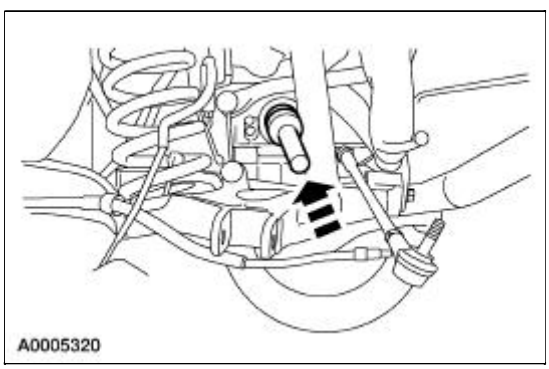
7. Install the stub shaft pilot bearing into the rear axle housing bore.



8. Lubricate the lip of the stub shaft pilot bearing seal with grease and install the seal onto the special tools.



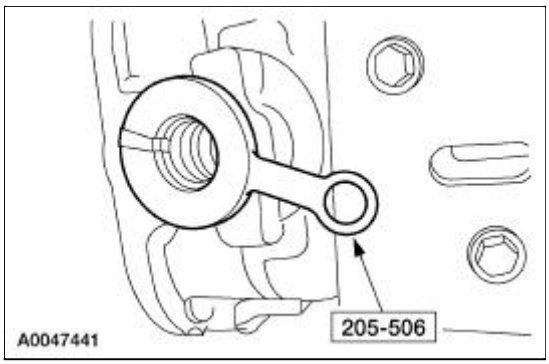
9. Carefully align the stub shaft pilot bearing seal with the housing bore and install the stub shaft pilot bearing seal.



10. **CAUTION: Use the special tool to avoid damaging the seal with the halfshaft.**

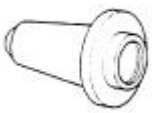
CAUTION: Inspect the stub shaft seal journal for rust, nicks, or scratches prior to installing the halfshaft. Polish the seal journal with fine crocus cloth, if required.

Install the halfshaft. For additional information, refer to Section 205-05 .



Drive Pinion Flange and Drive Pinion Seal

Special Tool(s)

 ST2026-A	2-Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1257-A	Holding Fixture, Drive Pinion Flange 205-126 (T78P-4851-A)
 ST1734-A	Installer, Drive Pinion Flange 205-233 (T85T-4851-AH)
 ST1325-A	Installer, Drive Pinion Oil Seal 205-208 (T83T-4676-A)

Material

Item	Specification
Premium Long Life Grease XG-1-C	ESA-M1C75-B
Threadlock and Sealer E0AZ-19554-AA	WSK-M2G351-A5 (type II)
SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL	WSL-M2C192-A

Removal

CAUTION: Remove the rear wheel and tire assemblies, brake calipers, and brake discs to prevent brake drag during the drive pinion bearing preload adjustment.

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by**

turning off the air suspension switch located in the RH kick panel area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations. Failure to follow these instructions may result in personal injury and vehicle damage.

Position the vehicle on a hoist. For additional information, refer to Section 100-02 .

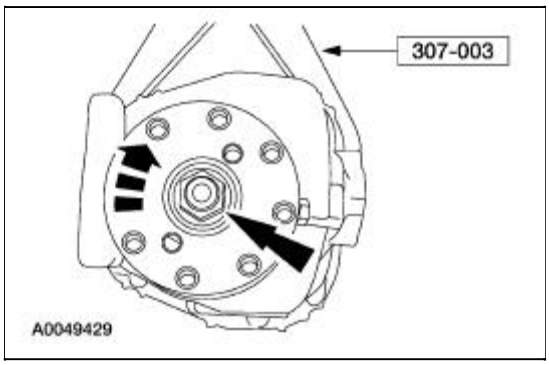
2. Remove the rear wheel and tire assemblies. For additional information, refer to Section 204-04 .

3. **CAUTION: Do not allow the brake caliper to hang from the brake hose. Provide a suitable support.**

   Remove the rear brake calipers, and the brake discs. Position the brake calipers aside. For additional information, refer to Section 206-04 .

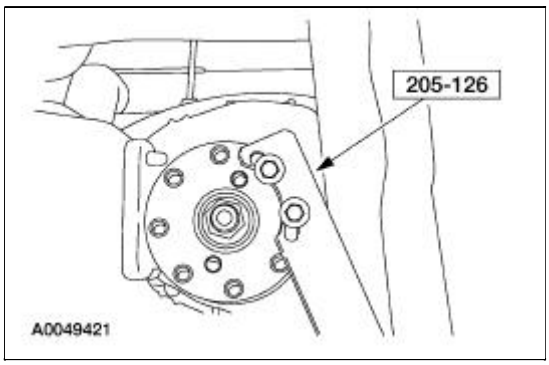
4. Remove the rear driveshaft assembly. For additional information, refer to Section 205-01 .

5. Install a Nm (inch-pound) torque wrench on the nut and record the torque necessary to maintain rotation of the drive pinion gear through several revolutions.

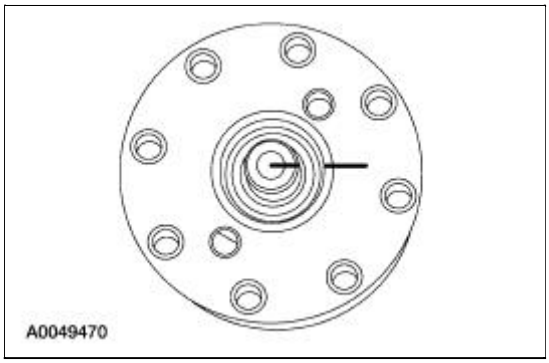


6. **CAUTION: After removing the pinion nut, discard it. Use a new nut for installation.**

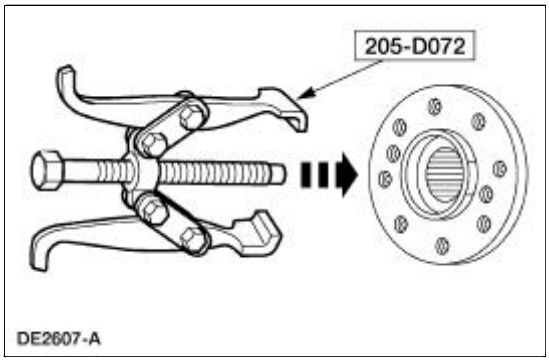
   Use the special tool to hold the pinion flange while removing the pinion nut.



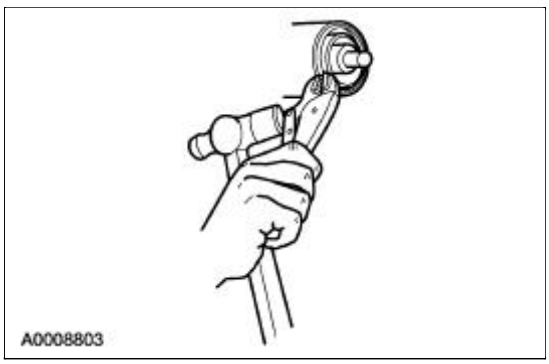
7. Index-mark the drive pinion flange and the drive pinion gear stem to maintain initial balance during installation.



8. Using the special tool, remove the drive pinion flange.



9. Force up on the metal flange of the drive pinion seal. Install gripping pliers and strike with a hammer until the pinion seal is removed.

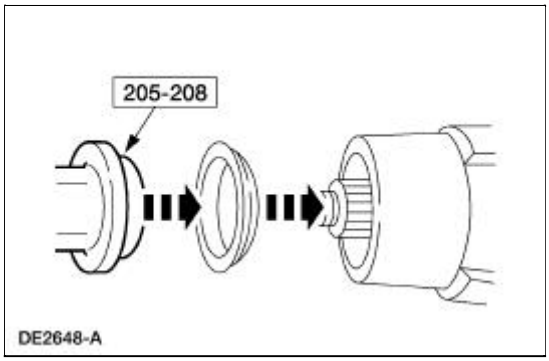


Installation

1. Lubricate the lips of the new drive pinion seal with grease.

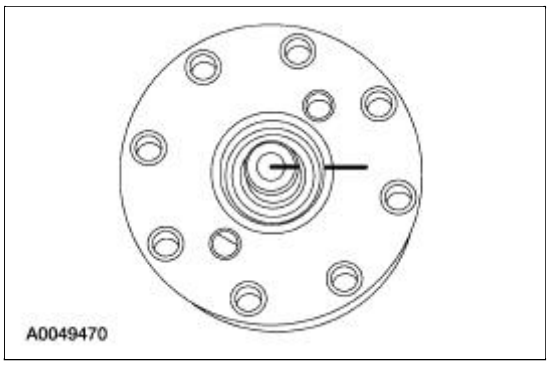
2. **CAUTION: If the drive pinion seal becomes misaligned during installation, remove it and install a new seal.**

   Using the special tool, install the drive pinion seal.

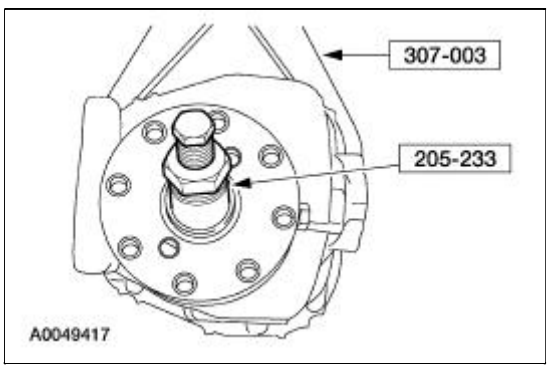


3. Lubricate the drive pinion flange splines with rear axle lubricant.
4. **NOTE:** Disregard the index marks if installing a new drive pinion flange.

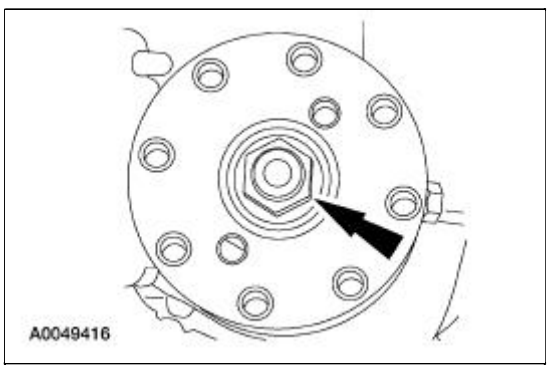
   Position the drive pinion flange.



5. Using the special tool, install the drive pinion flange.



6. Position the new drive pinion nut.

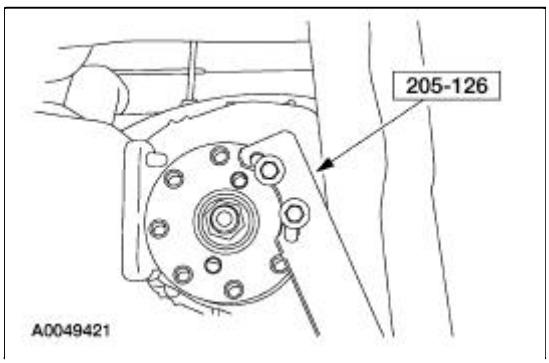


7. **CAUTION: Do not under any circumstance loosen the nut to reduce preload. If it is necessary to reduce preload, install a new drive pinion collapsible spacer and nut.**

   CAUTION: Remove the special tool while taking preload readings with the Nm (inch-pound) torque wrench.

   Use the special tool to hold the pinion flange while tightening the nut.

   - Rotate the pinion occasionally to make sure the pinion bearings seat correctly. Take frequent pinion bearing torque preload readings by rotating the drive pinion gear with a Nm (inch/pound) torque wrench.
   - If the preload recorded prior to disassembly is lower than the specification for used bearings, tighten the nut to specification. If the preload recorded prior to disassembly is higher than the specification for used bearings, tighten the nut to the original reading as recorded.
   - Refer to the torque specification for used pinion bearings in the Specifications portion of this section.



8. **CAUTION: Install the driveshaft with new bolts. If new bolts are not available, apply sealer to the threads of the original bolts.**

   CAUTION: Align the index marks.

   CAUTION: The driveshaft flange yoke fits tightly on the pinion flange pilot. To make sure that the yoke seats squarely on the flange, tighten the bolts evenly in a cross pattern as shown.

   Install the rear driveshaft. For additional information, refer to Section 205-01 .

9. Install the rear brake discs, and the brake calipers. For additional information, refer to Section 206-04 .

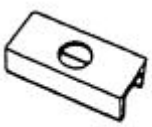
10. Install the rear wheel and tire assemblies. For additional information, refer to Section 204-04 .

11. Lower the vehicle.

12. If equipped with air suspension, reactivate the system.

Rear Axle Housing Support Insulator

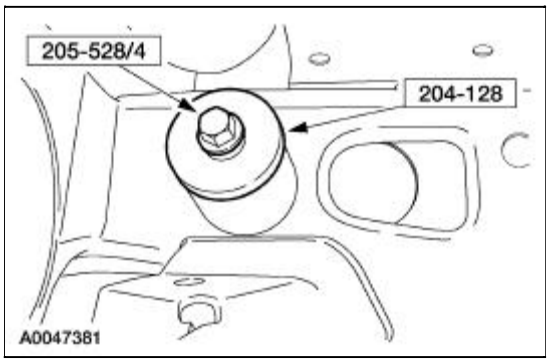
Special Tool(s)

 ST2668-A	Forcing Screw, Rear Differential Housing Bushing 205-528/4
 ST1970-A	Installer, Rear Differential Housing Bushing 205-528/2
 ST2669-A	Receiver Cup, Rear Differential Housing Bushing 205-528/3
 ST1965-A	Remover, Rear Differential Housing Bushing 205-528/1
 ST1569-A	Adapter for 204-S127 204-128 (T86P-5638-AH1)
 ST1367-A	Installer, Drive Pinion Bearing 205-488
 ST1254-A	Plate, Bearing/Oil Seal 205-090 (T75L-1165-B)

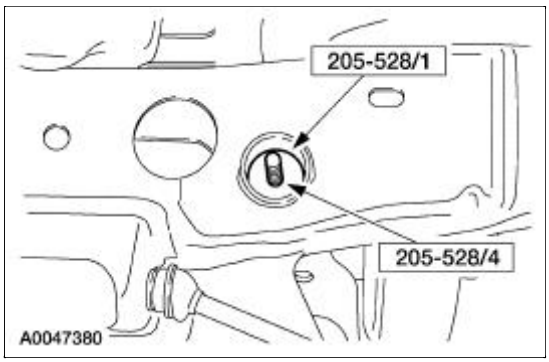
Removal

1. Remove the rear axle assembly. For additional information, refer to Axle Assembly—Air Suspension , or Axle Assembly—Coil Suspension in this section.

2. Insert the forcing screw through the adapter and the frame support insulator.

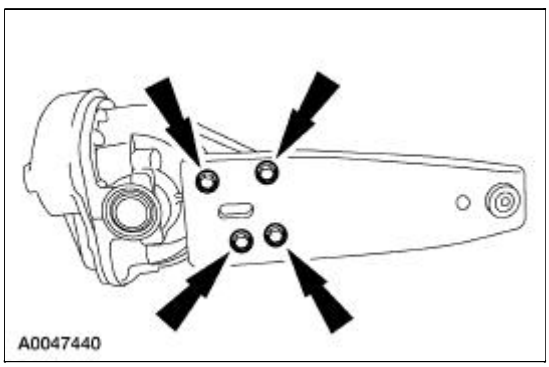


3. Thread the bushing remover on the forcing screw.

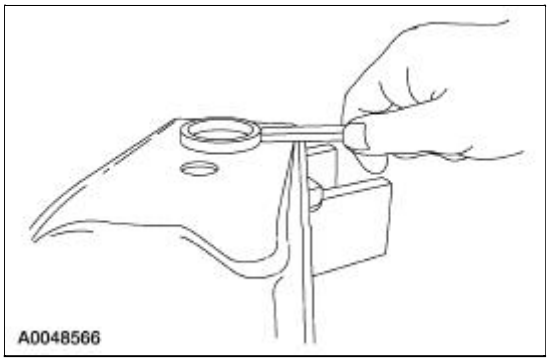


4. Tighten the special tool to remove the frame support insulator.

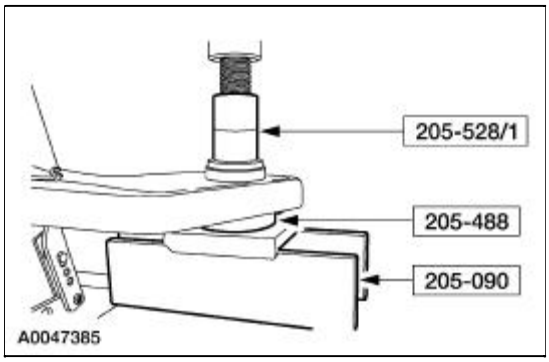
5. Remove the four bolts attaching the torque arm to the axle housing.



6. Measure and record the distance the insulator extends from the face of the torque arm.

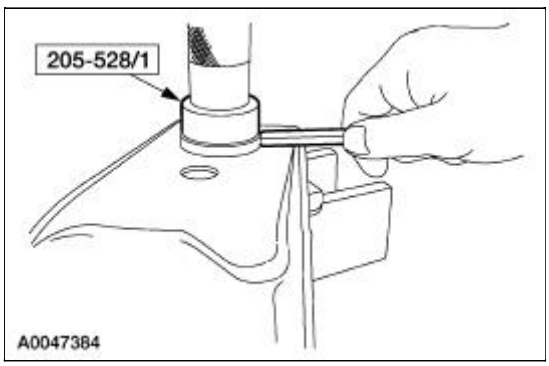


7. Using a suitable press and the special tools, remove the torque arm insulator from the torque arm.

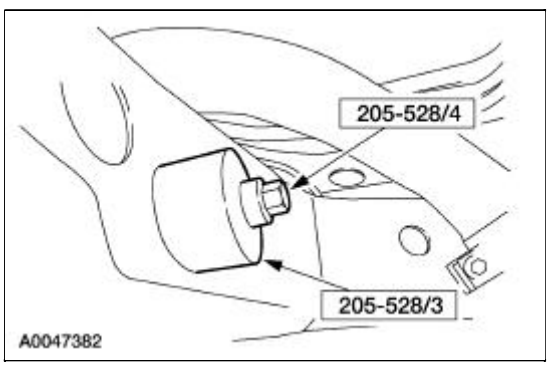


Installation

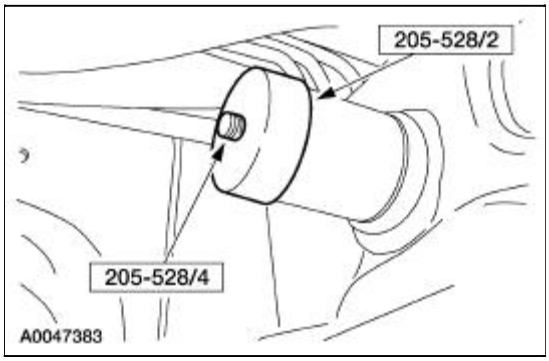
1. Using a suitable press and the special tools, install the new torque arm insulator to the previously recorded depth.



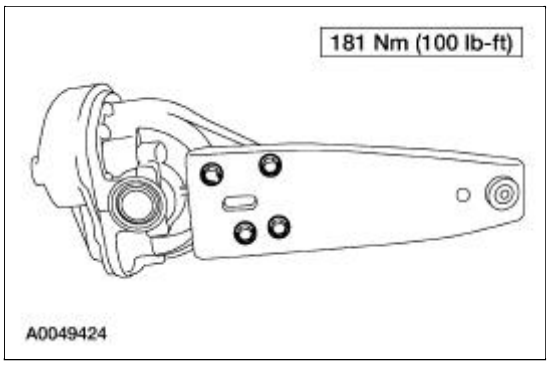
2. Position the special tools on the rear of the crossmember.



3. Position the new insulator and thread the special tools together.



4. Tighten the forcing screw to seat and position the new insulator.
5. Install the torque arm on the rear axle housing.



6. Install the rear axle assembly. For additional information, refer to Axle Assembly—Air Suspension , or Axle Assembly—Coil Suspension in this section.

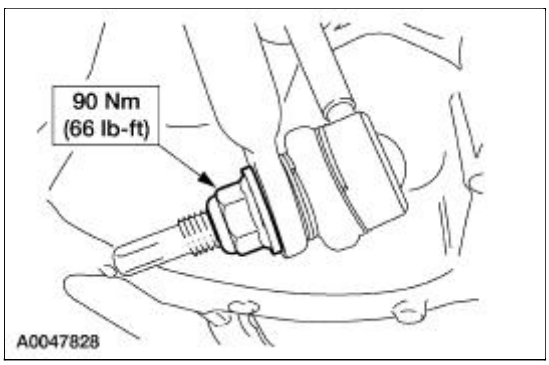
Axle Assembly —Air Suspension

Special Tool(s)

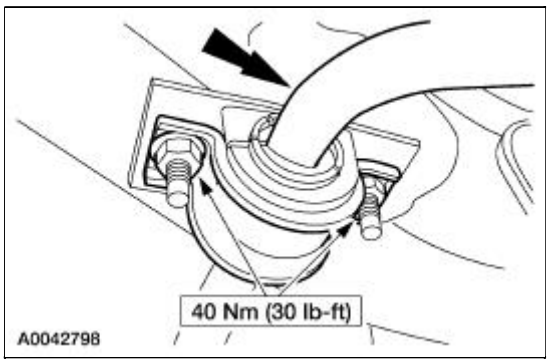
 ST1927-A	Hi-Lift Transmission Jack 164-R3508 or equivalent

Removal and Installation

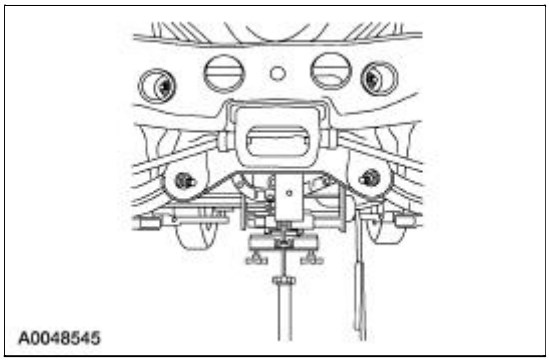
1. Position the vehicle on a hoist. For additional information, refer to Section 100-02 .
2. Deflate the rear air springs. For additional information, refer to Section 204-05 .
3. Remove the rear driveshaft assembly. For additional information, refer to Section 205-01 .
4. Remove the axle halfshafts. For additional information, refer to Section 205-05 .
5. Remove the lower rear sway bar links.



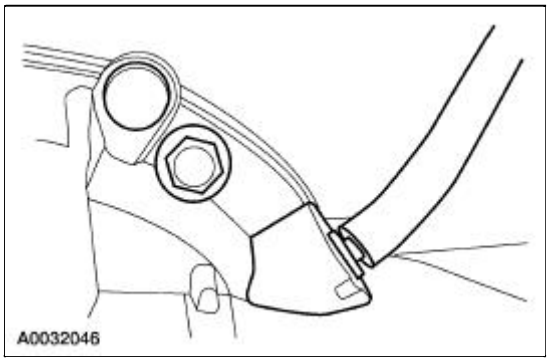
6. Remove the four bracket bolts and remove the rear sway bar.



7. Using a suitable jack, support the axle housing.

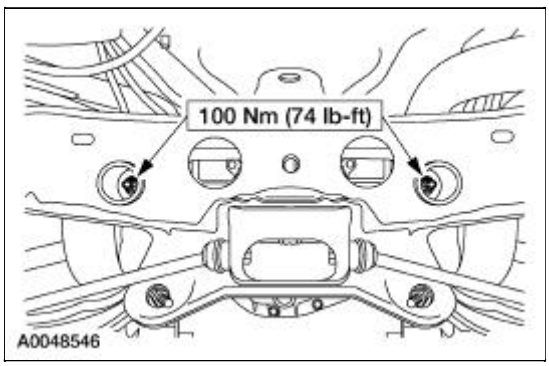


8. Disconnect the axle housing vent tube.

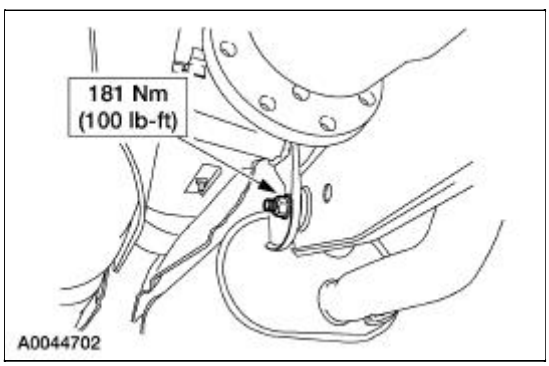


9. **NOTE:** Spare wheel removed for clarity.

   Remove the upper axle housing stud nuts.

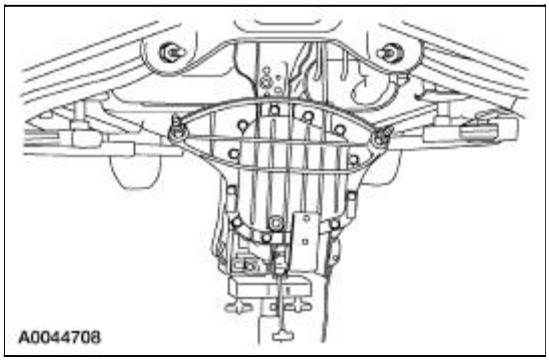


10. Remove the front torque arm bolt.



11. **NOTE:** Move the axle housing forward to clear the rear mounting studs from the bushings.

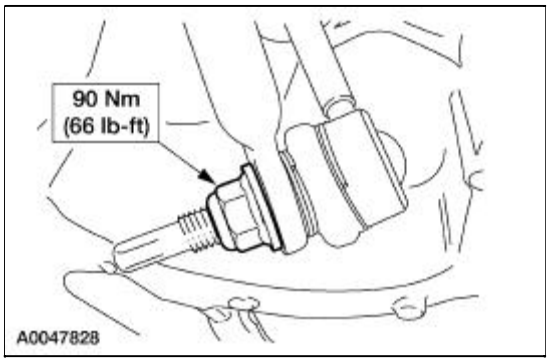
Lower the axle housing from the vehicle.



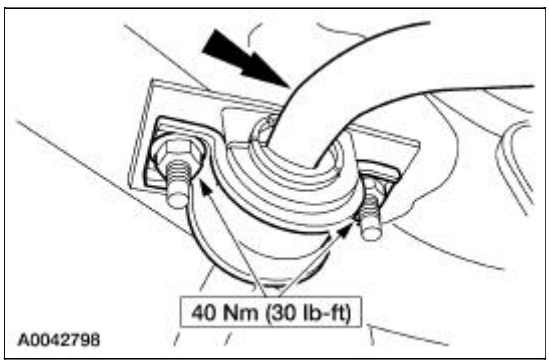
12. To install, reverse the removal procedure.

Axle Assembly —Coil Suspension

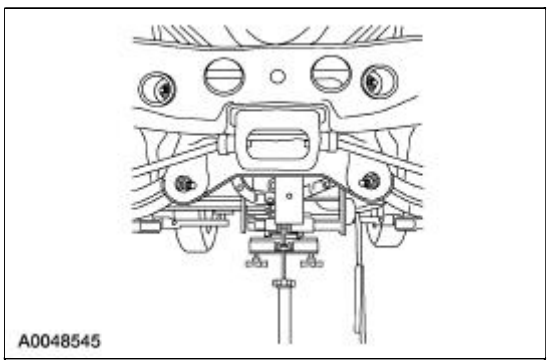
1. Position the vehicle on a hoist. For additional information, refer to Section 100-02 .
2. Remove the rear wheel and tire assemblies. For additional information, refer to Section 204-04 .
3. Remove the rear driveshaft assembly. For additional information, refer to Section 205-01 .
4. Remove the rear halfshafts. For additional information, refer to Section 205-05 .
5. Remove the lower rear sway bar links.



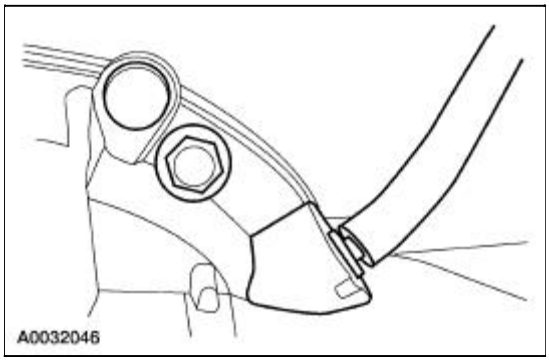
6. Remove the four bracket bolts and remove the rear sway bar.



7. Using a suitable jack, support the axle housing.

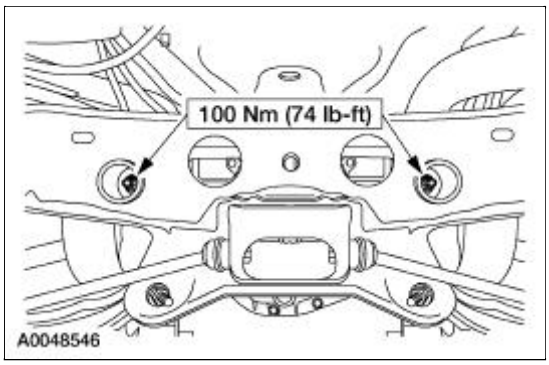


8. Disconnect the axle housing vent tube.

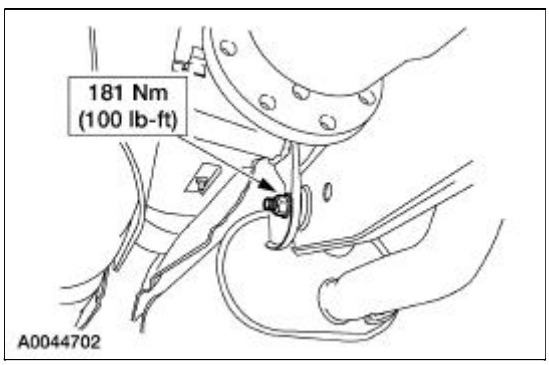


9. **NOTE:** Spare wheel removed for clarity.

   Remove the upper axle housing stud nuts.

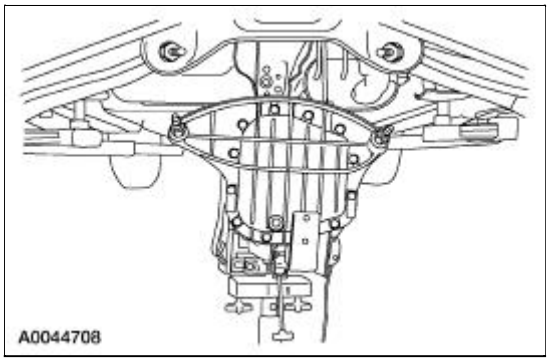


10. Remove the front torque arm bolt.



11. **NOTE:** Move the axle housing forward to clear the rear mounting studs from the bushings.

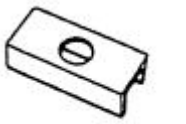
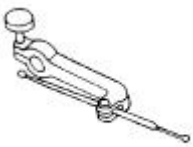
    Lower the axle housing from the vehicle.

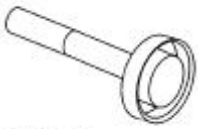
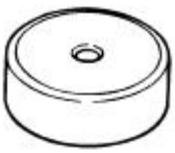


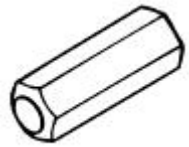
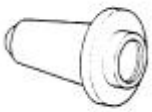
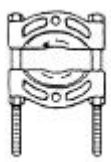
12. To install, reverse the removal procedure.

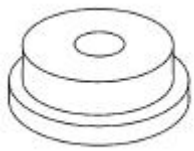
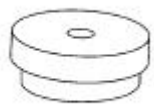
Axle

Special Tool(s)

 ST2026-A	2-Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1743-A	Depth Gauge/Aligner, Drive Pinion 205-226 (T85T-4020-AH1)
 ST1254-A	Plate, Bearing/Oil Seal 205-090 (T75L-1165-B)
 ST1348-A	Gauge, Clutch Housing 308-021 (T75L-4201-A)
 ST1257-A	Holding Fixture, Drive Pinion Flange 205-126 (T78P-4851-A)
 ST1724-A	Installer, Drive Pinion Flange 205-233 (T85T-4851-AH)
 ST1183-A	Dial Indicator Gauge 100-D005 (D78P-4201-G) or equivalent
	Dial Indicator Gauge with Holding Fixture

 ST1214-A	100-002 (TOOL-4201-C)
 ST2473-A	Installer, Differential Carrier Bearing 205-D044 (D81T-4221-A)
 ST1431-A	Adapter for 205-S156 205-159 (T80T-4020-F42)
 ST1743-A	Depth Gauge/Aligner, Drive Pinion 205-383 (T97T-4020-B)
 ST1434-A	Gauge Tube, Drive Pinion 205-377 (T97T-4020-A)
 ST1432-A	Adapter for 205-S127 205-111 (T76P-4020-A11)
 ST1367-A	Installer, Drive Pinion Bearing 205-388 (T97T-4630-A)
 ST1678-A	Installer, Drive Pinion Bearing Cup 205-024 (T67P-4616-A)
	Protector, Drive Pinion Thread 205-229 (T85T-4209-AH)

 ST1744-A	
 ST1325-A	Installer, Drive Pinion Oil Seal 205-208 (T83T-4676-A)
 ST1429-A	Adapter for 205-S156 205-160 (T80T-4020-F43)
 ST1725-A	Step Plate 205-D019 (D80L-630-8) or equivalent
 ST1374-A	Gauge, Differential Clutch 205-135 (T80P-4946-A)
 ST1857-A	Gauge, Differential (Traction Lock) 205-384 (T97T-4205-A)
 ST1368-A	Puller, Bearing 205-D064 (D84L-1123-A)
 ST1186-A	Holding Fixture, Transmission 307-003 (T57L-500-B)
	Installer, Differential Shim 205-228 (T85T-4067-AH)

 ST1485-A	
 ST1372-A	Gauge, Differential (Traction Lock) 205-389 (T97T-4946-A)
 ST1749-A	Gauge, Differential (Traction Lock) 205-386 (T97T-4205-D)
 ST2336-A	Handle 205-D055 (D81L-4000-A)
 ST2508-A	Installer, Rear Axle Bearing Cup 205-387 (T97T-4628-A)
 ST1077-B	Rotator, Differential 205-378 (T97T-4205-C)
 ST2562-A	Step Plate 205-D061 (D83T-4205-C2)

Material

Item	Specification
Premium Long Life Grease XG-1-C or equivalent	ESA-M1C75-B
SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL	WSL-M2C192-A
Additive Friction Modifier XL-3	EST-M2C118-A

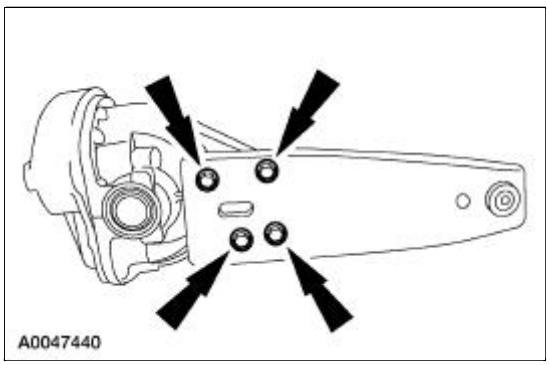
Ultra Silicone Rubber F7TZ-19554-AA	WSS-M4G320-A3
Stud and Bearing Mount E0AZ-19554-BA	WSK-M2G349-A1

Disassembly

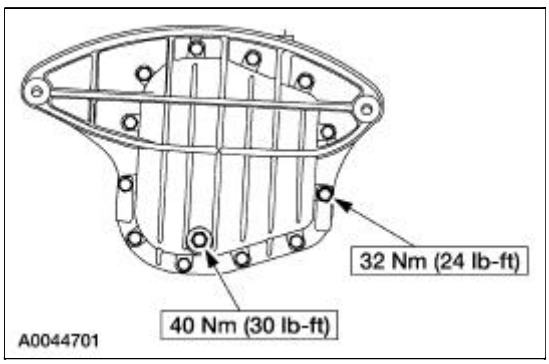
All Axles

1. Remove the axle assembly from the vehicle. For additional information, refer to Axle Assembly—Air Suspension or Axle Assembly—Coil Suspension in this section.

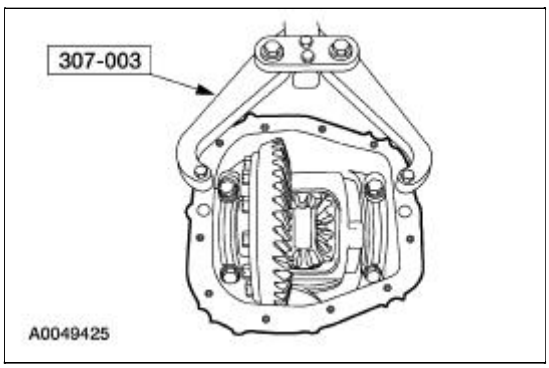
2. Remove the four bolts retaining the torque arm to the rear axle housing.



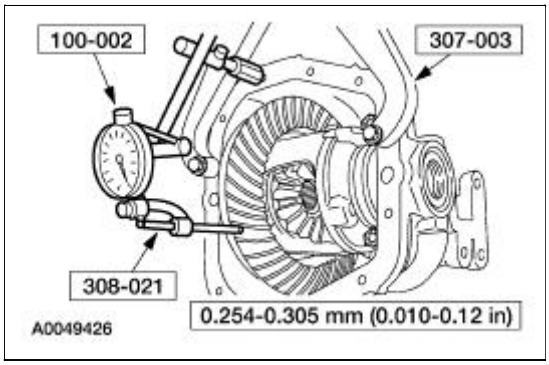
3. Drain the rear axle lubricant and remove the rear axle cover.



4. Using the special tools, mount the differential housing to a work bench.

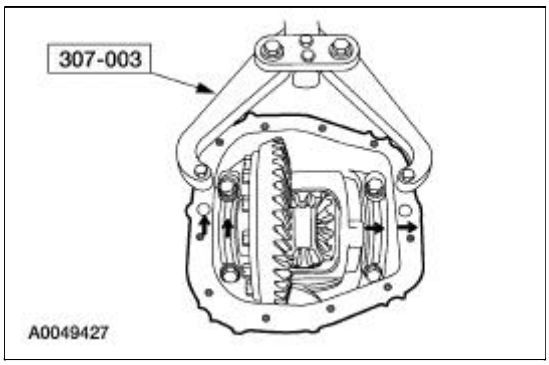


5. Using the special tool, measure and record the differential ring gear backlash between teeth in four equally spaced places around the ring gear.
    - Remove the dial indicator.



6. **CAUTION: Mark the position and location of the differential bearing caps as the arrows may not be visible. Always install the differential bearing caps in their identical location and position.**

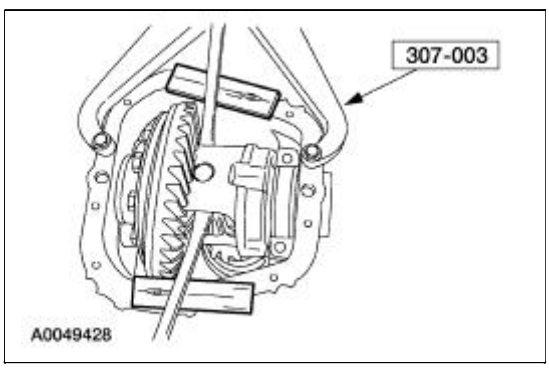
   Remove the differential bearing caps.



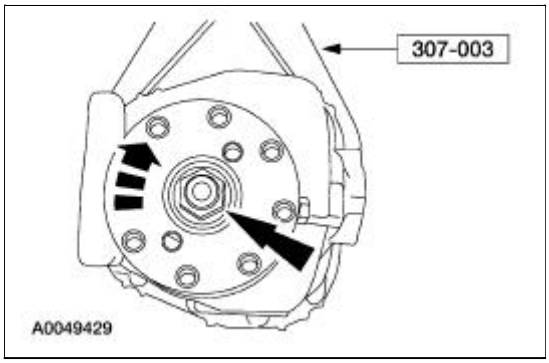
7. **CAUTION: Use wood blocks to avoid damaging the differential housing.**

   NOTE: Tag the bearing caps and shims for location as removed.

   Remove the differential assembly.
   1. Position wood blocks at the top and bottom of the differential case.
   2. Pry the differential assembly and the differential bearing shims out of the differential housing.

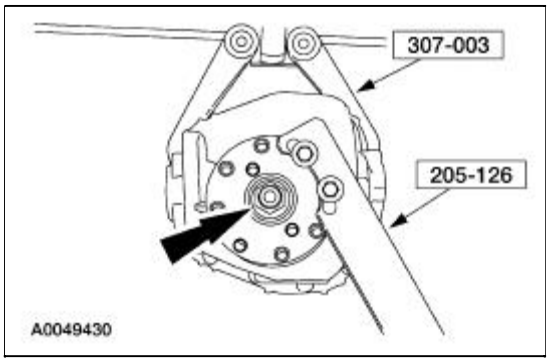


8. Record the torque necessary to maintain rotation of the drive pinion gear through several revolutions prior to removing the drive pinion flange.

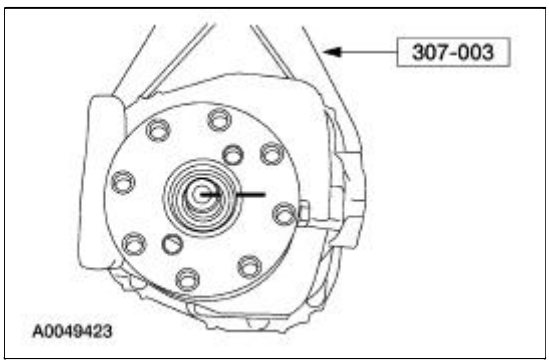


9. **CAUTION: After removing the drive pinion nut, discard it. Use a new nut for installation.**

   Using the special tool, remove the drive pinion nut.

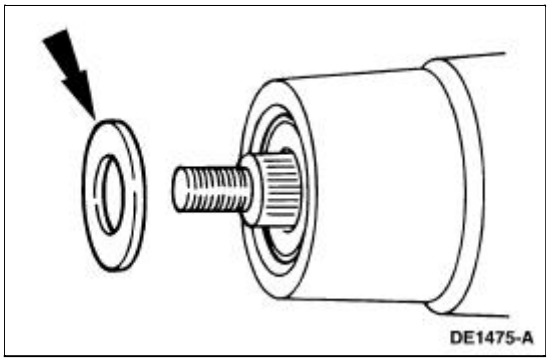


10. Index-mark the drive pinion flange and drive pinion gear stem to maintain initial balance during installation.

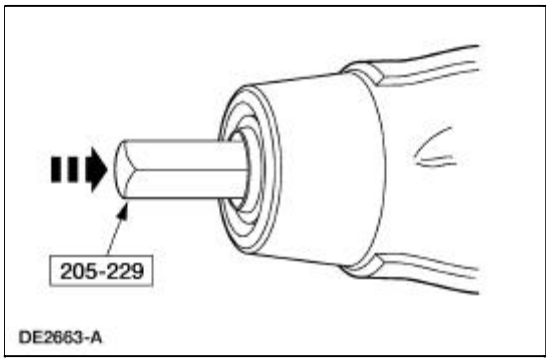


11. Remove the drive pinion flange and the pinion seal. For additional information, refer to Drive Pinion Flange and Drive Pinion Seal in this section.

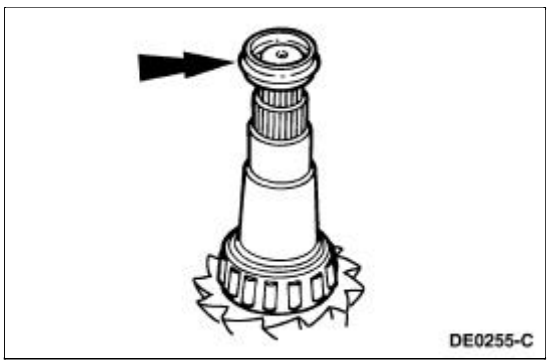
12. Remove the drive pinion shaft oil slinger.



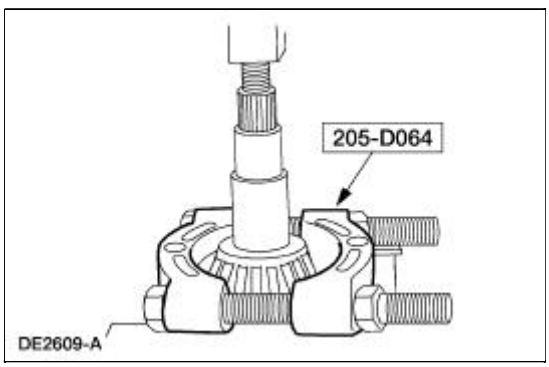
13. Using the special tool and a soft-faced hammer, drive the drive pinion gear out of the front pinion bearing and remove it through the rear of the differential housing.



14. Remove and discard the drive pinion collapsible spacer.

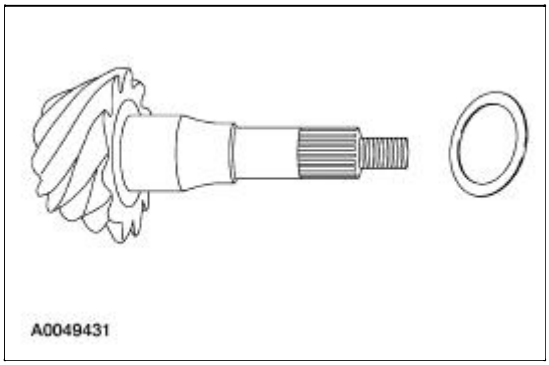


15. Using the special tool and a suitable press, remove the drive pinion bearing.

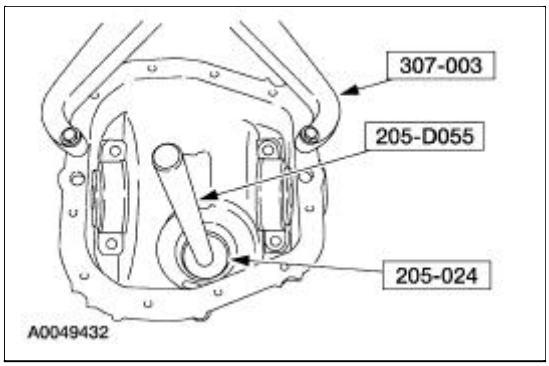


16. **NOTE:** Using a micrometer, measure the drive pinion bearing adjustment shim thickness. Use this measurement as a reference to compare to the shim gauge reading taken prior to installing the pinion bearing.

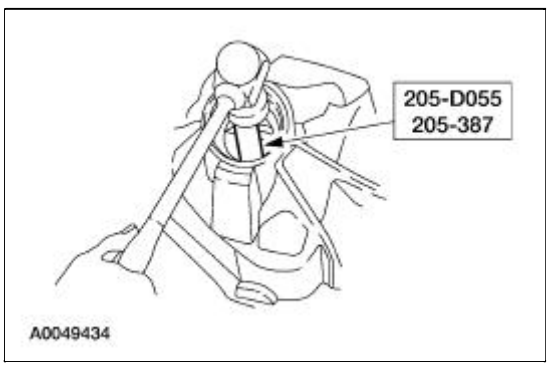
Remove the drive pinion bearing adjustment shim.



17. Using the special tools, remove the outer drive pinion bearing cup, if necessary.



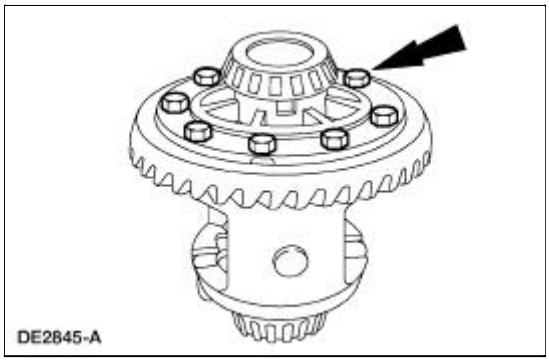
18. Using the special tools, remove the inner drive pinion bearing cup.



19. If the differential ring gear backlash between teeth measurement, taken at the beginning of this procedure, did not exceed the specification, proceed to Final disassembly in this procedure. If the differential ring gear backlash between teeth measurement exceeds the specification, the cause may be a warped differential ring gear, a damaged differential case, or loss of differential bearing preload. Proceed to Excessive differential ring gear backlash between teeth in this procedure to verify the cause of the excessive runout.

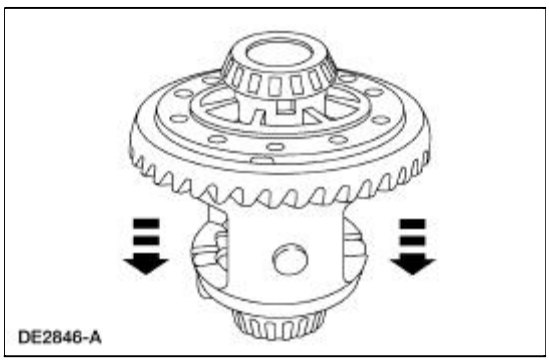
Excessive differential ring gear backlash between teeth

20. Remove the ring gear bolts.



21. **CAUTION: Do not damage the bolt hole threads.**

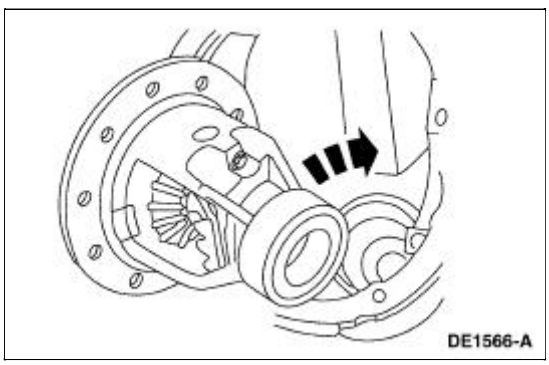
    Insert a punch in the bolt holes and drive off the differential ring gear.



22. **NOTE:** Visually inspect the differential carrier bearings and cups for discoloration or other signs of bearing failure.

    NOTE: Install the differential bearing cups and shims in the same locations they were in before disassembly.

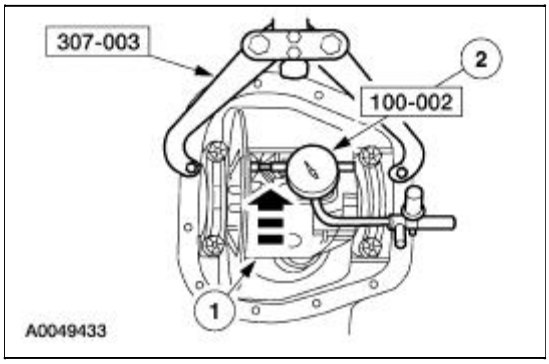
    Install the differential case. Rotate the differential case to seat the differential bearings.



23. Using the special tool, measure the differential case flange runout.
    1. Rotate the differential case to make sure the differential bearings are seated.
    2. Position the special tool.
    - If the runout does not exceed the specification, the cause of the original excessive runout is the differential ring gear. Remove the differential case. Discard the differential ring gear and the drive pinion gear. Proceed to Final disassembly in this procedure.
    - If the runout exceeds the specification, the differential ring gear is true and the concern is due to either differential case/differential bearing damage. Remove the differential case. Discard the differential bearings/differential case. Proceed to Final disassembly in this

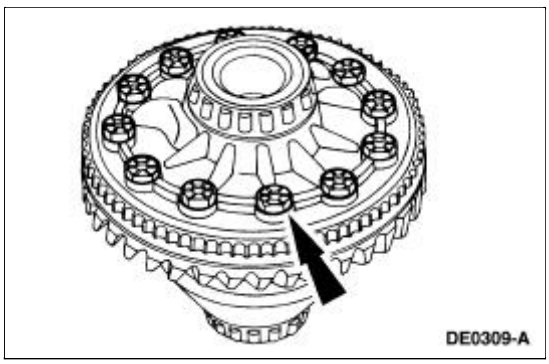
procedure.

- Remove the special tool.



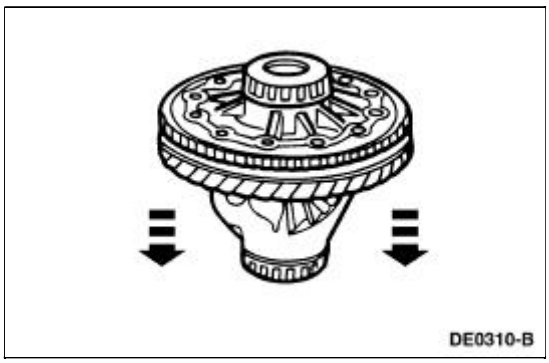
Final Disassembly, Differential Case and Ring Gear—Traction-Lok®

24. Remove the differential ring gear bolts



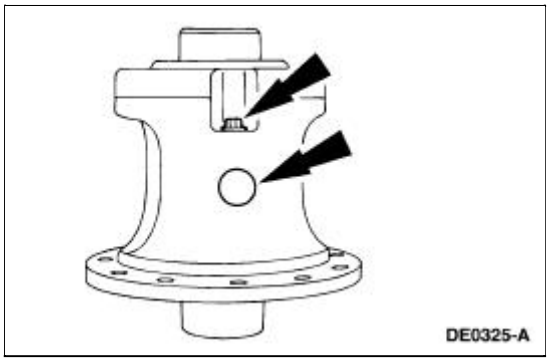
25. **CAUTION: Do not damage the ring gear bolt hole threads.**

    Insert a punch in the bolt holes and drive the differential ring gear off the differential case.

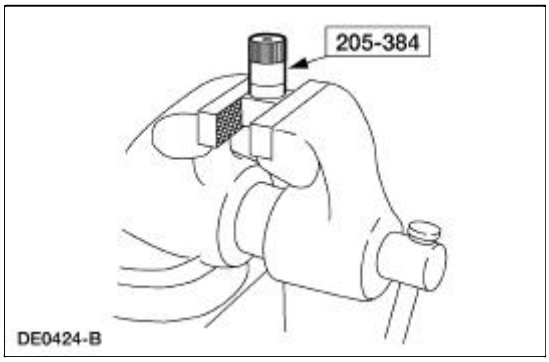


26. **NOTE:** The differential bearings do not need to be removed to overhaul the Traction-Lok® differential. If bearing removal is required, use special tool 205-D072 and special tool 205-D019 for the differential case bearings.

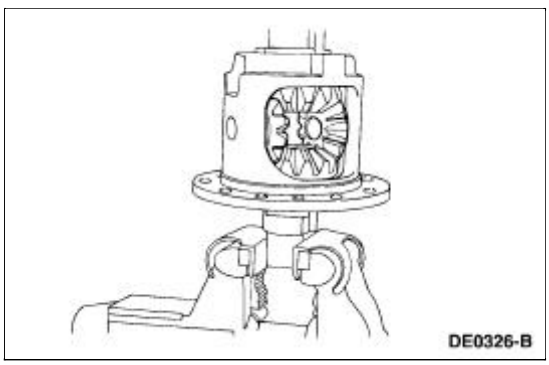
    Remove the differential pinion shaft lock bolt and remove the differential pinion shaft.



27. Install the special tool in a suitable vise.

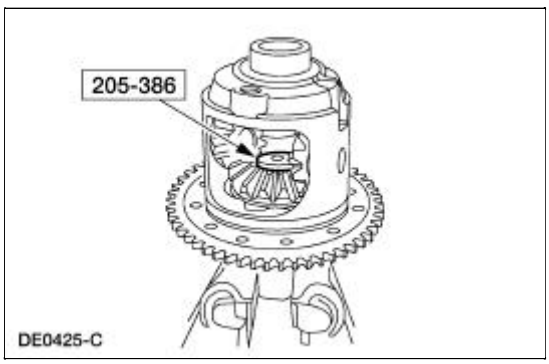


28. Install the differential case on the tool.

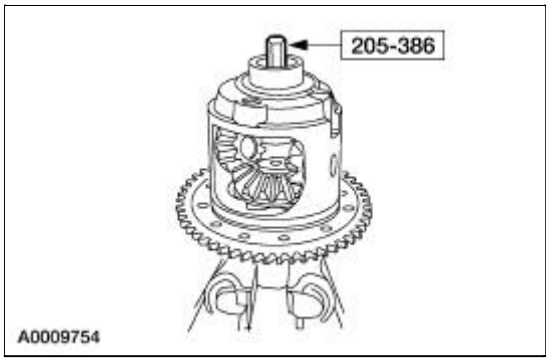


29. **NOTE:** Apply a small amount of grease to the centering hole of the special tool.

    Install the special tool in the bottom side gear bore.

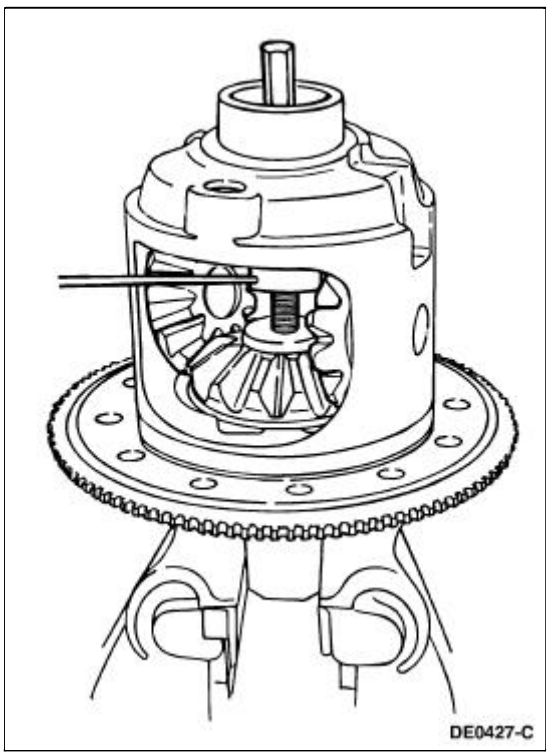


30. Install the nut in the upper differential side gear. Hold the nut in position while installing the hex screw. Tighten the hex nut until contact is made with the step plate.

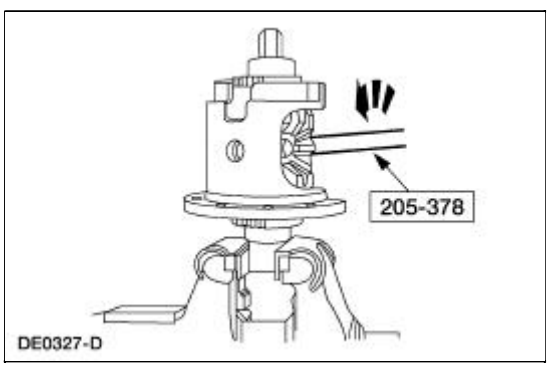


31. **NOTE:** The dowel bar is used to keep the nut from turning when the forcing screw is tightened.

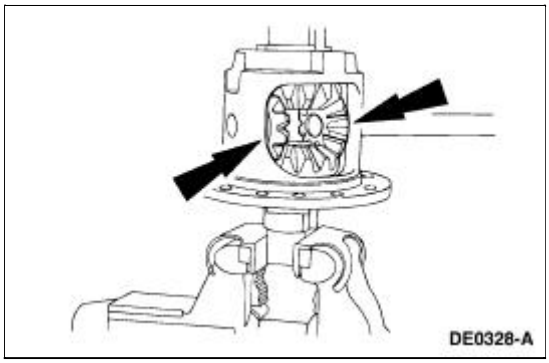
    Insert a suitable dowel bar in the hole of the nut. Tighten the forcing screw to force the differential side gear away from the differential pinion gears.



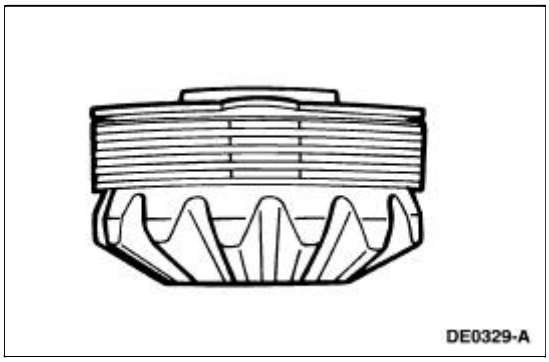
32. Insert the special tool in the pinion shaft bore and turn the differential case to move the differential pin gears and thrust washers to the differential case opening.



33. Remove the differential pinion gears and differential pinion gear thrust washers.



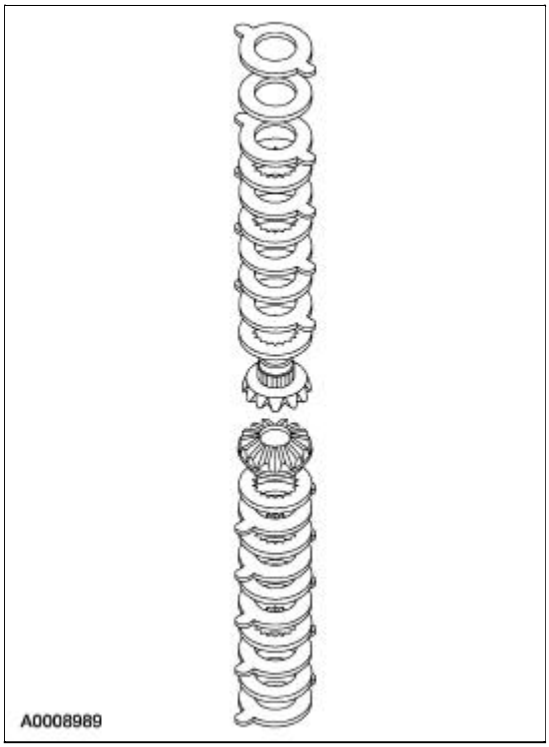
34. Remove the differential side gears and differential clutch packs. Tag the gears, clutch packs and shims for location.



35. **CAUTION: When separating the clutch plates and clutch discs, note the sequence in which they are disassembled. They must be reassembled in the same sequence.**

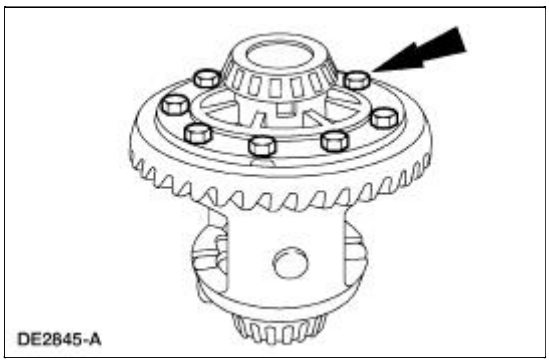
CAUTION: Do not use acids or solvents to clean the differential clutch components. Use a clean, lint-free cloth only.

Separate the differential clutch packs for cleaning and inspection.



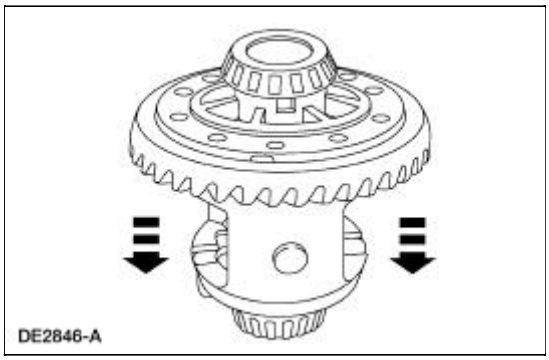
Final Disassembly, Differential Case and Ring Gear—Conventional

36. Remove the differential ring gear bolts.



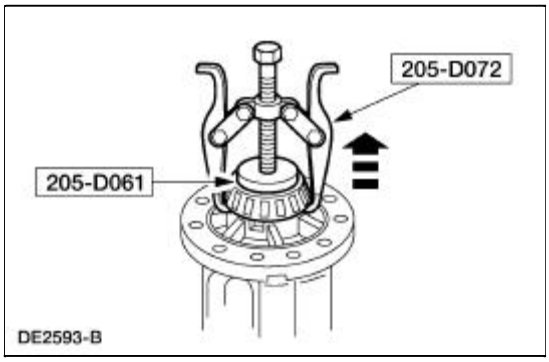
37. **CAUTION: Do not damage the ring gear bolt hole threads.**

    Insert a punch in the bolt holes and drive off the differential ring gear.



38. Using the special tools, remove the differential bearing.

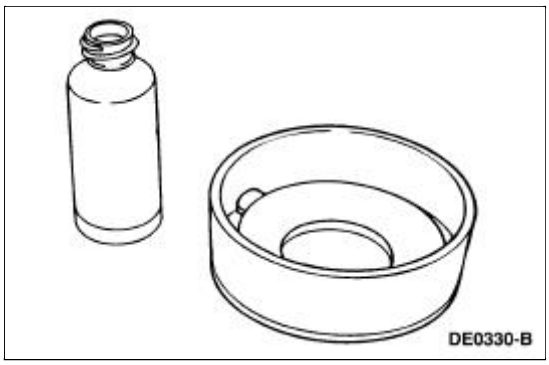
- Repeat for the other side.



Assembly

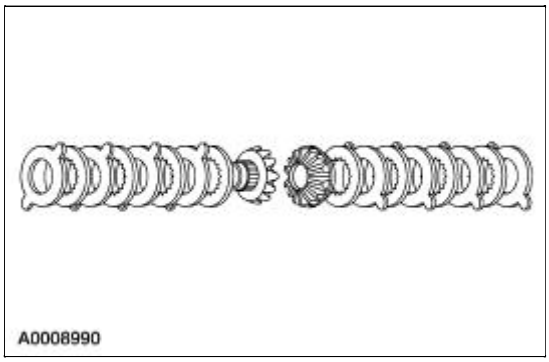
Assembly, Differential Case and Ring Gear—Traction-Lok®

1. Prelubricate each steel clutch plate and soak all friction plates with 118 ml (4 ounces) of friction modifier for at least 15 minutes.

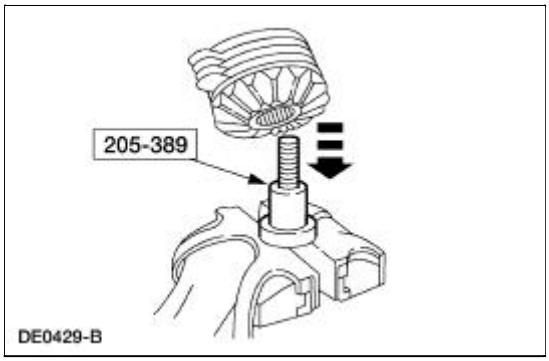


2. **NOTE:** Do not mix the differential clutch packs or shims from one side with the opposing side.

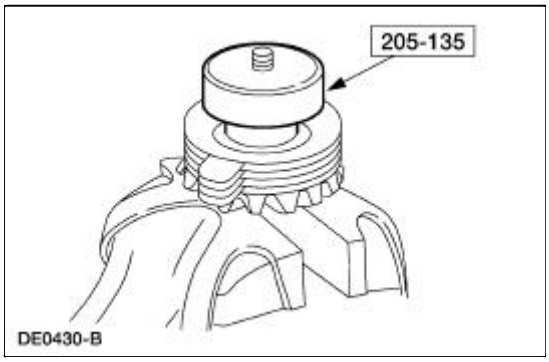
   Assemble the differential clutch packs (without the shims or Belleville springs) on the respective side gears.



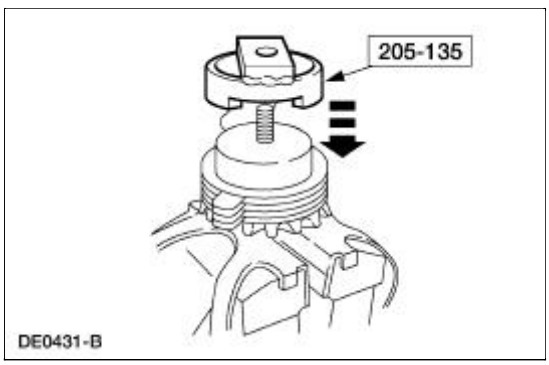
3. Clamp the bolt head of the special tool in a vise. Install the differential clutch pack and the differential side gear (without the shims or Belleville spring) on the gauge.



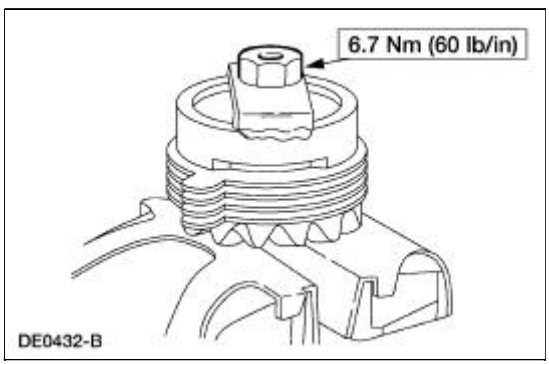
4. Position the special tool on top of the differential clutch pack.



5. Install the special tool over the disc and differential clutch pack.



6. Install the nut over the top and base stud.



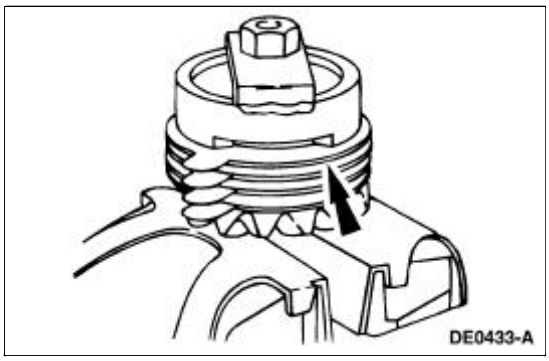
7. **NOTE:** A maximum of two shims can be used on each clutch pack.

   Select and insert the thickest feeler gauge blade that will enter between the tool and the differential clutch pack. Subtract 0.010 inch from the reading to obtain the thickness of the new

clutch shim. Select the correct shim and remove the special tool.

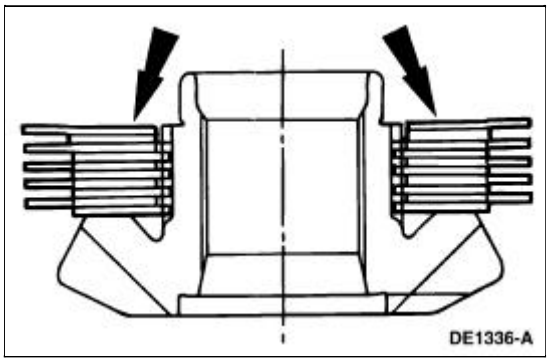
Selective Shims

Part Number	Description
F75Z-4A324-DA	0.030 Inch
F75Z-4A324-EA	0.035 Inch
F75Z-4A324-FA	0.040 Inch
F75Z-4A324-GA	0.045 Inch
F75Z-4A324-HA	0.050 Inch
F75Z-4A324-JA	0.055 Inch
F75Z-4A324-KA	0.060 Inch

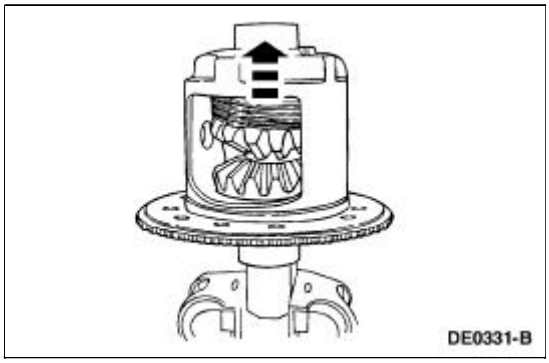


8. **NOTE:** The concave side of the Belleville spring must face up and against the thrust face of the differential case.

   Place the shim and the Belleville spring on the differential clutch pack.

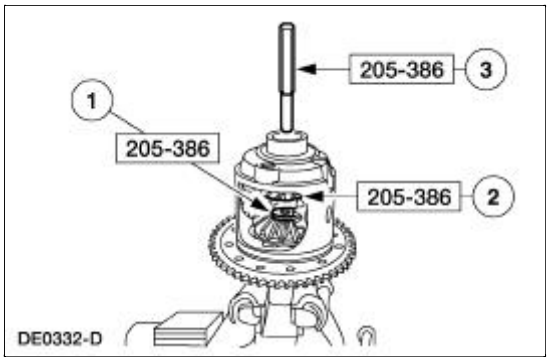


9. Insert the differential clutch packs with the shims and Belleville springs and differential side gears into the differential case.



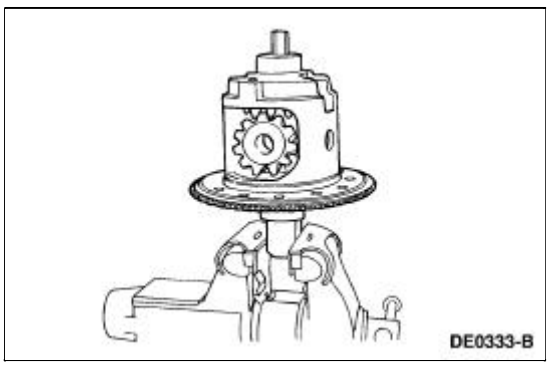
10. **NOTE:** If necessary, insert the dowel bar in the nut bore to keep the nut from turning as the hex screw is tightened.

    Assemble the special tool in the differential case.
    1. Position the special tool in the bottom side gear bore.
    2. Position the special tool in the top side gear bore and hold it in place.
    3. Install the special tool and tighten it two turns after it contacts the bottom step plate.



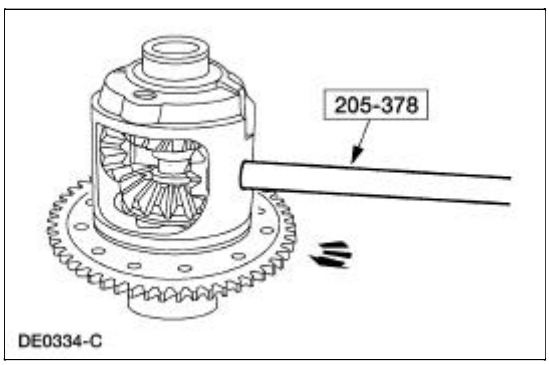
11. **NOTE:** Coat both sides of the differential pinion thrust washers with rear axle lubricant.

    Position the differential pinion gears and thrust washers in the differential case window so they mesh with the differential side gear teeth.

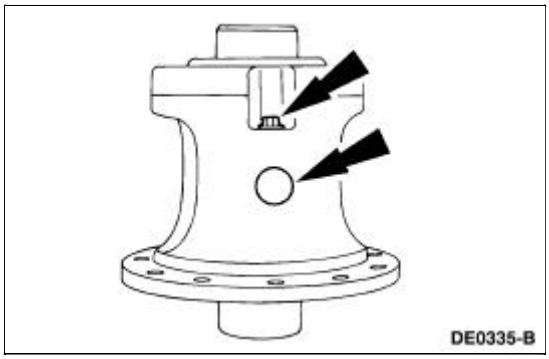


12. **NOTE:** It may be necessary to loosen or tighten the special tool forcing screw to allow the differential side gears to rotate.

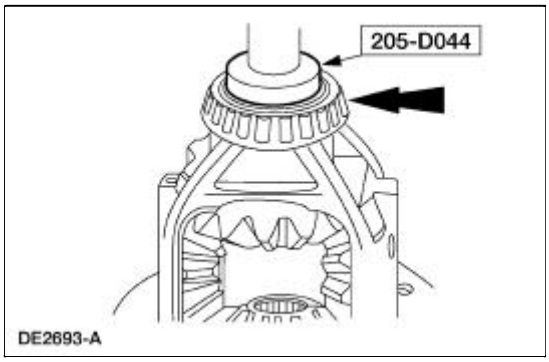
    Insert the special tool into the pinion shaft bore and turn the differential case. This will move the differential side gears and position them in the differential case. Rotate the differential case until the pinion mating shaft holes are aligned with the differential pinion gears.



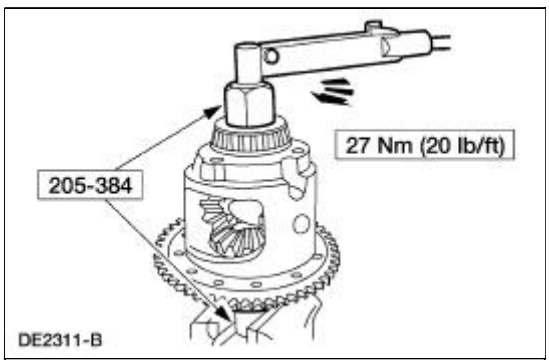
13. Loosen the special tool forcing screw and remove the special tool from the differential case. Install a new differential pinion shaft and bolt in the differential case.



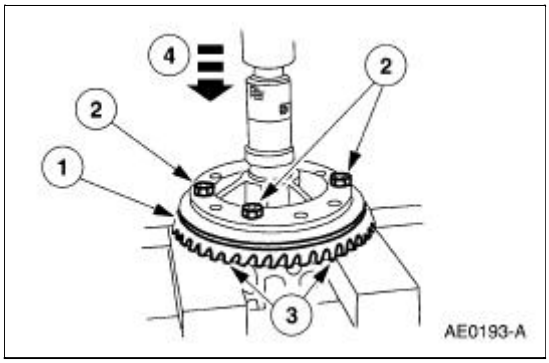
14. If removed, install new differential carrier bearings.



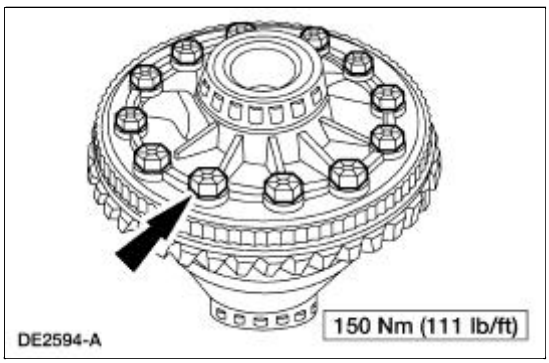
15. Using the special tools, check the torque required to rotate on differential side gear.
    1. Install the special tools as shown.
    2. If the original clutch plates are used, the initial breakaway torque must be within specification. The rotating torque required to turn the differential side gear with new clutch plates, may vary.



16. Install the differential ring gear.
    1. Place the differential ring gear on the differential case.
    2. Hand start three bolts to align the ring gear to the differential case.
    3. Place the differential case and ring gear on the press bed with the ring gear teeth facing down.
    4. Press the ring gear into place on the differential case.



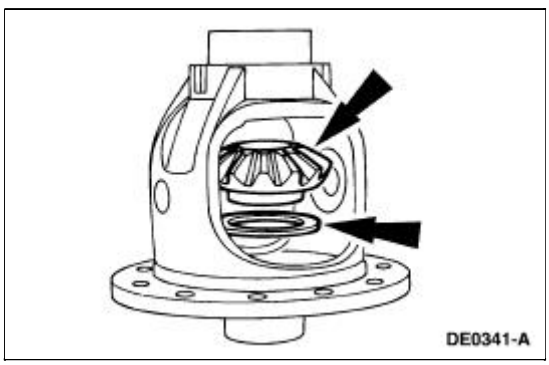
17. Install the ring gear bolts and tighten to specification.



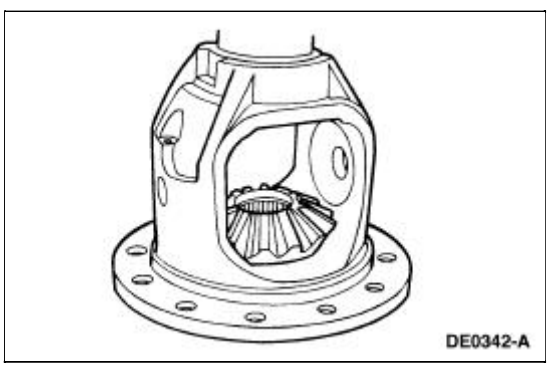
Assembly, Differential Case and Ring Gear—Conventional

18. **NOTE:** Coat the differential side gears and differential side gear thrust washers with rear axle lubricant.

    Position the differential thrust washers on the differential side gears.

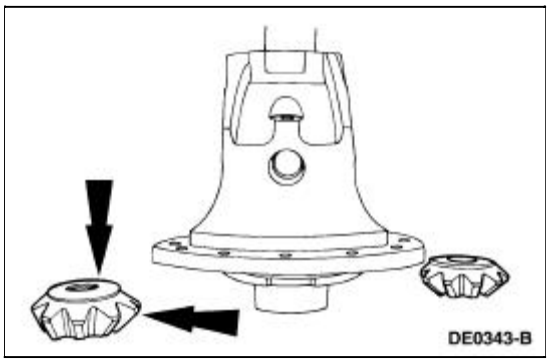


19. Position the differential side gears and thrust washers in the differential case.

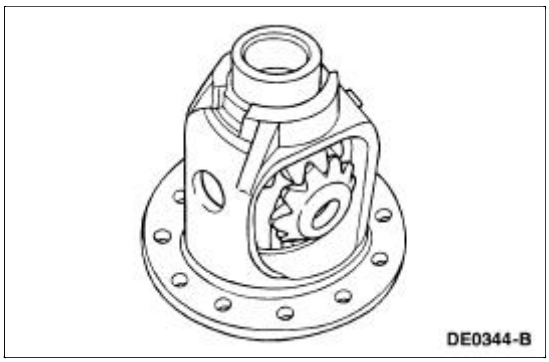


20. **NOTE:** Coat the differential pinion thrust washers and differential pinion gears with rear axle lubricant.

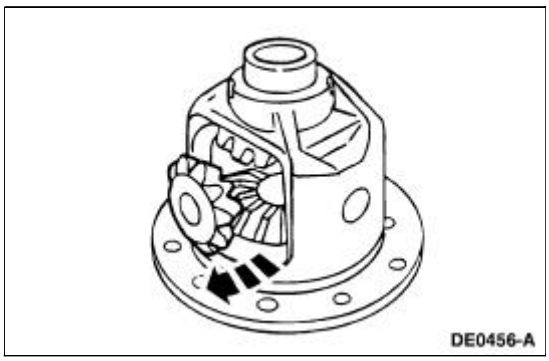
    Assemble the differential pinion thrust washers and the differential pinion gears.



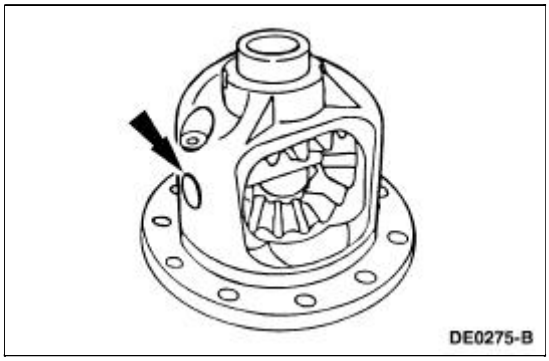
21. Engage the differential pinion gears opposite the differential side gears.



22. Rotate the differential pinion gears to align with the differential pinion shaft bore.

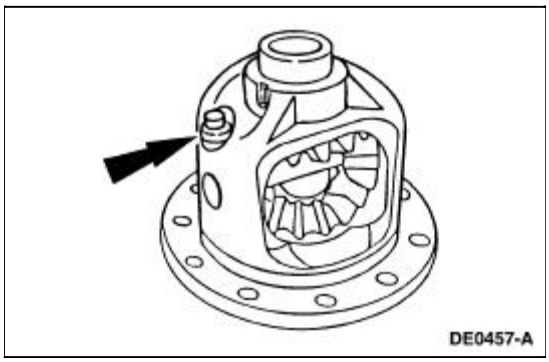


23. Insert the differential pinion shaft.

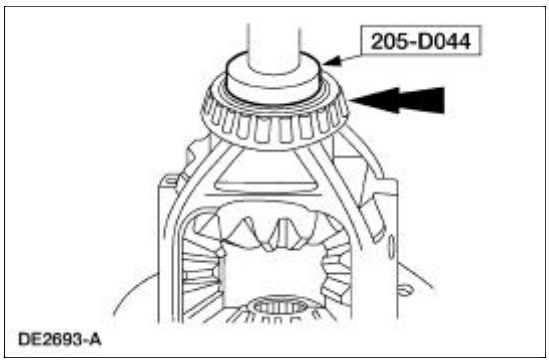


24. **NOTE:** If a new pinion shaft lock bolt is unavailable, coat the threads with sealer prior to installation.

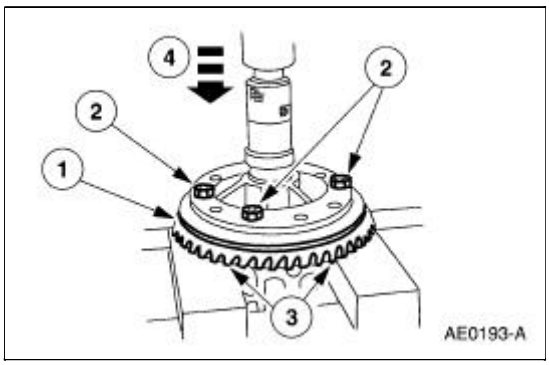
    Install a new differential shaft lock bolt and torque to specification.



25. Using the special tool, install the differential bearings.

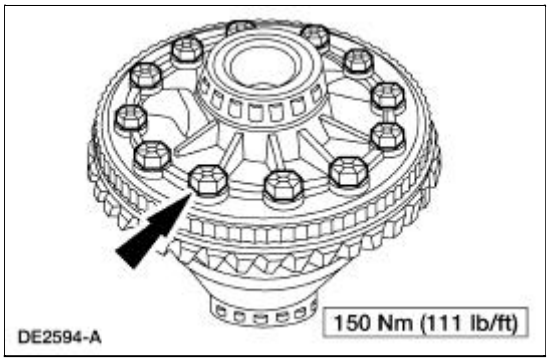


26. Install the differential ring gear.
    1. Place the differential ring gear on the differential case.
    2. Hand start three bolts to align the holes in the differential ring gear and the differential case.
    3. Place the differential case and the differential ring gear on the press bed with the ring gear facing down.
    4. Press the ring gear into place.



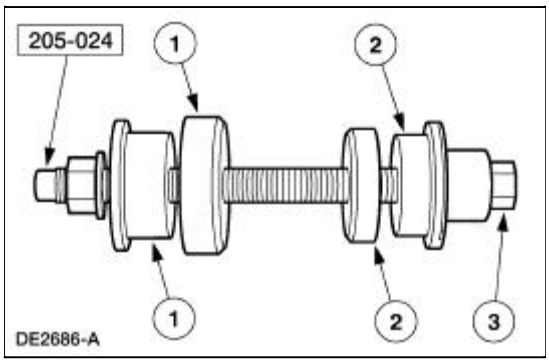
27. **NOTE:** Apply sealer to the threads of the ring gear bolts.

    Install the differential ring gear bolts and tighten.

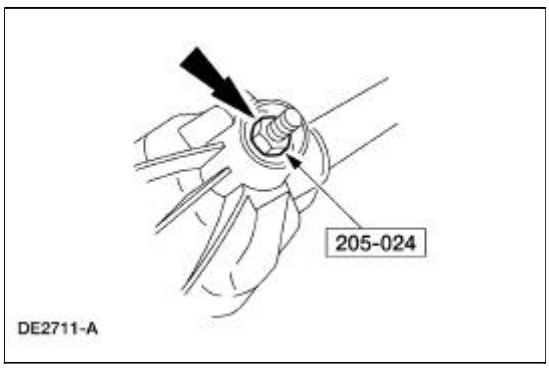


Final assembly—All Differentials

28. Position the inner and outer bearing cups in their respective bores.
    1. After positioning the bearing cups in the bores, place the special tool on the inner bearing cup.
    2. Place the special tool on the outer bearing cup.
    3. Install the special tools.

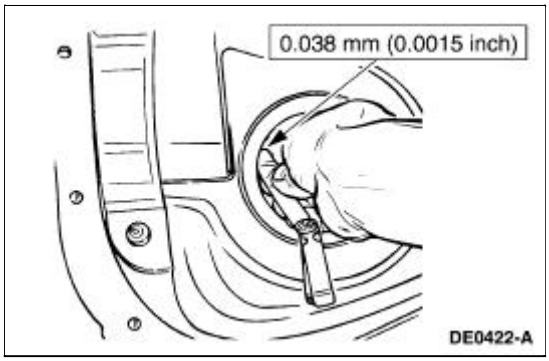


29. Tighten the special tool to seat the bearing cups in the bores.



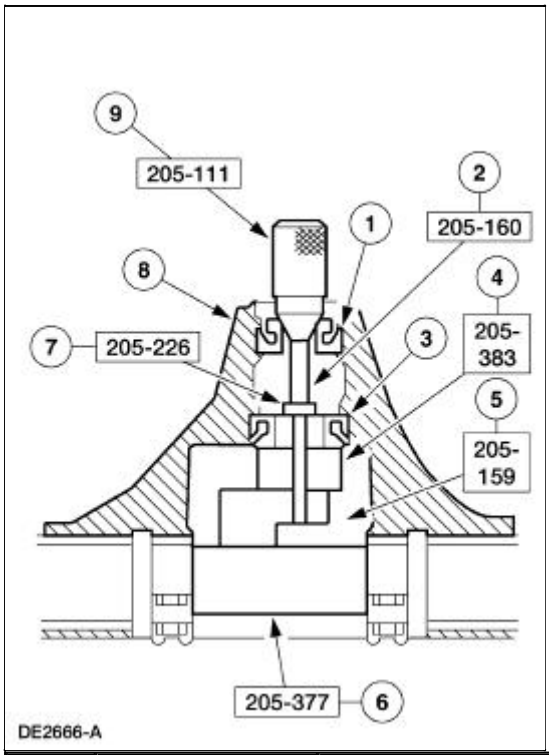
30. **NOTE:** If a feeler gauge of the specification shown can be inserted between a cup and the bottom of its bore at any point around the cup, the cup is not correctly seated.

    Make sure the differential pinion bearing cups are correctly seated.



31. **NOTE:** Apply a light film of lubricant on the front and rear pinion bearings.

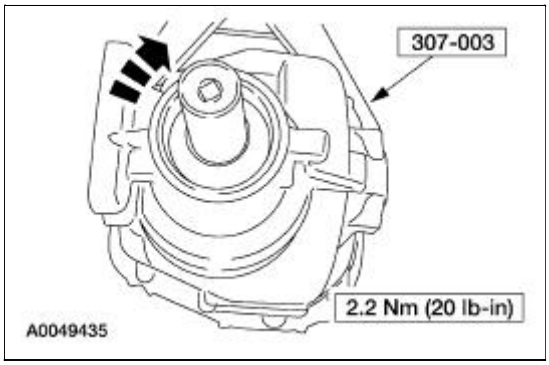
    Install the pinion bearings and special tools as shown.



Item	Part Number	Description
1	4621	Outer pinion bearing
2	205-160	Adapter for 205-S127
3	4630	Inner pinion bearing
4	205-383	Depth Gauge/Aligner, Drive Pinion
5	205-159	Adapter for 205-S126
6	205-377	Drive Pinion Gauge Tube
7	205-226	Depth Gauge/Aligner, Drive Pinion
8	4010	Rear axle housing
9	205-111	Adapter for 205-S127

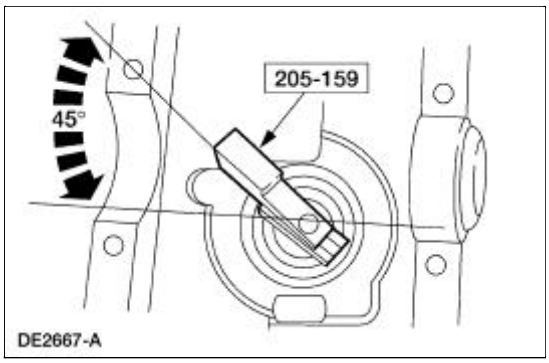
32. **NOTE:** This step duplicates pinion bearing preload.

    Thread the special tool onto the screw and tighten to the specification shown.

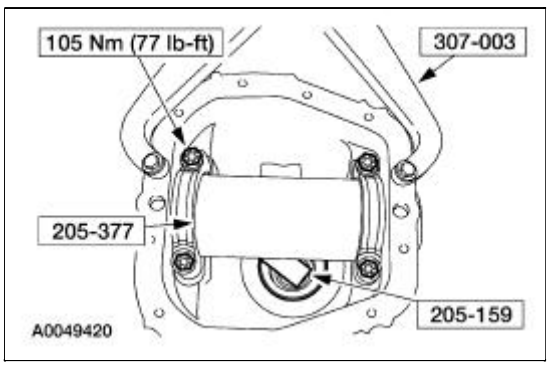


33. **NOTE:** The special tool must be offset to obtain an accurate reading.

    Position the special tool.



34. Install the special tool.

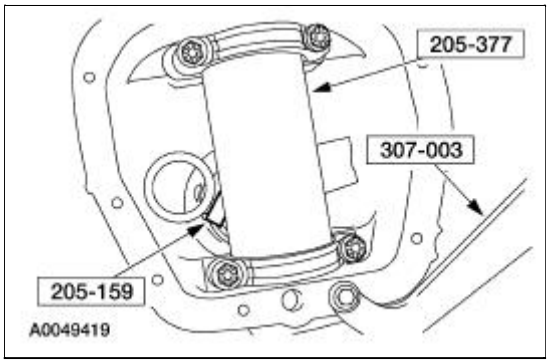


35. **NOTE:** Drive pinion bearing adjustment shims must be flat and clean.

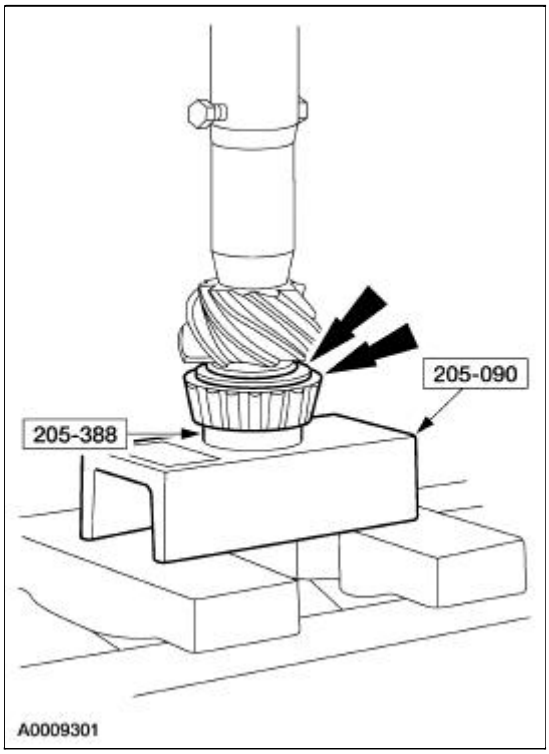
    NOTE: A slight drag should be felt for correct shim selection. Do not attempt to force the pinion shim between the Gauge Block and the Gauge Tube. This will minimize selection of a pinion shim thicker than required, which results in a deep tooth contact in the final assembly of integral rear axle assemblies.

    Use a drive pinion bearing adjustment shim as a gauge for shim selection.

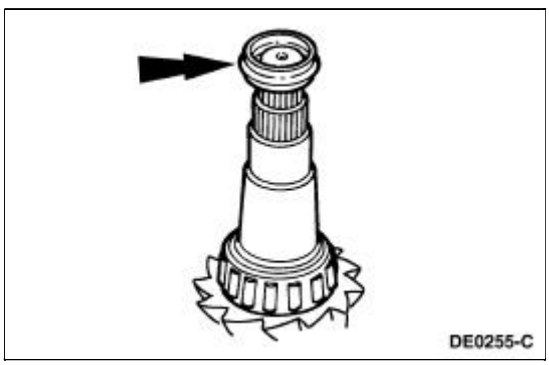
    - After the correct shim thickness has been determined, remove the special tools.



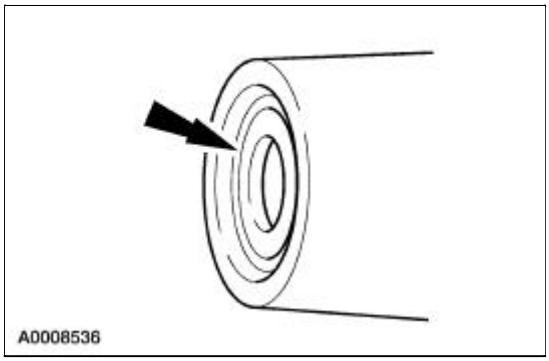
36. Using the special tools, press the inner pinion bearing and pinion shim until they are firmly seated on the pinion.



37. Place a new drive pinion collapsible spacer on the pinion shaft against the pinion stem shoulder.



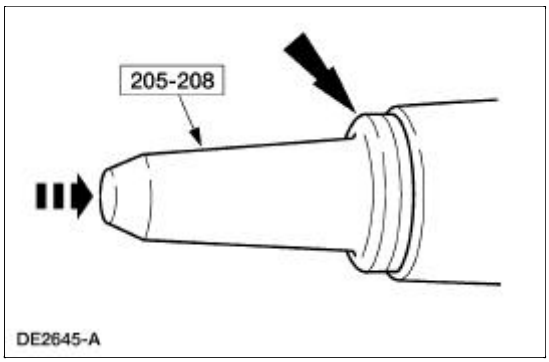
38. Install a new outer pinion bearing, and rear axle drive pinion shaft oil slinger.



39. **CAUTION: Installation without the correct tool can result in early seal failure. If the rear axle drive pinion seal becomes cocked during installation, remove it and install a new one.**

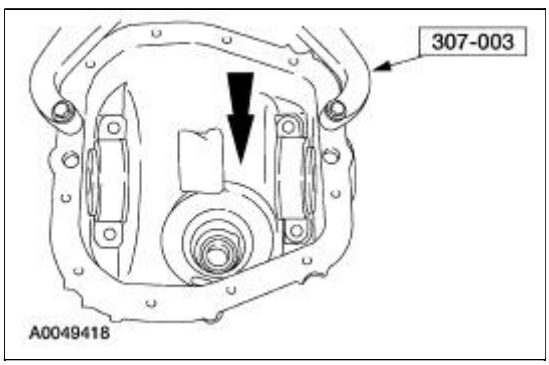
    CAUTION: Coat the lips of the rear axle drive pinion seal with grease.

    Place the drive pinion oil seal on the special tool and drive the seal into place.



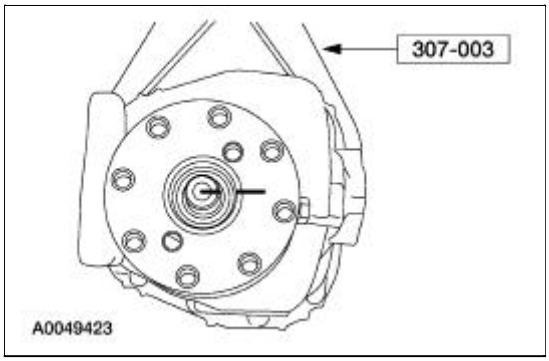
40. **NOTE:** Lubricate the pinion flange splines with rear axle lubricant.

    Install the drive pinion in the drive pinion carrier bore from inside the rear axle housing. Seat the drive pinion with a plastic hammer.

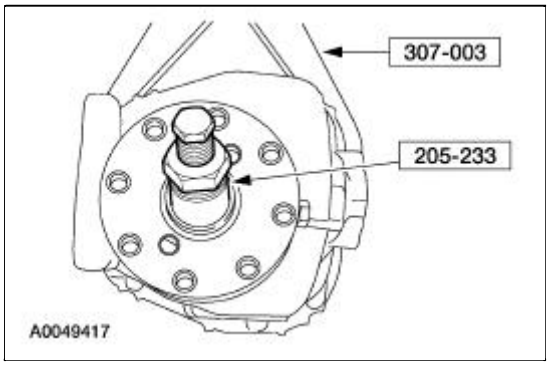


41. **NOTE:** Disregard the scribe marks if a new pinion flange is being installed.

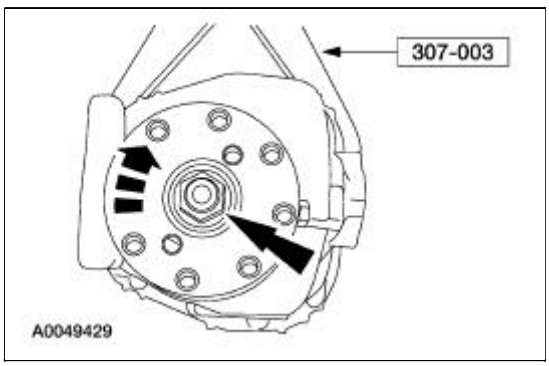
    Align the pinion flange with the drive pinion shaft.



42. With the drive pinion in the axle housing, install the pinion flange using the special tool.



43. Position the new pinion nut.



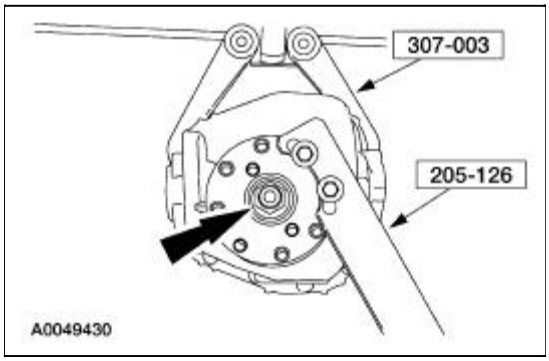
44. **CAUTION: Under no circumstances is the pinion nut to be backed off to reduce preload. If reduced preload is required, a new drive pinion collapsible spacer and pinion nut must be installed.**

CAUTION: The pinion flange holding tool must be removed before preload readings can be taken.

Using the special tool, tighten the pinion nut.

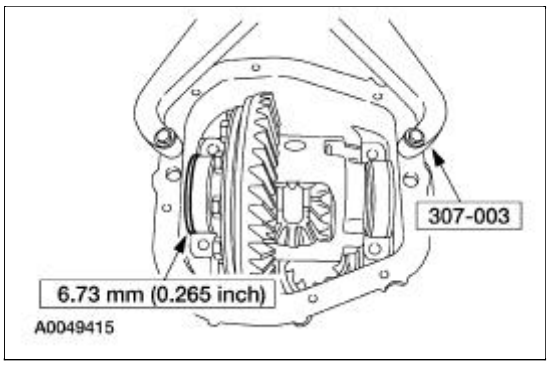
- Rotate the pinion occasionally to make sure the drive pinion bearings are seating correctly.
- Install a Nm (inch-pound) torque wrench on the pinion nut.
- Rotating the pinion through several revolutions, take frequent drive pinion bearing torque preload readings until the original recorded preload reading is obtained.
- If the original recorded preload is below specification, tighten to the appropriate specification for used bearings. If the preload is above specification, tighten the nut to the

original readings as recorded.



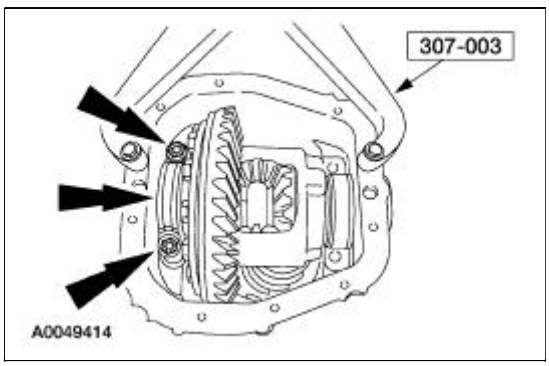
45. With the pinion depth set and the pinion installed, place the differential case in the rear axle housing.

46. Install a shim as shown on the left side.

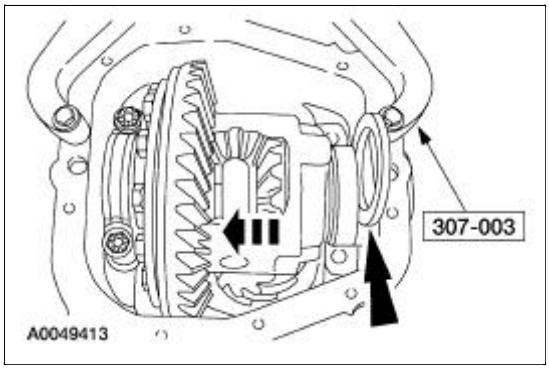


47. **NOTE:** Apply pressure toward the left side to make sure the left bearing cup is seated.

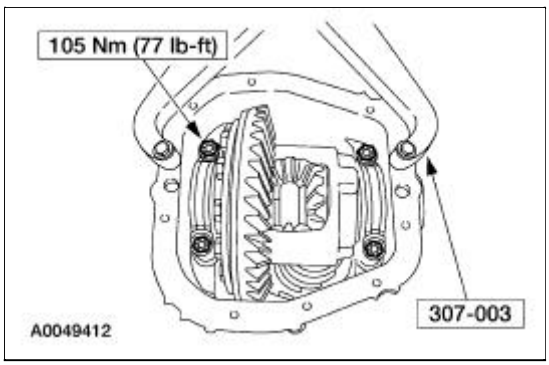
    Install the left bearing cap and loosely install the bearing cap bolts.



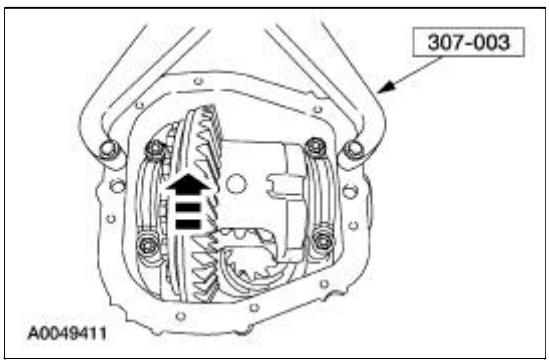
48. Install progressively larger shims on the right side until the largest shim selected can be installed by hand.



49. Install the right side bearing cap and tighten the bolts.



50. Rotate the differential case to make sure it rotates freely.

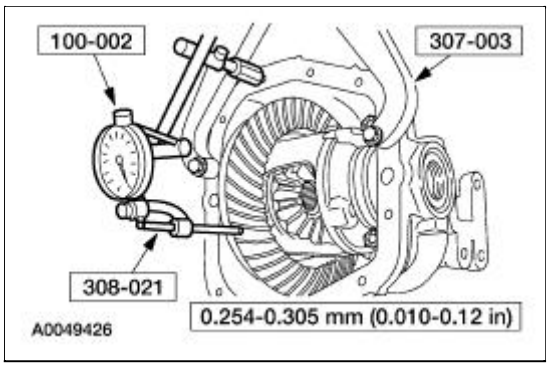


Measuring backlash

51. Using the special tools, measure and note the differential ring gear backlash.
    - If backlash is within the specification, refer to Backlash within specification in this procedure.
    - If a zero backlash condition occurs, refer to Zero backlash in this procedure.
    - If backlash is not within the specification, refer to Backlash not within specification in this procedure.

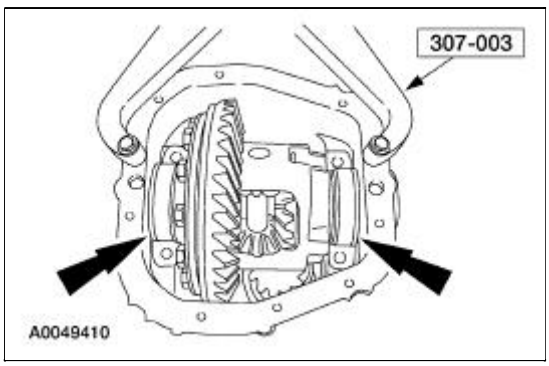
Backlash Change Required		Thickness Change Required	
mm	**Inch**	**mm**	**Inch**
0.025	0.001	0.050	0.002
0.050	0.002	0.050	0.002
0.076	0.003	0.101	0.004

0.101	0.004	0.152	0.006
0.127	0.005	0.152	0.006
0.152	0.006	0.203	0.008
0.177	0.007	0.254	0.010
0.203	0.008	0.254	0.010
0.228	0.009	0.304	0.012
0.254	0.010	0.355	0.014
0.279	0.011	0.355	0.014
0.304	0.012	0.406	0.016
0.330	0.013	0.457	0.018
0.335	0.014	0.457	0.018
0.381	0.015	0.508	0.020



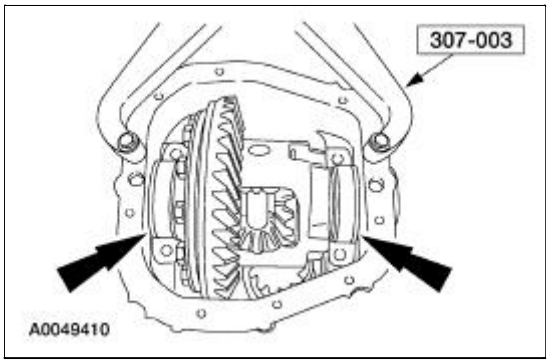
Zero backlash

52. If a zero backlash condition occurs, add 0.51 mm (0.020 inch) to the RH side and subtract 0.51 mm (0.020 inch) from the LH side to allow backlash indication. Measure the backlash. Refer to Measuring backlash in this procedure.

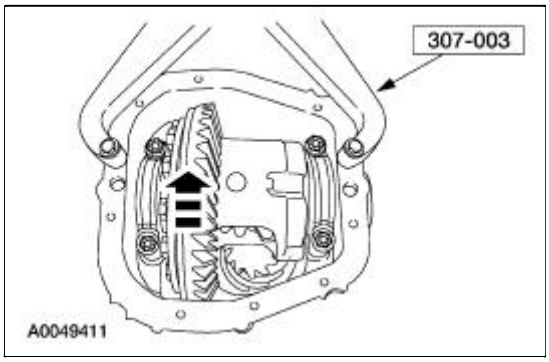


Backlash not within specification

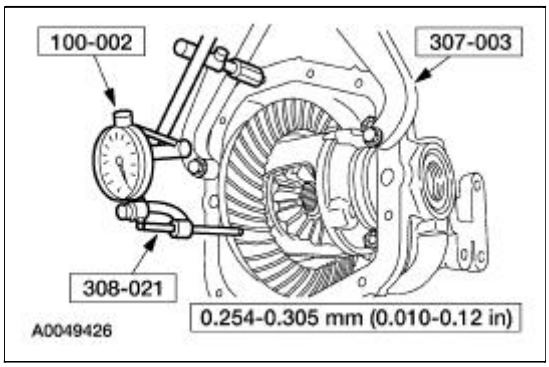
53. To increase or decrease backlash, remove the differential bearing caps and install a thicker shim and a thinner shim accordingly.
    - If backlash is not within the specification, increase the thickness of one differential bearing shim and decrease the thickness of the other differential bearing shim by the same amount.



54. Rotate the differential assembly several times to verify that the differential bearings seated correctly.



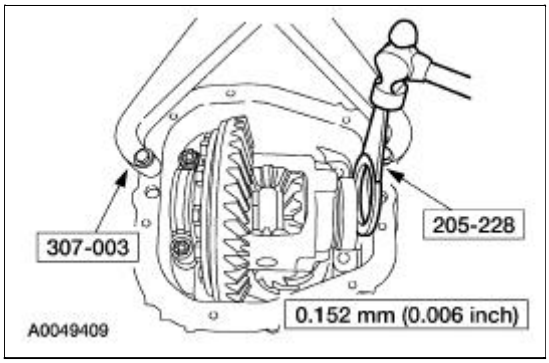
55. Using the special tools, recheck the backlash.
    - If backlash is within the specification, refer to Backlash within specification in this procedure. If backlash is not within the specification, repeat Backlash not within specification in this procedure.



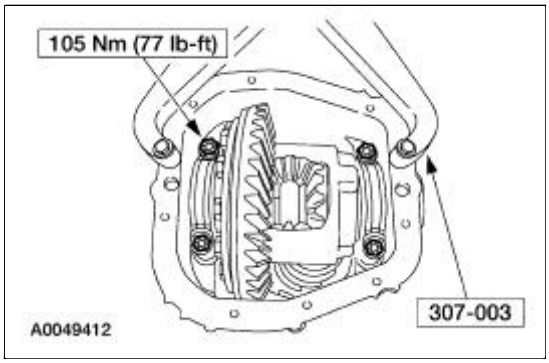
Backlash within specification

56. Remove the bolts and the differential bearing caps.

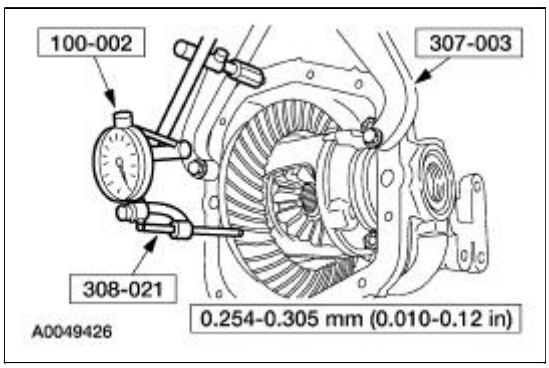
57. To establish differential bearing preload, increase both left and right differential bearing shim sizes by the specification shown.



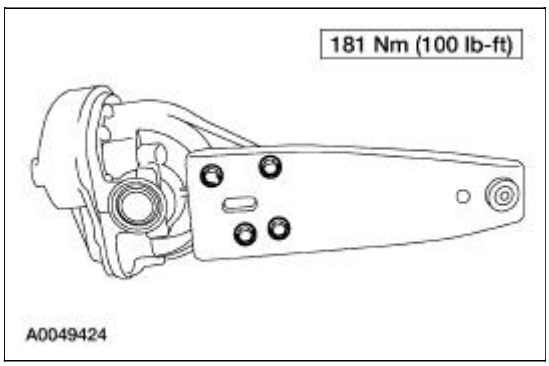
58. Install the differential bearing caps and bolts.



59. Using the special tools, recheck the backlash.

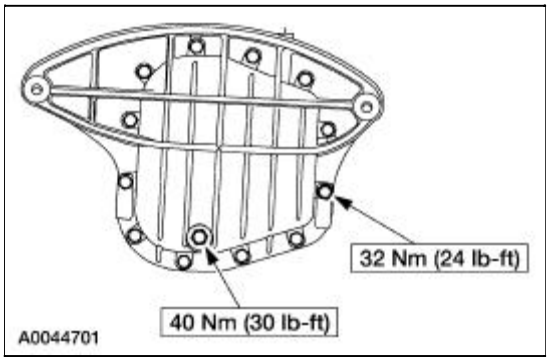


60. Remove the axle assembly from the holding fixture and install the torque arm.



61. **NOTE:** The differential housing cover must be installed within 15 minutes of application of the silicone, or new sealant must be applied. If possible, allow 1 hour before filling with lubricant to make sure the silicone sealant has cured correctly.

Install the differential housing cover and tighten the differential housing cover bolts.



General Specifications

Item	Specification
Lubricants and Sealants	
Motorcraft SAE 75W-90 Premium 4x4 Front Axle Lubricant XY-75W90-TQL	WSP-M2C201-A
Premium Long Life Grease XG-1-C	ESA-M1C75-B
Silicone Gasket and Sealant F7AZ-19554-EA	WSE-M4G323-A4
Threadlock® and Sealer EOAZ-19554-AA	WSK-M2G351-A5
Lubricant Fill Level Checks	
Front axle L (pints)	1.70 (3.6)
Lubricant level	9.56 mm (0.38 in) below bottom of differential housing cover fill hole
Backlash Specifications	
Ring gear backlash	0.254-0.305 mm (0.010-0.012 in)
Ring gear maximum backlash between teeth	0.101mm (0.004 in)
Rotational Torque Ranges	
Pinion bearing torque preload (used pinion bearing)	0.9-1.5 Nm 8-14 Lb-In
Pinion bearing torque preload (new pinion bearing)	1.8-3.3 Nm 16-29 Lb-In
Clearance Specifications	
Maximum differential housing spread	0.762 mm (0.030 in)
Differential case maximum runout	0.076 mm (0.003 in)
Front axle isolator gap	1.93 mm (0.076 in)
Housing spreader adapter thread engagement	12.5 mm (0.500 in)

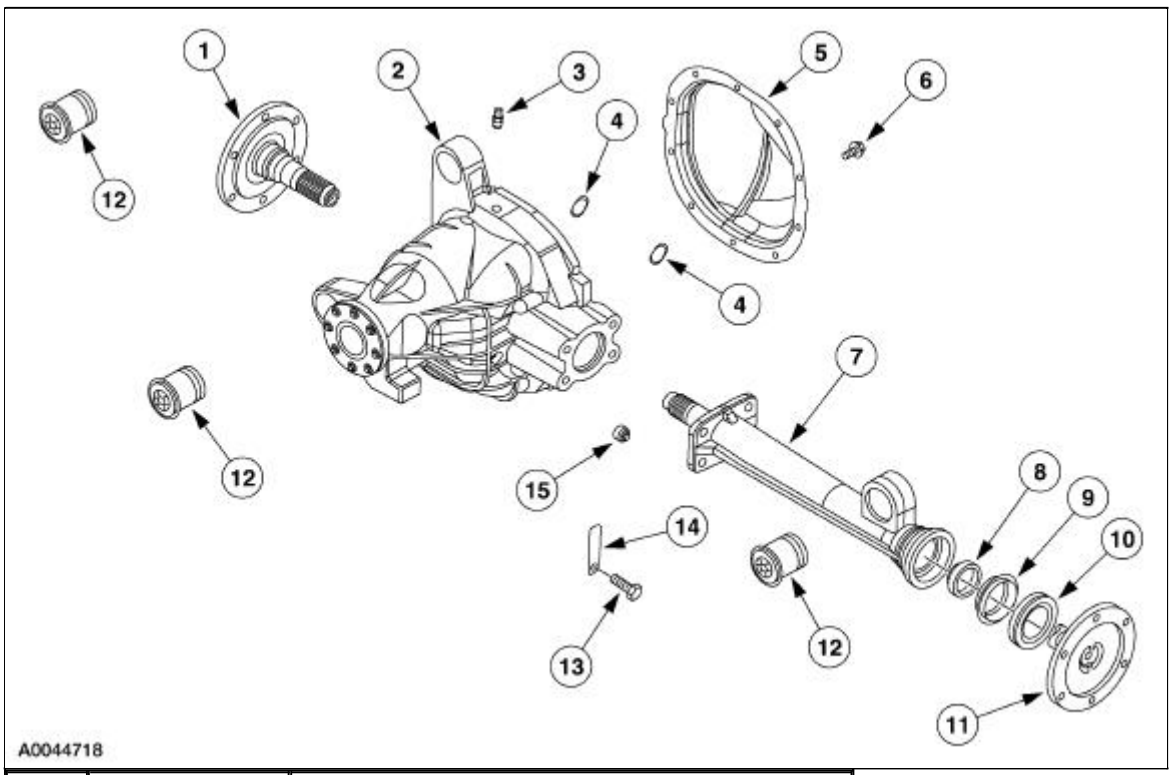
Torque Specifications

Description	Nm	lb-ft
Differential housing bushing bolts	102	75
Differential housing cover bolts	32	24
Differential pinion shaft lock bolt	30	22
Differential bearing cap bolts	105	77
Drain plug	25	18
Axle tube bolts	73	54
Axle vent	21	15
Fill plug	25	18

Ring gear bolts	105	77

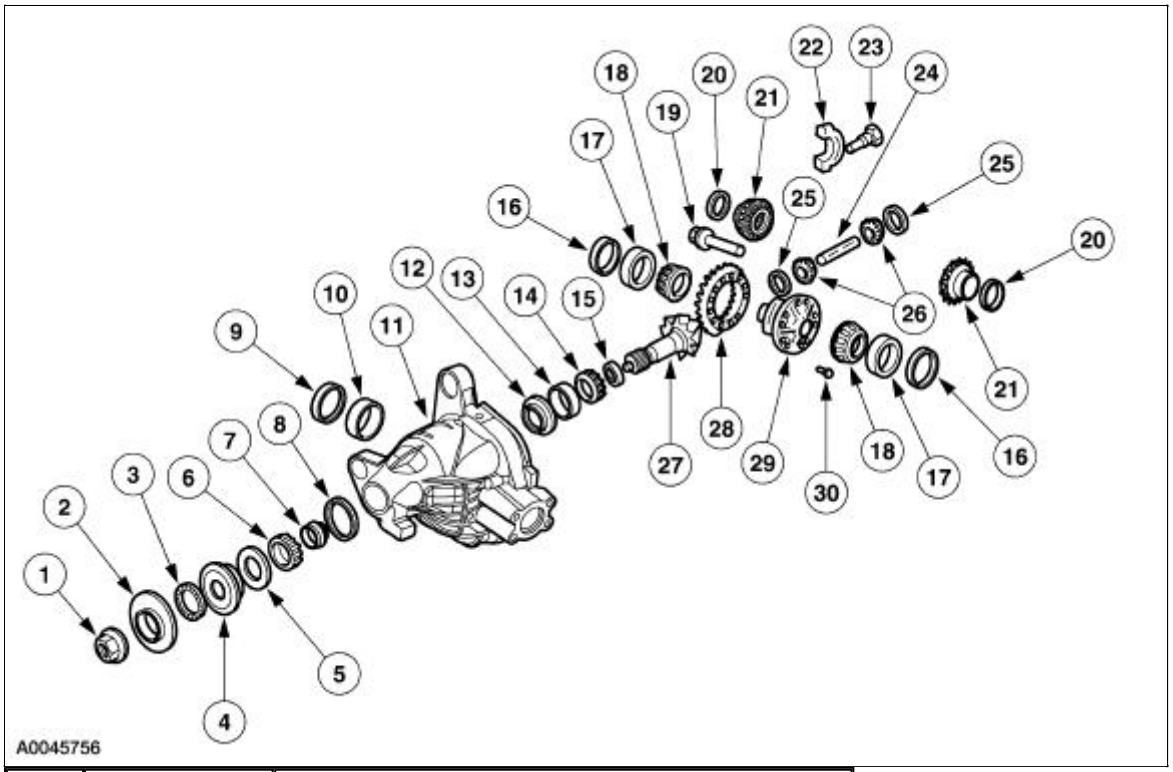
Front Drive Axle and Differential

Front Axle Assembly — Disassembled View



Item	Part Number	Description
1	3A381	Axle shaft (LH)
2	3C202	Differential carrier assembly
3	4338	Axle housing vent
4	N808765-S	Snap ring
5	3N136	Differential housing cover
6	390919	Differential housing cover bolt (10 req'd)
7	3B210	Axle housing tube
8	4B413	Axle shaft bearing assembly (outer)
9	3B112	Axle shaft dust seal
10	3A379	Axle shaft dust deflector
11	3A380	Axle shaft (RH)
12	3A443	Front axle support isolators (3 req'd)
13	N808703	Axle housing tube bolt (4 req'd)
14	4121	Axle identification tag
15	373098	Fill plug

Front Differential — Disassembled View



Item	Part Number	Description
1	389546	Drive pinion nut
2	4858	Drive pinion universal joint flange
3	4859	Drive pinion oil seal deflector
4	3N134	Drive pinion seal
5	386989	Drive pinion oil slinger
6	4621	Drive pinion bearing (outer)
7	4662	Drive pinion collapsible spacer
8	4616	Drive pinion bearing cup (outer)
9	3B112	Halfshaft inner dust seal
10	4B413	Halfshaft bearing assembly
11	3A412	Differential carrier
12	4631	Drive pinion bearing oil baffle
13	4628	Drive pinion bearing cup (inner)
14	4630	Drive pinion bearing (inner)
15	4663	Drive pinion bearing adjustment shim
16	4A451	Differential bearing shim (2 req'd)
17	4221	Differential bearing cup (2 req'd)
18	4221	Differential bearing (2 req'd)
19	387426	Differential pinion shaft bolt
20	386984	Differential side gear thrust washer (2 req'd)
21	4236	Differential side gear (2 req'd)
22	4224	Differential bearing cap (2 req'd)
23	391583	Differential bearing cap bolt (4 req'd)
24	4211	Differential pinion shaft

25	4230	Differential pinion thrust washer (2 req'd)
26	4215	Differential pinion gear (2 req'd)
27	3N175	Drive pinion gear
28	3A397	Differential ring gear
29	4205	Differential case
30	388056	Differential ring gear bolt (10 req'd)

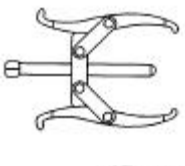
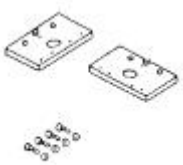
- The axle housing assembly consists of a cast-aluminum center section, a removable cast-aluminum axle housing tube, and a differential housing cover. Both the axle housing tube and the differential housing cover use silicone sealant as a gasket.
- The hypoid-design gearset consists of an 8.8-inch ring gear and a pinion gear. Two opposed tapered roller bearings support the drive pinion in the axle housing.
- A drive pinion collapsible spacer, located on the pinion shaft, maintains pinion bearing preload. The pinion nut adjusts the preload.
- Differential bearing shims, located between the differential bearing cups and the axle housing, adjust the differential bearing preload and the ring gear backlash.
- The differential case is a one-piece design with two openings to allow for assembly of the internal components and lubricant flow. Two opposed tapered roller bearings (differential bearings) support the differential case in the axle housing. Removable differential bearing caps retain the differential assembly in the axle housing.
- Inside the differential case, the differential pinion shaft supports two differential pinion gears. The pinion gears engage the differential side gears, to which the left axle shaft and the right axle shaft are splined. The differential pinion shaft bolt retains the differential pinion shaft in the differential case.
- An embossed metal tag, bolted to the rear face of the RH axle tube, contains front axle identification information.

Front Drive Axle

Refer to Section 205-00 .

Differential Case Runout Check

Special Tool(s)

 ST1321-A	2-Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1214-A	Dial Indicator With Holding Fixture 100-002 (TOOL-4201-C)
 ST1259-A	Spreader, Differential Carrier 205-001 (TOOL-4000-E)
 ST1344-A	Spreader, Differential Housing (Plate) 205-335 (T93P-4000-A)
 ST1437-A	Installer, Differential Side Bearing 205-010 (T57L-4221-A2)
 ST1188-A	Holding Fixture, Transmission 307-003 (T57L-500-B)
 ST2043-A	Step Plate 205-D061 (D83T-4205-C2)
	Gauge, Clutch Housing 308-021 (T75L-4201-A)

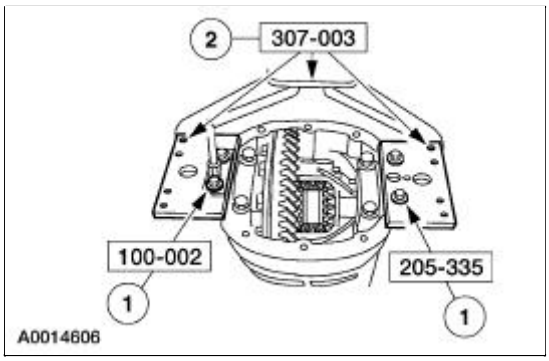


1. Remove the front drive axle assembly. For additional information, refer to Axle Assembly—Front Drive in this section.

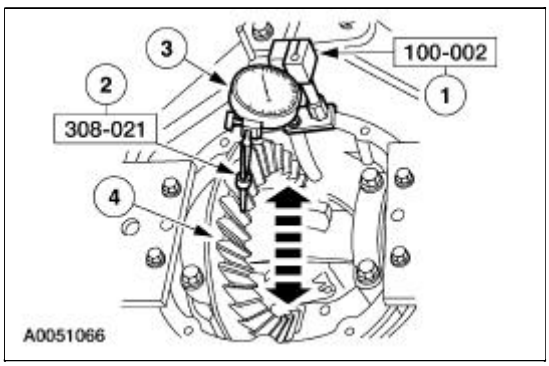
2. Remove the axle shafts from the differential assembly. For additional information, refer to Axle—Front Drive in this section.

3. **CAUTION: Do not damage the aluminium differential housing while carrying out these procedures.**

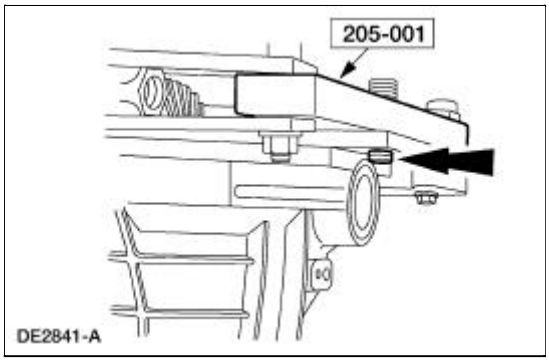
   Using the special tools, mount the differential housing to a work bench.
   1. Attach the special tools to the differential housing with four bolts that retain the differential housing cover to the differential housing.
   2. Attach the special tools together with two 3/8 inch x 1-1/2 inch bolts.



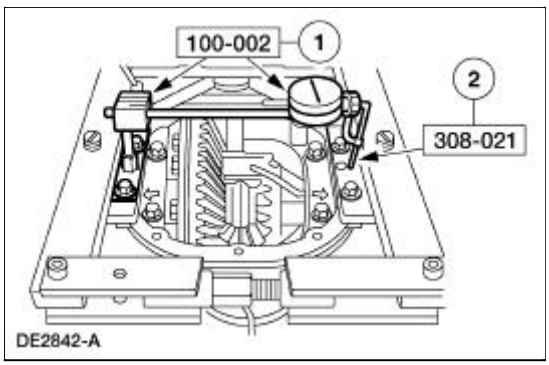
4. Install the special tools, measure and record the differential ring gear backlash between teeth in four opposing places.
   - If the backlash between teeth exceeds the specification of 0.254-0.305 mm (0.010-0.012 in.), the cause may be a warped ring gear, differential bearings, or a damaged differential case. To determine the cause of the excessive backlash, remove the dial indicator and proceed as follows:



5. Install the special tool by placing the spreader pins in the hole in the Differential Housing (Plate) Spreader.



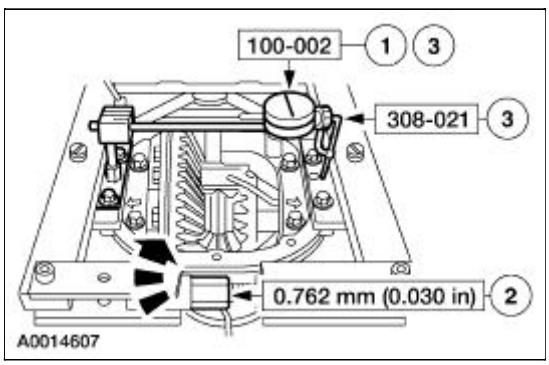
6. Assemble the special tool.
    1. Install the special tool.
    2. Attach the special tool and position the tip in the Differential Housing (Plate) Spreader hole.



7. **CAUTION: Overspreading can damage the differential housing.**

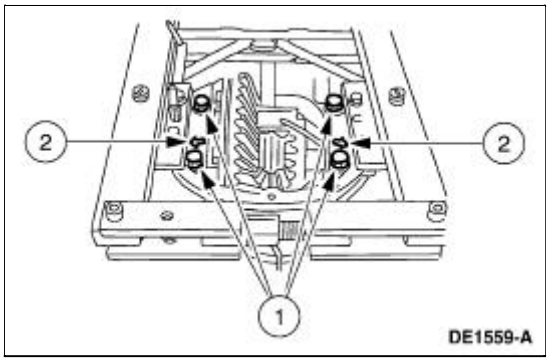
    NOTE: Tighten and loosen the Differential Carrier Spreader screw several times to normalize the Differential Housing (Plate) Spreader Adapters prior to taking the final Dial Indicator reading.

    Spread the differential housing to specifications.
    1. Adjust the Dial Indicator with Holding Fixture to zero.
    2. Tighten the screw until the differential housing is spread to specification.
    3. Remove the Dial Indicator with Holding Fixture and the Clutch Housing Gauge.



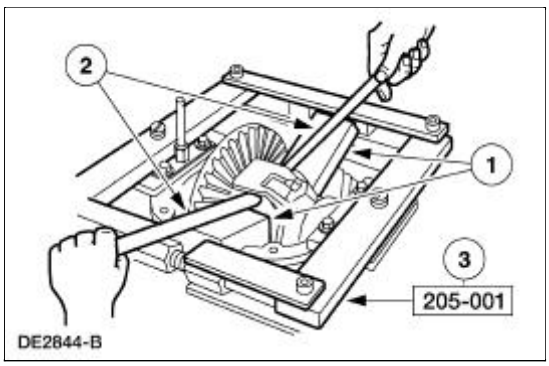
8. **CAUTION: Mark the position and location of the differential bearing caps as the arrows may not be visible.**

    Remove the bearing caps.
    1. Remove the bolts.
    2. Remove the bearing caps.



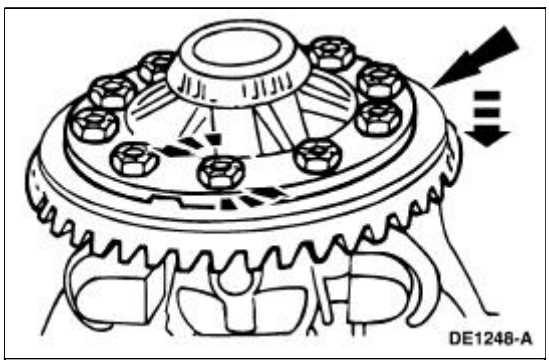
9. **CAUTION: Use wood blocks to avoid damaging the differential housing.**

   Remove the differential assembly.
   1. Position the wood blocks at the top and bottom of the differential case.
   2. Pry the differential assembly with the bearing cups and shims out of the differential housing.
   3. Remove the special tool.



10. Separate the bearing shims and cones from the differential assembly and tag them left and right for assembly.

11. Remove the ring gear.
    - Remove the ten bolts.
    - Use a drift punch to separate the ring gear from the differential case.

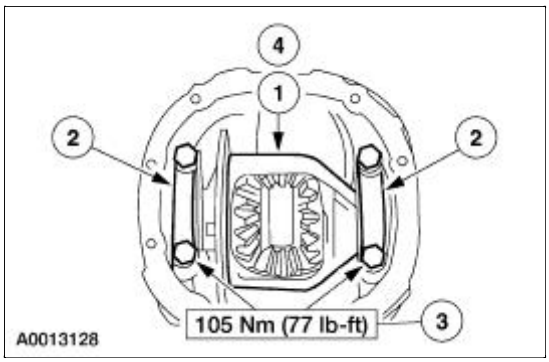


12. **NOTE:** Visually inspect the differential bearing cups and cones for discoloration indicating bearing overheating or failure.

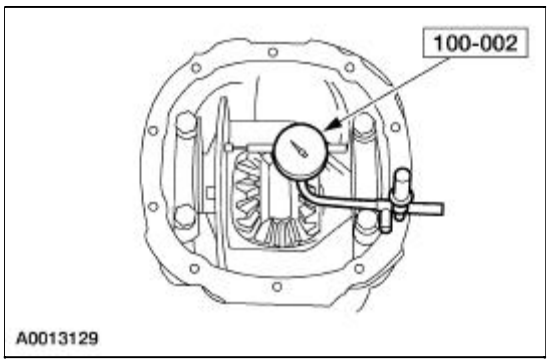
    NOTE: It may be necessary to use the Differential Carrier Spreader to carry out this step.

    Install the differential case with the bearing cups and all the shims in the housing.

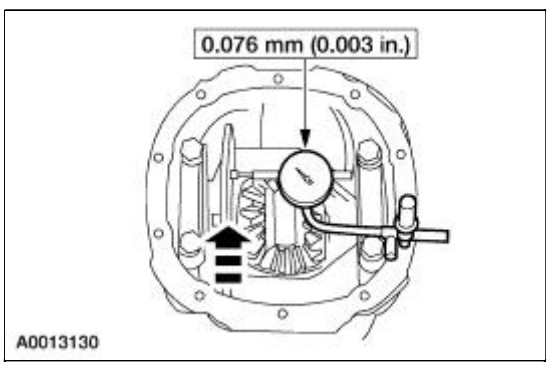
1. Position the differential case with the bearing cups and shims in their original location.
2. Install the bearing caps.
3. Install the bolts.
4. Rotate the differential case to make sure the bearings have seated correctly.



13. Install the special tool.

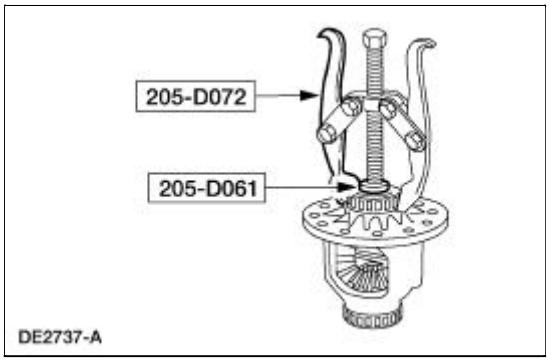


14. Rotate the differential case and check the differential case runout.
    - If the runout does not exceed the specification, install a new ring gear and pinion.
    - If runout exceeds the specification, the ring gear is true and the condition is due to differential case/differential bearing damage.
        - Inspect the differential bearings and the differential case. Always install new differential bearings when installing a new differential case, or if a bearing condition is questionable.



15. Remove the bearing caps, and the differential case with the bearing cups and shims from the housing.

16. If necessary, using the special tools, remove the differential bearings.

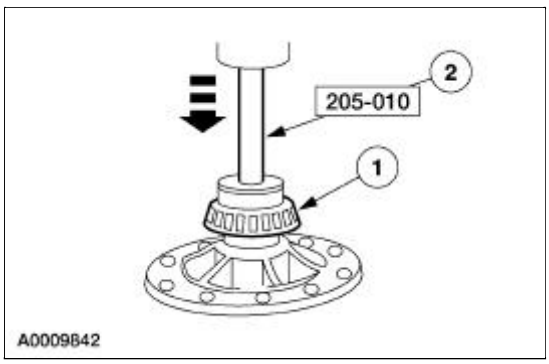


17. **CAUTION: Press against the differential bearing inner cone only.**

Install the new differential bearings.

1. Position the appropriate differential bearing (RH or LH).
2. Using a suitable press and the special tool, install the differential bearing.

- Repeat the steps for the other differential bearing.

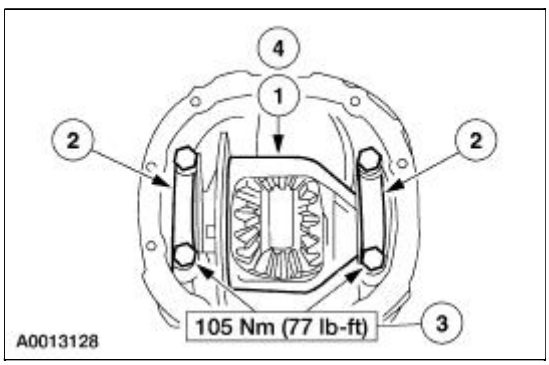


18. **NOTE:** It may be necessary to use the Differential Carrier Spreader to carry out this step.

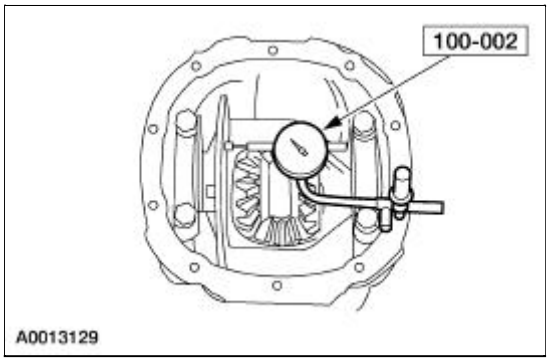
NOTE: Recheck the flange runout.

Install the differential case with the bearing cups and the shims in the housing.

1. Position the differential case with the bearing cups and shims in their original location.
2. Install the bearing caps.
3. Install the bolts.
4. Rotate the differential case to make sure the bearings have seated correctly.

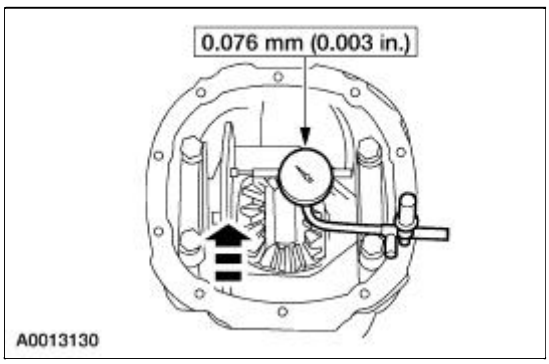


19. Install the special tool.

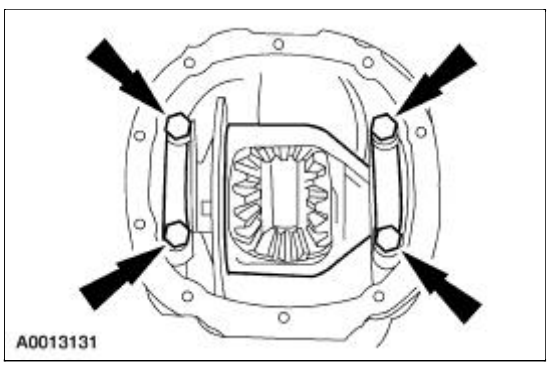


20. **NOTE:** If the runout is still excessive, install a new differential case.

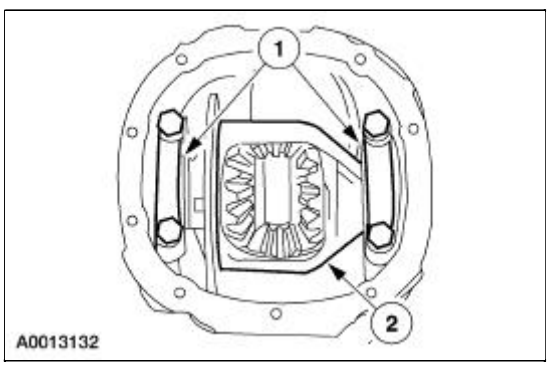
    Check the runout with the new differential bearings. If the runout does not exceed the specification, use the new differential bearings for assembly.



21. Remove the bolts.



22. Remove the differential case with the bearing cups and the shims from the housing.
    1. Remove the bearing caps.
    2. Remove the differential case with the bearing cups and the shims from the housing.



23. Install the ring gear and the differential assembly. For additional information, refer to Axle—Front Drive in this section.

24. Install the axle shafts in the differential assembly. For additional information, refer to Axle Assembly—Front Drive in this section.

25. Install the front drive axle assembly. For additional information, refer to Axle Assembly—Front Drive in this section.

Drive Pinion Seal

Special Tool(s)

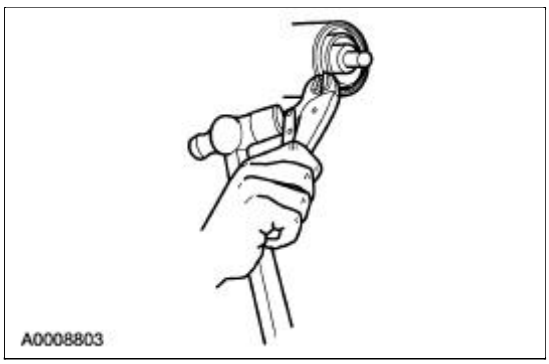
 ST1358-A	Installer, Drive Pinion Oil Seal 205-133 (T79P-4676-A)

Removal

1. Remove the front axle universal joint flange. For additional information, refer to Universal Joint Flange—Front in this section.

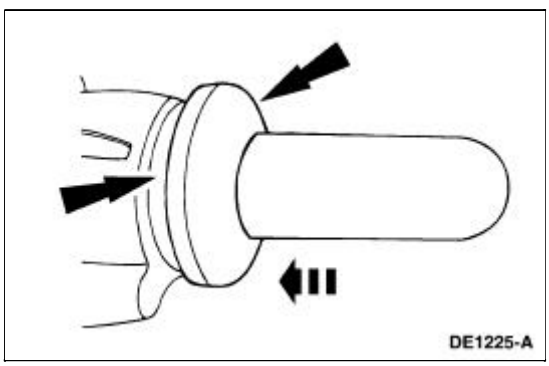
2. **CAUTION: Do not damage the front axle housing.**

   Force up on the metal flange of the rear axle drive pinion seal. Install gripping pliers and strike with a hammer to remove the pinion seal.



Installation

1. Clean the pinion seal bore, and use the Drive Pinion Oil Seal Installer to install the pinion seal.

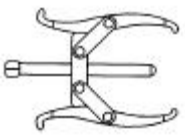


2. Install the front axle universal joint flange. For additional information, refer to Universal Joint

Flange—Front in this section.

Universal Joint Flange —Front

Special Tool(s)

 ST1321-A	2-Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1257-A	Holding Fixture, Drive Pinion Flange 205-126 (T78P-4851-A)
 ST1800-A	Installer, Drive Pinion Flange 205-002 (TOOL-4858-E)

Material

Item	Specification
SAE 75W-90 Premium 4x4 Front Axle Lubricant XY-75W90-TQL	WSP-M2C201-A

Removal

WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the RH kick panel area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.

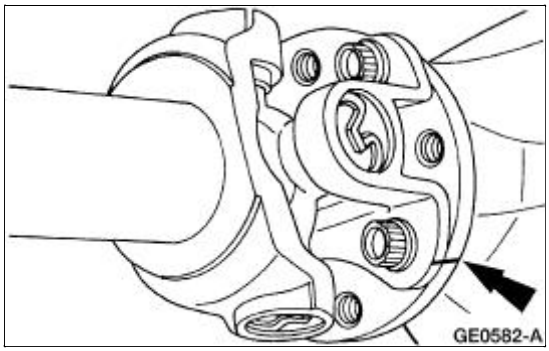
CAUTION: This operation disturbs the pinion bearing preload. Carefully reset the preload during assembly.

1. Position the vehicle on a hoist. For additional information, refer to Section 100-02 .
2. Remove the front wheel and tire assemblies. For additional information, refer to Section 204-04 .
3. **CAUTION: Remove the front brake caliper to prevent drag during the drive pinion bearing preload adjustment.**

CAUTION: Do not allow the calipers to hang from the brake hoses.

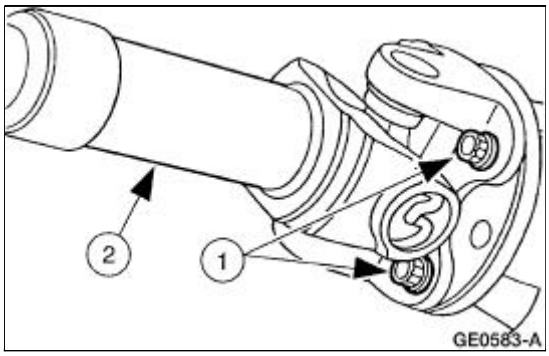
Remove the front brake calipers. Wire the caliper out of the way. For additional information, refer to Section 206-03 .

4. Index-mark the front driveshaft to the axle universal joint flange.

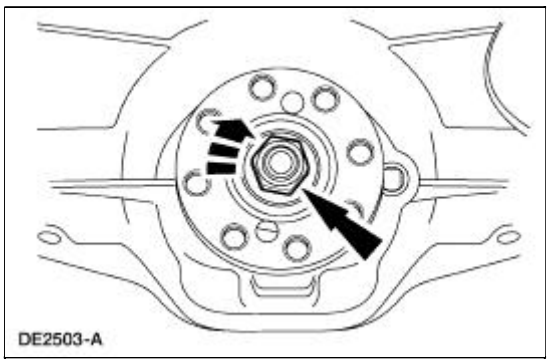


5. **CAUTION: Do not allow the driveshaft to hang unsupported.**

Disconnect and support the front driveshaft.
1. Remove the four bolts.
2. Carefully disconnect and support the front driveshaft.

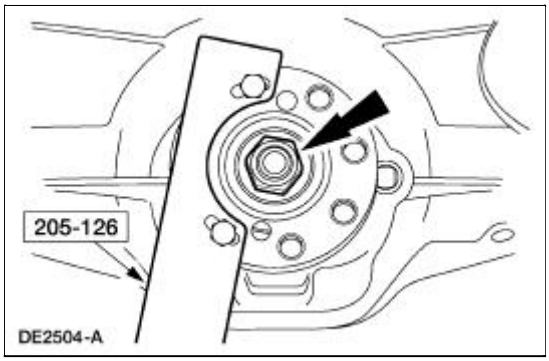


6. Using a Nm (inch/pound) torque wrench, measure the torque necessary to maintain pinion rotation. Record the measurement for reference during installation.

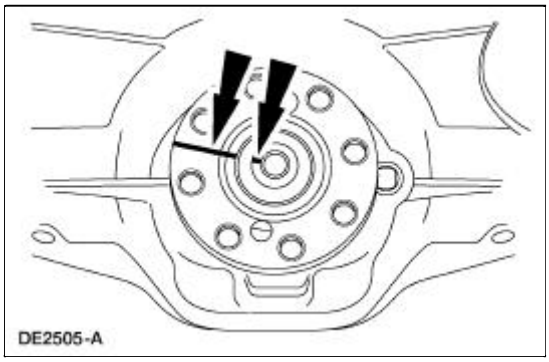


7. **CAUTION: After removing the pinion nut, discard it. Use a new pinion nut for installation.**

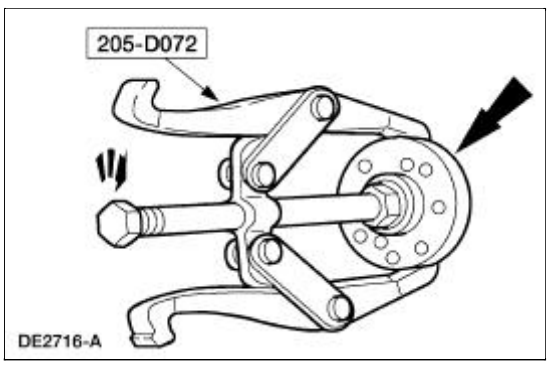
Install the special tool, and remove the pinion nut.



8. Index-mark the axle universal joint flange to the pinion stem.



9. Using the special tool, separate the axle universal joint flange from the pinion gear.



10. Remove the flange.

11. Inspect the axle universal joint flange for burrs, the nut counterbore and the seal contact surface for nicks, and the bearing cone contact area for damage. Install a new flange if necessary.

12. Check the pinion stem splines for burrs. If burrs are evident, remove them with a fine crocus cloth.

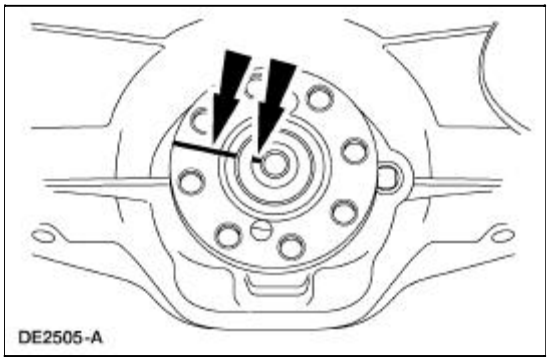
Installation

1. Lubricate the axle universal joint flange splines and the pinion seal.
    - Use front axle lubricant.

2. **CAUTION: Never install the axle universal joint flange with a hammer or power tools.**

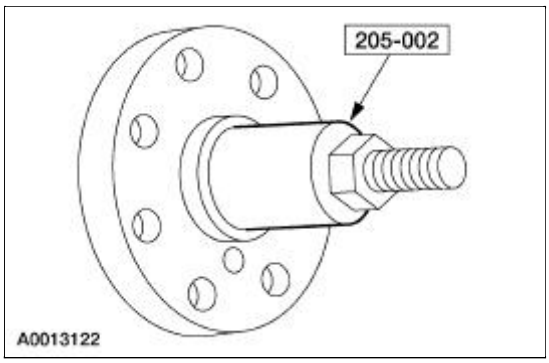
    NOTE: Disregard the scribe marks if installing a new flange.

Align the index-marks and position the axle universal joint flange on the pinion shaft.



3. **NOTE:** Rotate the pinion gear occasionally to make sure the pinion bearings seat correctly.

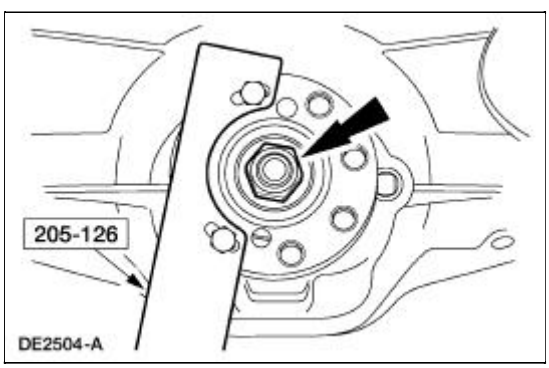
   Using the special tool, install the axle universal joint flange.

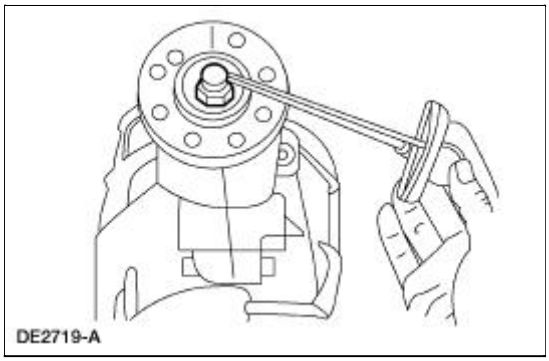


4. **CAUTION: Do not loosen the pinion nut to reduce preload under any circumstance. If it is necessary to reduce preload, install a new drive pinion collapsible spacer and pinion nut.**

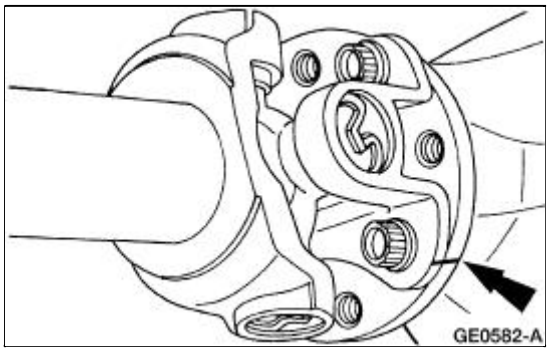
   Install the special tool, and tighten the pinion nut. Refer to the torque specifications for used bearings in the Specifications portion of this section.

   - Rotate the pinion gear occasionally to make sure the pinion bearings are seating correctly. Take frequent pinion bearing torque preload readings by rotating the pinion gear with a Nm (inch/pound) torque wrench.
   - If the preload recorded prior to disassembly is lower than the specification for used bearings, then tighten the pinion nut to the specification. If the preload recorded prior to disassembly is higher than the specification for used bearings, then tighten the pinion nut to the original reading as recorded.





5. Align the index-marks then attach the front driveshaft. Refer to Section 205-01 for driveshaft fastener tightening specifications.

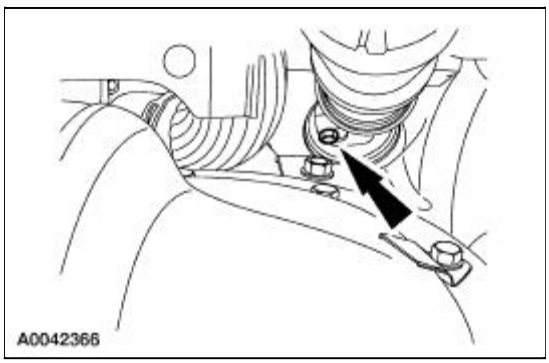


6. Inspect and, if necessary, fill the differential.
   - Use front axle lubricant.
7. Lower the vehicle.
8. If equipped with air suspension, reactivate the system by turning on the air suspension switch.

Axle Assembly —Front Drive

Removal

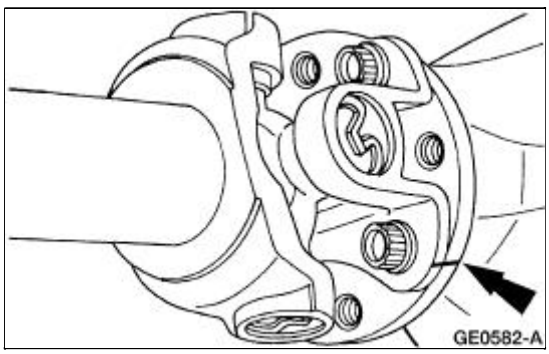
1. Position the vehicle on a hoist. For additional information, refer to Section 100-02 .
2. Open the air cleaner clamp and set the outlet air cleaner aside.
3. Remove the steering column shaft pinch bolt.



4. Disconnect the steering column coupling from the steering gear.
5. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the RH kick panel area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

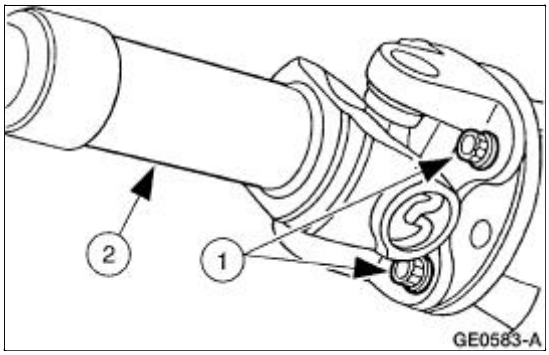
   With the transmission in NEUTRAL, raise and support the vehicle.

6. Index-mark the front driveshaft to the universal joint drive pinion flange.



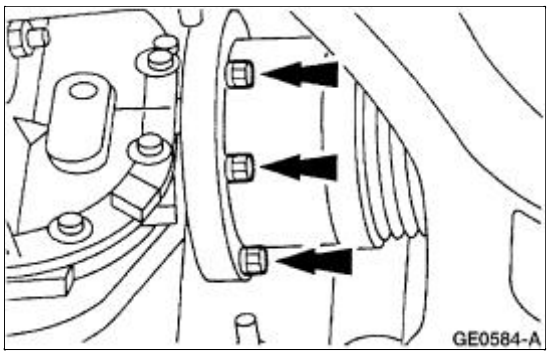
7. **CAUTION: Do not allow the driveshaft to hang unsupported.**

   Disconnect and support the front driveshaft.
   1. Remove the four bolts.
   2. Carefully disconnect and support the front driveshaft.

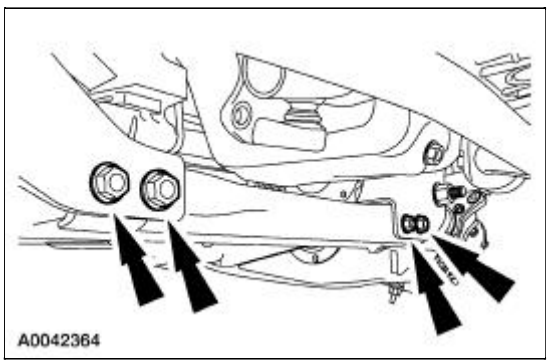


8. **CAUTION: Do not allow the halfshaft to hang unsupported.**

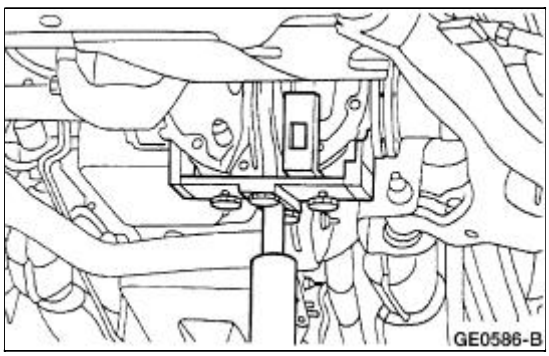
   Remove the six bolts, and disconnect the front drive halfshaft from the front axle shaft.
   - Repeat this step for the opposite side.



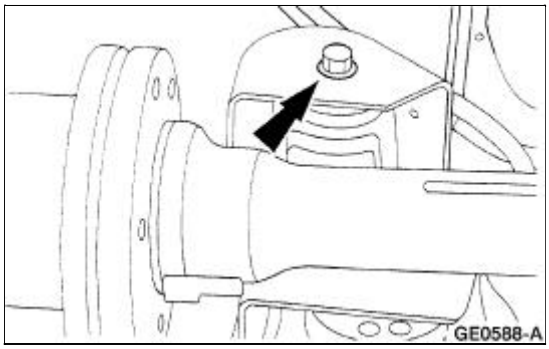
9. Remove the four crossmember bolts and the crossmember.



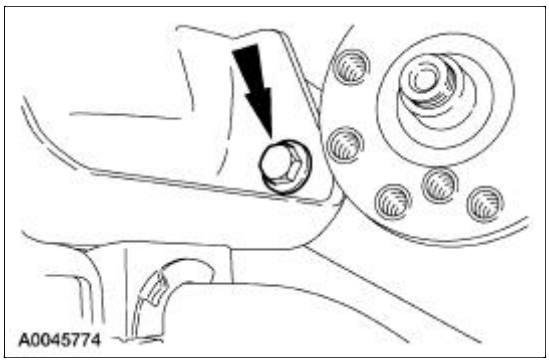
10. Use a high-lift jack to support the axle assembly.



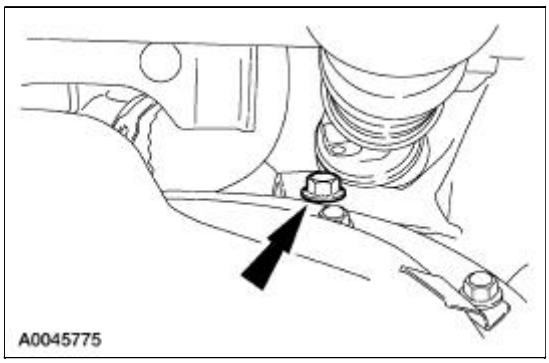
11. Remove the nut and bolt.



12. Remove the bolt.



13. Remove the bolt.



14. Carefully lower the front drive axle assembly.

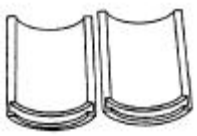
15. Disconnect the vent hose from the axle vent barbed fitting.

Installation

1. To install, reverse the removal procedure.
    - Refer to Section 205-04 for halfshaft fastener tightening specifications.
    - Refer to Section 205-01 for driveshaft fastener tightening specifications.
    - Refer to Section 211-04 for steering column tightening specifications.

Axle Carrier Bushing

Special Tool(s)

 ST1160-A	Installer, Front Axle Mounting Bushing Collet 205-372 (T96T-5638-F)
 ST1159-A	Remover, Front Axle Mounting Bushing Cup 205-371 (T96T-5638-E)
 ST1155-A	Remover, Bushing 205-527
 ST1156-A	Installer, Front Axle Mounting Bushing 205-370 (T96T-5638-B)
 ST1162-A	Drawbolt 205-527
 ST1167-B	Ring Gauge (0.225 in.) 204-206 (T96T-5638-D)

Removal

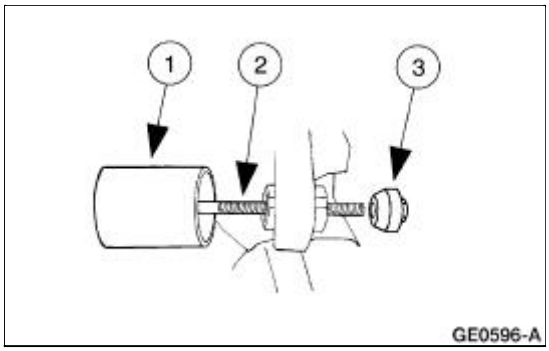
NOTE: The following procedure is applicable for all of the front axle mounting bushings.

1. **NOTE:** It is not necessary to remove the axle assembly from the jack.

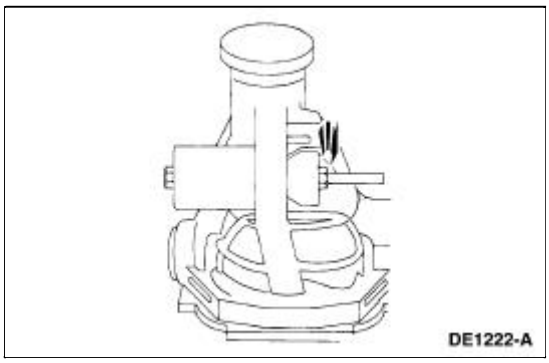
   Remove the front drive axle assembly. For additional information, refer to Axle Assembly—Front

Drive in this section.

2. Position the carrier bushing removal tools.
    1. Position the Front Axle Mounting Bushing Cup Remover.
    2. Position the Drawbolt through Front Axle Mounting Bushing Cup Remover and the bushing.
    3. Thread the Bushing Remover onto the Drawbolt.

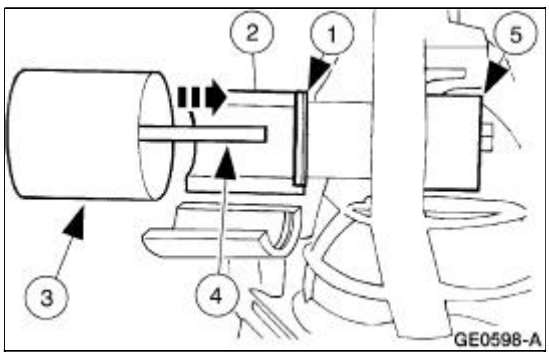


3. Tighten the Drawbolt to remove the carrier bushing.



Installation

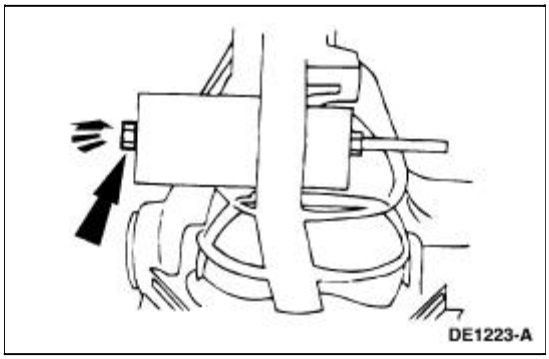
1. Position the carrier bushing and the carrier bushing installation tools.
    1. Position the Gauge Ring on the outer face of the bushing flange.
    2. Position the Front Axle Mounting Bushing Collet Installer over the Gauge Ring and the bushing flange.
    3. Slide the Front Axle Mounting Bushing Cup Remover over the Front Axle Mounting Bushing Collet Installer.
    4. Insert the Drawbolt.
    5. Thread the Front Axle Mounting Bushing Installer onto the Drawbolt.



2. **NOTE:** The Gauge Ring will correctly locate the carrier bushing when the Bushing Collet Installer bottoms out on the carrier.

Tighten the Drawbolt until the Bushing Collet Installer contacts the carrier.

- Remove the tools.



3. Install the front drive axle assembly. For additional information, refer to Axle Assembly—Front Drive in this section.

Axle Cover Bushing

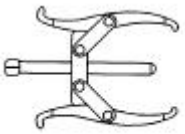
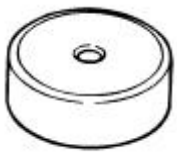
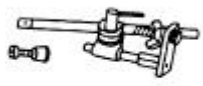
1. Refer to Axle Carrier Bushing in this section.

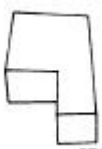
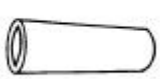
Axle Tube Bushing

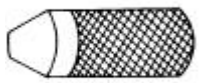
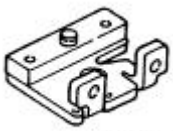
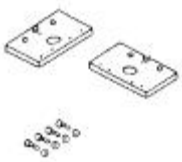
1. Refer to Axle Carrier Bushing in this section.

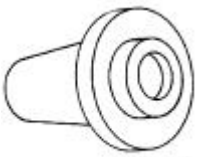
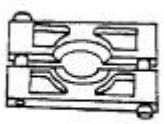
Axle —Front Drive

Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)
 ST1321-A	2-Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1743-A	Adapter for 205-S127 205-105 (T76P-4020-A3)
 ST1200-A	Remover, Bearing Cup 308-047 (T77F-1102-A)
 ST1165-A	Preload Gauge, Bearing 205-S337 (T93P-4220-AR)
 ST1182-A	Dial Indicator Gauge Brackets 100-D004 (D78P-4201-F) or equivalent
 ST1357-A	Installer, Differential Carrier Bearings 205-D044 (D81T-4221-A) or equivalent
	Gauge, Clutch Housing 308-021 (T75L-4201-A)

 ST1348-A	
 ST1257-A	Holding Fixture, Drive Pinion Flange 205-126 (T78P-4851-A)
 ST1800-A	Installer, Drive Pinion Flange 205-002 (TOOL-4858-E)
 ST1183-A	Dial Indicator 100-D005 (D78P-4201-G) or equivalent
 ST1259-A	Spreader, Differential Carrier 205-001 (TOOL-4000-E) or equivalent
 ST1437-A	Installer, Differential Side Bearing 205-010 (T57L-4221-A2)
 ST1431-A	Adapter for 205-S127 205-110 (T76P-4020-A10)
 ST1433-B	Adapter for 205-S127 205-129 (T79P-4020-A18)
 ST1434-A	Gauge Tube, Drive Pinion 205-336 (T93P-4020-A)

 ST1432-A	Adapter for 205-S127 205-111 (T76P-4020-A11)
 ST1186-A	Holding Fixture, Transmission 307-003 (T57L-500-B)
 ST1150-B	Adapter for Differential Housing Spreader 205-368 (T96T-4000-A)
 ST1344-A	Spreader, Differential Housing (Plate) 205-335 (T93P-4000-A) (RH)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
 ST1349-A	Gauge, Differential Bearing 205-338 (T93P-4222-A)
 ST1484-A	Installer, Drive Pinion Bearing Cone 205-005 (T53T-4621-C)
 ST1361-A	Installer, Drive Pinion Bearing Cup 205-024 (T67P-4616-A)
	Depth Gauge, Drive Pinion 205-S127 (T79P-4020-A)

 ST1258-A	
 ST1882-A	Protector, Drive Pinion Thread 205-460
 ST1358-A	Installer, Drive Pinion Oil Seal 205-133 (T79P-4676-A)
 ST1350-A	Gauge, Differential Bearing 205-339 (T93P-4222-B)
 ST1429-A	Adapter for 205-S127 205-109 (T76P-4020-A9)
 ST2043-A	Step Plate 205-D061 (D83T-4205-C2)
 ST1310-A	Remover, Bearing 205-055 (T71P-4621-B)

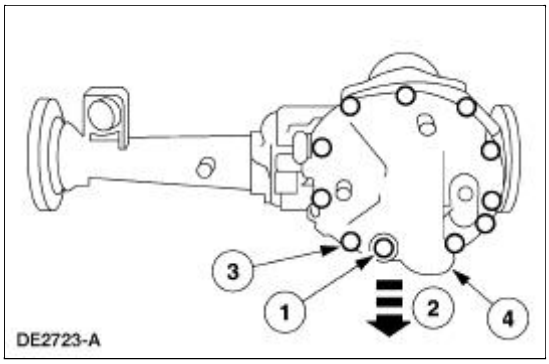
Material

Item	Specification
Silicone Gasket and Sealant F7AZ-19554-EA	WSE-M4G323-A4
Premium Long Life Grease XG-1-C	ESA-M1C75-B
SAE 75W-90 Premium 4x4 Front Axle Lubricant XY-75W90-TQL	WSP-M2C201-A

Disassembly

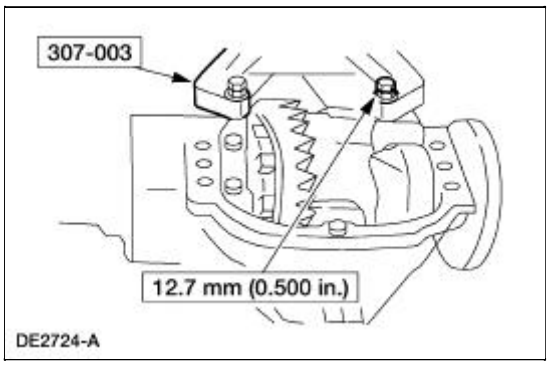
1. Remove the front drive axle assembly. For additional information, refer to Axle Assembly—Front Drive in this section.

2. Remove the differential housing cover.
    1. Remove the drain plug.
    2. Drain the fluid.
    3. Remove the bolts.
    4. Remove the differential housing cover.



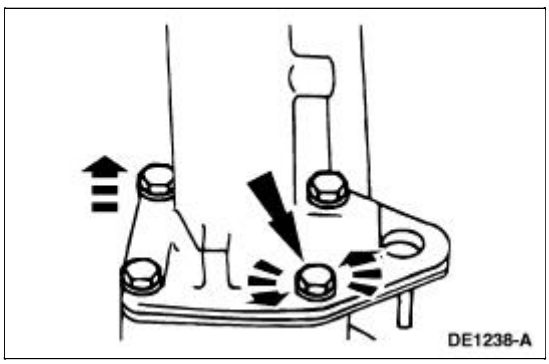
3. **CAUTION: The fixture mounting bolts must have the minimum specified thread engagement in the carrier.**

    Install the special tool.

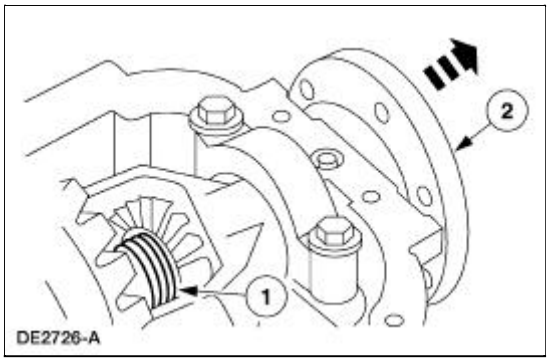


4. Remove the right hand axle shaft.
    1. Remove the snap ring.
    2. Remove the axle shaft.

5. Remove the axle housing tube.

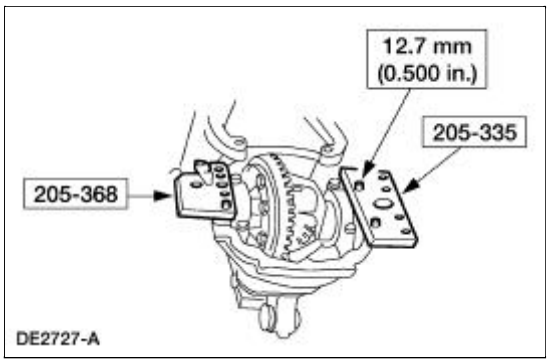


6. Remove the axle shaft.
    1. Remove the snap ring.
    2. Remove the axle shaft.

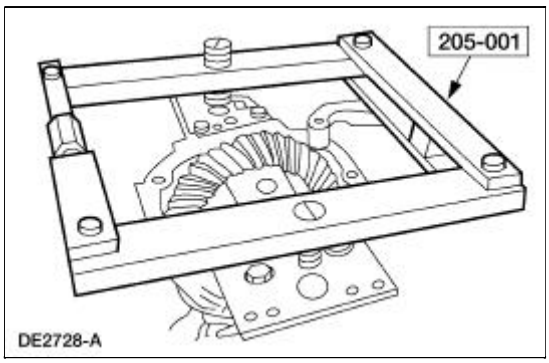


7. **CAUTION: The housing spreader adapter bolts must have the minimum specified thread engagement in the carrier.**

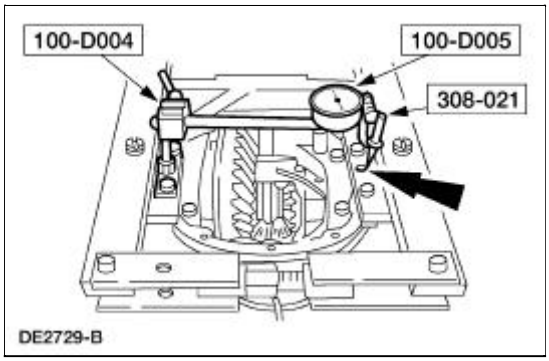
    Install the special tools.



8. Position the special tool on the spreader adapters.

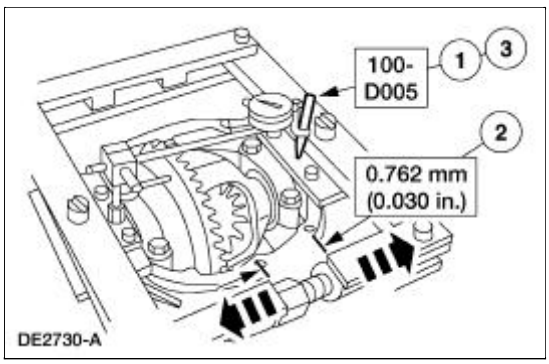


9. Install the special tools.
    - Position the adapter tip in the spreader adapter hole.



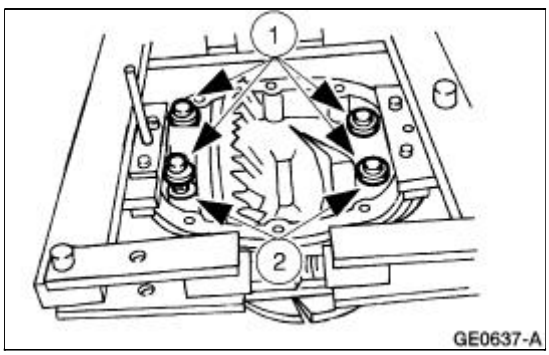
10. **CAUTION: Overspreading can damage the axle housing.**

Spread the axle housing to the specification.
1. Adjust the special tool to zero.
2. Tighten the housing spreader screw to spread the axle housing to the specification.
3. Remove the special tool.



11. **CAUTION: Mark the differential bearing caps Top or Bottom and LH or RH appropriately before removing them. Always install the bearing caps in their original place and position.**

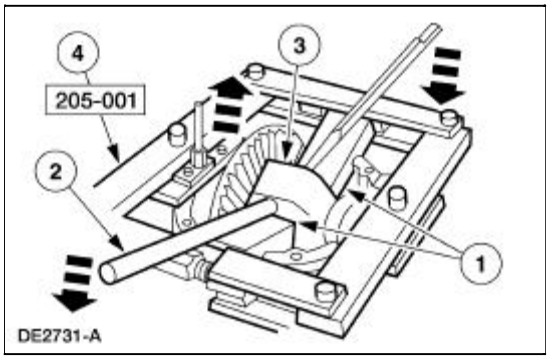
Mark and remove the differential bearing caps.
1. Remove the bolts.
2. Remove the differential bearing caps.



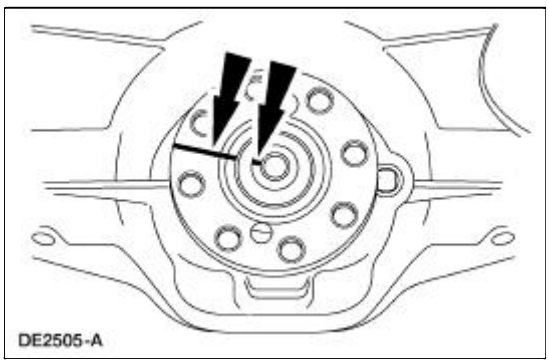
12. **CAUTION: Use wood blocks to avoid axle housing damage.**

Remove the differential assembly from the axle housing.
1. Position the wood blocks.
2. Position and push down on the two pry bars.
3. Remove the differential assembly.

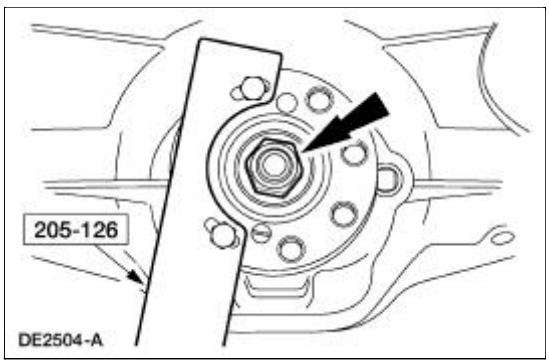
4. Remove the special tool.



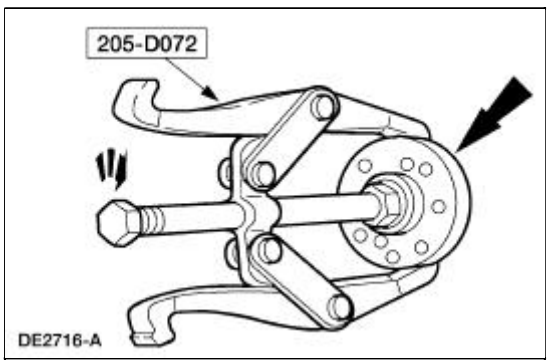
13. Index-mark the axle universal joint flange to the pinion stem.



14. Install the special tool and loosen, but do not remove, the pinion nut.

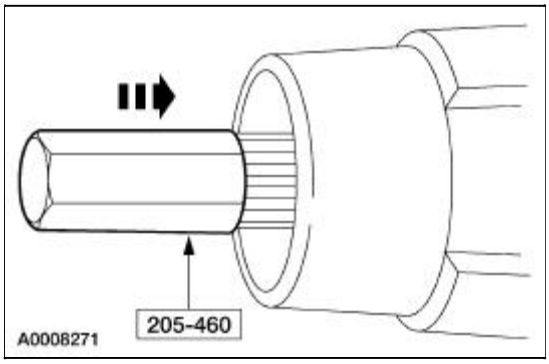


15. With the pinion nut still engaged by a few threads, use the special tool to separate the axle universal joint flange from the pinion gear.

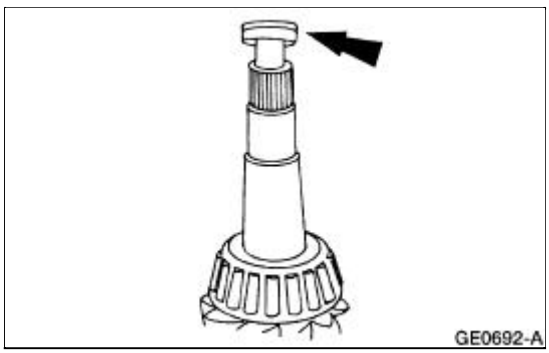


16. Remove the nut and the flange.

17. Using the special tool and a soft hammer, remove the pinion gear.



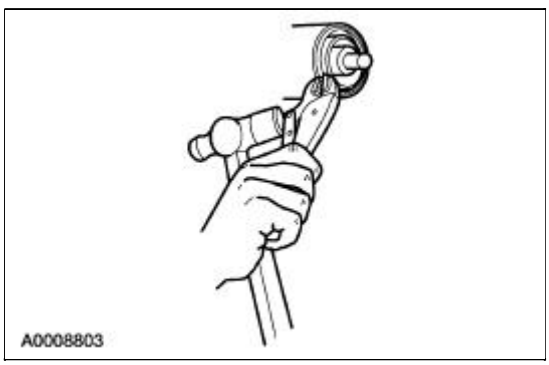
18. Discard the drive pinion collapsible spacer.



19. **CAUTION: Do not damage the carrier housing while removing the pinion seal.**

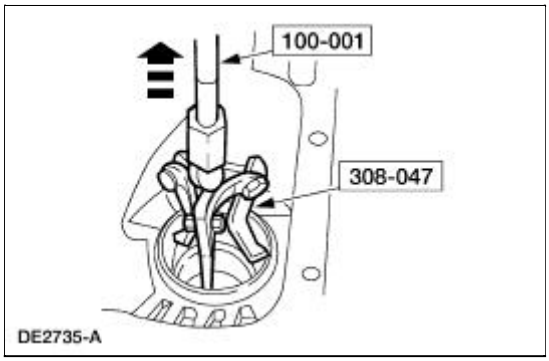
    Remove the pinion seal and slinger.

    - Pry up on the seal flange. Install gripping pliers, and strike with a hammer to remove the seal.



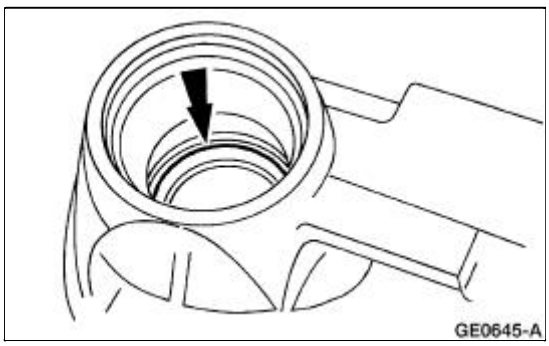
20. Remove the outer pinion bearing.

21. Using the special tools, remove the inner pinion bearing cup.

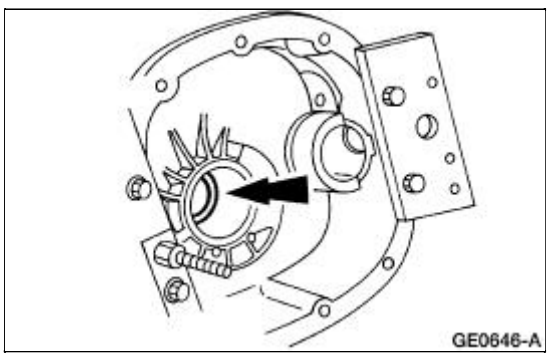


22. **NOTE:** The pinion bearing oil baffle aids in bearing lubrication. Normally, it is not necessary to remove the baffle.

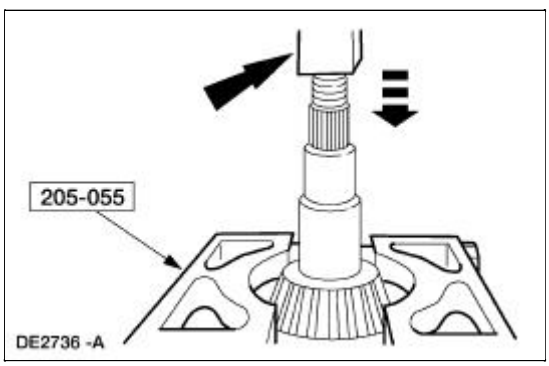
    If necessary, remove the pinion bearing oil baffle.



23. Remove the outer pinion bearing cup by tapping alternately on each side to prevent the cup from cocking.



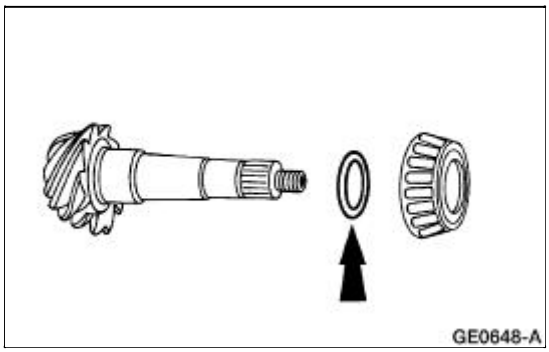
24. Using the special tool and a suitable press, remove the pinion bearing.



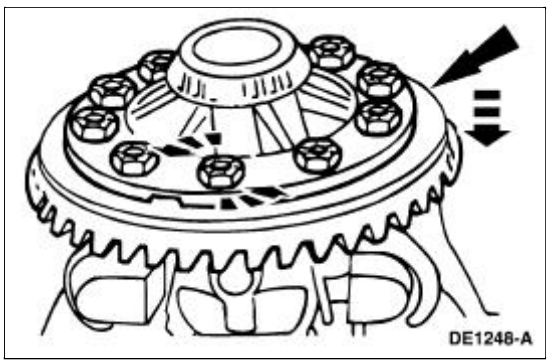
25. **NOTE:** A drive pinion bearing adjustment shim sits under the pinion bearing. Use a micrometer

to measure the shim thickness. Record the measurement for comparison to the shim gauge reading taken prior to installing the pinion bearing.

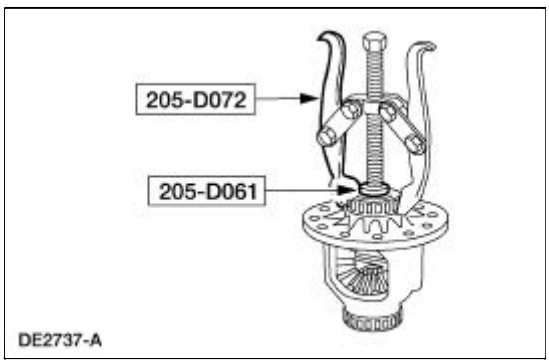
Remove and measure the drive pinion bearing adjustment shim.



26. Remove the ten bolts and the ring gear.
    - Use a drift punch to separate the ring gear from the differential case.



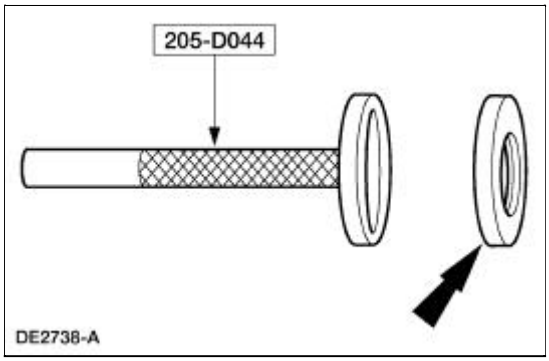
27. Using the special tools, remove the differential bearings.



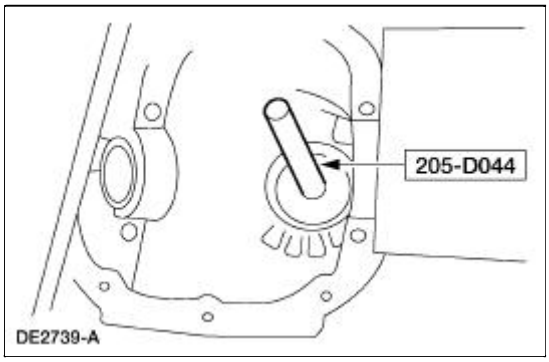
Assembly

1. **CAUTION: Do not omit the pinion bearing oil baffle; bearing failure can result.**

   If removed, position the baffle on the special tool.



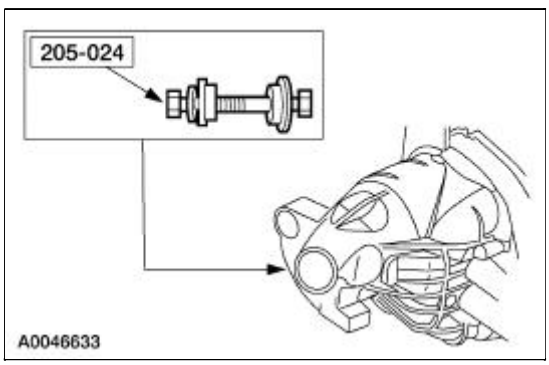
2. Using the special tool, install the baffle.



3. **NOTE:** Always install new pinion bearings when installing new pinion bearing cups.

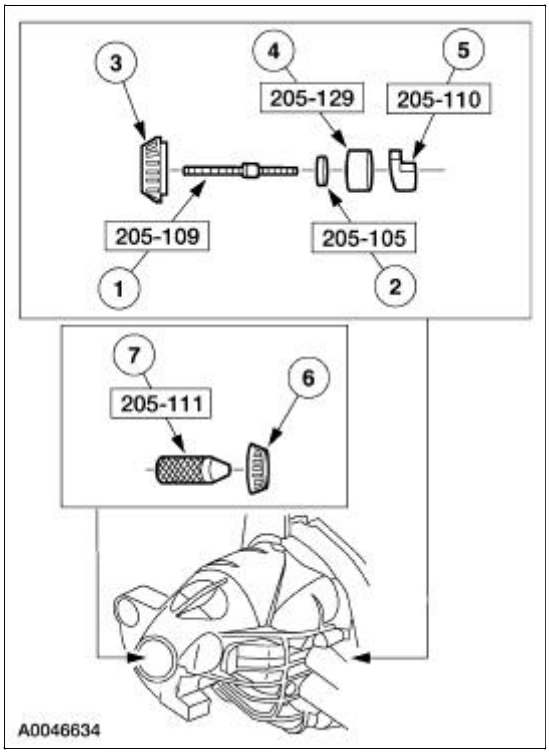
   Lightly oil the new pinion bearing cups and pinion bearings with front axle lubricant.

4. Using the special tool, install the bearing cups.



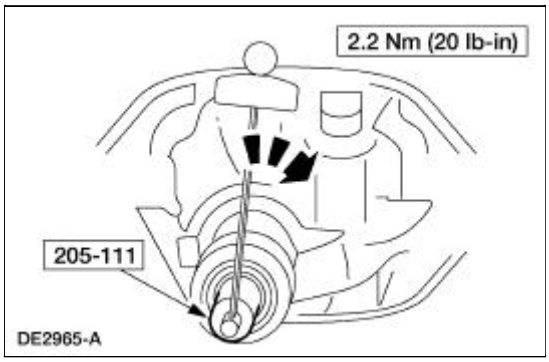
5. **NOTE:** You must use the pinion bearings assembled in this procedure step at final assembly.

   Assemble and position the special tools and the pinion bearings in the carrier housing.
   1. Position the screw Adapter.
   2. Position the aligning Adapter.
   3. Position the pinion bearing.
   4. Position the gauge disc Adapter.
   5. Position the gauge block Adapter.
   6. Position the pinion bearing.
   7. Thread on the handle Adapter.



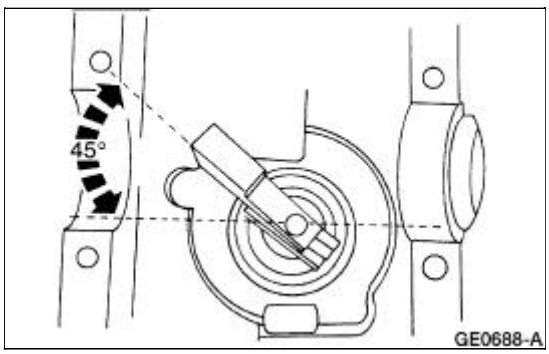
6. **NOTE:** This step duplicates final pinion bearing preload.

   Tighten the special tool to the specification to simulate bearing preload.



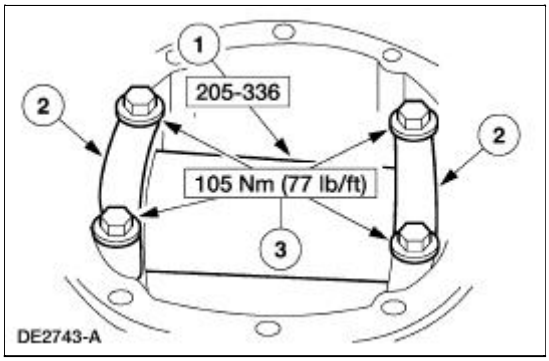
7. **NOTE:** Offset the gauge block Adapter to obtain an accurate reading.

   Rotate the gauge block Adapter several half-turns to make sure the pinion bearings seat correctly, and position the gauge block Adapter.



8. Install the special tool.
   1. Position the special tool.

2. Install the differential bearing caps.
3. Install the bolts.

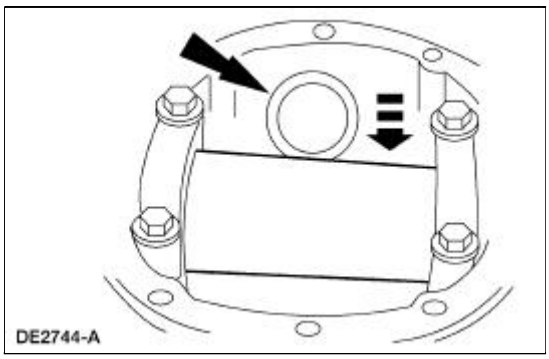


9. **NOTE:** Use only flat, clean drive pinion bearing adjustment shims.

   NOTE: Selection of too thick a shim results in a deep tooth contact at final assembly of integral axle assemblies. Do not attempt to force the shim between the gauge block Adapter and the gauge tube Adapter. A slight drag indicates correct shim selection.

   Use a drive pinion bearing adjustment shim as a gauge for shim selection.

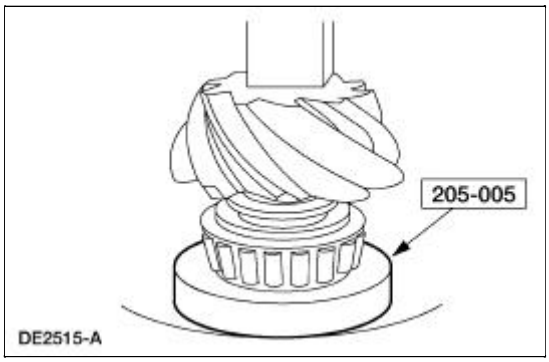
   - Check the adjustment shim thickness between the gauge block Adapter and the gauge tube Adapter.
   - After determining the correct shim thickness, remove the special tools.



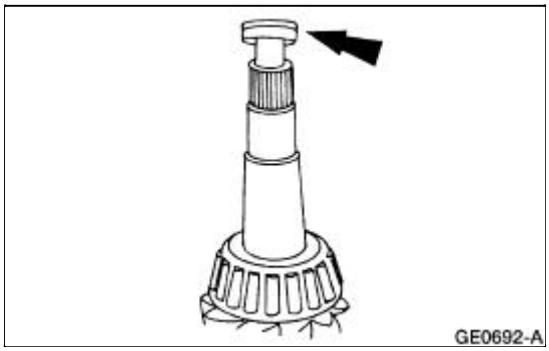
10. **NOTE:** You must use the same pinion bearings from the previous steps.

    Install the pinion bearing.

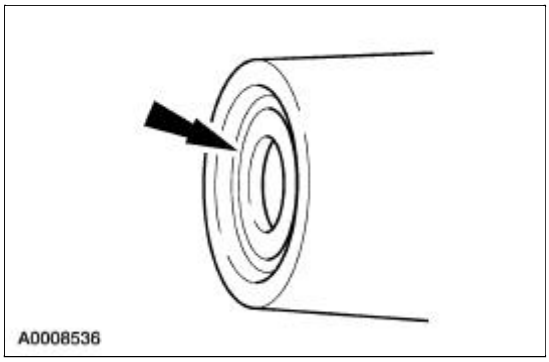
    - Place the drive pinion bearing adjustment shim on the pinion gear.
    - Using a suitable press and the special tool, press the pinion bearing until it is firmly seated on the pinion gear.



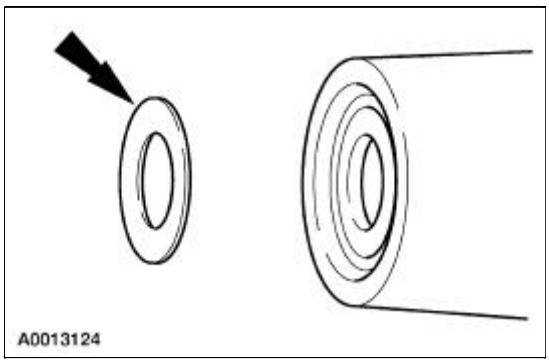
11. Place a new drive pinion collapsible spacer on the pinion stem.



12. Install the outer pinion bearing.

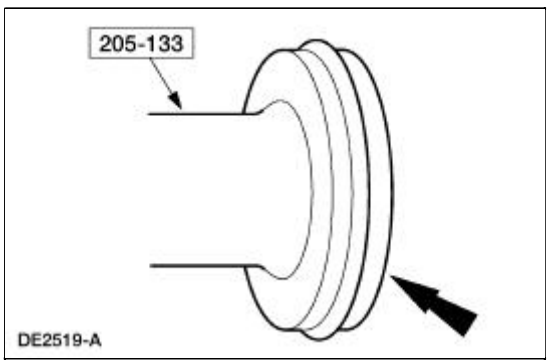


13. Install the slinger.

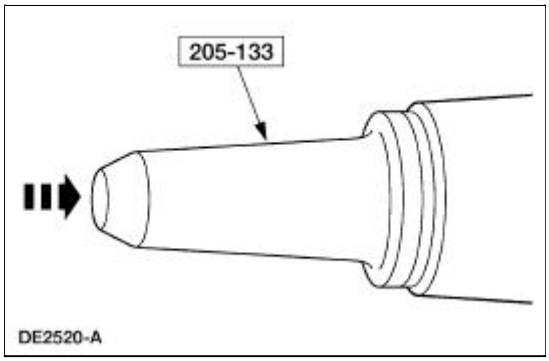


14. **NOTE:** Coat the lips of the pinion seal with front axle lubricant.

    Place the pinion seal on the special tool.

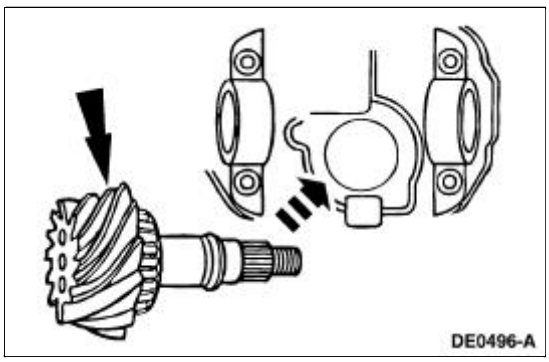


15. Place the special tool and seal in the pinion seal bore and drive the seal into place.



16. Lightly lubricate the pinion gear splines with front axle lubricant.

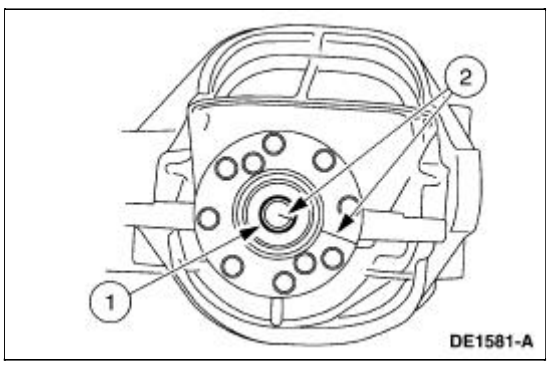
17. Position the drive pinion in the housing.



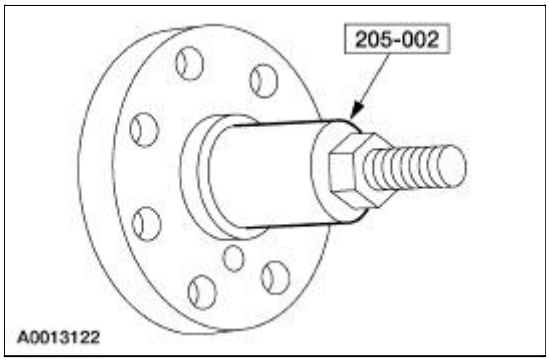
18. **CAUTION: Never install the drive pinion universal joint flange with a hammer or power tools.**

    NOTE: Disregard the scribe marks if installing a new flange.

    Align the index-marks and position the universal joint flange on the drive pinion.



19. Using the special tool, install the drive pinion universal joint flange.

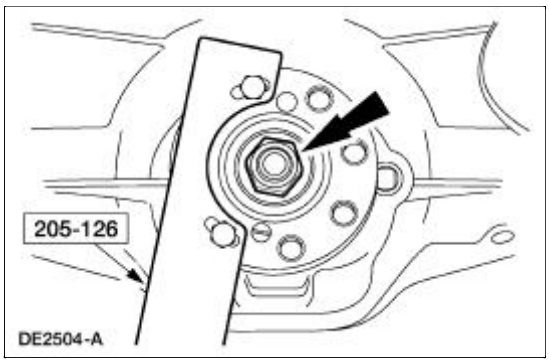


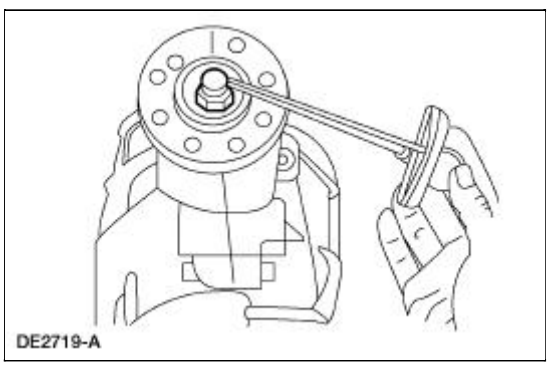
20. Apply a small amount of lubricant to the washer side of the new pinion nut, and install the nut.

21. **CAUTION: Do not loosen the pinion nut to reduce preload under any circumstance. If it is necessary to reduce preload, install a new drive pinion collapsible spacer and pinion nut.**

    Install the special tool, and tighten the pinion nut. Refer to the torque specifications in the Specifications portion of this section.

    - Rotate the pinion gear occasionally to make sure the pinion bearings are seating correctly. Take frequent pinion bearing torque preload readings by rotating the pinion gear with a Nm (inch-pound) torque wrench.

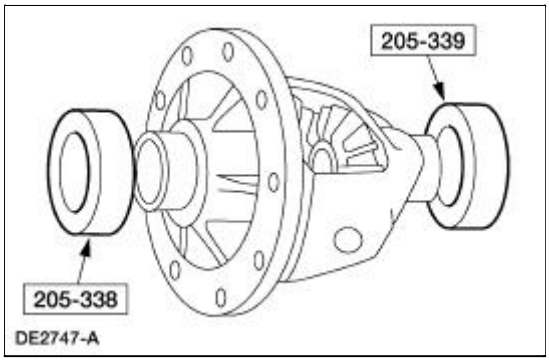




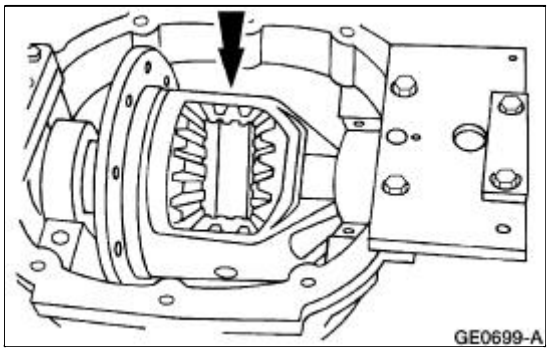
22. **CAUTION: Use extreme care not to damage the aluminum differential carrier housing while carrying out the following procedure steps.**

    CAUTION: The special tools are marked LH and RH. Install them accordingly.

    Install the special tools.

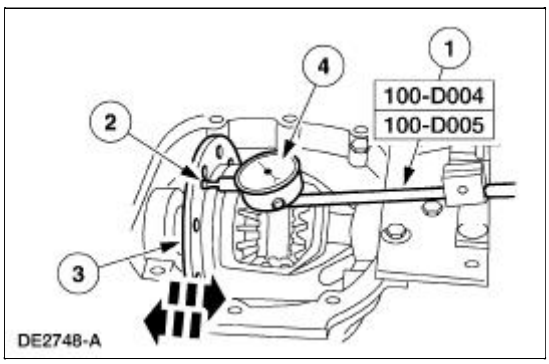


23. Install the differential case with the Differential Bearings Gauge in the differential carrier housing.

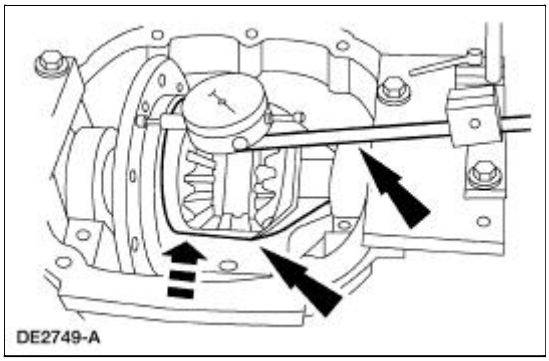


24. **NOTE:** Repeat this step until you obtain a consistent reading.

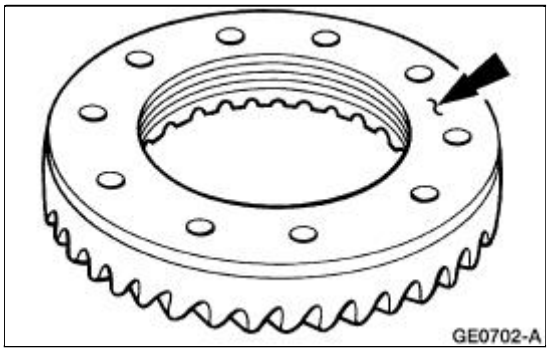
    Measure the total end play.
    1. Position the special tools.
    2. Position the indicator tip on the machined surface and adjust it to measure full travel.
    3. Push the differential case left and right (as far as possible).
    4. Measure the total end play and record the reading on the Differential Bearing Shim Selection Procedure Worksheet, Line A, in this procedure.



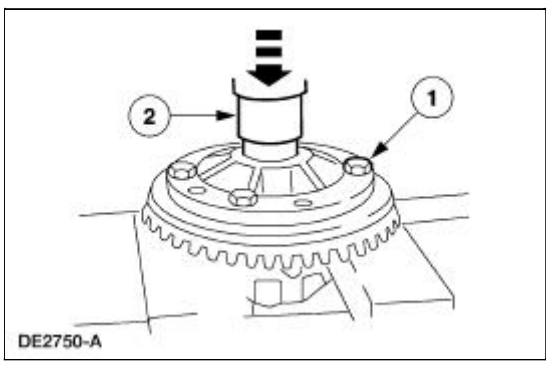
25. Remove the special tools and the differential case.



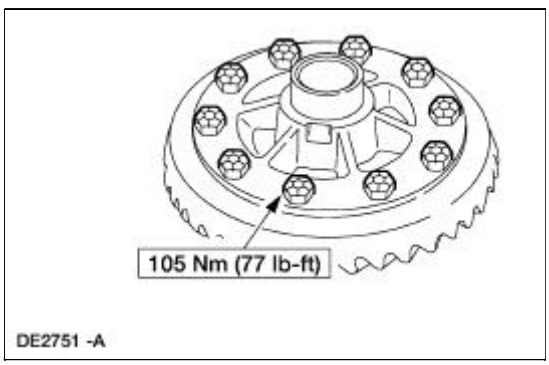
26. Use a fine flat file to remove any burrs or nicks from the ring gear mounting surface.



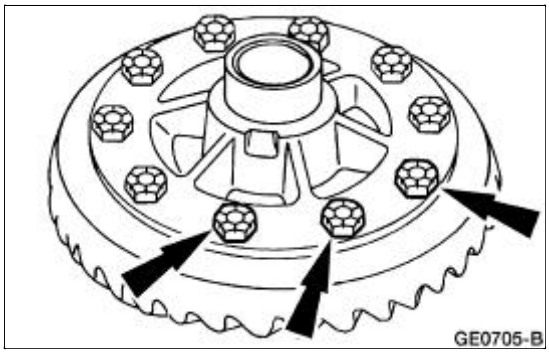
27. Install the ring gear.
    1. Position three bolts to align the holes in the ring gear and the differential case.
    2. Using a suitable press, install the ring gear.



28. Install the remaining bolts.

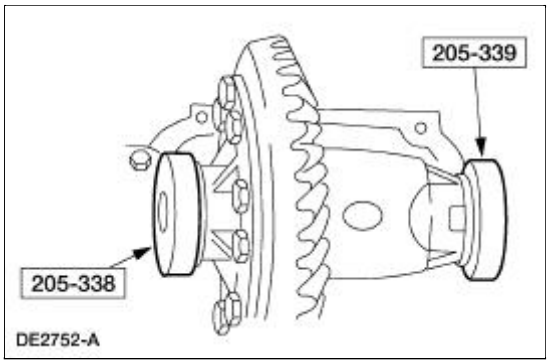


29. Remove three adjacent bolts.

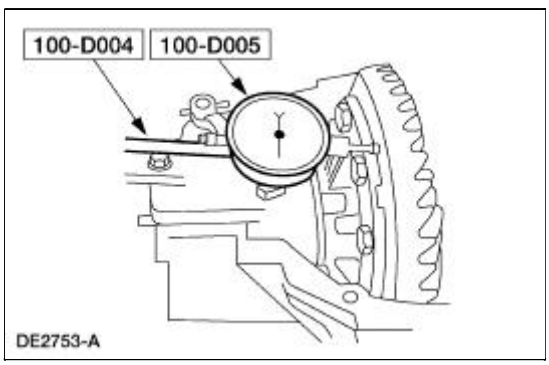


30. **CAUTION: Position the three empty bolt holes downward.**

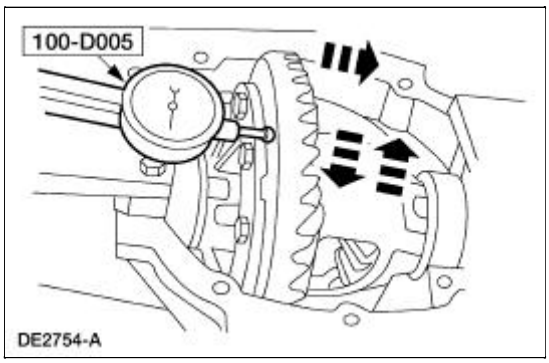
    Position the differential case with the special tools into the differential carrier housing.



31. Position the special tools.

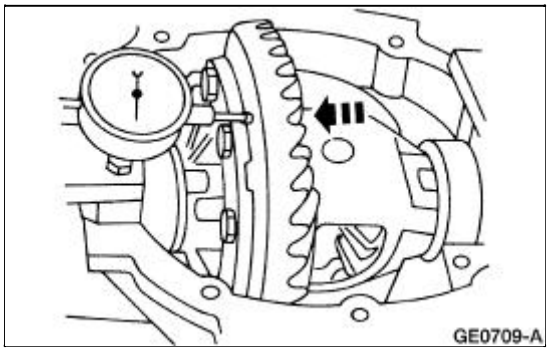


32. Push and rock the ring gear into mesh with the pinion gear (zero backlash) and adjust the special tool to zero.

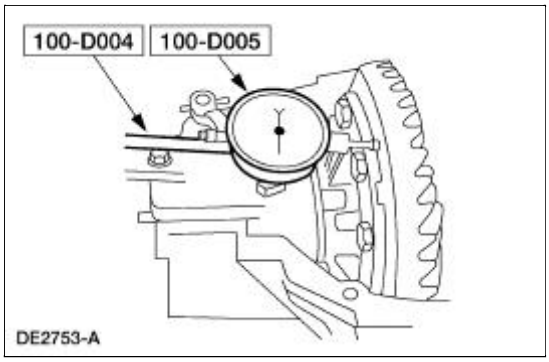


33. Move the ring gear away from the pinion gear as far as possible. Record the reading on the

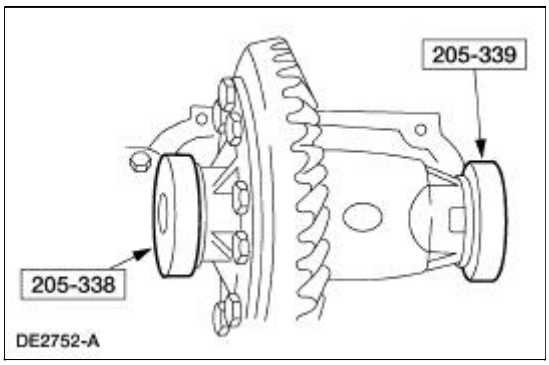
Differential Bearing Shim Selection Procedure Worksheet, Line B, in this procedure.



34. Remove the special tools.



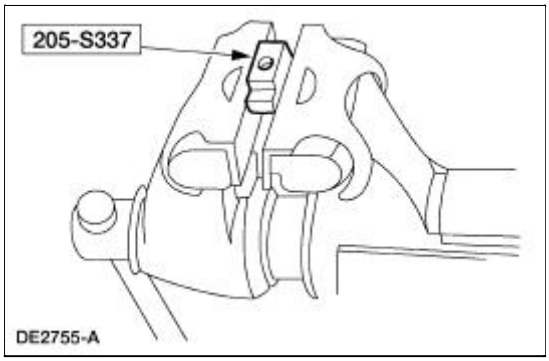
35. Remove the differential case and the special tools.



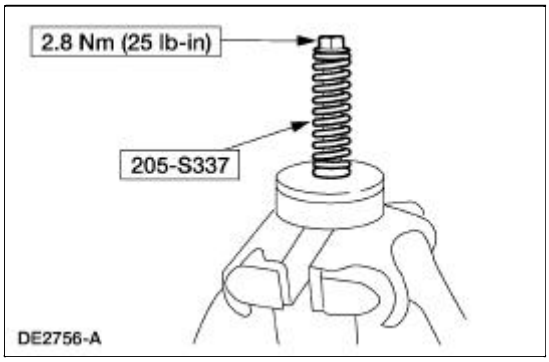
36. **NOTE:** Measure both of the differential bearing stand heights prior to installing them on the differential case.

    NOTE: Mark the left and right differential bearings before measuring them.

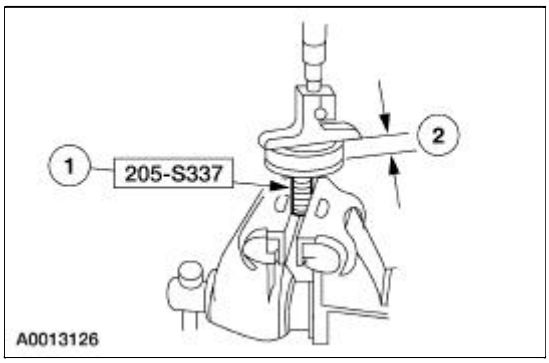
    Clamp the special tool base in a soft jawed vise with the bearing mounting surface above the surface of the vise.



37. Position the differential bearing assembly in the special tool, and tighten the tool.



38. Measure the differential bearing stand height.
    1. Invert the special tool and bearing assembly in the vise.
    2. Use a depth micrometer to measure and record the differential bearing stand height.
    - Repeat the procedure for the other bearing.



39. Select appropriate differential bearing shims.

Differential Bearing Shim Selection Chart

8.8-inch Aluminum Axle	Example	Actual
Line-A End play without ring gear	0.498	
Line-B End play with ring gear (ring gear side)	-0.245	minus (-)
Line-C Subtract Line-B from Line-A, also record on Line C, below	0.253	

8.8-inch Aluminum Axle	Left Differential Bearing Height		Right Differential Bearing Height	
	Example	Actual	Example	Actual

Master bearing height	0.8695	0.8695	0.8695	0.8695
Line-D Actual bearing height	-0.8478	minus (-)	-0.8491	minus (-)
Line-E Difference	0.0217		0.0204	

	Left Side			Right Side	
8.8-inch Aluminum Axle	**Example**	**Actual**	**8.8-inch Aluminum Axle**	**Example**	**Actual**
Line-B End play Line-E Bearing height	0.2450 +0.0217	+	Line-C End play Line-E Bearing height	0.2530 +0.0204	+
TOTAL Lines B and E Backlash (subtract)	0.2667 -0.0060	-0.006	TOTAL Lines C and E Backlash/preload (add)	0.2734 +0.020	+0.020
Initial thickness [a]	0.2607		Initial thickness	0.2934	
Final shim thickness — left	0.261		Final shim thickness — right	0.293	

[a] Round off initial thickness to the nearest shim thickness as in example for final shim thickness.

40. Select the appropriate shim by the thickness or the stripe color.

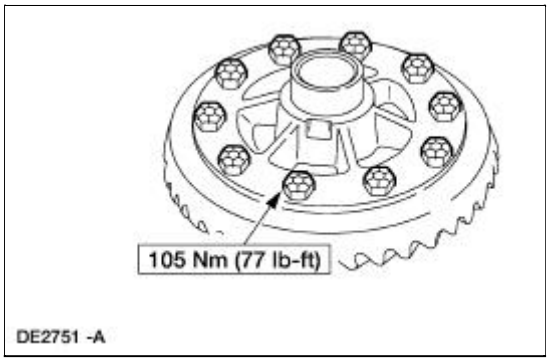
Backlash Change Required		**Thickness Change Required**	
mm	**In.**	**mm**	**In.**
0.025	0.001	0.050	0.002
0.050	0.002	0.050	0.002
0.076	0.003	0.101	0.004
0.101	0.004	0.152	0.006
0.127	0.005	0.152	0.006
0.152	0.006	0.203	0.008
0.177	0.007	0.254	0.010
0.203	0.008	0.254	0.010
0.228	0.009	0.304	0.012
0.254	0.010	0.355	0.014
0.279	0.011	0.355	0.014
0.304	0.012	0.406	0.016
0.330	0.013	0.457	0.018
0.335	0.014	0.457	0.018
0.381	0.015	0.508	0.020

Differential Shim Size Chart

Stripes/Color	**mm**	**In.**
2— C-COAL 1— C-COAL	7.7978-7.8105	0.3070-0.3075
5— BLU 4— BLU	7.7470-7.7597	0.3050-0.3055
3— BLU 2— BLU	7.6962-7.7089	0.3030-0.3035
5— PINK 4— PINK	7.6454-7.6581	0.3010-0.3015
3— PINK 2— PINK	7.5946-7.6073	0.2990-0.2995
1— PINK 5— GRN	7.5458-7.5565	0.2970-0.2975
4— GRN	7.4422-7.4549	0.2930-0.2935

3— GRN		
2— GRN	7.3914-7.4041	0.2910-0.2915
1— GRN		
5— WH	7.3406-7.3533	0.2890-0.2895
4— WH		
3— WH	7.2898-7.3025	0.2870-0.2875
2— WH		
1— WH	7.2390-7.2517	0.2850-0.2855
5— YEL		
4— YEL	7.1882-7.2009	0.2830-0.2835
3— YEL		
2— YEL	7.1374-7.1501	0.2810-0.2815
1— YEL		
5— ORNG	7.0866-7.0993	0.2790-0.2795
4— ORNG		
3— ORNG	7.0358-7.0485	0.2770-0.2775
2— ORNG		
1— ORNG	6.9850-6.9977	0.2750-0.2755
2— RED		
1— RED	6.9342-6.9469	0.2730-0.2735
	6.8834-6.8961	0.2710-0.2715
	6.8326-6.8453	0.2690-0.2695
	6.7818-6.7945	0.2670-0.2675
	6.7310-6.7437	0.2650-0.2655
	6.6802-6.6929	0.2630-0.2635
	6.6294-6.6421	0.2610-0.2615
	6.5786-6.5913	0.2590-0.2595
	6.5278-6.5405	0.2570-0.2575
	6.4770-6.4897	0.2550-0.2555
	6.4262-6.4389	0.2530-0.2535
	6.3754-6.3881	0.2510-0.2515
	6.3246-6.3373	0.2490-0.2495
	6.2738-6.2865	0.2470-0.2475
	6.2223-6.2357	0.2450-0.2455
	6.1722-6.1849	0.2430-0.2335
	6.1214-6.1341	0.2410-0.2415

41. Install the three bolts.

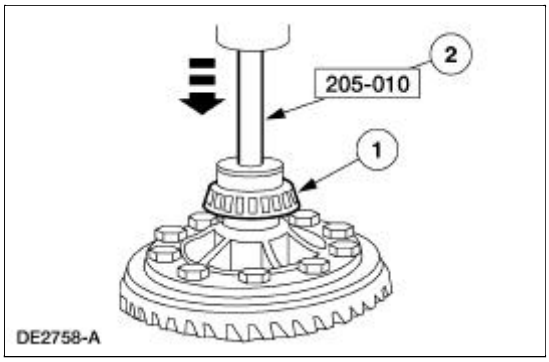


42. **CAUTION: Press against the bearing inner core only.**

Using a suitable press and the special tool, install the differential bearings.

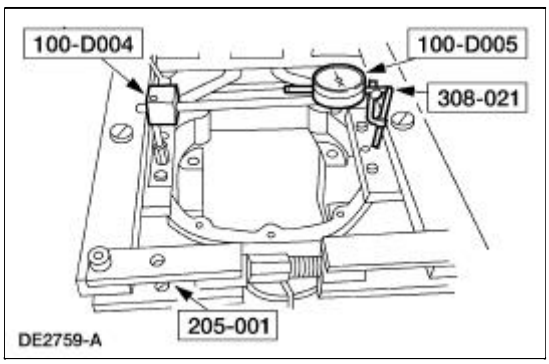
1. Position the appropriate differential bearing (RH or LH).
2. Using a suitable press and the special tool, install the differential bearing.

- Repeat the procedure for the other differential bearing.



43. **NOTE:** Make sure the indicator needle is in the spreader adapter hole.

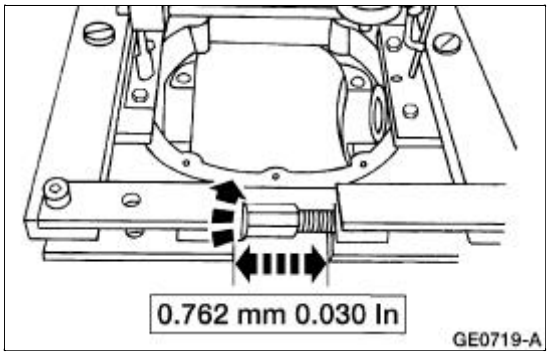
Install the special tools.



44. **CAUTION: Overspreading can damage the axle housing.**

Spread the axle housing to the specification.

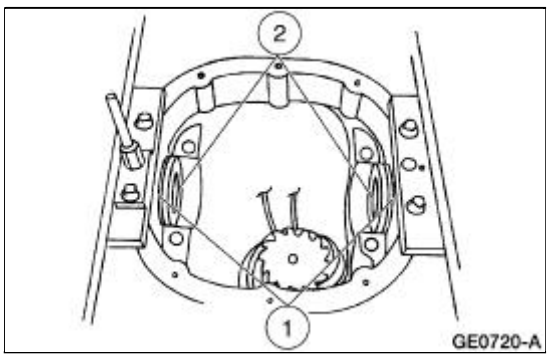
- Remove the Dial Indicator.



45. **CAUTION: Never attempt to drive the differential bearing shim in place. Permanent damage to the machined axle housing surfaces can occur.**

If removed, position the differential bearing shims.

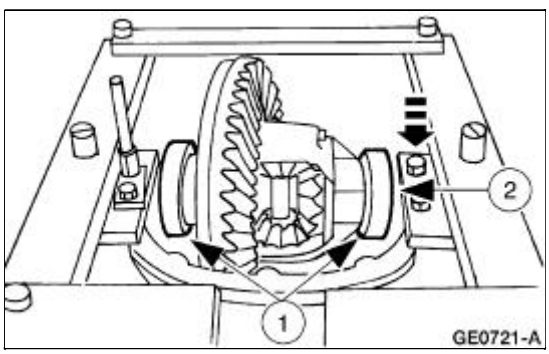
1. Apply a light coating of long life grease to one side of the differential bearing shims to help hold them in place.
2. Position the differential bearing shims.



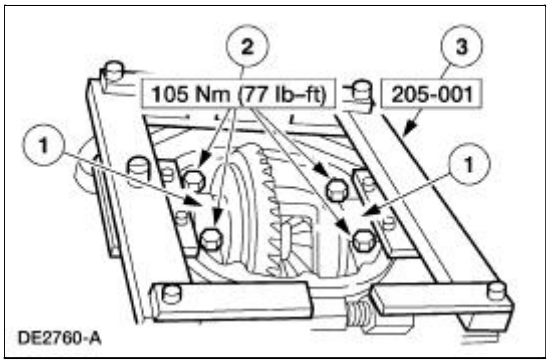
46. **NOTE:** Push the differential case downward to fully seat the differential bearing cups in the axle housing.

Position the differential case assembly.

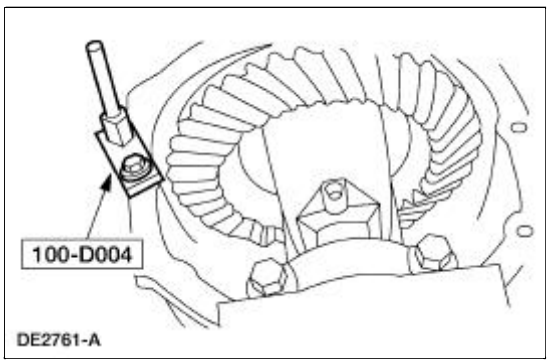
1. Position the differential bearing cups on the differential bearings.
2. Lower the differential case assembly in place between the differential bearing shims.



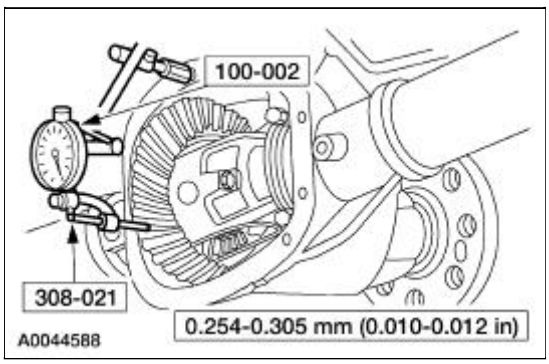
47. Install the bearing caps in their original positions and tighten with the housing still spread.
    1. Position the bearing caps.
    2. Install the bolts.
    3. Remove the special tool.



48. Install the special tool.

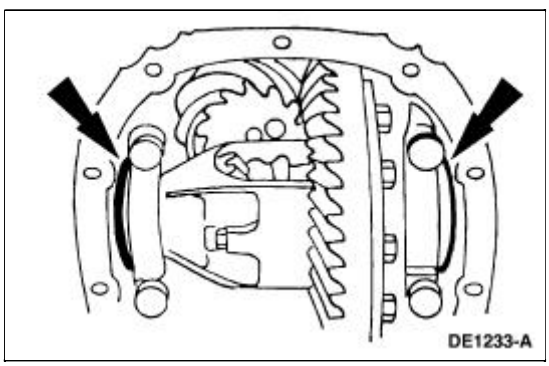


49. Measure the ring gear backlash at four places to obtain a consistent reading.

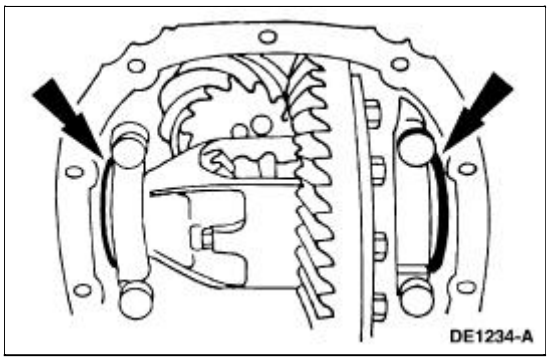


50. **NOTE:** If the backlash is not within the specifications, correct it by increasing the thickness of one differential bearing shim and decreasing the thickness on the other differential bearing shim by the same amount.

    To increase the backlash, install a thicker differential bearing shim and a thinner differential bearing shim as shown.



51. To decrease the backlash, install a thicker differential bearing shim and a thinner differential bearing shim as shown.



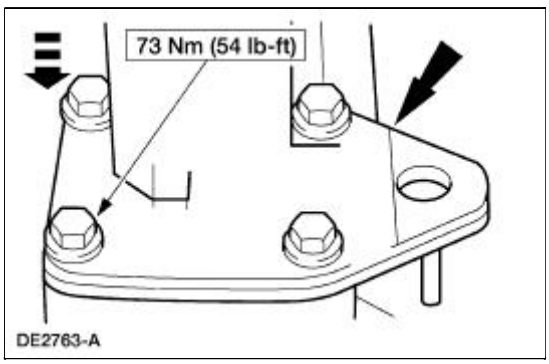
52. **CAUTION: Remove all of the old liquid gasket, and make sure the machined surfaces are free of oil before applying the new silicone rubber.**

CAUTION: Install the axle housing tube within 15 minutes of applying the silicone or it will be necessary to remove and reapply new sealant. If possible, allow one hour before filling with lubricant to make sure the silicone sealant has cured.

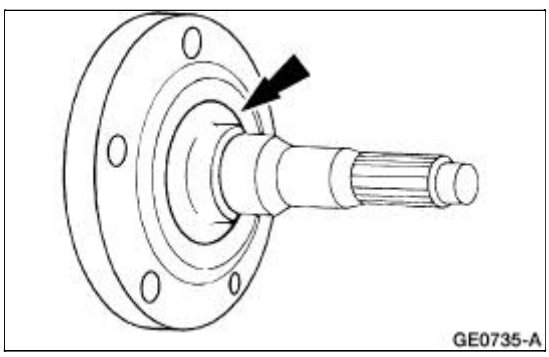
CAUTION: Do not allow any silicone rubber to squeeze inside during assembly.

Assemble the axle housing tube.

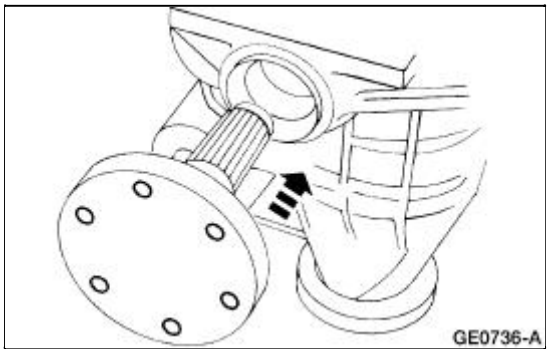
- Align the bolt holes and position the axle tube.
- Position the axle identification tag.
- Install the bolts.



53. Examine the axle shaft seal and bearing surface for damage. If necessary, polish the bearing surface with fine crocus cloth.

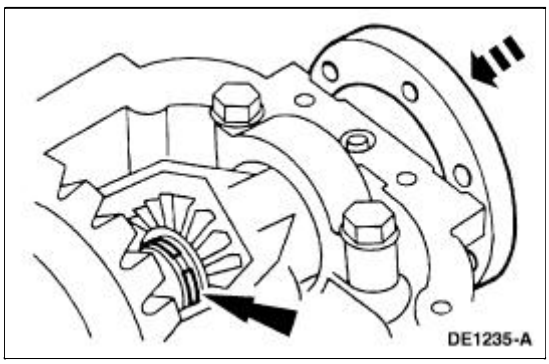


54. Insert the axle shafts and engage them with the side gears.



55. **NOTE:** Do not reuse the old snap rings.

    Push in on the axle shafts and install new snap rings.

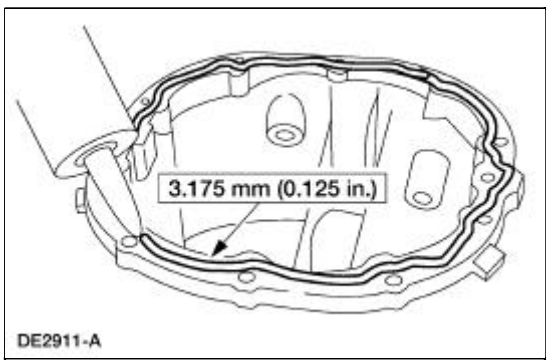


56. Remove the axle assembly from the Holding Fixture and place it on the bench.

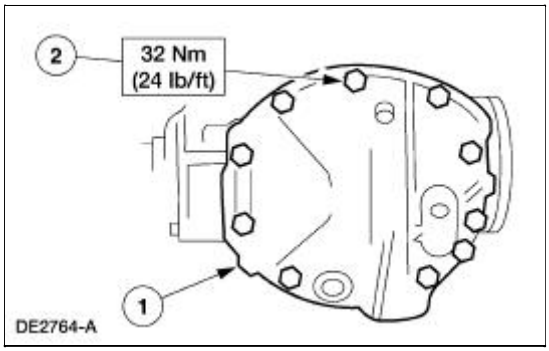
57. **CAUTION: Remove all of the old liquid gasket, and make sure the machined surfaces are free of oil before applying the new silicone rubber.**

    CAUTION: Install the differential housing cover within 15 minutes of applying the silicone, or it will be necessary to remove and reapply new sealant. If possible, allow one hour before filling with lubricant to make sure the silicone sealant has cured.

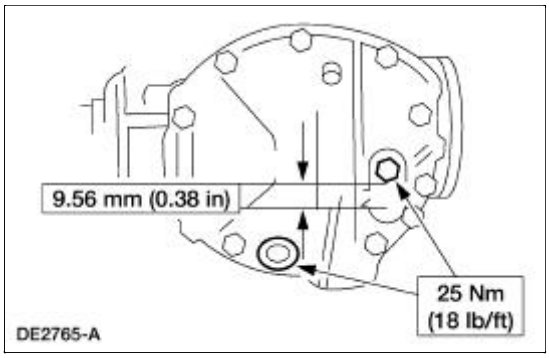
    Fill the sealing groove on the differential housing cover with silicone gasket and sealant.



58. Install the differential housing cover.
    1. Position the differential housing cover.
    2. Install the bolts.



59. Fill the differential carrier housing, and install the fill plug.
    - Use front axle lubricant.
    - Be sure to tighten both the drain and fill plugs.



60. Install the front drive axle assembly. For additional information, refer to Axle Assembly—Front Drive in this section.

Differential Case

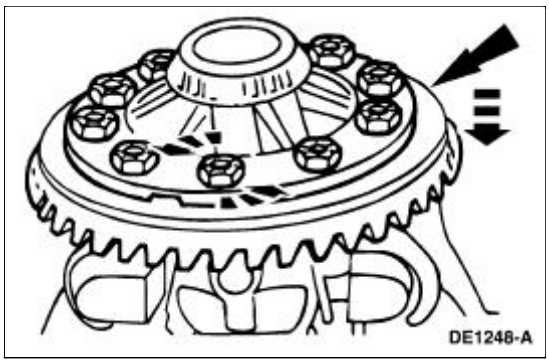
Material

Item	Specification
SAE 75W-90 Premium 4x4 Front Axle Lubricant XY-75W90-TQL	WSP-M2C201-A
Threadlock and Sealer E0AZ-19554-AA	WSK-M2G351-A5 (type II)

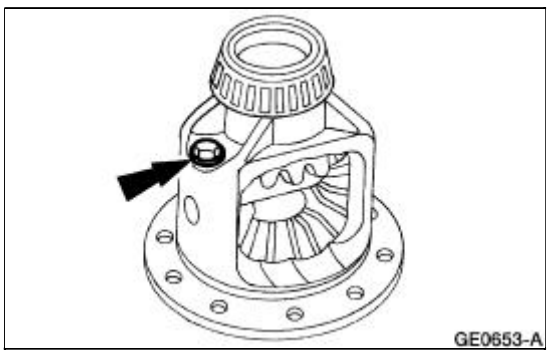
Disassembly

1. Remove the differential assembly from the differential carrier housing. For additional information, refer to Axle—Front Drive in this section.

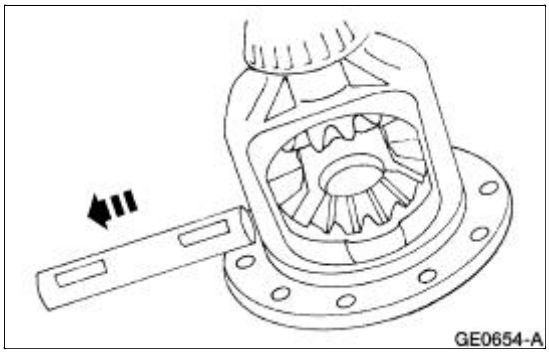
2. Remove the ring gear.
   - Remove the ten bolts.
   - Use a drift punch to separate the ring gear from the differential case.



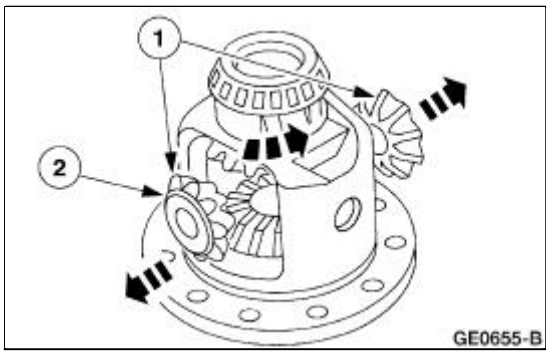
3. Remove the differential pinion shaft bolt.



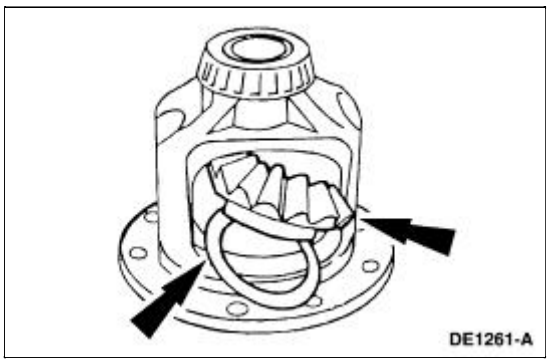
4. Remove the differential pinion shaft.



5. Remove the differential pinion thrust washers and the differential pinion gears.
    1. Rotate the differential pinion gears to the differential case window, and remove them.
    2. Separate the thrust washers from the gears.



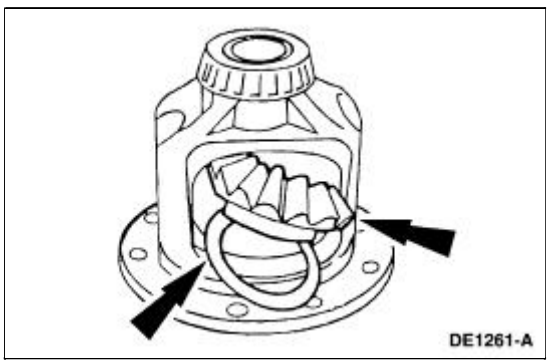
6. Remove the differential side gears and the differential side gear thrust washers.



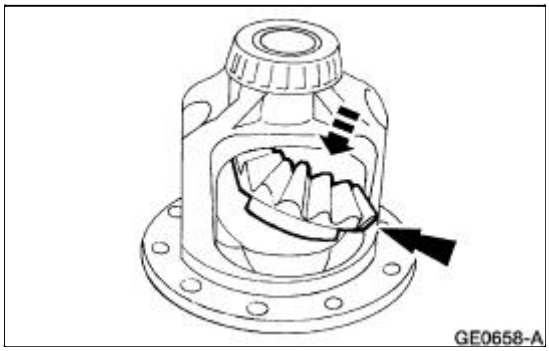
Assembly

1. Lubricate the differential side gear thrust washers and the differential side gear journals.

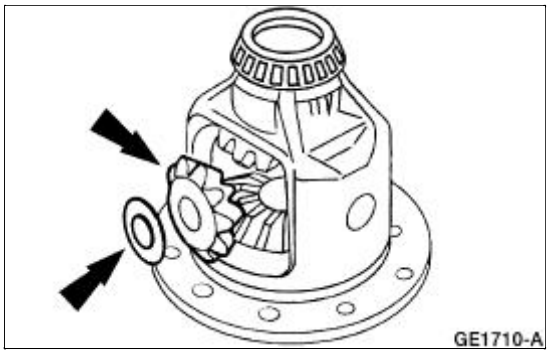
2. Position the differential side gear thrust washers on the differential side gears.



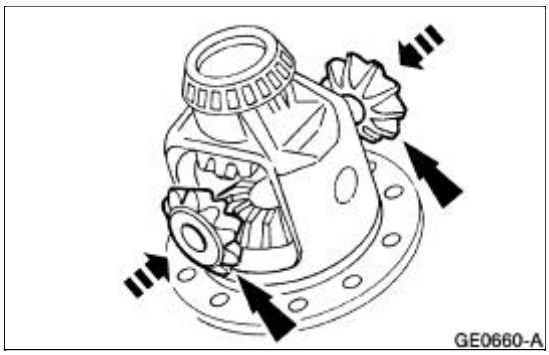
3. Position the differential side gears.



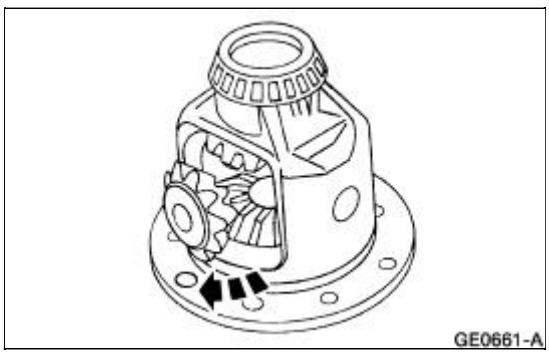
4. Lubricate the differential pinion thrust washers and the differential pinion gears and assemble them.



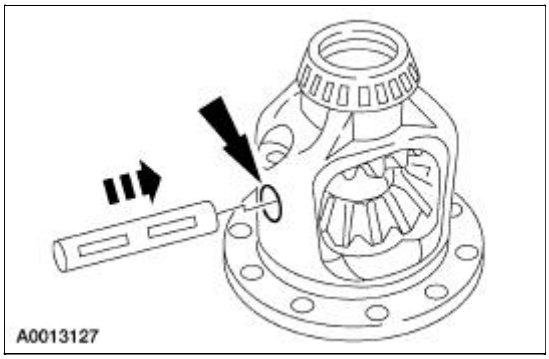
5. Engage the differential pinion gears opposite the differential side gears.



6. Rotate the differential pinion gears to align with the differential pinion shaft bore.

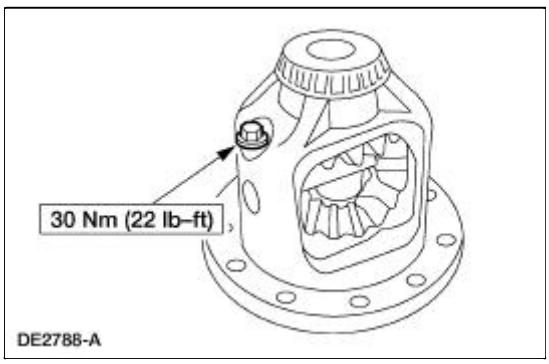


7. Insert the differential pinion shaft.



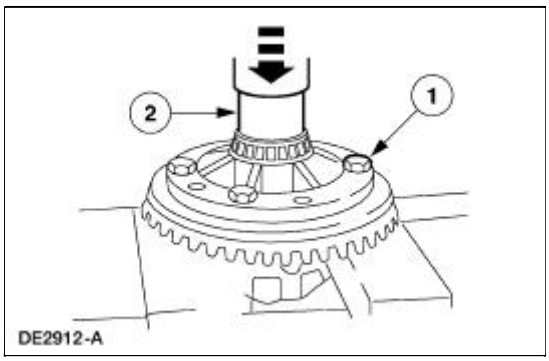
8. **NOTE:** If a new pinion shaft bolt is unavailable, coat the threads with sealer.

   Install a new differential pinion shaft bolt.

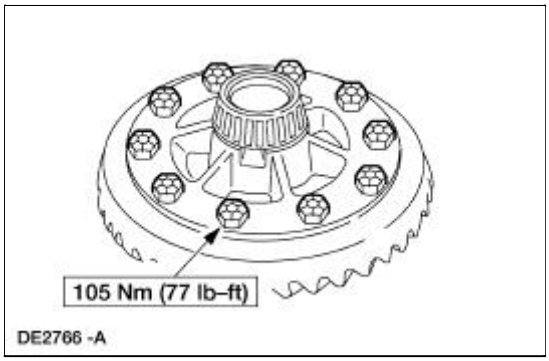


9. **CAUTION: Do not press on the bearing.**

   Install the ring gear.
   1. Position three bolts to align the holes in the ring gear and the differential case.
   2. Using a suitable press, install the ring gear.



10. Install the remaining bolts.



11. Install the differential carrier into the differential carrier housing. For additional information, refer to Axle—Front Drive in this section.

General Specifications

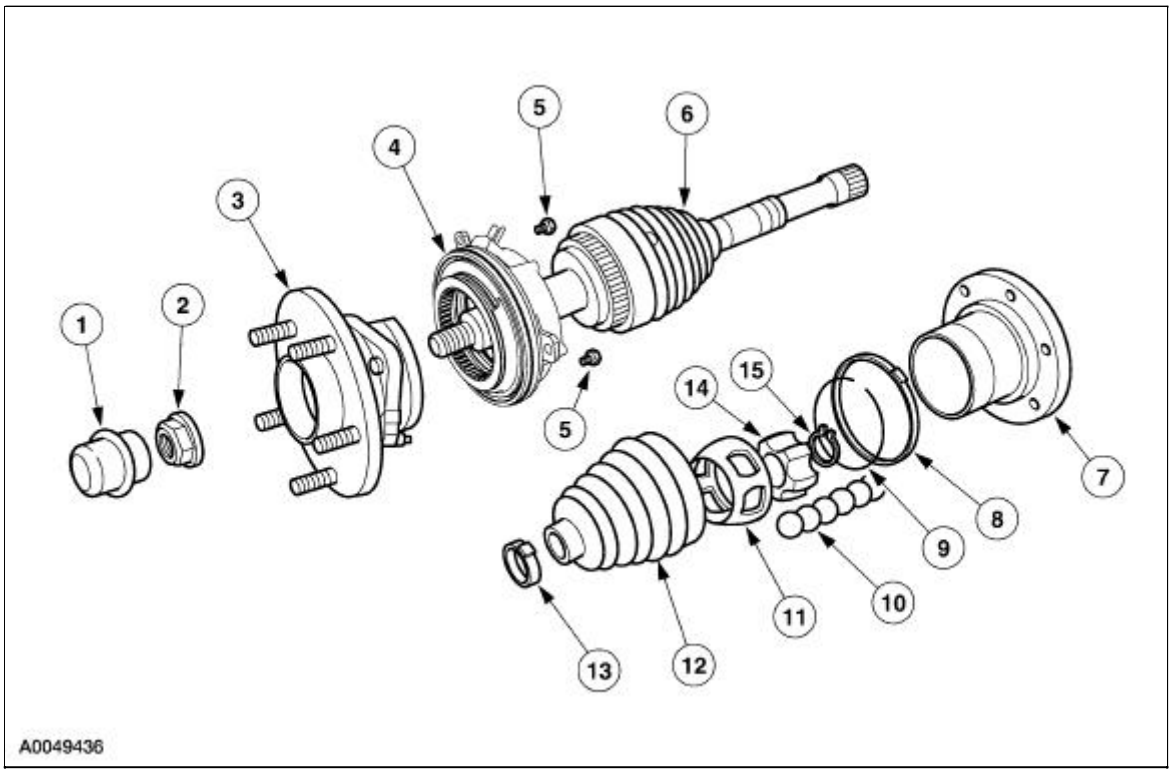
Item	Specification
Halfshaft assembled length mm (inch)	429.96 (16.93)

Torque Specifications

Description	Nm	lb-ft
Bolt retaining halfshaft to axle	82	60
Nut retaining knuckle-to-upper control arm	150	111
Nut retaining tie rod end to knuckle	150	111
Bolt retaining front disc brake caliper to anchor plate	32	24
Nut retaining halfshaft to hub	27	20
Nut retaining IWE disconnect to steering knuckle	15	11

Front Drive Halfshafts

Front Wheel Halfshaft and Joint, Disassembled View



Item	Description
1	Dust cap
2	Nut
3	Hub and bearing assembly
4	Integrated wheel end disconnect
5	Integrated wheel end disconnect retaining bolt (3)
6	Outboard constant velocity joint and interconnecting shaft assembly
7	Inboard constant velocity joint housing
8	Boot clamp
9	Retaining ring
10	Ball (6)
11	Ball cage
12	Inboard boot
13	Boot clamp
14	Inner race
15	Snap ring

New halfshaft components are available as follows:

- A repair kit includes the boots, clamps, snap ring, retaining ring, and grease.
- A new inboard CV joint (plunge type).
- A new outboard CV joint and interconnecting shaft assembly includes the outboard front wheel halfshaft joint (fixed type), boot, and clamps.
- A new integrated wheel end disconnect assembly.

Front Drive Halfshafts

Refer to Section 205-00 .

Halfshaft

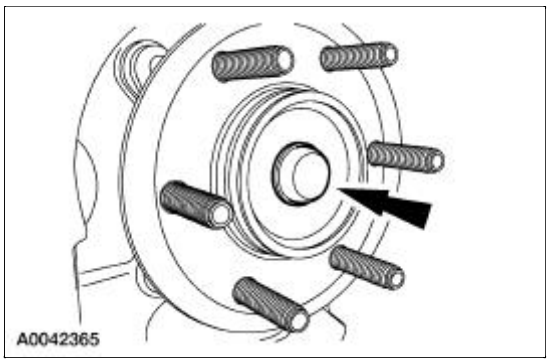
Removal and Installation

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the left rear quarter trim panel. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

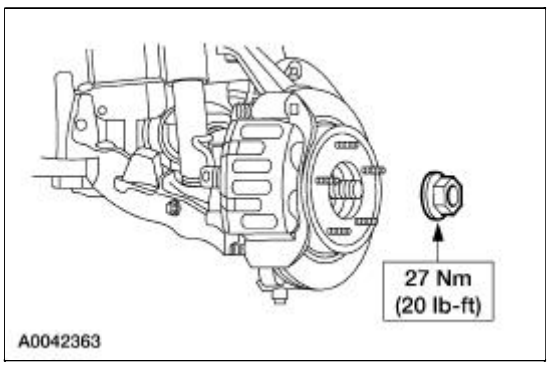
   Position the vehicle on a hoist. For additional information, refer to Section 100-02 .

2. Remove the front wheel and tire assembly. For additional information, refer to Section 204-04 .

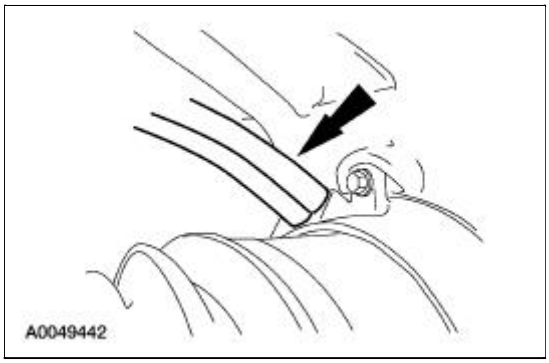
3. Remove the dust cap.



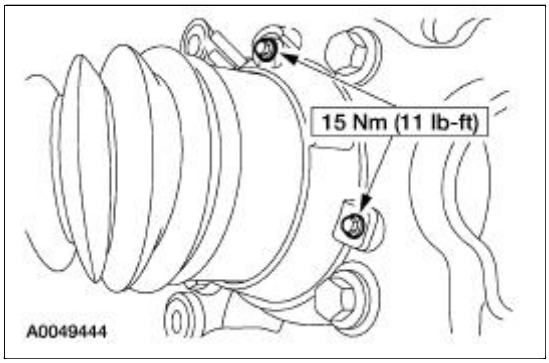
4. Remove the axle nut.
   - Discard the axle nut.



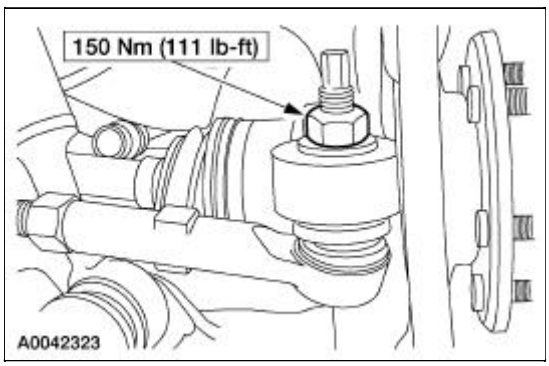
5. Remove the vacuum/vent line at the vacuum/vent port of the integrated wheel end disconnect.



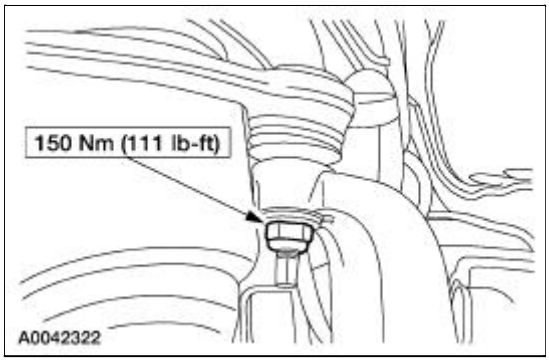
6. Remove the three bolts retaining the integrated wheel end disconnect to the steering knuckle.



7. Remove the tie rod end nut.
    - Disconnect the tie rod end from the steering knuckle.
    - Discard the tie rod end nut.



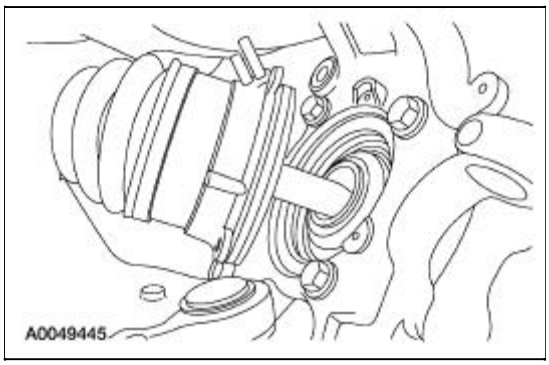
8. Remove the upper ball joint nut.
    - Disconnect the upper ball joint from the steering knuckle.
    - Discard the upper ball joint nut.



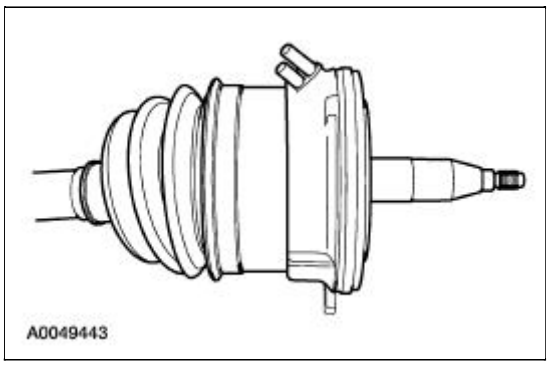
9. **CAUTION: Do not damage the hub seal.**

   NOTE: Allow the steering knuckle to swing outboard while keeping the constant velocity shaft pushed inboard.

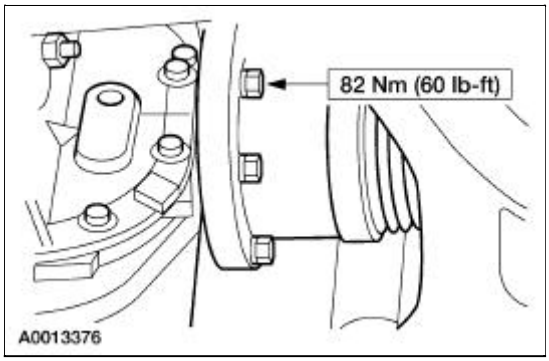
   Once clearance is available, remove the constant velocity shaft joint outboard end and integrated wheel end disconnect from the steering knuckle hub bearing.



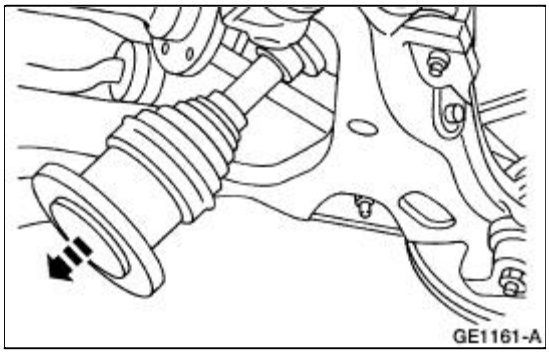
10. Remove the integrated wheel end disconnect from the outboard constant velocity joint housing.



11. Remove the six bolts retaining the halfshaft to the axle.



12. Separate the halfshaft from the axle and the hub, and remove the assembly from the vehicle.



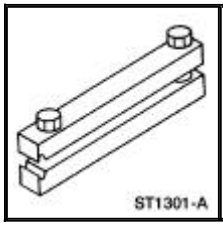
13. **CAUTION: Verify the spline engagement by checking for spline lash before installing the halfshaft nut.**

To install, reverse the removal procedure.

- Install a new axle nut, tie rod end nut and an upper ball joint nut.

Halfshaft

Special Tool(s)

 ST1301-A	Installer, Constant Velocity Joint Boot Clamp 205-343 (T95P-3514-A)

Material

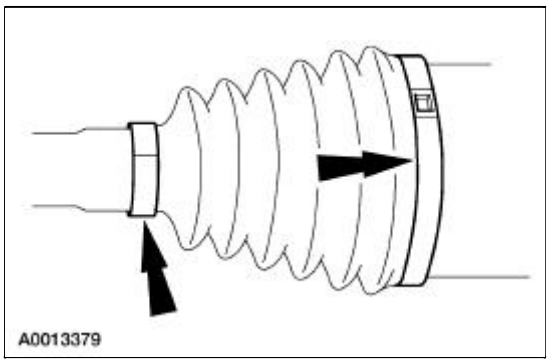
Item	Specification
Motorcraft Constant Velocity Joint Grease XG-5	WSS-M1C258-A1

Disassembly

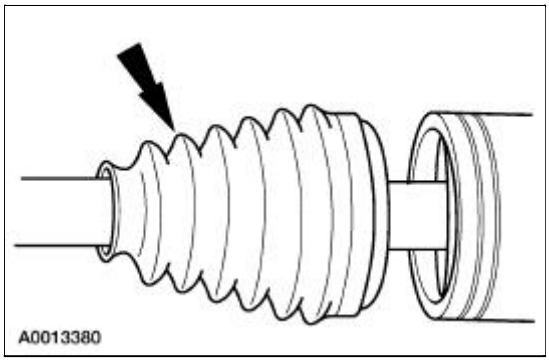
1. Remove the halfshaft from the vehicle. For additional information, refer to Halfshaft in the Removal and Installation portion of this section.

2. **CAUTION: Do not damage the boot.**

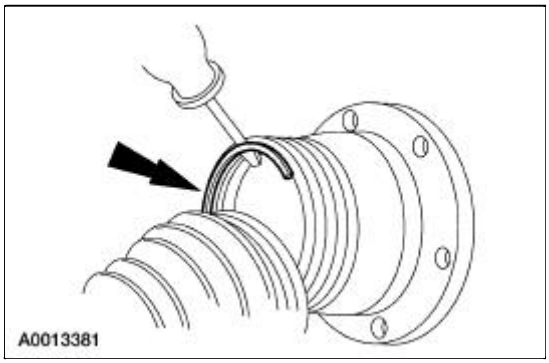
   Remove the boot clamps.



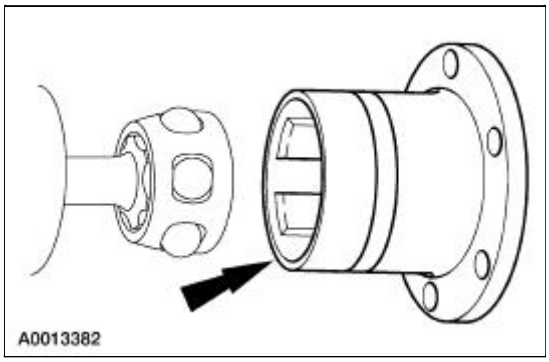
3. Separate the boot from the inboard CV joint housing.



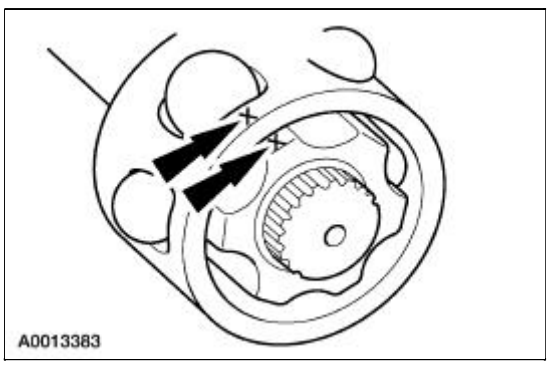
4. Remove the retaining ring.



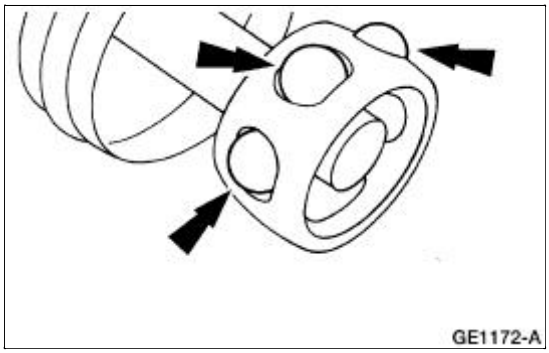
5. Remove the inboard CV joint housing.



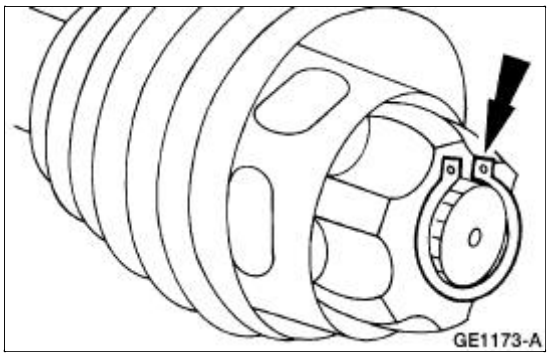
6. Index-mark the inner race and ball cage.



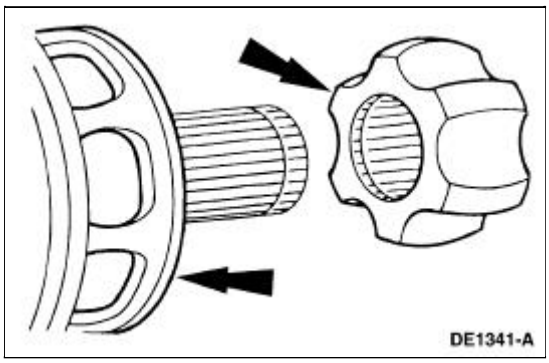
7. Remove the six balls.



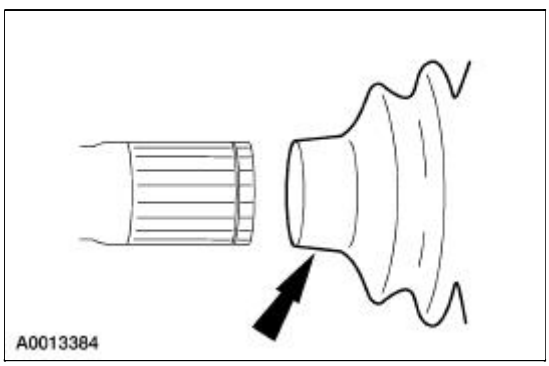
8. Remove the snap ring.



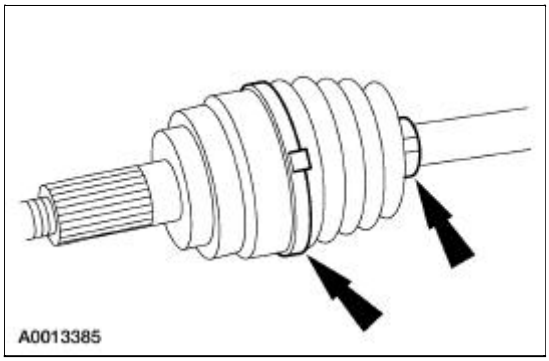
9. Remove the inner race and the ball cage.



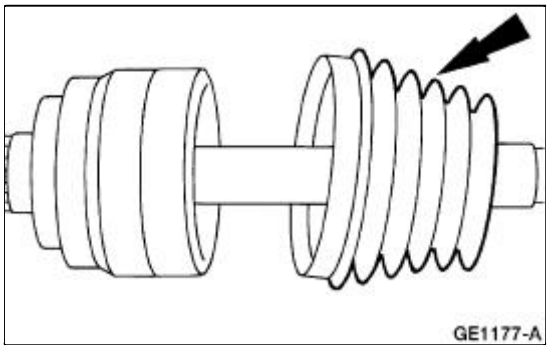
10. Remove the inboard boot.



11. Remove the boot clamps.



12. Remove the outboard boot.

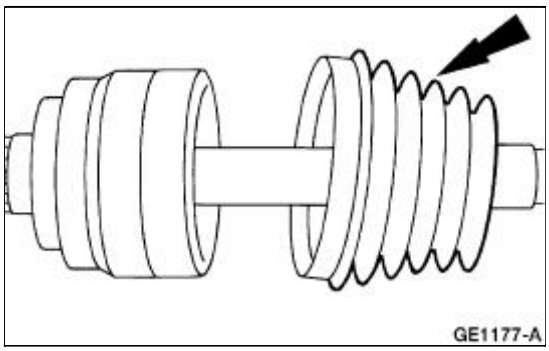


13. **NOTE:** If the grease is contaminated, clean and inspect the joint for wear. Install a new outboard CV joint and interconnecting shaft assembly if worn/damaged.

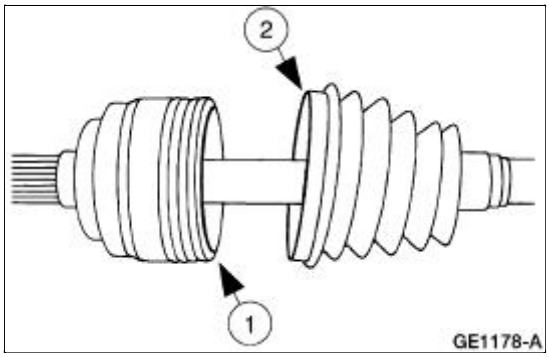
    Check the grease for contamination.

Assembly

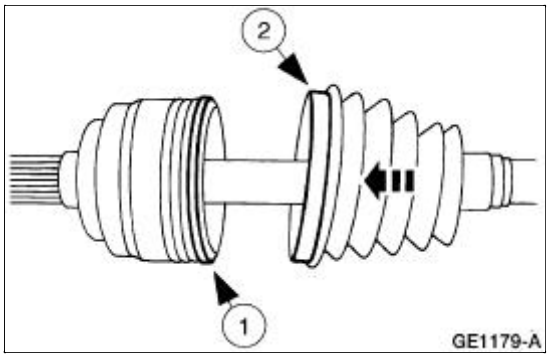
1. Position the outboard boot on the shaft.



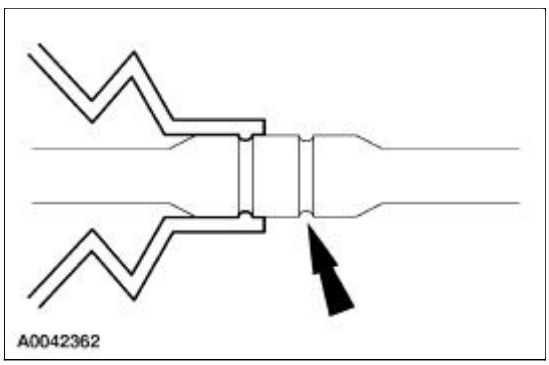
2. Pack the outboard CV joint with 165 grams (5.82 ounces) of grease.
    1. Use constant velocity joint grease or equivalent provided in the boot kit.
    2. Spread any remaining grease from the kit evenly inside the boot.



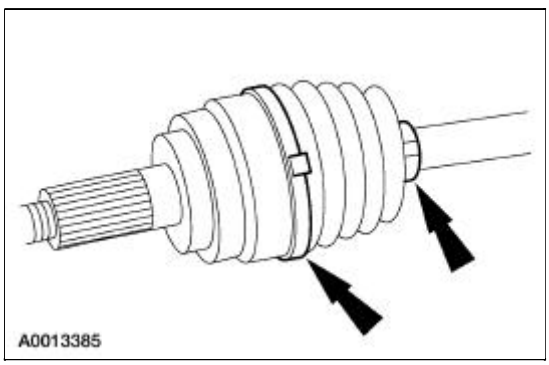
3. Install the outboard boot.
    1. Clean the boot mounting surface.
    2. Seat the boot in the joint boot groove.



4. Make sure a shaft groove is exposed by positioning the small end of the boot in the groove closest to the constant velocity joint housing.

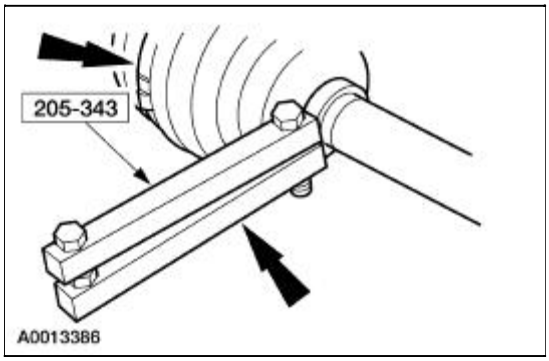


5. Position the boot clamps.

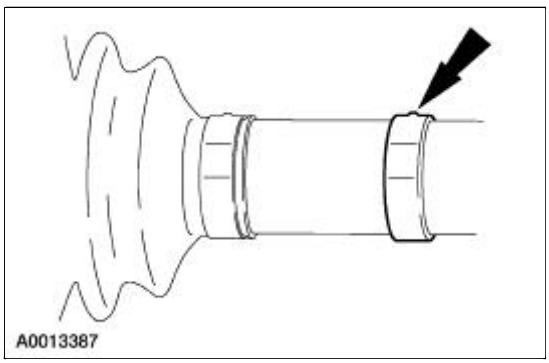


6. **NOTE:** Tighten the through-bolt until the tool is in the closed position.

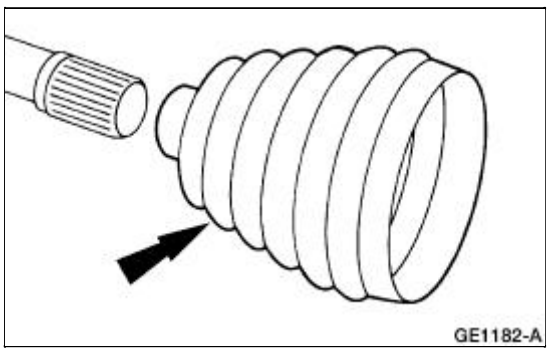
Using the special tool, install the two boot clamps.



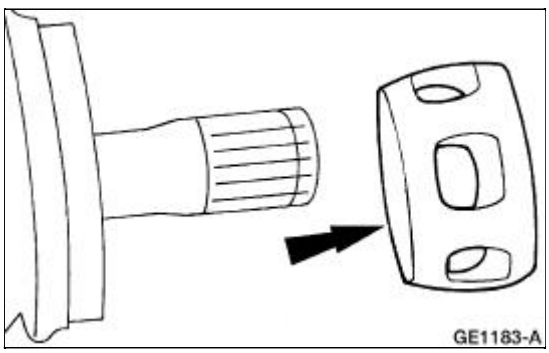
7. Position the boot clamp on the shaft.



8. Position the inboard boot on the shaft.

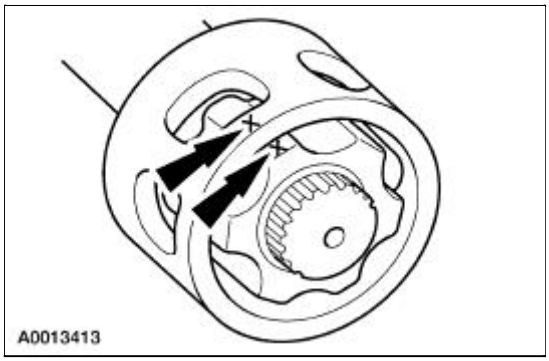


9. Position the ball cage on the shaft with the tapered end facing the boot.

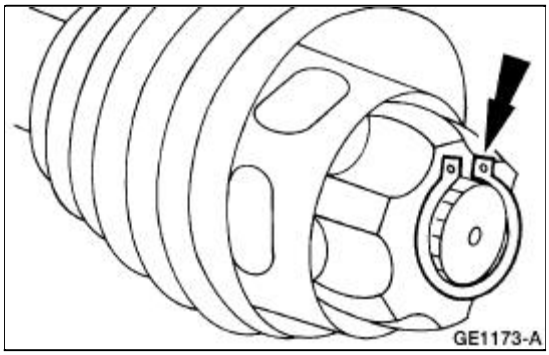


10. **NOTE:** Align the index marks.

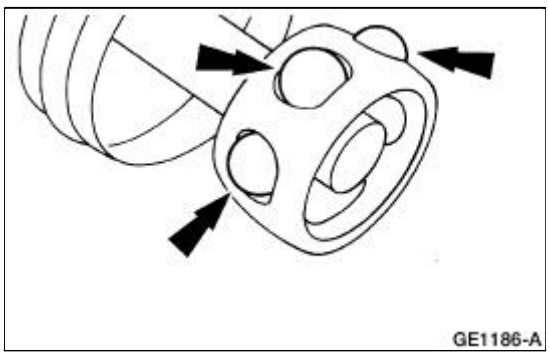
    Position the inner race on the shaft with the counterbored end facing the boot.



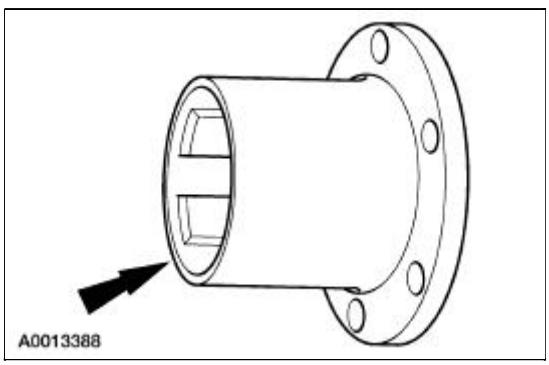
11. Install the snap ring.



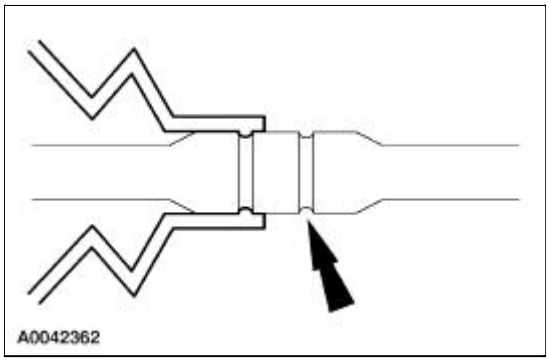
12. Lubricate and position the six balls.
    - Use constant velocity joint grease or equivalent provided in the boot kit.



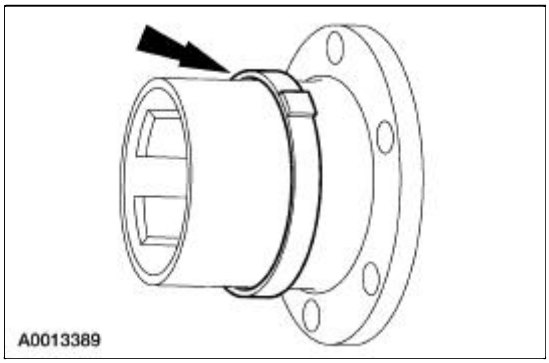
13. Fill the inboard CV joint housing with 235 grams (8.29 ounces) of grease.
    - Use constant velocity joint grease or equivalent provided in the boot kit.



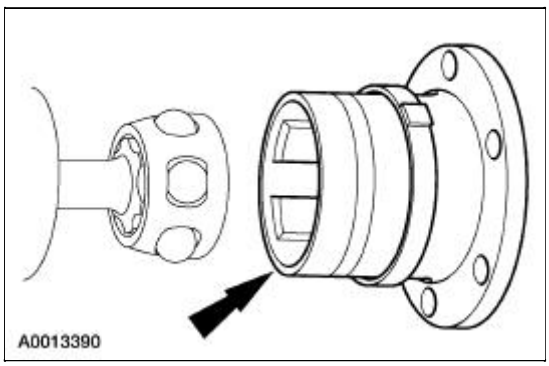
14. Make sure a shaft groove is exposed by positioning the small end of the boot in the groove closest to the constant velocity joint housing.



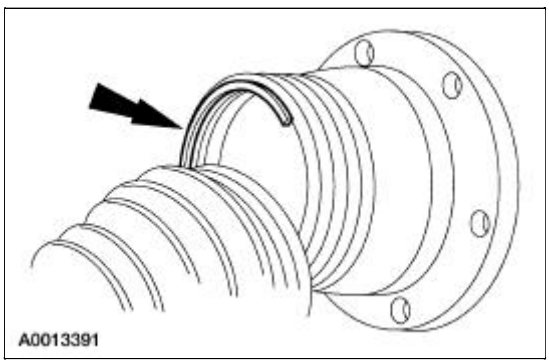
15. Position the boot clamp on the inboard CV joint housing.



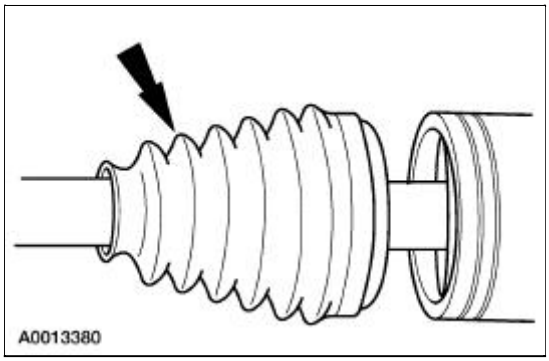
16. Position the inboard CV joint housing on the ball and race assembly.



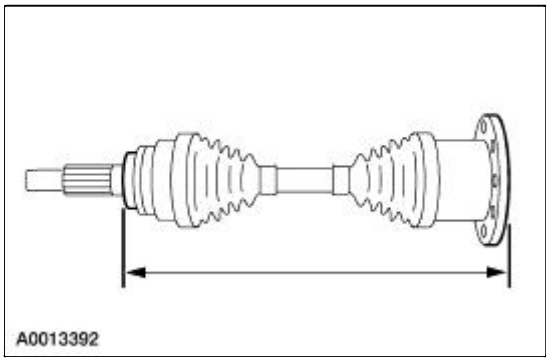
17. Install the retaining ring.



18. Remove any excess grease from the mating surface. Seat the boot in the joint boot groove.

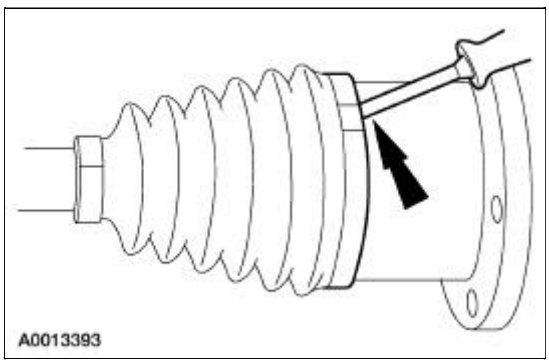


19. Set the halfshaft assembled length to specification. Refer to Specifications in this section.



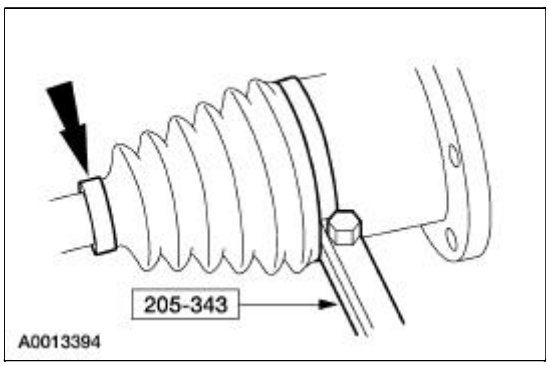
20. **CAUTION: Do not damage the boot.**

    Insert a dull screwdriver blade under the boot to release the pressure.



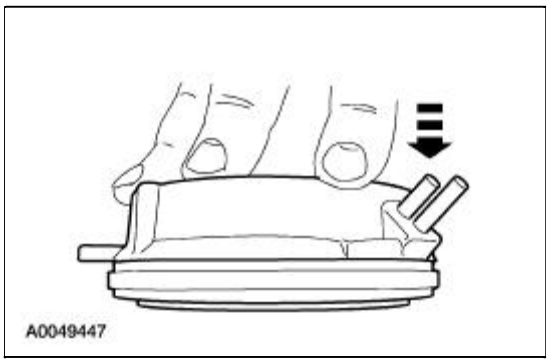
21. **NOTE:** Tighten the through-bolt until the tool is in the closed position.

    Using the special tool, install the two boot clamps.

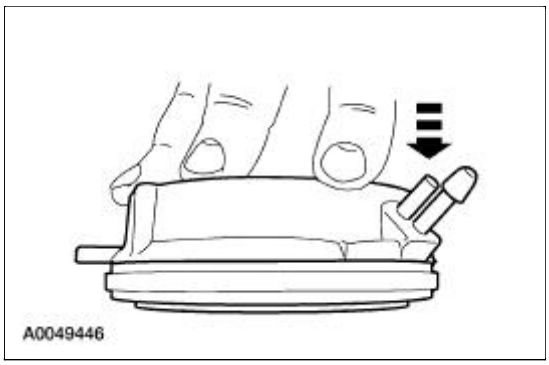


22. **NOTE:** Maintain a clean work surface.

    Compress the integrated wheel end disconnect on the bench to collapse the vacuum chamber.

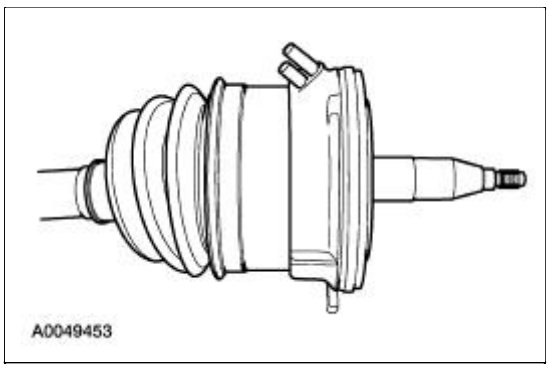


23. While the integrated wheel end disconnect is collapsed, install a vacuum cap on the vacuum port.



24. **CAUTION: Do not install the integrated wheel end disconnect in the knuckle. It must be installed on the outer constant velocity joint housing.**

    Install the integrated wheel end disconnect on the outer constant velocity joint housing.



25. **CAUTION: Verify the spline engagement by checking for spline lash before installing the halfshaft nut.**

    Install the halfshaft in the vehicle. For additional information, refer to Halfshaft in the Removal and Installation portion of this section.

General Specifications

Item	Specification
Halfshaft assembled length, 9.75 inch ring gear, LH	997.8 mm (39.29 in)
Halfshaft assembled length, 9.75 inch ring gear, RH	956.3 mm (37.65 in)
Halfshaft assembled length, 8.8 inch ring gear, LH	999.2 mm (39.34 in)
Halfshaft assembled length, 8.8 inch ring gear, RH	957.7 mm (37.70 in)

Torque Specifications

Description	Nm	lb-ft
Rear axle wheel hub retainer	338	250
Tow link nut	55	41
Knuckle to lower control arm bolt	400	295

Rear Drive Halfshafts

- The RH and LH halfshafts are different lengths, with the LH halfshaft being the longer of the two.
- Inboard and outboard CV joints connect to a splined shaft. A circlip stopper holds the cross groove inboard race assembly (inboard CV joint) together.
- An axle circlip retains the splined inboard CV joint to the differential side gear. Install a new axle circlip every time the halfshaft is removed from the vehicle.
- A rear axle wheel hub retainer secures the side shaft assembly (interconnecting shaft and outboard CV joint) to the rear hub. Install a new rear axle wheel hub retainer every time you remove the halfshaft from the vehicle.

Halfshaft Handling

CAUTION: Never pick up or hold the halfshaft by the inboard or outboard CV joint only.

NOTE: Only the inner CV joints are removable for installation of new CV boots and clamps. The boots and clamps are the only serviced parts of the halfshaft assembly.

Handle all halfshaft components carefully during removal and installation procedures.

- The halfshaft assemblies are not repairable. Install new assemblies if worn/damaged.
- To separate the halfshaft from the rear hub, press the outboard CV joint from the rear hub.
- To separate the halfshaft from the differential, apply a load to the back face of the inboard CV joint assembly to overcome the axle circlip.
- Do not over-angle the CV joints.
- Damage will occur to an assembled inboard CV joint if it is over-plunged outward from the joint housing.
- Never use a hammer to remove or install the halfshafts.
- Never use the halfshaft assembly as a lever to position other components. Always support the free end of the halfshaft.
- Do not allow the boots to contact sharp edges or hot exhaust components.
- Handle the halfshaft by the interconnecting shaft only to avoid pull-apart and potential damage to the CV joints.
- Do not drop assembled halfshafts. The impact can cut the boots from the inside without evidence of external damage.

Wheel and Tire Balancing, Rear

WARNING: Do not balance the rear wheels and tires while mounted on the vehicle. For additional information, refer to Section 204-04 .

Hoisting

CAUTION: Use a frame-contact hoist only. Vehicle or component damage can result if

other types of hoists are used. For additional information, refer to Section 100-02 .

Never raise the vehicle using the halfshafts as lift points.

Undercoating and Rustproofing

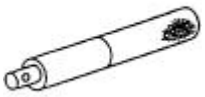
During undercoating and rustproofing procedures, protect the boots from the coating materials. Foreign materials on the rubber boots will cause extreme advanced wear.

Rear Drive Halfshafts

Refer to Section 205-00 .

Halfshaft

Special Tool(s)

 ST2258-A	Protector, Halfshaft Seal 205-506
 ST2666-A	Remover, Halfshaft 205-529
 ST1326-A	Adapter for 303-224 (Handle) 205-153 (T80T-4000-W)

Removal and Installation

NOTE: This procedure applies to both rear halfshaft assemblies.

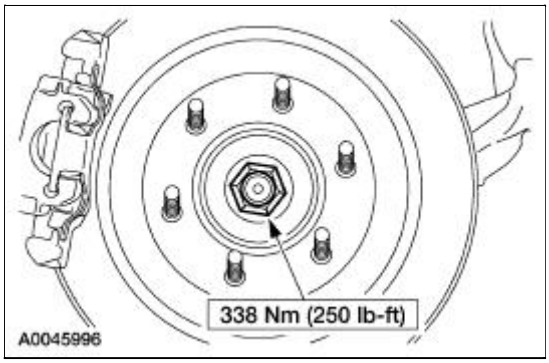
1. **CAUTION: Do not loosen the rear axle wheel hub retainer until after the wheel and tire assembly is removed from the vehicle. Wheel bearing damage will occur if the wheel bearing is unloaded with the weight of the vehicle applied.**

   With the vehicle in NEUTRAL, raise and support the vehicle. For additional information, refer to Section 100-02 .

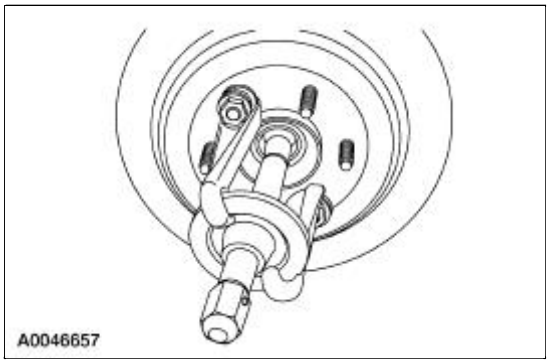
2. Remove the rear wheel and tire assembly. For additional information, refer to Section 204-04 .

3. **NOTE:** Have an assistant press the brake pedal to keep the axle from rotating.

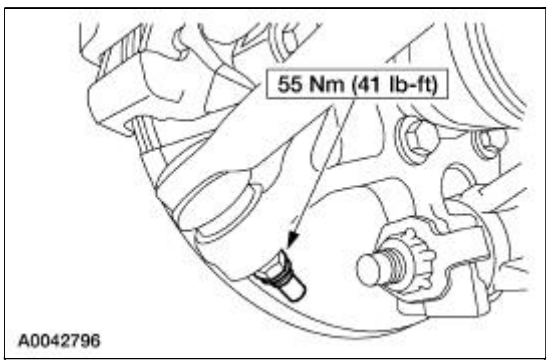
   Remove and discard the rear axle wheel hub retainer and the washer.



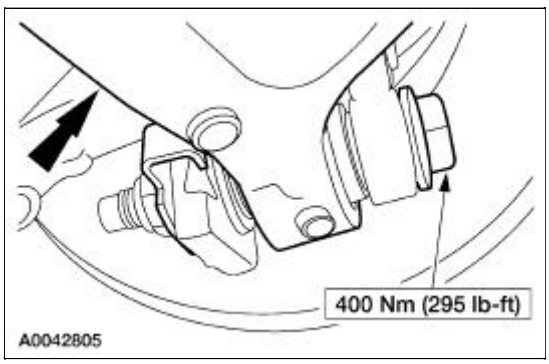
4. Using a suitable hub puller, separate the halfshaft from the knuckle.



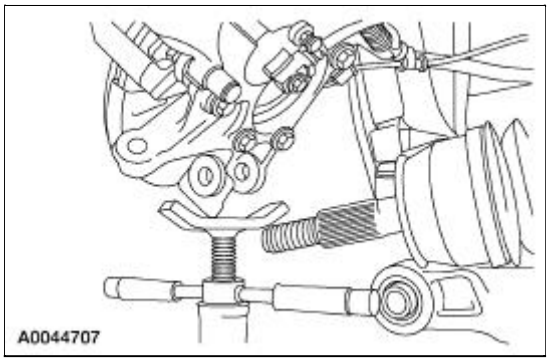
5. Disconnect the tow link from the rear knuckle.



6. Remove the bolt retaining the knuckle to the lower control arm.



7. Pivot the rear knuckle on the upper control arm bolts and support the knuckle in a raised position.

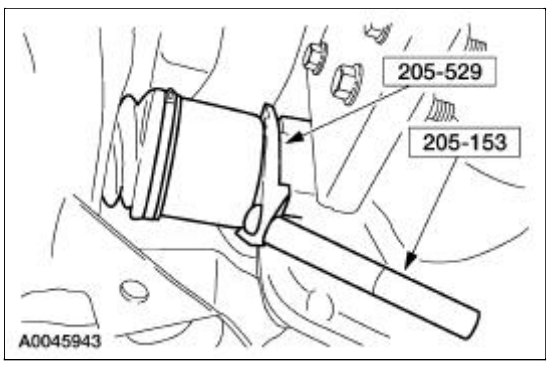


8. **CAUTION: Do not damage the axle shaft oil seal or the machined sealing surface on the inboard CV joint housing.**

   CAUTION: Do not allow the splines on inboard CV joint housing to touch the axle shaft oil seal.

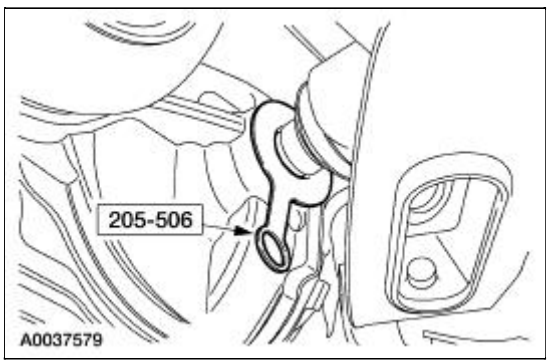
   NOTE: A circlip retains the inboard CV joint housing to the differential side gear in the axle.

   Using the special tool, disengage the inboard CV joint housing from the differential side gear.

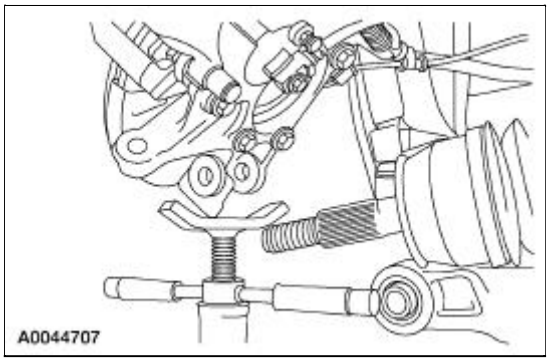


9. **CAUTION: To prevent damage to the axle shaft oil seal, install the special tool before removing the inboard CV joint housing from the axle.**

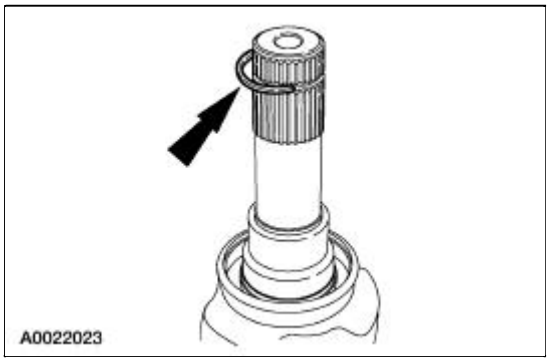
   Install the special tool.



10. Remove the halfshaft assembly from the vehicle.



11. Remove and discard the halfshaft retainer circlip.



12. **CAUTION: To prevent damage to the axle shaft oil seal, install the Halfshaft Seal Protector before positioning the inboard CV joint housing in the axle.**

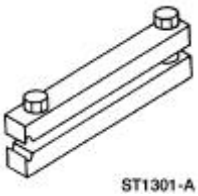
CAUTION: Always install the halfshaft with a new retainer circlip and a new rear axle wheel hub retainer.

CAUTION: Never use power tools to tighten the rear axle wheel hub retainer.

To install, reverse the removal procedure.

Halfshaft Joint

Special Tool(s)

 ST2266-A	Installer, Spindle/Axle Shaft 205-199 (T83T-3132-A1)
 ST1301-A	Installer, Constant Velocity Joint Boot Clamp 205-343 (T95P-3514-A)
 ST1358-A	Installer, Drive Pinion Oil Seal 205-133 (T79P-4676-A)
 ST2527-A	Installer, Inner CV Joint Dust Seal 205-531
 ST2528-A	Installer, Outer CV Joint Dust Seal 205-530

Material

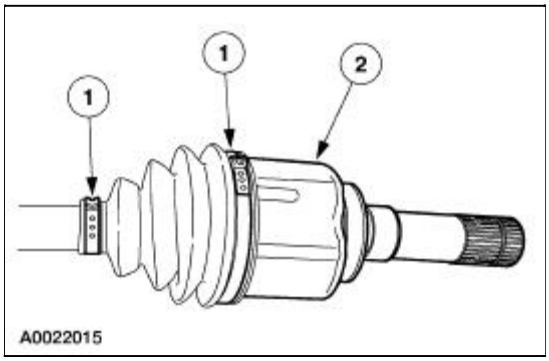
Item	Specification
Constant Velocity Joint Grease XG-5	WSS-M1C258-A1

Disassembly

1. Remove the halfshaft assembly from the vehicle. For additional information, refer to Halfshaft in this section.

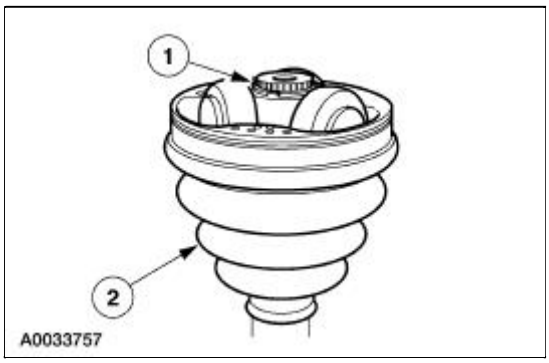
2. For the inboard CV joint, carry out the following:
    1. Remove and discard the boot clamps.

2. Remove the inboard CV joint housing.

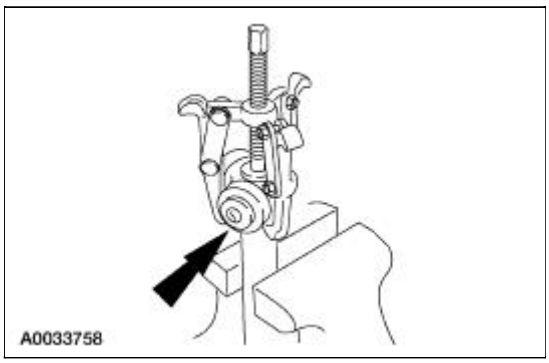


3. **NOTE:** Install the halfshaft in a soft jaw vise.

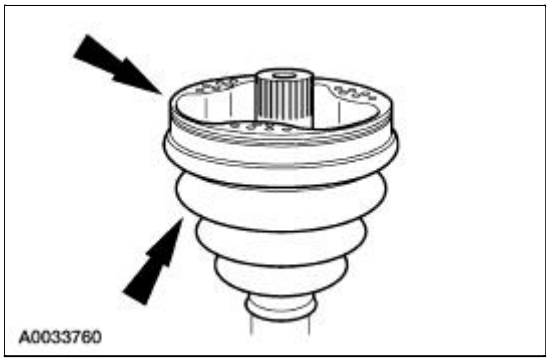
   For the inboard CV joint, carry out the following:
   1. Remove and discard the retainer circlip.
   2. Slide the boot away from the CV joint.



4. Using a suitable 3-jaw puller, remove the CV joint.

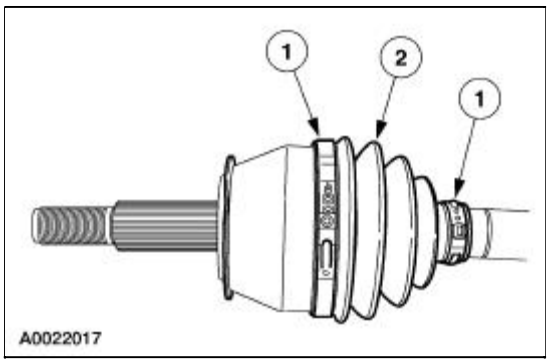


5. Remove and discard the tri-lobe insert and the boot.



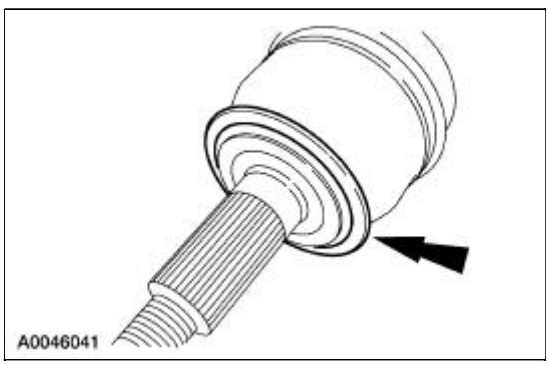
6. **NOTE:** The outboard CV joint is not removable from the halfshaft. The boot must be removed or installed from the inboard CV joint side of the shaft.

   For the outboard CV joint, carry out the following:
   1. Remove and discard the boot clamps.
   2. Remove and discard the boot.

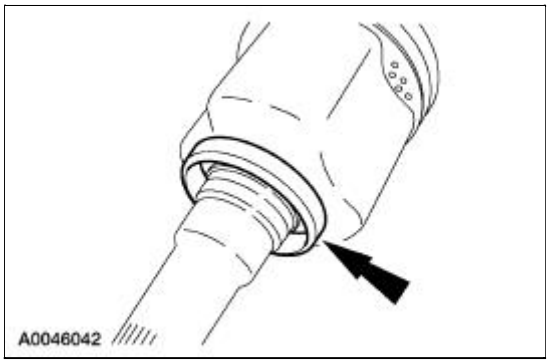


7. Inspect the grease, packed in the inboard CV joint and the outboard CV joint, for contamination. Rub some of the grease from each joint between two fingers. Any gritty feeling indicates contamination. Wash all of the grease from the inboard CV joint, the inboard CV joint housing, the outboard CV joint, and the interconnecting shaft. Thoroughly dry all of the components and inspect them for wear or damage. Discard the assembly, if necessary. Only proceed as follows if not discarding the assembly.

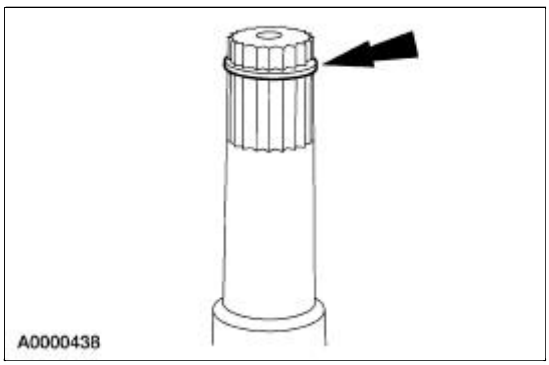
8. If necessary, remove and discard the outboard dust seal.
   - Tap uniformly around the seal to separate it from the joint.



9. If necessary, remove and discard the inboard dust seal.
   - Tap uniformly around the seal to separate it from the housing.



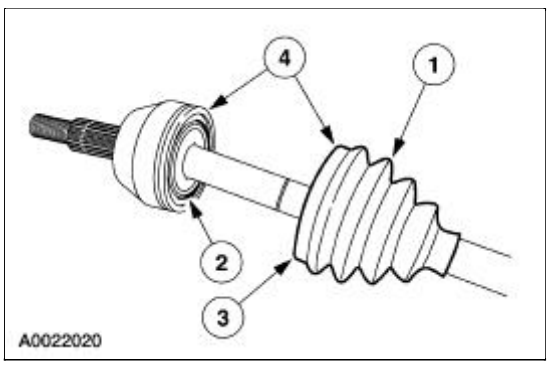
10. On the inboard end, remove and discard the retainer circlip.



Assembly

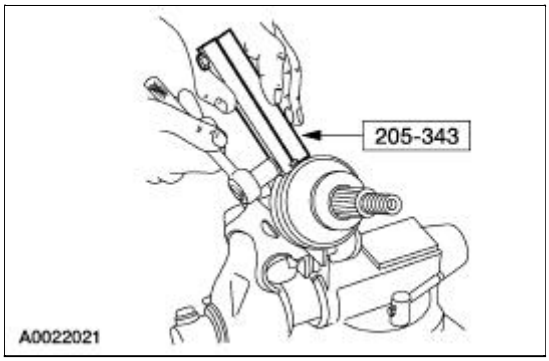
1. **NOTE:** Clean any excess grease from the boot mounting surfaces before installing the boot.

   For the outboard CV joint, carry out the following:
   1. Slide the boot on the interconnecting shaft.
   2. Pack the outboard CV joint with 275 grams (9.7 ounces) of grease.
   3. Spread any remaining grease evenly inside the boot.
   4. Install the boot by seating it in the groove in the CV joint housing.

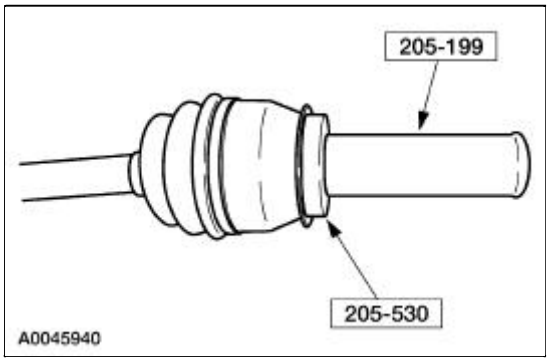


2. **NOTE:** Tighten the through-bolt until the special tool is in the closed position.

   Using the special tool, install both boot clamps.



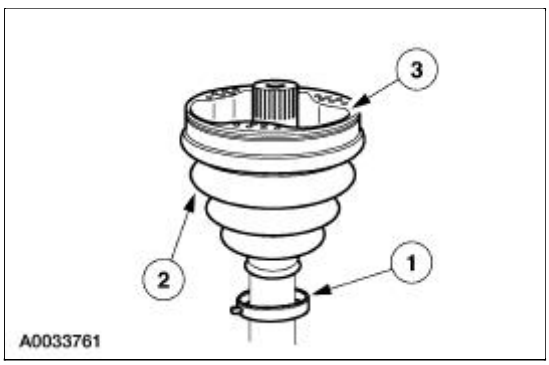
3. If removed, use the special tools to install the dust seal.



4. **NOTE:** Install the halfshaft in a soft jaw vise.

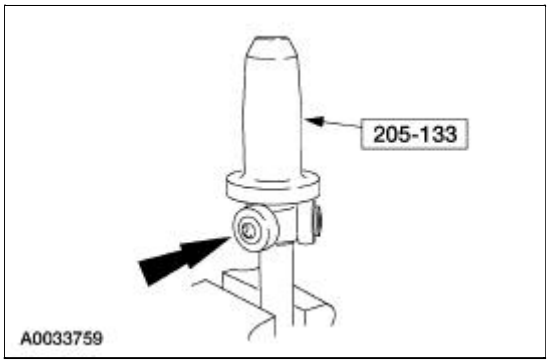
   NOTE: The lip on the end of the tri-lobe insert must seat against the end of the boot.

   For the inboard CV joint, carry out the following:
   1. Position the clamp on the interconnecting shaft.
   2. Position the boot on the interconnecting shaft.
   3. Install the tri-lobe insert.

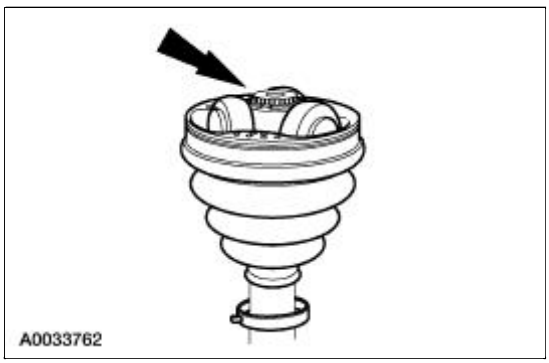


5. **NOTE:** One side of the inboard CV joint has a chamfer cut in the edge of joint at the inner diameter near the splines. Install the inboard CV joint so that the chamfer faces the outboard end of the halfshaft.

   Install the CV joint.

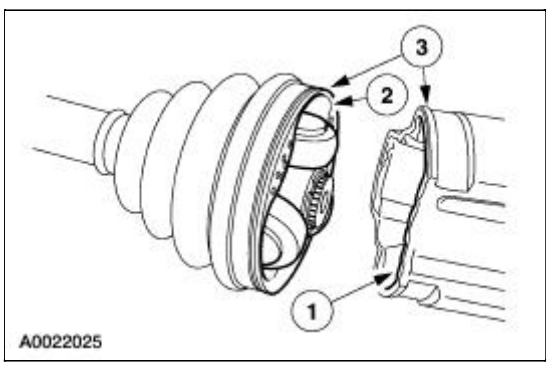


6. Install the retainer circlip.

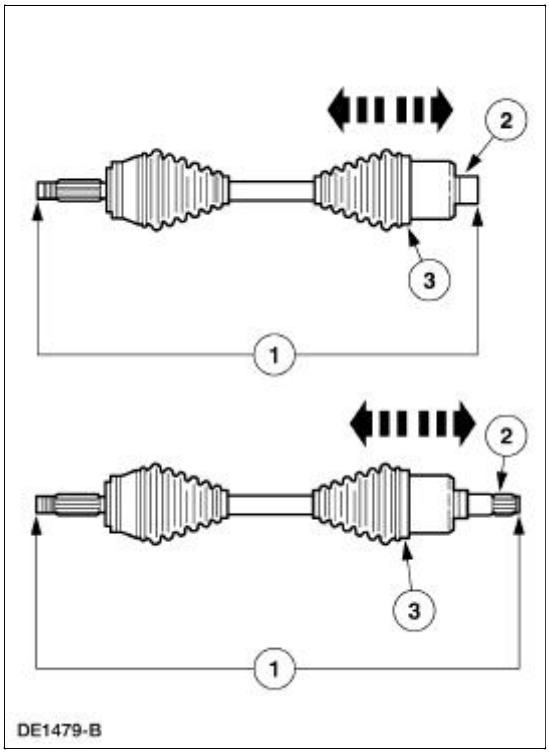


7. **NOTE:** Clean any excess grease from the boot mounting surfaces before installing the boot.

   For the inboard CV joint, carry out the following:
   1. Pack the inboard CV joint housing with 325 grams (11.5 ounces) of grease.
   2. Spread any remaining grease evenly inside the boot and on the CV joint.
   3. Install the inboard CV joint housing, seating the boot in the groove in the housing.

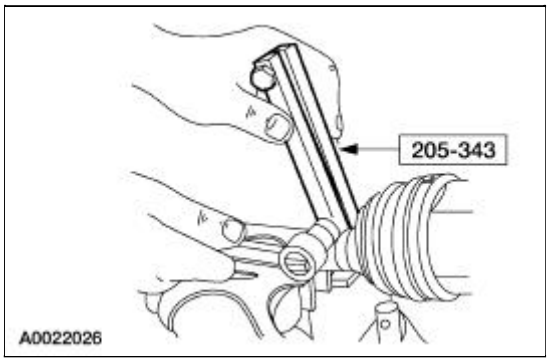


8. Set the halfshaft assembled length to specification. For additional information, refer to Specifications in this section.
   1. Measure the entire assembly length.
   2. Push in or pull out on the inner joint as necessary to adjust the halfshaft assembled length to specification.
   3. Hold the inner joint to prevent the assembled length from changing, and insert a small flat blade screwdriver between the boot and the joint to equalize the pressure.

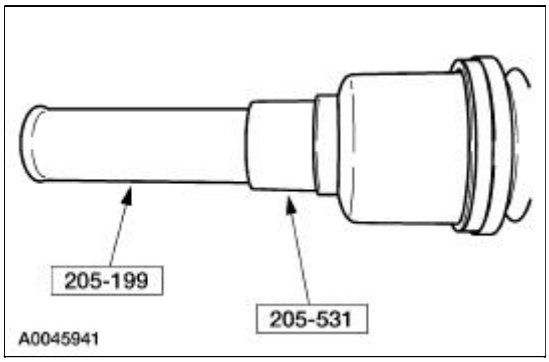


9. **NOTE:** Tighten the through-bolt until the special tool is in the closed position.

   Using the special tool, install both boot clamps.

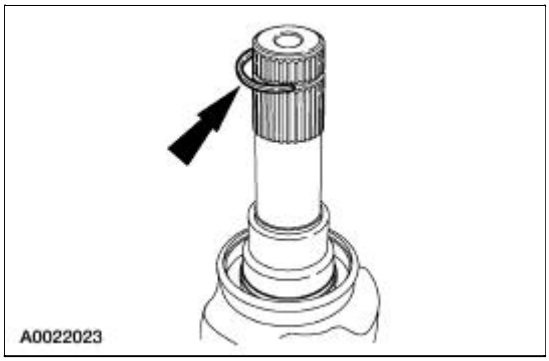


10. If removed, use the special tools to install the dust seal.



11. **CAUTION: Do not overexpand or twist the circlip during installation.**

    Install a new retainer circlip.



12. Install the halfshaft assembly in the vehicle. For additional information, refer to Halfshaft in this section.

Torque Specifications

Description	Nm	lb-ft
Disc brake caliper bleeder screw	15	11
Master cylinder brake tube	25	18

Brake System

The vehicle is equipped with a vacuum-assisted power braking system. For additional information, refer to Section 206-07 .

The braking system is a front-to-rear split hydraulic system. For additional information, refer to Section 206-06 .

The front wheel brakes utilize a dual piston brake caliper and disc brake system. For additional information, refer to Section 206-03 .

The rear brakes utilize a single piston brake caliper and disc brake system. For additional information, refer to Section 206-04 .

The parking brake system is a mechanical system that activates a shoe-and-drum system within the brake disc. For additional information, refer to Section 206-05 .

A 4-wheel anti-lock brake system (4WABS) is standard equipment. For additional information, refer to Section 206-09A or Section 206-09B .

Adjustable Pedals

Expedition and Navigator are equipped with an adjustable brake pedal. Using the adjustable pedal switch, located on the LH side of the instrument panel below the headlamp switch, the driver can adjust the brake and accelerator pedals for a more comfortable driving position. For removal and installation of adjustable pedals, refer to Section 206-06 .

Driver Seat Module

The adjustable pedals are controlled by the driver seat module (DSM) only when the vehicle is equipped with the programmable/recall memory option (Navigator only).

The DSM system consists of the following components:

- DSM
- Adjustable pedals
- Adjustable pedals switch
- Memory set switch
- Driver memory seat switch
- Memory mirror switch
- Front vertical seat motor
- Rear vertical seat motor
- Driver horizontal seat motor
- Left heated memory mirror
- Right heated memory mirror
- Remote anti-theft personality (RAP) module

The DSM incorporates multiple functions into one module and offers diagnostics to easily locate and

repair concerns affecting the subsystems that it controls.

The DSM constantly monitors the systems under its control and reports a concern in the form of diagnostic trouble codes (DTCs). A DTC can be retrieved with the Worldwide Diagnostic System (WDS) or equivalent scan tool through the communications link.

Adjustable Pedal Operation

The adjustable pedals, with memory feature, (Navigator only) are controlled by the DSM and are operational all the time, ignition switch ON, or OFF. Using the adjustable pedal switch, the driver can adjust the adjustable pedals forward, and rearward. The DSM will power the adjustable pedals until the switch is released, or until the travel limit is reached.

Memory Adjustable Pedal Operation

The memory adjustable pedal feature allows the driver to program a personalized pedal position that can be recalled using the memory switches or remote keyless entry transmitters. There are three memory settings possible. The outside rearview mirror and power driver seat positions are also stored and recalled with the power adjustable pedal positions.

Programming Adjustable Pedal Positions

Programming adjustable pedal positions can be accomplished by doing the following:

- An adjustable pedal position can be stored at any time. To store the adjustable pedal position to memory, the driver must move the pedals to the preferred position using the adjustable pedal switch. The driver must then depress the memory SET switch, activating the memory SET switch light emitting diode (LED). Within 5 seconds (before the LED goes out) the driver must select a memory position. Memory no. 1 is selected by depressing the 1 switch. Memory no. 2 is selected by depressing the 2 switch.
- If no memory switch input is received within the 5 second time limit, the operation is aborted and the memory SET switch LED is turned OFF. If one of the following inputs is received during the 5 second programming limit, the operation is aborted and the memory SET switch LED is turned OFF:
    - Adjustable pedal switch
    - Power driver seat switch
    - Power outside rearview mirrors switch
    - Memory SET switch.

Recalling a Stored Adjustable Pedal Position

Once the driver has stored a preferred adjustable pedal position, the driver can recall the setting by depressing the corresponding memory switch, or by using a programmed remote keyless entry transmitter. Recalling a stored adjustable pedal position can be accomplished by doing the following:

- The driver can recall a preferred adjustable pedal position by depressing one or both of the memory recall switches. Pressing memory switch 1 will initiate a recall of the adjustable pedal position stored in memory no. 1. Pressing memory switch 2 will initiate a recall of the adjustable pedal position stored in memory no. 2. Pressing both memory no. 1, and memory switch 2, will initiate a recall of the adjustable pedal position stored in memory no. 3.
- A remote keyless entry transmitter (RAP module interface) can be used to recall previously set memory positions. The remote keyless entry transmitters are manufactured with an assigned personality number (1, 2, or 3) and are so designated on the back of the remote keyless entry transmitter case. The remote keyless entry transmitter assigned with personality 1 is capable of only recalling memory position 1. Similarly, the remote keyless entry transmitters assigned with

personalities 1 and 2, can only recall memory positions 1 and 2, respectively.

- Memory recall occurs when the UNLOCK switch is pressed on the remote keyless entry transmitters. A second press of the UNLOCK switch, which unlocks the passenger doors, does not initiate a memory recall.
- A memory recall in progress does not prohibit the initiation of another memory recall; the most recently requested memory recall will be executed.

Brake System

Refer to Wiring Diagrams Cell 60 , Instrument Cluster for schematic and connector information.

Refer to Wiring Diagrams Cell 97 , Daytime Running Lamps for schematic and connector information.

Refer to Wiring Diagrams Cell 123 , Memory Seats for schematic and connector information.

Refer to Wiring Diagrams Cell 127 , Adjustable Pedal for schematic and connector information.

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 or equivalent scan tool New Generation Star (NGS) Tester 418-F052 or equivalent
 ST1137-A	73111 Digital Multimeter 105-R0057 or equivalent

Inspection and Verification

WARNING: Use of any other than the approved DOT 3 brake fluid will cause permanent damage to brake components and will render the brakes inoperative.

WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

CAUTION: Do not spill brake fluid onto painted surfaces. If spilled, wipe up immediately.

NOTE: Always check the fluid level in the brake master cylinder reservoir before performing the test procedures. If the fluid level is not at the correct level, add High Performance DOT 3 Brake Fluid PM-1 or equivalent DOT 3 fluid meeting Ford specification ESA-M6C25-A.

NOTE: Prior to performing any diagnosis, make sure the brake warning indicator is functional. Refer to Section 413-01 .

The first indication that something may be wrong in the brake system is a change in the feeling through the brake pedal. The brake warning indicator in the instrument cluster and the brake fluid level in the brake master cylinder reservoir are also indicators of system concerns.

If a wheel is locked and the vehicle must be moved, open a bleeder screw at the locked wheel to let out enough fluid to relieve the pressure. Close the bleeder screw. This bleeding operation may release the brakes but will not correct the cause of trouble. If this does not relieve the locked wheel condition, repair the locked components before proceeding.

Inspect all hoses and connections. All unused vacuum connectors should be capped. Make sure hoses and their connections are correctly secured and in good condition with no holes, soft or collapsed areas.

Non-Pressure Leaks

The only part of the brake system that could have a brake fluid loss that does not appear when the system is under pressure is the brake master cylinder reservoir area. Brake fluid loss can be caused by a missing or poorly-fitted brake master cylinder filler cap, a punctured or otherwise damaged brake master cylinder reservoir, a missing or damaged brake master cylinder filler cap gasket, or by missing, damaged or poorly-fitted sealing grommets between the brake master cylinder and the brake master cylinder reservoir

The brake master cylinder reservoir grommets are not separately serviceable and must be installed new as part of a new brake master cylinder reservoir

NOTE: The wet appearance on the outer cover of rubber brake hoses is called "sweating." This is a normal condition for neoprene rayon braid hose. The sweating condition is not evidence of a brake fluid leak and will not result in a loss of pressure in the system.

Install a new flexible brake hose if it shows signs of softening, cracking or other damage.

When installing a new brake hose, position the hose to avoid contact with other vehicle components.

Road Test

For an overview of a road test, refer to Section 100-04 .

Avoid locking the brakes. Locked brakes are not an indication of braking efficiency.

Visual Inspection Chart

Mechanical	Electrical
● Brake master cylinder ● Brake caliper piston ● Brake discs ● Wheel bearings ● Brake pads ● Power brake booster ● Brake pedal linkage ● Booster vacuum hose ● Tires ● Foreign material	● Parking brake switch ● Damaged or corroded wiring harness ● Brake master cylinder fluid level switch

For low or spongy brake pedal concerns:

- check and, if necessary, refill the brake master cylinder reservoir.
- bleed the brake system and retest the brake pedal feel.
- if the brake pedal is still low or spongy, check the wheel bearings. Refer to Section 206-03 (4x2) or Section 204-01B (4x4) for front wheel bearings, and to Section 205-02A or Section 205-02B for rear wheel bearings.

For a slow or incomplete brake pedal return concern:

- inspect for binding, damage, correct installation or interference at the brake pedal.
- check the power brake booster for binding, damage and correct installation.

For vibration concerns when brakes are applied:

- refer to Section 100-04 .

Adjustable Pedals With Memory Feature (Navigator only)

1. Verify the customer concern by operating the adjustable pedals.

NOTE: If the adjustable pedals are not installed on the vehicle, when a self-test is carried out, the module will set pedal codes.

2. Visually inspect for obvious signs of mechanical or electrical damage. Refer to the following chart:

Visual Inspection Chart

Mechanical	Electrical
● Adjustable pedals ● Adjustable pedal switch	● Damaged or corroded connector ● Damaged or corroded wiring harness ● Battery junction box (BJB) fuse: ■ 109 (30A)

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

4. If the scan tool does not power up, refer to the scan tool manual.

5. Carry out the DATA LINK DIAGNOSTIC TEST. If the scan tool responds with:
   - CKT914, CKT915 or CKT70—ALL ECUS NO RESP/NOT EQUIP. Refer to Section 418-00 .
   - NO RESP/NOT EQUIP for Driver Seat Module (DSM), Go To Pinpoint Test A .
   - System passed, retrieve and record the continuous DTCs and carry out self-test diagnostics for the DSM.

6. If the DTCs retrieved are related to the concern, go to the DSM Diagnostic Trouble Code (DTC) Index.

7. If no DTCs related to the concern are retrieved, GO to Symptom Chart to continue diagnostics.

DSM Diagnostic Trouble Code (DTC) Index

DSM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1342	ECU Is Defective	DSM	REFER to Section 419-10.
B1529	Memory Set Switch Circuit Short to Battery	DSM	REFER to Section 501-09.
B1533	Memory 1 Switch Circuit Short to Battery	DSM	REFER to Section 501-09.
B1537	Memory 2 Switch Circuit Short to Battery	DSM	REFER to Section 501-09.
B1663	Seat Driver Front Up/Down Motor Stalled	DSM	REFER to Section 501-10.
B1664	Seat Driver Rear Up/Down Motor Stalled	DSM	REFER to Section 501-10.
B1665	Seat Driver Forward/Backward Motor Stalled	DSM	REFER to Section 501-10.
B1667	Mirror Driver Up/Down Motor Stalled	DSM	REFER to Section 501-09.
B1668	Mirror Driver Right/Left Motor Stalled	DSM	REFER to Section 501-09.
B1669	Mirror Passenger Up/Down Motor Stalled	DSM	REFER to Section 501-09.
B1670	Mirror Passenger Right/Left Motor Stalled	DSM	REFER to Section 501-09.
B1676	Battery Pack Voltage Out of Range	DSM	REFER to Section 414-00.
B1697	Mirror Driver/Passenger Switch Circuit Short to Battery	DSM	REFER to Section 501-09.
B1711	Seat Driver Front Up Switch Circuit Short to Battery	DSM	REFER to Section 501-10.
B1715	Seat Driver Front Down Switch Circuit Short to Battery	DSM	REFER to Section 501-10.
B1719	Seat Driver Forward Switch Circuit Short to Battery	DSM	REFER to Section 501-10.
B1723	Seat Driver Rearward Switch Circuit Short to Battery	DSM	REFER to Section 501-10.
B1727	Seat Driver Rear Up Switch Circuit Short to Battery	DSM	REFER to Section 501-10.
B1731	Seat Driver Rear Down Switch Circuit Short to Battery	DSM	REFER to Section 501-10.
B1735	Mirror Driver Vertical Switch Circuit Short to Battery	DSM	REFER to Section 501-09.
B1739	Mirror Driver Horizontal Switch Circuit Short to Battery	DSM	REFER to Section 501-09.
B1743	Mirror Passenger Vertical Switch Circuit Short to Battery	DSM	REFER to Section 501-09.

B1747	Mirror Passenger Horizontal Switch Circuit Short to Battery	DSM	REFER to Section 501-09.
B1751	Park/Neutral Switch Circuit Short to Battery	DSM	REFER to Section 501-10.
B1950	Seat Rear Up/Down Potentiometer Feedback Circuit Failure	DSM	REFER to Section 501-10.
B1952	Seat Rear Up/Down Potentiometer Feedback Circuit Short to Battery	DSM	REFER to Section 501-10.
B1954	Seat Front Up/Down Potentiometer Feedback Circuit Failure	DSM	REFER to Section 501-10.
B1956	Seat Front Up/Down Potentiometer Feedback Circuit Short to Battery	DSM	REFER to Section 501-10.
B1962	Seat Horizontal Forward/Rearward Potentiometer Feedback Circuit Failure	DSM	REFER to Section 501-10.
B1964	Seat Horizontal Forward/Rearward Potentiometer Feedback Circuit Short to Battery	DSM	REFER to Section 501-10.
B1987	Pedal Forward / Rearward Motor Stalled	DSM	Go To Pinpoint Test I.
B1988	Pedal Position Forward Switch Circuit Short to Battery	DSM	Go To Pinpoint Test I.
B1989	Pedal Position Rearward Switch Circuit Short to Battery	DSM	Go To Pinpoint Test I.
B1990	Pedal Forward / Rearward Potentiometer Feedback Circuit Failure	DSM	Go To Pinpoint Test J.
B1991	Pedal Forward / Rearward Potentiometer Feedback Circuit Short to Battery	DSM	Go To Pinpoint Test J.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• No communication with the module — unable to carry out on-demand self test with the DSM (Navigator only)	• Central junction box fuses: ■ 109 (30A). • Circuitry. • DSM.	• Go To Pinpoint Test A.
• Brakes pull or drift	• Tire air pressure. • Wheel alignment. • Brake shoes. • Brake components. • Brake discs. • Suspension component.	• Go To Pinpoint Test B.
• Red brake warning indicator always on	• Circuit. • Parking brake.	• Go To Pinpoint Test C. • RELEASE the parking brake.

	• Brake fluid level. • Brake master cylinder.	• REFILL the brake master cylinder reservoir to MAX line. INSPECT hydraulic system for leaks. INSTALL new components as necessary. • CARRY OUT the Brake Master Cylinder Component Test in this section.
• Brake pedal goes down fast	• Brake fluid level. • Air in system. • Brake master cylinder.	• Go To Pinpoint Test D .
• Brakes lock up during light brake pedal force	• Brake pads. • Disc brake caliper. • Parking brake components. • Anti-lock control system.	• Go To Pinpoint Test E .
• Excessive brake pedal effort	• Power brake booster. • Power brake booster check valve. • Power brake booster hose.	• CARRY OUT a the Brake Booster Component Test in this section.
• Brake pedal application feels abnormal	• Power brake booster input shaft.	• CHECK the orientation of the power brake booster input shaft; the offset (if present) must be downward. If incorrect, CORRECT as necessary.
• Brake vibration/shudder — occurs when brakes are applied	• Uneven disc or drum wear. • Uneven disc brake pad or lining transfer. • Suspension components.	• REFER to Section 100-04 .
• Red brake warning indicator inoperative	• Circuit. • Bulb. • Parking brake switch. • Brake fluid level sensor. • Instrument cluster printed circuit. • Daytime running lamp control (DRL) (if so equipped).	• REFER to Section 413-01 . • REFER to Section 417-04 .
• Brake pedal eases down slowly	• Air in the system.	• BLEED the system. REFER to Brake

		System Bleeding in this section.
	• Brake master cylinder.	• CARRY OUT a Brake Master Cylinder Component Test in this section.
• Excessive/erratic brake pedal travel	• Leak in the hydraulic system. • Air in system. • Disc brake caliper. • Brake master cylinder. • Brake booster to brake master cylinder push rod adjustment.	• Go To Pinpoint Test F.
• Brakes drag	• Parking brake components.	• REPAIR or INSTALL new components as necessary. REFER to Section 206-05.
	• Disc brake caliper.	• REPAIR or INSTALL new components as necessary. REFER to Section 206-03 or Section 206-04.
	• Brake booster to brake master cylinder push rod adjustment.	• Go To Pinpoint Test G.
	• Brake master cylinder.	• CARRY OUT a Brake Master Cylinder Component Test in this section.
• Brake noise	• Brake discs.	• REPAIR or INSTALL new brake discs as necessary. REFER to Section 206-03 or Section 206-04.
	• Brake pads.	• CLEAN or INSTALL new brake pads as necessary.
	• Anti-rattle clips.	• INSTALL new components as necessary.
	• Disc brake caliper mounting bolts.	• REPAIR or INSTALL new components as necessary.
• Adjustable brake pedal does not operate correctly — system without memory	• Motor. • Obstruction(s). • Cable. • Switch.	• Go To Pinpoint Test H.
• Adjustable brake pedal does not operate correctly — does not operate using the adjustable pedal switch (Navigator only)	• Battery junction box (BJB) fuses: ▪ 109 (30A). • Circuitry.	• Go To Pinpoint Test I.

	• Switch. • Adjustable pedal motor. • Driver Seat Module (DSM).	
• Adjustable brake pedal does not operate correctly — does not operate using the memory set switch (Navigator only)	• Battery junction box (BJB) fuses: ■ 109 (30A). • Circuitry. • Switch. • Adjustable pedal motor. • Driver Seat Module (DSM).	• Go To Pinpoint Test J .
• Adjustable brake pedal does not operate correctly — does not operate using the remote transmitter (Navigator only)	• Battery junction box (BJB) fuses: ■ 109 (30A). • Circuitry. • Switch. • Adjustable pedal motor. • Driver Seat Module (DSM). • Remote transmitter.	• Go To Pinpoint Test K .

Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE MODULE — UNABLE TO CARRY OUT ON-DEMAND SELF TEST WITH THE DSM (NAVIGATOR ONLY)

Test Step	Result / Action to Take
A1 CHECK FUSE 3 (7.5A)	
• Key in OFF position. • Check fuse: Fuse 3 (7.5A). • **Is fuse 3 (7.5A) OK?**	**Yes** GO to A2 . **No** INSTALL a new fuse. REPEAT the self-test.
A2 CHECK FOR VOLTAGE AT BATTERY JUNCTION BOX FUSE 3 (7.5A)	
• Key in ON position. • Measure the voltage between central junction box fuse 3 (7.5A) pin 1, harness side and ground. • **Is the voltage greater than 10 volts?**	**Yes** GO to A3 . **No** REPAIR the central junction box. REPEAT the self-test, CLEAR the DTCs.
A3 CHECK CIRCUIT 956 (OG/LG) FOR OPEN	
• Key in OFF position.	**Yes**

• Disconnect: DSM C356. • Key in ON position. • Measure the resistance between DSM C356-1, circuit 956 (OG/LG), harness side and BJB fuse 3 (7.5A) cavity. • **Is the resistance greater than 5 ohms?**	GO to A4 . **No** REPAIR circuit 956 (OG/LG). REPEAT the self-test, CLEAR the DTCs.
A4 CHECK CIRCUIT 57 (BK) FOR OPEN	
• Key in OFF position. • Measure the resistance between DSM C356-2, circuit 57 (BK), harness side and ground. • **Is the resistance less than 5 ohms?**	**Yes** REFER to Section 418-00 . **No** REPAIR circuit 57 (BK). REPEAT the self-test, CLEAR the DTCs.

PINPOINT TEST B: BRAKES PULL OR DRIFT

Test Step	Result / Action to Take
B1 CHECK THE TIRE PRESSURE	
• Check for excessive wear and measure the air pressure in all four tires. • **Are the tires good and the tire pressure within specification?**	**Yes** GO to B2 . **No** ADJUST the tire pressure. ROTATE the tires front to rear. INSTALL new tires. TEST the system for normal operation.
B2 CHECK THE CALIPER PISTON AND PINS	
• Check the disc brake caliper pistons and pins for binding or sticking. • **Do the disc brake caliper pistons or pins bind or stick?**	**Yes** REPAIR or INSTALL new components as necessary. TEST the system for normal operation. **No** GO to B3 .
B3 INSPECT THE BRAKE PADS	
• Inspect the brake pads for contamination and wear concerns. • **Are the brake pads OK?**	**Yes** GO to B4 . **No** INSTALL new brake pads. REFER to Section 206-03 (front) or Section 206-04 (rear).
B4 CHECK THE ALIGNMENT	
• Check for correct camber, caster and toe-in settings. Refer to Section 204-00 . • **Is the alignment set to specification?**	**Yes** INSTALL a new disc brake caliper at the affected wheel. TEST the system for normal operation. **No** RESET the alignment and road test the vehicle.

PINPOINT TEST C: RED BRAKE WARNING INDICATOR ALWAYS ON

Test Step	Result / Action to Take
C1 CHECK BRAKE MASTER CYLINDER FLUID LEVEL SWITCH ● Key in OFF position. ● Disconnect: Brake Master Cylinder Fluid Level Switch. ● Key in ON position. ● **Does the brake warning indicator turn on?**	**Yes** GO to C2 . **No** INSTALL a new brake master cylinder fluid level switch. TEST the system for normal operation.
C2 CHECK PARKING BRAKE SWITCH ● Key in OFF position. ● Disconnect: Parking Brake Switch. ● Key in ON position. ● **Does the red brake warning indicator turn on?**	**Yes** For vehicles without daytime running lamps (DRL), GO to C3 . For vehicles equipped with DRL, GO to C4 . **No** INSTALL a new parking brake switch. TEST the system for normal operation.
C3 CHECK CIRCUITS 977 (PK/WH), 162 (LG/RD), 531 (DG/YE) ● Key in OFF position. ● Disconnect: Instrument Cluster C238. ● Measure the resistance between instrument cluster C238-10, circuit 977 (PK/WH), and ground. ● **Is the resistance greater than 10,000 ohms?**	**Yes** REPAIR the instrument cluster. TEST the system for normal operation. **No** REPAIR circuit 977 (PK/WH), 531 (DG/YE), or 162 (LG/RD). TEST the system for normal operation.
C4 CHECK CIRCUITS 977 (PK/WH) AND 531 (DG/YE) ● Key in OFF position. ● Disconnect: Instrument Cluster. ● Disconnect: DRL Module. ● Measure the resistance between instrument cluster C238-10, circuit 977 (PK/WH), and ground. ● **Is the resistance greater than 10,000 ohms?**	**Yes** GO to C5 . **No** REPAIR circuit 977 (PK/WH)/531 (DG/YE). TEST the system for normal operation.
C5 CHECK PARKING BRAKE CIRCUIT 162 (LG/RD) ● Measure the resistance between DRL module C142-4, circuit 162 (LG/RD), and ground. ● **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new DRL module. REFER to Section 417-04 . TEST the system for normal operation. **No** REPAIR circuit 162 (LG/RD). TEST the system for normal operation.

PINPOINT TEST D: BRAKE PEDAL GOES DOWN FAST

Test Step	Result / Action to Take
D1 CHECK THE BRAKE FLUID LEVEL IN	

THE BRAKE MASTER CYLINDER RESERVOIR	
• Check the brake fluid level at the brake master cylinder reservoir. • **Is the brake fluid level within specification?**	**Yes** GO to D2 . **No** ADD fluid. CHECK for leaks. INSTALL a new reservoir as necessary. TEST the system for normal operation.
D2 PRESSURIZE THE SYSTEM	
• Pump the brake pedal rapidly (five times). • **Does the brake pedal height build up and then hold?**	**Yes** BLEED the system of air. REFER to Brake System Bleeding in this section. **No** CARRY OUT the Brake Master Cylinder Component Test in this section. TEST the system for normal operation.

PINPOINT TEST E: BRAKES LOCK UP DURING LIGHT BRAKE PEDAL FORCE

Test Step	Result / Action to Take
E1 CHECK FOR BINDING OR STICKING BRAKE COMPONENTS	
• Key in OFF position. • Check brake components for binding, damage and correct installation at each wheel. • **Do any of the components bind or stick?**	**Yes** REPAIR or INSTALL new components as necessary. TEST the system for normal operation. **No** GO to E2 .
E2 CHECK PARKING BRAKE COMPONENTS	
• Check parking brake components for damage, seized condition, and correct adjustment. Refer to Section 206-05 . • **Are the parking brake components OK?**	**Yes** GO to E3 . **No** REPAIR or INSTALL new components as necessary. REFER to Section 206-05 . TEST the system for normal operation.
E3 INSPECT BRAKE PADS	
• Inspect brake pads for contamination, excessive wear or damage. Refer to Section 206-03 for front disc brakes. Refer to Section 206-04 for rear disc brakes. • **Are the brake pads OK?**	**Yes** GO to E4 . **No** INSTALL new brake pads as necessary. TEST the system for normal operation.
E4 CHECK FOR LOOSE BRAKE COMPONENT MOUNTINGS	
• Check for loose or damaged caliper mounting bolts. • **Are the component mountings OK?**	**Yes** CHECK the 4-wheel anti-lock brake system (4WABS). REFER to Section 206-09A or Section 206-09B .

	No REPAIR as necessary. TEST the system for normal operation.

PINPOINT TEST F: EXCESSIVE/ERRATIC BRAKE PEDAL TRAVEL

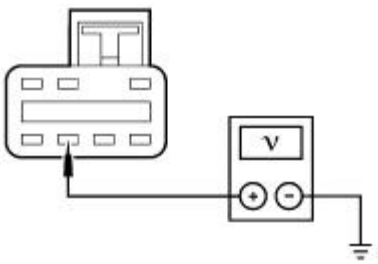
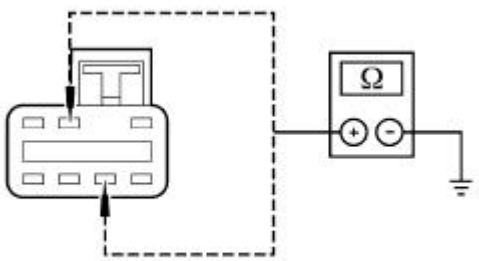
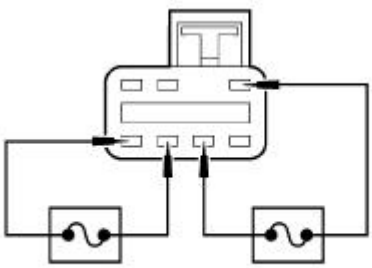
Test Step	Result / Action to Take
F1 CHECK FOR SPONGY PEDAL	
• Key in ON position. • Operate the brake pedal and note pedal feel. • **Does the pedal feed spongy?**	**Yes** BLEED the brake system. REFER to Brake System Bleeding in this section. TEST the system for normal operation. **No** GO to F2 .
F2 CHECK BRAKE PEDAL	
• Inspect the brake pedal and bracket for binding, obstruction or damage. • **Is the brake pedal OK?**	**Yes** GO to F3 . **No** REPAIR or INSTALL a new brake pedal as necessary. TEST the system for normal operation.
F3 CHECK BRAKE COMPONENTS	
• Inspect the disc brake calipers and brake pads for binding, damage, correct installation and contamination. • **Are the disc brake calipers and brake pads OK?**	**Yes** GO to F4 . **No** REPAIR or INSTALL new components as necessary. TEST the system for normal operation.
F4 CHECK BEARINGS	
• **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the RH kick panel area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.** • Raise and support the vehicle so that the tires clear the floor. • Check the wheel bearings for wear, damage and correct installation. Refer to Section 206-03 (4x2) or Section 204-01B (4x4) for front wheel bearings and Section 205-02A or Section 205-02B for rear wheel bearings. • **Are the bearings OK?**	**Yes** INSTALL a new power brake booster. TEST the system for normal operation. **No** REPAIR or INSTALL new bearings as necessary. TEST the system for normal operation.

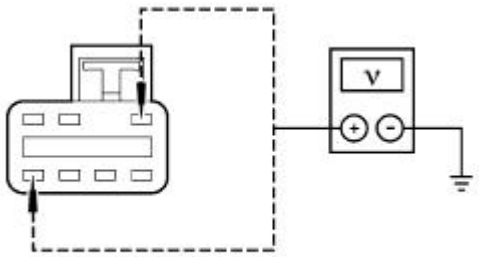
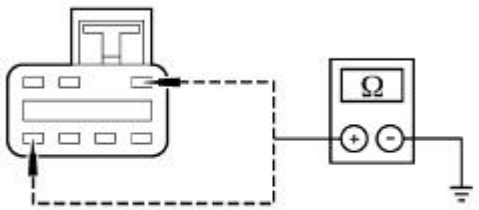
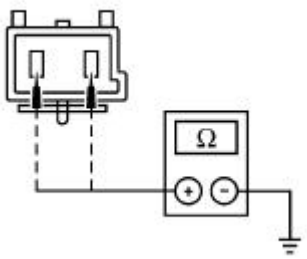
PINPOINT TEST G: BRAKES DRAG

Test Step	Result / Action to Take
G1 INSPECT PUSH ROD ADJUSTMENT ● Inspect brake master cylinder push rod adjustment. Refer to Section 206-07 . ● **Is brake master cylinder push rod adjustment within specification?**	**Yes** GO to G2 . **No** ADJUST the brake master cylinder push rod. REFER to Section 206-07 .
G2 CHECK PARKING BRAKE COMPONENTS ● Check all parking brake components for correct adjustment, correct installation, or binding. Refer to Section 206-05 . ● **Are all parking brake components OK?**	**Yes** CARRY OUT the Brake Master Cylinder Component Test in this section. TEST the system for normal operation. **No** ADJUST the parking brake or INSTALL new components as necessary. REFER to Section 206-05 .

PINPOINT TEST H: ADJUSTABLE BRAKE PEDAL DOES NOT OPERATE CORRECTLY — SYSTEM WITHOUT MEMORY

Test Step	Result / Action to Take
H1 CHECK MOTOR SOUND ● Allow two minutes for the thermal overload to reset. ● Operate the adjustable pedal control switch. ● **Can the adjustable pedal motor be heard to operate?**	**Yes** GO to H2 . **No** GO to H5 .
H2 CHECK MOTOR INSTALLATION ● Check adjustable pedal motor for correct installation. ● **Is the motor installation OK?**	**Yes** GO to H3 . **No** CORRECT the motor installation. TEST the system for normal operation.
H3 CHECK ADJUSTABLE ACCELERATOR PEDAL SYSTEM ● Disconnect the brake pedal-to-accelerator pedal cable. ● Operate the adjustable pedal control switch. ● **Does the adjustable brake pedal operate now?**	**Yes** REPAIR the adjustable accelerator pedal system. REFER to Section 310-02 . TEST the system for normal operation. **No** GO to H4 .
H4 INSPECT FOR FOREIGN MATERIAL ● Inspect the adjustable brake pedal assembly for foreign material causing a binding condition. ● **Was any foreign material found?**	**Yes** REMOVE the foreign material. RETEST for normal

	operation. **No** GO to H5 .
H5 CHECK CABLE ● Dismount the adjustable pedal motor. ● Inspect the ends of the brake pedal motor cable for wear or damage. ● **Are the cable ends OK?**	**Yes** GO to H6 . **No** INSTALL a new brake pedal motor cable. TEST the system for normal operation.
H6 CHECK POWER TO SWITCH ● Disconnect: Adjustable Pedal Switch C2089. ● Measure the voltage at C2089-6, circuit 566 (DG).  A0013396 ● **Is the voltage greater than 10 V?**	**Yes** GO to H7 . **No** REPAIR circuit 566 (DG). TEST the system for normal operation.
H7 CHECK GROUND TO SWITCH ● Measure resistance to ground at C2089-2, circuit 57 (BK) and C2089-5, circuit 57 (BK).  A0013397 ● **Is the resistance less than 5 ohms at both pins?**	**Yes** GO to H8 . **No** REPAIR the open circuit. TEST the system for normal operation.
H8 TEST SWITCH ● Connect fused jumpers between C2089-1 and 5 and between C2089-7 and 5.  A0013398	**Yes** INSTALL a new adjustable pedal switch. TEST the system for normal operation. **No** GO to H9 .

• **Does the adjustable pedal motor run?**	
H9 CHECK CIRCUITS FOR SHORT TO BATTERY	
• Measure voltage at C2089-1 and C2089-7.  A0013399 • **Is the voltage greater than 0 V at either pin?**	**Yes** REPAIR the short to battery. TEST the system for normal operation. **No** GO to H10 .
H10 CHECK CIRCUITS FOR SHORT TO GROUND	
• Measure resistance to ground at C2089-1 and C2089-7.  A0013400 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to H11 . **No** REPAIR the grounded circuit. TEST the system for normal operation.
H11 CHECK SWITCH-TO-MOTOR CIRCUITS CONTINUITY	
• Connect: Adjustable Pedal Switch C2089. • Disconnect: Adjustable Pedal Motor C2001. • Measure resistance to ground at both pins of the adjustable pedal motor connector, circuits 1494 (RD) and 1495 (WH).  DH1252-A • **Is the resistance less than 5 ohms at both pins?**	**Yes** INSTALL a new adjustable pedal motor. TEST the system for normal operation. **No** REPAIR the open circuit. TEST the system for normal operation.

PINPOINT TEST I: ADJUSTABLE BRAKE PEDAL DOES NOT OPERATE CORRECTLY — DOES NOT OPERATE USING THE ADJUSTABLE PEDAL SWITCH

Test Step	Result / Action to Take

I1 USE THE RECORDED DTCS FROM THE DSM CONTINUOUS AND ON-DEMAND SELF TEST

- Use the recorded results from DSM Continuous and On-Demand Self Test.
- **Are any DTCs recorded?**

Yes
If DTC B1987, GO to I9.

If DTC B1988, GO to I3.

If DTC B1989, GO to I3.

If DTC B1342, INSTALL a new DSM. For additional information, REFER to Section 419-10. REPEAT the self-test, CLEAR the DTCs.

No
GO to I2.

I2 CHECK DSM FOR CORRECT ADJUSTABLE PEDAL SWITCH INPUTS — MONITOR DSM PID PDL_POS

- Key in OFF position.
- Connect the diagnostic tool.
- Key in ON position.
- Monitor the DSM PID PDL_POS while activating the adjustable pedal switch.
- **Does the DSM PID PDL_POS value agree with the adjustable pedal switch position within 1 second of releasing the switch?**

Yes
GO to I9.

No
GO to I3.

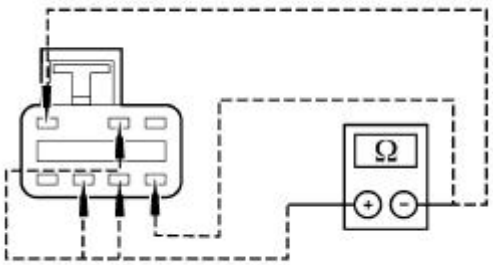
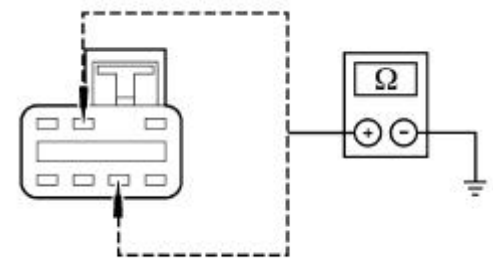
I3 CHECK ADJUSTABLE PEDAL SWITCH

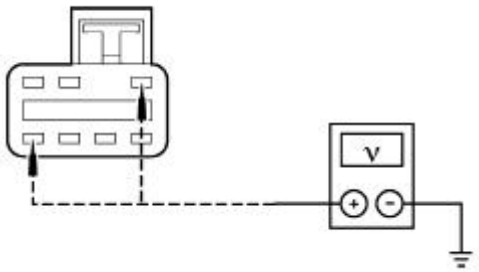
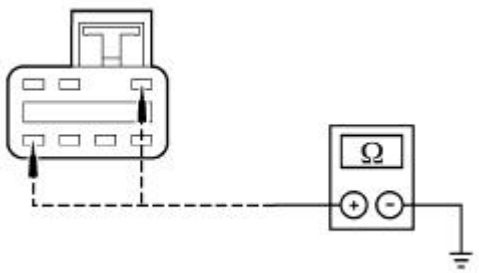
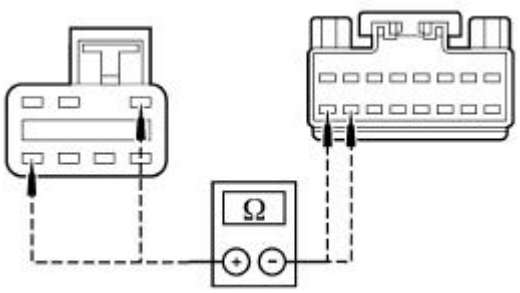
- Key in OFF position.
- Disconnect: Adjustable Pedal Switch C2089.
- Measure the resistance between the following pins on adjustable pedal switch C2089, component side:

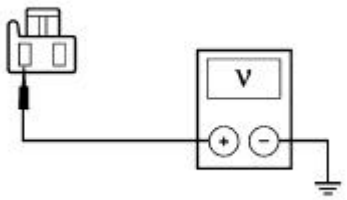
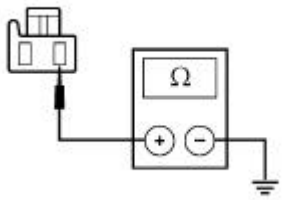
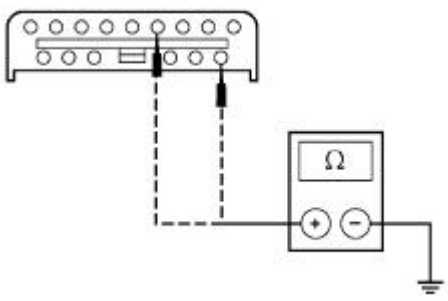
C2089 Pins	Forward	Neutral	Rearward
1, 6	Less than 5 ohms	Less than 5 ohms	Greater than 10,000 ohms
1, 2	Greater than 10,000 ohms	Greater than 10,000 ohms	Less than 5 ohms
7, 3	Greater than 10,000 ohms	Less than 5 ohms	Less than 5 ohms
7, 2	Less than 5 ohms	Greater than 10,000 ohms	Greater than 10,000 ohms

Yes
GO to I4.

No
INSTALL a new adjustable pedal switch. REPEAT the self-test, CLEAR the DTCs.

 A0013403 ● **Do the measured resistance values agree with the expected resistance values?**	
I4 CHECK CIRCUIT 1492 (LB/RD) AND 1493 (PK/BK) SHORT TOGETHER	
● Disconnect: DSM C341C. ● Measure the resistance between adjustable pedal switch C2089-7, and 1 harness side. ● **Is the resistance less than 10,000 ohms?**	**Yes** GO to I5 . **No** REPAIR circuit 566 (DG). REPEAT the self-test, CLEAR the DTCs.
I5 CHECK CIRCUIT 875 (BK/LB) FOR OPEN	
● Measure the resistance between adjustable pedal switch C2089-5, circuit 875 (BK/LB), harness side and ground; and between adjustable pedal switch C2089-2, circuit 875 (BK/LB), harness side and ground.  A0013402 ● **Are the resistances less than 5 ohms?**	**Yes** GO to I6 . **No** REPAIR circuit 875 (BK/LB). REPEAT the self-test. CLEAR the DTCs.
I6 CHECK CIRCUIT 1492 (LB/RD) AND CIRCUIT 1493 (PK/BK) FOR SHORT TO VOLTAGE	
● Disconnect: DSM C357. ● Measure the voltage between adjustable pedal switch C2089-7, circuit 1492 (LB/RD), harness side and ground; and between adjustable pedal switch C2089-1, circuit 1493 (PK/BK), harness side and ground.	**Yes** REPAIR circuit 1492 (LB/RD), or circuit 1493 (PK/BK), as necessary. REPEAT the self-test, CLEAR the DTCs. **No** GO to I7 .

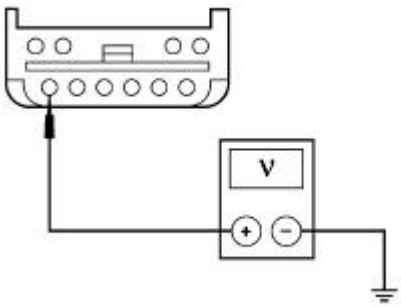
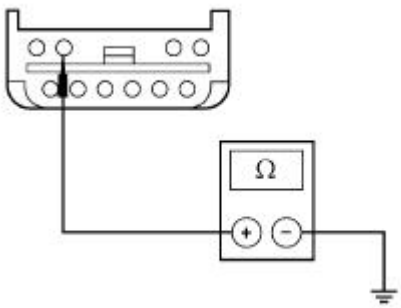
 A0013404 ● **Is any voltage indicated?**	
I7 CHECK CIRCUIT 1492 (LB/RD) AND CIRCUIT 1493 (PK/BK) FOR SHORT TO GROUND	
● Measure the resistance between adjustable pedal switch C2089-7, circuit 1492 (LB/RD), harness side and ground; and between adjustable pedal switch C2089-1, circuit 1493 (PK/BK), harness side and ground.  A0013405 ● **Is the resistance greater than 10,000 ohms?**	**Yes** GO to I8 . **No** REPAIR circuit 1492 (LB/RD), or circuit 1493 (PK/BK), as necessary. REPEAT the self-test, CLEAR the DTCs.
I8 CHECK CIRCUIT 1492 (LB/RD) AND CIRCUIT 1493 (PK/BK) FOR OPEN	
● Measure the resistance between adjustable pedal switch C2089-1, circuit 1492 (LB/RD), harness side and DSM C341c-9, circuit 1492 (LB/RD), harness side; and between adjustable pedal switch C2089-1, circuit 1493 (PK/BK), harness side and DSM C341c-10, circuit 1493 (PK/BK), harness side.  A0013406 ● **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new DSM. For additional information, REFER to Section 419-10 . REPEAT the self-test, CLEAR the DTCs. **No** REPAIR circuit 1492 (LB/RD), or circuit 1493 (PK/BK), as necessary. REPEAT the self-test, CLEAR the DTCs.
I9 CHECK DRIVER SEAT MODULE FOR CORRECT OUTPUTS — USE THE DSM ACTIVE COMMANDS PEDAL_FWD AND PEDAL_RWD.	
● Select PARK. ● Trigger the DSM active command PEDAL_FWD ON, and then OFF. ● Trigger the DSM active command PEDAL_RWD ON, and then OFF.	**Yes** INSTALL a new DSM. For additional information, REFER to Section 419-10 .

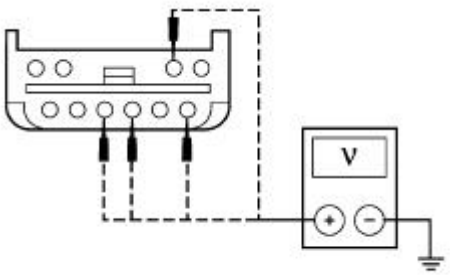
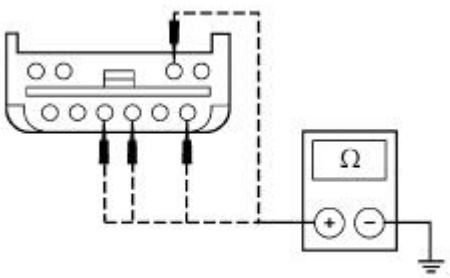
• **Do the adjustable pedals respond correctly to the corresponding active commands?**	REPEAT the self-test, CLEAR the DTCs. **No** GO to I10 .
I10 CHECK CIRCUIT 566 (DG) FOR VOLTAGE	
• Key in OFF position. • Disconnect: DSM C341a. • Measure the voltage between DSM C341a-1, circuit 566 (DG), harness side and ground.  GR2633-A • **Is the voltage greater than 10 volts?**	**Yes** GO to I11 . **No** REPAIR circuit 566 (DG). REPEAT the self-test, CLEAR the DTCs.
I11 CHECK CIRCUIT 57 (BK) FOR OPEN	
• Measure the resistance between DSM C341a-2, circuit 57 (BK), harness side and ground.  GR2636-A • **Is the resistance less than 5 ohms?**	**Yes** GO to I12 . **No** REPAIR circuit 57 (BK). REPEAT the self-test, CLEAR the DTCs.
I12 CHECK CIRCUIT 1490 (LB/OG) AND CIRCUIT 1489 (LB/BK) FOR SHORT TO GROUND	
• Key in OFF position. • Disconnect: DSM C341c. • Disconnect: Adjustable Pedal Motor C2003. • Measure the resistance between DSM C341c-7, circuit 1490 (LB/OG), harness side and ground; and between DSM C341c-16, circuit 1489 (LB/BK), harness side and ground  GH2535-A • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to I13 . **No** REPAIR circuit 1490 (LB/OG), or circuit 1489 (LB/BK), as necessary. REPEAT the self-test, CLEAR the DTCs.
I13 CHECK CIRCUIT 1490 (LB/OG) AND CIRCUIT 1489 (LB/BK) FOR	

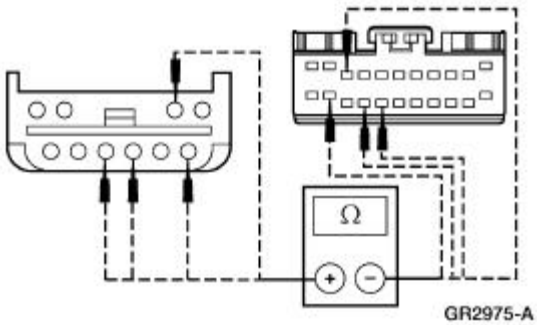
OPEN	
• Measure the resistance between DSM C341b-7, circuit 1490 (LB/OG), harness side and adjustable pedal motor C2003-5, circuit 1490 (LB/OG), harness side; and between DSM C341b-16, circuit 1489 (LB/BK), harness side and adjustable pedal motor C2003-6, circuit 1489 (LB/BK), harness side. • **Are the resistances less than 5 ohms?**	**Yes** GO to I14 . **No** REPAIR circuit 1489 (LB/BK), or circuit 1490 (LB/OG), as necessary. REPEAT the self-test, CLEAR the DTCs.
I14 CHECK CIRCUIT 1490 (LB/OG) AND CIRCUIT 1489 (LB/BK) FOR SHORT TO VOLTAGE	
• Measure the voltage between DSM C341b-7, circuit 1490 (LB/OG), harness side and ground; and between DSM C341b-16, circuit 1489 (LB/BK), harness side and ground. • **Is any voltage indicated?**	**Yes** REPAIR circuit 1489 (LB/BK), or circuit 1490 (LB/OG), as necessary. REPEAT the self-test, CLEAR the DTCs. **No** INSTALL a new DSM. For additional information, REFER to Section 419-10 . REPEAT the self-test, CLEAR the DTCs.

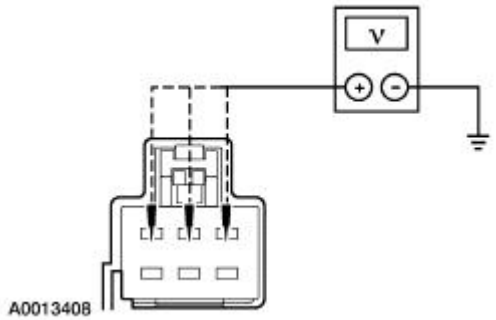
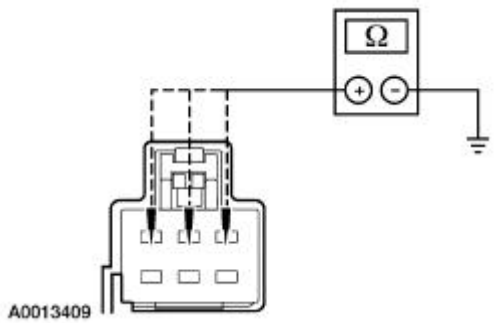
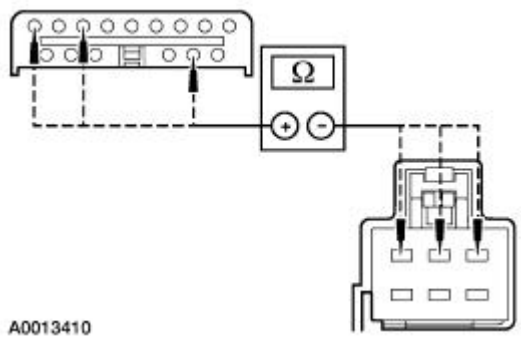
PINPOINT TEST J: ADJUSTABLE BRAKE PEDAL DOES NOT OPERATE CORRECTLY — DOES NOT OPERATE USING THE MEMORY SET SWITCH

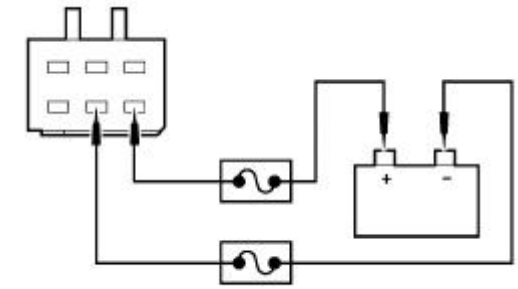
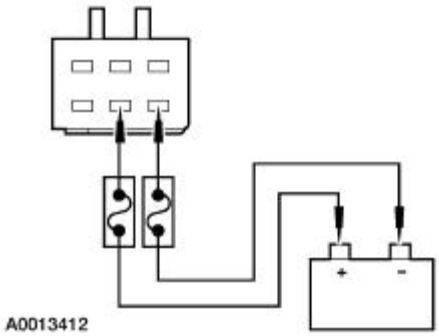
Test Step	Result / Action to Take
J1 USE THE RECORDED DTCS FROM THE DSM CONTINUOUS AND ON-DEMAND SELF TEST	
• Use the recorded results from DSM Continuous and On-Demand Self Test. • **Are any DTCs recorded?**	**Yes** If DTC B1529, GO to J6 . If DTC B1533, GO to J6 . If DTC B1537, GO to J6 . If DTC B1987, GO to J10 . If DTC B1990, GO to J10 . If DTC B1991, GO to J10 . If DTC B1342,

	INSTALL a new DSM. For additional information, REFER to Section 419-10 . REPEAT the self-test, CLEAR the DTCs. **No** GO to J2 .
J2 CHECK DSM FOR CORRECT MEMORY SET SWITCH INPUTS — MONITOR DSM PIDS MEM1_SW, MEM2_SW, AND MEMS_SW ● Monitor the DSM PIDS MEM1_SW, MEM2_SW, AND MEMS_SW, while activating the memory switch, . ● **Do the PID values agree with the switch position?**	**Yes** GO to J9 . **No** GO to J3 .
J3 CHECK THE MEMORY SET SWITCH ● Disconnect: Memory Set Switch C503. ● Carry out the memory set switch component test. For additional information, refer to wiring diagram cell 149. ● **Is the memory set switch OK?**	**Yes** GO to J4 . **No** INSTALL a new memory seat switch. REPEAT the self-test, CLEAR the DTCs.
J4 CHECK CIRCUIT 956 (OG/LG) FOR VOLTAGE — MEMORY SET SWITCH ● Measure the voltage between memory set switch C503-6, circuit 956 (OG/LG), harness side and ground.  GR2677-A ● **Is the voltage greater than 10 volts?**	**Yes** GO to J5 . **No** REPAIR circuit 956 (OG/LG). REPEAT the self-test, CLEAR the DTCs.
J5 CHECK CIRCUIT 875 (BK/LB) FOR OPEN ● Measure the resistance between memory set switch C503-9, circuit 875 (BK/LB), harness side and ground.  GR2658-A	**Yes** GO to J6 . **No** REPAIR circuit 875 (BK/LB). REPEAT the self-test, CLEAR the DTCs.

• **Is the resistance less than 5 ohms?**	
J6 CHECK CIRCUIT 267 (BN/LG), CIRCUIT 268 (BK/OG), CIRCUIT 270 (BN/OG), AND CIRCUIT 272 (WH/OG) FOR SHORT TO VOLTAGE	
• Disconnect: DSM C341c. • Measure the voltage between the following memory set switch C503 pins and ground: **Connector** / **Circuit** C503-1 — 270 (BN/OG) C503-3 — 268 (BK/OG) C503-4 — 267 (BN/LG) C503-8 — 272 (WH/OG)  GR2973-A • **Is any voltage indicated?**	**Yes** REPAIR circuit 267 (BN/LG), circuit 268 (BK/OG), circuit 270 (BN/OG), or circuit 272 (WH/OG), as necessary. REPEAT the self-test, CLEAR the DTCs. **No** GO to J7 .
J7 CHECK CIRCUIT 267 (BN/LG), CIRCUIT 268 (BK/OG), CIRCUIT 270 (BN/OG), AND CIRCUIT 272 (WH/OG) FOR SHORT TO GROUND	
• Measure the resistance between the following memory set switch C503 pins and ground: **Connector** / **Circuit** C503-1 — 270 (BN/OG) C503-3 — 268 (BK/OG) C503-4 — 267 (BN/LG) C503-8 — 272 (WH/OG)  GR2974-A • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to J8 . **No** REPAIR circuit 267 (BN/LG), circuit 268 (BK/OG), circuit 270 (BN/OG), or circuit 272 (WH/OG), as necessary. REPEAT the self-test, CLEAR the DTCs.
J8 CHECK CIRCUIT 267 (BN/LG), CIRCUIT 268 (BK/OG), CIRCUIT 270 (BN/OG), AND CIRCUIT 272 (WH/OG) FOR OPEN	
• Disconnect: DSM C341c.	**Yes**

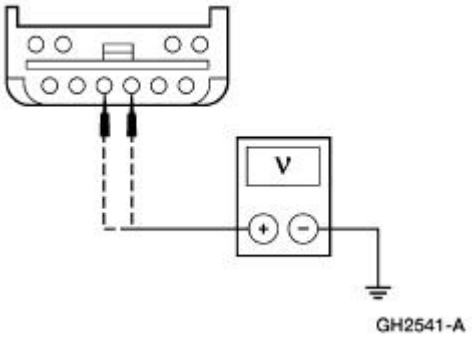
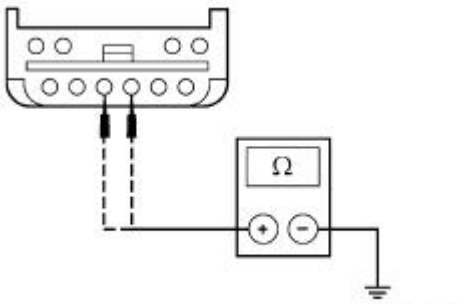
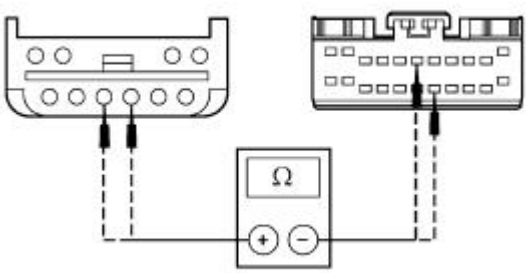
• Measure the resistance between the following memory set switch C503 pins and DSM C341c pins: **Memory Set Switch / Circuit / DSM** C503-4 / 267 (BN/LG) / C341c-16 C503-3 / 268 (BK/OG) / C341c-15 C503-1 / 270 (BR/OG) / C341c-3 C503-8 / 272 (WH/OG) / C341c-13  • **Is the resistance less than 5 ohms?**	INSTALL a new DSM. For additional information, REFER to Section 419-10 . REPEAT the self-test, CLEAR the DTCs. **No** REPAIR circuit 267 (BN/LG), circuit 268 (BK/OG), circuit 270 (BN/OG), or circuit 272 (WH/OG), as necessary. REPEAT the self-test, CLEAR the DTCs.
J9 CHECK CIRCUITS 268 (BK/OG), 267 (BN/LG), 270 (BN/OG), AND 272 (WH/OG) FOR SHORT TOGETHER	
• Measure the resistance between each of the following memory set switch circuit pins: **Connector / Circuit** C503-1 / 270 (BN/OG) C503-3 / 268 (BK/OG) C503-4 / 267 (BN/LG) C503-8 / 272 (WH/OG) • **Are the resistances less than 10,000 ohms?**	**Yes** REPAIR the affected circuit(s). CLEAR the DTC (s). REPEAT the self-test. **No** GO to J10 .
J10 CHECK DSM FOR CORRECT OUTPUTS — MONITOR THE DSM PID PDL_POS	
• Use the adjustable pedal switch to move the pedals to a central position. • Monitor the DSM PID PDL_POS while moving the adjustable pedal switch into the FWD position, then into the RWD position. • **Does the PID value increase with forward movement, and decrease with rearward movement, throughout the pedals entire travel?**	**Yes** INSTALL a new DSM. For additional information, REFER to Section 419-10 . REPEAT the self-test, CLEAR the DTCs. **No** GO to J10 .
J11 CHECK CIRCUIT 1491 (LB/YE), CIRCUIT 447 (OG/RD), AND CIRCUIT 446 (OG/WH) FOR SHORT TO VOLTAGE	
• Disconnect: DSM C341c. • Disconnect: Adjustable Pedal Motor Sensor C2090. • Measure the voltage between adjustable pedal motor sensor C2090-2, circuit 1491 (LB/YE), harness side and ground; and between	**Yes** REPAIR circuit 1491 (LB/YE), circuit 447

adjustable pedal motor sensor C2090-3, circuit 447 (OG/RD), harness side and ground; and between adjustable pedal motor sensor C2090-1, circuit 446 (OG/WH), harness side and ground.  ● **Is any voltage indicated?**	(OG/RD), or circuit 446 (OG/WH), as necessary. REPEAT the self-test, CLEAR the DTCs. **No** GO to J11 .
J12 CHECK CIRCUIT 1491 (LB/YE), CIRCUIT 447 (OG/RD), AND CIRCUIT 446 (OG/WH) FOR SHORT TO GROUND	
● Measure the resistance between adjustable pedal motor sensor C2090-2, circuit 1491 (LB/YE), harness side and ground; and between adjustable pedal motor sensor C2090-3, circuit 447 (OG/RD), harness side and ground; and between adjustable pedal motor sensor C2090-1, circuit 446 (OG/WH), harness side and ground.  ● **Is the resistance greater than 10,000 ohms?**	**Yes** GO to J12 . **No** REPAIR circuit 1491 (LB/YE), circuit 447 (OG/RD), or circuit 446 (OG/WH), as necessary. REPEAT the self-test, CLEAR the DTCs.
J13 CHECK CIRCUIT 1491 (LB/YE), CIRCUIT 447 (OG/RD), AND CIRCUIT 446 (OG/WH) FOR OPEN	
● Measure the resistance between adjustable pedal motor sensor C2090-2, circuit 1491 (LB/YE), harness side and DSM C341c-15, circuit 1491 (LB/YE), harness side; and between adjustable pedal motor sensor C2090-3, circuit 447 (OG/RD), harness side and DSM C341b-1, circuit 447 (OG/RD), harness side; and between adjustable pedal motor sensor C2090-1, circuit 446 (OG/WH), harness side and DSM C341b-3, circuit 446 (OG/WH), harness side.  ● **Are the resistances less than 5 ohms?**	**Yes** GO to J13 . **No** REPAIR circuit 1491 (LB/YE), circuit 447 (OG/RD), or circuit 446 (OG/WH), as necessary. REPEAT the self-test, CLEAR the DTCs.
J14 CHECK ADJUSTABLE PEDAL MOTOR	

• Disconnect: Adjustable Pedal Motor C2003. • Use a fused (10A) jumper between adjustable pedal motor C2003-6, circuit 1489 (LB/BK), component side and the battery positive terminal; and between adjustable pedal motor C2003-5, circuit 1490 (LB/OG), component side and battery negative terminal.  A0013411 • Use a fused (10A) jumper between adjustable pedal motor C2003-6, circuit 1489 (LB/BK), component side and the battery negative terminal; and between adjustable pedal motor C2003-5, circuit 1490 (LB/OG), component side and battery positive terminal.  A0013412 • **Does the adjustable pedal motor operate first in one direction, and then in the opposite direction?**	**Yes** INSTALL a new DSM. For additional information, REFER to Section 419-10 . REPEAT the self-test, CLEAR the DTCs. **No** INSTALL a new adjustable pedal motor. REPEAT the self-test, CLEAR the DTCs. REFER to Section 501-10 . REPEAT the self-test, CLEAR the DTCs.

PINPOINT TEST K: ADJUSTABLE BRAKE PEDAL DOES NOT OPERATE CORRECTLY — DOES NOT OPERATE USING THE REMOTE TRANSMITTER

Test Step	Result / Action to Take
K1 CHECK OPERATION OF REMOTE TRANSMITTER ONE	
• Adjust the driver seat to a new position and store for Memory 1. • Adjust the driver seat to a different position. • Press the UNLOCK button on remote transmitter one. • **Does the driver seat move to memory seat position one?**	**Yes** GO to K2 . **No** GO to Section 501-14 to diagnose the inoperative driver seat memory recall from the remote transmitter.
K2 CHECK CIRCUIT 267 (BN/LG) AND 268 (BK/OG) FOR SHORT TO VOLTAGE	
• Select PARK. • Disconnect: Memory Set Switch C503. • Measure the voltage between memory set switch C503-4, circuit	**Yes** REPAIR circuit 267 (BN/LG), or circuit

267 (BN/LG), harness side and ground; and between memory set switch C503-3, circuit 268 (BK/OG), harness side and ground.  GH2541-A • **Is any voltage indicated?**	268 (BK/OG). REPEAT the self-test, CLEAR the DTCs. **No** GO to K3 .
K3 CHECK CIRCUIT 267 (BN/LG) AND 268 (BK/OG) FOR SHORT TO GROUND	
• Measure the resistance between memory set switch C503-4, circuit 267 (BN/LG), harness side and ground; and between memory set switch C503-3, circuit 268 (BK/OG), harness side and ground.  GH2542-A • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to K4 . **No** REPAIR circuit 267 (BN/LG), or circuit 268 (BK/OG),as necessary. REPEAT the self-test, CLEAR the DTCs.
K4 CHECK CIRCUIT 267 (BN/LG) AND 268 (BK/OG) FOR OPEN	
• Disconnect: DSM C341c. • Measure the resistance between memory set switch C503-4, circuit 267 (BN/LG), harness side and DSM C341c-4, circuit 267 (BN/LG), harness side; and between memory set switch C503-3, circuit 268 (BK/OG), harness side and DSM C341c-3, circuit 268 (BK/OG), harness side.  GH2543-A • **Is the resistance less than 5 ohms?**	**Yes** REFER to Section 501-14 . REPEAT the self-test, CLEAR the DTCs. **No** REPAIR circuit 267 (BN/LG), or circuit 268 (BK/OG). REPEAT the self-test, CLEAR the DTCs.

Component Tests

Brake Booster

1. Check the hydraulic brake system for leaks or insufficient fluid.

2. With the transmission in NEUTRAL, stop the engine and apply the parking brake control. Apply the brake pedal several times to exhaust all vacuum in the system.

3. Apply the brake pedal and hold it in the applied position. Start the engine. If the vacuum system is operating, the brake pedal will tend to move downward under constant foot pressure. If no motion is felt, the power brake booster system is not functioning.

Brake Booster Operation Check

1. Remove the vacuum booster hose from the check valve connection. Manifold vacuum must be available at the check valve end of the vacuum booster hose with the engine at idle speed and the transmission in NEUTRAL. If the manifold vacuum is available to the power brake booster, connect the vacuum booster hose to the power brake booster check valve and repeat Steps 2 and 3 of the Brake Booster check. If no downward movement of the brake pedal is felt, install a new power brake booster.

2. Operate the engine a minimum of 10 seconds at fast idle. Stop the engine, and let the vehicle stand for 10 minutes. Then apply the brake pedal with approximately 89 N (20 lb) of force. The brake pedal feel should be the same as that noted with the engine operating. If the brake pedal feels hard (no power assist), install a new power brake booster check valve and retest. If the brake pedal feels spongy, bleed the hydraulic system to remove air. Refer to Brake System Bleeding in this section.

Check Valve

The function of the power brake booster check valve is to allow manifold vacuum to enter the power brake booster and prevent the escape of vacuum in case manifold vacuum is lost during sustained full throttle operation.

To test the function of the power brake booster check valve :

- Start and run the engine for at least 10 seconds.
- Operate the brake pedal to check for power assist.
- Disconnect the vacuum booster hose from the power brake booster. Do not remove the power brake booster check valve from the power brake booster.
- There should be enough vacuum retained in the power brake booster for at least one more power-assisted brake operation.

Brake Master Cylinder — Normal Conditions

The following conditions are considered normal and are not indications that the brake master cylinder is in need of service.

Condition 1: During normal operation of the brake master cylinder, the fluid level in the brake master cylinder reservoir will rise during brake application and fall during release. The net fluid level (i.e., after brake application and release) will remain unchanged.

Condition 2: A trace of brake fluid will exist on the booster shell below the master cylinder mounting flange. This results from the normal lubricating action of the master cylinder bore and seal.

Condition 3: Fluid level will decrease with pad wear.

Brake Master Cylinder — Abnormal Conditions

Changes in brake pedal feel or travel are indicators that something could be wrong in the brake system. GO to Symptom Chart for abnormal condition diagnosis.

Bypass Condition Test

1. Disconnect the brake lines at the brake master cylinder.
2. Plug the outlet ports of the brake master cylinder.
3. Apply the brakes. If brake pedal height cannot be maintained, the brake master cylinder has an internal leak and must be rebuilt or installed new.

Compensator Port Check

The purpose of the compensator ports in the brake master cylinder is to supply any additional brake fluid required by the system due to brake pad wear and to allow brake fluid returning from the brake lines to the brake master cylinder to enter the brake master cylinder reservoir

The returning brake fluid will cause a slight turbulence in the brake master cylinder reservoir. Turbulence seen in the brake master cylinder reservoir upon release of the brake pedal is normal and shows that the compensating ports are not plugged.

Brake System Bleeding

Special Tool(s)

 ST2332-A	Worldwide Diagnostic Tool (WDS) 418-F224, or equivalent scan tool New Generation Star (NGS) Tester 418-F052 or equivalent

Material

Item	Specification
High Performance DOT 3 Brake Fluid PM-1	ESA-M6C25-A

Master Cylinder, In Vehicle

WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

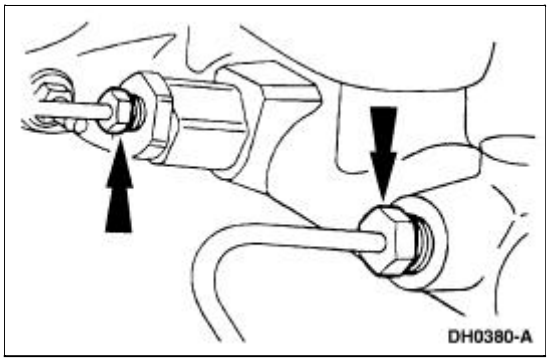
CAUTION: Do not allow the brake master cylinder reservoir to run dry during the bleeding operation. Keep the brake master cylinder reservoir filled with the specified brake fluid. Never reuse the brake fluid that has been drained from the hydraulic system.

CAUTION: Brake fluid is harmful to painted and plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

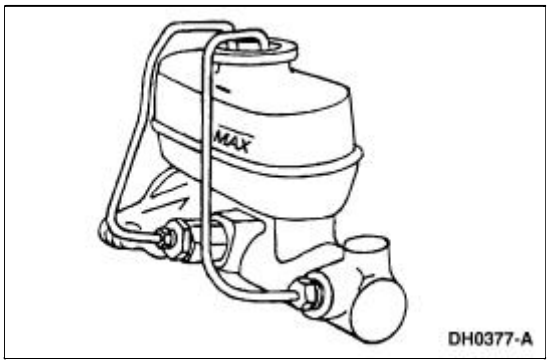
NOTE: When any part of the hydraulic system has been disconnected for repair or new installation, air may get into the system and cause spongy brake pedal action. This requires bleeding of the hydraulic system after it has been correctly connected. The hydraulic system can be bled manually or with pressure bleeding equipment.

1. **NOTE:** When a new brake master cylinder has been installed or the system has been emptied, or partially emptied, it should be primed to prevent air from getting into the system.

   Disconnect the brake master cylinder outlet tubes.



2. Install short brake tubes with ends submerged in the brake master cylinder reservoir and fill the brake master cylinder reservoir with brake fluid.

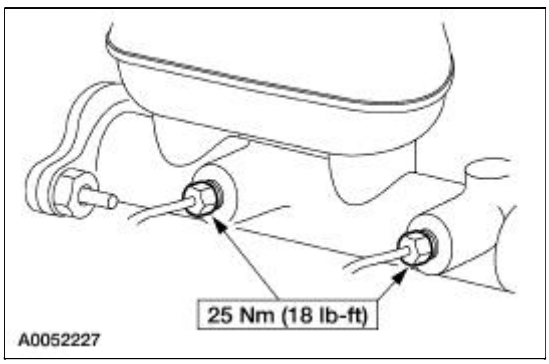


3. Have an assistant pump the brake pedal until clear fluid flows from both brake tubes without air bubbles.

4. Remove the short brake tubes and install the brake outlet tubes.

5. Bleed each brake tube at the brake master cylinder as follows:
    1. Have an assistant pump the brake pedal and then hold firm pressure on the brake pedal.
    2. Loosen the rearmost brake tube fittings until a stream of brake fluid comes out. Have an assistant maintain pressure on the brake pedal while tightening the brake tube fitting.
    3. Repeat this operation until clear, bubble-free fluid comes out.
    4. Refill the brake master cylinder reservoir as necessary. Repeat the bleeding operation at the front brake tube.

6. While the assistant maintains pressure on the brake pedal, tighten the brake tubes.



Four Wheel Anti-Lock Brake System (4WABS)

WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

CAUTION: Do not allow the brake master cylinder reservoir to run dry during the bleeding operation. Keep the brake master cylinder reservoir filled with the specified brake fluid. Never reuse the brake fluid that has been drained from the hydraulic system.

CAUTION: Brake fluid is harmful to painted and plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

NOTE: When any part of the hydraulic system has been disconnected for repair or new installation, air may get into the system and cause spongy brake pedal action. This requires bleeding of the hydraulic system after it has been correctly connected. The hydraulic system can be bled manually or with pressure bleeding equipment.

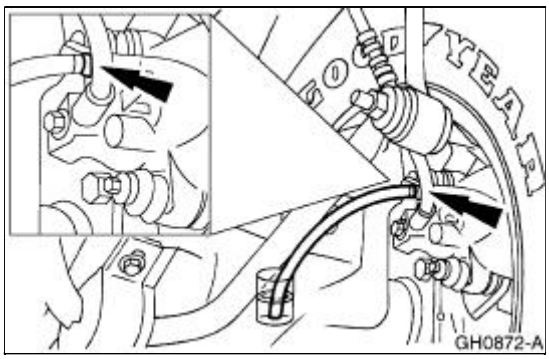
NOTE: This procedure must be performed if the 4 wheel anti-lock brake (4WABS) hydraulic control unit (HCU) has been installed new.

NOTE: One conventional pressure bleed cycle consists of advancing the brake pedal to its depressed position, opening the disc brake caliper bleeder screw, allowing fluid to be released into the waste container, closing the disc brake caliper bleeder screw and releasing the brake pedal.

NOTE: Performing the NGS program routine drives entrapped air from the otherwise inaccessible lower section of the 4WABS valve into the upper sections (accessible by bleeding the brakes). Subsequent bleedings remove the air from the system.

NOTE: Add recommended brake fluid as necessary throughout the procedure.

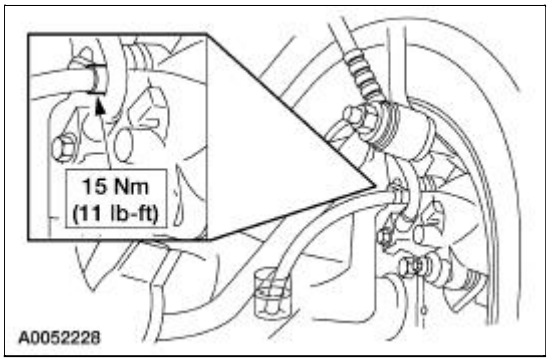
1. Connect a clear waste line to the RH rear disc brake caliper bleeder screw and the other end in a container partially filled with recommended brake fluid.



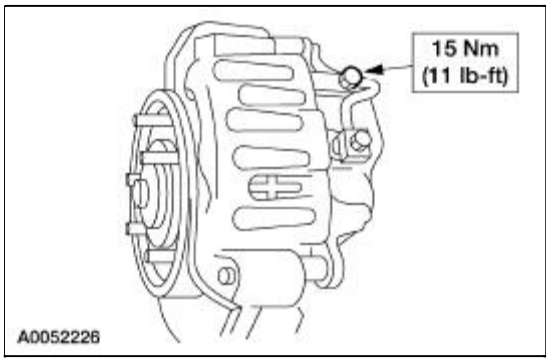
2. Have an assistant pump the brake pedal and then hold firm pressure on the brake pedal.

3. Loosen the RH rear disc brake caliper bleeder screw until a stream of brake fluid comes out. Have an assistant maintain pressure on the brake pedal while tightening the RH rear disc brake caliper bleeder screw.
    - Repeat until clear, bubble-free fluid comes out.
    - Refill the brake master cylinder reservoir as necessary.

4. Tighten the RH rear disc brake caliper bleeder screw.



5. Repeat Steps 1, 2, 3, and 4 for the LH rear disc brake caliper bleeder screw, RH front disc brake caliper bleeder screw, and the LH front disc brake caliper bleeder screw.



6. **NOTE:** Go to the help menu in the scan tool.

   Connect the scan tool DCL cable adapter into the vehicle data link connector (DLC) under the dash and follow the scan tool instructions.

7. Repeat the conventional bleed procedure as outlined in Steps 1 through 5.

8. If the brake pedal feels spongy, repeat the scan tool service bleed procedure.

Gravity

WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

CAUTION: Do not allow the brake master cylinder reservoir to run dry during the bleeding operation. Keep the brake master cylinder reservoir filled with the specified brake fluid. Never reuse the brake fluid that has been drained from the hydraulic system.

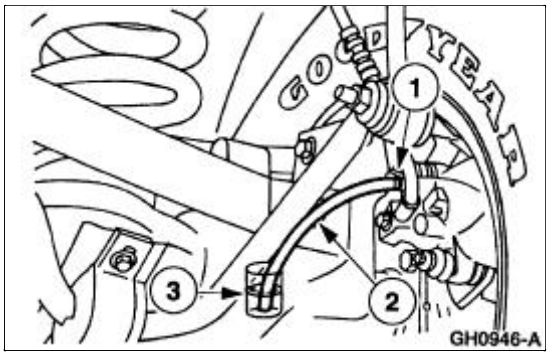
CAUTION: Brake fluid is harmful to painted and plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

NOTE: When any part of the hydraulic system has been disconnected for repair or new installation, air may get into the system and cause spongy brake pedal action. This requires bleeding of the hydraulic system after it has been correctly connected. The hydraulic system can be bled manually or with pressure bleeding equipment.

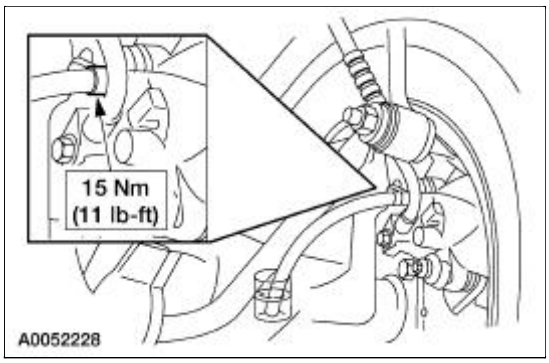
NOTE: When a new brake master cylinder has been installed or the system has been emptied, or partially emptied, it should be primed to prevent air from getting into the system.

1. Fill the brake master cylinder reservoir with brake fluid.

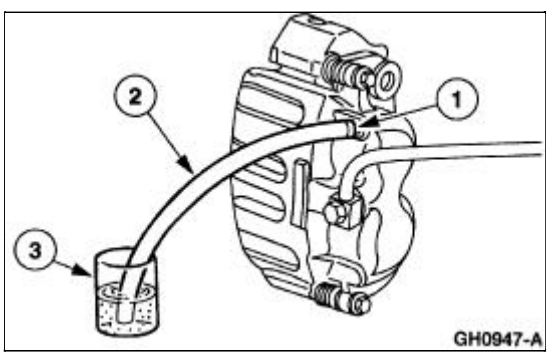
2. Bleed the rear disc brake calipers.
    1. Place a box end wrench on the RH rear disc brake caliper bleeder screw.
    2. Attach a rubber drain tube to the RH rear disc brake caliper bleeder screw and submerge the free end of the tube in a container partially filled with clean brake fluid.
    3. Open the bleeder screw and leave open until clear bubble-free brake fluid flows.
        - Repeat for LH rear disc brake caliper.



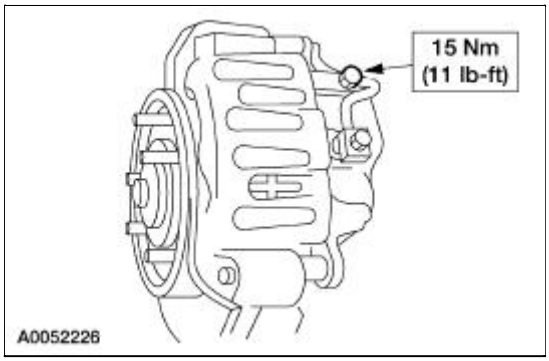
3. Tighten the rear disc brake caliper bleeder screws.



4. Bleed the front disc brake calipers.
    1. Place a box end wrench on the RH front disc brake caliper bleeder screw.
    2. Attach a rubber drain tube to the RH front disc brake caliper bleeder screw and submerge the free end of the tube in a container partially filled with clean brake fluid.
    3. Open the bleeder screw and leave open until clear bubble-free brake fluid flows.
        - Repeat for LH front disc brake caliper.



5. Tighten the front disc brake caliper bleeder screws.



Manual

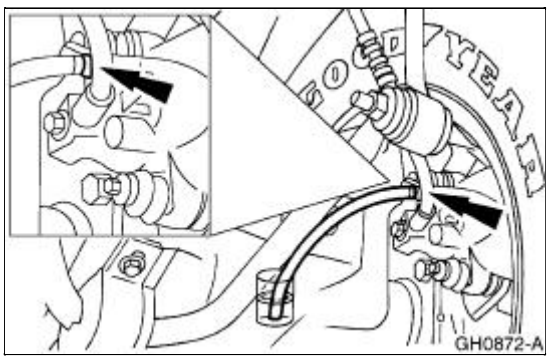
WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

CAUTION: Do not allow the brake master cylinder reservoir to run dry during the bleeding operation. Keep the brake master cylinder reservoir filled with the specified brake fluid. Never reuse the brake fluid that has been drained from the hydraulic system.

CAUTION: Brake fluid is harmful to painted and plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

NOTE: When any part of the hydraulic system has been disconnected for repair or new installation, air may get into the system and cause spongy brake pedal action. This requires bleeding of the hydraulic system after it has been correctly connected. The hydraulic system can be bled manually or with pressure bleeding equipment.

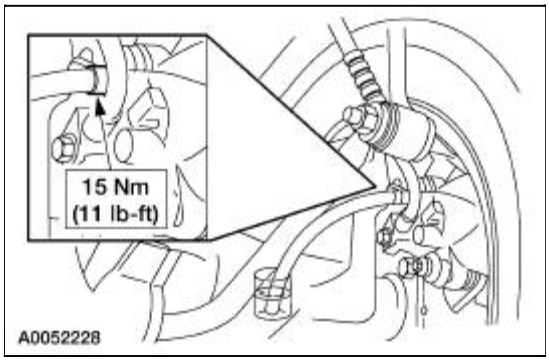
1. Place a box end wrench on the RH rear disc brake caliper bleeder screw. Attach a rubber drain tube to the RH rear disc brake caliper bleeder screw and submerge the free end of the tube in a container partially filled with clean brake fluid.



2. Have an assistant pump the brake pedal and then hold firm pressure on the brake pedal.

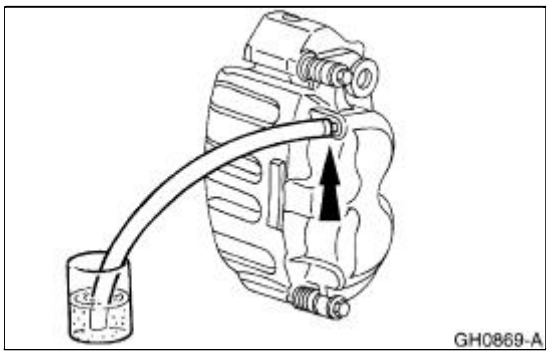
3. Loosen the RH rear disc brake caliper bleeder screw until a stream of brake fluid comes out. Have an assistant maintain pressure on the brake pedal while tightening the RH rear disc brake caliper bleeder screw.
    - Repeat until clear, bubble-free fluid comes out.
    - Refill the brake master cylinder reservoir as necessary.

4. Tighten the RH rear disc brake caliper bleeder screw.



5. Repeat Steps 1, 2, 3, and 4 for the LH rear disc brake caliper.

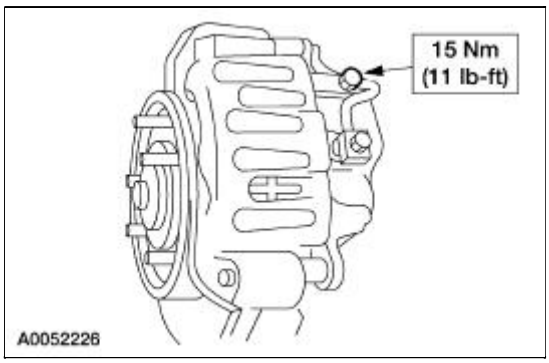
6. Place a box end wrench on the RH front disc brake caliper bleeder screw. Attach a rubber drain tube to the RH front disc brake caliper bleeder screw and submerge the free end of the tube in a container partially filled with clean brake fluid.



7. Have an assistant pump the brake pedal and then hold firm pressure on the brake pedal.

8. Loosen the RH front disc brake caliper bleeder screw until a stream of brake fluid comes out. Have an assistant maintain pressure on the brake pedal while tightening the RH front disc brake caliper bleeder screw.
    - Repeat until clear, bubble-free fluid comes out.
    - Refill the brake master cylinder reservoir as necessary.

9. Tighten the RH front disc brake caliper bleeder screw.



10. Repeat Steps 6, 7, 8, and 9 for the LH front disc brake caliper bleeder screw.

11. If necessary, bleed the brake master cylinder. For additional information, refer to Brake System Bleeding in this section.

Pressure

WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

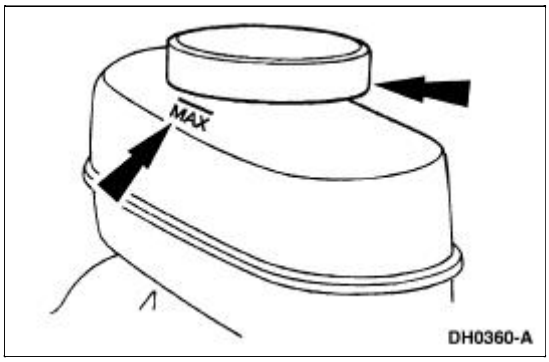
CAUTION: Do not allow the brake master cylinder reservoir to run dry during the bleeding operation. Keep the brake master cylinder reservoir filled with the specified brake fluid. Never reuse the brake fluid that has been drained from the hydraulic system.

CAUTION: Brake fluid is harmful to painted and plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

NOTE: When any part of the hydraulic system has been disconnected for repair or new installation, air may get into the system and cause spongy brake pedal action. This requires bleeding of the hydraulic system after it has been correctly connected. The hydraulic system can be bled manually or with pressure bleeding equipment.

NOTE: Bleed the longest line first. Be sure the bleeder tank contains enough specified brake fluid to complete the bleeding operation.

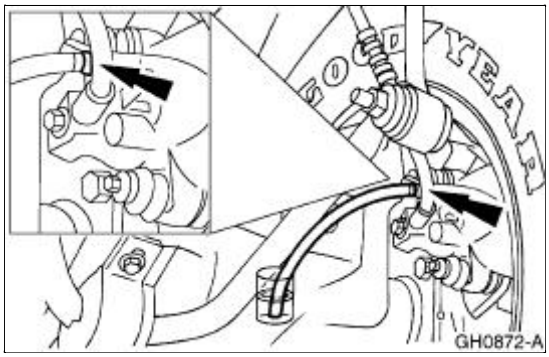
1. Clean all dirt from and remove the brake master cylinder filler cap and fill the brake master cylinder reservoir with the specified brake fluid.



2. **NOTE:** Master cylinder pressure bleeder adapter tools are available from various manufacturers of pressure bleeding equipment. Follow the instructions of the manufacturer when installing the adapter.

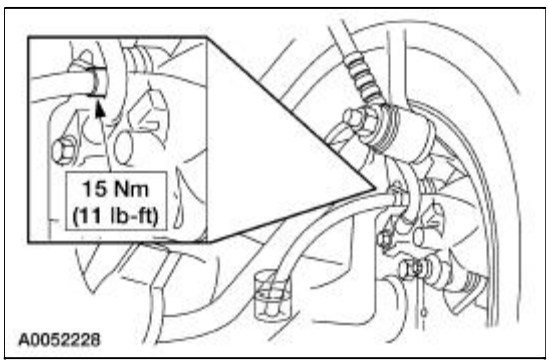
   Install the bleeder adapter to the brake master cylinder reservoir and attach the bleeder tank hose to the fitting on the adapter.

3. Place a box end wrench on the RH rear disc brake caliper bleeder screw. Attach a rubber drain tube to the RH rear disc brake caliper bleeder screw and submerge the free end of the tube in a container partially filled with clean brake fluid.



4. Open the valve on the bleeder tank.

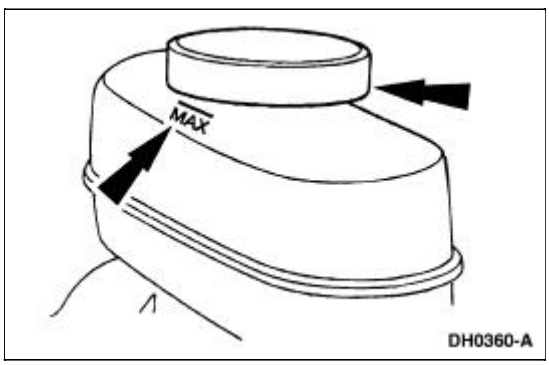
5. Loosen the rear disc brake caliper bleeder screw. Leave open until clear, bubble-free brake fluid flows, then tighten rear disc brake caliper bleeder screw and remove the rubber hose.



6. Continue bleeding the rest of the system, going in order from the LH rear disc brake caliper to the RH front disc brake caliper ending with the LH front disc brake caliper.

7. Close the bleeder tank valve and remove the tank hose from the adapter and remove the adapter.

8. Fill the brake master cylinder reservoir and install the brake master cylinder filler cap.



Master Cylinder, Bench

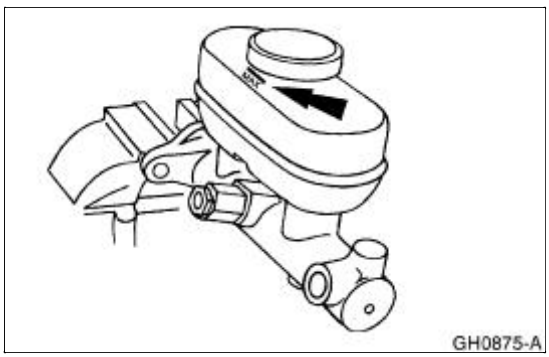
WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

CAUTION: Do not allow the brake master cylinder reservoir to run dry during the bleeding operation. Keep the brake master cylinder reservoir filled with the specified brake fluid. Never reuse the brake fluid that has been drained from the hydraulic system.

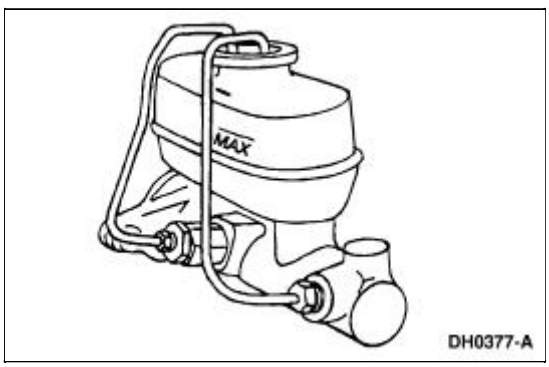
CAUTION: Brake fluid is harmful to painted and plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

NOTE: When any part of the hydraulic system has been disconnected for repair or new installation, air may get into the system and cause spongy brake pedal action. This requires bleeding of the hydraulic system after it has been correctly connected. The hydraulic system can be bled manually or with pressure bleeding equipment.

1. Support the brake master cylinder body in a vise and fill the brake master cylinder reservoir with specified brake fluid.
    - Use clean brake fluid.



2. Install short brake tubes with the ends submerged in the brake master cylinder reservoir.



3. Slowly depress the primary piston until clear fluid flows from both brake tubes, without air bubbles.

4. Remove the short brake tubes.

Brake System Leak Check

1. **NOTE:** Brake fluid is water soluble and therefore evidence of leakage can be washed away if the vehicle is operated in rain or snow.

   Fill the brake master cylinder reservoir.

2. Apply and hold the brakes several times.

3. Check the brake master cylinder reservoir to verify fluid loss.

4. Inspect the brake system for signs of fresh brake fluid leakage.

5. Locate and correct the source of the external leak.

General Specifications

Item	Specification
Disc brake lining wear limit	1.5 mm (0.059 in)
Disc minimum thickness	27 mm (1.06 in)
Disc thickness variation	0.009 mm (0.0003 in)

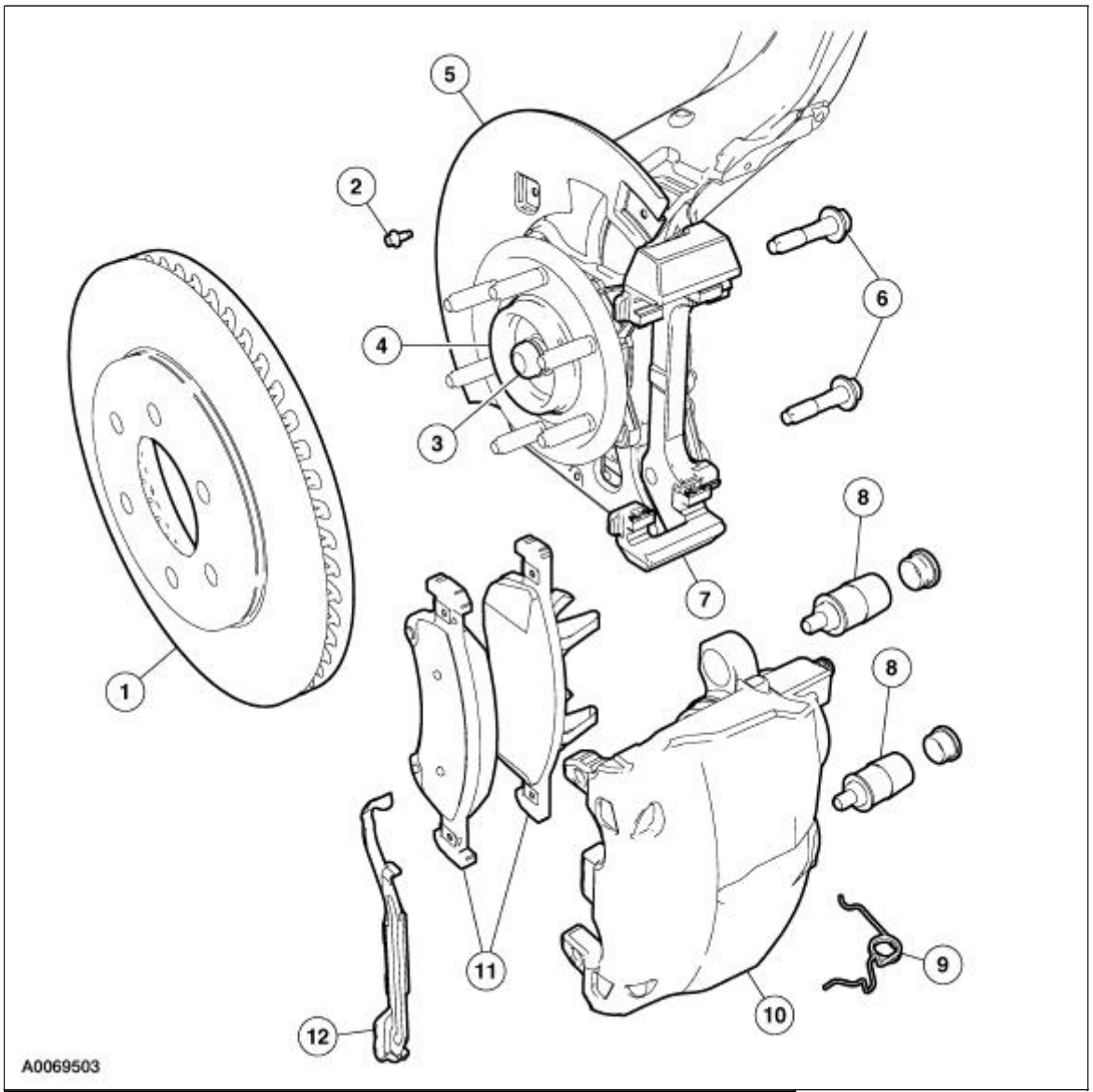
Torque Specifications

Description	Nm	lb-ft	lb-in
Caliper slide pins	55	41	—
Front brake hose bolt	35	26	—
Front disc brake caliper anchor plate bolts	200	148	—
Brake disc shield screws	12	—	106
Spindle nut 4x4 [a]	7	—	62

[a] Refer to the Brake Disc procedure in this section.

Front Disc Brake

Front Disc Brake System



Item	Part Number	Description
1	1125	Brake disc
2	W505211-S301	Brake disc shield screws (3 req'd)
3	1131	Grease cap (4x4)
4	1A148	Wheel hub and bearing assembly
5	2K004	Brake disc shield
6	—	Brake caliper anchor plate bolts (part of 2L527)
7	2C566	Brake caliper anchor plate
8	—	Brake caliper slide pin boot (part of 2L527)

8	—	Brake caliper slide pin (part of 2L527)
9	2035	Zero-drag spring
10	2B120	Brake caliper
11	2001	Brake pads
12	2B164	Anchor housing spring

On front disc brake systems:

- the disc brake caliper bolts to the front disc brake caliper anchor plate.
- the front disc brake caliper anchor plate bolts to the front wheel knuckle.
- a separate brake disc attaches to the wheel hub.

The disc brake caliper:

- is a pin slider, dual piston type.
- housing has a fluid inlet at the center of the bore. A square section seal fitted into an annular groove in the caliper cylinder bore seals against hydraulic pressure, while rubber boots seal the caliper pistons and caliper bore from contamination.

The brake disc shield:

- bolts to the front wheel knuckle.
- protects the inboard surface of the brake disc.

The pads are:

- contained within the front disc brake caliper anchor plate.
- held to the front disc brake caliper anchor plate abutments by disc brake anti-rattle clips.

Front Disc Brake

Refer to Section 206-00 .

Brake Pads

Material

Item	Specification
Brake Parts Cleaner PM-4	—

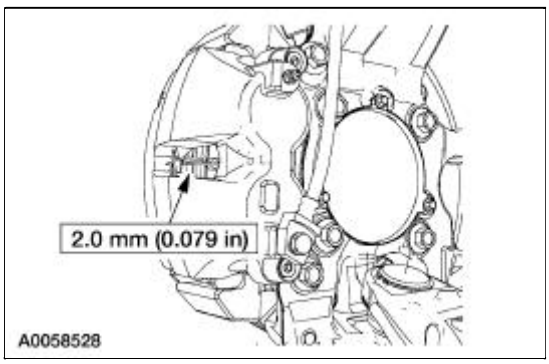
Removal

1. **CAUTION: Install a new lining if worn to or past the specified thickness above the metal backing plate or rivets. Install new pads in complete axle sets.**

   If necessary, using a suitable suction device, remove the brake fluid in the master cylinder reservoir until it is half filled.

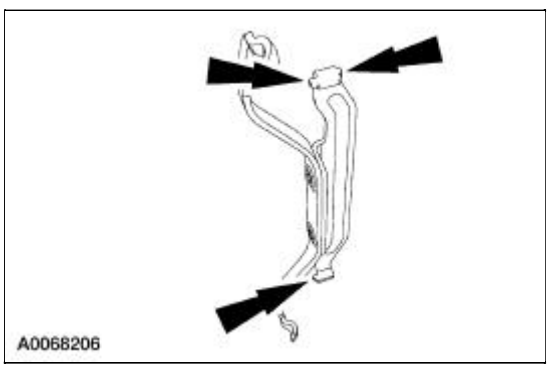
2. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .

3. Inspect the brake pads for wear or contamination.



4. **CAUTION: If the anchor housing spring is to be reused, do not force the anchor housing spring off the brake caliper. Do not install a damaged anchor housing spring.**

   Remove the anchor housing spring.

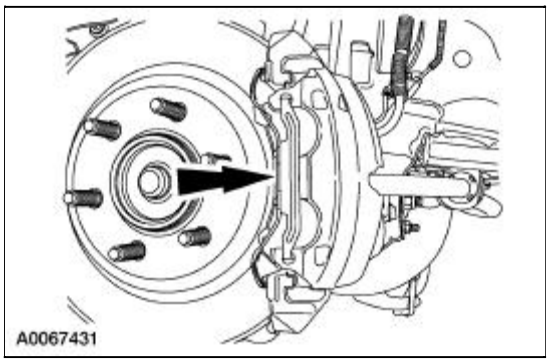


5. **NOTE:** Verify if the anchor housing spring has 1 end with 2 tabs. If yes, the LH side anchor

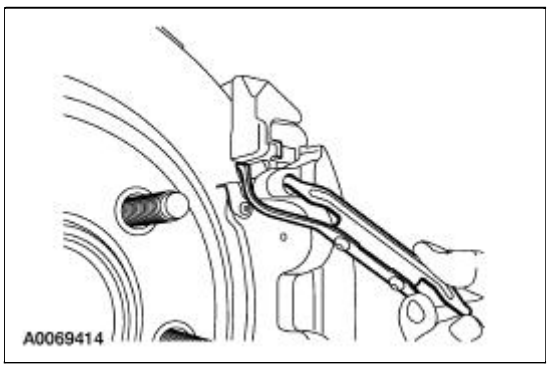
housing spring must be installed with the 2-tabbed end in the upper brake caliper cavity.

For the LH brake caliper, release the lower portion of the anchor housing spring.

- Apply force at the center of the anchor housing spring and pull outward at the bottom of the anchor housing spring to remove it from the lower brake caliper cavity.



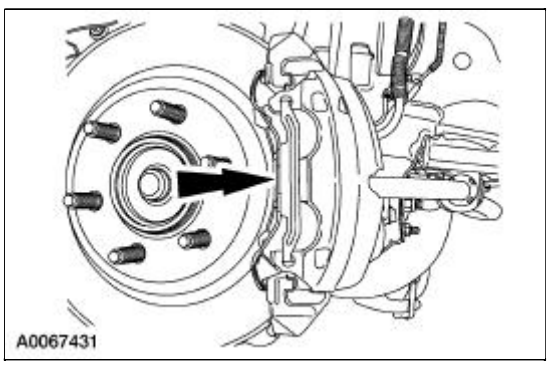
6. Rotate the spring upward then remove it from the brake caliper.



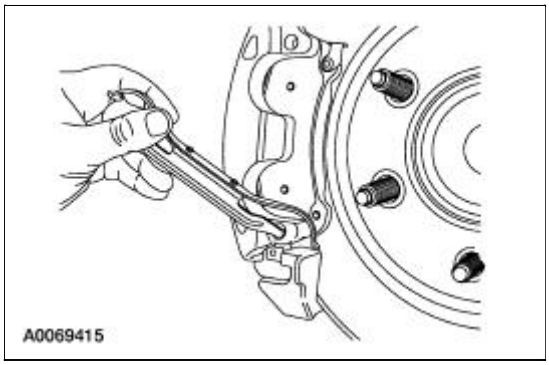
7. **NOTE:** On the RH side, the anchor housing spring must be installed with the 2-tabbed end in the lower brake caliper cavity. The illustration below shows the anchor housing spring end with 2 tabs.

   For RH brake caliper, release the upper portion of the anchor housing spring.

   - Apply force at the center of the anchor housing spring and pull outward at the top of the anchor housing spring to remove it from the upper brake caliper cavity.

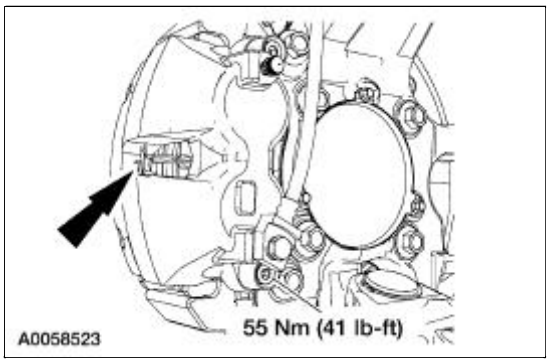


8. Rotate the spring downward then remove it from the brake caliper.



9. **NOTE:** Do not allow the brake caliper to hang from the brake hose.

   Remove the brake caliper.
   1. Remove the zero-drag spring.
   2. Remove and discard the brake caliper-to-anchor plate bolts, guide pins and boots.

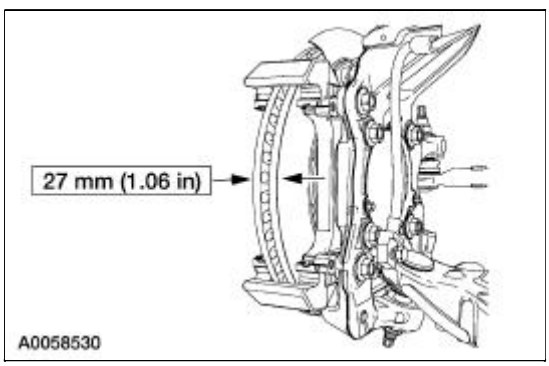


10. Remove the brake pads from the brake caliper.

11. **NOTE:** Use a wood block or used brake pad to protect the brake caliper piston boots.

    Compress the brake caliper pistons.

12. Measure the brake disc thickness.
    - Install a new brake disc if it is not within specification. For additional information, refer to Brake Disc in this section.



Installation

1. Using brake parts cleaner, clean the inner surfaces of the brake caliper where the brake pads attach.

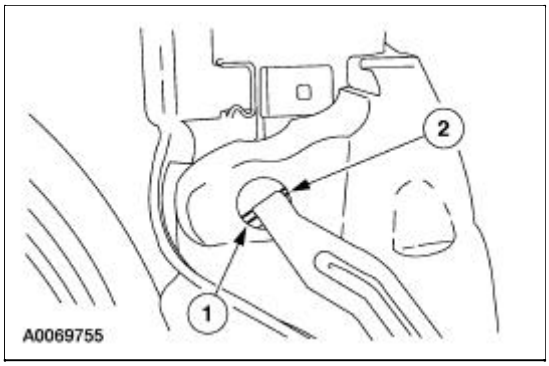
2. Install new brake hardware as follows:

- Install the guide pin bushings into the caliper bores.
- Apply grease to the inside of the guide pin bushing. Do not apply grease to the guide pin threads.
- Push the guide pins into the bushing.

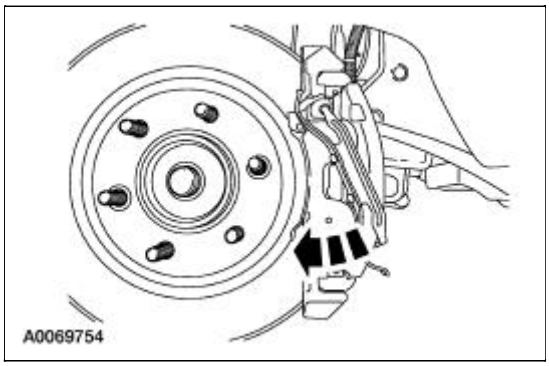
3. Install the inboard brake pad into the brake caliper.
4. Remove the protective paper from the outboard brake pad and install it into the brake caliper.
5. Install the brake caliper on the brake disc.
6. Tighten the guide pins and install the dust caps.
7. Install the zero-drag spring.

NOTE: If present, the 2-tabbed end of the anchor housing spring must be installed first.

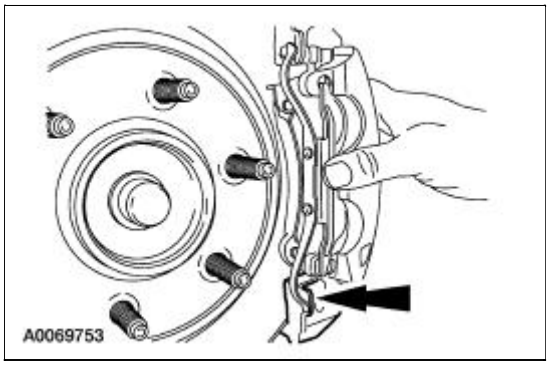
8. Install the anchor housing spring.
    1. Insert tab of the anchor housing spring into the brake caliper cavity.
    2. Twist tab into the brake caliper cavity (LH side-upper brake caliper cavity/RH side-lower brake caliper cavity).



9. Rotate the anchor housing spring and position the upper portion onto the anchor plate.



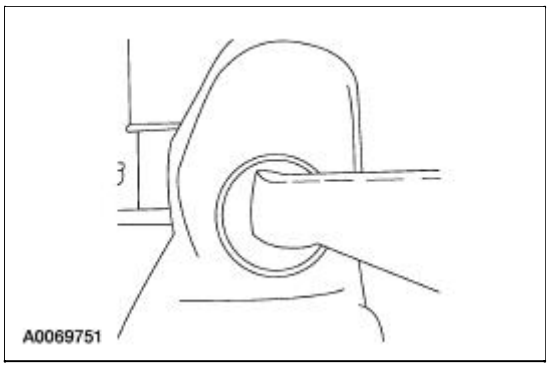
10. Position the other anchor housing spring portion onto the brake caliper anchor plate.



11. Push down and inward until the upper and lower ends of the anchor housing spring are latched and seated in the brake caliper cavities.

12. **NOTE:** The latch **MUST** be positioned as shown.

    Verify that the anchor housing spring is correctly latched.



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

14. Apply the brake several times to verify correct brake operation.

Brake Caliper

Removal and Installation

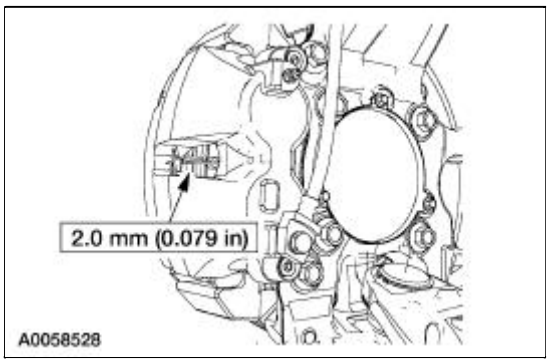
1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

   Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .

2. Remove the brake pads. For additional information, refer to Brake Pads in this section.

3. **CAUTION: Install a new lining if worn to or past the specified thickness above the metal backing plate or rivets. Install new pads in complete axle sets.**

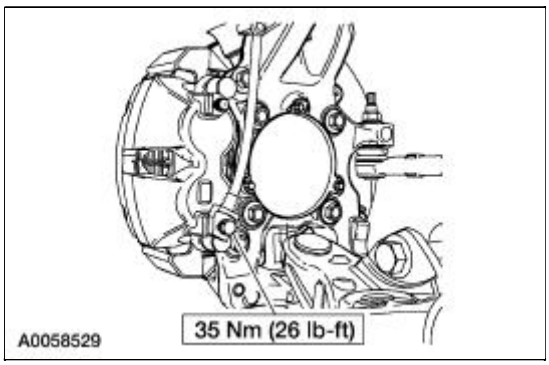
   Inspect the pads for wear or contamination.



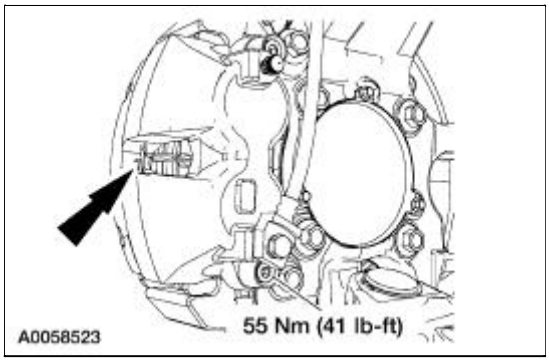
4. **WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.**

   Disconnect the front brake hose.

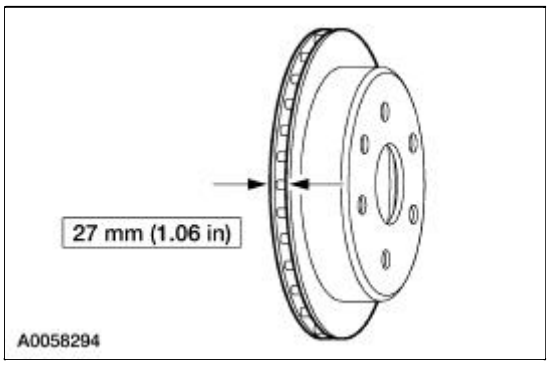
   - Use new copper washers to connect the front brake hose.



5. Remove the disc brake caliper bolts.



6. Measure the brake disc thickness.
    - Install a new brake disc (1125) if not within specification.



7. Inspect the disc brake caliper for leaks.
    - If leaks are found, the brake caliper must be disassembled. For additional information, refer to Brake Caliper .

8. Bleed the brake system. For additional information, refer to Section 206-00 .

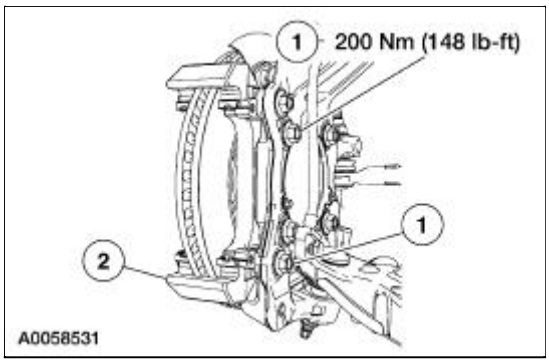
9. To install, reverse the removal procedure.

Brake Caliper Anchor Plate

Removal and Installation

1. Remove the brake pads. For additional information, refer to Brake Pads in this section.

2. Remove the brake caliper anchor plate.
    1. Remove the brake caliper anchor plate bolts.
    2. Remove the brake caliper anchor plate.



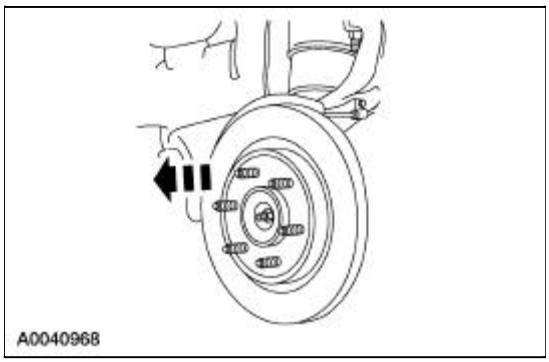
3. To install, reverse the removal procedure.

Brake Disc

Removal and Installation

1. Remove the brake caliper anchor plate. For additional information, refer to Brake Caliper Anchor Plate in this section.

2. Remove the brake disc.



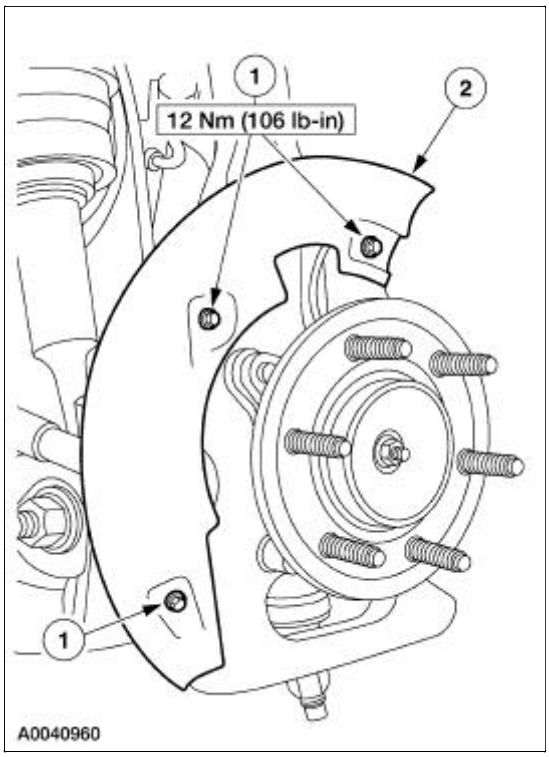
3. To install, reverse the removal procedure.

Brake Disc Shield

Removal and Installation

1. Remove the brake disc. For additional information, refer to Brake Disc in this section.

2. Remove the brake disc shield.
    1. Remove the brake disc shield screws.
    2. Remove the brake disc shield.



3. To install, reverse the removal procedure.

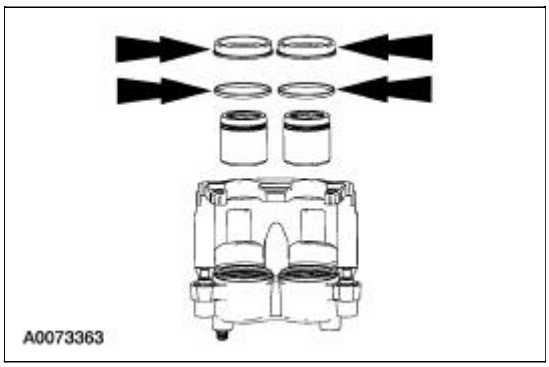
Brake Caliper

Material

Item	Specification
High Performance DOT 3 Motor Vehicle Brake Fluid PM1	ESA-M6C25-A

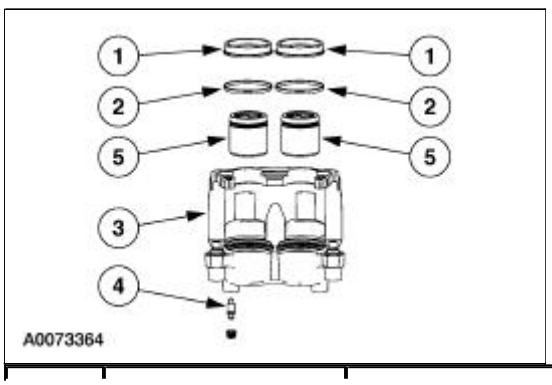
Disassembly

1. Remove the disc brake caliper. For additional information, refer to Brake Caliper in this section.
2. Drain the remaining brake fluid from the disc brake caliper.
3. Secure the disc brake caliper in a vise.
4. Remove the caliper pistons (2196).
    1. Place a block of wood between the caliper bridge and the caliper pistons.
    2. Apply low air pressure to the fluid port in the disc brake caliper.
    3. Force out the caliper pistons to the block of wood.
    4. Remove the block of wood and the caliper pistons.
5. Remove and discard the piston seals and boots.



6. **NOTE:** Do not hone the cylinder bores. Pistons are not available for honed cylinder bores.

   If the cylinder bores are excessively scored or corroded, replace the disc brake caliper.



Item	Part Number	Description
1	2L484	Piston boot (part of 2B120 kit)
2	—	Piston seal (part of 2B120)
3	2B120/2B121	Disc brake caliper (LH/RH)
4	2208	Bleeder screw (part of 2B120)
5	2C197	Caliper piston (part of 2B120)

Assembly

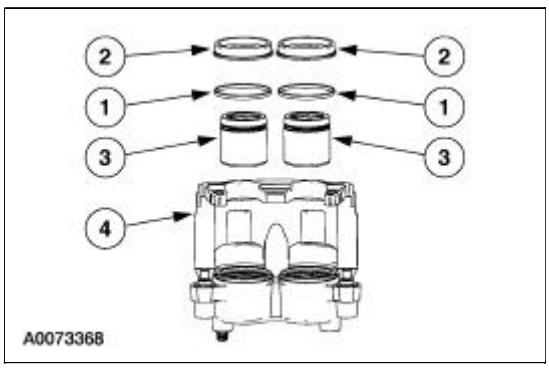
CAUTION: Never reuse piston seals and dust boots.

NOTE: Never reuse brake fluid that has been drained from the hydraulic system or has been allowed to stand in an open container for an extended period of time.

1. Lubricate the piston boot, caliper piston, piston seal, and cylinder bores with brake fluid.
2. Place the brake caliper in a vise.
3. Install the caliper pistons.
    1. Install the piston seal.
    2. Install the piston boot on the brake caliper.
    3. **CAUTION: Be careful not to damage or dislodge the piston seal.**

       Insert the caliper piston.
    4. **CAUTION: Be careful not to cock the caliper piston.**

       Insert the piston into the disc brake caliper bore.
        - Place the piston squarely against the dust boot.
        - While applying shop air to the fluid port in the disc brake caliper, push the piston squarely into the bore.
4. Install the disc brake caliper. For additional information, refer to Brake Caliper in this section.



General Specifications

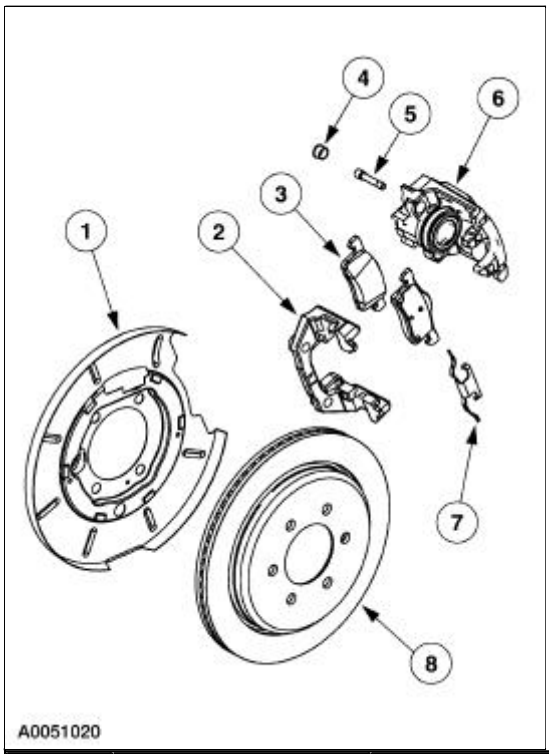
Item	Specification
Rear disc brake lining minimum thickness mm (in)	1.0 (0.039)
Brake disc minimum thickness mm (in)	19.0 (0.75)
Maximum brake disc runout mm (in)	0.0025 (0.000098)
Maximum brake disc thickness variation mm (in)	0.009 (0.0004)
Lubricants	
High-Performance Dot 3 Brake Fluid PM-1	ESA-M6C25-A

Torque Specifications

Description	Nm	lb-ft
Brake caliper guide pins	35	26
Brake caliper flow bolt	35	26
Brake caliper anchor plate bolts	190	140

Rear Disc Brake

Rear Disc Brake Components



Item	Part Number	Description
1	2C028	Brake disc shield
2	2209	Brake caliper anchor plate
3	2200	Brake pads
4	—	Cap
5	—	Brake caliper bolt
6	2555	Brake caliper
7	—	Anchor housing spring
8	2C026	Brake disc

NOTE: The inboard and outboard brake pads are not interchangeable.

The brake disc is a vented, full-cast, drum-in-hat type. The rear disc brake caliper is a single-piston type. Each brake pad is equipped with a riveted spring clip that secures it to either the rear disc brake caliper piston or the rear disc brake caliper housing.

Rear Disc Brake

Refer to Section 206-00 .

Brake Caliper

Removal and Installation

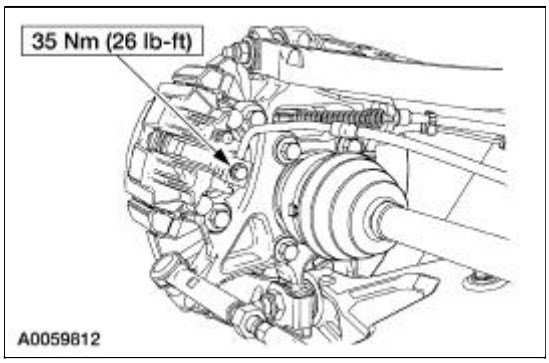
1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the RH kick panel area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

   Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .

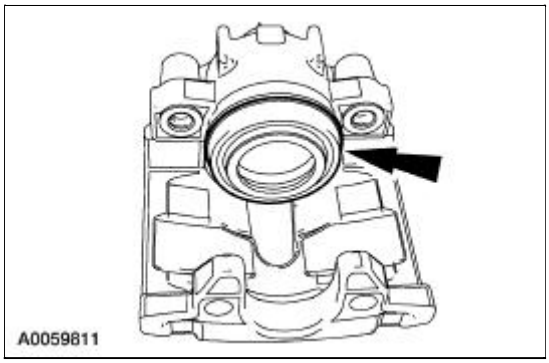
2. **WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.**

   CAUTION: Brake fluid is harmful to painted or plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

   Remove the bolt and disconnect the hose.
   - Remove and discard the copper washers.



3. Remove the brake pads. For additional information, refer to Brake Pads in this section.
4. Inspect the rear disc brake caliper for leaks.
   - If leaks are found, disassembly is required. For additional information refer to Caliper , Disassembly in this section.



5. To install, reverse the removal procedure.

Brake Pads

Removal and Installation

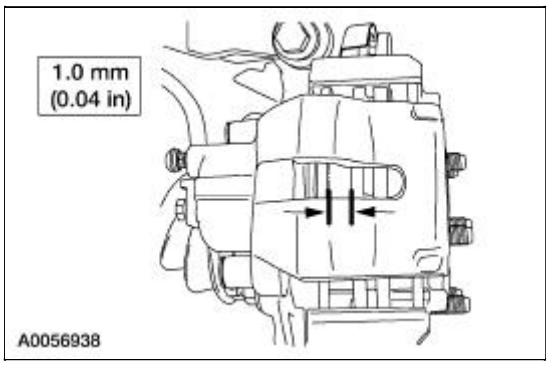
1. Using a clear suction device, remove brake fluid in the master cylinder reservoir until the reservoir is half full.

2. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the RH kick panel area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

   Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .

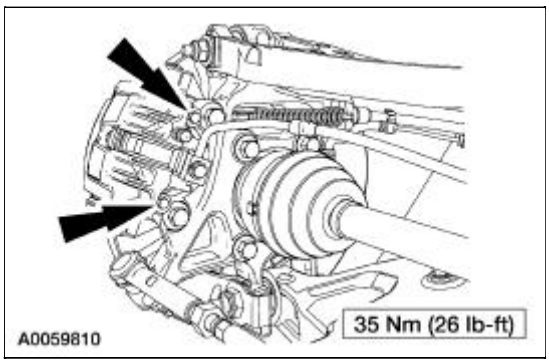
3. **CAUTION: Install new pads if worn to or past the specified thickness above the metal backing plate. Install new pads in complete axle sets.**

   Inspect the brake pads for wear or contamination. Install new pads if worn to or past specification.



4. Remove the anchor housing spring.
   - Squeeze at the center of the spring until it unlatches from the brake caliper at both ends.
   - Rotate the spring, then remove it from the caliper housing.

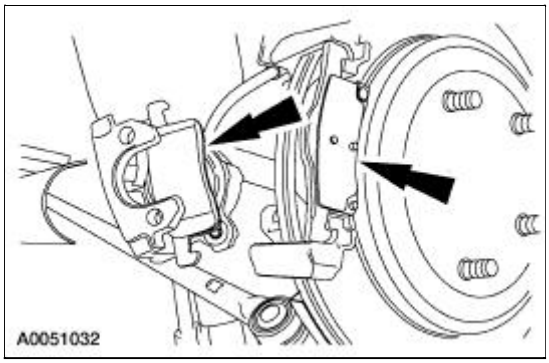
5. Remove the caps and brake caliper bolts.



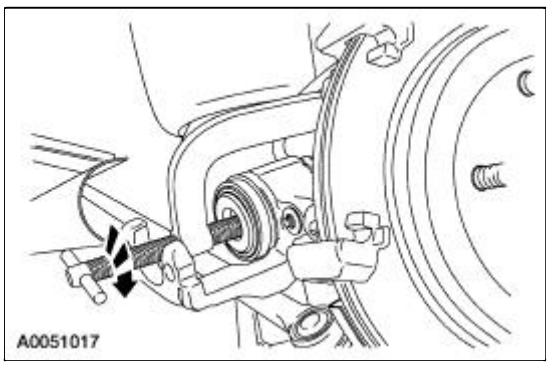
6. **CAUTION: Do not allow the brake caliper to hang by the flexible brake hose.**

   NOTE: It is not necessary to remove the rear wheel brake hose when carrying out this procedure.

   Remove the caliper and the brake pads.

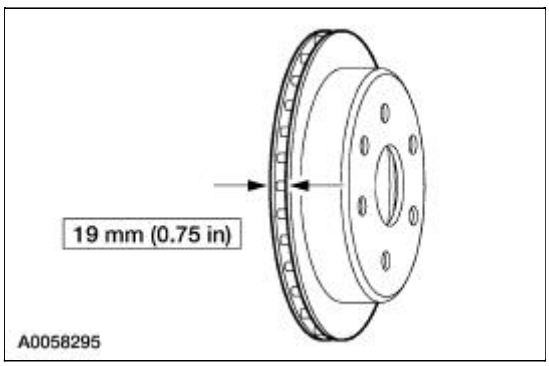


7. Using a suitable clamp, press the piston into the caliper.



8. **CAUTION: If machining is necessary, use a hub-mount brake lathe to machine the rear brake disc.**

   Inspect the brake disc. If it is scored it must be resurfaced.

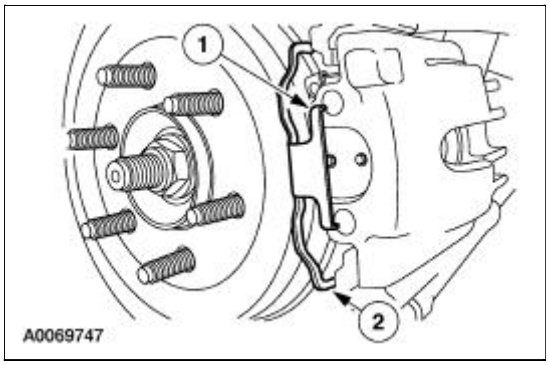


9. **NOTE:** Also, resurface the rear brake disc if a test drive has identified vibration transmitted through the steering wheel, seat, or brake pedal while braking.

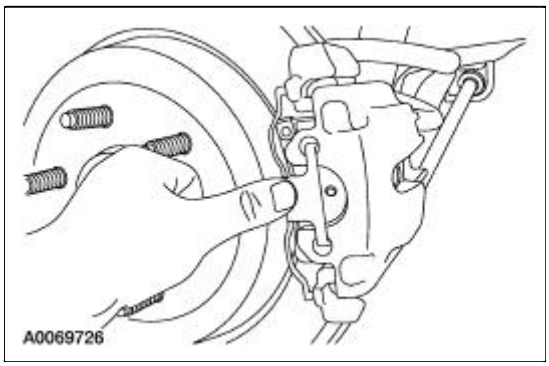
   Measure the rear brake disc, and resurface as necessary. Install a new rear brake disc if beyond specification.

10. To install, reverse the removal procedure.

11. Install the anchor housing spring.
    1. Insert the upper anchor housing spring end into the brake caliper cavity.
    2. Rotate the anchor housing spring and position the lower arm onto the anchor plate.

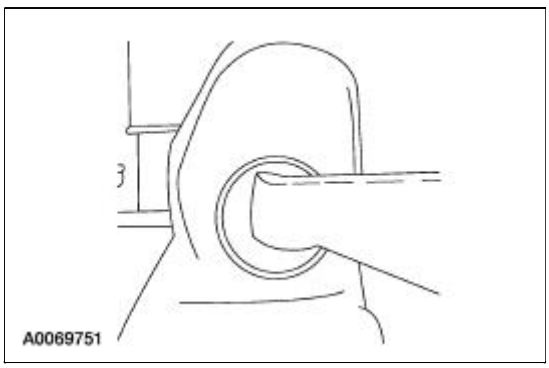


12. Position the upper arm onto the anchor plate, then press down and inward until it is correctly seated and latched into the brake caliper cavities.



13. **NOTE:** The latch **MUST** be positioned as shown.

    Verify that the anchor housing spring is correctly latched.



Brake Disc

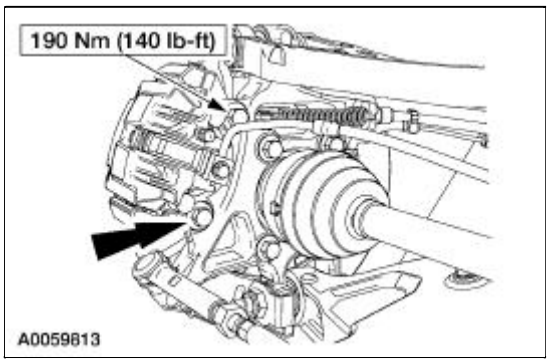
Removal and Installation

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the RH kick panel area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

   Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .

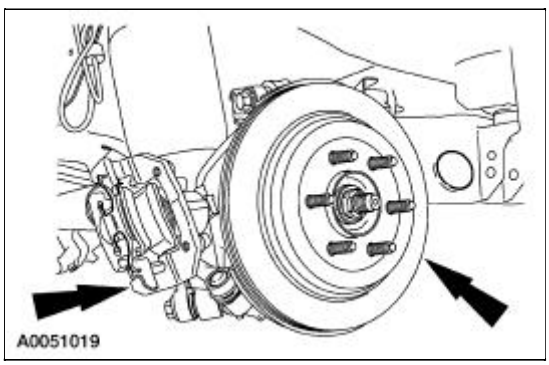
2. **NOTE:** When removing the rear disc brake caliper in this procedure, it is not necessary to disconnect the rear wheel brake hose.

   Remove the brake caliper anchor plate bolts.



3. **CAUTION: Do not allow the brake caliper to hang by the flexible brake hose.**

   Remove the anchor plate and caliper as an assembly.



4. **NOTE:** If the brake disc binds on the parking brake shoe, remove the adjustment hole access plug and contract the parking brake shoe.

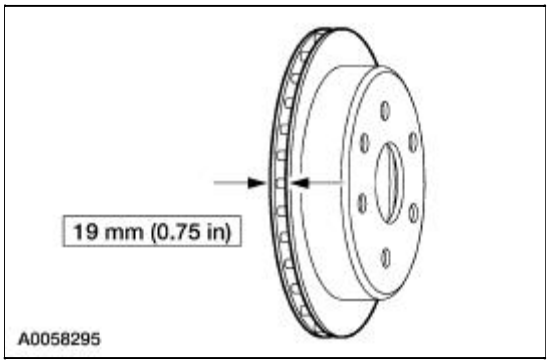
   Remove the brake disc.

5. **CAUTION: If machining is necessary use a hub-mount brake lathe to machine the**

rear brake disc.

NOTE: Inspect the brake disc. If it is scored, it must be resurfaced. Also, resurface the rear brake disc if a test drive has identified vibration transmitted through the steering wheel, seat or brake pedal while braking.

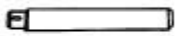
Measure the rear brake disc, and resurface as necessary. Install a new rear brake disc if beyond specification.



6. To install, reverse the removal procedure.

Caliper

Special Tool(s)

 ST1255-A	Adapter for 303-224 (Handle) 205-153 (T80T-4000-W)
 ST1588-A	Installer, Rear Wheel Hub Dust Seal 206-053 (T92P-2588-AH)

Material

Item	Specification
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1	ESA-M6C25-A

Disassembly

1. Remove the rear disc brake caliper. For additional information, refer to Brake Caliper in this section.

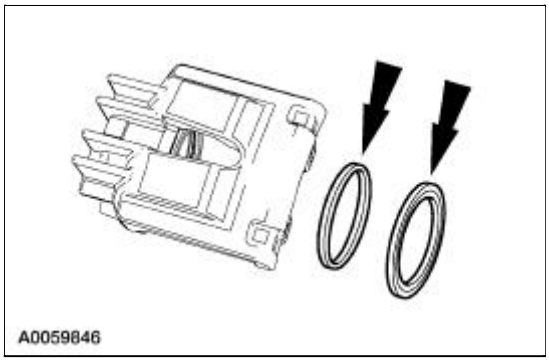
2. Drain the remaining brake fluid from the rear disc brake caliper.

3. Secure the rear disc brake caliper in a vise.

4. Remove the caliper piston.
    1. Place a block of wood between the caliper bridge and the caliper piston.
    2. Apply low air pressure to the fluid port in the rear disc brake caliper.
    3. Force out the caliper piston to the block of wood.
    4. Remove the block of wood and the caliper piston.

5. **NOTE:** Do not hone the cylinder bore. Caliper pistons are not available for honed cylinder bores. If the rear disc brake caliper cylinder bore or piston is excessively scored or corroded, install a new rear disc brake caliper.

   Remove and discard the piston seal and dust boot.

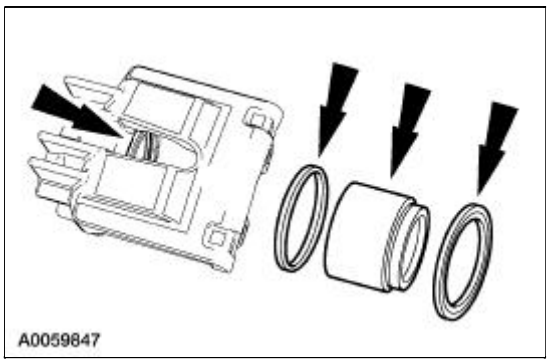


Assembly

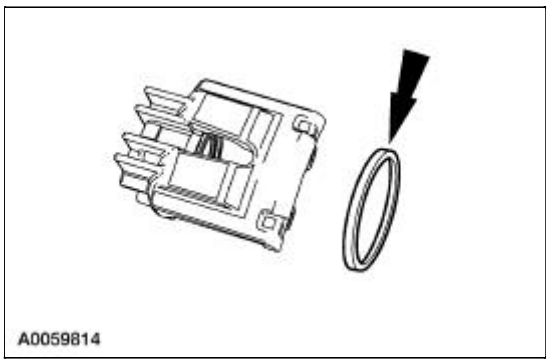
CAUTION: Never reuse the piston seal or dust boot.

NOTE: Never reuse brake fluid that has been drained from the hydraulic system or has been allowed to stand in an open container for an extended period of time.

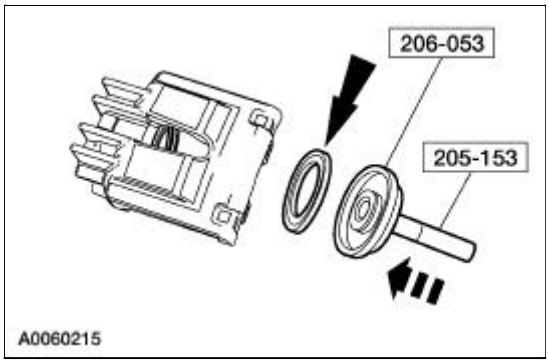
1. Lubricate the following with brake fluid.
    - Cylinder bore.
    - Piston seal.
    - Caliper piston.
    - Dust boot.



2. Install the piston seal.



3. Using the special tools, install the dust boot.



4. **CAUTION: Be careful not to damage or dislodge the piston seal.**

   CAUTION: Insert the caliper piston squarely into the caliper bore.

   Install the caliper piston.
   1. Place the brake caliper in a vise.
   2. Place the piston squarely against the dust boot.
   3. While applying shop air into the brake caliper, push the piston squarely into the brake caliper bore.

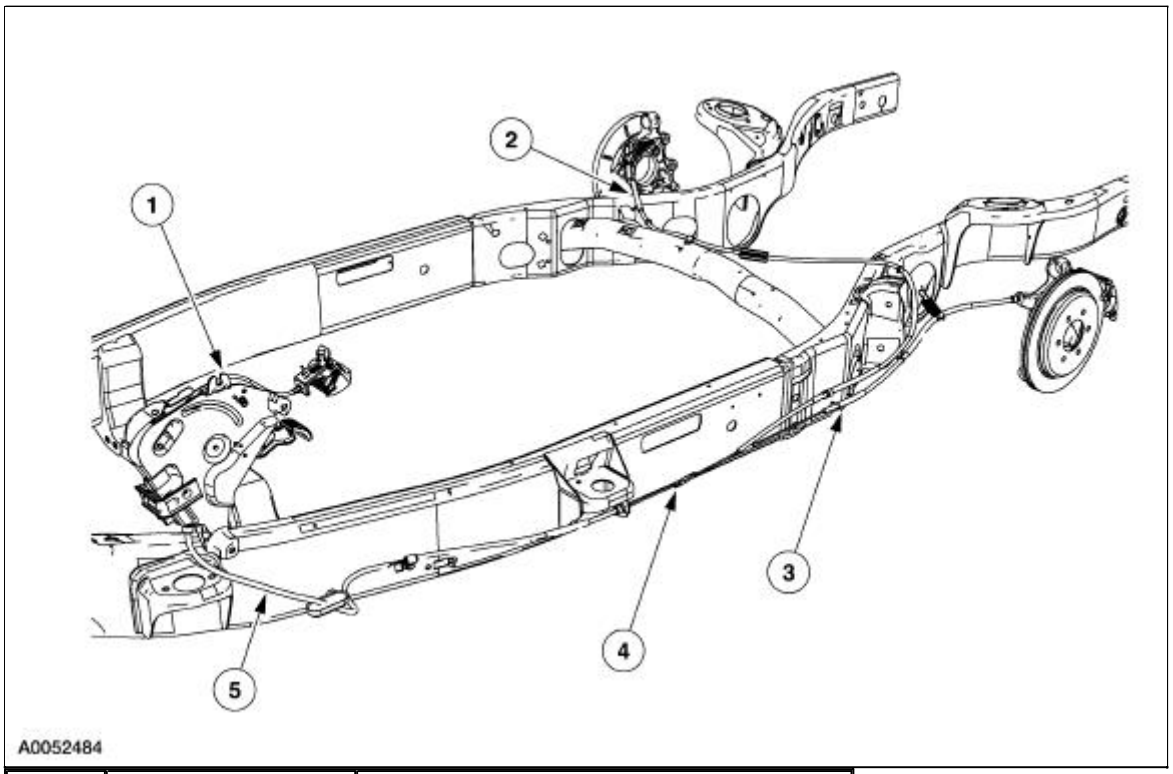
5. Install the rear disc brake caliper. For additional information, refer to Brake Caliper in this section.

Torque Specifications

Description	Nm	lb-ft
Parking brake control to cowl panel bolts	18	13
Wireform bracket screws	35	26

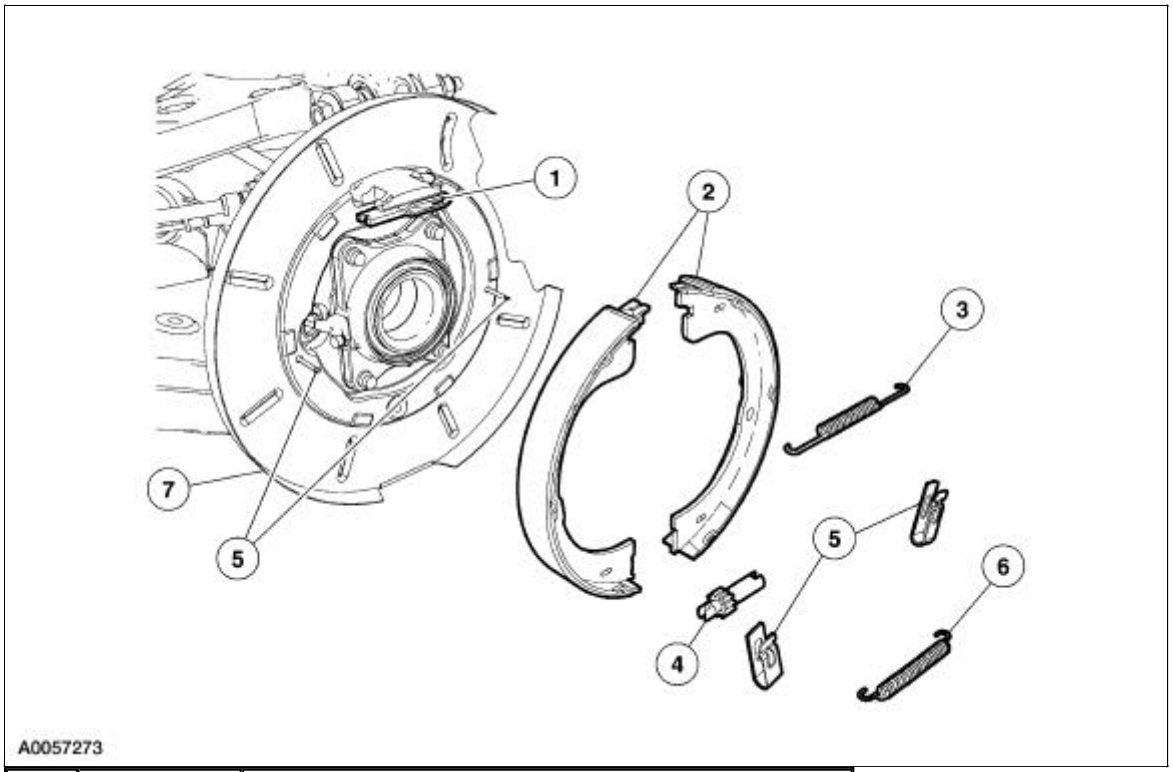
Parking Brake

Parking Brake System Components



Item	Part Number	Description
1	2780	Parking brake control
2	2A635	RH rear parking brake cable
3	2A635	LH rear parking brake cable
4	2A602	Parking brake equalizer
5	2853	Front parking brake cable

Parking Shoes and Hardware



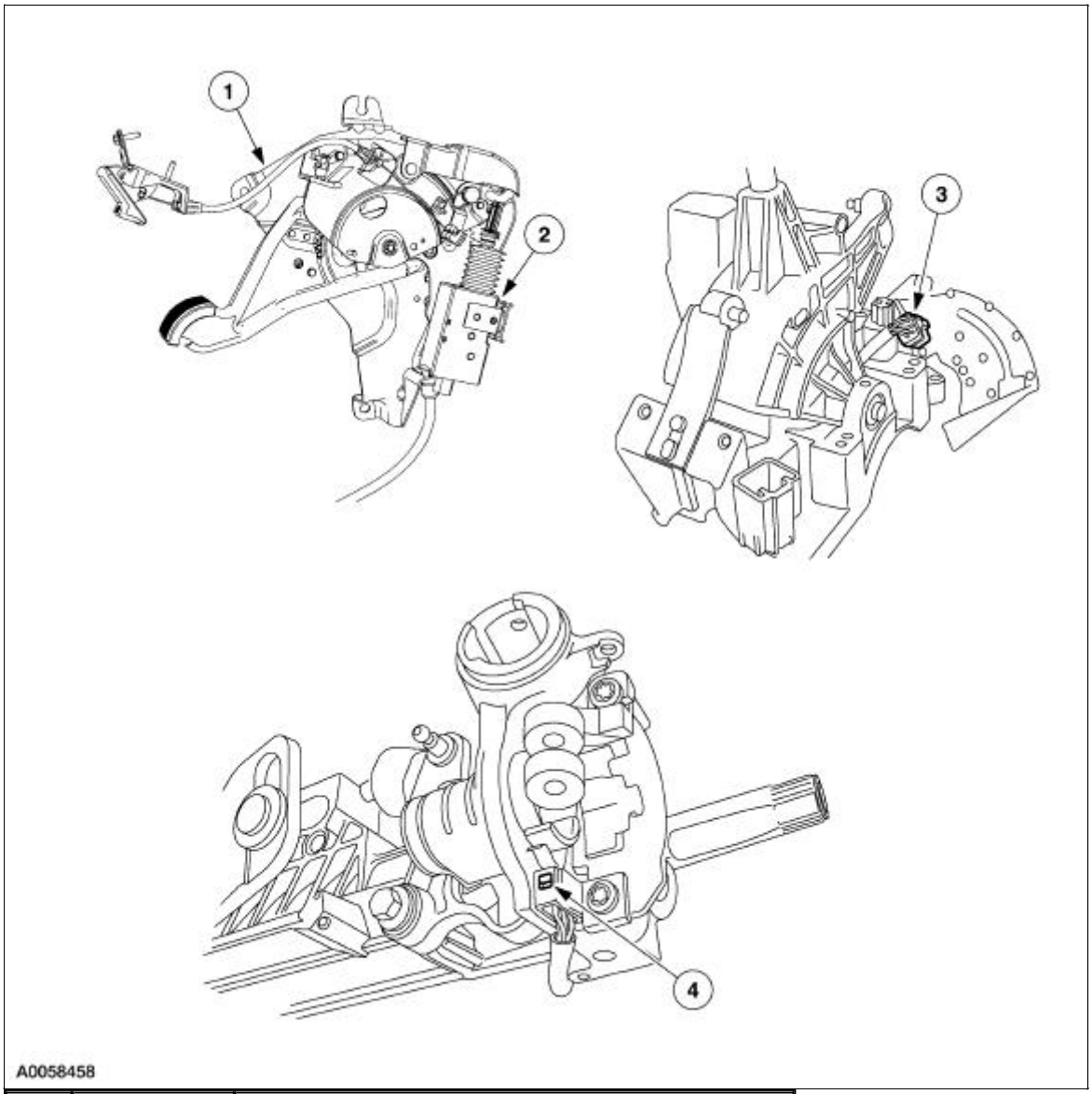
Item	Part Number	Description
1	2A637	Actuator lever
2	2049	Parking brake shoes (kit)
3	2648	Spring (part of brake shoe kit 2049)
4	2041	Parking brake shoe adjuster
5	2049	Parking shoe retainer and pin (part of brake shoe kit 2049)
6	2648	Spring (part of brake shoe kit 2049)
7	2C028	Brake disc shield

Electronic Parking Brake Release

The parking brake release uses an electrically operated solenoid to release the park brake. The solenoid is mounted on the parking brake control. With the brake pedal depressed and the gear shift lever shifted from the park position, the solenoid retracts to release the parking brake.

Operation of the actuator is controlled through release and return relays. Output from the electronic cluster controls the opening and closing of the relay contacts. The cluster actually provides a path to ground for the coils in the relays. Actuation of the cluster depends on input signals from the brake pedal switch, park brake switch and a gear shift-operated micro switch.

Automatic Parking Brake Release Components



A0058458

Item	Part Number	Description
1	2780	Parking brake control
2	—	Parking brake release solenoid
3	—	Floor shift mounted actuator switch
4	—	Column mounted actuator switch (Expedition only)

Parking Brake

Principles of Operation—Automatic Parking Brake Release (Lincoln Navigator)

The automatic parking brake release consists of the following components:

- Release actuator
- Electromechanical solenoid
- Gearshift lever position switch
- Parking brake warning indicator switch
- Wiring harnesses connecting the various components

When the parking brake is set and the gearshift lever is moved to "R" or "D", the gearshift lever position switch closes. The instrument cluster module energizes the parking brake return solenoid. Once the parking brake is released, the parking brake warning indicator switch opens, and the instrument cluster module's second signal releases the actuator. The solenoid is energized only when both the parking brake warning indicator switch and the gearshift lever position switch are closed with the brake pedal applied.

Inspection and Verification

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the RH kick panel area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

   Check the operation of the parking brake with the vehicle on a hoist and the parking brake control fully released. Check for any cable damage and install a new cable as necessary.

2. Check the parking brake by depressing the parking brake control pedal. The parking brake must fully set upon full apply.

3. Inspect to determine if one of the following mechanical or electrical concerns apply:

Visual Inspection Chart

Mechanical	Electrical
● Release actuator ● Electromechanical solenoid ● Gearshift lever position switch ● Parking brake warning indicator switch	● Battery junction box (BJB) fuses: ■ 18 (10A) ■ 21 (15A) ● Wiring harness ● Connectors or connections ● Circuitry

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
● Parking brake will not apply	● Clearance.	● CHECK the brake cable for slack, or breaks. ADJUST or REPAIR as necessary.
	● Grease-soaked parking brake shoe linings.	● REPAIR the source of the leak and INSTALL a new parking brake shoe and lining.
	● Binding linkage.	● CHECK for linkage binding and misalignment. LUBRICATE all friction points.
	● Parking brake shoe and lining.	● INSTALL a new parking brake shoe and lining. CHECK the drum-in-hat surface for scoring and INSTALL new as necessary. REFER to Section 206-04 .
	● Worn or damaged parking brake components.	● INSTALL new components as necessary.
● Parking brake will not release	● Parking brake control. ● Parking brake cables binding. ● Binding parking brake components.	● INSPECT and REPAIR as necessary.
● Automatic parking brake release does not operate	● Battery junction box (BJB) fuses: ■ 18 (10A) ■ 21 (15A) ● Gearshift lever position switch. ● Wiring. ● Release actuator. ● Retract relay.	● Go To Pinpoint Test A .
● Excessive lining wear	● Brake drag.	● CHECK the parking brake cables for a binding condition. INSPECT for broken or missing springs.
	● Rough brake disc drum surface.	● INSTALL a new brake disc if drum section is badly scored. REFER to Section 206-04 .

Pinpoint Tests

PINPOINT TEST A: AUTOMATIC PARKING BRAKE RELEASE DOES NOT OPERATE

Test Step	Result / Action to Take
A1 VERIFY THE CONDITION	
	Yes

WARNING: Chock the wheels and make sure the service brake is pressed firmly down to prevent vehicle movement. Failure to follow these instructions can result in personal injury. ● Apply the parking brake. ● Key in ON position. ● Move the transmission shift lever from P to R, and to D. ● **Does the parking brake release actuate?**	System is OK. RETURN the vehicle to the customer. **No** GO to A2.
A2 CHECK BATTERY JUNCTION BOX (BJB) FUSE 18 (10A) AND FUSE 21 (15A)	
● Check BJB fuses 18 (10A) and 21 (15A). ● **Are the fuses okay?**	**Yes** GO to A3. **No** INSTALL new fuses. CHECK the system for normal operation.
A3 CHECK THE PARKING BRAKE RELEASE SOLENOID	
● Disconnect: Parking Brake Release Solenoid C2132. ● Connect a fused (15A) wire between parking brake release motor pin 1 and ground. ● Momentarily connect a fused (15A) wire between parking brake release motor pin 2 and battery. ● **Does the parking brake release actuate?**	**Yes** GO to A4. **No** INSTALL a new parking brake release solenoid. REFER to Parking Brake Release Solenoid in this section. TEST the system for normal operation.
A4 CHECK THE PARKING BRAKE RETRACT RELAY	
● Carry out the relay component test for the parking brake retract and release relays. Refer to Wiring Diagrams Cell 149 for schematic and connector information. ● **Do the relays pass the component test?**	**Yes** GO to A5. **No** INSTALL a new parking brake retract or release relay. TEST the system for normal operation.
A5 CHECK CIRCUIT 1892 (OG/BK) FOR AN OPEN	
● Disconnect: Parking Brake Release Relay C2244. ● Measure the resistance between parking brake release motor C2132 pin 2, circuit 1892 (OG/BK), harness side and parking brake release relay C2244 pin 3, circuit 1892 (OG/BK), harness side. ● **Is the resistance less than 5 ohms?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** GO to A6.
A6 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
● Measure the resistance between parking brake retract relay C2245 pin 4, circuit 57 (BK), harness side and ground; and between parking brake release relay C2244 pin 4, circuit 57 (BK), harness side and ground. ● **Are the resistances less than 5 ohms?**	**Yes** GO to A7. **No** REPAIR the circuit. TEST the system for normal operation.
A7 CHECK CIRCUIT 3049 (BK/LG) FOR AN OPEN	
● Measure the resistance between parking brake retract relay C2245 pin 5, circuit 3049 (BK/LG), harness side and BJB fuse cavity 21 (15A), output side; and between parking brake release relay C2244 pin 5, circuit 3049	**Yes** GO to A8. **No**

(BK/LG), harness side and BJB fuse cavity 21 (15A) output side. ● **Are the resistances less than 5 ohms?**	REPAIR the circuit. TEST the system for normal operation.
A8 CHECK CIRCUIT 294 (WH/LB) FOR AN OPEN	
● Measure the resistance between parking brake retract relay C2245 pin 2, circuit 294 (WH/LB), harness side and BJB fuse cavity 18 (10A) output side; and between parking brake release relay C2245 pin 2, circuit 294 (WH/LB), harness side and BJB fuse cavity 18 (10A) output side. ● **Are the resistances less than 5 ohms?**	**Yes** GO to A9 . **No** REPAIR the circuit. TEST the system for normal operation.
A9 CHECK CIRCUIT 1794 (WH) AND CIRCUIT 1795 (GY) FOR AN OPEN	
● Disconnect: Instrument Cluster C220a. ● Disconnect: Instrument Cluster C220b. ● Measure the resistance between parking brake retract relay C2245 pin 1, circuit 1794 (WH), harness side and instrument cluster C220a pin 19, circuit 1794 (WH), harness side; and between parking brake release relay C2244 pin 1, circuit 1795 (GY), harness side and instrument cluster C220b pin 9, circuit 1795 (GY), harness side. ● **Are the resistances less than 5 ohms?**	**Yes** GO to A10 . **No** REPAIR the circuit(s). TEST the system for normal operation.
A10 CHECK THE PARK DETECTION SWITCH	
NOTE: The park detection switch is part of the brake shift interlock solenoid assembly and is not serviced separately. ● Disconnect: Park Detection Switch. ● Close the park detection switch contacts. ● Measure the resistance between park detection switch pin 1 and 2. ● **Is the resistance less than 5 ohms?**	**Yes** GO to A11 . **No** INSTALL a new park detection switch. REFER to Section 307-05 . TEST the system for normal operation.
A11 CHECK PARK DETECTION SWITCH CIRCUIT 1794 (WH) AND CIRCUIT 1795 (GY) FOR AN OPEN	
● Measure the resistance between park detection switch pin 1, circuit 1794 (WH), harness side and instrument cluster C220a pin 19, circuit 1794 (WH), harness side; and between park detection switch pin 2, circuit 1795 (GY) and instrument cluster C220b pin 9, circuit 1795 (GY). ● **Are the resistances less than 5 ohms?**	**Yes** CARRY OUT the instrument cluster diagnostics. For additional information, REFER to Section 413-01 . **No** REPAIR circuit 1794 (WH) or circuit 1795 (GY). TEST the system for normal operation.

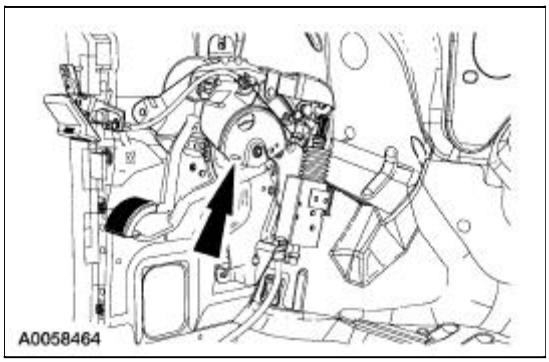
Parking Brake Control

Removal and Installation

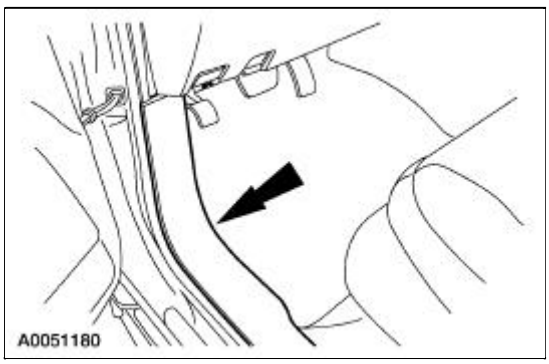
1. **NOTE:** The parking brake control is shown removed for clarity.

   Make sure tension on the parking brake cables is fully released.

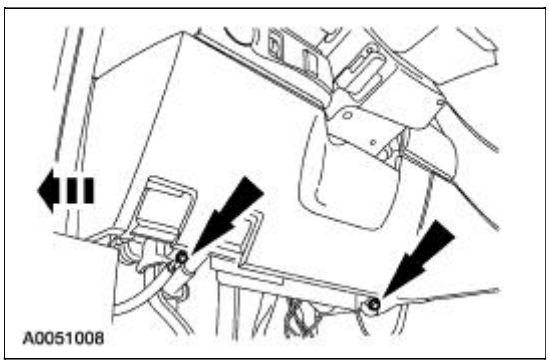
   - While a helper pulls down on the front cable, insert a pin through the park brake control frame and cam.



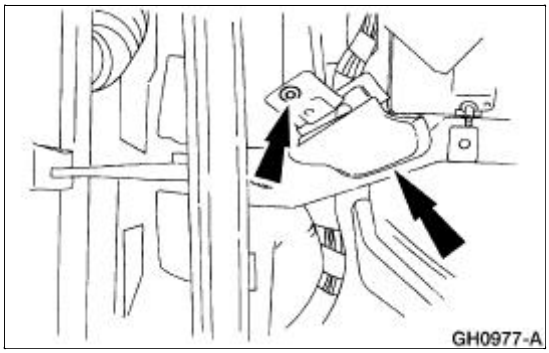
2. Remove the door scuff plate.



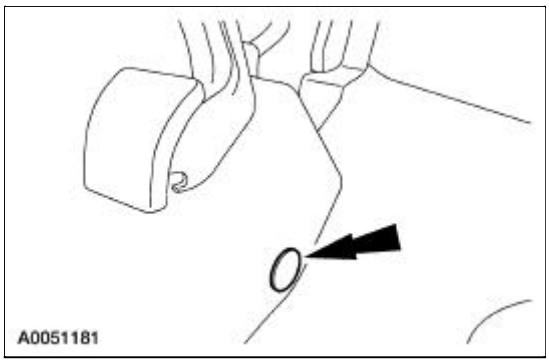
3. Remove the screws and the finish panel.
   - Pull the weatherstrip back to release the edge of the panel.



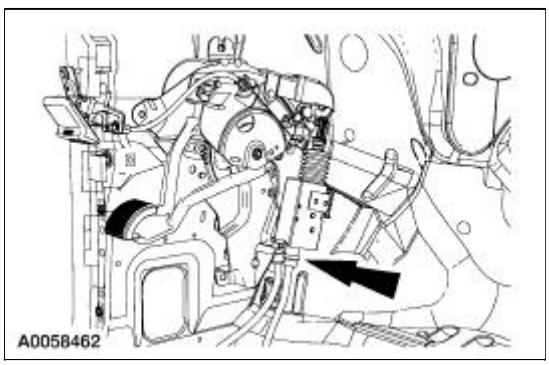
4. Remove the release handle bolt.



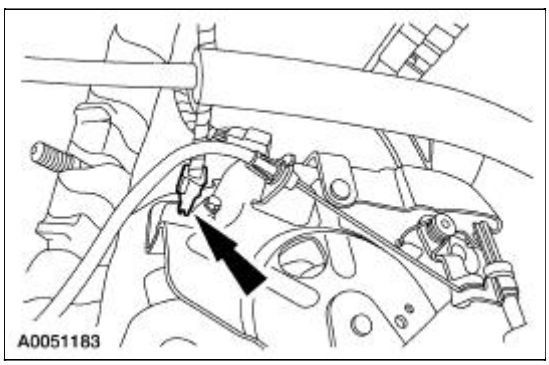
5. Remove the retainer and the cowl trim panel.



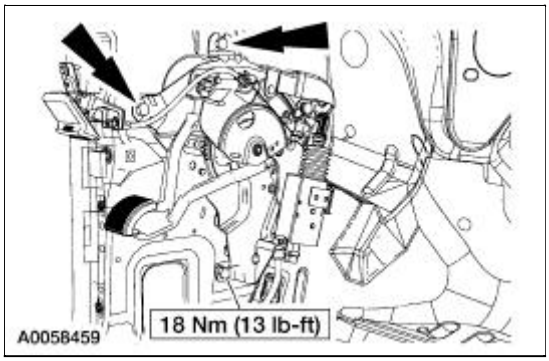
6. Disconnect the electrical connector at the solenoid.



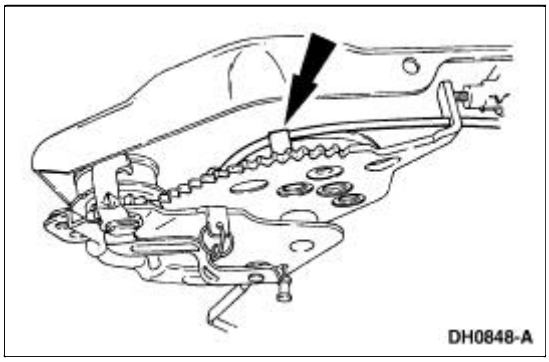
7. Disconnect the electrical connector at the park detection switch.



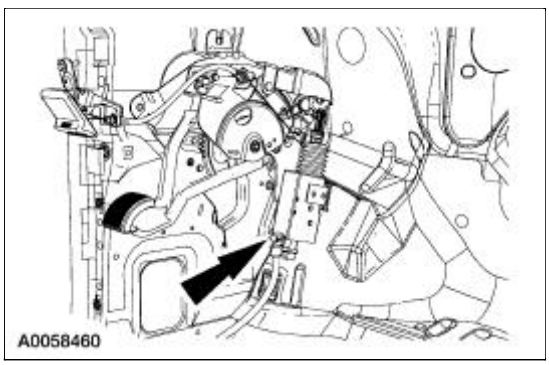
8. Remove the park brake control bolts.



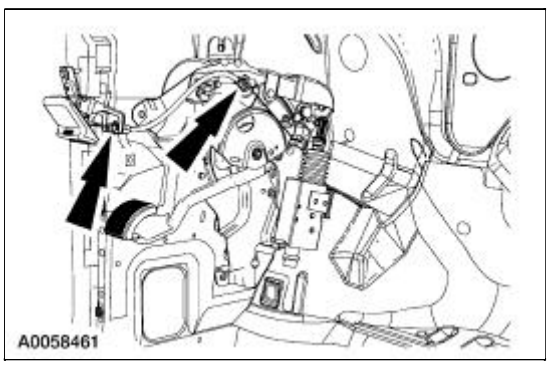
9. Straighten the tab on the take-up spool.



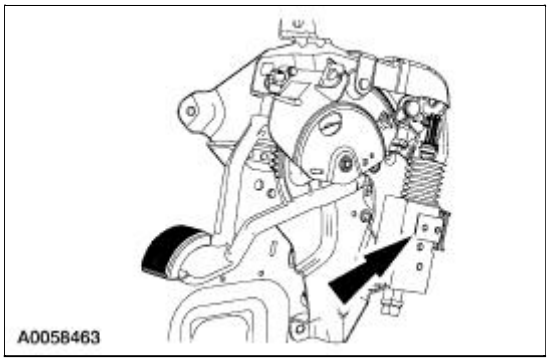
10. Disconnect the conduit and remove the park brake control.
    - Compress the conduit retainer to disconnect it from the control.



11. Remove the release handle and cable assembly.



12. Remove the release solenoid.
    - Pry the mounting bracket apart slightly to release the solenoid.



13. To install, reverse the removal procedure.

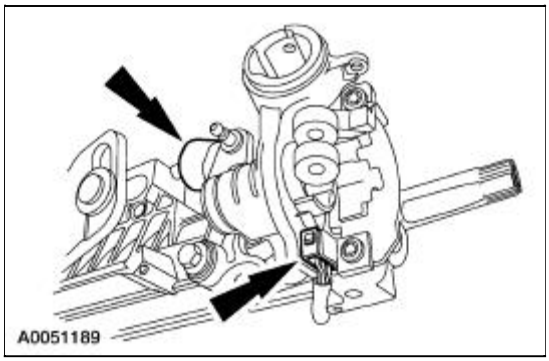
Parking Brake Release Switch

Removal and Installation

Column shift (Expedition only)

1. **NOTE:** The parking brake release switch is located on the steering column. It is serviced as an assembly with the brake shift interlock.

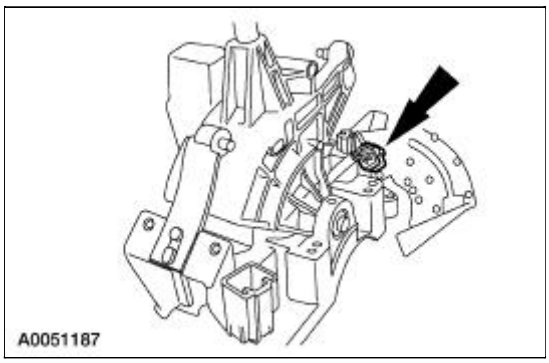
   Remove the brake shift interlock/park brake release switch assembly. For additional information, refer to Section 307-05 .



Floor shift

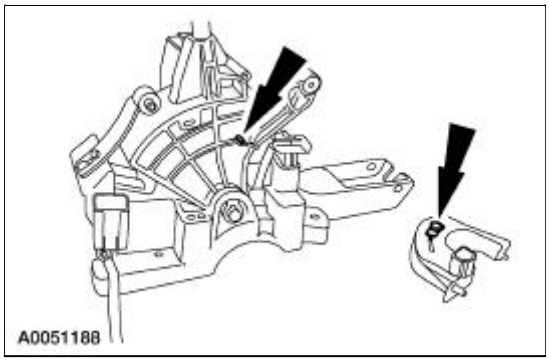
2. Remove the floor shift selector lever. For additional information, refer to Section 307-05 .

3. Remove the screws, disconnect the electrical connector and remove the switch.



All vehicles

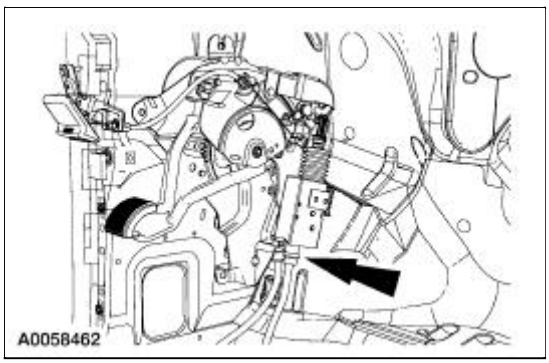
4. To install, reverse the removal procedure.
   - Make sure the switch is correctly aligned with the extension on the shifter before installing the screws.


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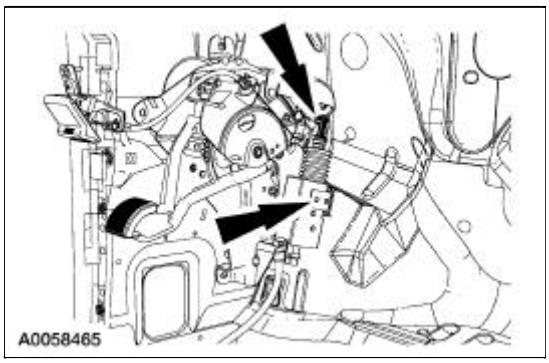
Parking Brake Release Solenoid

Removal and Installation

1. Disconnect the electrical connector.



2. Remove the solenoid.
   - Pry the mounting bracket apart slightly to release the solenoid.
   - Disengage the solenoid from the release lever.

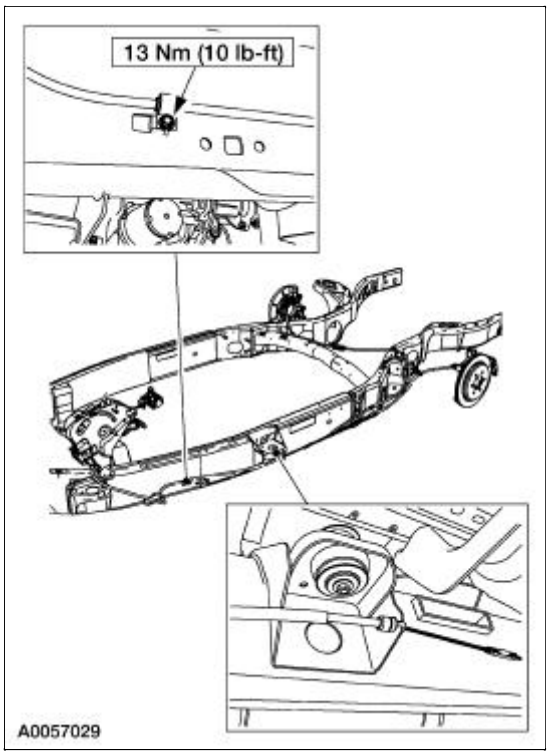


Parking Brake Cable —Front

Removal and Installation

1. Remove the parking brake control. For additional information, refer to Parking Brake Control in this section.

2. Remove the front parking brake cable and conduit.
   - Pry the rubber seal from the front floor pan.
   - Compress the retainer and release the conduit from the bracket.
   - Remove the front cable and conduit from the cable union.



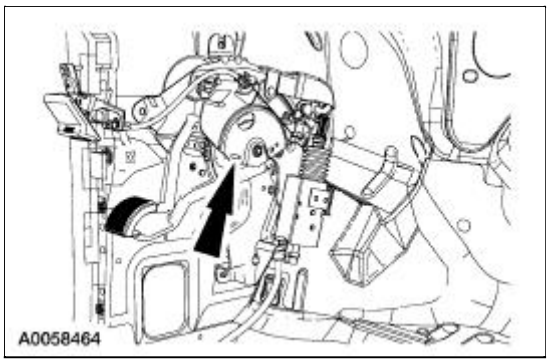
3. To install, reverse the removal procedure.

Parking Brake Cable —RH Rear

Removal and Installation

1. **NOTE:** The parking brake control is shown removed for clarity.

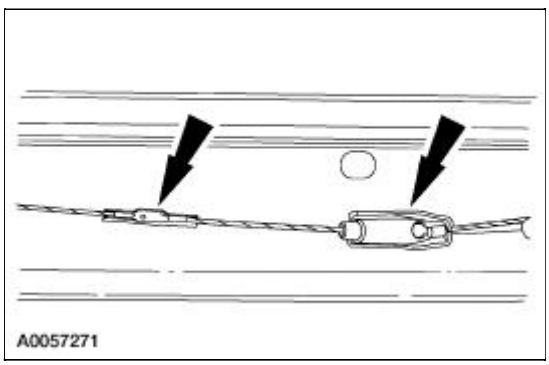
   Make sure tension on the parking brake cables is fully released
   1. While a helper pulls down on the front cable, insert a pin through the park brake control frame and cam.



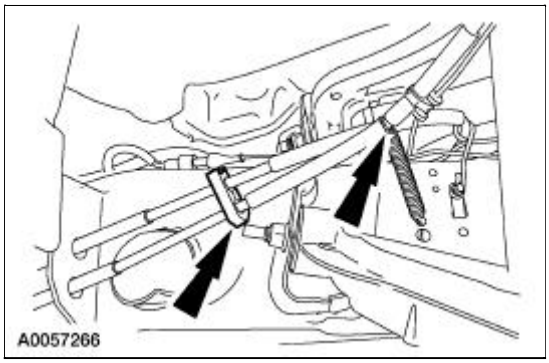
2. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the RH kick panel area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

   Raise and support the vehicle. For additional information, refer to Section 100-02 .

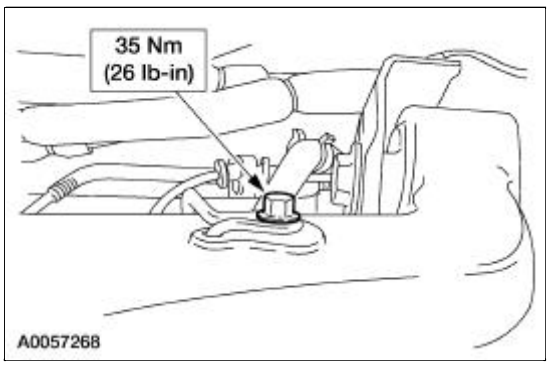
3. Disconnect the RH rear cable.
   - Remove the RH rear cable from the cable union.
   - Compress the cable clip and release the conduit from the equalizer.



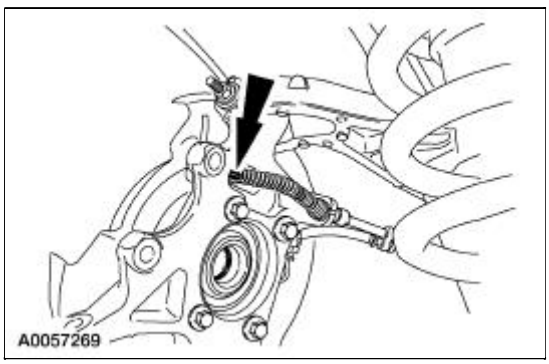
4. Remove the RH rear cable from the retaining clip.



5. Remove the wireform bracket from the upper control arm.



6. Compress the retainer and release the conduit, then unclip the cable end from the lever.



7. To install, reverse the removal procedure.

Parking Brake Shoes

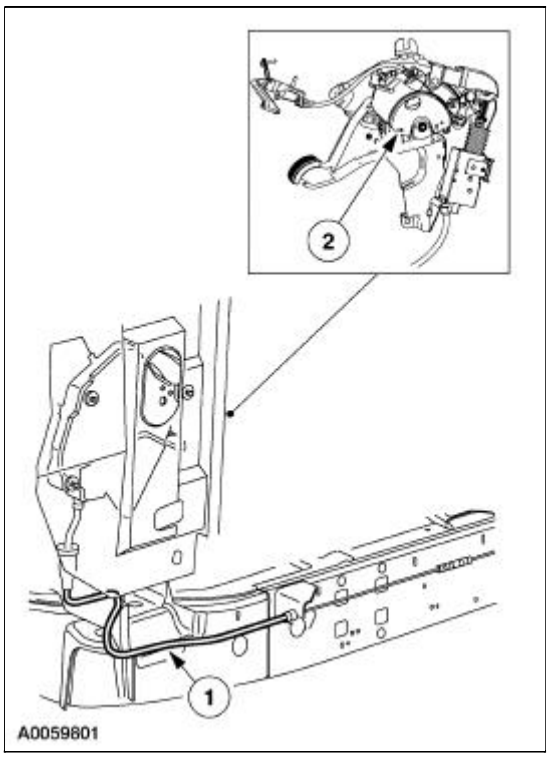
Special Tool(s)

 ST1468-A	Gauge, Brake Adjusting 206-D002 (D81L-1103-A) or equivalent

Removal and Installation

1. **NOTE:** Verify that the parking brake control (2780) is fully released.

   Relieve the tension on the parking brake system.
   1. Pull the front parking brake cable and conduit (2853).
   2. Insert a 4 mm (5/32-inch) drill bit or equivalent retainer.



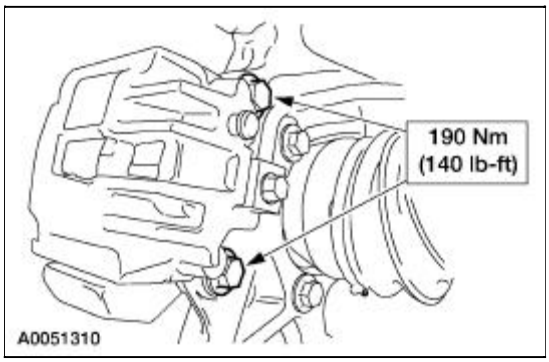
2. Remove the rear tire and wheel assembly. For additional information, refer to Section 204-04 .

3. **CAUTION: To prevent damage to the brake hose, do not allow the disc brake caliper to hang suspended from the hose.**

   Remove the disc brake caliper and anchor plate.

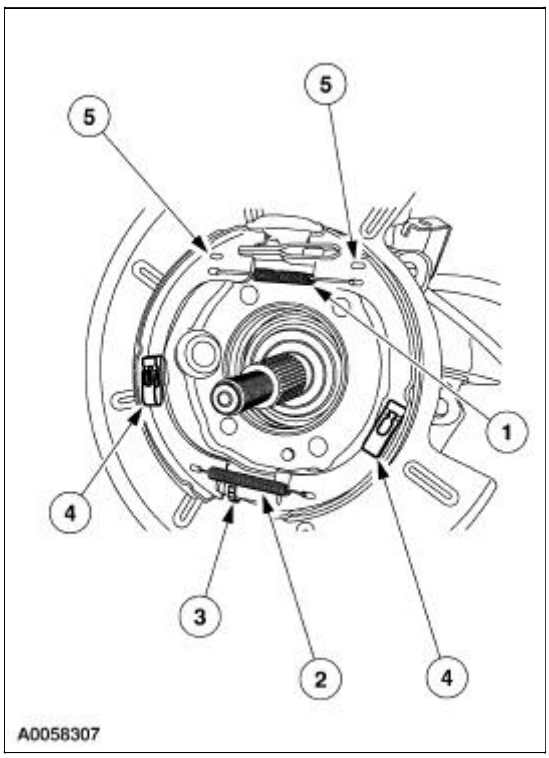
   - Remove the two bolts and lift the disc brake caliper and brake pads and anchor plate off the brake disc.

- Using mechanics wire, position the disc brake caliper brake pads and anchor plate aside.
- Remove the brake disc.



4. **NOTE:** Wheel hub has been removed for clarity.

   Remove the brake shoe components in the following order:
   1. Retracting spring
   2. Adjusting screw spring
   3. Adjuster screw
   4. Hold down springs
   5. Brake shoe and linings



5. Inspect the components for excessive wear or damage and install new as required.

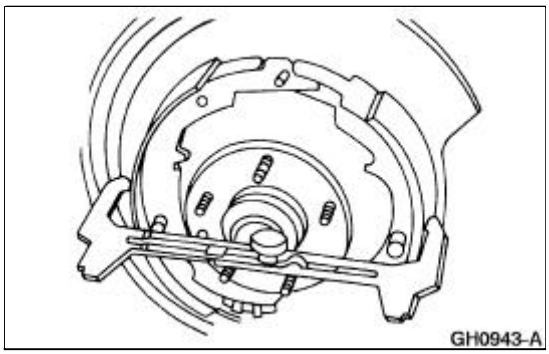
6. **WARNING: Always remove any corrosion, dirt or foreign material present on the mounting surfaces of the wheel, the surface of the wheel or the surface of the wheel hub, brake drum or brake disc that contacts the wheel. Installing wheels without correct metal-to-metal contact at the wheel mounting surfaces can cause the wheel nuts to loosen and come off while the vehicle is in motion, causing loss of control.**

NOTE: Before installation, lubricate the applied parking brake shoe at points where it contacts the wheel knuckle using Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A (Motorcraft WA-10) or an equivalent silicone compound meeting Ford specification ESE-M1C171-A.

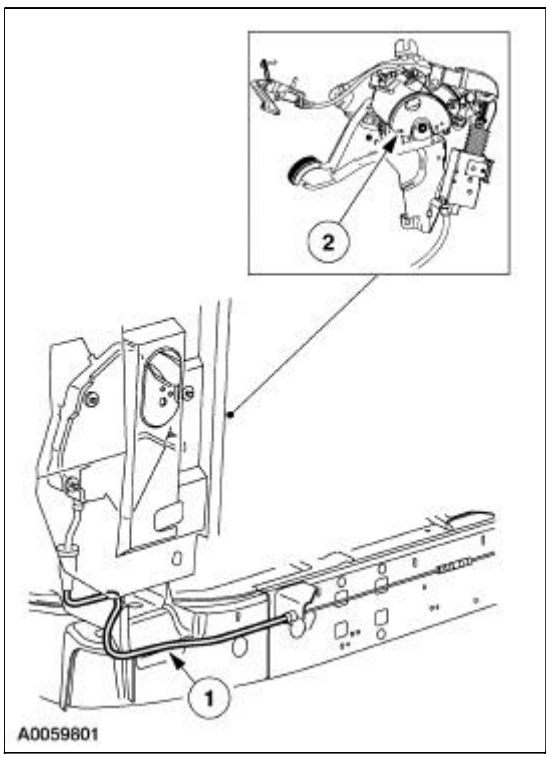
To install, reverse the removal procedure.

- Use the Brake Adjusting Gauge to measure the inside diameter of the drum position of the rear brake disc.
- **NOTE:** Make sure the shoes are correctly centered. Take measurement across the center of the shoes.

  Use the Brake Adjusting Gauge to set the rear brake shoe and lining diameter to 0.45 mm (0.018 in) less than the inside diameter of the drum portion of the rear brake disc.



7. Apply tension to the parking brake cable system.
   1. Hold the front parking brake cable and conduit taut.
   2. Remove the retainer from the parking brake control.



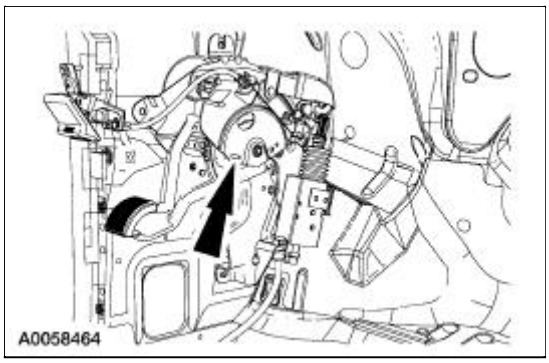
8. Check the operation of the parking brake.

Parking Brake Cable —LH Rear

Removal and Installation

1. **NOTE:** The parking brake control is shown removed for clarity.

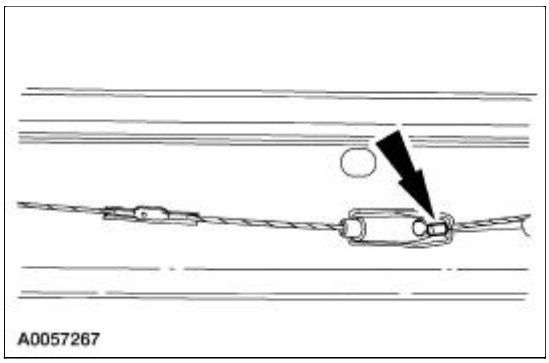
   Make sure tension on the parking brake cables is fully released
   1. While a helper pulls down on the front cable, insert a pin through the park brake control frame and cam.



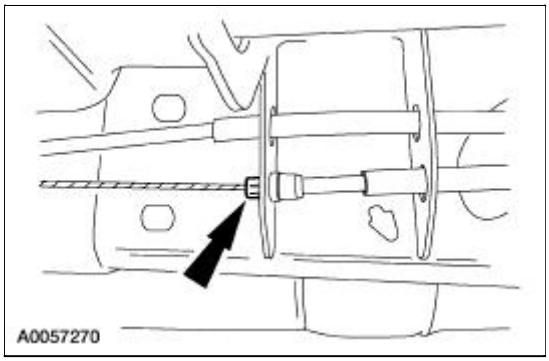
2. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the RH kick panel area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

   Raise and support the vehicle. For additional information, refer to Section 100-02 .

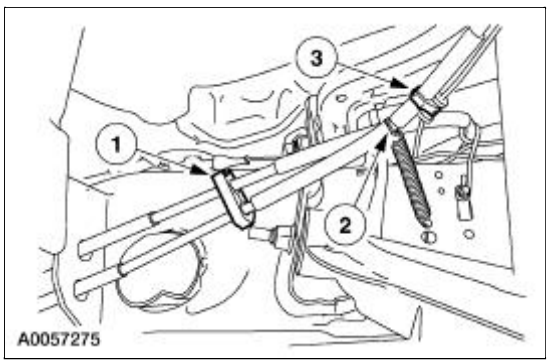
3. Separate the LH rear cable from the equalizer.



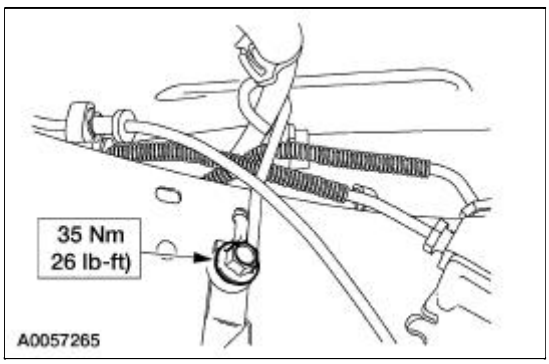
4. Remove the conduit from the bracket.
   1. Compress the retainer.
   2. Remove the conduit from the bracket.



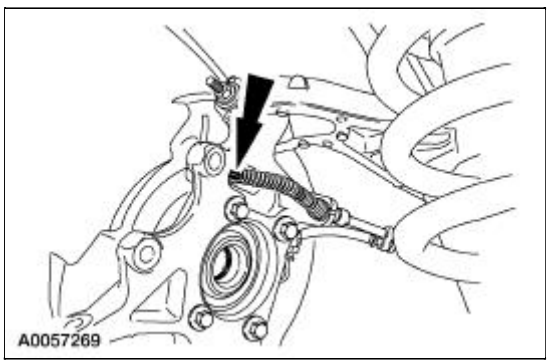
5. Remove the LH rear cable.
    1. Remove the LH rear cable from the retaining clip.
    2. Disconnect the spring.
    3. Disconnect the ABS sensor wire.



6. Remove the wireform bracket retaining screw.



7. Compress the retainer and release the conduit, then unclip the cable end from the lever.



8. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-ft
Brake master cylinder nuts	22-28	17-20
Brake pedal bracket nuts and bolt	21-29	16-21
Brake pressure switch	14-20	11-14

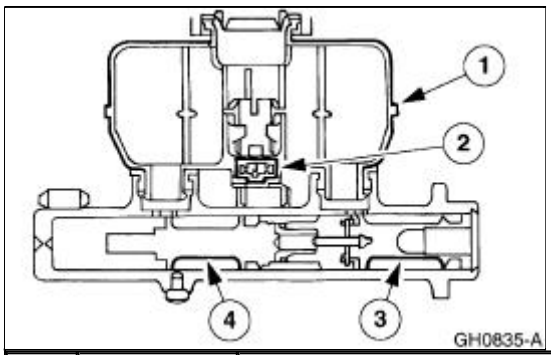
Hydraulic Brake Actuation

The brake pedal is connected to the power brake booster, which is connected to the brake master cylinder. The brake pedal is adjustable, either non-memory or memory is available. When the brake pedal is depressed, brake fluid is pushed from the master cylinder through the metal tubing and flexible hoses to the front disc brake calipers and the rear disc brake calipers. The front disc brake caliper pistons are forced outward against the brake pads, and contact the braking surface of the brake discs. The brake fluid enters the rear disc brake calipers, forcing the rear disc brake caliper pistons outward against the brake pads. The brake pads press against the braking surface on the brake discs. When the brake pedal is released, the pressure is relieved, returning the brake caliper pistons and the brake shoes and linings to the unapplied position.

The dual brake system is split front and rear with the front wheel brakes comprising one circuit and the rear wheel brakes, the other circuit.

The ability of a brake system to stop the vehicle is dependent on the available traction.

Brake Master Cylinder



Item	Part Number	Description
1	2K478	Brake master cylinder reservoir
2	—	Brake master cylinder fluid level warning switch (part of 2K478)
3	2149	Primary piston (part of 2140)
4	2149	Secondary piston (part of 2140)

The brake master cylinder is a dual-piston type.

The brake master cylinder is assisted by a power brake booster. For additional information, refer to Section 206-07 .

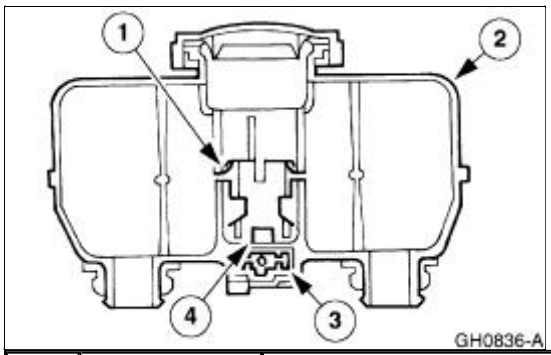
The following conditions are considered normal, and are not indications that the brake master cylinder is in need of repair or replacement:

- Low brake fluid level detected without signs of leakage. This condition is caused by displacement of brake fluid from the brake master cylinder reservoir into the disc brake calipers to compensate for normal brake wear. Add brake fluid as needed.
- A momentary or slight ripple of brake fluid inside the brake master cylinder reservoir upon

application or release of the brake pedal.

- A trace of brake fluid found on the outside of the power brake booster below the brake master cylinder mounting flange. This condition results from the lubricating action of the brake master cylinder wiping seal.

Brake Fluid Level Warning Switch



Item	Part Number	Description
1	—	Float (part of 2K478)
2	2K478	Brake master cylinder reservoir
3	—	Brake fluid level warning switch (part of 2K478)
4	—	Magnet (part of 2K478)

The brake fluid level warning switch is an integral part of the brake master cylinder reservoir. It consists of a float containing a magnet and a reed switch mounted in the bottom of the brake master cylinder reservoir.

When the brake fluid in the brake master cylinder reservoir gets to a predetermined level, the floating magnet actuates the reed switch, causing the red brake warning indicator to illuminate. Loss of brake fluid from either the primary (front) or secondary (rear) system will cause this system to activate. If the brake fluid level warning switch is inoperative, a new brake master cylinder reservoir must be installed.

Lines and Hoses

CAUTION: Only Ford authorized inlet hydraulic brake tubes should be used. These tubes are of a specific design and new Ford authorized parts only should be installed.

Steel tubing with flex hoses are used in the hydraulic lines between the brake master cylinder and the hydraulic control unit. Steel tubing is used between the hydraulic control unit and the front and rear hoses.

Double flared brake tubing should provide good leakproof connections.

When replacing hydraulic brake tubing, hoses, or connectors, tighten all connections securely. After replacement, bleed the brake system. For additional information, refer to Section 206-00.

Hydraulic Brake Actuation

Refer to Section 206-00 .

Brake Pedal and Bracket

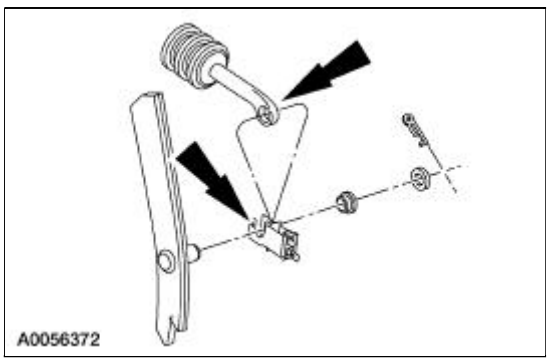
Removal and Installation

1. **CAUTION: The brake pedal and the accelerator pedal must be in the same position when installing a new cable or a new pedal. The pedals must be in the all the way forward or all the way rearward position.**

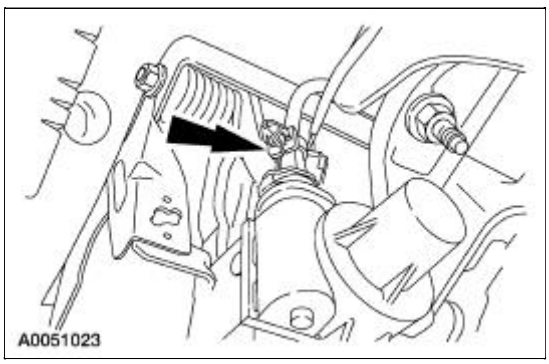
   Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

2. **CAUTION: Do not install the cruise control deactivation switch after detaching it from the brake pedal bracket. Always install a new unit in its place.**

   Remove the stoplight switch self-lock pin and slide the stoplight switch, booster push rod and the bushing off the brake pedal pin.

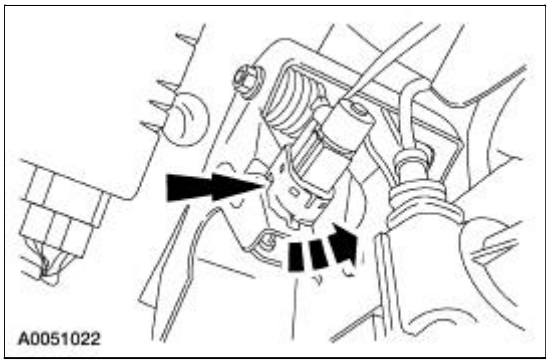


3. Remove the accelerator pedal-to-brake pedal cable.

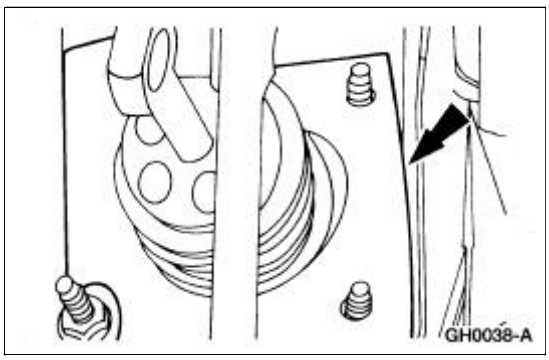


4. **CAUTION: The booster pushrod must be installed with pushrod offset, if present, pointing downward.**

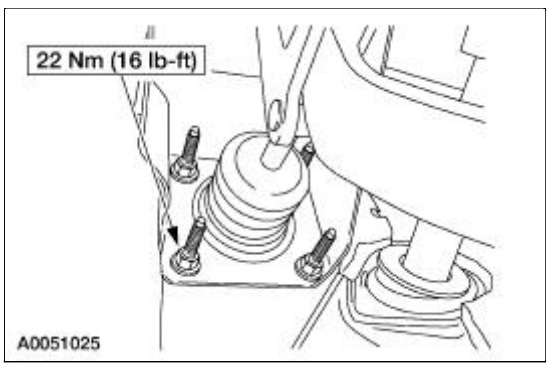
   Turn the cruise control deactivation switch counterclockwise and detach it from the brake pedal bracket.



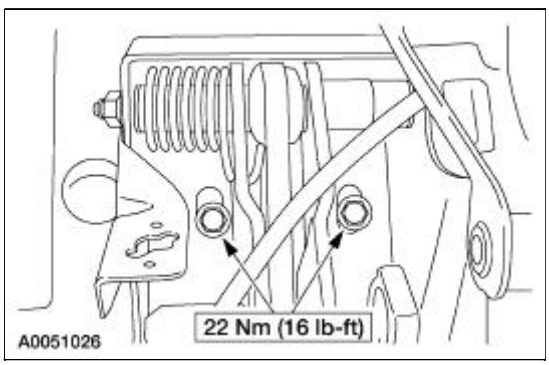
5. Remove the bulkhead sound insulator.



6. Remove the four brake pedal bracket nuts.



7. Remove the brake pedal bracket bolts, and remove the brake pedal and bracket.



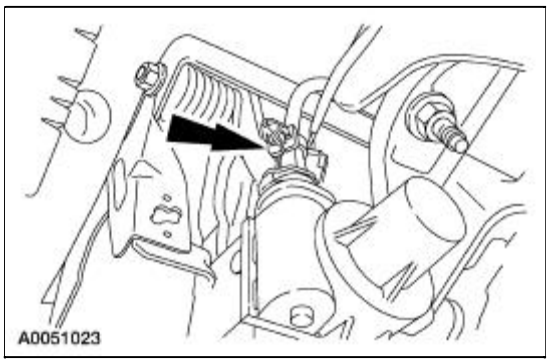
8. To install, reverse the removal procedure.

Brake Pedal Motor Cable

Removal and Installation

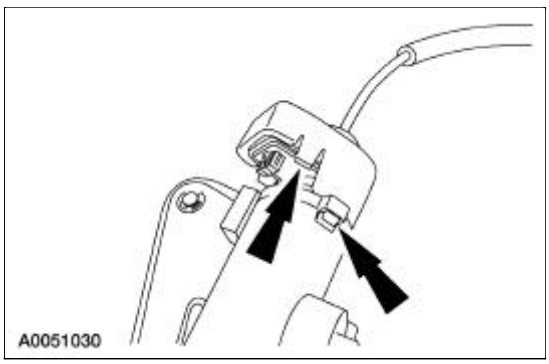
All vehicles

1. Disconnect the brake pedal motor cable at the brake pedal and bracket assembly.

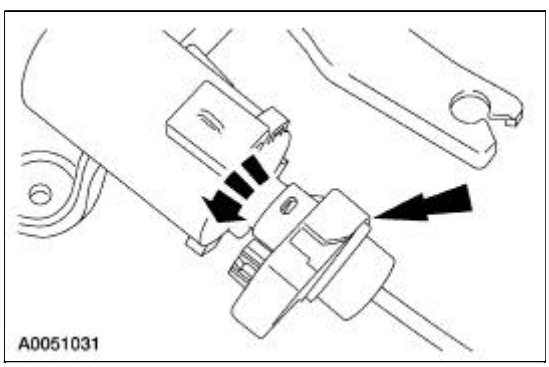


Vehicles with memory

2. Unclip the protective cover from the memory potentiometer.

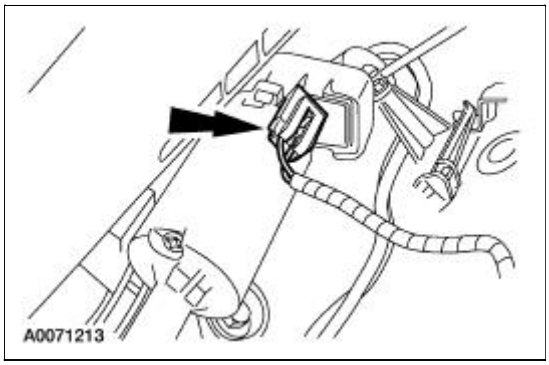


3. Remove the memory potentiometer and cable from the adjustable pedal motor.

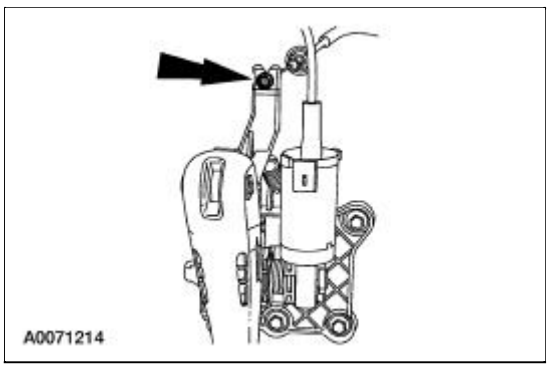


Vehicles without memory

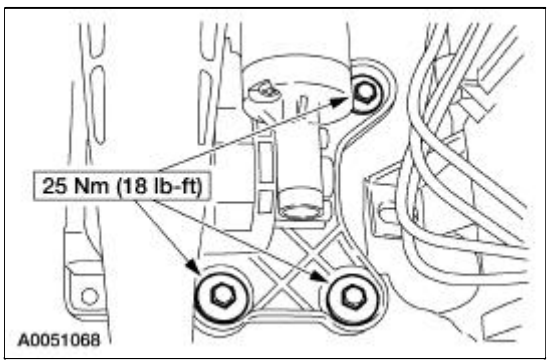
4. Disconnect the drive motor electrical cnnector.



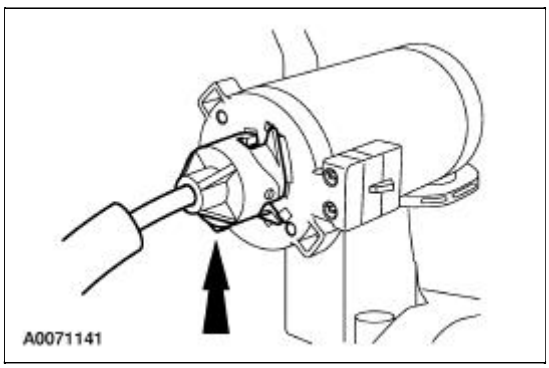
5. Disconnect the accelerator cable from the accelerator pedal.



6. Remove the bolts and the accelerator pedal.



7. Disconnect the cable from the adjustable pedal motor.



All vehicles

8. To install, reverse the removal procedure.

Brake Master Cylinder

Removal and Installation

All vehicles

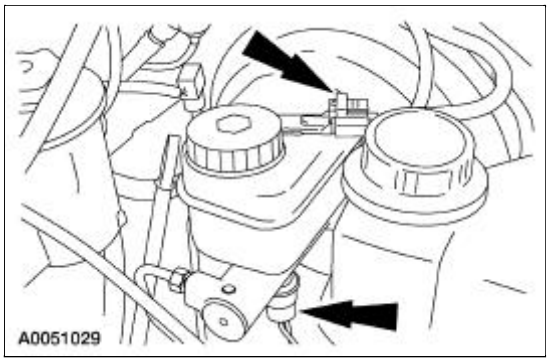
1. Disconnect the battery negative cable. For additional information, refer to Section 414-01 .

Vehicles with cruise control

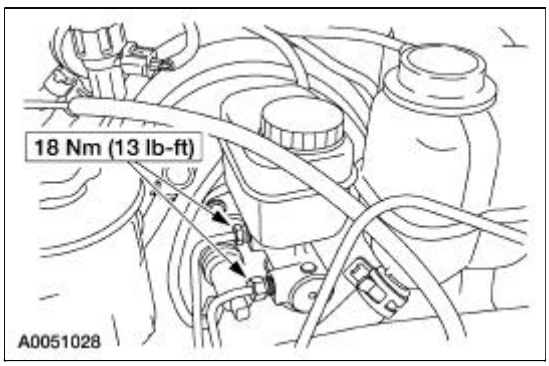
2. Disconnect the brake pressure switch.

All vehicles

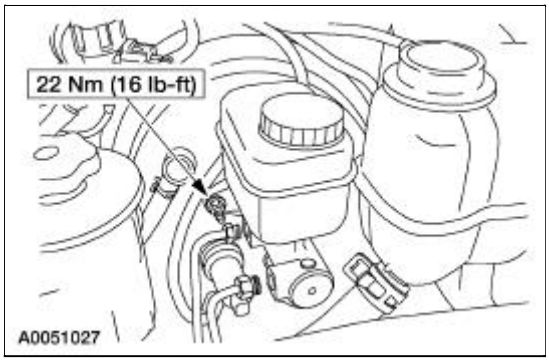
3. Disconnect the brake fluid level switch.



4. Disconnect the brake lines and plug the master cylinder ports.



5. Remove the two nuts and the brake master cylinder.



6. To install, reverse the removal procedure.
    - Bleed the brake system. For additional information, refer to Section 206-00 .

Torque Specifications

Description	Nm	lb-ft
Power brake booster nuts	25	18

Brake Booster

The power brake booster:

- is a dual diaphragm, vacuum-assisted power brake booster.
- reduces brake pedal pressure and travel distance.
- is divided into separate vacuum and atmospheric pressure chambers by a diaphragm.

If the power assist fails, the brake system will continue to operate with increased brake pedal effort.

Hose and Check Valve

The power brake booster check valve:

- closes when the engine is turned off.
- in the closed position, traps engine vacuum in the power brake booster.
- retains vacuum to provide several power-assisted brake applications with the engine off.

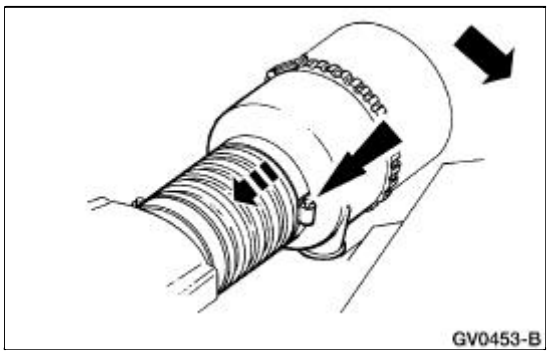
Power Brake System

Refer to Section 206-00 .

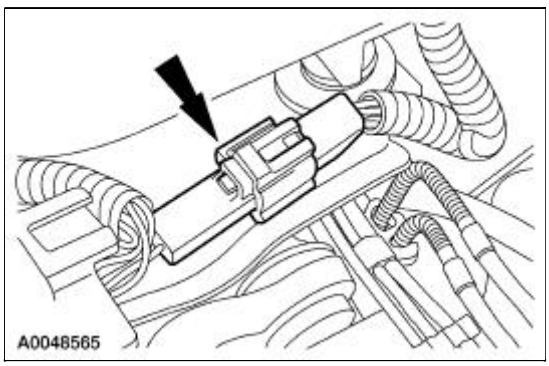
Brake Booster

Removal and Installation

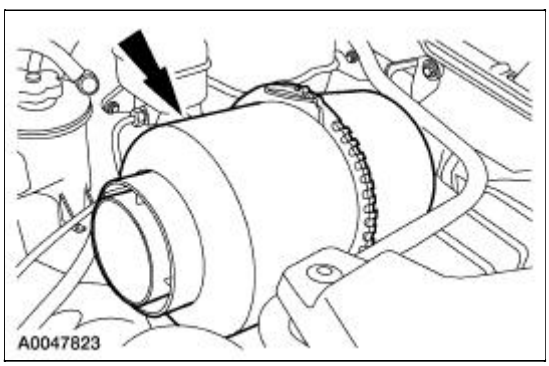
1. Disconnect the battery negative cable. For additional information, refer to Section 414-01 .
2. Loosen the clamp and separate the air cleaner outlet tube and resonator from the air cleaner.



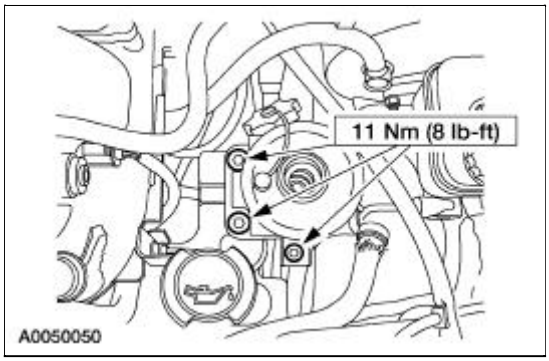
3. Disconnect the mass air flow (MAF) sensor electrical connector.



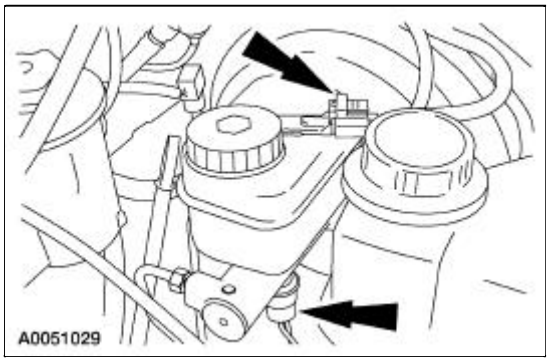
4. Lift the air cleaner assembly from the air cleaner tray.



5. Remove the screws and position aside the power steering reservoir.

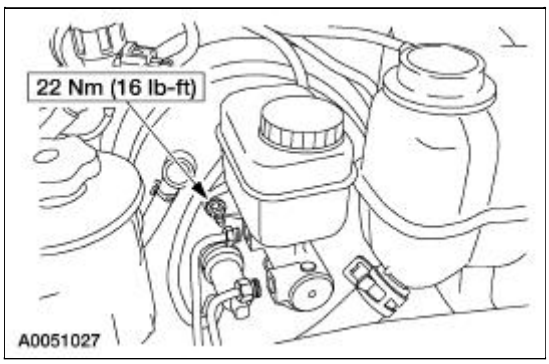


6. Disconnect the brake fluid level switch and if equipped, the brake pressure switch.

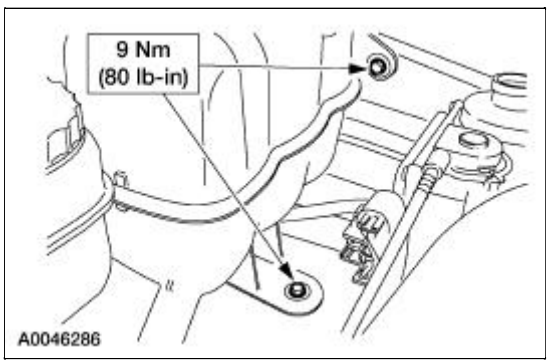


7. **NOTE:** Support the master cylinder with a wire tie or mechanics wire.

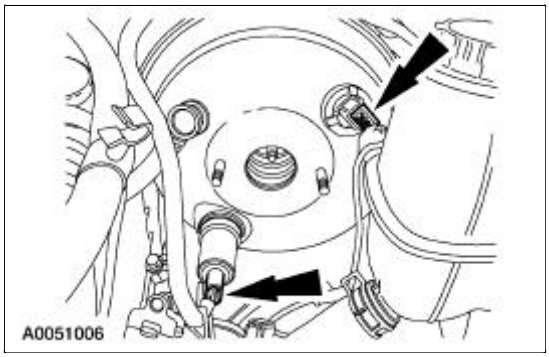
   Remove and discard the two nuts and position the master cylinder aside.



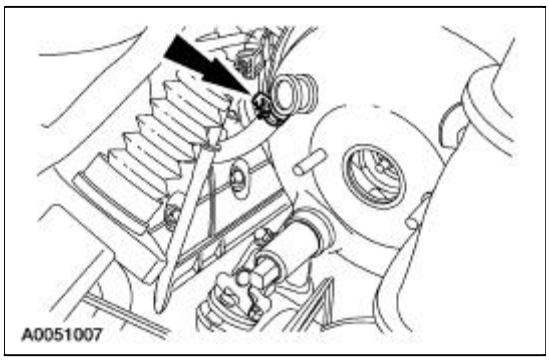
8. Remove the mounting bolts for the degas bottle and position aside.



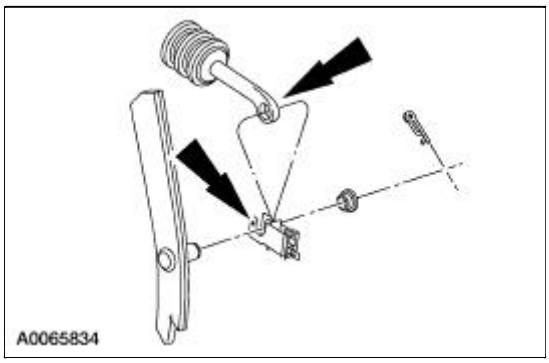
9. If equipped, disconnect the wiring at the pedal travel sensor and solenoid.



10. Release the clamp and disconnect the hose.



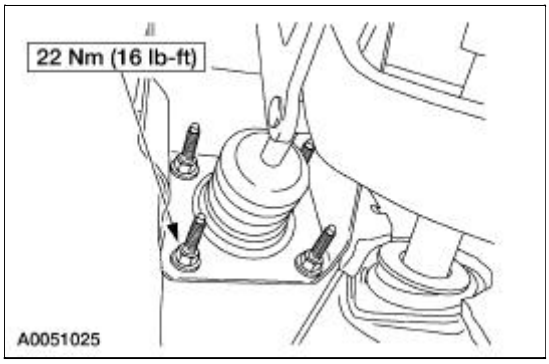
11. Remove the pin, washer, bushing and switch, and disconnect the booster pushrod.



12. Remove the nuts and the brake booster.
    - To access the retaining nuts, fold back the sound insulation.

13. **NOTE:** The booster pushrod must be installed with the pushrod offset pointing downward.

    To install, reverse the removal procedure.
    - Use new nuts when installing the master cylinder.


22 Nm (16 lb-ft)
A0051025

Torque Specifications

Description	Nm	lb-ft	lb-in
Electronic hydraulic control unit (EHCU) bracket bolts to frame	30	22	—
Electronic hydraulic control unit (EHCU) bolts to bracket	35	26	—
Front anti-lock brake sensor bolt	7-9	—	63-80
1/2-20 hydraulic brake tube	23	17	—
7/16-24 hydraulic brake tube	17	13	—
Rear anti-lock brake sensor bolt	27	20	—

Anti-Lock Control

The 4-wheel, 4-channel anti-lock brake system (4WABS) consists of the following components:

- Anti-lock brake control module
- Front wheel speed sensor
- Front wheel speed sensor ring
- Hydraulic control unit
- Rear wheel speed sensor
- Rear wheel speed sensor ring
- Yellow ABS warning indicator

Anti-Lock Control

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool
 ST2574-A	Flex Probe Kit 105-R025B

Refer to Wiring Diagrams Cell 42 , ABS for schematic and connector information.

Principles of Operation

The anti-lock-brake control module receives wheel speed readings from each anti-lock brake sensor and processes this information to determine if an ABS event is necessary. The anti-lock brake sensor electrically senses each tooth of the anti-lock brake sensor indicators as it passes through the anti-lock brake sensor magnetic field.

The anti-lock brake control module continuously monitors and compares the rotational speed of each wheel and, when it detects an impending wheel lock, modulates brake pressure to the appropriate brake caliper. This is accomplished by triggering the hydraulic control unit (HCU) to open and close the appropriate solenoid valves. Once the affected wheel returns to normal speed, the anti-lock brake control module returns the solenoid valves to their normal position, and normal (base) braking resumes.

The anti-lock brake control module is self-monitoring. When the ignition switch is turned to the RUN position, the anti-lock brake control module will do a preliminary electrical check, and at approximately 20 km/h (12 mph) the pump motor is turned on for approximately one-half second. Any malfunction of the ABS will cause the ABS or anti-lock brake system (ABS) to shut off and the yellow anti-lock brake warning indicator to illuminate. However, the power assist braking system functions normally.

Electronic Brake Distribution

The electronic brake distribution (EBD) controls rear brake pressure and acts as an electronic proportioning valve. It is controlled by the anti-lock brake control module. When EBD is disabled, the amber ABS warning indicator and the red brake warning indicator will illuminate.

Inspection and Verification

NOTE: The anti-lock brake control module must be reconfigured when installed new. For additional information, refer to Section 418-01 .

1. Verify the customer concern by applying the brakes under different conditions.

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

Visual Inspection Chart

Mechanical	Electrical
● Base brake concerns ● Tire pressure ● Tire size or mismatched tires ● Hydraulic control unit (HCU) ● Wheel speed sensor ring	● Battery junction box (BJB) fuses: ■ 16 (10A) ■ 102 (30A) ● Anti-lock brake control module ● Wheel speed sensors ● Brake on/off (BOO) switch ● Circuitry ● Connectors or connections ● EVAC and fill connector ● Wire harness routing

3. If the fault is not visually evident, connect the scan tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the scan tool menu. If the scan tool does not communicate with the vehicle:
   - check the connections to the vehicle.
   - check the ignition switch position.
   - check that the program card is correctly installed.

4. If the scan tool still does not communicate with the vehicle, refer to the scan tool manual.

5. Carry out the DATA LINK DIAGNOSTIC TEST. If the scan tool responds with:
   - CKT914, CKT915, or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for anti-lock brake control module, Go To Pinpoint Test A .
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out the self-test diagnostics for the anti-lock brake control module.

6. If the DTCs retrieved are related to the concern, go to Anti-Lock Brake Control Module Diagnostic Trouble Code (DTC) Index to continue diagnostics.

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

Anti-Lock Brake Control Module Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1342	ECU is Defective	Anti-Lock Brake Control Module	CLEAR the DTCs. RETRIEVE the DTCs. If other DTCs are retrieved, REPAIR them. CLEAR the DTCs, and REPEAT the self-test. If DTC B1342 is retrieved, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module .
B1483	Brake Pedal Input Circuit Failure	Anti-Lock Brake Control Module	Go To Pinpoint Test B .
B1676	Battery Pack Voltage Out of Range	Anti-Lock Brake Control Module	Go To Pinpoint Test C .
B2477	Module Configuration Failure	Anti-Lock Brake Control Module	CONFIGURE the anti-lock brake control module. REFER to Section 418-01 . CLEAR the DTCs. REPEAT the self-test. If DTC B2477 is retrieved again, INSTALL a new anti-lock brake control module. REFER to Anti-Lock Brake System (ABS) Module . REPEAT the self-test.
C1095	Hydraulic Pump Motor Circuit Failure	Anti-Lock Brake Control Module	Go To Pinpoint Test D .
C1145	Speed Wheel Sensor RF Input Circuit Failure	Anti-Lock Brake Control Module	Go To Pinpoint Test E .
C1155	Speed Wheel Sensor LF Input Circuit Failure	Anti-Lock Brake Control Module	Go To Pinpoint Test E .
C1165	Speed Wheel Sensor RR Input Circuit Failure	Anti-Lock Brake Control Module	Go To Pinpoint Test E .
C1175	Speed Wheel Sensor LR Input Circuit Failure	Anti-Lock Brake Control Module	Go To Pinpoint Test E .
C1233	Speed Wheel LF Input Signal Missing	Anti-Lock Brake Control Module	Go To Pinpoint Test F .
C1234	Speed Wheel RF Input Signal Missing	Anti-Lock Brake Control Module	Go To Pinpoint Test F .
C1235	Speed Wheel RR Input Signal Missing	Anti-Lock Brake Control Module	Go To Pinpoint Test F .
C1236	Speed Wheel LR	Anti-Lock	Go To Pinpoint Test F .

	Input Signal Missing	Brake Control Module	
U1009	SCP (J1850) Invalid or Missing Data for Engine Torque	ABS	CARRY OUT the PCM self-test.
U1027	SCP (J1850) Invalid or Missing Data for Engine RPM	ABS	CARRY OUT the PCM self-test.
U1262	SCP (J1850) Communication Bus Fault	ABS	REFER to Section 418-00 .

Symptom Chart

NOTE: Refer to the wiring diagrams for connector numbers stated in the pinpoint tests.

Symptom Chart

Condition	Possible Sources	Action
● No communication with the anti-lock brake control module	● BJB Fuses 16 (10A) and 102 (30A). ● Circuitry. ● Anti-lock brake control module.	● Go To Pinpoint Test A .
● The yellow anti-lock brake warning indicator does not self-check	● Anti-lock brake control module. ● Circuitry.	● REFER to Section 413-01 .
● Spongy brake pedal with no warning indicator	● Air in brake hydraulic system.	● REFER to Section 206-00 .

Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE ANTI-LOCK BRAKE CONTROL MODULE/UNABLE TO ENTER SELF-TEST

Test Step	Result / Action to Take
CAUTION: Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multimeter probes.	
A1 CHECK VOLTAGE TO THE ANTI-LOCK BRAKE CONTROL MODULE	
● Key in OFF position. ● Disconnect: Anti-Lock Brake Control Module C135. ● Key in ON position. ● Measure the voltage between anti-lock brake control module C135 pins, harness side and ground as follows:	**Yes** GO to A2 . **No** REPAIR the circuit in

	question. TEST the system for normal operation.

Pin	Circuit
1	534 (YE/LG)
4	533 (TN/RD)
32	532 (OG/YE)

- **Are the voltages greater than 10 volts?**

A2 CHECK ANTI-LOCK BRAKE MODULE GROUNDS	
• Key in OFF position. • Measure the resistance between anti-lock brake control module C135 pin 16, circuit 530 (LG/YE), harness side and ground; and between anti-lock brake control module C135 pin 47, circuit 530 (LG/YE), harness side and ground. • **Are the resistances less than 5 ohms?**	**Yes** CHECK the module communication network. REFER to Section 418-00 . **No** REPAIR the circuit 530 (LG/YE). TEST the system for normal operation.

PINPOINT TEST B: DTC B1483, BRAKE PEDAL INPUT CIRCUIT FAILURE

Test Step	Result / Action to Take
CAUTION: Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multimeter probes.	
B1 CHECK THE STOPLAMP OPERATION	
• Press the brake pedal. • **Do the stoplamps operate correctly?**	**Yes** GO to B2 . **No** REFER to Section 417-01 .
B2 CHECK CIRCUIT 810 (RD/LG) FOR OPEN	
• Key in OFF position. • Disconnect: Anti-Lock Brake Control Module C135. • Key in ON position. • Measure the voltage between anti-lock brake control module pin 41 circuit 810 (RD/LG), harness side and ground, while depressing the brake pedal. • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new anti-lock brake control module. REFER to Anti-Lock Brake System (ABS) Module . CLEAR the DTC. REPEAT the self-test. **No** REPAIR circuit 810 (RD/LG). CLEAR the DTC. REPEAT the self-test.

PINPOINT TEST C: DTC B1676, BATTERY PACK VOLTAGE OUT OF RANGE

Test Step	Result / Action to Take
CAUTION: Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multimeter probes.	

NOTE: DTC B1676 is generated when the anti-lock brake control module detects system voltage is less than 9 volts or greater than 19 volts for more than 8 seconds.

C1 CHECK THE BATTERY VOLTAGE	
• Key in OFF position. • Measure the voltage between positive and negative battery posts. • **Is the voltage between 10 and 17 volts?**	**Yes** GO to C2 . **No** REFER to Section 414-00 .
C2 CHECK VOLTAGE TO THE ANTI-LOCK BRAKE CONTROL MODULE	
• Disconnect: Anti-Lock Brake Control Module C135. • Key in ON position. • Measure the voltage between anti-lock brake control module C135 pins, harness and ground as follows: Pin / Circuit 1 – 534 (YE/LG) 4 – 533 (TN/RD) 32 – 532 (OG/YE) • **Are the voltages greater than 10 volts?**	**Yes** GO to C3 . **No** REPAIR the circuit in question. CLEAR the DTC. REPEAT the self-test.
C3 CHECK CIRCUIT 530 (YE/LG) FOR AN OPEN	
• Key in OFF position. • Measure the resistance between anti-lock control module pin 16, circuit 530 (YE/LG), harness side and ground; and between anti-lock control module pin 47, circuit 530 (YE/LG), harness side and ground. • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new anti-lock brake control module. REFER to Anti-Lock Brake System (ABS) Module . CLEAR the DTCs. REPEAT the self-test. **No** REPAIR the circuit in question. CLEAR the DTC. REPEAT the self-test.

PINPOINT TEST D: DTC C1095, HYDRAULIC PUMP MOTOR CIRCUIT FAILURE

Test Step	Result / Action to Take
CAUTION: Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multimeter probes.	
D1 CHECK THE ABS PUMP MOTOR	
• Key in ON position. • **Is the ABS pump motor running all the time?**	**Yes** INSTALL a new stability assist module. REFER to Anti-Lock Brake System (ABS) Module in this section. CLEAR the DTC. REPEAT the self-test. **No** GO to D2 .
D2 CHECK PUMP MOTOR OPERATION	
• Key in ON position.	**Yes**

• Connect the scan tool. • Trigger the stability assist module pump motor active command. • **Does the ABS pump motor run for approximately three seconds?**	CLEAR the DTC. CHECK the yellow ABS warning indicator while driving the vehicle (brakes must not be applied) above 32 km/h (20 mph). If the yellow ABS warning indicator illuminates, RETRIEVE the DTCs. If DTC C1095 is retrieved, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CLEAR the DTC. REPEAT the self-test. If the yellow ABS warning indicator does not illuminate, the system is OK. **No** TRIGGER the stability assist module pump motor off active command. GO to D3.
D3 CHECK CIRCUIT 534 (YE/LG) FOR AN OPEN	
• Disconnect: Stability Assist Module C135. • Measure the voltage between stability assist module C135-1, circuit 534 (YE/LG) harness side, and ground. • **Is the voltage greater than 10 volts?**	**Yes** GO to D4. **No** REPAIR circuit 534 (YE/LG). CLEAR the DTC. REPEAT the self-test.
D4 CHECK CIRCUIT 530 (LG/YE) FOR AN OPEN	
• Disconnect: Stability Assist Module C135. • Measure the resistance between stability assist module C135-16, circuit 530 (LG/YE) harness side, and ground; and between stability assist module C135-47, circuit 530 (LG/YE) harness side and ground. Then, measure the resistance between stability assist module C135-16 and C135-47 circuit 530 (LG/YE), component side. • **Is the resistance greater than 5 ohms?**	**Yes** INSTALL a new stability assist module. REFER to Anti-Lock Brake System (ABS) Module in this section. CLEAR the DTC. REPEAT the self-test. **No** REPAIR circuit 530 (LG/YE). CLEAR the DTC. REPEAT the self-test.

PINPOINT TEST E: DTC C1145 (RF), DTC C1155 (LF), DTC C1165 (RR), DTC C1175 (LR), ANTI-LOCK BRAKE SENSOR CIRCUIT FAILURE

Test Step	Result / Action to Take
CAUTION: Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multimeter probes.	
E1 CHECK FOR SHORT TO POWER	
NOTE: Both circuits must be checked for each DTC. • Key in OFF position. • Disconnect: Anti-Lock Brake Control Module C135. • Disconnect: Suspect Wheel Speed Sensor. • Key in ON position. • Measure the voltage between anti-lock brake control module C135 pins, harness side and ground as follows:	**Yes** REPAIR the affected circuit(s). CLEAR the DTC(s). REPEAT the self-test. **No** GO to E2.

DTC	Anti-Lock Brake Control Module C135	Circuit
C1145 (RF)	Pin 33	516 (YE/BK)
C1145 (RF)	Pin 34	514 (YE/RD)
C1155 (LF)	Pin 45	521 (TN/OG)
C1155 (LF)	Pin 46	522 (TN/BK)
C1165 (RR)	Pin 42	524 (PK/BK)
C1165 (RR)	Pin 43	523 (RD/PK)
C1175 (LR)	Pin 36	518 (LG/RD)
C1175 (LR)	Pin 37	519 (LG/BK)

- **Is any voltage present?**

E2 CHECK FOR SHORT TO GROUND

NOTE: Both circuits must be checked for each DTC.
- Key in OFF position.
- Measure the resistance between anti-lock brake control module C135 pin, harness side and ground as follows:

DTC	Anti-Lock Brake Control Module C135	Circuit
C1145 (RF)	Pin 33	516 (YE/BK)
C1145 (RF)	Pin 34	514 (YE/RD)
C1155 (LF)	Pin 45	521 (TN/OG)
C1155 (LF)	Pin 46	522 (TN/BK)
C1165 (RR)	Pin 42	524 (PK/BK)
C1165 (RR)	Pin 43	523 (RD/PK)
C1175 (LR)	Pin 36	518 (LG/RD)
C1175 (LR)	Pin 37	519 (LG/BK)

- **Are the resistances greater than 10,000 ohms?**

Yes
GO to E3 .

No
REPAIR the affected circuit(s). CLEAR the DTC(s). REPEAT the self-test.

E3 CHECK FOR AN OPEN

NOTE: Both circuits must be checked for each DTC.
- Measure the resistance between anti-lock brake control module C135 pins, harness side and suspect wheel speed sensor connector pins, harness side as follows:

Yes
GO to E4 .

No

DTC	Anti-Lock Brake Control Module C135 Pin No.	Wheel Speed Sensor Pin No.	Circuit
C1145	33	2	516 (YE/BK)
C1145	34	1	514 (YE/RD)
C1155	45	1	521 (TN/OG)
C1155	46	2	522 (TN/BK)
C1165	42	1	524 (PK/BK)
C1165	43	2	523 (RD/PK)
C1175	36	1	518 (LG/RD)
C1175	37	2	519 (LG/BK)

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

REPAIR the affected circuit(s). CLEAR the DTC(s). REPEAT the self-test.

E4 CHECK FOR WHEEL SPEED SENSOR CIRCUITS SHORTED TOGETHER

- Measure the resistance across the suspect wheel speed sensor pins
- **Are the resistances less than 10,000 ohms?**

Yes
REPAIR the affected circuit(s). CLEAR the DTC(s). REPEAT the self-test.

No
GO to E5 .

E5 CHECK THE ANTI-LOCK BRAKE CONTROL MODULE OUTPUT

- Connect: Anti-Lock Brake Control Module C135.
- Key in ON position.
- Measure the voltage between suspect anti-lock brake sensor connector pins, harness side.

DTC	Suspect Anti-Lock Brake Sensor Circuit	Suspect Anti-Lock Brake Sensor Circuit
C1234 (RF)	514 (YE/RD)	516 (YE/BK)
C1233 (LF)	521 (TN/OG)	522 (TN/BK)
C1235 (RR)	523 (RD/PK)	524 (PK/BK)
C1236 (LR)	518 (LG/RD)	519 (LG/BK)

- **Are the voltages greater than 9 volts?**

Yes
INSTALL a new anti-lock brake sensor. REFER to Front Wheel Speed Sensor , or Rear Wheel Speed Sensor . CLEAR the DTC(s). REPEAT the self-test.

No
INSTALL a new anti-lock brake control module. REFER to Anti-Lock Brake System (ABS) Module . CLEAR the DTC(s). REPEAT the self-test.

PINPOINT TEST F: DTC C1233 (LF), DTC C1234 (RF), DTC C1235 (RR), DTC C1236 (LR) — ANTI-LOCK BRAKE SENSOR INPUT SIGNAL MISSING

Test Step	Result / Action to Take
CAUTION: Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multimeter probes.	
NOTE: Any time an anti-lock brake sensor is removed, thoroughly clean the mounting surfaces, apply High Temperature 4x4 Front Axle and Wheel Bearing Grease E8TZ-19590-A or equivalent meeting Ford specification ESA-M1C198-A.	
F1 VERIFY DTC(S) ● Connect the diagnostic tool. ● Key in ON position. ● RETRIEVE the DTC(s). ● **Is DTC C1145, C1155, C1165, or C1175 retrieved?**	**Yes** Go To Pinpoint Test E . **No** GO to F2 .
F2 MONITOR THE WHEEL SPEED SENSOR PIDS ● Monitor the wheel speed PIDs while driving the vehicle at a constant speed. ● **Are the wheel speed PIDs consistent?**	**Yes** CLEAR the DTC(s). DRIVE the vehicle. RETRIEVE the DTC(s). IF DTC C1233, C1234, C1235, or C1236 is retrieved, INSTALL a new anti-lock brake control module. REFER to Anti-Lock Brake System (ABS) Module in this section. REPEAT the self-test. **No** GO to F3 .
F3 CHECK THE WHEEL SPEED SENSOR AND MOUNTING **NOTE:** Any time a wheel speed sensor is removed, thoroughly clean the mounting surfaces. Apply High-Temperature 4x4 Front Axle and Wheel Bearing Grease before installation. ● Raise the vehicle on a hoist. For additional information, REFER to Section 100-02 . ● **CAUTION: Examine the wheel speed sensor wire carefully, using a good light source. Failure to verify damage in the wheel speed sensor wire can lead to unnecessary installation of a new component.** ● Inspect the anti-lock brake sensor mounting for looseness or corrosion. CLEAN as necessary. ● **Are the wheel speed sensor and mounting OK?**	**Yes** GO to F4 . **No** If the wheel speed sensor is loose or corroded, REMOVE it and thoroughly clean the mounting surfaces. APPLY High Temperature 4x4 Front Axle and Wheel Bearing Grease. CLEAR the DTCs. REPEAT the self-test.
F4 CHECK THE WHEEL SPEED SENSOR RING FOR DAMAGE **NOTE:** Any time a wheel speed sensor is removed, thoroughly clean the mounting surfaces. Apply High-Temperature 4x4 Front Axle and Wheel Bearing Grease before installation. ● Remove the wheel speed sensor. ● **CAUTION: Examine the wheel speed sensor indicator carefully, using a good light**	**Yes** GO to F5 . **No** INSTALL a new wheel speed sensor ring. REFER to Front Wheel Speed Sensor Ring or Rear Wheel Speed Sensor Ring in this section. CLEAR

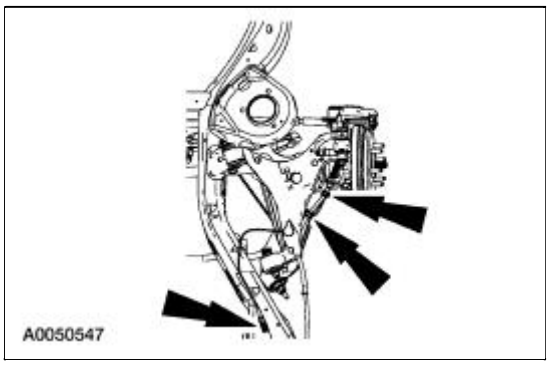
<table>
<tr>
<td>source. Failure to verify damage in the wheel speed sensor indicator can lead to unnecessary installation of a new component.
● Inspect the anti-lock brake sensor ring for damaged or missing teeth. Rotate the wheel to verify that no teeth are missing.
● Is the wheel speed sensor ring OK?</td>
<td>the DTC(s). REPEAT the self-test.</td>
</tr>
<tr>
<td>F5 CHECK THE ANTI-LOCK BRAKE CONTROL MODULE OUTPUT
● Connect: Anti-Lock Brake Control Module C135.
● Key in ON position.
● Measure the voltage between suspect anti-lock brake sensor connector pins, harness side.
<table><tr><th>DTC</th><th>Suspect Anti-Lock Brake Sensor Circuit</th><th>Suspect Anti-Lock Brake Sensor Circuit</th></tr><tr><td>C1234 (RF)</td><td>514 (YE/RD)</td><td>516 (YE/BK)</td></tr><tr><td>C1233 (LF)</td><td>521 (TN/OG)</td><td>522 (TN/BK)</td></tr><tr><td>C1235 (RR)</td><td>523 (RD/PK)</td><td>524 (PK/BK)</td></tr><tr><td>C1236 (LR)</td><td>518 (LG/RD)</td><td>519 (LG/BK)</td></tr></table>● Are the voltages greater than 9 volts?</td>
<td>Yes
INSTALL a new anti-lock brake sensor. REFER to Front Wheel Speed Sensor , or Rear Wheel Speed Sensor . CLEAR the DTC(s). REPEAT the self-test.

No
INSTALL a new anti-lock brake control module. REFER to Anti-Lock Brake System (ABS) Module . CLEAR the DTC(s). REPEAT the self-test.</td>
</tr>
</table>

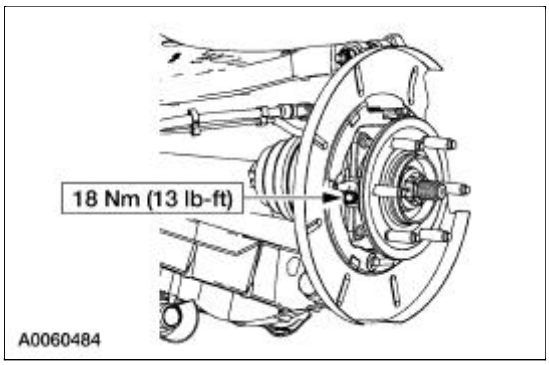
Rear Wheel Speed Sensor

Removal and Installation

1. Remove the parking brake shoes. For additional information, refer to Section 206-05 .
2. Disconnect the wheel speed sensor wire from the retaining clips.



3. Remove the bolt and remove the rear wheel speed sensor.



4. To install, reverse the removal procedure.

Front Wheel Speed Sensor Ring

Removal and Installation

NOTE: The front wheel speed sensor ring is integral to the front hub and bearing assembly.

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

Rear Wheel Speed Sensor Ring

Removal and Installation

1. **NOTE:** The rear wheel speed sensor ring is integral to the rear wheel hub and bearing assembly.

   For rear wheel speed sensor ring removal and installation, refer to Section 204-02 .

Torque Specifications

Description	Nm	lb-ft	lb-in
Hydraulic control unit (HCU) bracket bolts to frame	40	30	—
Hydraulic control unit (HCU) bolts to bracket	16	12	—
Front wheel speed sensor bolt	8	—	71
Hydraulic brake tubes	18	13	—
Rear wheel speed sensor bolt	8	—	71

Anti-Lock Control

CAUTION: The following stability assist system components installed on vehicles built before February 2003 cannot be interchanged with components manufactured for vehicles built after February 2003:

- **stability assist module**
- **lateral accelerometer**
- **longitudinal accelerometer**
- **yaw rate sensor**

The four wheel anti-lock brake system (4WABS) with traction control and stability assist system consists of the following components:

- active brake booster with integral solenoid
- brake booster release switch
- front anti-lock brake sensors
- front anti-lock brake sensor indicators
- hydraulic control unit (HCU)
- stability assist event indicator
- stability assist module
- lateral accelerometer
- rear anti-lock brake sensors
- rear anti-lock brake sensor indicators
- steering wheel position sensor
- two brake pressure transducers
- Advance Trac®/stability assist switch
- yaw rate sensor
- yellow anti-lock brake warning indicator

For removal and installation of the brake booster release switch, refer to Section 206-07 .

For removal and installation of the front anti-lock brake sensor indicators, refer to Section 204-01A for 4x2 vehicles or Section 204-01B for 4x4 vehicles.

For removal and installation of the rear anti-lock brake sensor indicator, refer to Section 205-05 .

For removal and installation of the steering wheel position sensor, refer to Section 211-04 .

Anti-Lock Control

Refer to Wiring Diagrams Cell 42 for schematic and connector information.

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool
 ST1137-A	73III Automotive Meter 105-R0057 or equivalent

Principles of Operation

NOTE: The diagnostic tool refers to the stability assist module as an "ABS module". The stability assist module is an ABS module at its core.

The stability assist module simultaneously manages the anti-lock braking, traction control, and engine control systems to maintain vehicle control during deceleration and acceleration.

When the ignition switch is put in the RUN position, the stability assist module will do a preliminary electrical check, and at approximately 20 km/h (12 mph) the hydraulic pump motor is turned on for approximately one half-second. Any malfunction of the anti-lock brake control system will disable the ABS/TC/Stability Assist and the anti-lock brake warning indicator will illuminate, however the power-assist braking system will function normally.

With the ignition in the START or RUN positions, the stability assist module functions similar to a conventional anti-lock brake module by monitoring and comparing the rotational speed of each wheel. Wheel speeds are measured by the anti-lock brake sensor which electrically senses each tooth of the anti-lock sensor indicator as they pass through the sensor's magnetic field. When the stability assist module detects an impending wheel lock, wheel spin or vehicle motion that is inconsistent with the driver's commands, brake pressure is modulated to the appropriate brake caliper(s). The stability assist module triggers the hydraulic control unit (HCU) to open and close the appropriate solenoid valves. Once the affected wheel(s) return to the desired speed, the stability assist module returns the solenoid valves to their normal position, and normal base brake operation is restored.

The stability assist module communicates with the powertrain control module (PCM) to assist with traction control. At speeds under 40 km/h (25 mph), when drive wheels loose traction and begin to spin, the stability assist module requests the PCM to reduce engine torque, while simultaneously applying and releasing the appropriate brake caliper(s) to maintain traction. The PCM accomplishes this by minor incremental timing changes and fewer fuel injector pulses until the stability assist module ends the request, the request is ended when the driven wheel speed returns to normal. After the vehicle speed exceeds 40 km/h (25 mph), the traction control is accomplished only through the PCM

torque control.

The stability assist system constantly monitors vehicle motion relative to the driver's intended course. This is done by using sensors to compare the driver's steering input and brake application with that of the actual vehicle motion. The system does not activate when the vehicle is traveling in reverse, however, ABS and traction control will continue to function as usual.

The stability assist/Advance Trac® switch allows the driver to control use of the stability assist system. This is independent of the ABS function, which cannot be switched off by the driver. The stability assist system's status is indicated by a stability assist warning light in the stability assist/Advance Trac® switch. An illuminated stability assist/Advance Trac® switch indicates that the stability assist system is switched off. In vehicles with a message center, the message "ADVANCETRAC OFF" is displayed. If a failure is detected somewhere in the stability assist system which affects either the yaw control or traction control functions, the stability assist indicator will be illuminated. The anti-lock brake function will continue to work as designed unless the yellow anti-lock brake warning indicator is also illuminated. The normal brake function will always occur, unless the red brake warning indicator is illuminated.

When stability assist activates, the following can occur:

- a rumble or grinding sound much like ABS or traction control.
- a small deceleration or a reduction in the acceleration of the vehicle.
- the stability assist indicator will flash.
- a vibration in the brake pedal much like ABS when the pedal is applied.
- if the event is severe and the brake pedal is not applied, the pedal will move to generate higher brake forces. A whoosh sound can also be heard from under the instrument panel in an event this severe.

Some drivers may notice a slight movement of the brake pedal when the system checks itself. The brake pedal moves when an active test of the brake booster is run. During this test a small amount of pressure will be generated at the master cylinder, but no pressure will be generated in the brake calipers. This test will occur above 48 km/h (30 mph) after the vehicle has been running approximately 8 minutes. The test will only be run if the vehicle is stable, the driver is not braking and the accelerator pedal is slightly depressed. If the brake system has not been bled correctly, the brake pedal movement can become more significant.

Yaw Rate Sensor

The yaw rate sensor measures the relative vehicle motion about the vertical axis through its center of gravity.

Lateral Accelerometer

The lateral accelerometer measures the acceleration which corresponds to the force involved while the vehicle slides sideways. This acceleration has two forms. The first is the centrifugal acceleration which is generated when the vehicle travels around in a circle. The second is the acceleration due to gravity. The accelerometer only measures the acceleration along the lateral (or sideways) direction of the vehicle, on level ground there is no contribution from this acceleration. However, if the vehicle is parked sideways on a bank or incline, the sensor will measure some lateral acceleration due to gravity even though the vehicle is not moving.

Longitudinal Accelerometer (4x4 vehicles)

The longitudinal accelerometer measures the acceleration corresponding to the force involved when the vehicle moves forward and rearward in the horizontal plane, along the centerline of the vehicle's front and rear wheels.

Steering Wheel Rotation Sensor

The steering wheel rotation sensor measures the rate of rotation of the steering wheel by monitoring the steering wheel rotation ring as it passes through the sensor gap. The steering wheel rotation sensor uses two signal lines to transmit information to the stability assist module, whether the steering wheel is being turned left or right and how far it is being turned. The steering wheel rotation sensor does not indicate the position of the steering wheel relative to straight ahead. The stability assist system learns this position by comparing the steering wheel position with other signals and storing the position it has learned. The stability assist system confirms this position and modifies it as necessary during every new driving cycle.

Active Brake Booster

The active brake booster functions like a conventional brake booster with the added feature that it can be actuated electrically by the stability assist module. The electrical brake booster actuation is necessary in severe stability assist events and makes sure that the hydraulic control unit can generate enough brake pressure to maintain vehicle stability. The brake assist from the brake booster is especially useful in cold weather when the hydraulic control unit cannot draw the brake fluid from the reservoir quickly at cold temperatures.

A solenoid within the active brake booster has a release switch to indicate when the driver is stepping on the brake pedal. The solenoid provides electrical actuation of the brake booster. Without the force of the input rod, the air valve is directly opened due to the movement of the energized solenoid. With increasing current applied to the solenoid, the air valve opens and output force is created. With decreasing current applied to the solenoid, the air valve is closed and the vacuum valve opens reducing output force.

The release switch indicates when the brake pedal has been depressed. It is integrated into the booster key that normally sits against the rear shell of the boot in its rest position and it adjoins the valve body when in its balance position. The switch itself provides indication from two positions. In its rest position, it supplies two signals, normally open (NO) and normally closed (NC). Upon application of sufficient force to initiate movement of the key away from the valve body, the brake booster switch changes state, signifying a driver application.

When the stability assist module is activating the brake booster, the brake pedal is pulled forward as the valve body moves. The release switch is held in position by the input rod spring and remains against the valve body. Although the pedal travel sensor (PTS) switch changes state when the brake pedal drops, the release switch remains inactive until such time as it encounters an external force from the driver, whether in a stability assist event controlled by the stability assist module, or in a standard mechanical braking event.

Electronic Brake Distribution

The electronic brake distribution (EBD) controls rear brake pressure and acts as an electronic proportioning valve. It is controlled by the stability assist module. When EBD is disabled, the amber ABS warning indicator and the red brake warning indicator will illuminate.

Brake Assist Braking

Brake assist braking functions by fully applying the brake booster during a panic stop. Depending on vehicle speed, if pedal stroke is more rapid than normal, it manipulates a valve in the brake booster that automatically applies full brake boost. Brake assist will be disabled when the driver releases the brake pedal.

DTC C1963

This Diagnostic Trouble Code (DTC) is stored if the stability assist warning indicator has been turned ON because the system could not confirm the straight-ahead steering wheel position for more than 30 seconds above 18 km/h (11 mph) or if driving aggressively immediately after turning the ignition on. This condition will most likely occur if there is some other DTC or if the vehicle reaches 75 km/h (47 mph) before confirming the straight-ahead position. If there is another DTC logged, the repair procedure is to follow the procedure for the first DTC. This DTC can be stored if:

- the PRNDL or Reverse switch has failed (check operation of PRNDL display and back-up lights).
- chassis modifications have been made that were not authorized by Ford.
- the vehicle is driven aggressively immediately after start-up.

In very rare circumstances this DTC can be stored by itself without the occurrence of any actual component failure. These conditions can cause DTC C1963 to set with no other DTC:

- The steering wheel has been turned while the ignition is off and then the vehicle is started, and either the vehicle is driven continuously in a circle or the vehicle is driven with continuous swerving, sliding or tire spinning.
- A new stability assist module can have been installed in the vehicle and was not calibrated.

Stability Assist Module Calibration

NOTE: When carrying out a calibration on a 4x2 vehicle, if the diagnostic tool instructs to calibrate the longitudinal accelerometer, ignore this request — 4x2 vehicles are not equipped with a longitudinal accelerometer.

The stability assist module needs to be recalibrated whenever a component specific to the stability assist system is disconnected or a new component is installed. For additional information regarding the DTCs that require the recalibration procedure, refer to the Stability Assist Calibration List. If a DTC is logged for any component of the stability assist system, the DTC must be cleared before carrying out the recalibration procedure. The need to recalibrate the stability assist module is also indicated by the active/fail lamp flashing and the presence of DTC C1998. The lamp will flash after clearing the DTCs that are indicated on the stability assist calibration list. If a DTC is retrieved after recalibration; refer to the Stability Assist Module Diagnostic Trouble Code (DTC) Index. If installing a new stability assist module, the calibration procedures as well as the configuration procedure must be carried out. For additional information regarding the module configuration procedure, refer to Section 418-01 .

When carrying out the lateral or longitudinal accelerometer or yaw rate calibration on the scan tester, the vehicle must be on a level surface, must not be moving and the ignition switch must be in the RUN position. When carrying out the steering wheel rotation sensor calibration on the scan tester, the ignition switch must be in the RUN position with the engine running and the steering wheel must be rotated back and forth from lock position to lock position.

Inspection and Verification

NOTE: If a new stability assist module is installed it must be reconfigured. For additional information, refer to Section 418-01 .

1. Verify the customer's concern by operating the vehicle to duplicate the condition.

2. Verify the stoplamps operate correctly by depressing and releasing the brake pedal with the ignition switch in the OFF position. If the stoplamps do not operate correctly, refer to Section 417-01 . If the stoplamps operate correctly, proceed to the next step.

3. Verify that the PRNDL operates correctly on the instrument cluster. If the PRNDL does not operate correctly, refer to Section 413-01 . If the PRNDL operates correctly, proceed to the next step.

4. Inspect to determine if one of the following mechanical or electrical concerns apply:

Visual Inspection Chart

Mechanical	Electrical
● Wheel speed sensor ring ● Hydraulic control unit (HCU) ● Incorrectly inflated tires ● Mismatched wheels or tires on vehicle ● Base brake concern ● Brake booster vacuum hose ● Ford specified steering components, suspension components and tire size ● Steering wheel rotation ring	● Battery junction box (BJB) Fuse: ■ 2 (20A) ■ 16 (10A) ■ 28 (5A) ■ 102 (30A) ■ 103 (30A) ■ 112 (30A) ● Stability assist module ● EVAC and fill connector ● Anti-lock brake sensor ● Stability assist/Advance Trac® switch ● BPP switch ● Steering wheel rotation sensor ● Brake booster solenoid ● Brake booster release switch ● Primary/main pressure transducer ● Yaw rate sensor ● Lateral accelerometer. ● Longitudinal rotation sensor (4x4 vehicles) ● Brake light switch ● IVD stoplamp relay ● Brake fluid level switch ● Wiring harness ● Connectors or connections ● Circuitry

5. If the concern remains after the inspection, connect the scan tester to the data link connector (DLC) located beneath the instrument panel, and select the vehicle to be tested from the scan tester menu. If the scan tester does not communicate with the vehicle:
   - Check that the program card is correctly installed.
   - Check the connection of the data link connector to the vehicle.
   - Check that the ignition switch is in the RUN position.

6. If the scan tester still does not communicate with the vehicle, refer to the scan tester manual.

7. Carry out the DATA LINK DIAGNOSTIC TEST. If scan tester responds with:
   - CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for stability assist module, Go To Pinpoint Test A .
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out the self-test diagnostics for the stability assist module.

8. If the DTCs retrieved are related to the concern, go to Stability Assist Module Diagnostic Trouble Code (DTC) Index to continue diagnostics.

9. If no DTCs related to the concern are retrieved, GO to Symptom Chart to continue diagnostics.

Stability Assist Module Diagnostic Trouble Code (DTC) Index

NOTE: The need to recalibrate the stability assist module is indicated by the active/fail lamp flashing and the presence of DTC C1998. There are other service actions that can require recalibration when there is no flashing lamp. For additional information, refer to the Stability Assist Module Calibration section. The lamp will flash after clearing the DTCs that are indicated on the stability assist calibration list.

Stability Assist Module Diagnostic Trouble Code (DTC) Index

NOTE: DTC C1730 (Reference Voltage Out Of Range) must be repaired before DTC C1279, C1280, C1281, C1282, C1288, C1289.

DTC	Description	Source	Action
B1342	ECU Is Defective	Stability Assist	**CAUTION:Do not replace stability assist modules installed on vehicles built before February 2003 with those manufactured after February 2003.** CLEAR the DTCs. RETRIEVE the DTCs. If other DTCs are retrieved, repair them, CLEAR the DTCs, and REPEAT the self-test. If DTC B1342 is retrieved, INSTALL a new stability assist module. REFER to Anti-Lock Brake System (ABS) Module—Stability Assist . REPEAT the self-test.
B1483	Brake Pedal Input Circuit Failure	Stability Assist	Go To Pinpoint Test B .
B1676	Battery Pack Voltage Out of Range	Stability Assist	Go To Pinpoint Test C .
B2477	Module Configuration Failure	Stability Assist	REFER to Section 418-01 .
B2734	Pedal Travel Sensor (PTS) Supply Error	Stability Assist	REFER to Section 418-01 .
B2736	Pedal Travel Sensor (PTS) Circuit Fault	Stability Assist	REFER to Section 418-01 .
B2737	Pedal Travel Sensor (PTS) Jammed Error	Stability Assist	REFER to Section 418-01 .
B2738	Pedal Travel Sensor (PTS) Spike Error	Stability Assist	REFER to Section 418-01 .
B2740	Pedal Travel Sensor (PTS) Spike Error	Stability Assist	REFER to Section 418-01 .
B2741	Sensor Cluster Loop End	Stability Assist	REFER to Section 418-01 .
B2900	VIN Mismatched	Stability Assist	Go To Pinpoint Test S .
C1095	ABS Hydraulic Pump Motor Circuit Failure	Stability Assist	Go To Pinpoint Test D .
C1145	Speed Wheel Sensor RF Input Circuit Failure	Stability Assist	Go To Pinpoint Test E .
C1155	Speed Wheel Sensor LF Input	Stability	Go To Pinpoint Test E .

	Circuit Failure	Assist	
C1165	Speed Wheel Sensor RR Input Circuit Failure	Stability Assist	Go To Pinpoint Test E .
C1175	Speed Wheel Sensor LR Input Circuit Failure	Stability Assist	Go To Pinpoint Test E .
C1233	Speed Wheel LF Input Signal Missing	Stability Assist	Go To Pinpoint Test F .
C1234	Speed Wheel RF Input Signal Missing	Stability Assist	Go To Pinpoint Test F .
C1235	Speed Wheel RR Input Signal Missing	Stability Assist	Go To Pinpoint Test F .
C1236	Speed Wheel LR Input Signal Missing	Stability Assist	Go To Pinpoint Test F .
C1277	Steering Wheel Angle 1 and 2 Circuit Failure	Stability Assist	Go To Pinpoint Test G .
C1278	Steering Wheel Angle 1 and 2 Signal Faulted	Stability Assist	Go To Pinpoint Test G .
C1279	Yaw Rate Sensor Circuit Failure	Stability Assist	Go To Pinpoint Test H .
C1280	Yaw Rate Sensor Signal Fault	Stability Assist	Go To Pinpoint Test H .
C1281	Lateral Accelerometer Circuit Failure	Stability Assist	Go To Pinpoint Test H .
C1282	Lateral Accelerometer Signal Fault	Stability Assist	Go To Pinpoint Test H .
C1285	Booster Solenoid Circuit Failure	Stability Assist	Go To Pinpoint Test I .
C1287	Booster Pedal Force Switch Circuit Failure	Stability Assist	Go To Pinpoint Test J .
C1288	Pressure Transducer Main/Primary Input Circuit Failure	Stability Assist	Go To Pinpoint Test K .
C1440	Pressure Transducer Main/Primary Signal Fault	Stability Assist	Go To Pinpoint Test P .
C1730	Reference Voltage Out of Range (+5 V)	Stability Assist	Go To Pinpoint Test L .
C1805	Mismatched PCM and/or Stability Assist Module	Stability Assist	**CAUTION:Do not replace stability assist modules installed on vehicles built before February 2003 with those manufactured after February 2003.** CHECK for correct component and correct PCM and stability assist module configuration; INSTALL a new component as necessary. REFER to Anti-Lock Brake System (ABS) Module—Stability Assist or Section 303-14 as necessary. CLEAR the DTC. REPEAT the self-test.
C1960	Driver Brake Apply Circuit Fault	Stability Assist	Go To Pinpoint Test M .
C1963	Stability Control Inhibit Warning	Stability Assist	This DTC is for information only. GO to the Principles of Operation. CLEAR the DTC.

			REPEAT the self-test.
C1991	Module Configuration Failure	Stability Assist	CLEAR the DTC. CARRY OUT the IVD calibration procedure following the scan tool directions. REFER to Section 418-00 . Be sure to turn the steering wheel from lock-to-lock (as part of the IVD calibration procedure). TEST DRIVE the vehicle. REPEAT the self-test. If DTC C1991 is still present, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module—Stability Assist .
C1996	Active Yaw Control Disabled	Stability Assist	This DTC can be set if the Stability Assist System is activated for 15 seconds of continuous operation. CHECK for any major chassis modifications, gross suspension misalignment, or other items that can alter the vehicle tracking dynamics.
C1998	Module Calibration Not Complete	Stability Assist	Go To Pinpoint Test Q .
C2769	Longitudinal Acceleration Sensor Circuit Failure	Stability Assist	Go To Pinpoint Test H .
C2770	Longitudinal Acceleration Sensor Signal Fault	Stability Assist	Go To Pinpoint Test H .
C2777	Sensor Cluster Bus Failure	Stability Assist	Go To Pinpoint Test R .
C2778	Sensor Cluster Power Supply Failure	Stability Assist	Go To Pinpoint Test R .
U1009	SCP (J1850) Invalid or Missing Data for Engine Torque	PCM	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U1027	SCP (J1850) Invalid or Missing Data for Engine RPM	PCM	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U1059	SCP (J1850) Invalid or Missing Data for Transmission/Transaxle/PRNDL	PCM	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U1073	SCP (J1850) Invalid or Missing Data for Engine Coolant	PCM	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U1243	SCP (J1850) Invalid or Missing Data for Exterior Environment	PCM	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U1262	SCP (J1850) Communication Bus Fault	Network Fault	REFER to Section 418-00 .
U1900	CAN Network #1 Communication Bus Fault-Receive Error	Network Fault	REFER to Section 418-00 .
U1901	CAN Network #2 Communication Bus Fault-Receive Error	Network Fault	REFER to Section 418-00 .

Stability Assist Calibration List

NOTE: The need to recalibrate the stability assist module is indicated by the active/fail lamp flashing and the presence of DTC C1998. For additional information, refer to the Stability Assist Module Calibration section for other service actions requiring recalibration. The lamp will flash after the DTCs on the stability assist calibration list are cleared.

Stability Assist Calibration List

DTC	Description	Stability Assist Calibration
C1277	Steering Wheel Angle 1 and 2 Circuit Failure	YES
C1278	Steering Wheel Angle 1 and 2 Signal Fault	YES
C1279	Yaw Rate Sensor Circuit Failure	YES
C1280	Yaw Rate Sensor Signal Fault	YES
C1281	Lateral Accelerometer Circuit Failure	YES
C1282	Lateral Accelerometer Signal Fault	YES
C1283	Switch Test Signal Failure	YES
C1285	Booster Solenoid Circuit Failure	YES
C1286	Booster Mechanical Failure	YES
C1287	Booster Pedal Force Switch Circuit Failure	YES
C1288	Pressure Transducer Main/Primary Input Circuit Failure	YES
C1440	Pressure Transducer Main/Primary Signal Fault	YES
C1730	Reference Voltage Out of Range (+5 V)	YES
C1960	Driver Brake Apply Circuit Fault	NO
C1963	Stability Control Inhibit Warning	NO
C1991	Module Configuration Failure	YES
C2769	Longitudinal Acceleration Sensor Circuit Failure	YES
C2770	Longitudinal Acceleration Sensor Signal Fault	YES

Symptom Chart

NOTE:

Refer to Wiring Diagrams Cell 42 for schematic and connector information.

Symptom Chart

Condition	Possible Sources	Action
• No communication with the stability assist module	• BJB Fuse 16 (10A), 103 (30A) or 112 (30A). • Circuitry. • Stability assist module.	• Go To Pinpoint Test A .
• The yellow ABS warning indicator does not self-check	• Circuitry. • Stability assist module. • Instrument cluster.	• REFER to Section 413-01 .
• Spongy brake pedal with no warning indicator	• Air in brake hydraulic system.	• REFER to Section 206-00 .

• The Advance Trac® switch indicator is always on/cannot be disabled	• Circuitry. • Stability assist/Advance Trac® switch. • Stability assist module.	• Go To Pinpoint Test O .
	• Base brake system.	• REFER to Section 206-00 .
	• Thermal model.	• Wait for brakes to cool down, the thermal model will reset automatically.

Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE STABILITY ASSIST MODULE

Test Step	Result / Action to Take
A1 CHECK THE VOLTAGE TO THE STABILITY ASSIST MODULE	
• Key in OFF position. • Disconnect: Stability Assist Module C135. • Key in ON position. • Measure the voltage between stability assist module C135-4, circuit 533 (TN/RD), harness side and ground. • **Is the voltage greater than 10 volts?**	**Yes** GO to A2 . **No** REPAIR circuit 533 (TN/RD). REPEAT the self-test.
A2 CHECK THE STABILITY ASSIST MODULE GROUNDS	
• Key in OFF position. • Disconnect the battery ground cable. Refer to Section 414-01 . • Measure the resistance between stability assist module C135-16, circuit 530 (LG/YE), harness side, and ground; and between stability assist module C135-47 circuit 530 (LG/YE) harness side, and ground. • **Are the resistances less than 5 ohms?**	**Yes** CHECK the SCP communication network. REFER to Section 418-00 . **No** REPAIR circuit 530 (LG/YE). REPEAT the self-test.

PINPOINT TEST B: DTC B1483 — BRAKE PEDAL INPUT CIRCUIT FAILURE

Test Step	Result / Action to Take
B1 CHECK THE STOPLAMP OPERATION	
• Press the brake pedal. • **Do the stoplamps operate correctly?**	**Yes** GO to B2 . **No** REFER to Section 417-01 .
B2 CHECK THE BRAKE ON/OFF (BOO) SWITCH PID	

• Connect the diagnostic tool. • Key in ON position. • Monitor the BOO switch PID while pressing and releasing the brake pedal. • **Does the BOO switch PID match the brake pedal positions (ON/OFF)?**	**Yes** The vehicle is OK. CLEAR the DTC. The ABS module will set DTC B1483 if the vehicle is driven with one foot on the brake pedal while the other foot is on the accelerator. **No** GO to B3 .
B3 CHECK CIRCUIT 810 (RD/LG) FOR AN OPEN	
• Key in OFF position. • Disconnect: Anti-Lock Brake Control Module C135. • Key in ON position. • Measure the voltage between anti-lock brake control module pin 41 circuit 810 (RD/LG), harness side and ground, while depressing the brake pedal. • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new anti-lock brake control module. REFER to Anti-Lock Brake System (ABS) Module—Stability Assist . CLEAR the DTC. REPEAT the self-test. **No** REPAIR circuit 810 (RD/LG). CLEAR the DTC. REPEAT the self-test.

PINPOINT TEST C: DTC B1676 — BATTERY PACK VOLTAGE OUT OF RANGE

Test Step	Result / Action to Take
C1 CHECK THE BATTERY VOLTAGE	
• Measure the battery voltage between the positive and negative battery posts with the key ON engine OFF (KOEO), and with the engine running. • **Is the battery voltage between 10 and 13 volts with KOEO, and between 11 and 17 volts with the engine running?**	**Yes** GO to C2 . **No** REFER to Section 414-00 . TEST the system for normal operation.
C2 CHECK THE VOLTAGE TO THE ANTI-LOCK BRAKE CONTROL MODULE	
• Disconnect: Anti-Lock Brake Control Module C135. • Key in ON position. • Measure the voltage between anti-lock brake control module C135 pins, harness and ground as follows: Pin / Circuit 1 — 534 (YE/LG) 4 — 533 (TN/RD) 32 — 532 (OG/YE) • **Are the voltages greater than 10 volts?**	**Yes** GO to C3 . **No** REPAIR the circuit in question. CLEAR the DTC. REPEAT the self-test.
C3 CHECK CIRCUIT 530 (LG/YE) FOR AN OPEN	
• Key in OFF position. • Disconnect the battery ground cable. Refer to Section 414-01 . • Measure the resistance between anti-lock control module pin 16, circuit 530 (LG/YE), harness side and ground; and between anti-lock control module pin 47, circuit 530 (LG/YE), harness side and	**Yes** INSTALL a new anti-lock brake control module. REFER to Anti-Lock Brake System (ABS) Module—Stability Assist . CLEAR the DTCs. REPEAT the self-test.

ground. ● **Are the resistances less than 5 ohms?**	**No** REPAIR circuit 530 (LG/YE). CLEAR the DTC. REPEAT the self-test.

PINPOINT TEST D: DTC C1095 — ABS HYDRAULIC PUMP MOTOR CIRCUIT FAILURE

Test Step	Result / Action to Take
D1 CHECK THE ABS PUMP MOTOR	
● Key in ON position. ● **Is the ABS pump motor running all the time?**	**Yes** INSTALL a new stability assist module. REFER to Anti-Lock Brake System (ABS) Module—Stability Assist in this section. CLEAR the DTC. REPEAT the self-test. **No** GO to D2.
D2 CHECK THE PUMP MOTOR OPERATION	
● Key in ON position. ● Connect the scan tool. ● Trigger the stability assist module pump motor active command. ● **Does the ABS pump motor run for approximately three seconds?**	**Yes** CLEAR the DTC. CHECK the yellow ABS warning indicator while driving the vehicle (brakes must not be applied) above 32 km/h (20 mph). If the yellow ABS warning indicator illuminates, RETRIEVE the DTCs. If DTC C1095 is retrieved, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module—Stability Assist in this section. CLEAR the DTC. REPEAT the self-test. If the yellow ABS warning indicator does not illuminate, the system is OK. **No** TRIGGER the stability assist module pump motor off active command.GO to D3.
D3 CHECK CIRCUIT 534 (YE/LG) FOR AN OPEN	
● Disconnect: Stability Assist Module C135. ● Measure the voltage between stability assist module C135-1, circuit 534 (YE/LG) harness side, and ground. ● **Is the voltage greater than 10 volts?**	**Yes** GO to D4. **No** REPAIR circuit 534 (YE/LG). CLEAR the DTC. REPEAT the self-test.
D4 CHECK CIRCUIT 530 (LG/YE) FOR AN OPEN	
● Disconnect: Stability Assist Module C135. ● Disconnect the battery ground cable. Refer to Section 414-01. ● Measure the resistance between stability assist module C135-16, circuit 530 (LG/YE) harness side, and ground; and between stability assist module C135-47, circuit 530 (LG/YE) harness side and ground. Then, measure the resistance between stability assist	**Yes** INSTALL a new stability assist module. REFER to Anti-Lock Brake System (ABS) Module—Stability Assist in this section. CLEAR the DTC. REPEAT the self-test. **No** REPAIR circuit 530 (LG/YE). CLEAR the DTC. REPEAT the self-test.

module C135-16 and C135-47 circuit 530 (LG/YE), component side. • **Is the resistance greater than 5 ohms?**	

PINPOINT TEST E: DTC C1145 (RF), DTC C1155 (LF), DTC C1165 (RR), DTC C1175 (LR) — ANTI-LOCK BRAKE SENSOR INPUT CIRCUIT FAILURE

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>E1 CHECK FOR A SHORT TO POWER

NOTE: Both circuits must be checked for each DTC.
• Key in OFF position.
• Disconnect: Stability Assist Module C135 .
• Disconnect: Suspect Anti-lock Brake Sensor.
• Key in ON position.
• Measure the voltage between stability assist module C135 pin, harness side, and ground, as follows:

<table>
<tr><th>DTC</th><th>Stability Assist Module C135 Pin</th><th>Circuit</th></tr>
<tr><td>C1145 (RF)</td><td>33</td><td>516 (YE/BK)</td></tr>
<tr><td>C1145 (RF)</td><td>34</td><td>514 (YE/RD)</td></tr>
<tr><td>C1155 (LF)</td><td>45</td><td>521 (TN/OG)</td></tr>
<tr><td>C1155 (LF)</td><td>46</td><td>522 (TN/BK)</td></tr>
<tr><td>C1165 (RR)</td><td>42</td><td>524 (PK/BK)</td></tr>
<tr><td>C1165 (RR)</td><td>43</td><td>523 (RD/PK)</td></tr>
<tr><td>C1175 (LR)</td><td>36</td><td>518 (LG/RD)</td></tr>
<tr><td>C1175 (LR)</td><td>37</td><td>519 (LG/BK)</td></tr>
</table>
• Is voltage present?</td><td>Yes
REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.

No
GO to E2 .</td></tr>
<tr><td>E2 CHECK FOR A SHORT TO GROUND

NOTE: Both circuits must be checked for each DTC.
• Key in OFF position.
• Measure the resistance between stability assist module C135 pins harness side and ground, as follows:

<table>
<tr><th>DTC</th><th>Stability Assist Module C135 Pin</th><th>Circuit</th></tr>
<tr><td>C1145</td><td>33</td><td>516</td></tr>
</table></td><td>Yes
GO to E3 .

No
REPAIR the circuit in question. CLEAR the DTC. REPEAT the self-test.</td></tr>
</table>

(RF)		(YE/BK)
C1145 (RF)	34	514 (YE/RD)
C1155 (LF)	45	521 (TN/OG)
C1155 (LF)	46	522 (TN/BK)
C1165 (RR)	42	524 (PK/BK)
C1165 (RR)	43	523 (RD/PK)
C1175 (LR)	36	518 (LG/RD)
C1175 (LR)	37	519 (LG/BK)

- **Are the resistances greater than 10,000 ohms?**

E3 CHECK FOR AN OPEN

NOTE: Both circuits must be checked for each DTC.

- Measure the resistance between stability assist module C135 pins, harness side and the suspect anti-lock brake sensor connector pins, harness side, as follows:

DTC	Circuit	Stability Assist Module C135 Pin	Wheel Speed Sensor Connector Pin
C1145 (RF)	516 (YE/BK)	33	2
C1145 (RF)	514 (YE/RD)	34	1
C1155 (LF)	521 (TN/OG)	45	1
C1155 (LF)	522 (TN/BK)	46	2
C1165 (RR)	523 (RD/PK)	42	1
C1165 (RR)	524 (PK/BK)	43	2
C1175 (LR)	518 (LG/RD)	36	2
C1175 (LR)	519 (LG/BK)	37	1

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

Yes
GO to E4 .

No
REPAIR the circuit in question. CLEAR the DTC. REPEAT the self-test.

E4 CHECK FOR SHORTED WHEEL SPEED SENSOR CIRCUITS

- Measure the resistance between the suspect anti-lock brake sensor pins.
- **Is the resistance greater 10,000 ohms?**

Yes
GO to E5 .

	No REPAIR the circuit in question. CLEAR the DTC. REPEAT the self-test.
E5 CHECK THE STABILITY ASSIST MODULE OUTPUT ● Connect: Stability Assist Module C135. ● Key in ON position. ● Measure the voltage between the suspect anti-lock brake sensor pins, harness side. **DTC** / **Suspect Anti-Lock Brake Sensor Circuit** / **Suspect Anti-Lock Brake Sensor Circuit** C1234 (RF) — 514 (YE/RD) — 516 (YE/BK) C1233 (LF) — 521 (TN/OG) — 522 (TN/BK) C1235 (RR) — 523 (RD/PK) — 524 (PK/BK) C1236 (LR) — 518 (LG/RD) — 519 (LG/BK) ● **Are the voltages greater than 9 volts?**	**Yes** INSTALL a new stability assist module. REFER to Anti-Lock Brake System (ABS) Module—Stability Assist in this section. CLEAR the DTC. REPEAT the self-test. **No** INSTALL a new anti-lock brake sensor. For the front anti-lock brake sensor, REFER to Front Wheel Speed Sensor in this section. CLEAR the DTC. REPEAT the self-test. For the rear anti-lock brake sensor, REFER to Rear Wheel Speed Sensor in this section. CLEAR the DTC. REPEAT the self-test.

PINPOINT TEST F: DTC C1233 (LF), DTC C1234 (RF), DTC C1235 (RR), DTC C1236 (LR) — ANTI-LOCK BRAKE SENSOR INPUT SIGNAL MISSING

Test Step	Result / Action to Take
F1 CHECK FOR DTCS ● Key in ON position. ● Connect the diagnostic tool. ● Retrieve DTCs. ● **Is DTC C1145, C1155, C1165 or C1175 present?**	**Yes** Go To Pinpoint Test E . **No** GO to F2 .
F2 CHECK THE WHEEL SPEED PIDS ● Use the scan tool to monitor the wheel speed PIDS while driving the vehicle at a constant speed. ● **Are the four wheel speed PID values similar?**	**Yes** CLEAR the DTC. DRIVE the vehicle. RETRIEVE DTCs. If DTC C1233, C1234, C1235 or C1236 is present, INSTALL a new anti-lock brake control module. REFER to Anti-Lock Brake System (ABS) Module—Stability Assist in this section. REPEAT the self-test. **No** GO to F3 .
F3 CHECK THE ANTI-LOCK BRAKE SENSOR FOR DAMAGE AND/OR LOOSENESS ● Key in OFF position.	**Yes**

- Raise and support the vehicle. Refer to Section 100-02 .
- **CAUTION: Examine the anti-lock brake sensor wire carefully with a good light. Failure to verify damage in the anti-lock brake sensor wire can lead to unnecessary installation of a new component.**
- Inspect the anti-lock brake sensor mounting for looseness. If the anti-lock brake sensor is suspected, inspect the sensor for corrosion or on the front anti-lock brake mounting flange. Clean as necessary.
- **Is the anti-lock brake sensor OK?**

GO to F4 .

No
INSTALL a new anti-lock brake sensor. For the front anti-lock brake sensor, REFER to Front Wheel Speed Sensor in this section. CLEAR the DTC. REPEAT the self-test. For the rear anti-lock brake sensor, REFER to Rear Wheel Speed Sensor in this section. CLEAR the DTC. REPEAT the self-test.

F4 CHECK FOR WHEEL SPEED SENSOR RING DAMAGE

- Raise and support the vehicle. Refer to Section 100-02 .
- Remove the anti-lock brake sensor.
- Inspect the wheel speed sensor ring for damaged or missing teeth. Rotate the wheel to verify that no teeth are missing.
- **Is the wheel speed sensor ring OK?**

Yes
GO to F5 .

No
INSTALL a new wheel speed sensor ring. For the front wheel speed sensor ring, REFER to Front Wheel Speed Sensor Ring in this section. CLEAR the DTC. REPEAT the self-test. For the rear wheel speed sensor ring, REFER to Rear Wheel Speed Sensor Ring in this section. CLEAR the DTC. REPEAT the self-test.

F5 CHECK THE ANTI-LOCK BRAKE CONTROL MODULE OUTPUT

- Key in ON position.
- Measure the voltage between the stability assist module C135 and the suspect wheel speed sensor connectors as follows:

DTC	Circuit	Stability Assist Module C135 Pin	Wheel Speed Sensor Connector Pin
C1234 (RF)	516 (YE/BK)	33	2
C1234 (RF)	514 (YE/RD)	34	1
C1233 (LF)	521 (TN/OG)	45	1
C1233 (LF)	522 (TN/BK)	46	2
C1235 (RR)	523 (RD/PK)	42	1
C1235 (RR)	524 (PK/BK)	43	2
C1236 (LR)	518 (LG/RD)	36	1
C1236 (LR)	519 (LG/BK)	37	2

Yes
INSTALL a new anti-lock brake sensor. For the front anti-lock brake sensor, REFER to Front Wheel Speed Sensor in this section. CLEAR the DTC. REPEAT the self-test. For the rear anti-lock brake sensor, REFER to Rear Wheel Speed Sensor in this section. CLEAR the DTC. REPEAT the self-test.

No
INSTALL a new anti-lock brake control module. REFER to Anti-Lock Brake System (ABS) Module—Stability Assist in this section. TEST the system for normal operation.

• **Are the voltages greater than 9 volts?**	

PINPOINT TEST G: DTC C1277/C1278 — STEERING WHEEL ANGLE 1 AND 2 CIRCUIT FAILURE/FAULT

Test Step	Result / Action to Take
G1 CARRY OUT THE RECALIBRATION PROCEDURE	
• Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Clear the DTC. • Carry out the steering wheel angle recalibration procedure using the scan tester. • Test drive the vehicle. • Enter the following diagnostic mode on the diagnostic tool: Retrieve DTCs. • **Are any DTCs retrieved or does the recalibration procedure indicate a fault?**	**Yes** If DTC C1277 or C1278 is retrieved or the recalibration procedure indicates a fault, GO to G2 . If any other DTC, GO to the Stability Assist Module Diagnostic Trouble Code (DTC) Index. **No** The stability assist system is operating correctly. The DTC C1278 was meant for detection of steering wheel rotation sensor harness wiring problems at vehicle assembly time. The steering wheel rotation sensor circuit is checked for swapped wires (channel A and B). This DTC should not occur during repair unless the harness wiring to the steering wheel rotation sensor was changed or the PRNDL position indicator is not operating correctly. The DTC will occur only after driving a few feet and making a turn if the wiring problem or PRNDL problem exists.
G2 MONITOR THE STEERING WHEEL ROTATION SENSOR PIDS	
• Key in ON position. • Monitor the steering wheel rotation sensor PIDs while rotating the steering wheel clockwise and counterclockwise. • **Are the two steering wheel rotation sensor PID values switching as the wheel rotates?**	**Yes** CLEAR the DTC. Drive the vehicle. RETRIEVE the DTCs. IF DTC C1278 is present, CHECK for swapped circuit in connector C226. Otherwise, GO to G7 . **No** GO to G3 .
G3 CHECK THE STEERING WHEEL ROTATION SENSOR RING	
• Check the steering wheel rotation sensor ring for damage. • **Is the steering wheel rotation sensor OK?**	**Yes** GO to G4 . **No** INSTALL a new steering wheel rotation sensor ring. REFER to Section 211-04 .
G4 CHECK CIRCUIT 1574 (DB) FOR POWER	
• Disconnect: Sensor Cluster. • Key in ON position. • Measure the voltage between sensor cluster C3073-3, circuit 1574 (DB), harness side and	**Yes** GO to G5 . **No** INSTALL a new sensor cluster. REFER to Yaw Rate

<table>
<tr><td>ground.
● Is the voltage 10 volts or greater?</td><td>Sensor in this section. CLEAR the DTC. RECALIBRATE the system. REPEAT the self-test.</td></tr>
<tr><td>G5 CHECK THE VOLTAGE TO THE STEERING WHEEL ROTATION SENSOR</td><td rowspan="2">Yes
GO to G6 .

No
REPAIR circuit 1574 (DB). CLEAR the DTC. RECALIBRATE the stability assist module. REPEAT the self-test.</td></tr>
<tr><td>● Key in OFF position.
● Disconnect: Steering Wheel Rotation Sensor C226.
● Key in ON position.
● Measure the voltage between steering wheel rotation sensor C226-1, circuit 1574 (DB), harness side, and ground.
● Is the voltage greater than 10 volts?</td></tr>
<tr><td>G6 CHECK THE STEERING WHEEL ROTATION SENSOR GROUND</td><td rowspan="2">Yes
GO to G7 .

No
REPAIR circuit 1571 (BK), CLEAR the DTC. RECALIBRATE the stability assist module. REFER to Section 418-01 . REPEAT the self-test.</td></tr>
<tr><td>● Key in OFF position.
● Measure the resistance between steering wheel rotation sensor C226-4, circuit 1571 (BK) harness side and ground.
● Is the resistance less than 5 ohms?</td></tr>
<tr><td>G7 CHECK THE STEERING WHEEL ROTATION SENSOR CIRCUITRY FOR AN OPEN</td><td rowspan="2">Yes
GO to G8 .

No
REPAIR the circuit in question. CLEAR the DTC. RECALIBRATE the stability assist module. REPEAT the self-test.</td></tr>
<tr><td>● Key in OFF position.
● Measure the resistance between stability assist module C135 pins, (harness side), and steering wheel rotation sensor C226 pins, harness side, as follows:
<table><tr><th>Stability Assist Module C135 Pin</th><th>Steering Wheel Rotation Sensor C226 Pin</th></tr><tr><td>6</td><td>2</td></tr><tr><td>3</td><td>3</td></tr><tr><td>5</td><td>4</td></tr></table>● Is the resistance less than 5 ohms?</td></tr>
<tr><td>G8 CHECK CIRCUITS 1572 (DG) AND 1573 (YE) FOR A SHORT TOGETHER</td><td rowspan="2">Yes
GO to G9 .

No
REPAIR circuit 1572 (DG) and 1573 (YE). CLEAR the DTC. RECALIBRATE the stability assist module.</td></tr>
<tr><td>● Key in OFF position.
● Measure the resistance between steering wheel rotation sensor C226-2, circuit 1572 (DG) and C226-3 circuit 1573 (YE), harness and ground.</td></tr>
</table>

<table>
<tr><td>

- **Is the resistance greater than 10,000 ohms?**

</td><td>REFER to Section 418-01 . REPEAT the self-test.</td></tr>
<tr><td>G9 CHECK THE STEERING WHEEL ROTATION SENSOR FOR A SHORT TO POWER</td><td></td></tr>
<tr><td>

- Key in OFF position.
- Disconnect: Stability Assist Module C135.
- Key in ON position.
- Measure the voltage between stability assist module C135 pins, harness side and ground as follows:

<table>
<tr><th>Stability Assist Module C135 Pin</th><th>Circuit</th></tr>
<tr><td>6</td><td>1573 (YE)</td></tr>
<tr><td>3</td><td>1572 (DG)</td></tr>
<tr><td>5</td><td>1571 (BK)</td></tr>
</table>

- **Is voltage present?**

</td><td>Yes
REPAIR the circuit in question. CLEAR the DTC. RECALIBRATE the stability assist module. REPEAT the self-test.

No
GO to G10 .</td></tr>
<tr><td>G10 CHECK THE STEERING WHEEL ROTATION SENSOR CIRCUITRY FOR A SHORT TO GROUND</td><td></td></tr>
<tr><td>

- Key in OFF position.
- Measure the resistance between stability assist module C135 pins, (harness side), and ground as follows:

<table>
<tr><th>Stability Assist Module C135 Pin</th><th>Circuit</th></tr>
<tr><td>2</td><td>1573 (YE)</td></tr>
<tr><td>3</td><td>1572 (DG)</td></tr>
<tr><td>4</td><td>1571 (BK)</td></tr>
</table>

- **Is the resistance greater than 10,000 ohms?**

</td><td>Yes
INSTALL a new steering wheel rotation sensor. REFER to Steering Wheel Rotation Sensor in this section. CLEAR the DTC. REPEAT the self-test.

No
REPAIR the circuit in question. CLEAR the DTC. RECALIBRATE the stability assist module. REPEAT the self-test.</td></tr>
</table>

PINPOINT TEST H: DTC C1279, C1280, C1281, C1282, C2769, C2770— SENSOR CLUSTER FAULT

Test Step	Result / Action to Take
NOTE: The yaw rate sensor, lateral accelerometer, and longitudinal accelerometer (4x4 vehicles) are integral to the sensor cluster.	

The sensor cluster is not serviceable and must be installed as an assembly.

H1 CARRY OUT THE RECALIBRATION PROCEDURE

- Key in ON position.
- Enter the following diagnostic mode on the diagnostic tool: Clear DTC.
- Carry out the yaw rate sensor recalibration procedure using the scan tester.
- Enter the following diagnostic mode on the diagnostic tool: Diagnostic Tool.
- Test drive the vehicle.
- **Are any DTCs retrieved or does the recalibration procedure indicate a fault?**

Yes
GO to H2 .

No
The stability assist system is operating correctly.

H2 CHECK THE STABILITY ASSIST MODULE YAW RATE PID

- Monitor the stability assist module yaw rate PID.
- **Is the stability assist module yaw rate PID value between -4 and +4?**

Yes
GO to H3 .

No
INSTALL a new yaw rate sensor. REFER to Yaw Rate Sensor in this section. CLEAR DTCs. RECALIBRATE the stability assist module. REPEAT the self-test.

H3 CHECK THE VOLTAGE FROM THE STABILITY ASSIST MODULE

- Connect: Stability Assist Module C135.
- Key in ON position.
- Measure the voltage between yaw rate sensor C3073-3, circuit 1574 (DB), (harness side), and yaw rate sensor C3073-5, circuit 1571 (BK), (harness side).
- **Is the voltage 10 volts or greater?**

Yes
INSTALL a new sensor cluster. REFER to Yaw Rate Sensor in this section. CLEAR the DTC. REPEAT the self-test.

No
GO to H4 .

H4 CHECK THE YAW RATE SENSOR CIRCUITRY FOR AN OPEN

- Measure the resistance between stability assist module C135 pins, (harness side), and yaw rate sensor C3073 pins, harness side as follows:

Stability Assist Module C135 Pin	Yaw Rate Sensor C3073 Pin	Circuit
7	3	1574 (DB)
5	5	1571 (BK)
25	1	1879 (PK/BK)
29	2	1878 (WH/BK)

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

Yes
GO to H5 .

No
REPAIR the circuit in question. CLEAR the DTC. RECALIBRATE the stability assist module. REPEAT the self-test.

H5 CHECK THE YAW RATE SENSOR CIRCUITRY FOR A SHORT TO POWER

- Key in OFF position.
- Disconnect: Stability Assist Module C135.

Yes
REPAIR the circuit in question. CLEAR

<table>
<tr><td>

- Disconnect: Yaw Rate Sensor C3073.
- Key in ON position.
- Measure the voltage between yaw rate sensor C3073 pins, (harness side), and ground as follows:

Yaw Rate Sensor C3073 Pin	Circuit
3	1574 (DB)
5	1571 (BK)
1	1879 (PK/BK)
2	1878 (WH/BK)

- **Is voltage present?**

</td><td>the DTC. RECALIBRATE the stability assist module. REPEAT the self-test.

No
GO to H6 .</td></tr>
<tr><td>H6 CHECK THE SENSOR CLUSTER CIRCUITRY FOR A SHORT TO GROUND</td><td rowspan="2">Yes
INSTALL a new stability assist module. REFER to Anti-Lock Brake System (ABS) Module—Stability Assist in this section. CLEAR the DTC. REPEAT the self-test.

No
REPAIR the circuit in question. CLEAR the DTC. RECALIBRATE the stability assist module. REPEAT the self-test.</td></tr>
<tr><td>

- Key in OFF position.
- Measure the resistance between yaw rate sensor C3072 pins, (harness side), and ground as follows:

Yaw Rate Sensor C3073 Pin	Circuit
3	1574 (DB)
5	1571 (BK)
1	1879 (PK/BK)
2	1878 (WH/BK)

- **Are the resistances greater than 10,000 ohms?**

</td></tr>
</table>

PINPOINT TEST I: DTC C1285—BRAKE BOOSTER SOLENOID OUTPUT FAILURE

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>I1 CHECK THE BRAKE BOOSTER SOLENOID</td><td rowspan="2">Yes
GO to I2 .

No
INSTALL a new brake booster. REFER to Section 206-07 . CLEAR the DTC. RECALIBRATE the stability assist module. REPEAT the self-test.</td></tr>
<tr><td>

- Key in OFF position.
- Disconnect: Brake Booster C149.
- Measure the resistance between brake booster C149-3 (component side) and brake booster solenoid C149-4 (component side).
- **Is the resistance between 1 and 2 ohms?**

</td></tr>
<tr><td>I2 CHECK CIRCUIT 1582 (LG/RD) AND CIRCUIT 1583 (BK/WH) FOR AN OPEN</td><td rowspan="2">Yes
GO to I3 .

No
REPAIR circuit 1582 (LG/RD) or circuit 1583 (BK/WH). CLEAR the</td></tr>
<tr><td>

- Key in OFF position.
- Measure the resistance between stability assist module C135-17, circuit 1582 (LG/RD), harness side, and brake booster C149-3, circuit 1582 (LG/RD), harness side; and between stability assist module C135-31, circuit 1583 (BK/WH), harness side, and

</td></tr>
</table>

brake booster C149-4, circuit 1583 (BK/WH) harness side. ● **Are the resistances less than 5 ohms?**	DTC. RECALIBRATE the stability assist module. REPEAT the self-test.
I3 CHECK CIRCUIT 1582 (LG/RD) AND 1583 (BK/WH) HARNESS SIDE FOR A SHORT TO GROUND	
● Measure the resistance between brake booster C149-3, circuit 1582 (LG/RD), harness side and ground and between brake booster C149-4, circuit 1583 (BK/WH) harness side and ground. ● **Is the resistance greater than 10,000 ohms?**	**Yes** GO to I4 . **No** REPAIR circuit 1582 (LG/RD) or circuit 1583 (BK/WH). CLEAR the DTC. RECALIBRATE the stability assist module. REPEAT the self-test.
I4 CHECK CIRCUIT 1583 (BK/WH) FOR A SHORT TO POWER	
● Disconnect: Stability Assist Module C135. ● Key in ON position. ● Measure the voltage between brake booster solenoid C149-4, circuit 1583 (BK/WH), harness side, and ground and between brake booster C149-3, circuit 1582 (LG/RD) harness side and ground. ● **Is voltage present?**	**Yes** REPAIR circuit 1582 (LG/RD) or circuit 1583 (BK/WH). CLEAR the DTC. RECALIBRATE the stability assist module. REFER to Section 418-01 . REPEAT the self-test. **No** GO to I5 .
I5 CHECK THE BRAKE BOOSTER SOLENOID FOR CORRECT OPERATION	
● Connect: Brake Booster C149. ● Start the engine. ● Wait a few minutes to create engine vacuum in the brake booster and then place the ignition switch in the OFF position. ● Connect a fused (10A) jumper wire between stability assist module C135-31, circuit 1583 (BK/WH), harness side, and ground; and connect a fused (10A) jumper wire for several seconds between stability assist module C135-17, circuit 1582 (LG/RD), harness side, and the positive battery post, while observing the brake pedal for movement. ● **Does the brake pedal move?**	**Yes** INSTALL a new stability assist module. REFER to Anti-Lock Brake System (ABS) Module—Stability Assist in this section. REPEAT the self-test. **No** INSTALL a new brake booster. REFER to Section 206-07 . CLEAR the DTC. RECALIBRATE the stability assist module. REPEAT the self-test.

PINPOINT TEST J: DTC C1287 — BRAKE BOOSTER PEDAL FORCE SWITCH CIRCUIT FAILURE

Test Step	Result / Action to Take
J1 CHECK THE NORMALLY CLOSED RELEASE SWITCH	
● Key in OFF position. ● Disconnect: Brake Booster C149. ● Measure the resistance between brake booster C149-2 (component side) and brake booster C149-5 (component side), while depressing and releasing the brake pedal. ● **Is the resistance less than 5 ohms with the brake pedal released and greater than 10,000 ohms with the brake pedal depressed?**	**Yes** GO to J2 . **No** INSTALL a new brake booster. REFER to Section 206-07 . CLEAR the DTC. RECALIBRATE the stability assist module. REPEAT the self-test.

<table>
<tr><th>J2 CHECK THE NORMALLY OPEN RELEASE SWITCH</th><td></td></tr>
<tr><td>

Measure the resistance between brake booster C149-1 (component side) and brake booster C149-5 (component side), while depressing and releasing the brake pedal.
Is the resistance less than 5 ohms with the brake pedal depressed and greater than 10,000 ohms with the brake pedal released?

</td><td>Yes
GO to J3 .

No
INSTALL a new brake booster. REFER to Section 206-07 . CLEAR the DTC. RECALIBRATE the stability assist module. REPEAT the self-test.</td></tr>
<tr><th>J3 CHECK THE BRAKE BOOSTER CIRCUITRY FOR A SHORT TO POWER</th><td></td></tr>
<tr><td>

Disconnect: Stability Assist Module C135.
Key in ON position.
Measure the voltage between stability assist module C135 pins, harness side, and ground, as follows:

<table>
<tr><th>Stability Assist Module C135 Pin</th><th>Circuit</th></tr>
<tr><td>27</td><td>1581 (PK/LB)</td></tr>
<tr><td>28</td><td>547 (LG/YE)</td></tr>
<tr><td>30</td><td>1580 (WH/LG)</td></tr>
</table>

Is voltage present?

</td><td>Yes
REPAIR the circuit in question. CLEAR the DTC. RECALIBRATE the stability assist module. REPEAT the self-test.

No
GO to J4 .</td></tr>
<tr><th>J4 CHECK THE BRAKE BOOSTER CIRCUITRY</th><td></td></tr>
<tr><td>

Key in OFF position.
Measure the resistance between stability assist module C135 pins, harness side, and brake booster C149 pins, harness side, as follows:

<table>
<tr><th>Stability Assist Module C135 Pin</th><th>Brake Booster C149 Pin</th><th>Circuit</th></tr>
<tr><td>27</td><td>1</td><td>1581 (PK/LB)</td></tr>
<tr><td>30</td><td>2</td><td>1580 (WH/LG)</td></tr>
<tr><td>28</td><td>5</td><td>547 (LG/YE)</td></tr>
</table>

Are the resistances less than 5 ohms?

</td><td>Yes
INSTALL a new stability assist module. REFER to Anti-Lock Brake System (ABS) Module—Stability Assist in this section. REPEAT the self-test.

No
REPAIR the circuit in question. CLEAR the DTC. RECALIBRATE the stability assist module. REPEAT the self-test.</td></tr>
</table>

PINPOINT TEST K: DTC C1288—PRESSURE TRANSDUCER MAIN/PRIMARY INPUT CIRCUIT FAILURE

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><th>K1 CHECK THE PRESSURE TRANSDUCER CIRCUITRY FOR A SHORT TO POWER</th><td></td></tr>
<tr><td>

Key in OFF position.
Disconnect: Stability Assist Module C135.
Disconnect: Pressure Transducer C147.
Key in ON position.
Measure the voltage between stability assist module C135 pins, harness side, and ground as follows:

</td><td>Yes
REPAIR the circuit in question. CLEAR the DTC. REPEAT the self-test.

No</td></tr>
</table>

	GO to K2 .

Stability Assist Module C135 Pin	Circuit
18	3601 (WH/RD)
19	3603 (RD)
20	3600 (RD/WH)

- **Is voltage present?**

K2 CHECK THE PRESSURE TRANSDUCER CIRCUITRY FOR A SHORT TO GROUND	
• Key in OFF position. • Measure the resistance between stability assist module C135 pins, harness side, and ground, as follows:	**Yes** GO to K3 . **No** REPAIR the circuit in question. CLEAR the DTC. REPEAT the self-test.

Stability Assist Module C135 Pin	Circuit
18	3601 (WH/RD)
19	3603 (RD)
20	3600 (RD/WH)

- **Are the resistances greater than 10,000 ohms?**

K3 CHECK THE PRESSURE TRANSDUCER CIRCUITRY FOR AN OPEN	
• Measure the resistance between stability assist module C135 pins, harness side, and pressure transducer C147 pins, harness side, as follows:	**Yes** GO to K4 . **No** REPAIR the circuit in question. CLEAR the DTC. REPEAT the self-test.

Stability Assist Module C135 Pin	Pressure Transducer C147 Pin	Circuit
19	1	3603 (RD)
20	2	3600 (RD/WH)
18	3	3601 (WH/RD)

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

K4 CHECK THE STABILITY ASSIST MODULE OUTPUT	
• Connect: Stability Assist Module C135. • Key in ON position. • Measure the voltage between pressure transducer C147-3, circuit 3601 (WH/RD), harness side, and pressure transducer C147-1, circuit 3603 (RD), harness side. • **Is the voltage approximately 5 volts?**	**Yes** GO to K5 . **No** INSTALL a new stability assist module. REFER to Anti-Lock Brake System (ABS) Module—Stability Assist in this section. REPEAT the self-test.
K5 CHECK THE PRESSURE TRANSDUCER OUTPUT	
• Connect: Pressure Transducer C147. • Disconnect: Stability Assist Module C135. • Remove the stability assist module C135-20, circuit 3600 (RD/WH) from the harness connector. • Connect: Stability Assist Module C135.	**Yes** INSTALL a new stability assist module. REFER to Anti-Lock Brake System (ABS) Module—Stability Assist in this section. REPEAT the

• Key in ON position. • Measure the voltage between stability assist module C135-20, with circuit 3600 (RD/WH) removed from the harness connector and ground, while depressing and releasing the brake pedal. • **Is the voltage between 0.125 and 0.375 volt with the brake pedal released and between 0.125 and 5 volts with the brake pedal depressed?**	self-test. **No** INSTALL a new pressure transducer. REFER to Primary Pressure Transducer in this section. CLEAR the DTC. RECALIBRATE the stability assist module. REPEAT the self-test.

PINPOINT TEST L: DTC C1730 — REFERENCE VOLTAGE OUT OF RANGE (+5 V)

Test Step	Result / Action to Take
L1 CHECK CIRCUIT 3601 (WH/RD) FOR A SHORT TO BATTERY	
• Key in OFF position. • Disconnect: Stability Assist Module C135. • Disconnect: Pressure Transducer C147. • Disconnect: Pedal Travel Sensor C146. • Key in ON position. • Measure the voltage between stability assist module C135-18, circuit 3601 (WH/RD), harness side, and ground. • **Is voltage present?**	**Yes** REPAIR circuit 3601 (WH/RD) or circuit 1902 (RD). CLEAR the DTC. RECALIBRATE the stability assist module. REPEAT the self-test. **No** GO to L2 .
L2 CHECK CIRCUIT 3601 (WH/RD) FOR A SHORT TO GROUND	
• Key in OFF position. • Measure the resistance between stability assist module C135-18, circuit 3601 (WH/RD), harness side, and ground. • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to L3 . **No** REPAIR circuit 3601 (WH/RD). CLEAR the DTC. RECALIBRATE the stability assist module. REPEAT the self-test.
L3 CHECK CIRCUIT 1902 (RD) FOR A SHORT TO BATTERY	
• Key in ON position. • Measure the voltage between stability assist module C135-26, circuit 1902 (RD), harness side, and ground. • **Is voltage present?**	**Yes** REPAIR circuit 1902 (RD). CLEAR the DTC. RECALIBRATE the stability assist module. REPEAT the self-test. **No** GO to L4 .
L4 CHECK CIRCUIT 1902 (RD) FOR A SHORT TO GROUND	
• Key in OFF position. • Measure the resistance between stability assist module C135-26, circuit 1902 (RD), harness side, and ground. • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to L5 . **No** REPAIR circuit 1902 (RD). CLEAR the DTC. RECALIBRATE the stability assist module. REPEAT the self-test.
L5 CHECK THE PRESSURE TRANSDUCER AND	

PEDAL TRAVEL SENSOR (PTS) CIRCUITS FOR AN OPEN

- Key in OFF position.
- Measure the resistance between the following pins:

Stability Assist Module Connector C135 Pin	Pressure Transducer C147 Pin	Circuit
18	3	3601 (WH/RD)
19	1	3603 (RD)
26	1	1902 (RD)
24	2	1904 (GY/BK)

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

Yes
GO to L6 .

No
REPAIR the circuit in question. CLEAR the DTC. REPEAT the self-test.

L6 CHECK THE STABILITY ASSIST MODULE OUTPUT

- Connect: Stability Assist Module C135.
- Key in ON position.
- Measure the voltage between pressure transducer C147-3 and C147-1 and between pedal travel sensor C146-1 and C146-2.
- **Is the voltage approximately 5 volts?**

Yes
GO to L7 .

No
INSTALL a new stability assist module. REFER to Anti-Lock Brake System (ABS) Module—Stability Assist in this section. REPEAT the self-test.

L7 CHECK THE STABILITY ASSIST COMPONENTS

- Reconnect the pedal travel sensor C146 and the pressure transducer C147, one at a time, while clearing the DTCs and retrieving the DTCs in between each component being reconnected.
- **Is DTC C1730 retrieved?**

Yes
If DTC C1730 appeared after plugging in the PTS, INSTALL a new PTS. If DTC C1730 appeared after plugging in the pressure transducer, INSTALL a new brake booster. REFER to Section 206-07 .

No
System is OK. REPEAT the self-test.

PINPOINT TEST M: DTC C1960 — DRIVER BRAKE APPLY CIRCUIT FAULT

Test Step	Result / Action to Take
M1 CHECK FOR OTHER DTCs	
NOTE: DTC C1960 does not set a warning lamp. The driver brake apply circuit only provides a power signal to an aftermarkert trailer brake module. If the electric trailer brakes are not required, there is no need to repair this circuit. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Clear DTCs.	**Yes** GO to M2 . **No** If a different DTC is retrieved, GO to the Stability Assist Module Diagnostic Trouble Code (DTC) Index. If no DTCs are retrieved, system is OK.

• Press and release the brake pedal several times. • Enter the following diagnostic mode on the diagnostic tool: Retrieve DTCs. • **Is DTC C1960 retrieved?**	
M2 CHECK CIRCUIT 1791 (RD) FOR SHORT TO POWER	
• Key in OFF position. • Disconnect: Stability Assist Module C135. • Key in ON position. • Measure the voltage between ABS module C135-44, circuit 1791 (RD) and ground. • **Is the voltage greater than 0 volts?**	**Yes** REPAIR circuit 1791 (RD). CLEAR the DTC. REPEAT the self-test. **No** GO to M3 .
M3 CHECK THE STABILITY ASSIST MODULE OUTPUT	
• Key in OFF position. • Connect: Stability Assist Module C135. • Key in ON position. • Measure the voltage between the trailer tow harness connector and ground while pressing the brake pedal. • **Is the voltage greater than 8 volts?**	**Yes** RELEASE the brake pedal and MEASURE the voltage between the trailer tow harness connector and ground. If the voltage drops below 2 volts, system is OK. If not, INSPECT the aftermarket trailer tow components. CLEAR the DTC. REPEAT the self-test. **No** GO to M4 .
M4 CHECK CIRCUIT 1791 (RD) FOR A SHORT TO GROUND	
• Key in OFF position. • Disconnect: Stability Assist Module C135. • Measure the resistance between C135-44 circuit 1791 (RD) and ground. • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new stability assist module. REFER to Anti-Lock Brake System (ABS) Module—Stability Assist in this section. **No** REPAIR circuit 1791 (RD). CLEAR the DTC. REPEAT the self-test.

PINPOINT TEST N: THE ADVANCE TRAC® CANNOT BE DISABLED/IS INOPERATIVE

Test Step	Result / Action to Take
N1 CHECK FOR DTCS	
• Connect the diagnostic tool. • Retrieve and document continuous DTCs. • **Are any DTCs retrieved?**	**Yes** GO to the Stability Assist Module Diagnostic Trouble Code (DTC) Index. **No** GO to N2 .
N2 CHECK THE ADVANCE TRAC® SWITCH	
• Disconnect: Advance Trac® Switch C206. • Key in OFF position. • Press and hold the Advance Trac® switch in the ON position.	**Yes** INSTALL a new Advance Trac® switch. TEST the system for normal operation. **No**

• Measure the resistance between Advance Trac® switch C206-4, circuit 959 (GY/BK), and C206-1, circuit 640 (RD/YE). • **Is the resistance greater than 5 ohms?**	GO to N3 .
N3 CHECK THE POWER TO THE ADVANCE TRAC® SWITCH	
• Key in ON position. • Measure the voltage between Advance Trac® switch C206-1 circuit 640 (RD/YE), harness side and ground. • **Is the voltage greater than 10 volts?**	**Yes** GO to N4 . **No** REPAIR circuit 640 (RD/YE). TEST the system for normal operation.
N4 CHECK THE ADVANCE TRAC® SWITCH INPUT	
• Key in OFF position. • Connect: Advance Trac® Switch C206. • Disconnect: Stability Assist Module C135. • Key in ON position. • Measure the voltage between stability assist module C135-38 circuit 959 (GY/BK) and ground while pressing the Advance Trac® switch on. • **Is the voltage greater than 10 volts?**	**Yes** RELEASE the Advance Trac® switch. If the voltage drops to less than 2 volts, INSTALL a new stability assist module. REFER to Anti-Lock Brake System (ABS) Module—Stability Assist in this section. **No** REPAIR circuit 959 (GY/BK). TEST the system for normal operation.

PINPOINT TEST O: ADVANCE TRAC® SWITCH INDICATOR IS ALWAYS ON/CANNOT BE DISABLED

Test Step	Result / Action to Take
O1 CHECK THE ADVANCE TRAC® SWITCH	
• Disconnect: Advance Trac® Switch C206. • Key in OFF position. • Measure the resistance between Advance Trac® switch C206-1 (component side), and Advance Trac® switch C206-4 (component side). • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to O2 . **No** INSTALL a new Advance Trac® switch. TEST the system for normal operation.
O2 CHECK CIRCUIT 959 (GY/BK) FOR A SHORT TO POWER	
• Key in OFF position. • Disconnect: Stability Assist Module 135. • Key in ON position. • Measure the voltage between stability assist module C135-38, circuit 959 (GY/BK), harness side, and ground. • **Is voltage present?**	**Yes** REPAIR the circuit. CLEAR the DTC. REPEAT the self-test. **No** GO to O3 .
O3 CHECK CIRCUIT 960 (BK/LB) FOR SHORT TO POWER	
• Measure the voltage between stability assist module C135-13, circuit 960 (BK/LB), harness side and ground; and between Advance Trac® switch C206-5, circuit 960 (BK/LB) and ground.	**Yes** REPAIR the circuit(s). TEST the system for normal operation.

• **Is voltage present?**	**No** GO to O4 .
O4 CHECK CIRCUIT 960 (BK/LB) FOR A SHORT TO GROUND	
• Measure the resistance between stability assist module C135-13 circuit 960 (BK/LB) and ground. • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new stability assist module. REFER to Anti-Lock Brake System (ABS) Module—Stability Assist in this section. TEST the system for normal operation. **No** REPAIR circuit 960 (BK/LB). TEST the system for normal operation.

PINPOINT TEST P: DTC C1440 PRESSURE TRANSDUCER INPUT CIRCUIT FAILURE

Test Step	Result / Action to Take
NOTE: Excessive clearance between brake pad and rotor, leaks, or air in the hydraulic brake system can also set DTC C1440.	
P1 CHECK FOR DTCS	
• Key in ON position. • Connect the diagnostic tool. • Retrieve DTCs. • **Is DTC C1483, C1287, B2734, B2736, B2737, B2738, or B2740 present?**	**Yes** SERVICE these DTCs first. GO to the appropriate pinpoint test for each DTC received. **No** GO to P2 .
P2 CHECK FOR 5 VOLT REFERENCE VOLTAGE TO THE PRESSURE TRANSDUCER	
• Key in OFF position. • Disconnect: Pressure Transducer C147. • Key in ON position. • Measure the voltage at the pressure transducer C147 between pin 1 and 3 harness side. • **Does the meter show 5 volts?**	**Yes** GO to P6 . **No** GO to P3 .
P3 CHECK CIRCUITS FOR A SHORT TO POWER	
• Key in OFF position. • Disconnect: Stability Assist Module C135. • Key in ON position. • Check the voltage between pressure transducer pin 3 and ground, between pin 1 and ground, and between pin 2 and ground. • **Is voltage present?**	**Yes** REPAIR the circuit in question. CLEAR the DTC. REPEAT the self-test. **No** GO to P4 .
P4 CHECK CIRCUITS FOR A SHORT TO GROUND	
• Key in OFF position. • Check the resistance between pressure transducer pin 3 and ground, between pin 1 and ground, and between pin 2 and ground. • **Is the resistance greater than 10,000 ohms in each test?**	**Yes** GO to P5 . **No** REPAIR the circuit in question. CLEAR the DTC. REPEAT the self-test.
P5 CHECK CIRCUIT RESISTANCE	

- Check the resistance between stability assist module C135 and pressure transducer C147 pins.

Stability Assist Module C135 Pin	Pressure Transducer C147 Pin	Circuit
18	3	3601 (WH/RD)
20	2	3600 (RD/WH)
19	1	3603 (RD)

- **Is the resistance less than 5 ohms in each test?**

Yes
GO to P6 .

No
REPAIR the circuit in question. CLEAR the DTC. REPEAT the self-test.

P6 CHECK THE SIGNAL FROM THE PRESSURE TRANSDUCER

- Disconnect: Pressure Transducer C147.
- Disconnect: Stability Assist Module C135 pin 20, circuit 3600 (RD/WH).
- Connect: Stability Assist Module C135.
- Key in ON position.
- Measure the voltage between terminal pin 20, circuit 3600 (RD/WH) and ground while pressing and releasing the brake pedal.
- **Is the voltage between 0.125 and 5 volts?**

Yes
INSTALL a new stability assist module. REFER to Anti-Lock Brake System (ABS) Module—Stability Assist in this section.

No
NOTE: The pressure transducer is not serviceable and a new transducer must be installed as part of the brake booster assembly.

INSTALL a new pressure transducer. REFER to Section 206-07 . CLEAR the DTC. REPEAT the self-test.

PINPOINT TEST Q: DTC C1998 IVD SENSOR AND STABILITY ASSIST MODULE CALIBRATION

Test Step	Result / Action to Take
NOTE: Stability assist lamp will flash when calibration is required. IVD calibration is required after certain DTCs are cleared.	
Q1 CHECK FOR DTCS - Connect the diagnostic tool. - Key in ON position. - Retrieve DTCs. - **Is any other DTC retrieved with C1998?**	**Yes** GO to the appropriate pinpoint test for the DTC. **Note:** Some of the pinpoint tests recommend IVD calibration prior to any further diagnostics, in this case GO to Q2 . **No** GO to Q2 .
Q2 IVD CALIBRATION - Connect the diagnostic tool. - Key on, engine running. - **NOTE:** Be sure to rotate the steering wheel lock-to-lock during the	**Yes** GO to Q3 . **No**

calibration of the stability assist system. ● Carry out IVD calibration per the diagnostic tool instructions. ● **Did calibration complete for all IVD sensors? And did stability assist lamp stop flashing and go off?**	GO to **Q1** . **NOTE:** Some concerns will cause a calibration not complete. If sent here from another pinpoint test return to that pinpoint test for further diagnostics.
Q3 CLEAR DTC C1998	
NOTE: You must clear DTC C1998 after the completion of the IVD calibration. ● Connect the diagnostic tool. ● Key in ON position. ● Clear the DTC. ● **Did the DTC clear?**	**Yes** TEST DRIVE the vehicle. REPEAT the self-test. **NOTE:** If sent here from another pinpoint test, return to that pinpoint test for further diagnostics. **No** GO to **Q1** .

PINPOINT TEST R: DTCS C2777 AND C2778 SENSOR CLUSTER BUS FAILURE

Test Step	Result / Action to Take
NOTE: Check all pins of the sensor cluster and stability assist module when removing connectors. Care should be taken when reinstalling these connectors.	
R1 CHECK THE VOLTAGE TO THE SENSOR CLUSTER	
● Disconnect: Sensor Cluster C3073. ● Key in ON position. ● Measure the voltage between sensor cluster C3073-3, circuit 1574 (DB), harness side and ground. ● **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new sensor cluster. REFER to Yaw Rate Sensor in this section. CLEAR the DTCs. RECALIBRATE the system. REPEAT the self-test. **No** GO to R2 .
R2 CHECK THE STEERING WHEEL ROTATION SENSOR	
● Disconnect: Steering Wheel Rotation Sensor C226. ● Measure the voltage between sensor cluster C3073-3, circuit 1574 (DB), harness side and ground. ● **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new steering wheel rotation sensor. REFER to Steering Wheel Rotation Sensor in this section. CLEAR the DTCs. RECALIBRATE the system. REPEAT the self-test. **No** GO to R3 .
R3 CHECK CIRCUIT 1574 (DB) FOR A SHORT TO GROUND	
● Disconnect: ABS Module C135. ● Measure the resistance between sensor cluster C3073-3 circuit 1574 (DB), harness side and ground. ● **Is the resistance greater than 10,000 ohms?**	**Yes** GO to R4 . **No** REPAIR the circuit. CLEAR the DTCs. RECALIBRATE the system. REPEAT the self-test.

R4 CHECK CIRCUIT 1574 (DB) FOR AN OPEN FROM THE SENSOR CLUSTER	
• Measure the resistance between steering wheel rotation sensor C226-1, harness side and ABS module C135-7, harness side, circuit 1574 (DB). • **Is the resistance less than 5 ohms?**	**Yes** GO to R5 . **No** REPAIR the circuit. CLEAR the DTCs. RECALIBRATE the system. REPEAT the self-test.
R5 CHECK THE CAN BUS CIRCUITS FOR A SHORT TO POWER	
• Key in ON position. • Measure the voltage between sensor cluster C3073-1, circuit 1879 (PK/BK), harness side and ground. • Measure the voltage between sensor cluster C3073-2, circuit 1878 (WH/BK), harness side and ground. • **Is voltage present?**	**Yes** REPAIR circuit 1878 (WH/BK) or circuit 1879 (PK/BK). CLEAR the DTC. RECALIBRATE the system. REPEAT the self-test. **No** GO to R6 .
R6 CHECK THE CAN BUS CIRCUITS FOR A SHORT TO GROUND	
• Key in OFF position. • Measure the resistance between sensor cluster C3073-1, circuit 1879 (PK/BK), harness side and ground. • Measure the resistance between sensor cluster C3073-2, circuit 1878 (WH/BK), harness side and ground. • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to R7 . **No** REPAIR circuit 1878 (WH/BK) or circuit 1879 (PK/BK). CLEAR the DTC. RECALIBRATE the system. REPEAT the self-test.
R7 CHECK THE CAN BUS CIRCUITS FOR A SHORT TOGETHER	
• Measure the resistance between sensor cluster C3073-1, circuit 1879 (PK/BK), harness side and sensor cluster C3073-2, circuit 1878 (WH/BK), harness side. • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to R8 . **No** REPAIR circuit 1878 (WH/BK) and circuit 1879 (PK/BK). CLEAR the DTC. RECALIBRATE the system. REPEAT the self-test.
R8 CHECK THE CAN BUS CIRCUITS FOR AN OPEN	
• Measure the resistance between sensor cluster	**Yes** INSTALL a new sensor cluster. REFER to Yaw Rate

C3073-1, harness side and ABS module C135-25, harness side, circuit 1879 (PK/BK). • Measure the resistance between sensor cluster C3073-2, harness side and ABS module C135-25, harness side, circuit 1878 (WH/BK). • **Is the resistance less than 5 ohms?**	Sensor in this section. CLEAR the DTCs. RECALIBRATE the system. TEST DRIVE the vehicle. REPEAT the self-test. IF DTC C2777 or C2778 is retrieved, INSTALL a new ABS module. REFER to Anti-Lock Control in this section. CLEAR the DTC. RECONFIGURE the ABS module. RECALIBRATE the system. REPEAT the self-test. **No** REPAIR circuit 1878 (WH/BK) or circuit 1879 (PK/BK). CLEAR the DTC. RECALIBRATE the system. REPEAT the self-test.

PINPOINT TEST S: DTC B2900: VIN MISMATCHED

Test Step	Result / Action to Take
NOTE: When the stability assist module is configured, the VIN number is stored. At the beginning of each ignition cycle, that VIN is compared to the VIN stored in the PCM. If the VIN stored in the stability assist module does not match the VIN stored in the PCM, DTC B2900 is set and the yellow ABS lamp and the Advance Trac® lamp will illuminate.	
S1 CHECK THE PCM • Check the PCM repair history. • **Has the PCM been reflashed or replaced recently?**	**Yes** VERIFY that the correct VIN is stored in the PCM. REPROGRAM the PCM if the VIN is not correct. CLEAR the DTC. REPEAT the self-test. **No** GO to S2.
S2 CHECK THE STABILITY ASSIST MODULE • Check the stability assist module repair history. • **Has the stability assist module been replaced recently?**	**Yes** VERIFY that the correct VIN is stored in the stability assist module. If the VIN does not match the stored VIN in the PCM, RECONFIGURE the module using the vehicle as-built data. REPEAT the self-test. **No** GO to S3.
S3 CHECK THE MODULE COMMUNICATION NETWORK FOR FAULTS • Check for module communication network DTCs in the stability assist module and the PCM. • **Are there any DTCs present?**	**Yes** REPAIR the DTC(s). REFER to the Stability Assist Module Diagnostic Trouble Code (DTC) Index. CLEAR the DTC. REPEAT the self-test. **No** RECONFIGURE the stability assist module using the vehicle as-built data. REPEAT the self-test.

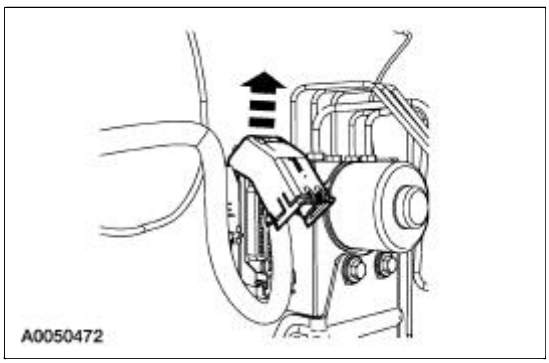
Hydraulic Control Unit (HCU)

Removal and Installation

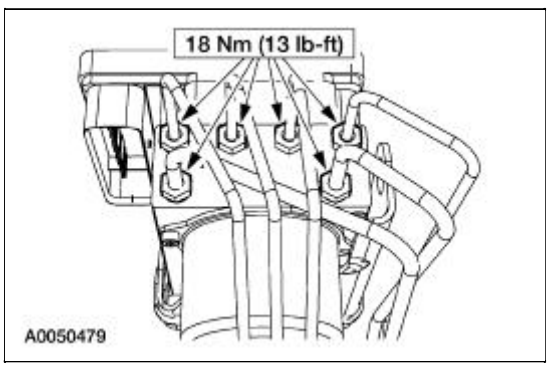
1. **CAUTION: Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage can result.**

   Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

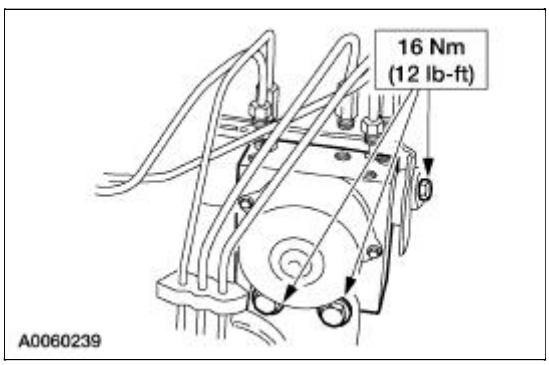
2. Disconnect the stability assist module (ECU) electrical connector.



3. Disconnect the brake tubes from the hydraulic control unit (HCU).



4. Remove the bolts and remove the HCU/ECU assembly.



5. Disconnect the ECU from the HCU.

6. To install, reverse the removal procedure.

Anti-Lock Brake System (ABS) Module —Stability Assist

Removal and Installation

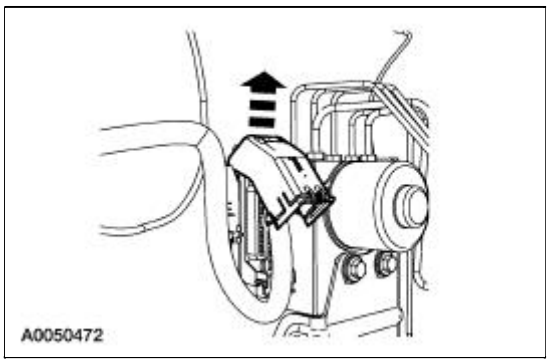
CAUTION: Do not replace stability assist modules installed on vehicles built before February 2003 with those manufactured after February 2003.

NOTE: When installing a new module, it must be calibrated and reconfigured (either by download/upload or uploading the as-built database method).

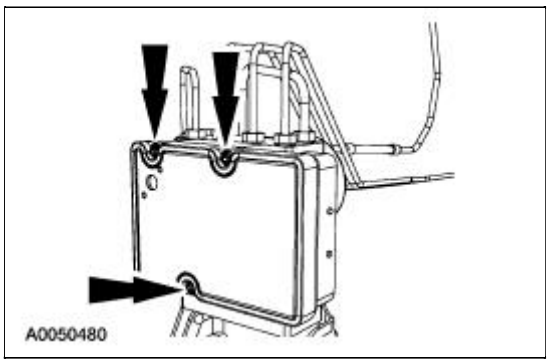
1. **CAUTION: Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage can result.**

   Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

2. Disconnect the anti-lock brake control module electrical connector.



3. Remove the screws and the anti-lock brake control module.

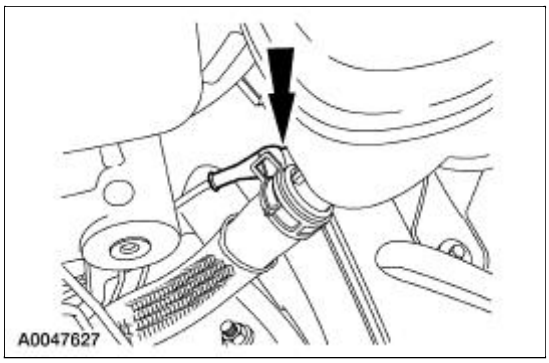


4. To install, reverse the removal procedure.

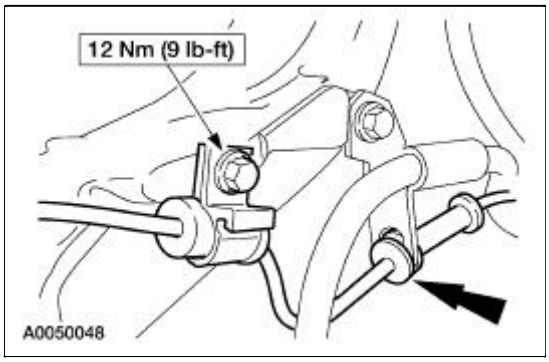
Front Wheel Speed Sensor

Removal and Installation

1. If equipped, turn the air suspension switch to the OFF position.
2. Disconnect the wheel speed sensor connector.

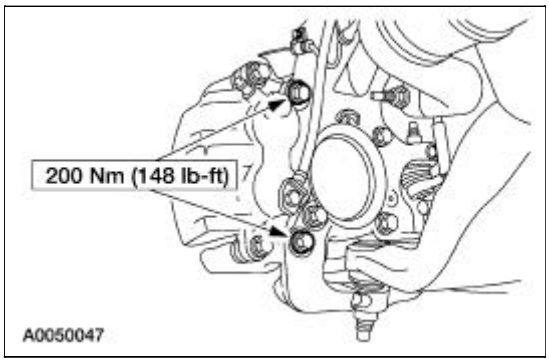


3. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .
4. Remove the bolt and detach the retainers.

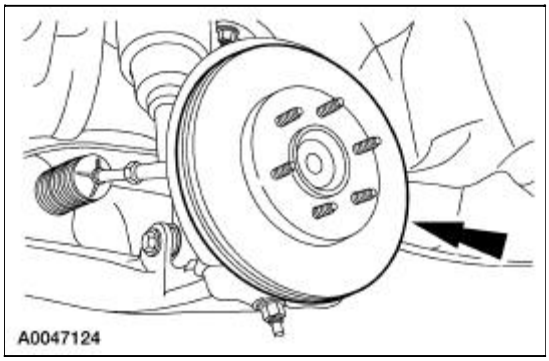


5. **CAUTION: Do not allow the caliper to hang from the brake hose or damage to the hose can result.**

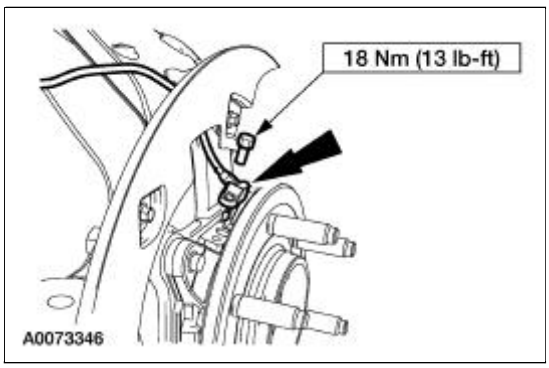
   Remove the bolts, and position the caliper, pads and anchor plate aside.



6. Remove the brake disc.



7. Remove the bolt and the front wheel speed sensor.

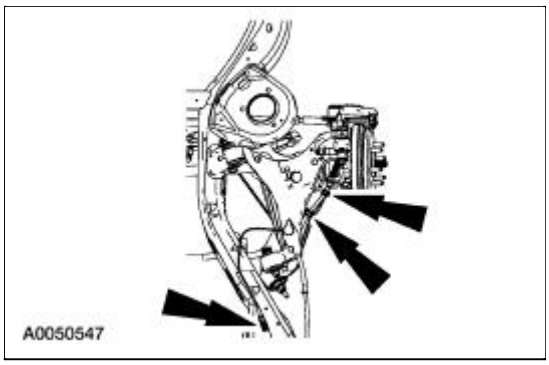


8. To install, reverse the removal procedure.

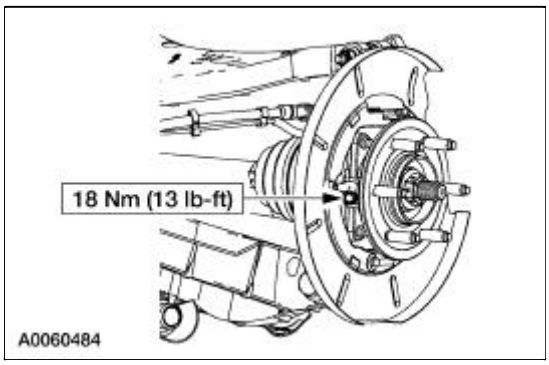
Rear Wheel Speed Sensor

Removal and Installation

1. Remove the parking brake shoes. For additional information, refer to Section 206-05 .
2. Disconnect the wheel speed sensor wire from the retaining clips.



3. Remove the bolt and remove the rear wheel speed sensor.



4. To install, reverse the removal procedure.

Front Wheel Speed Sensor Ring

Removal and Installation

1. **NOTE:** The front wheel speed sensor ring is integral to the front wheel hub and bearing assembly.

   For front wheel speed sensor ring removal and installation, refer to Section 204-01A for 4x2 vehicles or Section 204-01B for 4x4 vehicles.

Rear Wheel Speed Sensor Ring

Removal and Installation

1. **NOTE:** The rear wheel speed sensor ring is integral to the rear wheel hub and bearing assembly.

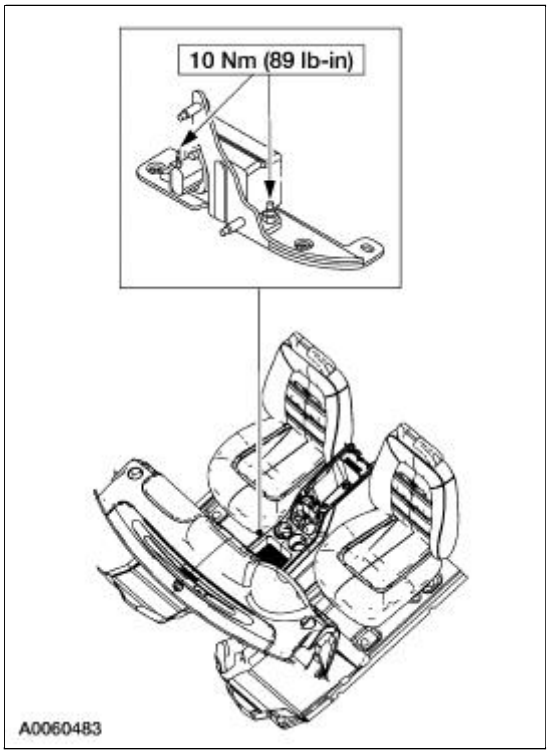
   For rear wheel speed sensor ring removal and installation, refer to Section 204-02 .

Yaw Rate Sensor

Removal and Installation

CAUTION: Do not replace yaw rate sensors installed on vehicles built before February 2003 with those manufactured for vehicles built after February 2003.

1. Remove the front floor console. For additional information, refer Section 501-12 .
2. Remove the yaw rate sensor.



3. To install, reverse the removal procedure.

Accelerometer

Removal and Installation

CAUTION: Do not replace accelerometers installed on vehicles built before February 2003 with those manufactured after February 2003.

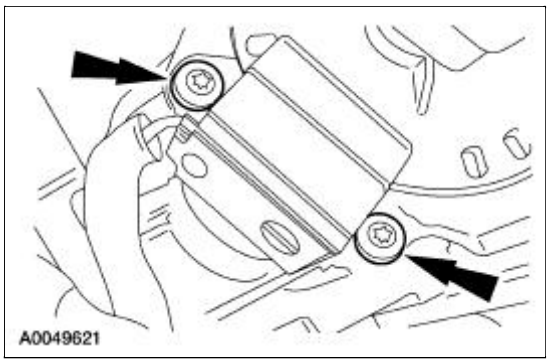
1. **NOTE:** The lateral and longitudinal accelerometer are located within the same component as the yaw rate sensor.

   For additional information, refer to Yaw Rate Sensor .

Steering Wheel Rotation Sensor

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the screws and remove the steering wheel rotation sensor.



3. To install, reverse the removal procedure.

General Specifications

Item	Specification
Lubricants	
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®
Fluid capacity (included in pump reservoir fill)	1.3 L (2.7 pt) (approximate)
Power Steering Gear	
Type	Rack and Pinion
Ratio — Navigator (all) and Expedition vehicles built before 6/2002	17:1
Ratio — Expedition vehicles built 6/2002 onward	20:1
Static steering wheel turning effort Navigator Expedition	 4.0 Nm (35 lb-in) 5.0 Nm (44 lb-in)
Turning effort Navigator Expedition	 2.14 kg (4.7 lbs) 2.68 kg (5.9 lbs)
Turns of steering wheel (lock to lock — linkage disconnected)	3.3
Power Steering Purge Vacuum	
Minimum vacuum	67-84 kPa (20-25 in-Hg)
Power Steering Pump	
Flow (Navigator)	3.0 gpm ± 0.2 @ 50 psi and 2,500 rpm
Flow (Expedition)	3.0 gpm ± 0.2 @ 50 psi and 1,000 rpm 2.5 gpm ± 0.2 @ 50 psi and 2,800 rpm
Minimum capacity	1.6 gpm @ 750 psi and 500 rpm
Relief pressure	1,300-1,480 psi

Steering System

The steering system consists of the following components:

- power steering pump
- fluid reservoir
- steering column
- steering gear
- fluid cooler

For information on the power steering pump, steering gear, steering lines and fluid reservoir, refer to Section 211-02 .

For information on the steering wheel, column assembly and intermediate shaft, refer to Section 211-04 .

Steering System

Refer to Wiring Diagrams Cell 41 for schematic and connector information.

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool
 ST1477-A	Power Steering Analyzer 014-00207 or equivalent
 ST1396-A	Dial Thermometer 0-220°F 023-R0007 or equivalent
 ST1137-A	73 III Automotive Meter 105-R0057 or equivalent

Principles of Operation

Variable Assist Power Steering (VAPS)

Navigator vehicles include a VAPS system that controls the level of power assistance available to the driver based on vehicle speed. Below 3.2 km/h (2 mph), full power steering assist is provided to lessen steering efforts and increase maneuverability. Between 3.2 km/h (2 mph) and 191 km/h (119 mph), steering assist will decrease gradually at a calibrated rate to raise steering efforts for increased directional stability and greater road feel. Above 191 km/h (119 mph), steering assist is constant.

The 4-wheel air suspension module (4WAS) outputs a pulse-width-modulated (PWM) current to the control valve actuator. The control valve actuator controls the hydraulic valve that determines the amount of hydraulic assist provided to the steering gear. The amount of assistance provided varies with the control valve actuator current, which is based on vehicle speed according to a look-up table internal to the module. The module pulse-width modulates the VAPS actuator current to provide the desired amount of assistance. The amount of hydraulic steering assistance provided by the VAPS subsystem is proportional to the average control valve current.

The vehicle speed is provided to the air suspension module through a transmission mounted vehicle

speed sensor (VSS).

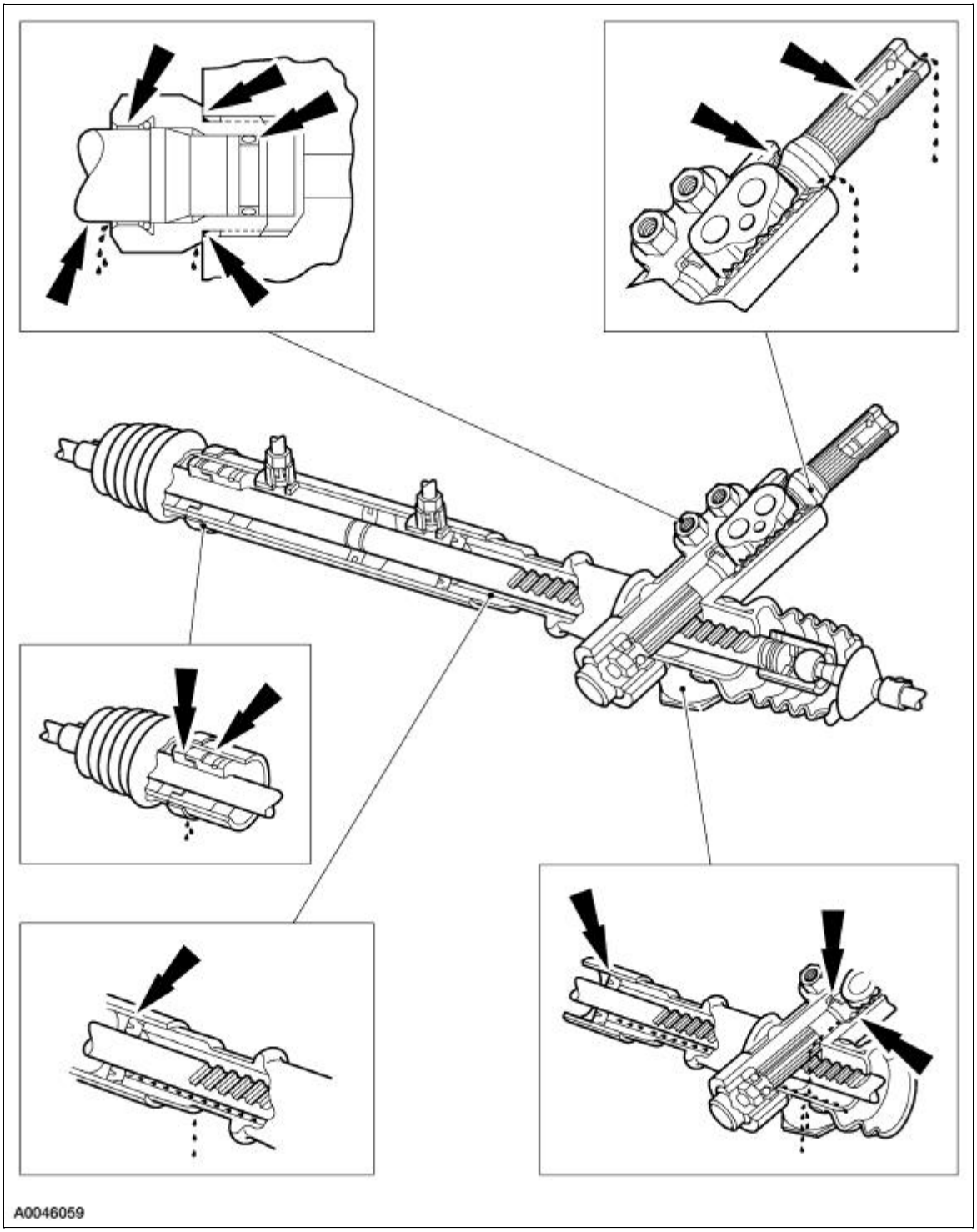
Inspection and Verification

CAUTION: Do not hold the steering wheel (3600) at the stops for an extended amount of time. Damage to the power steering pump (3A674) can result.

NOTE: Make the following preliminary checks before repairing the steering system:

1. Verify the customer concern by operating the steering system.
2. Inspect Tires
   - Check the tire pressure. For additional information, refer to the Vehicle Certification (VC) label.
   - Verify that all tires are sized to specification. For additional information, refer to Section 204-04 .
   - Check the tires for damage or uneven wear. For additional information, refer to Section 204-04 .
3. Belt and Tensioner Check
   - Refer to Section 303-05 for diagnosis and testing of the accessory drive system.
4. Fluid Level Check
   - Verify that the power steering fluid level is within the appropriate hot or cold range on the dipstick. Add MERCON® Multi-Purpose (ATF) Transmission Fluid XT-02-QDX or MERCON® equivalent.
5. Air Bleeding
   - Verify that there is no air in the power steering system. Run the engine (6007) until it reaches normal operating temperature. Turn the steering wheel to the left and right several times without hitting the stops. If any air bubbles are present, refer to Power Steering System Purging in this section.

External Leak Check — Typical Power Rack-and-Pinion Steering Gear



6. External Leak Check
    - With the ignition switch at OFF, wipe off the power steering pump, power steering pressure hose (3A719), power steering return hose (3A713), power steering fluid cooler and hose assembly and steering gear (3504).
    - With the engine running, turn the steering wheel from stop-to-stop several times. Do not hold the steering wheel at stops. Check for leaks. Repair as necessary if leaks are observed.

7. Turning Effort Check
    - Refer to Turning Effort Test under Component Tests in this section.

8. Visually inspect for obvious signs of mechanical damage. For additional information, refer to the following chart.

Visual Inspection Chart

Mechanical	Electrical
● Loose tie-rod ends ● Loose suspension components ● Loose steering column shaft universal joints ● Loose column intermediate shaft bolts ● Steering gear ● Binding or misaligned steering column ● Power steering pump ● Bent or pinched power steering hoses	● Wiring ● Connectors

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

10. If the concern remains after the inspection, connect the Scan Tool to the data link connector (DLC) located beneath the instrument panel, and select the vehicle to be tested from the Scan Tool menu. If the Scan Tool does not communicate with the vehicle:
    - check that the program card is correctly installed.
    - check the connections to the vehicle.
    - check the ignition switch position.

11. If the Scan Tool still does not communicate with the vehicle, refer to the tester manual.

12. Carry out the DATA LINK DIAGNOSTIC TEST. If the Scan Tool responds with:
    - CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
    - NO RESP/NOT EQUIP for 4WAS module, refer to Section 418-00 .
    - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out the self-test diagnostics for the 4WAS module.

13. If the DTCs retrieved are related to the concern, go to Diagnostic Trouble Code (DTC) Index to continue diagnostics.

14. If no DTCs related to the concern are retrieved, GO to Symptom Chart to continue diagnostics.

15. If the fault is not visually evident, determine the symptom and GO to Symptom Chart .

Diagnostic Trouble Code (DTC) Index

4WAS/VAPS Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
C1897	Steering VAPS Circuit Loop Failure	Circuit, Valve Solenoid, 4WAS Module	Go To Pinpoint Test B .
C1445	Vehicle Speed Signal Circuit Failure	4WAS	REFER to Section 204-05 .
U1950	VAP Communication BUS Fault	4WAS	REFER to Section 204-05
B1317	Battery Voltage High	4WAS Module	REFER to Section 204-

			05 .
B1318	Battery Voltage Low	4WAS Module	REFER to Section 204-05 .
B1342	ECU is Defective	4WAS Module	REFER to Section 204-05 .
B2477	Module Configuration Failure	4WAS Module	REFER to Section 418-01 .

Steering System Symptom Definitions

Drift/Pull

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

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

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

Excessive Steering Wheel Play

Excessive steering wheel play is a condition in which there is too much steering wheel movement before the wheels move. A small amount of steering wheel play is considered normal.

Feedback

Feedback is a roughness felt in the steering wheel when the vehicle is driven over rough pavement.

Hard Steering or Lack of Assist

Hard steering or lack of assist is experienced when the steering wheel effort exceeds specifications. Hard steering can remain constant through the full turn or occur near the end of a turn. It is important to know the difference between hard steering/lack of assist and binding.

Hard steering or lack of assist can result from either hydraulic or mechanical conditions. It is extremely important to know if this concern occurs during driving, or during very heavy or static parking maneuvers.

Nibble

Sometimes confused with shimmy, nibble is a condition resulting from tire interaction with various road surfaces and observed by the driver as small rotational oscillations of the steering wheel.

Poor Returnability/Sticky Steering

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

Shimmy

Shimmy, as observed by the driver, is large, consistent, rotational oscillations of the steering wheel

resulting from large, side-to-side (lateral) tire/wheel movements.

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

Wander

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

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• No communication with the 4WAS module/unable to enter self-test	• Circuit(s). • Module.	• Go To Pinpoint Test A .
• Hard steering or lack of assist (without DTCs or air suspension light illuminated)	• Seized lower steering column shaft U-joints.	• INSTALL a new lower steering column shaft. REFER to Section 211-04 .
	• Damaged, fractured steering column bearing(s).	• REPAIR the steering column. REFER to Section 211-04 .
	• Power steering pump.	• GO to Pump Flow and Pressure Test Component Test in this section.
	• Suspension components.	• REFER to Section 204-00 for suspension system diagnosis and testing.
	• Steering gear internal leakage.	• GO to Pump Flow and Pressure Test Component Test in this section.
• Excessive steering pump noise	• Power steering pump.	• GO to Pump Flow and Pressure Test Component Test in this section.
• Excessive steering wheel play	• Damaged, loose, or worn tie-rod end (3290).	• GO to the Steering Linkage Component Test.
	• Loose, worn or damaged tie-rod (3280).	• GO to the Tie-Rod Articulation Torque Component Test.
	• Damaged/worn steering gear.	• INSTALL a new steering gear. REFER to Section 211-02 .
	• Loose, worn or damaged steering	• INSTALL new steering column

	column bearing(s). ● Loose, worn or damaged lower steering column shaft U-joint(s).	bearing(s). REFER to Section 211-04 . ● INSTALL a new lower steering column shaft. REFER to Section 211-04 .
● Wander	● Unevenly loaded or overloaded vehicle. ● Loose, worn or damaged tie-rod. ● Loose, worn or damaged tie-rod ends. ● Loose or damaged steering gear mounting bolts. ● Loose lower steering column shaft U-joint bolts. ● Loose, worn or damaged lower steering column shaft U-joints. ● Loose, worn or damaged steering column bearing(s). ● Suspension components.	● INFORM the customer of incorrect vehicle loading. ● GO to the Tie-Rod Articulation Torque Component Test. ● GO to the Steering Linkage Component Test. ● INSTALL new bolts or TIGHTEN the bolts. REFER to Section 211-02 . ● TIGHTEN the bolts. REFER to Section 211-04 . ● INSTALL a new lower steering column shaft. REFER to Section 211-04 . ● INSTALL new steering column bearings. REFER to Section 211-04 . ● REFER to Section 204-00 for suspension system diagnosis and testing.
● Drift/pull	● Unevenly loaded or overloaded vehicle. ● Wheel alignment. ● Loose, worn or damaged tie-rod. ● Loose, worn or damaged tie-rod ends. ● Suspension components. ● The steering gear	● INFORM the customer of incorrect vehicle loading. ● ADJUST as required. REFER to Section 204-00 . ● GO to the Tie-Rod Articulation Torque Component Test. ● GO to the Steering Linkage Component Test. ● REFER to Section 204-00 for suspension system diagnosis and testing. ● GO to Steering Gear

	valve effort out of balance. ● Check the brake system for correct operation. ● Incorrect frame/underbody alignment.	Valve Component Test in this section. ● REFER to Section 206-00 . ● CORRECT as required. REFER to Frame Dimension Manual.
● Feedback	● Loose, worn or damaged tie-rod. ● Loose, worn or damaged tie-rod ends. ● Loose or damaged steering gear insulators or bolts. ● Loose lower steering column shaft U-joint bolts. ● Loose suspension bushings, fasteners or ball joints. ● Worn or damaged steering column bearing(s).	● GO to the Tie-Rod Articulation Torque Component Test. ● GO to the Steering Linkage Component Test. ● INSTALL new bolts or TIGHTEN the retaining bolts. REFER to Section 211-02 . ● TIGHTEN the bolts. REFER to Section 211-04 . ● INSTALL new components as necessary. REFER to Section 204-01A or Section 204-01B . ● INSTALL new steering column bearing(s). REFER to Section 211-04 .
● Poor returnability/sticky steering	● Binding lower steering column shaft U-joints. ● Loose, worn or damaged front wheel spindle tie-rod. ● Loose, worn or damaged tie-rod ends. ● Suspension components. ● Binding steering column bearing(s).	● INSTALL a new lower steering column shaft. REFER to Section 211-04 . ● GO to the Tie-Rod Articulation Torque Component Test. ● GO to the Steering Linkage Component Test. ● REFER to Section 204-00 for suspension system diagnosis and testing. ● INSTALL new steering column bearing(s). REFER to Section 211-04 .
● Shimmy	● Loose, worn or damaged tie-rod end. ● Loose, worn or damaged tie-rod.	● GO to the Steering Linkage Component Test. ● GO to the Tie-Rod Articulation Torque

		Component Test.
	• Suspension components.	• REFER to Section 204-00 for suspension system diagnosis and testing.
• Power steering pump noisy	• Low fluid level and possible leakage.	• FILL reservoir to specified level. CHECK for leaks. REPAIR as necessary.
	• Plugged reservoir filter.	• INSTALL a new reservoir. REFER to Section 211-02 .
	• Power steering pump.	• INSTALL a new power steering pump. REFER to Section 211-02 .
	• Entrained air.	• REFER to Power Steering System Purging in this section.

Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE 4WAS MODULE/UNABLE TO ENTER SELF-TEST

Test Step	Result / Action to Take
A1 CHECK CIRCUITS 1003 (GY/YE) AND 1524 (DB) FOR AN OPEN	
• Key in OFF position. • Disconnect: 4WAS C2131b. • Key in ON position. • Measure the voltage between the following 4WAS module C2131b pins, harness side and ground: **Pin** / **Circuit** 1 / 1524 (DB) 4 / 1003 (GY/YE) 15 / 1524 (DB) • **Are the voltages greater than 10 volts?**	**Yes** GO to A2 . **No** REPAIR the affected circuit(s). TEST the system for normal operation.
A2 CHECK CIRCUIT 875 (BK/LG) FOR AN OPEN	
• Disconnect: Air Suspension Control Module C2131b. • Measure the resistance between 4WAS module C2131b pin 19, circuit 875 (BK/LG), harness side and ground. • **Is the resistance less than 5 ohms?**	**Yes** CHECK the module communication network. REFER to Section 418-00 . **No** REPAIR circuit 875 (BK/LG). TEST the system for normal operation.

PINPOINT TEST B: DTC 1897 — STEERING VAPS CIRCUIT LOOP FAILURE

Test Step	Result / Action to Take
B1 CHECK CIRCUITS 412 (OG/LB) AND 413 (LG) FOR SHORT TO GROUND	
• **WARNING: The electrical power to the air suspension system must be turned off prior to hoisting, jacking or towing an air suspension vehicle. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.** • Turn the air suspension switch off. • Raise and support the vehicle. For additional information, REFER to Section 100-02 . • Disconnect: 4WAS Module C2131b. • Measure the resistance between 4WAS module C2131b pin 21, circuit 413 (LG), harness side and ground and between 4WAS module C2131b pin 22, circuit 412 (OG/LB), harness side and ground. • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to B2 . **No** GO to B5 .
B2 CHECK CIRCUITS 412 (OG/LB) AND 413 (LG) FOR SHORT TO BATTERY	
• Disconnect: Air Suspension Control Module C2131b. • Measure the voltage between 4WAS module C2131b pin 21, circuit 413 (LG), harness side and ground and between 4WAS module C2131b pin 22, circuit 412 (OG/LB), harness side and ground. • **Are the voltages greater than 10.0 volts?**	**Yes** REPAIR the affected circuit(s). CLEAR the DTC. REPEAT the self-test. **No** GO to B3 .
B3 CHECK CIRCUITS 412 (OG/LB) AND 413 (LG) FOR AN OPEN	
• Key in OFF position. • Disconnect: VAPS Actuator C120. • Raise the vehicle on a hoist. For additional information, refer to Section 100-02 . • Measure the resistance between 4WAS module C2131b pin 22 and VAPS actuator C120 pin 1, circuit 412 (OG/LB) and between 4WAS module C2131b pin 21 and VAPS actuator C120 pin 2, circuit 413 (LG). • **Are the resistances less than 5 ohms?**	**Yes** GO to B4 . **No** REPAIR the affected circuit(s). CLEAR the DTC. REPEAT the self-test.
B4 CHECK VAPS ACTUATOR FOR AN OPEN	
• Measure the resistance between the VAPS actuator C120 pin 1 and pin 2, component side. • **Is the resistance between 4 and 8 ohms?**	**Yes** INSTALL a new 4WAS module. REFER to Section 204-05 . REPEAT the self-test. **No** INSTALL a new steering gear. REFER to Section 211-02 . CLEAR the DTC. REPEAT the self-test.
B5 CHECK VAPS ACTUATOR FOR SHORT TO GROUND	
• Raise the vehicle on a hoist. For additional information, refer to	**Yes**

Section 100-02 . ● Disconnect: VAPS Actuator C120. ● Measure the resistance between VAPS actuator C120 pin 1, component side and ground and between VAPS actuator C120 pin 2, component side and ground. ● **Are the resistances greater than 10,000 ohms?**	GO to B6 . **No** INSTALL a new steering gear. REFER to Section 211-02 . CLEAR the DTC. REPEAT the self-test.
B6 CHECK CIRCUITS 412 (OG/LB) AND 413 (LG) FOR A SHORT TOGETHER ● Measure the resistance between VAPS actuator C120 pin 1 and 2, component side. ● Disconnect: VAPS Actuator C120. ● Measure the resistance between VAPS actuator C120 pin 1 and pin 2, harness side. ● **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new 4WAS module. REFER to Section 204-05 . REPEAT the self-test. **No** INSTALL a new steering gear. REFER to Section 211-02 . CLEAR the DTC. REPEAT the self-test.

Component Tests

Steering Linkage

1. With the parking brake applied, carry out the following:
    1. **NOTE:** Excessive vertical or horizontal motion of the stud relative to the steering linkage ball sockets may indicate excessive wear.

       Have an assistant rotate the steering wheel back and forth 360 degrees and watch for relative motion of the studs in the steering linkage ball sockets.
    2. Watch for a loose steering gear attachment to the frame.

2. Another method is to raise the front tires off the ground, grasp the tire at the front and rear and watch for excessive play in the joints while trying to pivot the wheels by hand.

3. **NOTE:** Incorrect separation of the tapered stud from its seat will cause premature failure of the ball socket.

   Joints can be checked for excessive wear by measuring the torque it takes to turn the stud.
    1. Separate the tapered stud from its seat and thread the attaching nut back onto the stud.
    2. **NOTE:** Some joint turning torques will be as little as 0.2 Nm (2 lb-in) within the first 1,000 miles and will remain there for the life of the joint.

       Turn the stud with an inch-pound torque wrench and note the torque required to turn the stud.

Torque Required to Turn Stud in Socket	Nm	Lb-In
New joints	2.0-5.0	18-47
Used joints	0.2-3	2-26
Joints with excessive play	Less than 0.2	Less than 2

    3. **NOTE:** Only install a new ball joint if the stud torque is less than 0.2 Nm (2 lb-in) and the

joint has any play when moved by hand.

Install new tie-rod ends as necessary.

Pump Flow and Pressure Test

WARNING: Do not touch the flowmeter during the test procedure or severe burns and serious injury may occur.

1. **CAUTION: Make sure that the connection point will not interfere with any of the engine accessory drive components or drive belts.**

   Install the Power Steering Analyzer at the high pressure port of the power steering pump. Make sure the power steering analyzer gate valve is fully open.

   - On some vehicles, the power steering pump high pressure port is inaccessible, and therefore, the power steering analyzer should be installed either at the steering gear or at a point in the high pressure line between the power steering pump and the steering gear.

2. Place a Dial Thermometer in the power steering pump reservoir.

3. Check the power steering fluid level. If necessary, add power steering fluid.
   - Use Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX or equivalent meeting Ford specification MERCON®.

4. Install the digital tachometer.

5. **CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump will occur.**

   Start the engine. Place the transmission in N (NEUTRAL). Set the parking brake. Raise the power steering fluid temperature to 74-80°C (165-175°F) by rotating the steering wheel fully to the left and right several times.

6. Set the engine speed to idle. Record the flow rate and pressure readings.
   - If the flow rate is below the idle flow rate specification, the power steering pump may require repair. Continue with the test procedure.
   - If the pressure reading is above the idle pressure specification, then check power steering hoses for kinks and restrictions.

7. Partially close the gate valve to obtain 5,175 kPa (750 psi). Record the flow rate.
   - If the flow rate is less than the specified flow rate, install a new power steering pump.

8. **CAUTION: Do not allow the gate valve to remain closed for more than five seconds.**

   Completely close and partially open the gate valve three times. Record the pressure relief valve actuation pressure reading.

   - If the pressure does not meet the relief pressure specification, install a new power steering pump.

9. Set the engine speed to 1,500 rpm. Record the flow rate.

- If the flow rate varies more than 3.785 liters/minute (1 gallon/minute) from the initial flow rate reading, install a new power steering pump.

10.  **CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump will occur.**

    Set the engine speed at idle. Turn (or have an assistant turn) the steering wheel to the left and right stops. Record flow rate and pressure readings at the stops.
    - The pressure reading at both stops should be nearly the same as the maximum pump relief pressure.
    - The flow rate should drop below 1.9 liters/minute (0.5 gallon/minute).
    - If the pressure does not reach the maximum pump relief pressure or the flow rate does not drop below the specified value, excessive internal leakage is occurring. Install a new steering gear as necessary. For additional information, refer to Section 211-02 .

11. Turn (or have an assistant turn) the steering wheel slightly in both directions and release it quickly while watching the pressure gauge.
    - The pressure reading should move from the normal backpressure reading and snap back as the steering wheel is released.
    - If the pressure returns slowly or sticks, the rotary valve in the steering gear is binding. Check the steering column and linkage before installing a new steering gear.

Turning Effort Test

NOTE: Make sure front wheels are correctly aligned and tire pressure is correct before checking turning effort.

1. Park the vehicle on dry concrete and set the parking brake.

2. Idle the engine for two to three minutes. Turn the steering wheel to the left and right several times to warm the fluid to 43-49°C (110-120°F).

3. With the engine running, attach a pull scale to the rim of the steering wheel. Measure pull required to turn one complete revolution in each direction. Refer to Specifications for Static Steering Wheel Turning Efforts for acceptable measurements.

Steering Gear Insulator

1. With the wheel normally loaded (on the ground), check the steering gear housing for excessive lateral movement.
    - If the steering gear housing moves more than 1.5 mm (0.05 in), the steering gear insulators may have deteriorated or the steering gear mounting nuts may have loosened. Tighten the steering gear mounting nuts.
    - If the steering gear housing movement is still excessive after tightening the gear mounting nuts, install new steering gear insulators.

Steering Gear Valve

NOTE: For vehicles with a steering pull.

1. With the vehicle in motion, place the transmission in N (NEUTRAL) and turn the engine OFF.
    - If the vehicle does not pull with the engine OFF, repair or install a new steering gear. For additional information, refer to Section 211-02 .
    - If the vehicle pull direction does not change, check the front suspension components and wheel alignment. For additional information, refer to Section 204-00 .

Tie-Rod Articulation Torque

1. **NOTE:** This check can be done with the steering gear on or off the vehicle.

   Disconnect the tie-rod end from the front wheel spindle. Refer to Section 211-02 .

2. Move the tie-rod back and forth three times.

3. Hook the Spring Scale over the tie-rod end or the threaded portion of the tie-rod and measure the force required to move the front wheel spindle tie-rod. Refer to Tie-Rod Articulation Torque in General Specifications in this section.

4. If the force required to move the front wheel spindle tie-rod does not meet the specifications, install a new tie-rod.

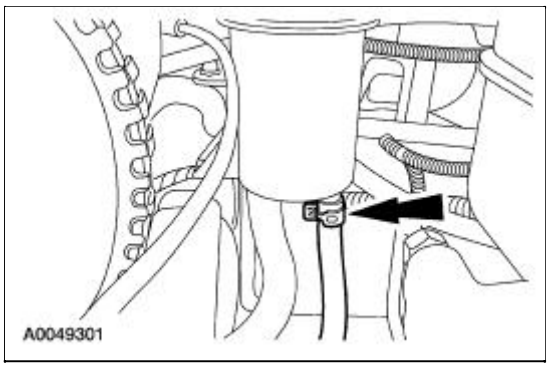
Power Steering System Flushing

Material

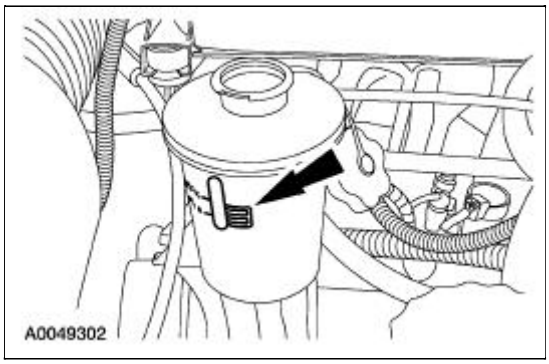
Item	Specification
Motorcraft MERCON®Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®

WARNING: Do not mix fluid types. Any mixture or any unapproved fluid can lead to seal deterioration and leaks. A leak can ultimately cause loss of fluid, which can result in a loss of power steering assist.

1. Remove the ignition coil fuse to disable the engine from starting.
2. Loosen the clamp, disconnect the power steering return hose and plug the reservoir inlet.



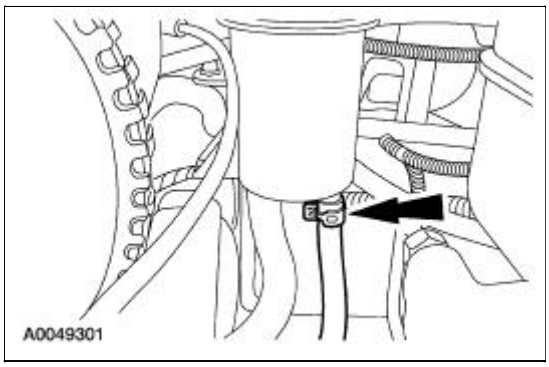
3. Attach an extension hose between the power steering return hose and an empty container.
4. Fill the power steering fluid reservoir.



5. Raise the front wheels off the ground. For additional information, refer to Section 100-02 .
6. **CAUTION: Do not operate the starter motor for more than 10 seconds at a time. Damage to the starter motor can result.**

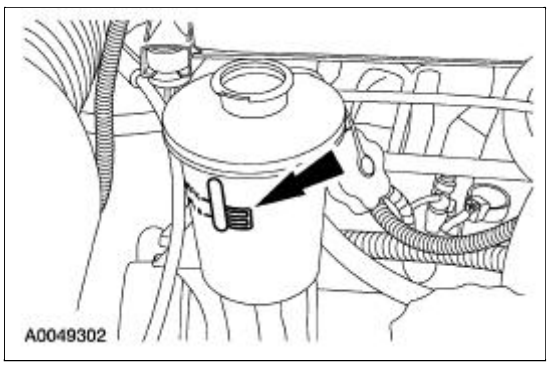
Turn the steering wheel from stop to stop while cranking the engine until the fluid exiting the extension hose is clean.

7. Disconnect the extension hose from the power steering return hose and attach the power steering return hose to the fluid reservoir.



8. **NOTE:** Do not overfill the power steering fluid reservoir.

   Fill the power steering fluid reservoir.



9. Install the ignition coil fuse.

10. **CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump will occur.**

    Start the engine and turn the steering wheel from stop to stop.

11. **NOTE:** If power steering is noisy and accompanied by aerated fluid, it will be necessary to purge the power steering system. For additional information, refer to Power Steering System Purging in this section.

    Check the power steering fluid level.

12. Clear diagnostic trouble codes (DTCs). For additional information, refer to Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Power Steering System Purging

Special Tool(s)

 ST1176-B	Vacuum Pump Kit 416-D002 (D95L-7559-A)
 ST2670-A	Evacuation Cap, Power Steering 211-265

Material

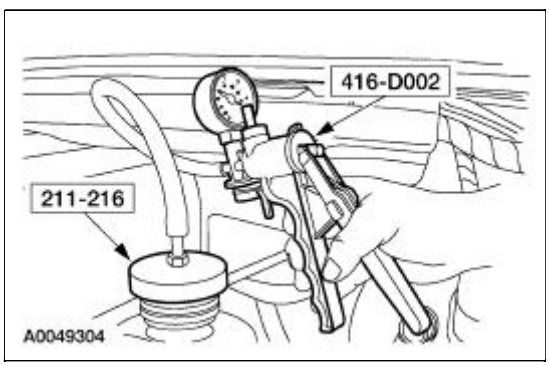
Item	Specification
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®

NOTE: If the air is not purged from the power steering system correctly, pump failure can result. This condition can occur on pre-delivery vehicles with evidence of aerated fluid or on vehicles that have had steering component repairs.

A whine heard from the power steering pump may be caused by air in the system. The power steering purging procedure must be carried out under the following conditions:

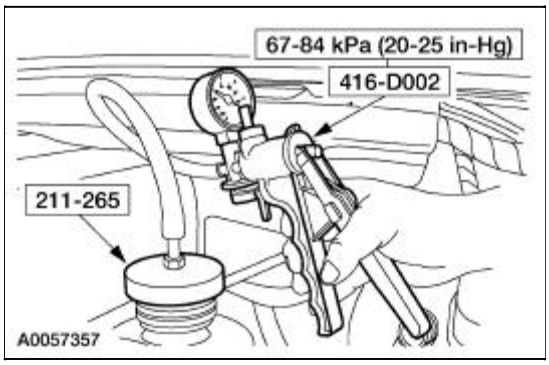
- Prior to any component repair for which power steering noise complaints are accompanied by evidence of aerated fluid.
- After replacement of any power steering system component (gear, hose, etc.).

1. Remove the cap and install the special tools.



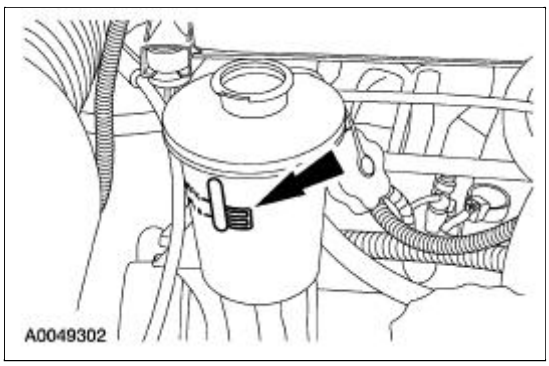
2. Start the engine and allow it to idle.

3. Using the special tool, apply maximum vacuum for a minimum of three minutes with the engine at idle. Maintain the maximum vacuum with vacuum pump.

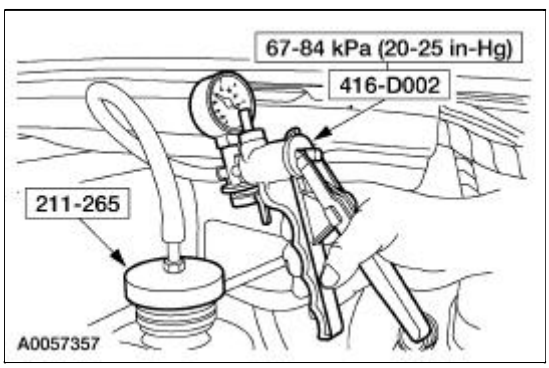


4. Release the vacuum source and remove the vacuum pump.

5. Add fluid to the power steering fluid reservoir.



6. Using the special tool, reinstall the vacuum pump stopper and apply maximum vacuum.

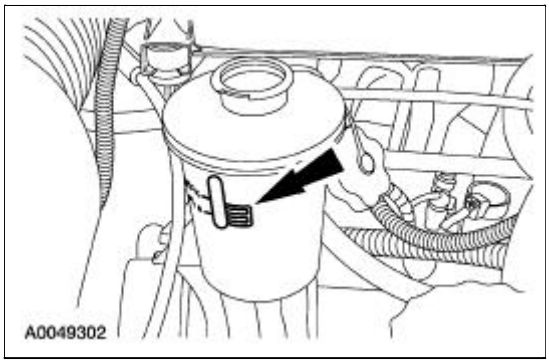


7. **CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump will occur.**

   Cycle the steering wheel from stop to stop every 30 seconds for approximately five minutes.

8. Stop the engine, release the vacuum source, and remove the vacuum pump.

9. Add power steering fluid if necessary. Install the power steering fluid reservoir cap.



10. **CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump will occur.**

    Start the engine and cycle the steering wheel from stop to stop every 30 seconds for approximately five minutes.

11. Check for power steering fluid leaks at all connections. If the power steering fluid still shows signs of aeration, repeat this procedure.

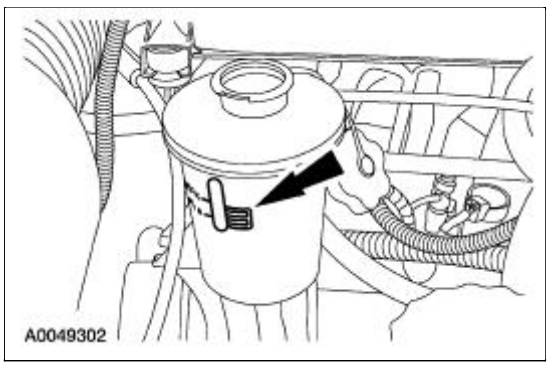
Power Steering System Filling

Material

Item	Specification
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®

WARNING: Do not mix fluid types. Any mixture or any unapproved fluid can lead to seal deterioration and leaks. A leak can ultimately cause loss of fluid, which can result in a loss of power steering assist.

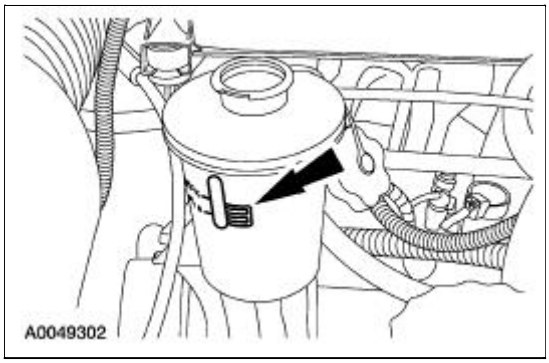
1. Fill the power steering reservoir to the appropriate level.



2. Remove the ignition coil fuse to disable the engine from starting.
3. Raise the front wheels off the floor. For additional information, refer to Section 100-02 .
4. **CAUTION: Do not operate the starter motor for more than 10 seconds at a time. Damage to the starter motor can result.**

   Turn the steering wheel from stop to stop while cranking the engine.
5. Lower the vehicle.
6. **CAUTION: Do not overfill the power steering fluid reservoir.**

   Fill the power steering fluid reservoir to the appropriate level.



7. Install the ignition coil fuse.

8. **NOTE:** If the power steering is noisy and accompanied by evidence of aerated fluid it will be necessary to purge the power steering system. For additional information, refer to Power Steering System Purging in this section.

   Clear the diagnostic trouble codes (DTCs). For additional information, refer to Powertrain Control/Emissions Diagnosis (PC/ED) manual.

   - Start the engine and check the system for leaks.

General Specifications

Item	Specification
Lubricants	
Motorcraft MERCON® ATF XT-2-QDX	MERCON®
Multi-Purpose Grease DOAZ-19584-AA	ESR-M1C159-A

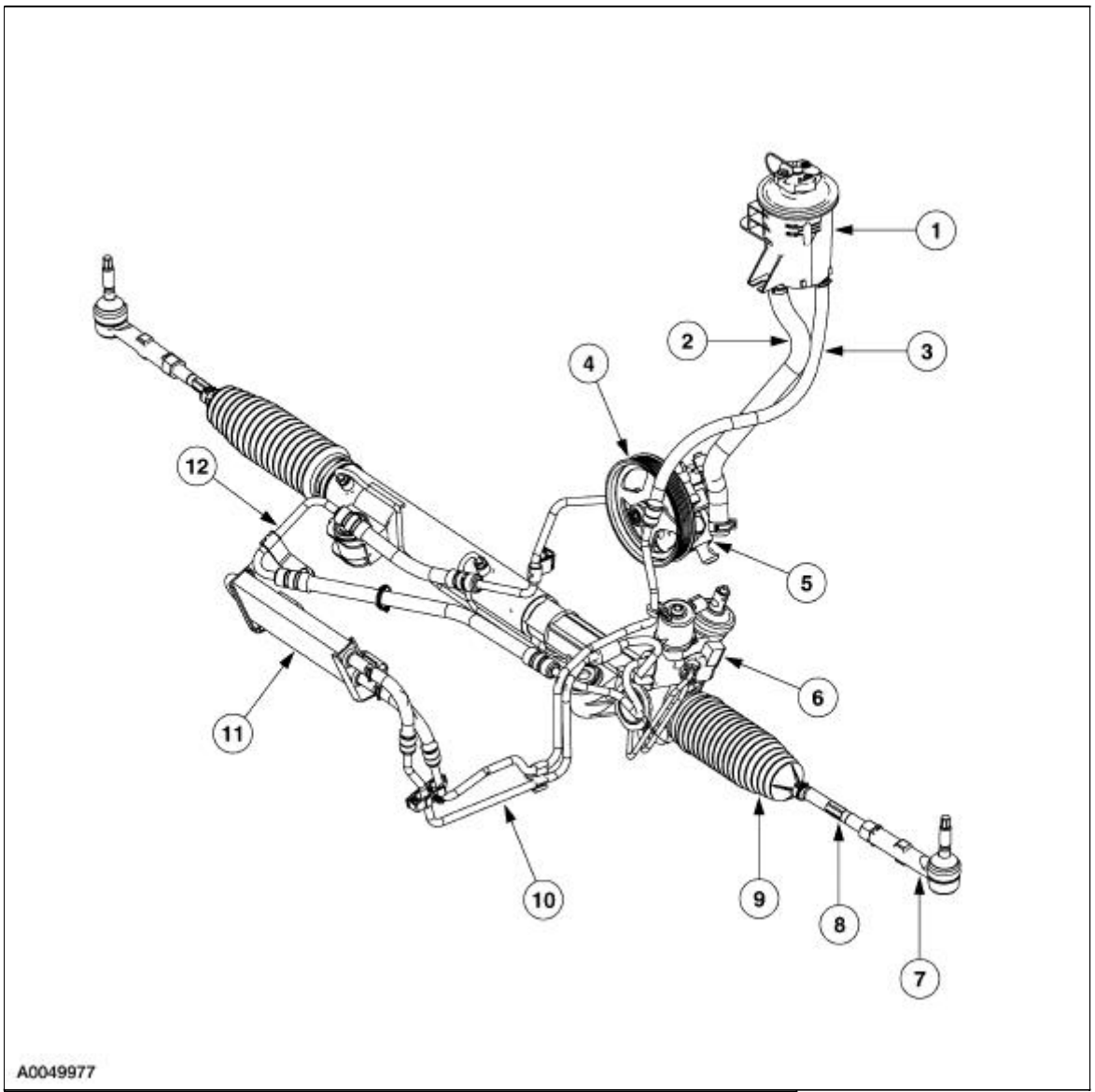
Torque Specifications

Description	Nm	lb-ft	lb-in
Reservoir bolts	11	8	—
Fluid cooler bolts	11	8	—
Intermediate shaft-to-gear pinch bolt	30	22	—
Pressure line bracket-to-engine nut (5.4L)	40	30	—
Pressure line bracket-to-engine nut (4.6L)	11	8	—
Pressure line bracket-to-crossmember bolt	12	9	—
Steering line clamp plate bolt	23	17	—
Steering gear bracket-to-gear bolts and nuts (M14)	150	111	—
Steering gear bracket-to-crossmember bolts and nuts (M12)	103	76	—
Pressure line fitting-to-pump	65	48	—
Pump bolts	25	18	—
Tie rod-to-wheel knuckle nut	150	111	—
Spindle tie-rod jam nut	103	76	—
Spindle tie rod-to-gear	120	88	—
Oil drip shield bolts	10	—	89
Lower control arm nut	200	148	—
Oil drip shield bolts	9	—	80
Lower arm-to-frame nut and bolt	200	148	—

Power Steering

Power Steering — Hydraulic System

NOTE: Navigator shown, Expedition similar.



Item	Part Number	Description
1	3A697	Fluid reservoir
2	3691	Supply hose (reservoir-to-pump)
3	3A713	Return hose (cooler-to-reservoir)
4	3A733	Pulley
5	3A764	Power steering pump
6	3504	Steering gear

7	3A131	Tie-rod end
8	3280	Spindle tie-rod
9	3332	Bellows boot
10	3A713	Return line (gear-to-cooler)
11	3D746	Fluid cooler
12	3A719	Pressure line (pump-to-gear)

Power Steering Pump

The CIII power steering pump has the following features:

- It is a belt-driven, vane-type, power steering pump.
- It is mounted directly to the engine by three bolts.
- The power steering pump uses a quick-connect fitting for the power steering pressure hose.
- The power steering pump is replaced as an assembly.
- The identification tag attached to the power steering pump indicates the model number and bar code. Refer to the identification tags when installing a new pump.

Power Steering Gear

The Expedition and Navigator steering gears have the following features:

- It is a torsion-bar type hydraulic assisted system.
- It reduces road shock and vibration.
- It includes a rotary-style hydraulic valve.

Navigator vehicles are equipped with Variable Assist Power Steering (VAPS). The VAPS system is equipped with an actuator that is located on the steering gear. As the vehicle speed increases, the solenoid changes the level of assist to the steering system, increasing the amount of torque required to turn the steering wheel.

The VAPS control strategy is integrated into the air suspension module.

Steering Gear Identification

The steering gear is stamped with a manufacturer's code. The following is an example:

- SFRA A 102501 1142

The code is interpreted as follows:

- SFRA-Model code
- A 102501 1142-Build code
    - A — Test stand
    - 10 — Month

- 25 — Day
- 01 — Year
- 1142 — Time

Power Steering

Refer to Section 211-00 .

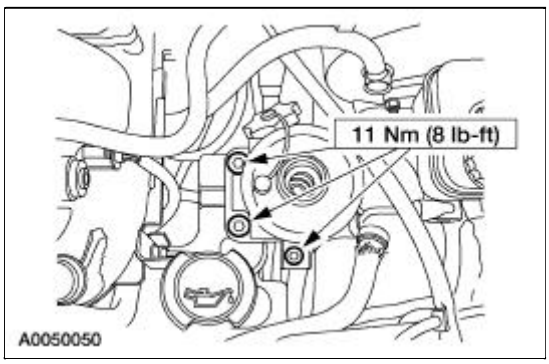
Power Steering Fluid Reservoir

Material

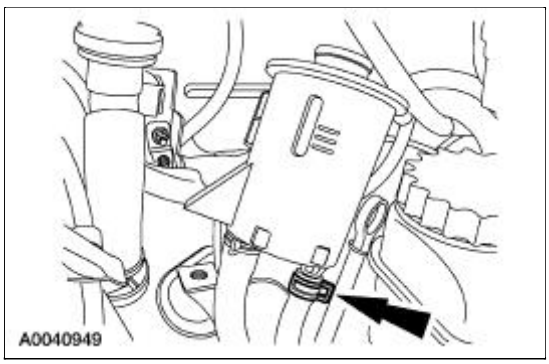
Item	Specification
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®

Removal and Installation

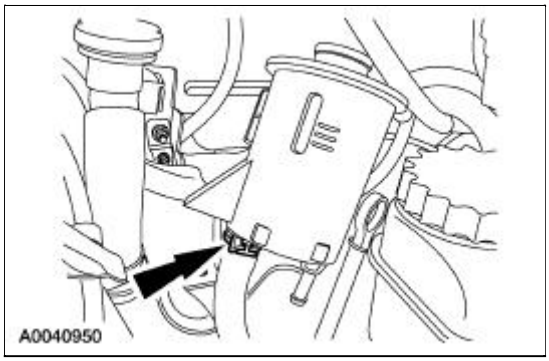
1. Remove the screws.



2. Disconnect the hose.



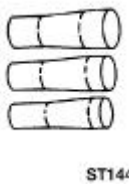
3. Disconnect the hose and remove the power steering pump reservoir.



4. To install, reverse the removal procedure.
5. Fill, purge and leak check the system. For additional information, refer to Section 211-00 .

Power Steering Pump

Special Tool(s)

 ST1444-A	Installer Set, Teflon Seal D90P-3517-A or Equivalent

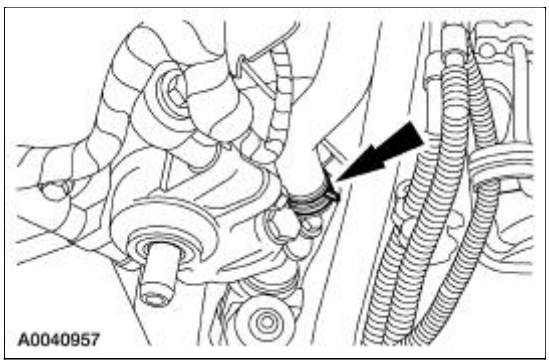
Material

Item	Specification
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®

Removal and Installation

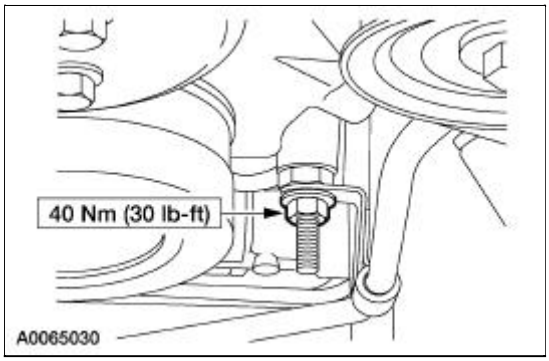
All vehicles

1. Remove the cooling fan. For additional information, refer to Section 303-03 .
2. Remove the power steering pump pulley. For additional information, refer to Power Steering Pump Pulley in this section.
3. Disconnect the hose.



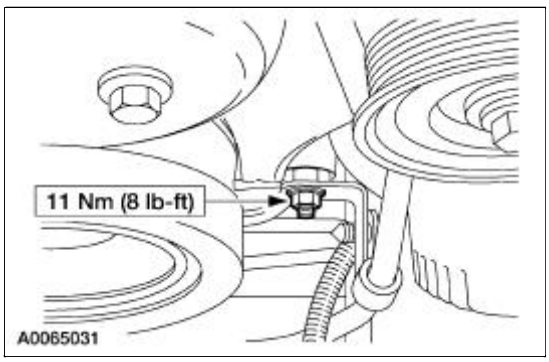
Vehicles with 5.4L engine

4. Remove the nut.



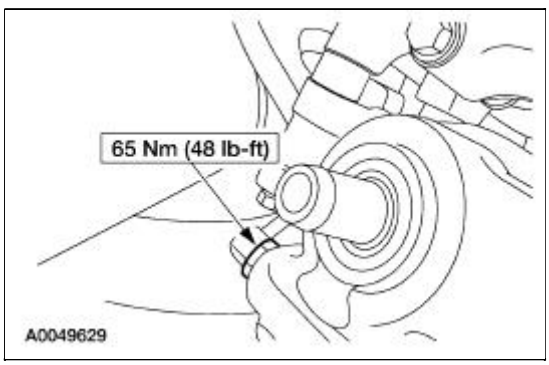
Vehicles with 4.6L engine

5. Remove the nut.

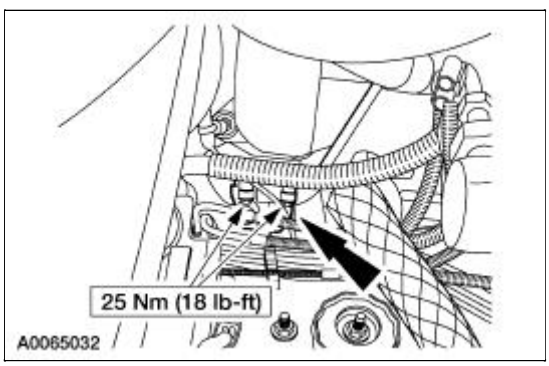


All vehicles

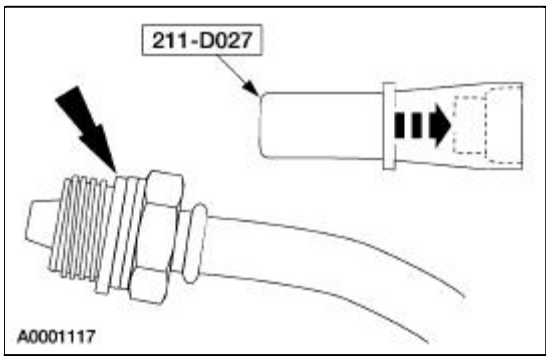
6. Disconnect the line.



7. Remove the three bolts.
    - Detach the harness retainer and remove the pump.



8. To install, reverse the removal procedure.
9. Using the special tool, install a new seal on the pressure hose fitting.



10. Fill, purge and leak check the system. For additional information, refer to Section 211-00 .

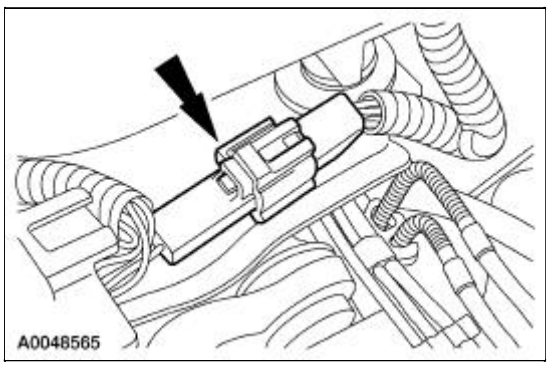
Power Steering Pump Pulley

Special Tool(s)

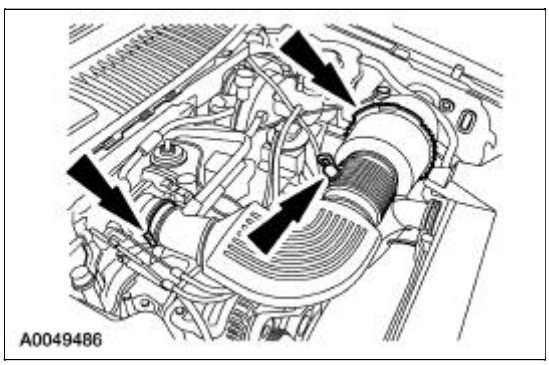
	Remover, Power Steering Pump Pulley 211-016 (T69L-10300-B)
 ST1586-A	Installer, Power Steering Pump Pulley 211-185 (T91P-3A733-A)

Removal and Installation

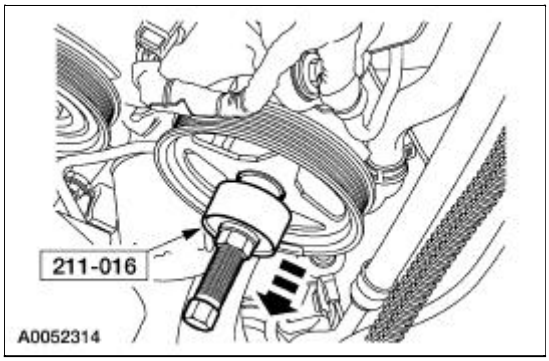
1. Remove the drive belt. For additional information, refer to Section 303-05 .
2. Disconnect the mass air flow sensor electrical connector.



3. Loosen the clamps, then disconnect the electrical connector.
   - Remove the air cleaner outlet canister and pipe.



4. Using the special tool, remove the power steering pump pulley.

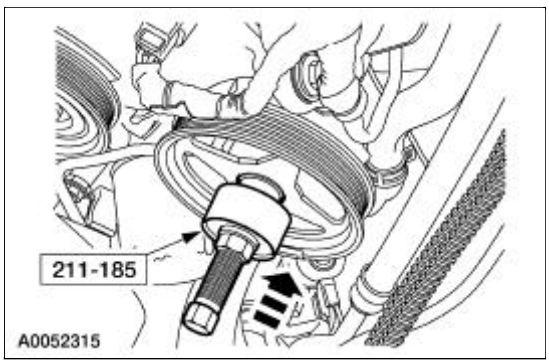


5. To install, reverse the removal procedure.

6. **CAUTION: If the pulley has been removed and installed twice, install a new power steering pump pulley.**

   Using the special tool, install the power steering pump pulley.

   - Inspect the pulley for paint marks in the web area near the hub. If there are two paint marks, install a new pulley. If there is one paint mark or none at all, use a paint pencil to mark the web area of the pulley near the hub.



Steering Gear to Fluid Cooler Return Hose

Material

Item	Specification
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®

Removal and Installation

All vehicles

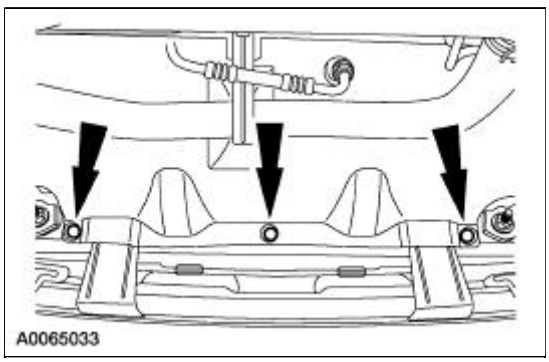
1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located near the jack storage area in the rear of the passenger compartment. Failure to do so may result in unexpected inflation or deflation of the air springs which may result in shifting of the vehicle during these operations.**

   If equipped, turn the air suspension switch to the OFF position.

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

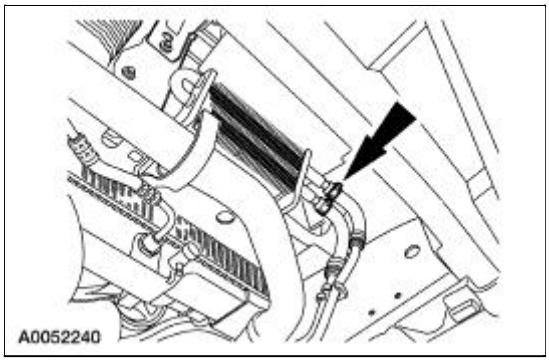
Navigator vehicles

3. Remove the pushpins and the deflector shield.

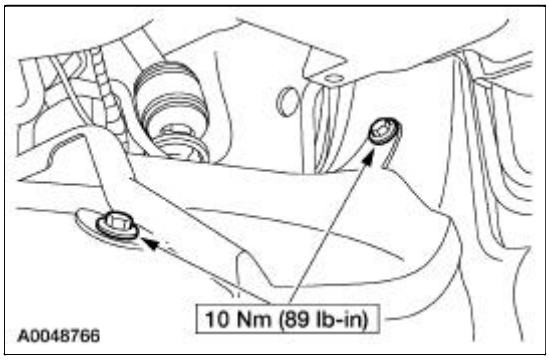


All vehicles

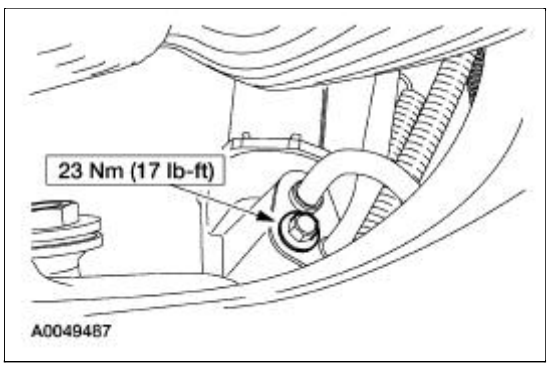
4. Disconnect the hose.



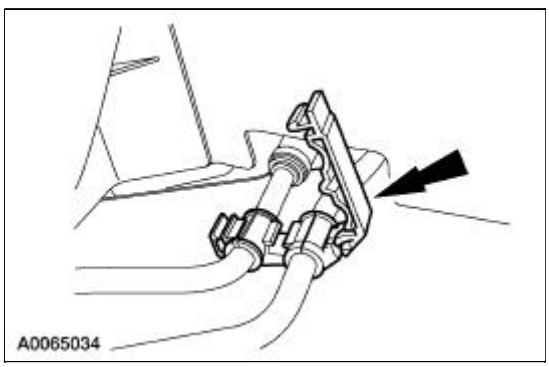
5. Remove the bolts and the oil drip shield.



6. Remove the bolt.



7. Detach the hose from the frame rail retainers and remove the hose.



8. To install, reverse the removal procedure.

9. Fill, purge and leak check the system. For additional information, refer to Section 211-00 .

Power Steering Pump to Steering Gear Pressure Line —4x2

Material

Item	Specification
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®

Removal and Installation

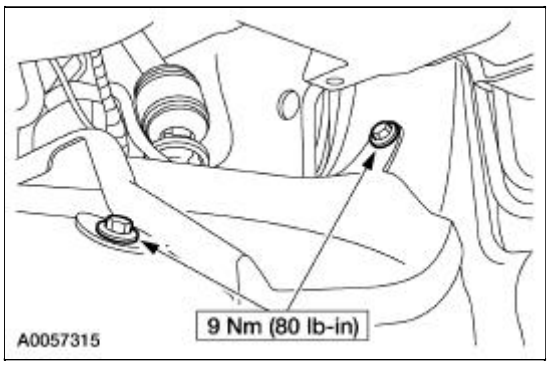
All vehicles

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located near the jack storage area in the rear of the passenger compartment. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

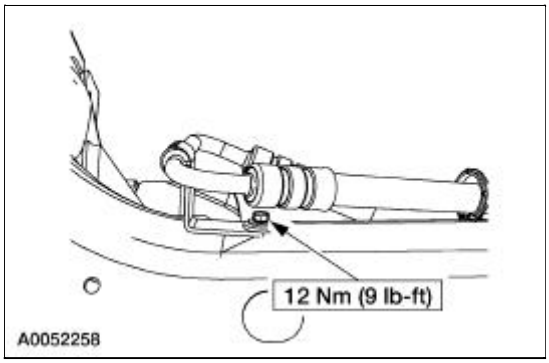
   If equipped, turn the air suspension switch to the OFF position.

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

3. Remove the bolts and the oil drip shield.

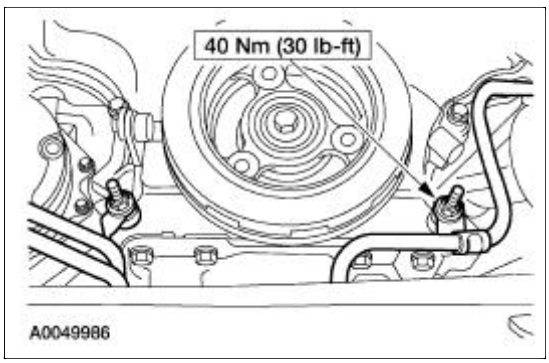


4. Remove the bolt and detach the crossmember retainers.



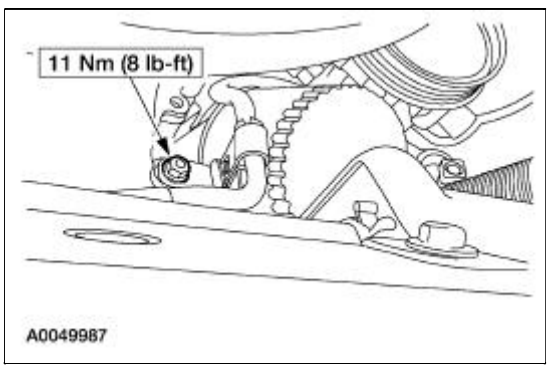
5.4L engine

5. Remove the nut.



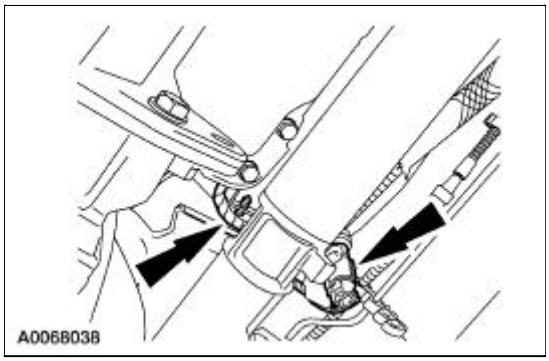
4.6L engine

6. Remove the nut.



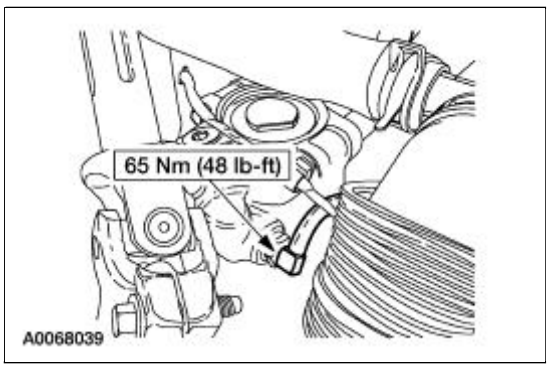
Expedition vehicles

7. If equipped, disconnect the pressure sensor electrical connector and detach the harness retainer.

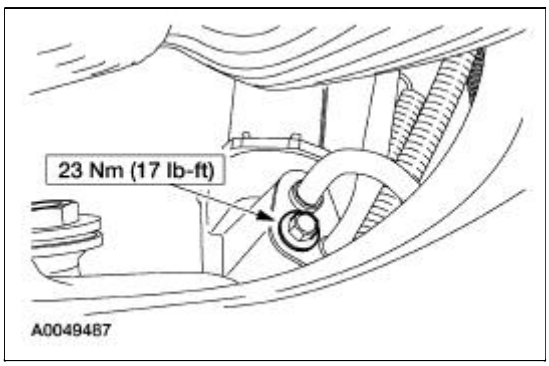


All vehicles

8. From the back side of the pump, disconnect the line.



9. Remove the bolt and the pressure line.



10. To install, reverse the removal procedure.

11. Fill, purge and leak check the system. For additional information, refer to Section 211-00 .

Power Steering Pump to Steering Gear Pressure Line —4x4

Material

Item	Specification
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®

Removal and Installation

All vehicles

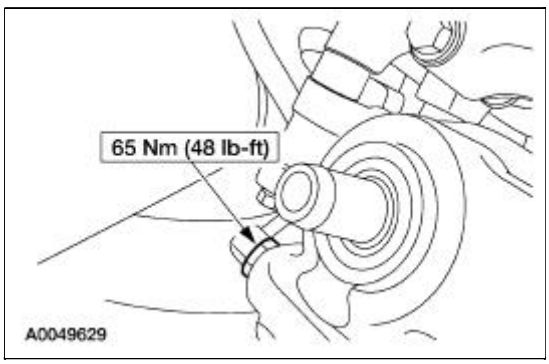
1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located near the jack storage area in the rear of the passenger compartment. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

   If equipped, turn the air suspension switch to the OFF position.

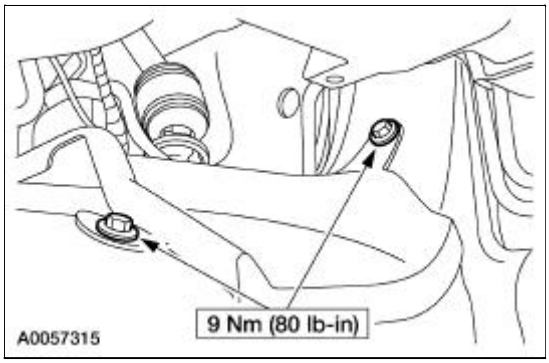
2. Remove the cooling fan and shrouds. For additional information, refer to Section 303-03 .

3. Remove the power steering pump pulley. For additional information, refer to Power Steering Pump Pulley in this section.

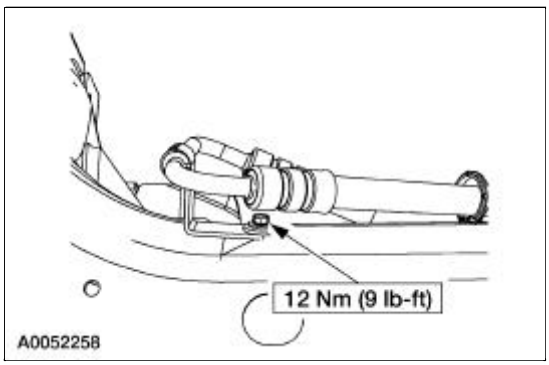
4. Disconnect the line.



5. Remove the bolts and the oil drip shield.

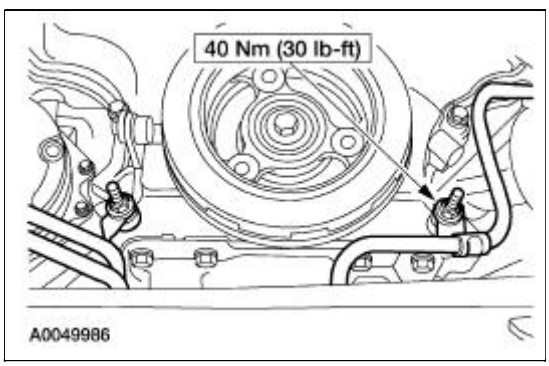


6. Remove the bolt and detach the crossmember retainers.



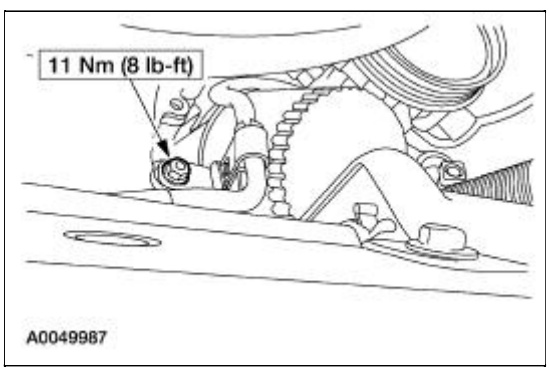
5.4L engine

7. Remove the nut.



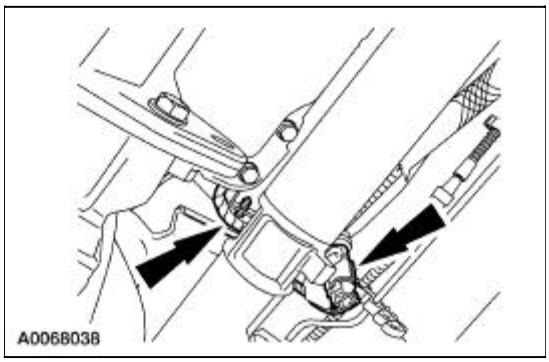
4.6L engine

8. Remove the nut.



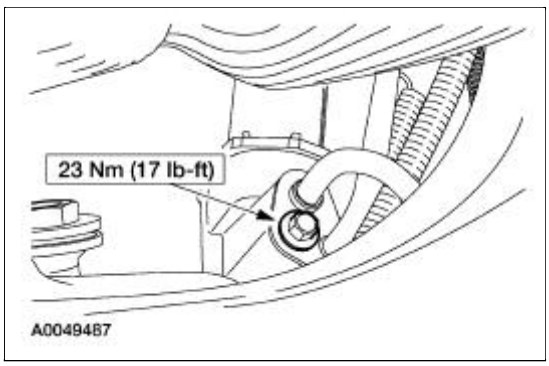
Expedition vehicles

9. If equipped, disconnect the pressure sensor electrical connector and detach the harness retainer.



All vehicles

10. Remove the bolt and the pressure line.



11. To install, reverse the removal procedure.

12. Fill, purge and leak check the system. For additional information, refer to Section 211-00 .

Power Steering Fluid Cooler

Material

Item	Specification
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®

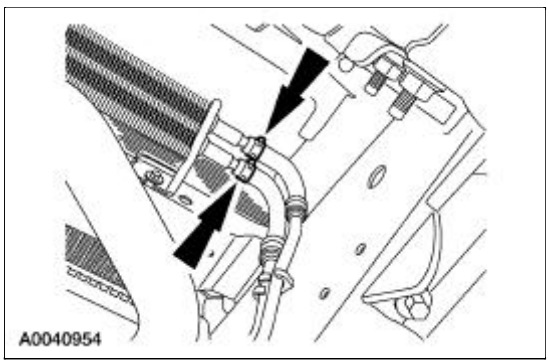
Removal and Installation

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located near the jack storage area in the rear of the passenger compartment. Failure to do so may result in unexpected inflation or deflation of the air springs which may result in shifting of the vehicle during these operations.**

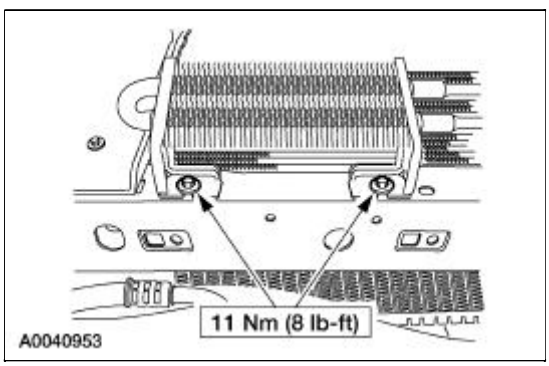
   If equipped, turn the air suspension switch to the OFF position.

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

3. Disconnect the hoses.



4. Remove the screws and the power steering fluid cooler.



5. To install, reverse the removal procedure.

6. Fill, purge and leak check the system. For additional information, refer to Section 211-00 .

Steering Gear —4x2

Removal and Installation

All vehicles

1. Place the front wheels in the straight-ahead position and the ignition switch in the OFF position.

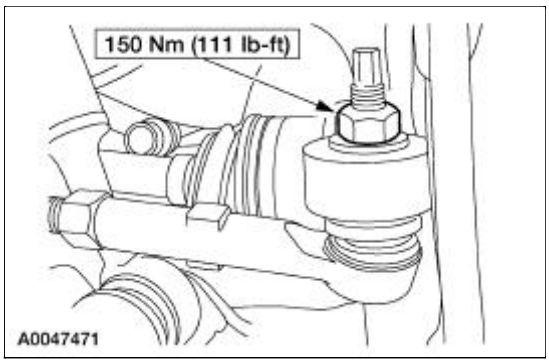
2. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located near the jack storage area in the rear of the passenger compartment. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

   If equipped, turn the air suspension switch to the OFF position.

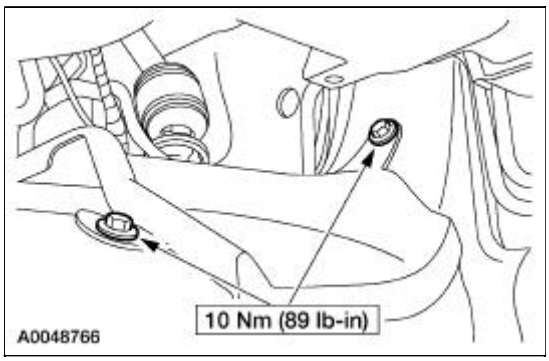
3. With the vehicle in NEUTRAL, position on a hoist. For additional information, refer to Section 100-02 .

4. **NOTE:** The hex holding feature can be used to prevent turning of the stud while removing the nut.

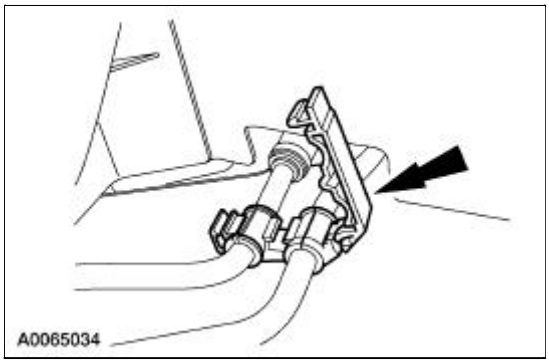
   Remove the nuts and detach the tie-rods from the wheel knuckles.



5. Remove the bolts and the oil drip shield.

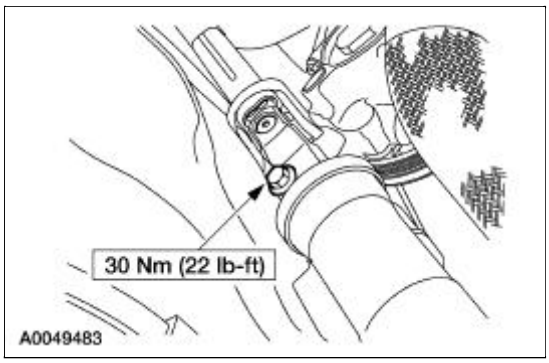


6. Detach the lines from the clip.

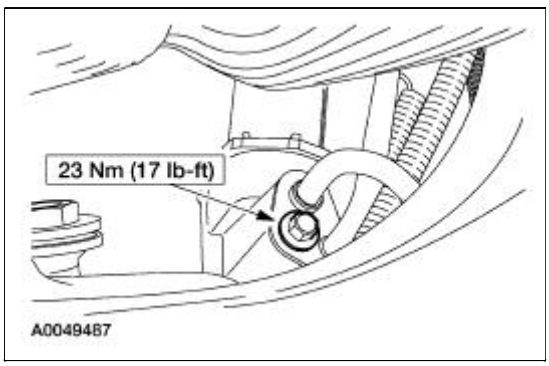


7. **CAUTION: Do not allow the intermediate shaft to rotate while it is disconnected from the gear or damage to the clockspring can occur. If there is evidence that the intermediate shaft has rotated, the clockspring must be removed and recentered. For additional information, refer to Section 501-20B .**

   Remove the bolt and detach the intermediate shaft from the gear.

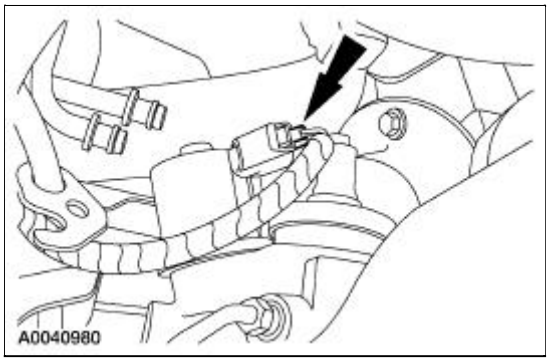


8. Remove the bolt and disconnect the power steering lines.
   - Position the lines aside.



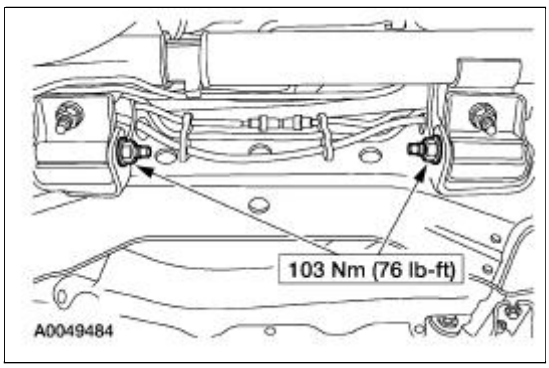
Navigator vehicles

9. Disconnect the electrical connector.
   - Rotate the actuator until the connector housing is facing the steering gear input shaft.



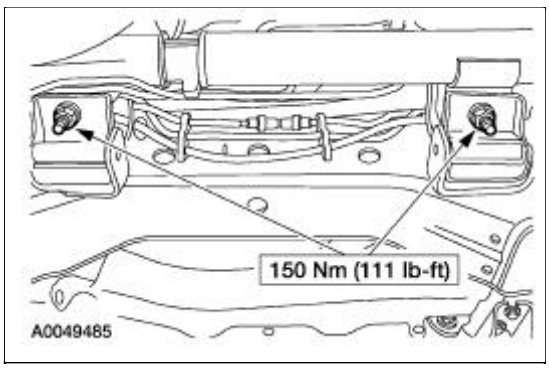
All vehicles

10. Remove the nuts and bolts.
    - Discard the nuts.



11. **CAUTION: Make sure that the steering lines are clear from the removal path of the gear or damage to the lines can result.**

    Remove the nuts, bolts, brackets and the steering gear.
    - Discard the nuts.



12. **CAUTION: On 4x4 vehicles make sure that the wheel end vacuum line is clear of the steering gear mounting fasteners before tightening the bolts or damage to the line can result.**

    CAUTION: Make sure to tighten the bracket-to-steering gear bolts (M14) before tightening the bracket-to-crossmember bolts (M12) or damage to the steering gear can result.

To install, reverse the removal procedure.

13. Fill, purge and leak check the system. For additional information, refer to Section 211-00 .

Steering Gear —4x4

Removal and Installation

All vehicles

1. Place the front wheels in the straight-ahead position and the ignition switch in the OFF position.

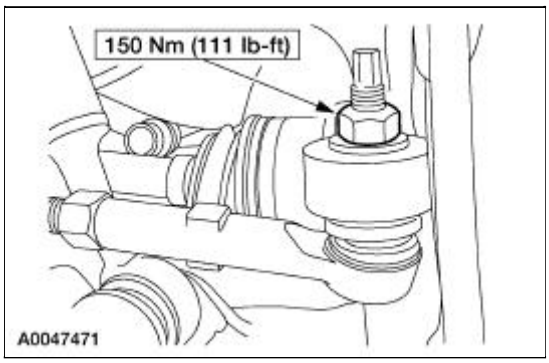
2. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located near the jack storage area in the rear of the passenger compartment. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

   If equipped, turn the air suspension switch to the OFF position.

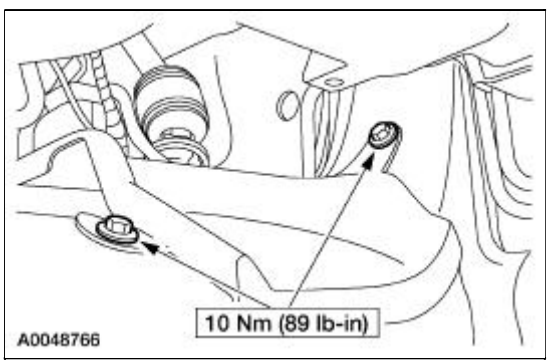
3. Remove the cooling fan and shrouds. For additional information, refer to Section 303-03 .

4. **NOTE:** The hex holding feature can be used to prevent turning of the stud while removing the nut.

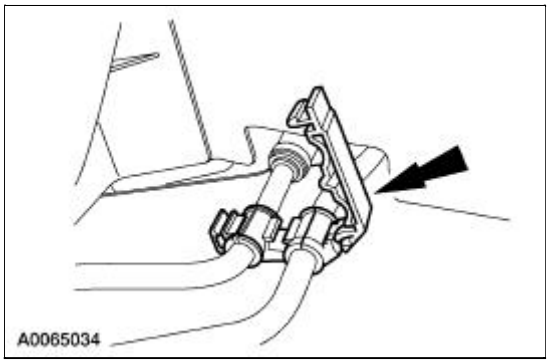
   Remove the nuts and detach the tie-rods from the wheel knuckles.



5. Remove the bolts and the oil drip shield.

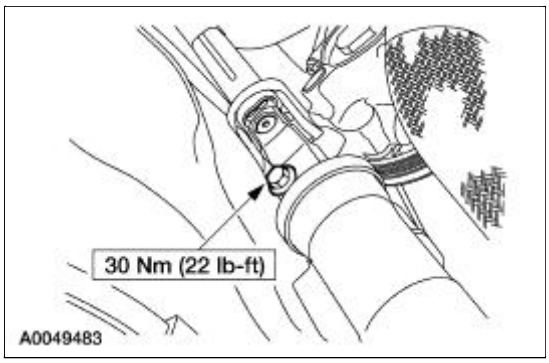


6. Detach the lines from the clip.

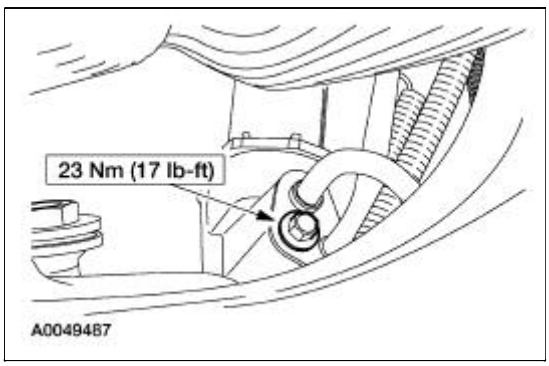


7. **CAUTION: Do not allow the intermediate shaft to rotate while it is disconnected from the gear or damage to the clockspring can occur. If there is evidence that the intermediate shaft has rotated, the clockspring must be removed and recentered. For additional information, refer to Section 501-20B .**

   Remove the bolt and detach the intermediate shaft from the gear.

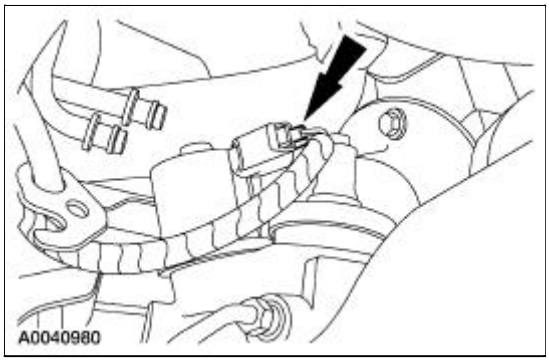


8. Remove the bolt and disconnect the power steering lines.
   - Position the lines aside.

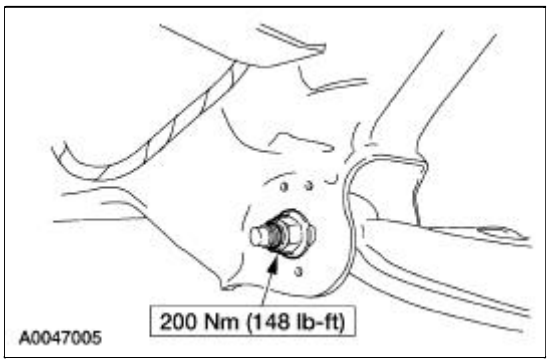


Navigator vehicles

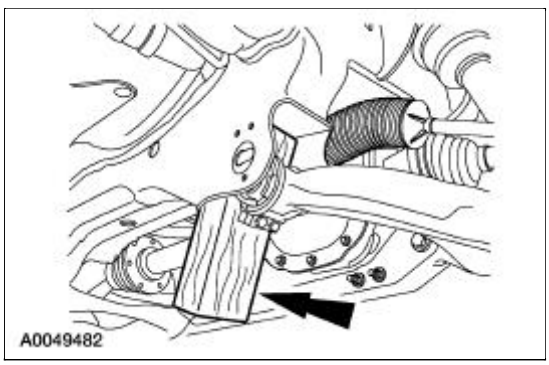
9. Disconnect the electrical connector.
   - Rotate the actuator until the connector housing is facing the steering gear input shaft.



10. Remove the nut and bolt.
    - Discard the nut.

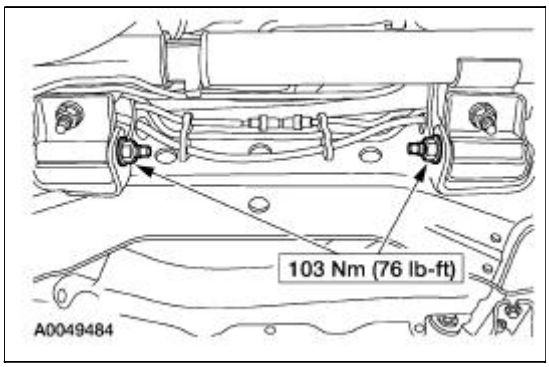


11. Insert a block of wood between the lower arm and the frame.



All vehicles

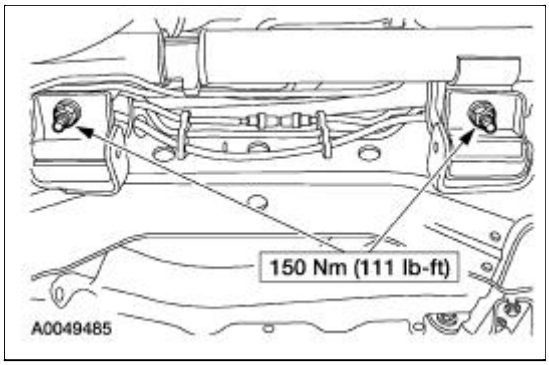
12. Remove the nuts and bolts.
    - Discard the nuts.



13. **CAUTION: Make sure that the steering lines are clear from the removal path of the gear or damage to the lines can result.**

    Remove the nuts, bolts, brackets and the steering gear.

    - Discard the nuts.



14. **CAUTION: Make sure that the wheel end vacuum line is clear of the steering gear mounting fasteners before tightening the bolts or damage to the line can result.**

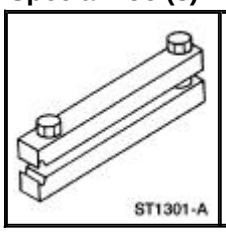
    CAUTION: Make sure to tighten the bracket-to-steering gear bolts (M14) before tightening the bracket-to-crossmember bolts (M12) or damage to the steering gear can result.

    To install, reverse the removal procedure.

15. Fill, purge and leak check the system. For additional information, refer to Section 211-00 .

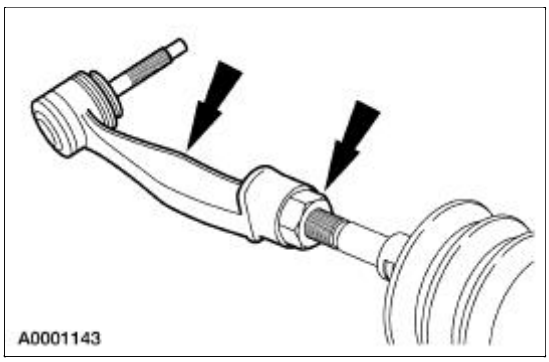
Steering Gear —Power

Special Tool(s)

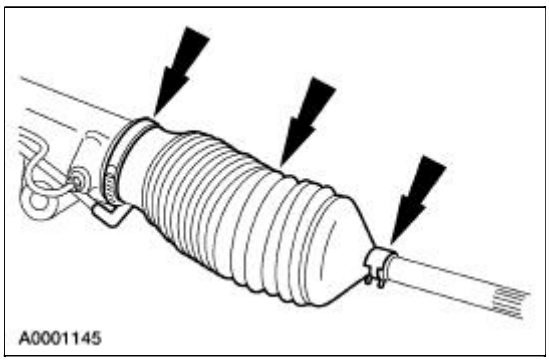
 ST1301-A	Installer, Constant Velocity Boot Camp 205-343 (T95P-3514-A)

Disassembly

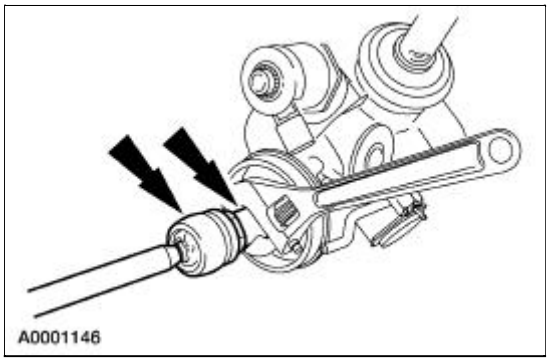
1. Remove the steering gear. For additional information, refer to Steering Gear—4x2 or Steering Gear—4x4 in this section.
2. Position the steering gear in a soft-jawed vice.
3. Make marks to index the tie-rods end and jam nuts for reference during installation.
4. Loosen the jam nuts and remove the tie-rod ends.
   - Remove and discard the jam nuts.


A0001143

5. Remove the clamps and the bellows boots.
   - Discard the clamps.

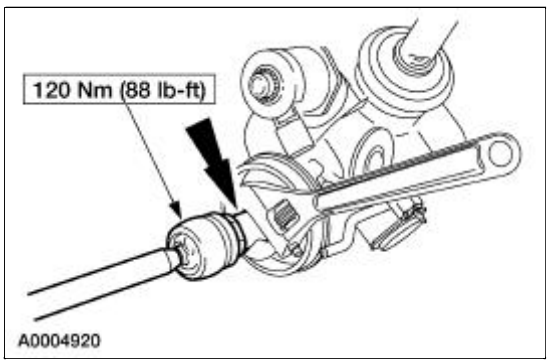

A0001145

6. While holding the steering gear rack, remove and discard the tie-rods.



Assembly

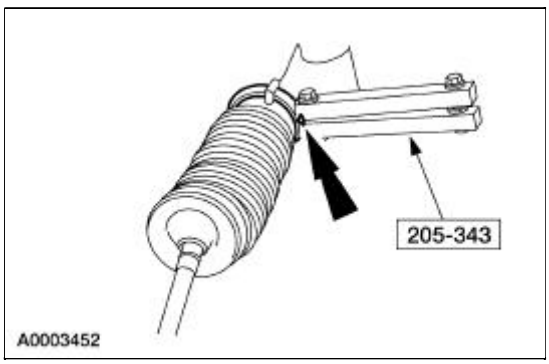
1. While holding the steering gear rack, install the tie-rods.



2. **NOTE:** Apply a thin coat of grease to the inner diameter of the inboard end of the bellows.

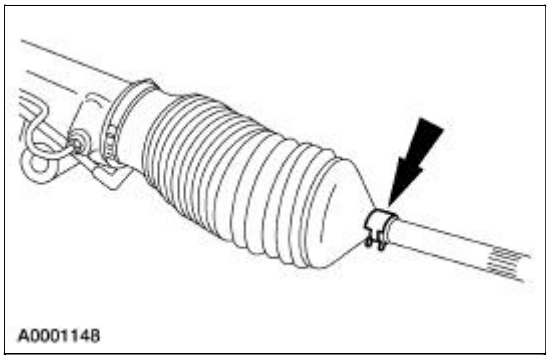
   Install the bellows boots and inboard clamps making sure that the air tube is inserted into the boot.

   - Using the special tool, tighten the clamps.

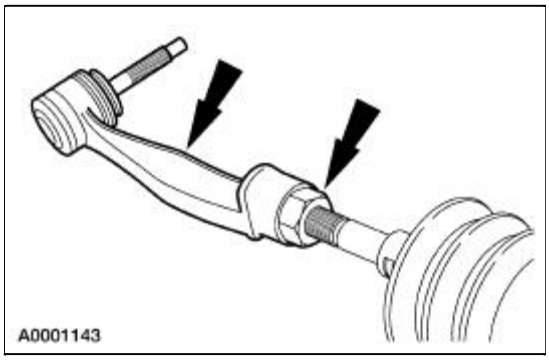


3. **CAUTION: Make sure that the end of the boot is positioned between the two grooves on the inner tie-rod or an internal leak can result.**

   Install the clamps.



4. Install the jam nuts and the tie-rods using the index marks made during disassembly.



5. Install the steering gear. For additional information, refer to Steering Gear—4x2 or Steering Gear—4x4 in this section.

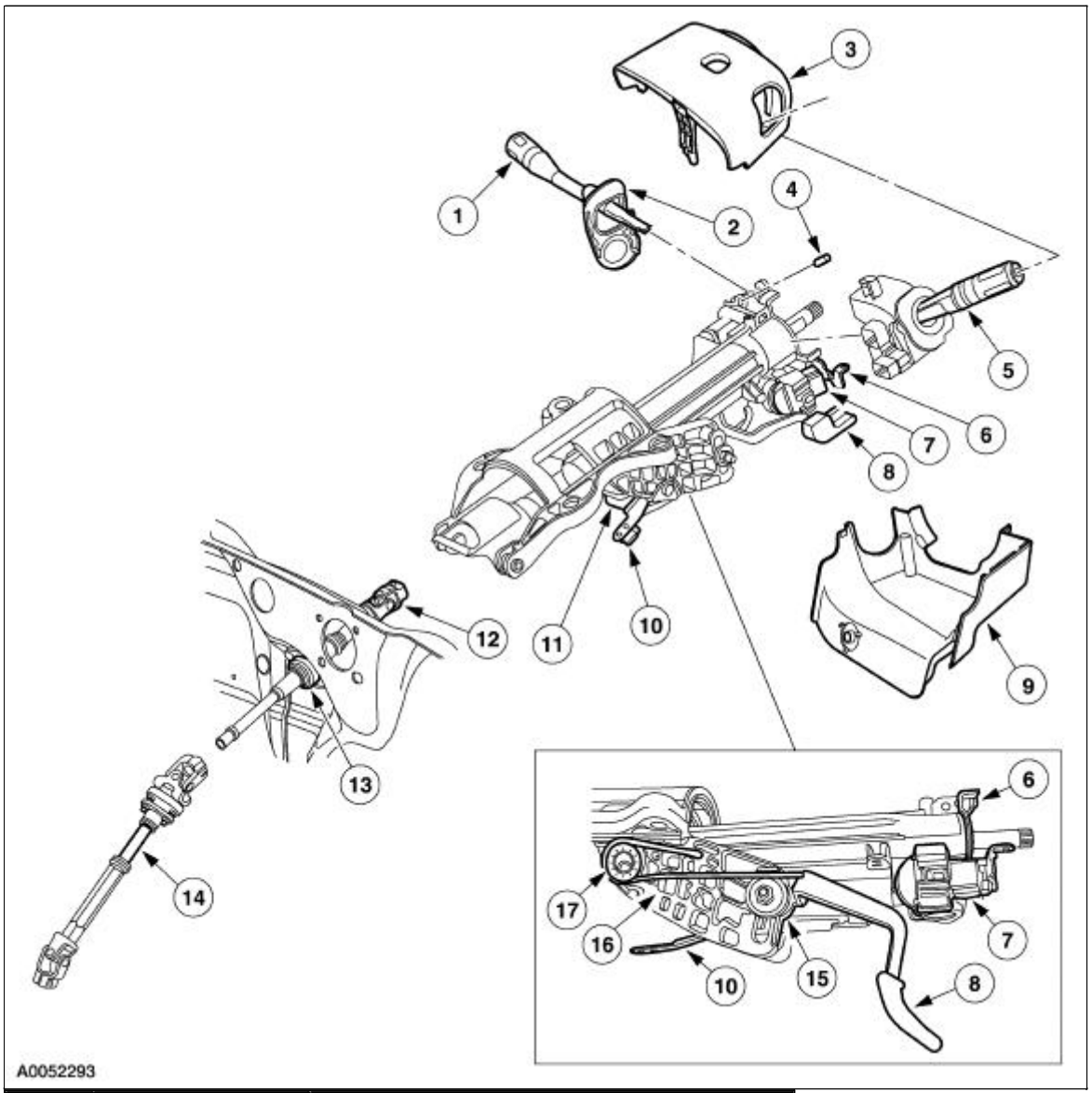
General Specifications

Item	Specification
Lubricants	
Premium Long Life Grease XG-1C	ESA-M1C75-B

Torque Specifications

Description	Nm	lb-ft	lb-in
Steering wheel bolt	40	30	—
Steering column support bracket-to-instrument panel nuts	15	11	—
Clockspring bracket-to-steering column screws	6	—	53
Shift cable bracket bolts	21	15	—
Steering column shaft-to-steering column shaft bolt	30	22	—
Upper steering column shaft-to-lower steering column shaft bolt	48	35	—
Steering column shaft-to-steering gear bolt	30	22	—
Steering column shaft dash seal bolts	12	9	—
Driver air bag module bolts	9	—	80

Steering Column



Item	Part Number	Description
1	7F256	Gearshift lever
2	7N097	Gearshift lever boot
3	3530	Steering column upper shroud
4	3G357	Gearshift lever pin
5	13K359	Multi-function switch
6	3678	Clockspring upper bracket
7	11572	Ignition switch
8	3B661	Tilt lever assembly
9	3530	Steering column lower shroud
10	14A206	Harness retainer bracket

11	7E364	Shift cable bracket
12	3B676	Upper steering column shaft
13	3513	Steering column shaft dash seal
14	3A525	Lower steering column shaft
15	3D672	Steering column clamp retainer
16	3D655	Spring
17	3D686	Spring retainer

For shift interlock service information, refer to Section 307-05 .

For ignition lock cylinder service information, refer to Section 501-14 .

For ignition switch service information, refer to Section 211-05 .

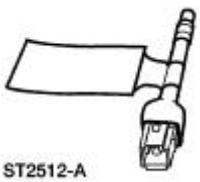
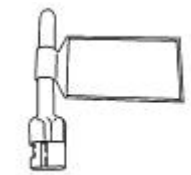
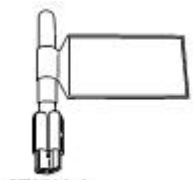
For steering wheel rotation sensor service information, refer to Section 206-09B .

Steering Column

Refer to Section 211-00 .

Supplemental Restraint System (SRS) Deactivation and Reactivation

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (2 req'd) 418-F395 (014-R1079)
 ST2512-A	Diagnostic Tool, Restraint System (1 req'd) 418-F403
 ST2507-A	Diagnostic Tool, Restraint System (2 req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 req'd) 418-F088 (105-R0012)

Deactivation

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Do not set a live air bag module down with the trim cover face down. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an airbag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

WARNING: Never probe the connectors on the safety canopy module. Doing so can result in safety canopy module deployment.

WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

WARNING: Restraint system diagnostic tools are for service only. Tools must be removed prior to operating the vehicle over the road. Failure to remove restraint system diagnostic tools could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side air bag and/or a safety belt pretensioner (if equipped) system is being serviced, **the air bag system must be deactivated.**

NOTE: Restraint system diagnostic tools **MUST** be installed under the seats in the seat side air bag (if equipped) and safety belt pretensioner (if equipped) to floor connectors.

NOTE: Diagnostics or repairs are not to be carried out on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road.**

NOTE: After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

All vehicles

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

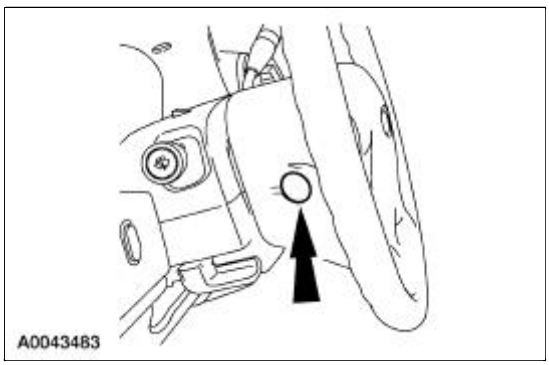
   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

The second row side impact sensors (if equipped) are located at or near the base of the C-pillars.

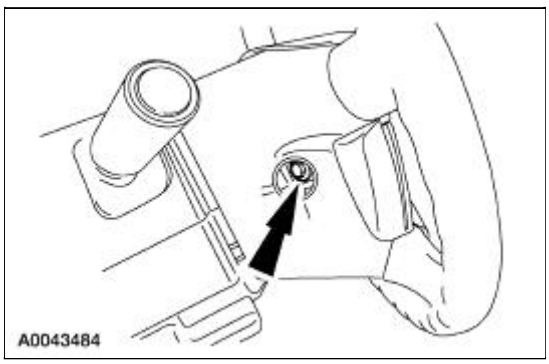
To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

2. Remove the two steering wheel back cover plugs (one shown).

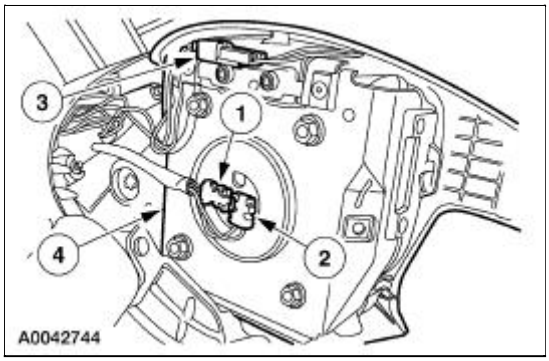


3. Remove the two driver air bag module bolts (one shown).



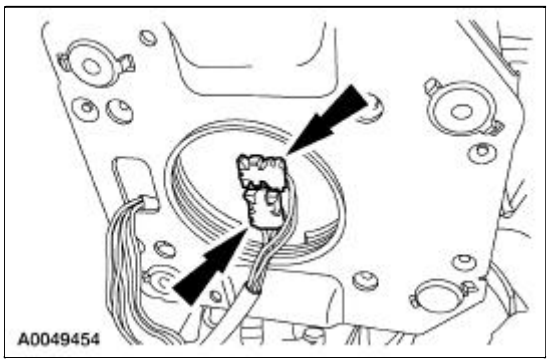
Expedition vehicles

4. Remove the driver air bag module.
    1. Release the two retaining tabs. Disconnect the driver air bag module electrical connector.
        - Label the driver air bag module squib number on the driver air bag module electrical connector before disconnecting.
    2. Release the two retaining tabs. Disconnect the driver air bag module electrical connector.
        - Label the driver air bag module squib number on the driver air bag module electrical connector before disconnecting.
    3. Disconnect the horn switch electrical connector.
    4. Remove the driver air bag module.

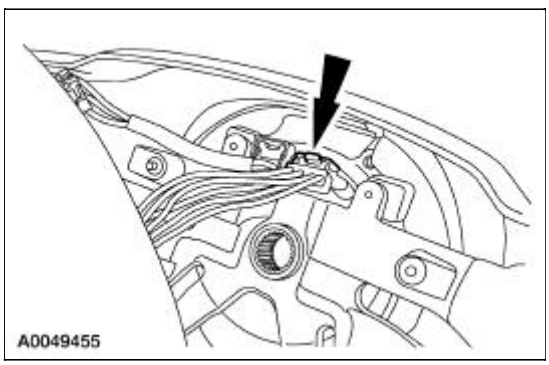


Navigator vehicles

5. Disconnect the driver air bag module
    - Release the two tabs on each driver air bag module electrical connector and disconnect them.
        - Label each driver air bag module electrical connector before disconnecting.

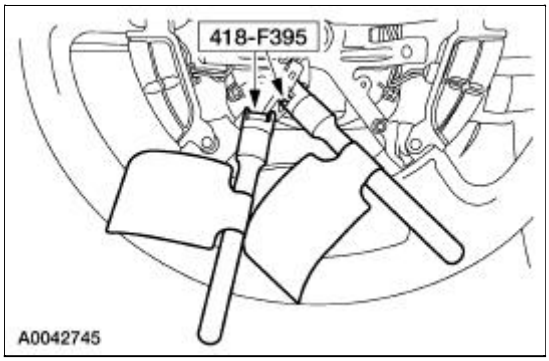


6. Release the tab and disconnect the driver air bag module accessories electrical connector at the top of the clockspring and remove the driver air bag module.

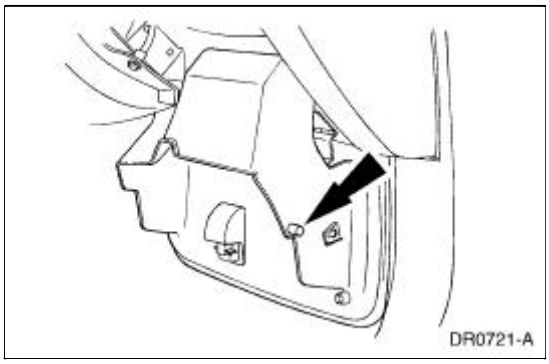


All vehicles

7. Attach the restraint system diagnostic tools to the clockspring electrical connectors at the top of the steering column.

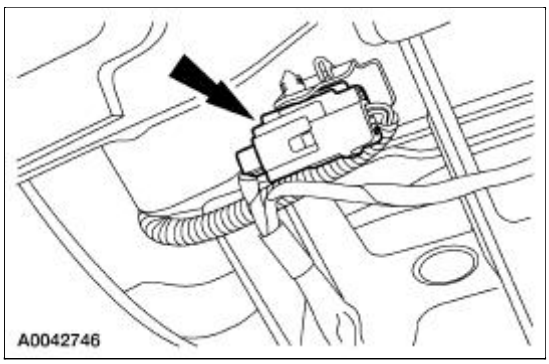


8. While pushing in on the two glove compartment door tabs, position the glove compartment downward.

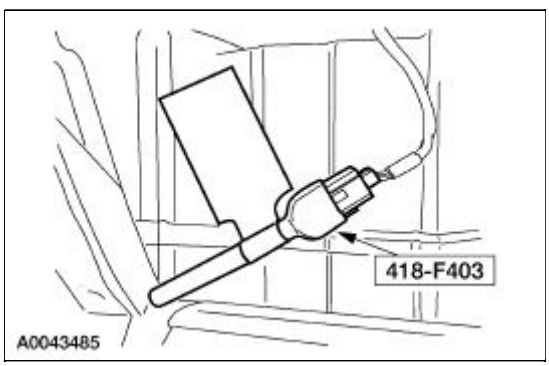


9. **NOTE:** The Expedition is shown, the Navigator is similar.

   Through the glove compartment opening, release the tab and disconnect the passenger air bag module electrical connector.



10. Attach the restraint system diagnostic tool to the vehicle harness side of the passenger air bag module electrical connector.



Vehicles without safety canopies

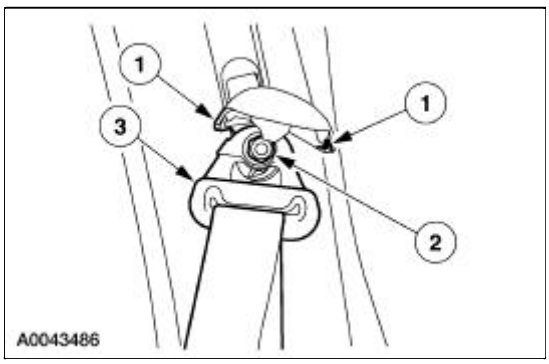
11. **CAUTION: Do not deactivate the safety canopy module circuit by removing the safety canopy bridge resistor from the safety canopy electrical connector.**

    If the safety canopy bridge resistor is removed, an open circuit fault will be generated by the restraints control module (RCM).
    If a restraint system diagnostic tool is installed at the safety canopy electrical connector, a low resistance fault will be generated by the RCM.

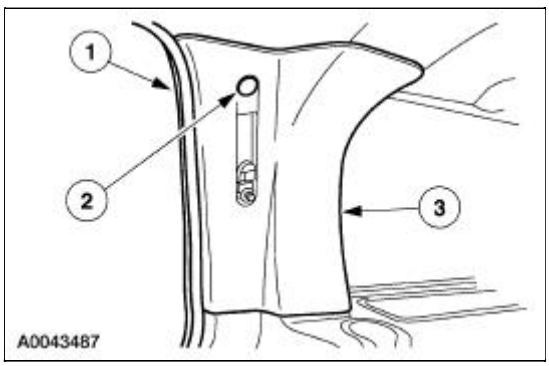
Vehicles with safety canopies

12. **NOTE:** Inspect the shoulder safety belt guide cover for damage. If the shoulder safety belt guide cover is damaged or if it does not remain closed, install a new shoulder safety belt guide cover.

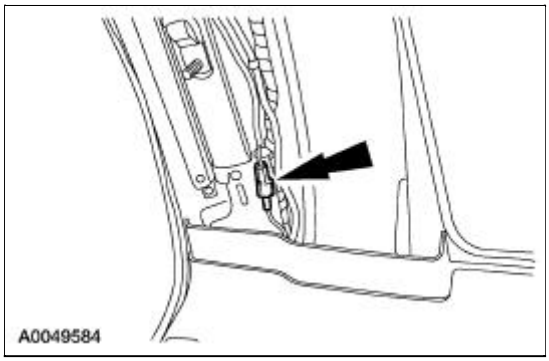
    Remove the second row passenger side safety belt guide.
    1. Release the retaining tab at each side and open the safety belt guide cover.
    2. Remove the nut.
    3. Remove the second row passenger side safety belt guide.



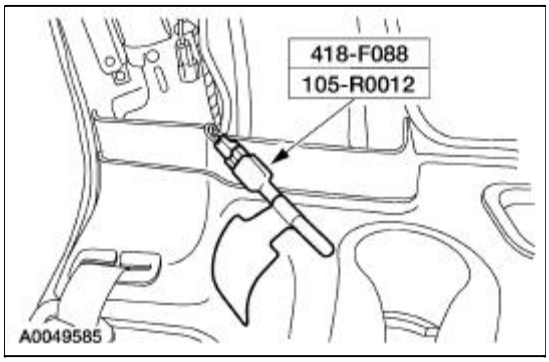
13. Remove the passenger side C-pillar trim panel.
    1. Separate the weather-stripping along the passenger side C-pillar trim panel.
    2. Remove the bolt cover and bolt.
    3. Pull out to release the retainers and remove the passenger side C-pillar trim panel.



14. Disconnect the passenger side safety canopy electrical connector.

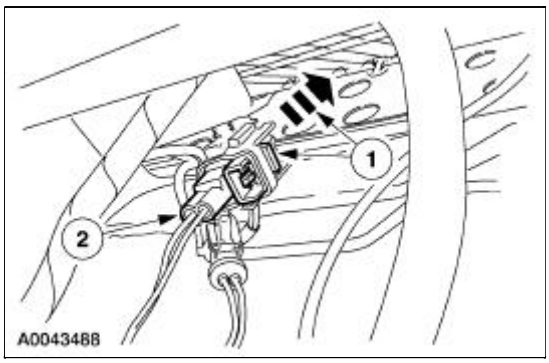


15. Attach the restraint system diagnostic tool to the vehicle harness side of the passenger side safety canopy electrical connector.

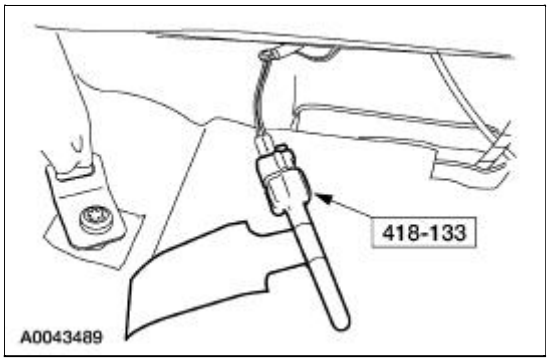


All vehicles

16. Disconnect the passenger seat safety belt buckle pretensioner electrical connector.
    1. Slide and disengage the passenger seat safety belt buckle pretensioner electrical connector locking clip.
    2. Push in to release the tab and disconnect the passenger seat safety belt buckle pretensioner electrical connector.



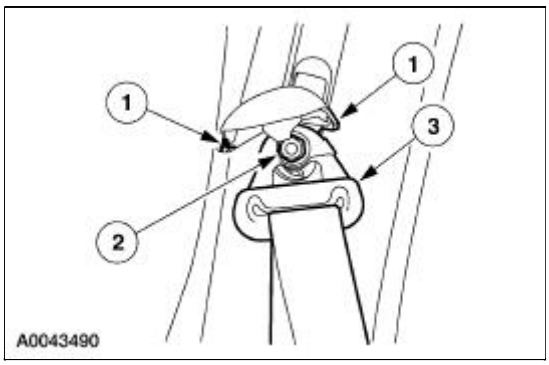
17. Attach the restraint system diagnostic tool to the passenger seat safety belt buckle pretensioner floor electrical connector.



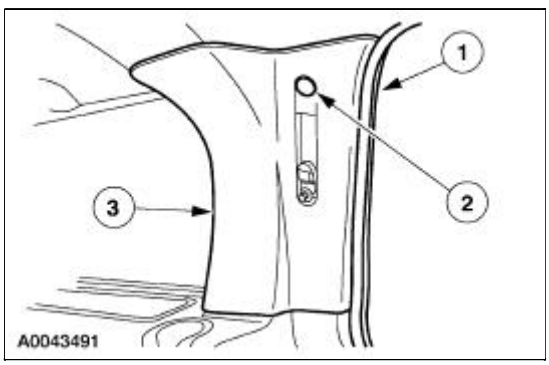
Vehicles with safety canopies

18. **NOTE:** Inspect the shoulder safety belt guide cover for damage. If the shoulder safety belt guide cover is damaged or if it does not remain closed, install a new shoulder safety belt guide cover.

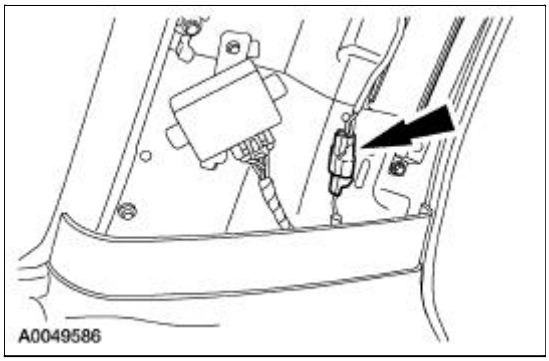
    Remove the second row driver side safety belt guide.
    1. Release the retaining tab at each side and open the safety belt guide cover.
    2. Remove the nut.
    3. Remove the second row driver side safety belt guide.



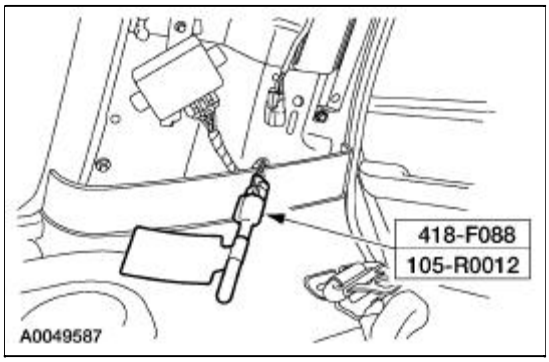
19. Remove the driver side C-pillar trim panel.
    1. Separate the weather-stripping along the driver side C-pillar trim panel.
    2. Remove the bolt cover and bolt.
    3. Pull out to release the retainers and remove the driver side C-pillar trim panel.



20. Disconnect the driver side safety canopy electrical connector.

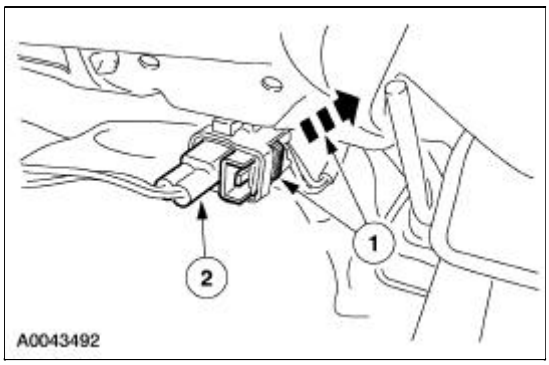


21. Attach the restraint system diagnostic tool to the vehicle harness side of the driver side safety canopy electrical connector.

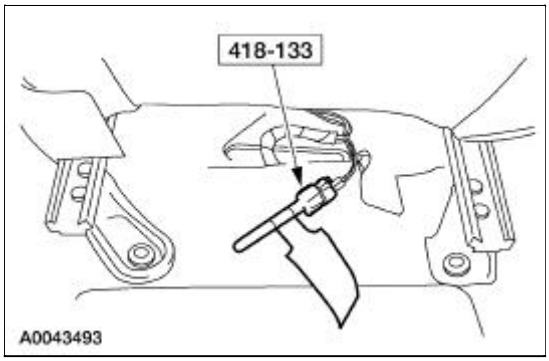


All vehicles

22. Disconnect the driver seat safety belt buckle pretensioner electrical connector.
    1. Slide and disengage the driver seat safety belt buckle pretensioner electrical connector locking clip.
    2. Push in to release the tab and disconnect the driver seat safety belt buckle pretensioner electrical connector.



23. Attach the restraint system diagnostic tool to the driver seat safety belt buckle pretensioner floor electrical connector.



24. Connect the battery ground cable. For additional information, refer to Section 414-01 .

25. With the restraint system diagnostic tools installed at all deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of Section 501-20B .

26. Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

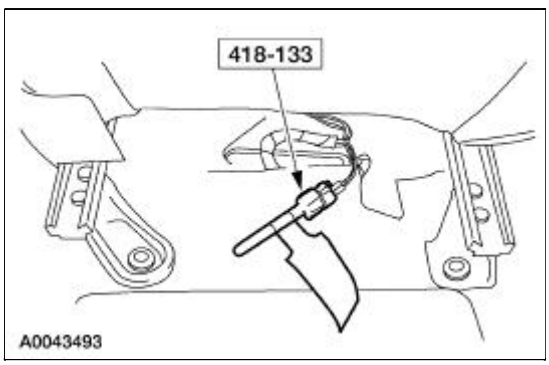
Reactivation

WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the deactivation procedure.

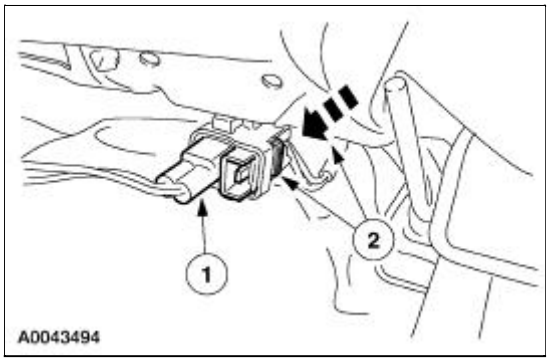
All vehicles

1. **NOTE:** Make sure the battery negative cable is still disconnected before proceeding with the reactivation portion of this procedure.

   Remove the restraint system diagnostic tool from the driver seat safety belt buckle pretensioner floor electrical connector.

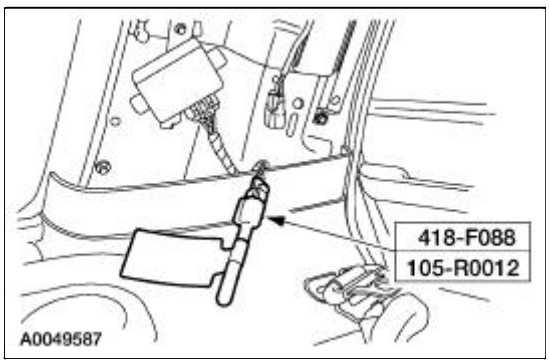


2. Connect the driver seat safety belt buckle pretensioner electrical connector.
   1. Connect the driver seat safety belt buckle pretensioner electrical connector.
   2. Slide and engage the driver seat safety belt buckle pretensioner electrical connector locking clip.

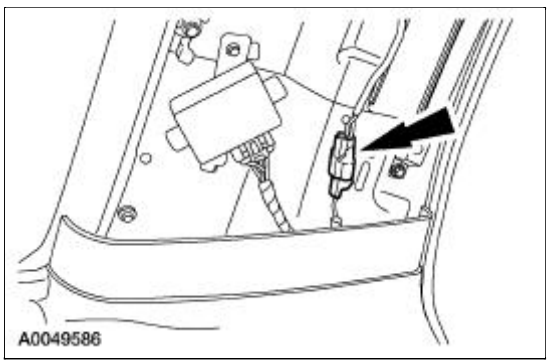


Vehicles with safety canopies

3. Remove the restraint system diagnostic tool from the vehicle harness side of the driver side safety canopy electrical connector.

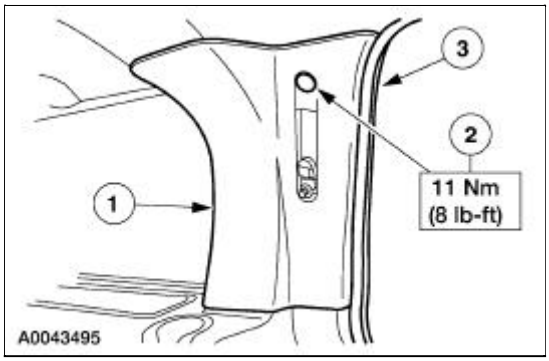


4. Connect the driver side safety canopy electrical connector.



5. **WARNING: Anytime the safety canopy module has deployed, the headliner, and all A, B, and C pillar upper trim panels and attaching hardware must be replaced along with any other damaged components and hardware. Failure to do so may result in personal injury in the event of a safety canopy module deployment.**

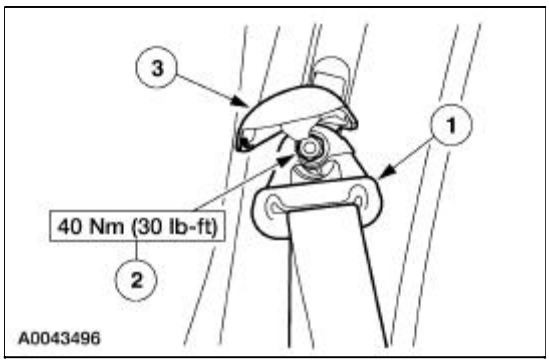
   Install the driver side C-pillar trim panel.
   1. Position the driver side C-pillar trim panel and push in, engaging the retainers.
   2. Install the bolt and bolt cover.
   3. Install the weather-stripping along the driver side C-pillar trim panel.



6. **NOTE:** Inspect the shoulder safety belt guide cover for damage. If the shoulder safety belt guide cover is damaged or if it does not remain closed, install a new shoulder safety belt guide cover.

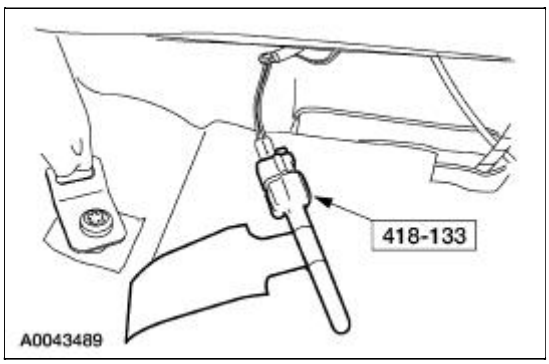
   NOTE: Make sure the safety belt is not twisted prior to installation.

   Install the second row driver side safety belt guide.
   1. Position the second row driver side safety belt guide.
   2. Install the nut.
   3. Close the safety belt guide cover.

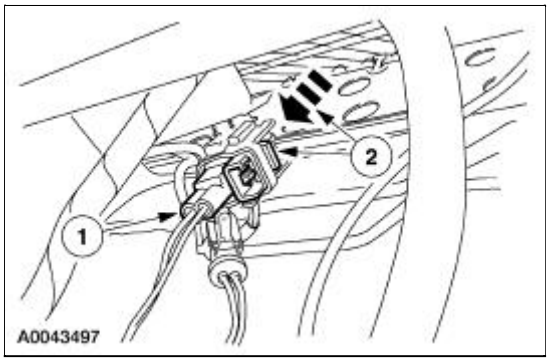


All vehicles

7. Remove the restraint system diagnostic tool from the passenger seat safety belt buckle pretensioner floor electrical connector.

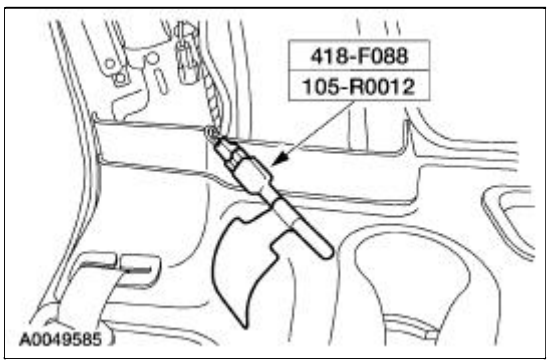


8. Connect the passenger seat safety belt buckle pretensioner electrical connector.
   1. Connect the passenger seat safety belt buckle pretensioner electrical connector.
   2. Slide and engage the passenger seat safety belt buckle pretensioner electrical connector locking clip.

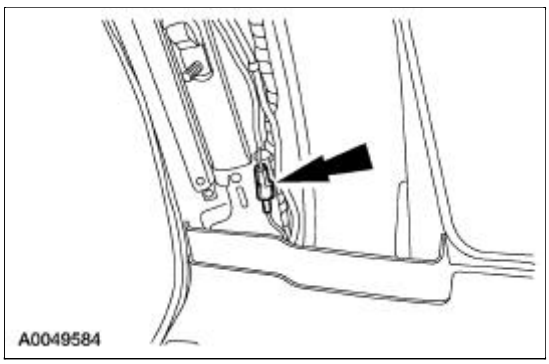


Vehicles with safety canopies

9. Remove the restraint system diagnostic tool from the vehicle harness side of the passenger side safety canopy electrical connector.

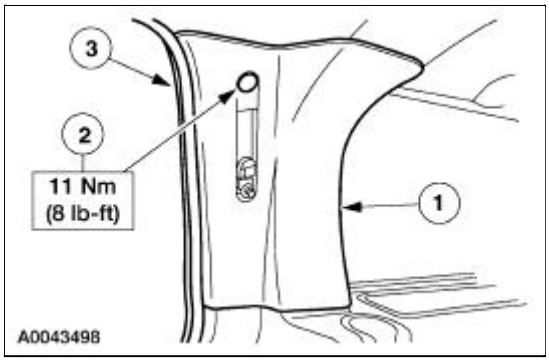


10. Connect the passenger side safety canopy electrical connector.



11. **WARNING: Anytime the safety canopy module has deployed, the headliner, and all A, B, and C pillar upper trim panels and attaching hardware must be replaced along with any other damaged components and hardware. Failure to do so may result in personal injury in the event of a safety canopy module deployment.**

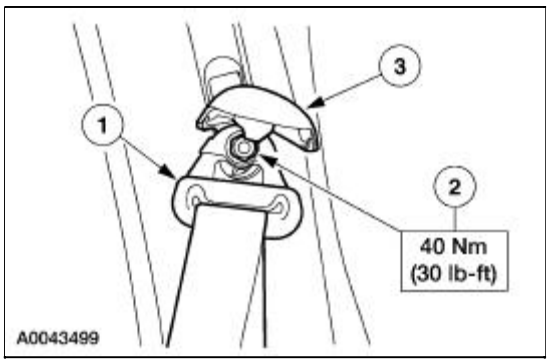
    Install the passenger C-pillar trim panel.
    1. Position the passenger side C-pillar trim panel and push in, engaging the retainers.
    2. Install the bolt and bolt cover.
    3. Install the weather-stripping along the passenger side C-pillar trim panel.



12. **NOTE:** Inspect the shoulder safety belt guide cover for damage. If the shoulder safety belt guide cover is damaged or if it does not remain closed, install a new shoulder safety belt guide cover.

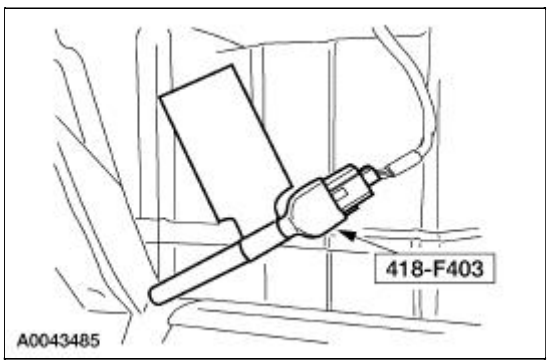
    NOTE: Make sure the safety belt is not twisted prior to installation.

    Install the second row passenger side safety belt guide.
    1. Position the second row passenger side safety belt guide.
    2. Install the nut.
    3. Close the safety belt guide cover.



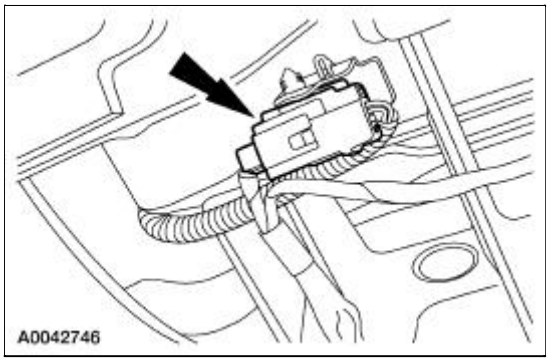
All vehicles

13. Remove the restraint system diagnostic tool from the vehicle harness side of the passenger air bag module electrical connector.



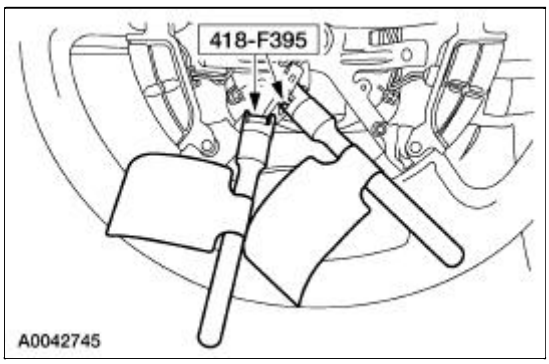
14. **NOTE:** The Expedition is shown, the Navigator is similar.

    Connect the passenger air bag module electrical connector.



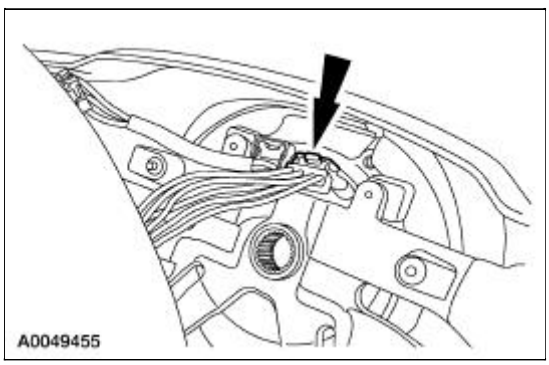
15. Close the glove compartment.

16. Remove the restraint system diagnostic tools from the clockspring electrical connector at the top of the steering column.



Navigator vehicles

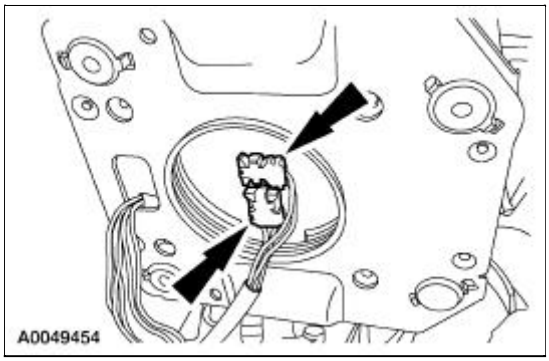
17. Connect the driver air bag module accessories electrical connector to the connector end at the top of the clockspring.



18. **CAUTION: The clockspring electrical connectors are unique and cannot be reversed when connected to the driver air bag module. Match the electrical connector key to the keyway in the driver air bag module. Do not force the electrical connectors into the driver air bag module.**

    Connect the driver air bag module electrical connectors as noted during removal.

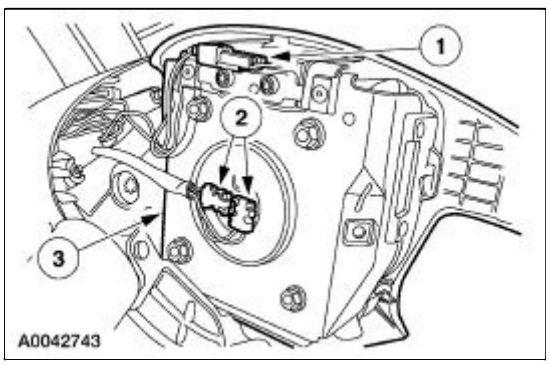
    - Position the driver air bag module to the steering wheel.



Expedition vehicles

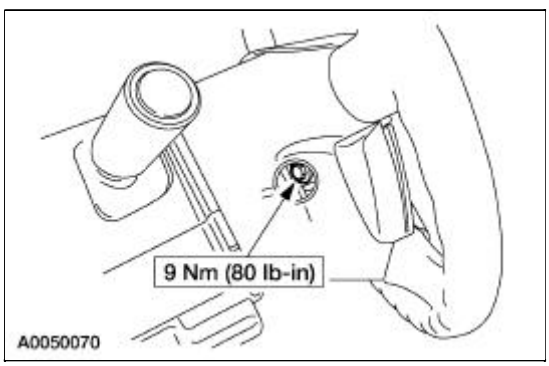
19. Position the driver air bag module to the steering wheel.
    1. Connect the horn switch electrical connector.
    2. **CAUTION: The clockspring electrical connectors are unique and cannot be reversed when connected to the driver air bag module. Match the electrical connector key to the keyway in the driver air bag module. Do not force the electrical connectors into the driver air bag module.**

       Connect the driver air bag module electrical connectors as noted during removal.
    3. Position the driver air bag module to the steering wheel.

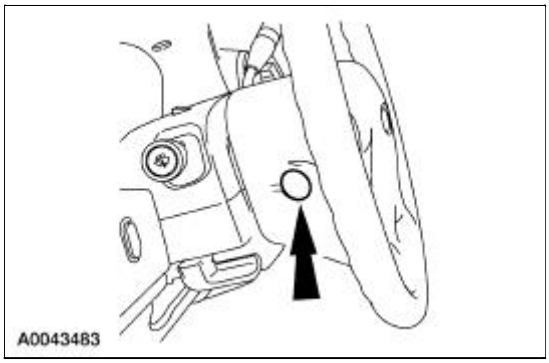


All vehicles

20. Install the two driver air bag module bolts (one shown).



21. Install the two steering wheel back cover plugs (one shown).



22. Connect the battery ground cable. For additional information, refer to Section 414-01 .

23. **WARNING: Restraint system diagnostic tools are for service only. Tools must be removed prior to operating the vehicle over the road. Failure to remove restraint system diagnostic tools could result in injury and possible violation of vehicle safety standards.**

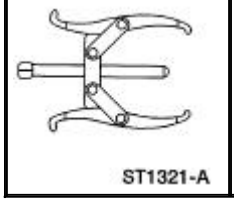
    With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of Section 501-20B .

Vehicles with safety canopies

24. Check the active restraint system for correct operation. For additional information, refer to Section 501-20A .

Steering Wheel

Special Tool(s)

 ST1321-A	Remover, Differential Bearing 205-116 (T77F-4220-B1)

Removal and Installation

1. Turn the steering wheel to the straight ahead position and turn the ignition switch to the OFF position.

2. Disconnect the battery ground cable (14301) and wait at least one minute to allow depletion of the restraint system backup power supply. For additional information, refer to Section 414-01 .

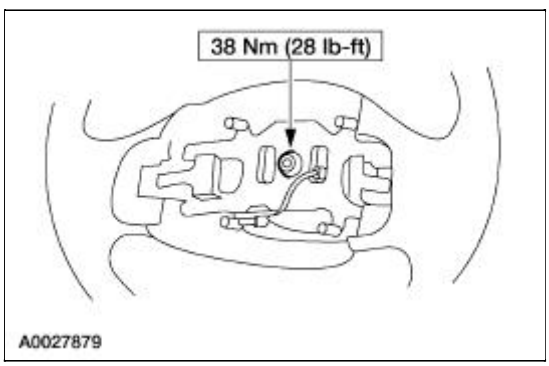
3. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions and notes in the deactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

4. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, notes and instructions in the driver air bag removal and installation procedure.**

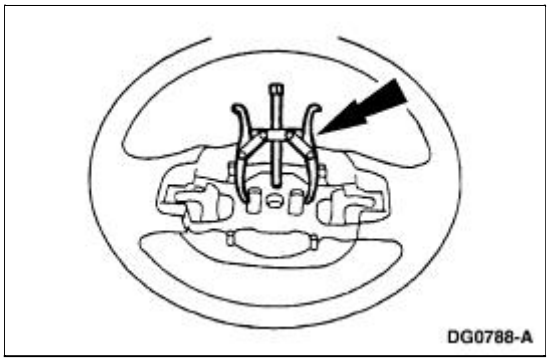
   Remove the driver side air bag module (043B13). For additional information, refer to Section 501-20B .

5. Remove the steering wheel bolt.



6. **CAUTION: Removing the steering wheel without using a puller can damage the column bearings.**

   Use the Differential Side Bearing Puller to remove the steering wheel (3600).



7. To install, reverse the removal procedure.

8. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions and notes in the reactivation procedure.**

   Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

Steering Column

Removal and Installation

All vehicles

1. Disconnect the battery ground cable and wait at least one minute to allow for the depletion of the supplemental restraint system (SRS) backup power supply. For additional information, refer to Section 414-01 .

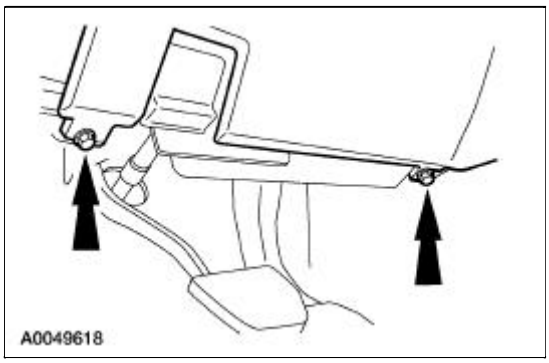
2. **WARNING: To avoid the risk of serious personal injury, follow all warnings, cautions, notes and instructions in the supplemental restraint system (SRS) deactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

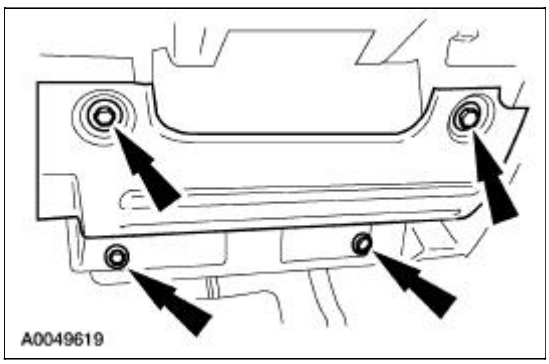
3. **WARNING: To avoid the risk of serious personal injury, follow all warnings, cautions, notes and instructions in the clockspring removal and installation procedure.**

   Remove the clockspring. For additional information, refer to Section 501-20B .

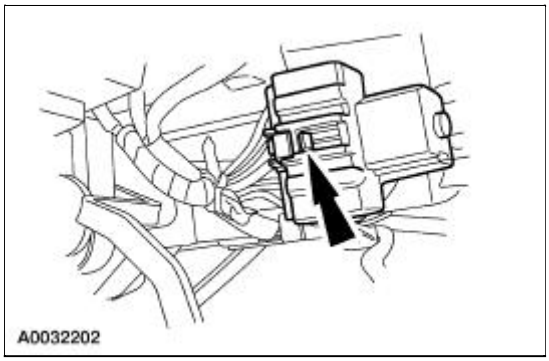
4. Remove the screws and the instrument panel steering column cover.



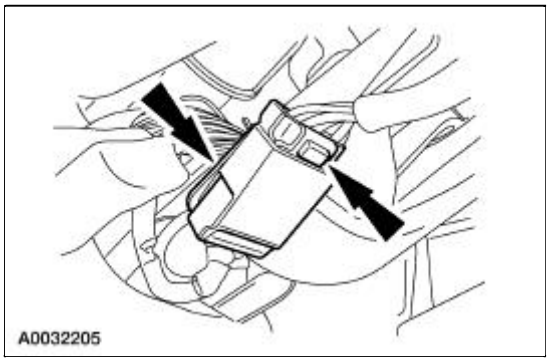
5. Remove the screws and the steering column cover reinforcement.



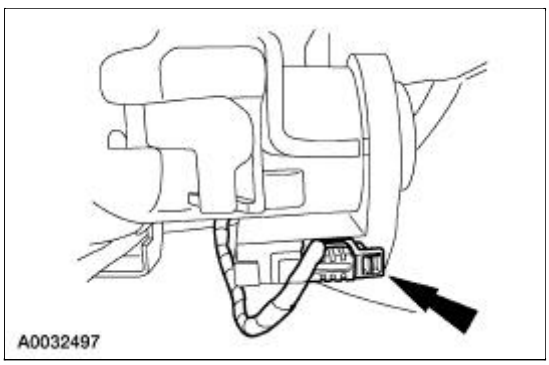
6. Disconnect the ignition switch electrical connector.



7. Disconnect the electrical connector and detach the push pin from the column.

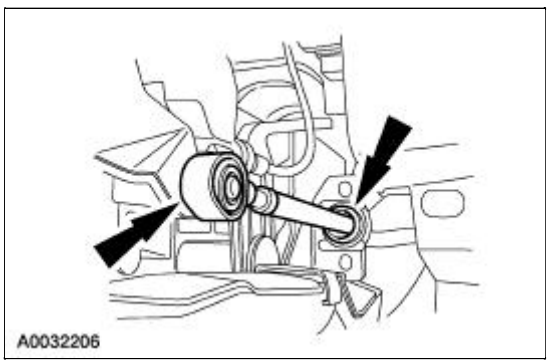


8. Disconnect the PATS transceiver electrical connector.

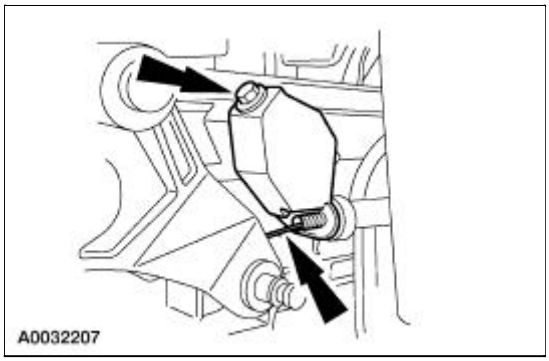


Vehicles with column shift

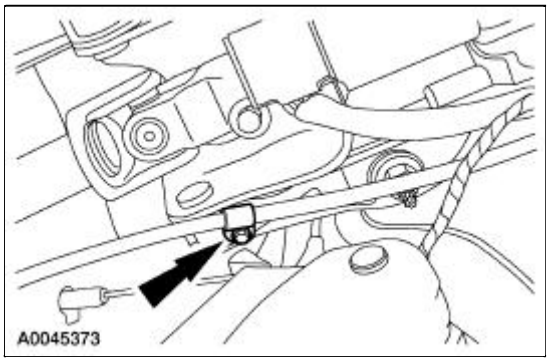
9. Detach the shift cable from the column and the bracket.



10. Remove the bolt and disconnect the transmission range indicator cable.

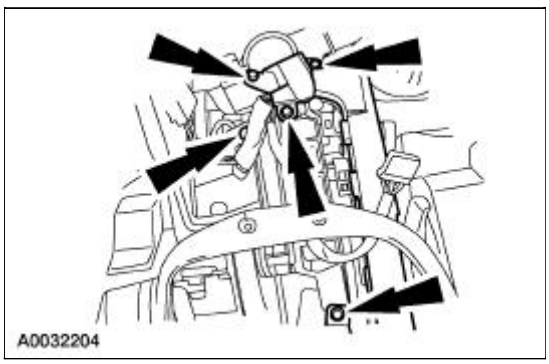


11. Remove the screw.

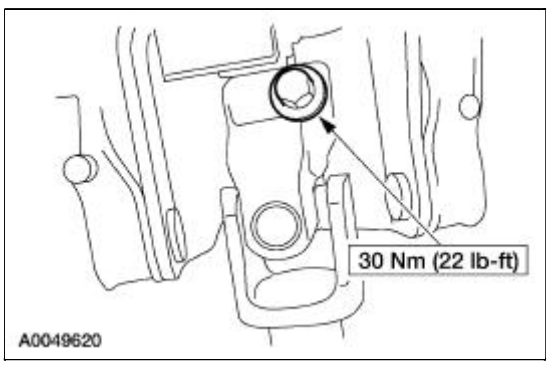


All vehicles

12. Remove the screws and detach the conduit from the column.

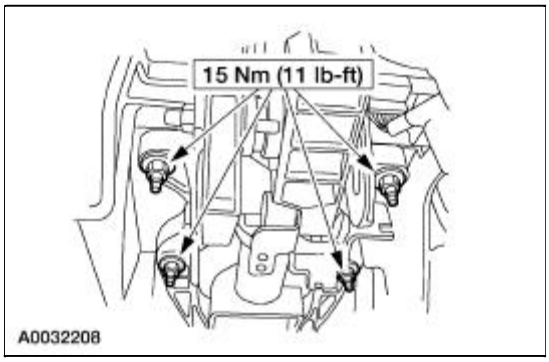


13. Remove the bolt and detach the intermediate shaft from the column.
    - Discard the bolt.



14. Remove the nuts and the steering column.

- Discard the nuts.



15. **CAUTION: Make sure that the column support is flush with the instrument panel before tightening the nuts.**

    To install, reverse the removal procedure.

16. **WARNING: To avoid the risk of serious personal injury, follow all warnings, cautions, notes and instructions in the supplemental restraint system (SRS) reactivation procedure.**

    Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

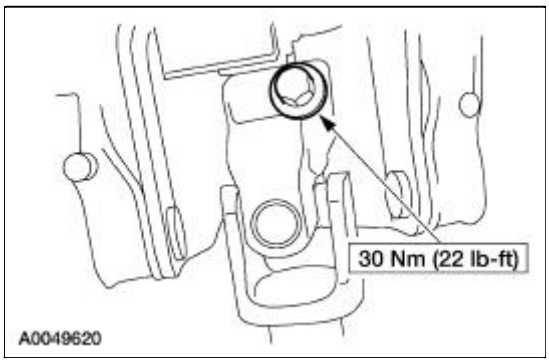
Steering Column Shaft

Removal and Installation

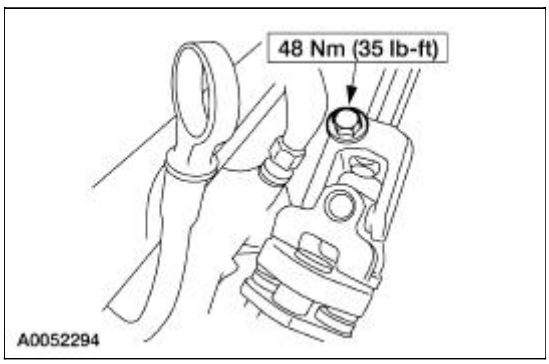
All vehicles

1. **CAUTION: Do not allow the steering column shaft to rotate while the intermediate shaft is disconnected or damage to the clockspring can result. If there is evidence that the shaft has rotated, the clockspring must be removed and recentered. For additional information, refer to Section 501-20B**

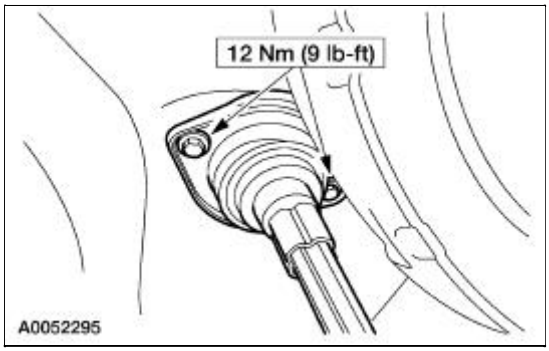
   Remove the bolt and disconnect the intermediate shaft from the steering column.
   - Discard the bolt.



2. Remove the bolt and disconnect the upper intermediate shaft from the lower intermediate shaft.
   - Discard the bolt.



3. Remove the bolts, dash seal and the upper intermediate shaft.

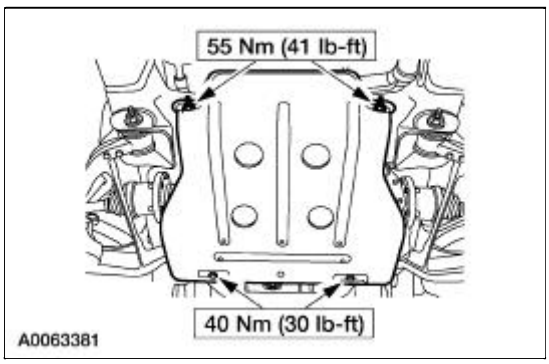


Navigator 4x4 vehicles

4. Remove the cooling fan and shroud. For additional information, refer to Section 303-03 .

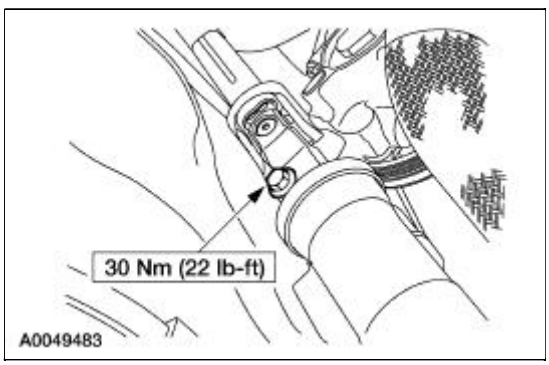
All vehicles except Navigator 4x4

5. Raise and support the vehicle. For additional information, refer to Section 100-02 .
6. If equipped, remove the skid plate.



All vehicles

7. Remove the bolt and the lower intermediate shaft.
   - Discard the bolt.



8. To install, reverse the removal procedure.

Steering Column

Material

Item	Specification
Premium Long Life Grease XG-1-C	ESA-M1C75-B

Disassembly

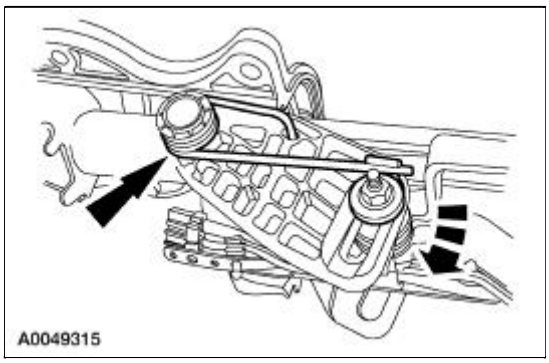
NOTE: For shift interlock service information, refer to Section 307-05 .

1. **WARNING: To avoid the risk of serious personal injury, follow all warnings, cautions, notes and instructions in the steering column removal procedure.**

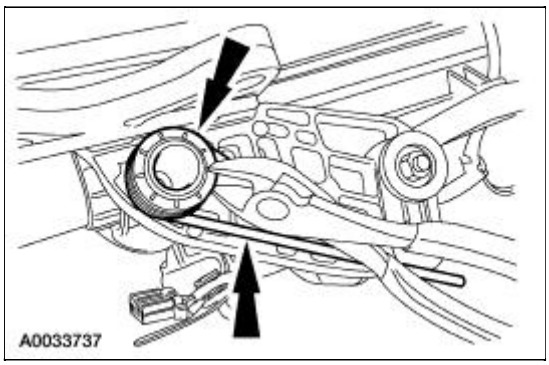
   Remove the steering column. For additional information. refer to Steering Column in this section.

2. **NOTE:** To ease the removal of the spring, make sure that the column tilt assembly is in the upward position.

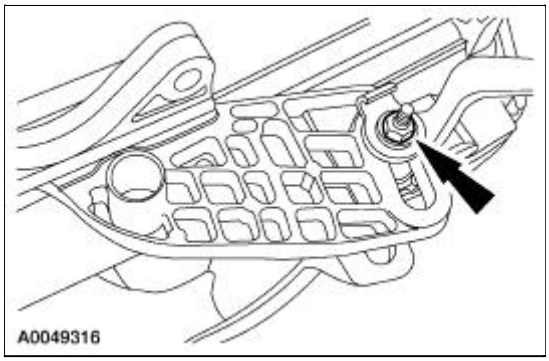
   Pull downward on the spring and release the spring tension, and route the spring above the spring hanger.



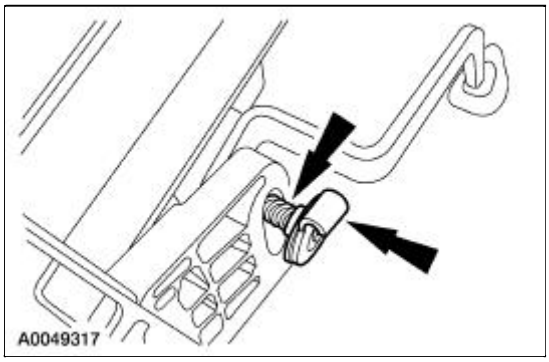
3. Cut the spring retainer and remove the spring.



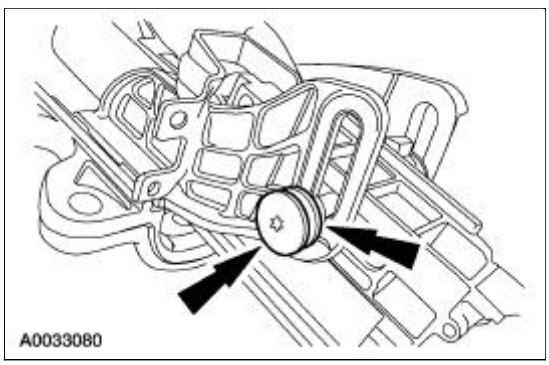
4. Remove the nut.



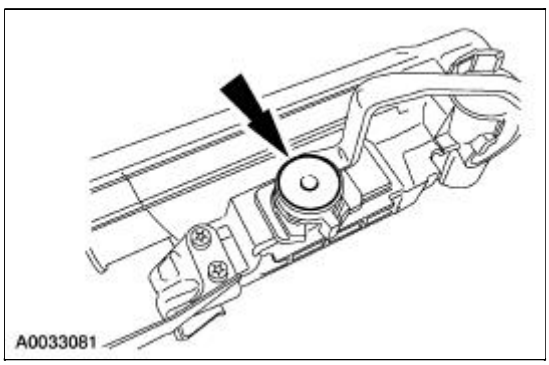
5. Remove the spring hanger, sleeve washer and spring.



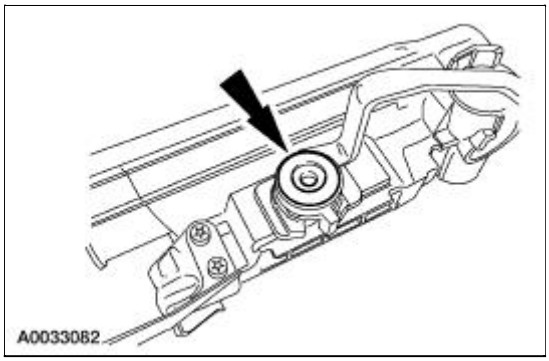
6. Remove the bolt and sleeve washer, and pivot the steering column mounting bracket upward.



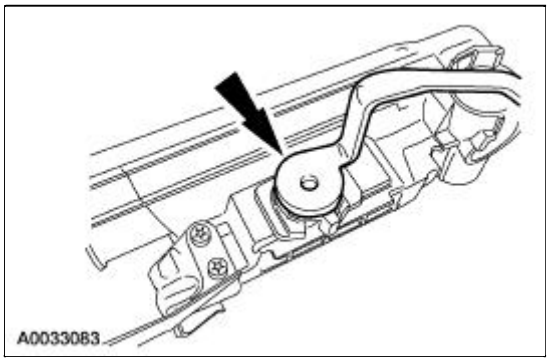
7. Remove the washer.



8. Remove the bearing.

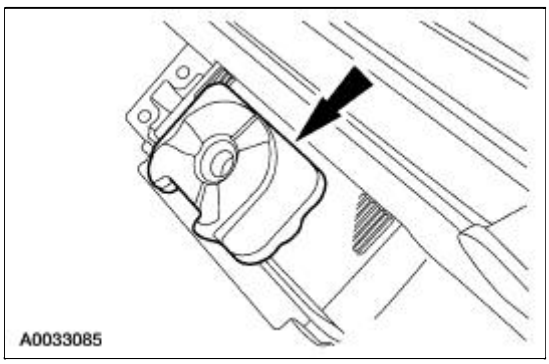


9. Remove the tilt lever.



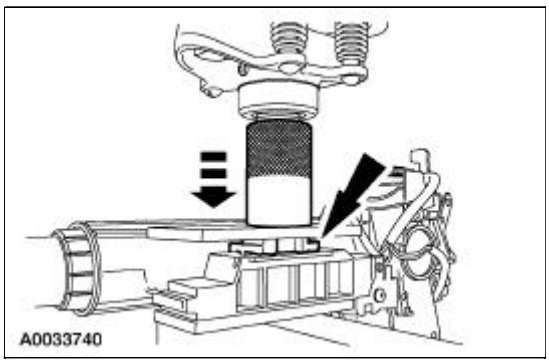
10. **CAUTION: Do not use a screwdriver to separate the clamp retainer or damage can result.**

    Turn the column over and use a suitable punch to remove the steering column clamp retainer.

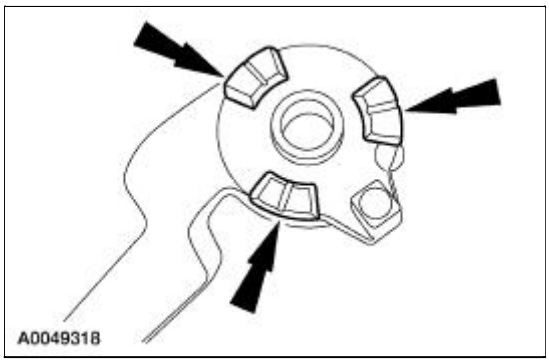


Assembly

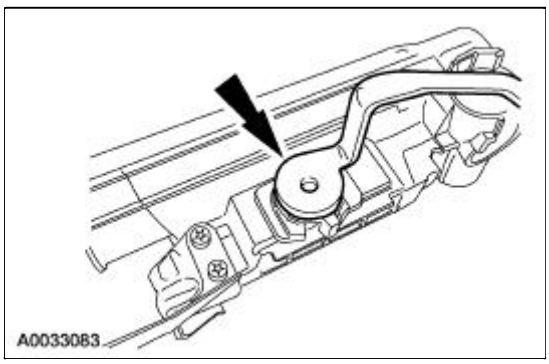
1. Using a suitable press and protective adapters, install the clamp retainer.



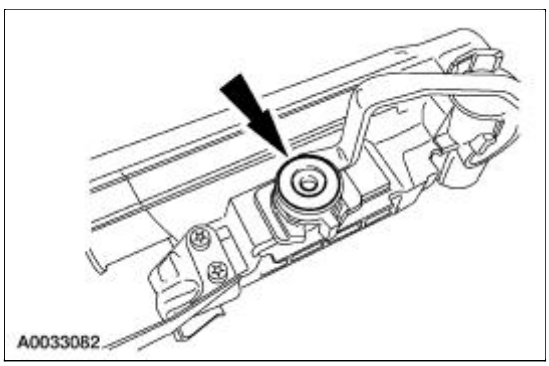
2. Apply a small amount of grease to the tilt lever cam mating surface, making sure to fill the grooves.



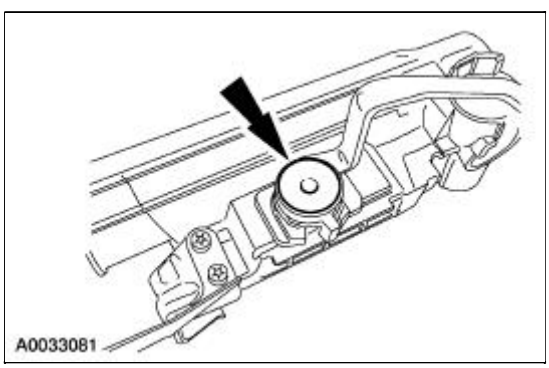
3. Install the tilt lever.



4. Install the bearing.

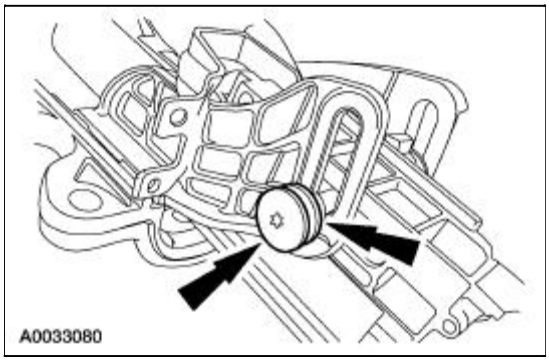


5. Install the washer.

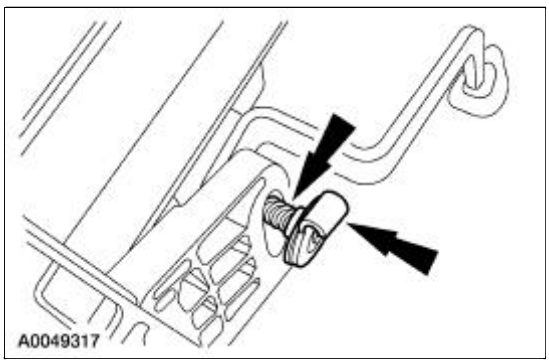


6. While holding the tilt lever, pivot the steering column mounting bracket downward and install the

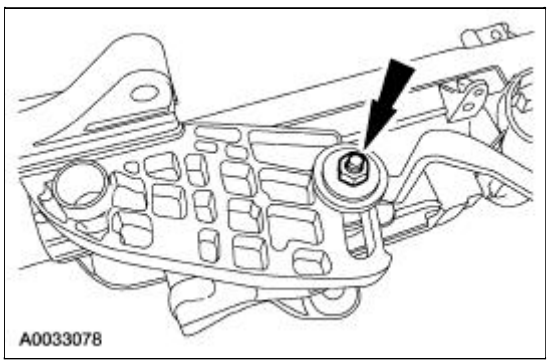
bolt and sleeve washer.



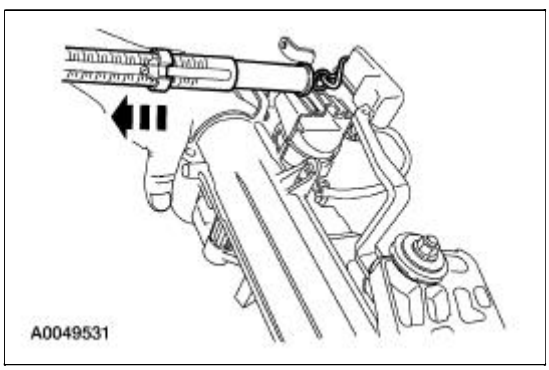
7. Install the spring, sleeve washer and the spring hanger.



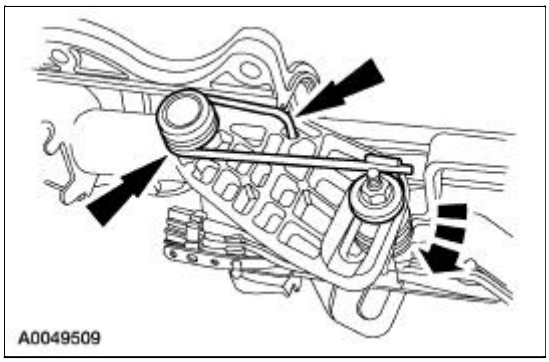
8. Install and snug the nut.



9. Attach a suitable spring scale with a capacity of 30 pounds to the end of the tilt lever and pull the lever into the locked position. Tighten or loosen the nut until 12-16 pounds is required to lock the lever.

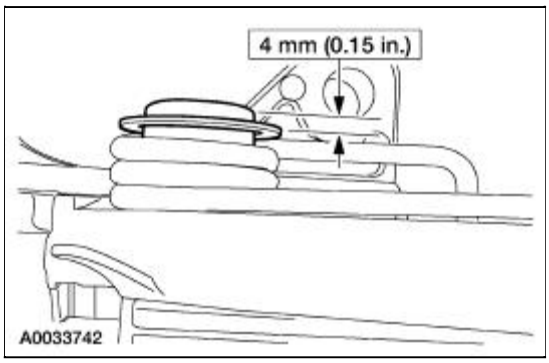


10. Insert the short end of the spring into the bracket and while holding it in place, position the long end of the spring under the spring hanger.



11. **CAUTION: Make sure that the retainer is 4 mm (0.16 in) from top of the post or damage can result.**

    Install the spring retainer.



12. **WARNING: To avoid the risk of serious personal injury, follow all warnings, cautions, notes and instructions in the steering column installation procedure.**

    Install the steering column. For additional information, refer to Steering Column in this section.

Steering Column Switches

The steering column switches consist of the following:

- multifunction switch which controls the:
  - turn signal
  - hazard flasher
  - windshield wiper/washer
  - rear wiper/washer
  - headlamp dimmer/flash-to-pass
- ignition switch

Steering Column Switches

Refer to Wiring Diagrams Cell 13 for schematic and connector information.

Refer to Wiring Diagrams Cell 81 for schematic and connector information.

Refer to Wiring Diagrams Cell 92 for schematic and connector information.

Refer to Wiring Diagrams Cell 90 for schematic and connector information.

Refer to Wiring Diagrams Cell 149 for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418–F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool

Inspection and Verification

1. Verify the customer concern by operating the multifunction switch or ignition switch.
2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
● Multifunction switch ● Ignition switch ● Key efforts	● Central junction box (CJB) fuse(s): ■ 1 (10A) ■ 7 (10A) ■ 13 (10A) ■ 14 (10A) ■ 15 (10A) ■ 16 (10A) ■ 18 (10A) ■ 19 (10A) ■ 27 (1A) ■ 28 (10A)

	■ 29 (10A) ■ 101 (30A) ■ 102 (30A) ● Circuitry ● Instrument cluster ● Passive anti-theft system (PATS) module ● Wiring harness

3. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If diagnostic tool does not communicate with the vehicle:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.
4. If diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool manual.
5. Carry out the DATA LINK DIAGNOSTICS TEST. If the diagnostic tool responds with:
   - CKT914, CKT91 or CKT693 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for INSTRUMENT CLUSTER, go to Section 413-01 .
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs, and carry out the self-test diagnostics for the instrument cluster.
6. If the DTCs retrieved are related to the concern, go to the Instrument Cluster Diagnostic Trouble Code (DTC) Index to continue diagnostics.
7. If no DTCs related to the concern are retrieved, proceed to the Symptom Chart to continue diagnostics.

Ignition Switch Mechanical Check

Test the mechanical operation of the ignition switch by rotating the lock cylinder through all switch positions. The movement should not stick or bind and should return from the START position back to the ON position without assistance (spring return). If sticking or binding is encountered, check for the following:

- burrs on the lock cylinder key
- insufficient lube on the lock cylinder
- bent or damaged the ignition rod
- object rubbing against the ignition rod
- excessive rubbing of the actuator against the transmission shift socket
- binding lock cylinder
- shroud rubbing the against lock cylinder
- burrs or foreign material around the rack and pinion actuator in the lock cylinder housing
- insufficient lube on the actuator (Do not apply lubricant to the inside of the ignition switch.)
- binding ignition switch

If the steering wheel lock is engaged with the wheels loaded against a curb, high effort will be necessary to turn the key from LOCK. Turn the steering wheel to either side of the lock to unload the

system.

Instrument Cluster Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1352	Ignition Key-In Circuit Failure	Instrument cluster	REFER to Section 419-01 .
B1360	Ignition Run/Acc Circuit Open	Instrument cluster	Go To Pinpoint Test B .
—	All Other DTCs	Instrument cluster	REFER to Section 419-10 .

Symptom Chart

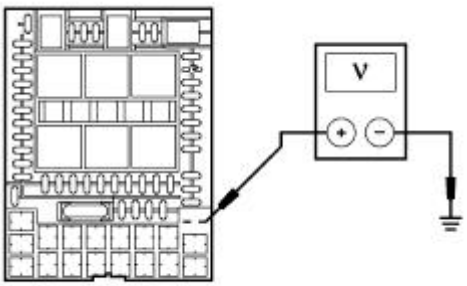
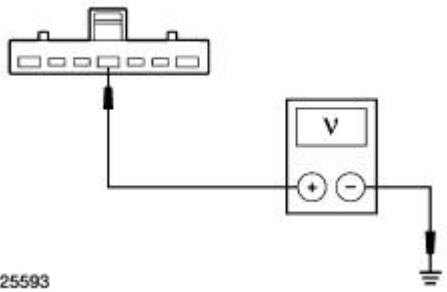
Symptom Chart

Condition	Possible Sources	Action
● The ignition switch is inoperative	● Central junction box (CJB) fuse: ■ 101 (30A). ■ 102 (30A). ● Ignition switch. ● Circuitry.	● Go To Pinpoint Test A .
● No power in ACC	● Central junction box (CJB) fuse 1 (10A). ● Ignition switch. ● Circuitry.	● Go To Pinpoint Test B .
● No power in RUN	● Central junction box (CJB) fuse: ■ 1 (10A). ■ 7 (7.5A). ■ 13 (10A). ■ 14 (10A). ■ 15 (5A). ■ 16 (10A). ■ 18 (10A). ■ 19 (10A). ■ 27 (5A). ■ 28 (5A). ■ 101 (30A). ■ 102 (30A). ● Ignition switch. ● Circuitry.	● Go To Pinpoint Test C .
● No power in START	● Central junction box (CJB) fuse(s): ■ 101 (30A). ■ 102 (30A). ● Ignition switch. ● Circuitry.	● Go To Pinpoint Test D .
● The multifunction switch/hazard switch does not operate correctly	● Multifunction switch.	● CARRY OUT the Multifunction Switch Continuity Test for electrical diagnosis. Refer to Wiring

		Diagrams Cell 149 for schematic and connector information.

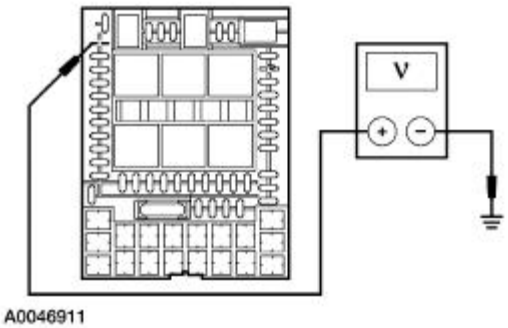
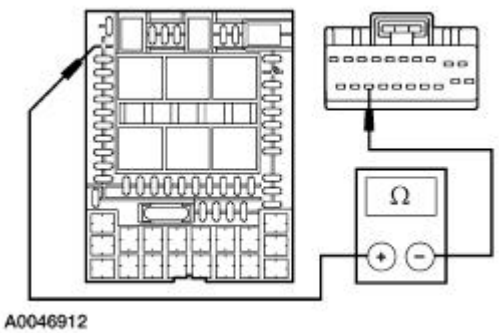
Pinpoint Tests

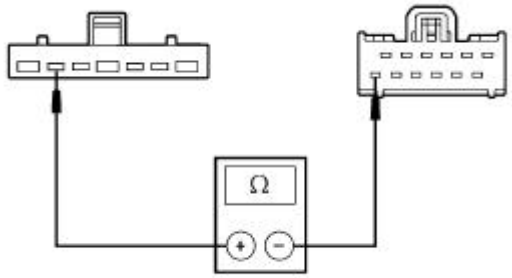
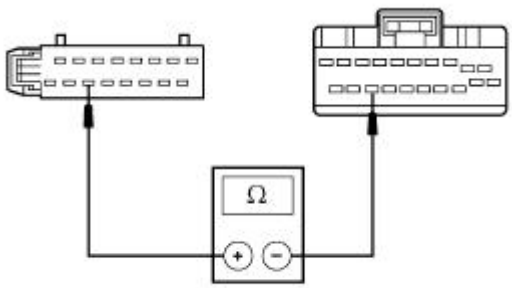
PINPOINT TEST A: THE IGNITION SWITCH IS INOPERATIVE

Test Step	Result / Action to Take
A1 CHECK FOR VOLTAGE AT CENTRAL JUNCTION BOX (CJB) FUSE 102 (30A)	
• Disconnect: CJB Fuse 102 (30A). • Measure the voltage between the CJB fuse 102, input side and ground.  A0046910 • **Is the voltage greater than 10 volts?**	**Yes** GO to A2 . **No** INSTALL a new CJB. TEST the system for normal operation.
A2 CHECK CIRCUIT 1050 (LG/VT) FOR AN OPEN	
• Disconnect: Ignition Switch C250. • Measure the voltage between the ignition switch C250 pin 4, circuit 1050 (LG/VT), harness side and ground.  A0025593 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new ignition switch. REFER to Ignition Switch in this section. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.

PINPOINT TEST B: NO POWER IN ACC

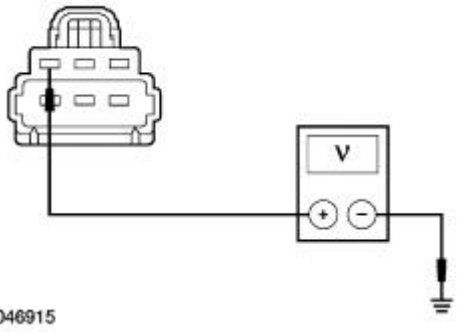
Test Step	Result / Action to Take
B1 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCS)	
• Carry out the on-demand self-test for the instrument cluster. • **Is DTC B1360 recorded from the instrument cluster module?**	**Yes** GO to B3 . **No**

	GO to B2 .
B2 CHECK THE IGNITION SWITCH PIDS ● Key in ACCESSORY position. ● Monitor the instrument cluster IGN_A and the instrument cluster IGN A/R PIDs. ● **Do any of the instrument cluster PIDs indicate NO?**	**Yes** GO to B3 . **No** GO to B8 .
B3 CHECK FOR VOLTAGE AT CENTRAL JUNCTION BOX (CJB) FUSE 1 (10A) ● Key in OFF position. ● Disconnect: CJB Fuse 1 (10A). ● Key in ACCESSORY position. ● Measure the voltage between the CJB fuse 1 (10A) input side, circuit 297 (BK/LG) and ground.  A0046911 ● **Is the voltage greater than 10 volts?**	**Yes** GO to B5 . **No** GO to B4 .
B4 CHECK THE IGNITION SWITCH ● Carry out the ignition switch component test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. ● **Is the ignition switch OK?**	**Yes** GO to B6 . **No** INSTALL a new ignition switch. REFER to Ignition Switch in this section. TEST the system for normal operation.
B5 CHECK CIRCUIT 295 (LB/PK) FOR AN OPEN ● Key in OFF position. ● Disconnect: Instrument Cluster C220a. ● Measure the resistance between the instrument cluster C220a pin 18, circuit 1002 (BK/PK), harness side and the CJB fuse 1, circuit 1002 (BK/PK), output side.  A0046912 ● **Is the resistance less than 5 ohms?**	**Yes** GO to B8 . **No** GO to B7 .
B6 CHECK THE CIRCUIT 297 (BK/LG) FOR AN OPEN ● Key in OFF position.	**Yes**

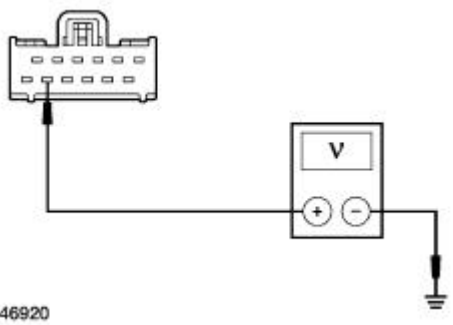
• Disconnect: CJB C270h. • Disconnect: Ignition Switch C250. • Measure the resistance between the ignition switch C250 pin 6, circuit 297 (BK/LG), harness side and the CJB C270h pin 12, circuit 297 (BK/LG), harness side.  A0046913 • **Is the resistance less than 5 ohms?**	INSTALL a new CJB. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
B7 CHECK THE CJB • Key in OFF position. • Disconnect: CJB C270j. • Measure the resistance between the instrument cluster C220a pin 18, circuit 1002 (BK/PK), harness side and the CJB C270j pin 5, circuit 1002 (BK/PK), harness side.  A0046914 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new CJB. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
B8 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION • Key in OFF position. • Disconnect all instrument cluster connectors. • Check for: • corrosion • pushed-out pins • Connect all instrument cluster connectors and make sure they are seated correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Section 419-10 . REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST C: NO POWER IN RUN

Test Step	Result / Action to Take
C1 CHECK CIRCUIT 964 (DB/LG) FOR VOLTAGE	

• Key in OFF position. • Disconnect: CJB C270g. • Key in ON position. • Measure the voltage between the CJB C270g pin 3, circuit 964 (DB/LG), harness side and ground.  A0046915 • **Is the voltage greater than 10 volts?**	**Yes** GO to C2 . **No** REPAIR or INSTALL a new CJB as necessary. TEST the system for normal operation.
C2 CHECK THE IGNITION SWITCH	
• CARRY OUT the ignition switch continuity check. Refer to Wiring Diagrams Cell 149 for schematic and connector information. • **Does the ignition switch test OK?**	**Yes** REPAIR circuit 964 (DB/LG) between ignition switch and CJB. TEST the system for normal operation. **No** INSTALL a new ignition switch; REFER to Ignition Switch in this section. TEST the system for normal operation.

PINPOINT TEST D: NO POWER IN START

Test Step	Result / Action to Take
D1 CHECK CIRCUIT 32 (RD/LB) FOR VOLTAGE	
• Key in OFF position. • Disconnect: CJB C270h. • Key in ON position. • Measure the voltage between the CJB C270h pin 11, circuit 32 (RD/LB), harness side and ground.  A0046920 • **Is the voltage greater than 10 volts?**	**Yes** GO to D2 . **No** REPAIR or INSTALL a new CJB as necessary. TEST the system for normal operation.
D2 CHECK THE IGNITION SWITCH	
• CARRY OUT the ignition switch continuity check. Refer to Wiring Diagrams Cell 149 for schematic and	**Yes** REPAIR circuit 32 (RD/LB) between ignition switch and CJB. TEST the system for

connector information. • **Does the ignition switch test OK?**	normal operation. **No** INSTALL a new ignition switch; REFER to Ignition Switch in this section. TEST the system for normal operation.

Component Test

Ignition Switch Continuity Check

Refer to Wiring Diagrams Cell 149 for schematic and connector information.

Multifunction Switch

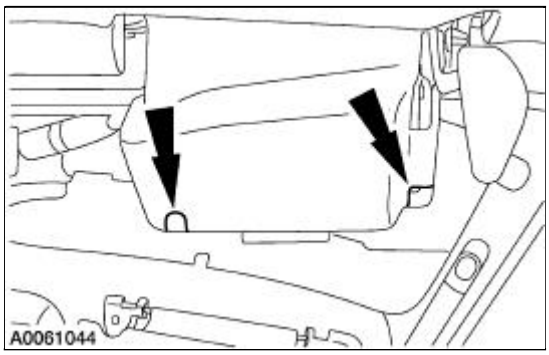
Refer to Wiring Diagrams Cell 149 for schematic and connector information.

Steering Column Multifunction Switch

Removal and Installation

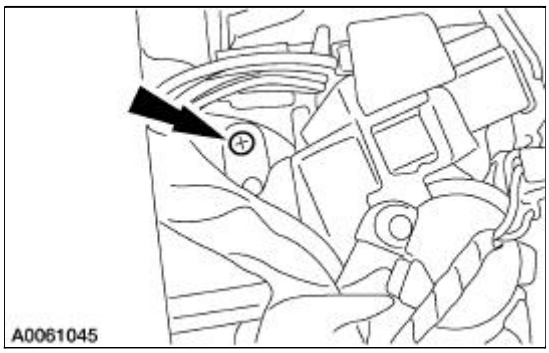
1. Remove the steering wheel. For additional information, refer to Section 211-04 .
2. **NOTE:** Lower tilt release handle to access the second screw.

   Remove the lower steering column shroud.
   - Remove the screws.

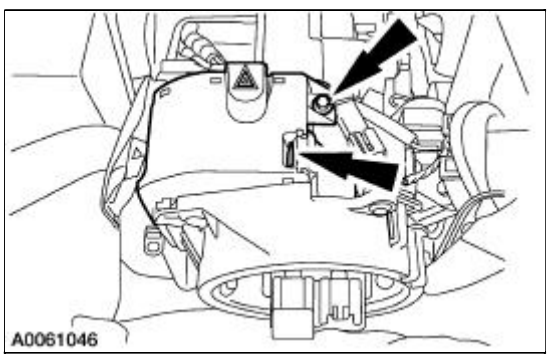


3. **NOTE:** The screw is located behind the multifunction switch.

   Remove the screw and the upper steering column shroud.



4. Remove the bolt, push the release and raise the switch.

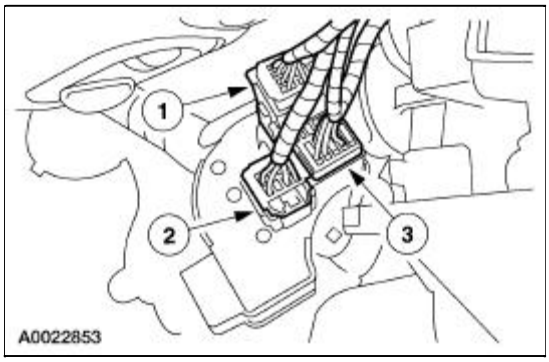


5. **NOTE:** A small screwdriver will be required to depress the connector release tab on connector

number 2.

Remove the multifunction switch.

- Disconnect the connectors in the sequence shown.
- Remove the switch.



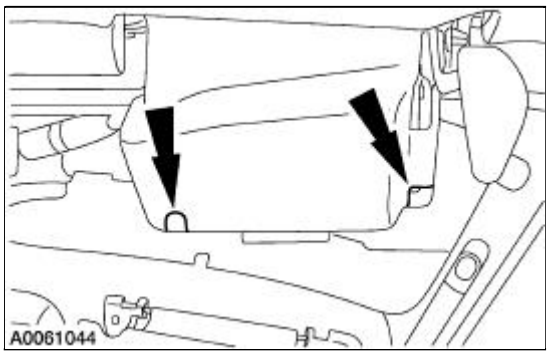
6. To install, reverse the removal procedure.

Ignition Switch

Removal and Installation

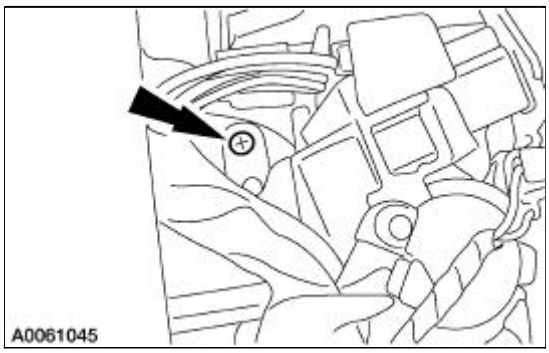
1. Remove the steering wheel. For additional information, refer to Section 211-04 .
2. **NOTE:** Lower tilt release handle to access second screw.

   Remove the lower steering column shroud.
   - Remove the screws.

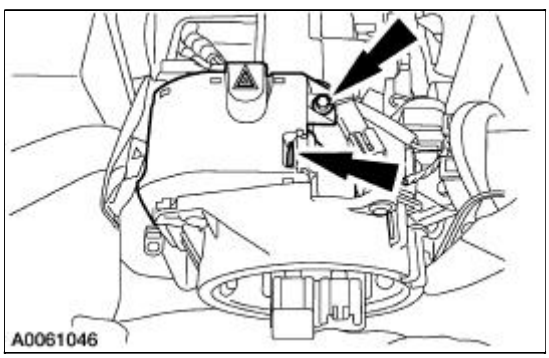


3. **NOTE:** The screw is located behind the multifunction switch.

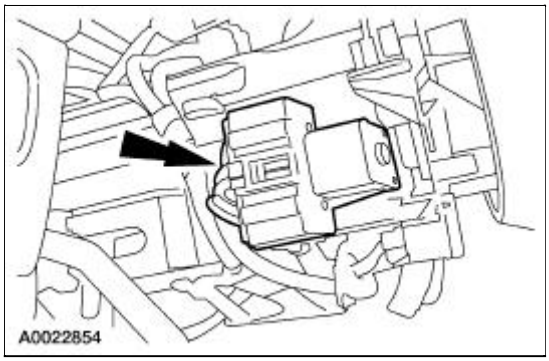
   Remove the screw and the upper steering column shroud.



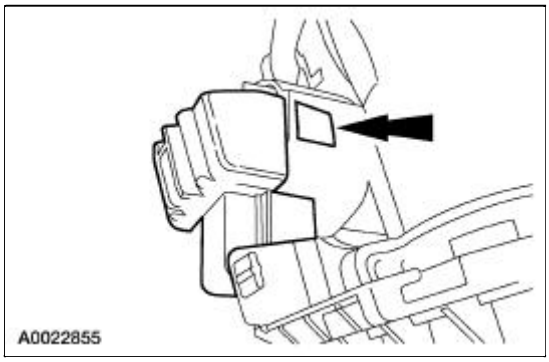
4. Remove the bolt, push the release and position the multifunction switch aside.



5. Disconnect the ignition switch electrical connector.



6. Remove the ignition switch.



7. To install, reverse the removal procedure.
    - Make sure that the spring located under the ignition switch is positioned on the steering column lock rod.

General Specifications

Item	Specification
Lubricants and Sealants	
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP	WSS-M2C153-H
Diesel engine oil	Refer to owner literature
Gasoline Engine Oil Dye 164-R3705	ESE-M99C103-B1
Threadlock® 262 E2FZ-19554-B	WSK-M2G351-A6

Engine

NOTE: This section contains information, steps and procedures that may not be specific to your engine.

This section covers general procedures and diagnosis and testing of the engine system, except for exhaust emission control devices, which are covered in the Powertrain Control/Emissions Diagnosis Manual.

The engine incorporates the following features:

- a closed positive crankcase ventilation (PCV) system. For additional information, refer to Section 303-08 .
- an exhaust emission control system. For additional information, refer to Section 303-08 .
- an evaporative emission control system. For additional information, refer to Section 303-13 .

Some engines incorporate a fail-safe cooling system. Refer to the appropriate section in Group 303 for the procedure.

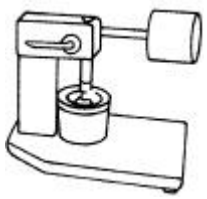
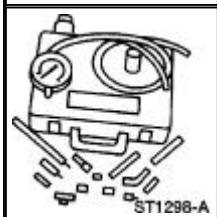
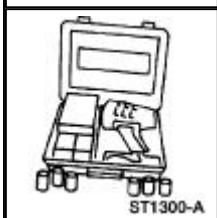
The engine, fuel system, ignition system, emissions system and exhaust system all affect exhaust emission levels and must be maintained according to the maintenance schedule. Refer to the scheduled Maintenance Guide.

Correct engine identification is required to order parts. Refer to the appropriate section in Group 303 for the procedure.

For complete vehicle and engine identification codes, refer to Section 100-01 .

Engine

Special Tool(s)

	Commercially Available Leakdown Tester —
	Quick Disconnect Compression Tester 134-R0212 or equivalent
	Dial Indicator Gauge Adapter 303-007 (TOOL-6565-AB) or equivalent
	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent
	Engine Cylinder Leak Detection/Air Pressurization Kit 014-00708 or equivalent
	Oil Pressure Gauge 303-088 (T73L-6600-A)
	UV Leak Detector Kit 164-R0756 or equivalent
	Vacuum/Pressure Tester 164-R0253 or equivalent

 ST1297-A	

Material

Item	Specification
Gasoline Engine Oil Dye 164-R3705 or equivalent	ESE-M99C103-B1
Engine Oil	Refer to owner literature

Inspection and Verification

1. Verify the customer concern by operating the engine to duplicate the condition.
2. Visually inspect for obvious signs of mechanical damage. Refer to the following chart.

Visual Inspection Chart

Mechanical
● Engine coolant leaks ● Engine oil leaks ● Fuel leaks ● Damaged or severely worn parts ● Loose mounting bolts, studs and nuts

3. If the inspection reveals obvious concerns that can be readily identified, repair as necessary.
4. If the concerns remain after the inspection, determine the symptoms. GO to Symptom Chart .

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
● Difficult starting	● Damaged ignition system.	● Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	● Damaged fuel system.	● Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	● Damaged starting system.	● Refer to the appropriate section in Group 303 for the procedure.

		REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	• Damaged charging system/battery.	• REFER to Section 414-00 .
	• Burnt valve.	• INSTALL a new valve.
	• Worn piston.	• INSTALL a new piston.
	• Worn piston rings.	• INSTALL new piston rings.
	• Worn cylinder.	• REPAIR or INSTALL a new cylinder block.
	• Damaged head gasket.	• INSTALL a new head gasket.
	• Damaged cooling system.	• Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
• Poor idling	• Vacuum leaks.	• Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	• Malfunctioning or damaged ignition system.	• Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	• Malfunctioning or damaged fuel system.	• Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	• Damaged valve tappet or lash adjuster.	• INSTALL a new valve tappet or lash adjuster.
	• Damaged valve tappet guide or lash adjuster.	• INSTALL a new valve tappet guide or valve tappet.
	• Incorrect valve-to-valve seat contact.	• REPAIR or INSTALL a new valve or valve seat.
	• Damaged head gasket.	• INSTALL a new head gasket.
• Abnormal combustion	• Malfunctioning or damaged fuel system.	• Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	• Malfunctioning or damaged ignition system.	• Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	• Malfunctioning or damaged air intake system.	• Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis

		(PC/ED) manual.
	• Damaged valve tappet or lash adjuster.	• INSTALL a new valve tappet or lash adjuster.
	• Damaged valve tappet guide or valve tappet.	• INSTALL a new valve tappet guide or valve tappet.
	• Burnt or sticking valve.	• REPAIR or INSTALL a new valve.
	• Weak or broken valve spring.	• INSTALL a new valve spring.
	• Carbon accumulation in combustion chamber.	• ELIMINATE carbon buildup.
• Excessive oil consumption	• Leaking oil.	• REPAIR oil leakage.
	• Malfunctioning PCV system.	• REPAIR or INSTALL new necessary components.
	• Worn valve stem seal.	• INSTALL a new valve stem seal.
	• Worn valve stem or valve guide.	• INSTALL a new valve and valve guide.
	• Sticking piston rings.	• REPAIR or INSTALL new piston rings.
	• Worn piston ring groove.	• INSTALL a new piston and piston pin.
	• Worn piston or cylinder.	• REPAIR or INSTALL a new piston or cylinder block.
• Engine noise	• Leaking exhaust system.	• REPAIR exhaust leakage.
	• Incorrect drive belt tension.	• REFER to Section 303-05 .
	• Malfunctioning generator bearing.	• Refer to the appropriate section in Group 414 for the procedure.
	• Malfunctioning water pump bearing.	• REFER to Section 303-03 .
	• Malfunctioning or damaged cooling system.	• REFER to Section 303-03 .
	• Malfunctioning or damaged fuel system.	• Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	• Loose timing chain/belt (6268).	• ADJUST or INSTALL a new timing chain/belt.
	• Damaged timing chain tensioner (6L266).	• INSTALL a new timing chain tensioner.
	• Excessive main bearing clearance.	• ADJUST clearance or INSTALL a new crankshaft main bearing (6333).

	• Seized or heat damaged crankshaft main bearing.	• INSTALL a new crankshaft main bearing.
	• Excessive crankshaft end play.	• INSTALL a new thrust bearing or crankshaft (6303).
	• Excessive connecting rod bearing clearance.	• INSTALL a new connecting rod bearing or connecting rod (6200).
	• Heat damaged connecting rod bearing (6211).	• INSTALL a new connecting rod bearing.
	• Damaged connecting rod bushing (6207).	• INSTALL a new connecting rod bushing.
	• Worn cylinder.	• REPAIR or INSTALL a new cylinder block (6010).
	• Worn piston (6108) or piston pin (6135).	• INSTALL a new piston or piston pin.
	• Damaged piston rings.	• INSTALL new piston rings.
	• Bent connecting rod.	• INSTALL a new connecting rod.
	• Malfunctioning valve tappet (6500) or lash adjuster.	• INSTALL a new valve tappet or lash adjuster.
	• Excessive valve tappet or lash adjuster clearance.	• ADJUST clearance or INSTALL a new valve tappet guide or valve tappet.
	• Broken valve spring (6513).	• INSTALL a new valve spring.
	• Excessive valve guide clearance.	• ADJUST clearance or INSTALL a new valve guide (6510) or valve.
• Insufficient power	• Malfunctioning or damaged ignition system.	• Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	• Malfunctioning or damaged fuel system.	• Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	• Malfunctioning or damaged air intake system.	• Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	• Damaged or plugged exhaust system.	• INSPECT exhaust system.
	• Incorrect tire size.	• REFER to Section 204-04 .
	• Dragging brakes.	• REFER to Section 206-00 .

	• Slipping transmission. • Malfunctioning valve tappet or lash adjuster. • Damaged valve tappet guide or valve tappet. • Compression leakage at valve seat. • Seized valve stem. • Weak or broken valve spring. • Worn or damaged camshaft. • Damaged head gasket (6051). • Cracked or distorted cylinder head. • Damaged, worn or sticking piston ring (s). • Worn or damaged piston.	• Refer to the appropriate section in Group 307 for the procedure. • INSTALL a new valve tappet or lash adjuster. • INSTALL a new valve tappet guide or valve tappet. • REPAIR or INSTALL a new valve, valve seat or cylinder head (6049). • INSTALL a new valve. • INSTALL a new valve spring. • INSTALL a new camshaft. • INSTALL a new head gasket. • INSTALL a new cylinder head. • REPAIR or INSTALL a new piston ring(s). • INSTALL a new piston and piston pin.

Component Tests

Engine Oil Leaks

NOTE: When diagnosing engine oil leaks, the source and location of the leak must be positively identified prior to repair.

Prior to carrying out this procedure, clean all sealing surface areas with a suitable solvent to remove all traces of oil.

Engine Oil Leaks—Fluorescent Oil Additive Method

Use the UV Leak Detector Kit to carry out the following procedure for oil leak diagnosis.

1. Add gasoline engine oil dye. Use a minimum 14.8 ml (0.5 ounce) to a maximum 29.6 ml (1 ounce) of fluorescent additive to all engines. If the oil is not premixed, fluorescent additive must first be added to crankcase.

2. Run the engine for 15 minutes. Stop the engine and inspect all seal and gasket areas for leaks using the UV Leak Detector Kit. A clear bright yellow or orange area will identify the leak. For extremely small leaks, several hours may be required for the leak to appear.

Leakage Points—Underhood

Examine the following areas for oil leakage:

- valve cover gaskets

- intake manifold gaskets
- cylinder head gaskets
- oil bypass filter
- oil filter adapter
- engine front cover
- oil filter adapter and filter body
- oil level indicator tube connection
- oil pressure sensor

Leakage Points—Under Engine—With Vehicle on Hoist

- oil pan gaskets (6710)
- oil pan sealer
- oil pan rear seal (6723)
- engine front cover gasket
- crankshaft front seal (6700)
- crankshaft rear oil seal (6701)
- crankshaft main bearing cap side bolts
- oil filter adapter and filter body
- oil cooler, if equipped

Leakage Points—With Transmission and Flywheel Removed

- crankshaft rear oil seal
- rear main bearing cap parting line
- rear main bearing cap and seals
- flywheel mounting bolt holes (with flywheel [6375] installed)
- camshaft rear bearing covers (6266) or pipe plugs at the end of oil passages

Oil leaks at crimped seams in sheet metal parts and cracks in cast or stamped parts can be detected when using the dye method.

Compression Test—Compression Gauge Check

1. Make sure the oil in the crankcase is of the correct viscosity and at the correct level and that the battery (10655) is correctly charged. Operate the vehicle until the engine is at normal operating temperature. Turn the ignition switch to the OFF position, then remove all the spark plugs (12405).

2. Set the throttle plates in the wide-open position.

3. Install a compression gauge such as the Compression Tester in the No. 1 cylinder.

4. Install an auxiliary starter switch in the starting circuit. With the ignition switch in the OFF position, and using the auxiliary starter switch, crank the engine a minimum of five compression strokes and record the highest reading. Note the approximate number of compression strokes

required to obtain the highest reading.

5. Repeat the test on each cylinder, cranking the engine approximately the same number of compression strokes.

Compression Test—Test Results

The indicated compression pressures are considered within specification if the lowest reading cylinder is at least 75 percent of the highest reading. Refer to the Compression Pressure Limit Chart.

Compression Pressure Limit Chart

Maximum Pressure	Minimum Pressure	Maximum Pressure	Minimum Pressure	Maximum Pressure	Minimum Pressure	Maximum Pressure	Minimum Pressure
924 kPa (134 psi)	696 kPa (101 psi)	1131 kPa (164 psi)	848 kPa (123 psi)	1338 kPa (194 psi)	1000 kPa (146 psi)	1544 kPa (224 psi)	1158 kPa (168 psi)
938 kPa (136 psi)	703 kPa (102 psi)	1145 kPa (166 psi)	855 kPa (124 psi)	1351 kPa (196 psi)	1014 kPa (147 psi)	1558 kPa (226 psi)	1165 kPa (169 psi)
952 kPa (138 psi)	717 kPa (104 psi)	1158 kPa (168 psi)	869 kPa (126 psi)	1365 kPa (198 psi)	1020 kPa (148 psi)	1572 kPa (228 psi)	1179 kPa (171 psi)
965 kPa (140 psi)	724 kPa (106 psi)	1172 kPa (170 psi)	876 kPa (127 psi)	1379 kPa (200 psi)	1034 kPa (150 psi)	1586 kPa (230 psi)	1186 kPa (172 psi)
979 kPa (142 psi)	738 kPa (107 psi)	1186 kPa (172 psi)	889 kPa (129 psi)	1303 kPa (202 psi)	1041 kPa (151 psi)	1600 kPa (232 psi)	1200 kPa (174 psi)
933 kPa (144 psi)	745 kPa (109 psi)	1200 kPa (174 psi)	903 kPa (131 psi)	1407 kPa (204 psi)	1055 kPa (153 psi)	1055 kPa (153 psi)	1207 kPa (175 psi)
1007 kPa (146 psi)	758 kPa (110 psi)	1214 kPa (176 psi)	910 kPa (132 psi)	1420 kPa (206 psi)	1062 kPa (154 psi)	1627 kPa (154 psi)	1220 kPa (177 psi)
1020 kPa (148 psi)	765 kPa (111 psi)	1227 kPa (178 psi)	917 kPa (133 psi)	1434 kPa (208 psi)	1075 kPa (156 psi)	1641 kPa (238 psi)	1227 kPa (178 psi)
1034 kPa (150 psi)	779 kPa (113 psi)	1241 kPa (180 psi)	931 kPa (135 psi)	1448 kPa (210 psi)	1083 kPa (157 psi)	1655 kPa (240 psi)	1241 kPa (180 psi)
1048 kPa (152 psi)	786 kPa (114 psi)	1255 kPa (182 psi)	936 kPa (136 psi)	1462 kPa (212 psi)	1089 kPa (158 psi)	1669 kPa (242 psi)	1248 kPa (181 psi)
1062 kPa (154 psi)	793 kPa (115 psi)	1269 kPa (184 psi)	952 kPa (138 psi)	1476 kPa (214 psi)	1103 kPa (160 psi)	1682 kPa (244 psi)	1262 kPa (183 psi)
1076 kPa (156 psi)	807 kPa (117 psi)	1282 kPa (186 psi)	965 kPa (140 psi)	1489 kPa (216 psi)	1117 kPa (162 psi)	1696 kPa (246 psi)	1269 kPa (184 psi)
1089 kPa (158 psi)	814 kPa (118 psi)	1296 kPa (188 psi)	972 kPa (141 psi)	1503 kPa (218 psi)	1124 kPa (163 psi)	1710 kPa (248 psi)	1202 kPa (186 psi)
1103 kPa (160 psi)	827 kPa (120 psi)	1310 kPa (190 psi)	979 kPa (142 psi)	1517 kPa (220 psi)	1138 kPa (165 psi)	1724 kPa (250 psi)	1289 kPa (187 psi)
1110 kPa (161 psi)	834 kPa (121 psi)	1324 kPa (192 psi)	993 kPa (144 psi)	1631 kPa (222 psi)	1145 kPa (166 psi)	—	—

If one or more cylinders reads low, squirt approximately one tablespoon of engine oil on top of the pistons in the low-reading cylinders. Repeat the compression pressure check on these cylinders.

Compression Test—Interpreting Compression Readings

1. If compression improves considerably, piston rings are faulty.

2. If compression does not improve, valves are sticking or seating incorrectly.

3. If two adjacent cylinders indicate low compression pressures and squirting oil on each piston does not increase compression, the head gasket may be leaking between cylinders. Engine oil or coolant in cylinders could result from this condition.
   Use the Compression Pressure Limit Chart when checking cylinder compression so that the lowest reading is within 75 percent of the highest reading.

Cylinder Leakage Detection

When a cylinder produces a low reading, use of the Engine Cylinder Leak Detection/Air Pressurization Kit will be helpful in pinpointing the exact cause.

The leakage detector is inserted in the spark plug hole, the piston is brought up to dead center on the compression stroke, and compressed air is admitted.

Once the combustion chamber is pressurized, a special gauge included in the kit will read the percentage of leakage. Leakage exceeding 20 percent is excessive.

While the air pressure is retained in the cylinder, listen for the hiss of escaping air. A leak at the intake valve (6507) will be heard in the throttle body (9E926). A leak at the exhaust valve (6505) can be heard at the tail pipe. Leakage past the piston rings will be audible at the positive crankcase ventilation (PCV) connection. If air is passing through a blown head gasket to an adjacent cylinder, the noise will be evident at the spark plug hole of the cylinder into which the air is leaking. Cracks in the cylinder block or gasket leakage into the cooling system may be detected by a stream of bubbles in the radiator (8005).

Oil Consumption Test

The following diagnostic procedure is used to determine the source of excessive internal oil consumption.

1. **NOTE:** Oil use is normally greater during the first 16,100 km (10,000 miles) of service. As mileage increases, oil use generally decreases. Vehicles in normal service should get at least 1,450 km per liter (900 miles per quart) after 16,000 km (10,000 miles) of service. High speed driving, towing, high ambient temperature and other factors may result in greater oil use.

   Define excessive oil consumption, such as the number of miles driven per liter (quart) of oil used. Also determine customer's driving habits, such as sustained high speed operation, towing, extended idle and other considerations.

2. Verify that the engine has no external oil leak as described under Engine Oil Leaks in the Diagnosis and Testing portion of this section.

3. Verify that the engine has the correct oil level dipstick (6750).

4. Verify that the engine is not being run in an overfilled condition. Check the oil level at least five minutes after a hot shutdown with the vehicle parked on a level surface. In no case should the level be above MAX or the letter F in FULL. If significantly overfilled, carry out Steps 6a through 6d.

5. Verify the spark plugs are not oil saturated. If the spark plugs are oil saturated and compression is good it can be assumed the valve seals or valve guides are at fault.

6. Carry out an oil consumption test:

a. Drain the engine oil, remove the oil bypass filter (6714) and refill with one liter (quart) less than the recommended amount.
b. Run the engine for three minutes (10 minutes if cold), and allow the oil to drain back for at least five minutes with the vehicle on a level surface.
c. Remove oil level dipstick and wipe clean. (Do not wipe with anything contaminated with silicone compounds.) Reinstall the oil level dipstick, being sure to seat it firmly in the oil level indicator tube (6754). Remove the oil level dipstick and draw a mark on the back (unmarked) surface at the indicated oil level. This level should be about the same as the MIN or ADD mark on the face of the oil level dipstick.
d. Add one liter (quart) of oil. Restart the engine and allow to idle for at least two minutes. Shut off the engine and allow the oil to drain back for at least five minutes. Mark the oil level dipstick, using the procedure above.
e. Record the vehicle mileage.
f. Instruct the customer to drive the vehicle as usual and perform the following:
    - Check the oil level regularly at intervals of 160 to 240 km (100-150 miles).
    - Return to the service point when the oil level drops below the lower (MIN or ADD) mark on the oil level dipstick.
    - Add only full liters (quarts) of the same oil in an emergency. Note the mileage at which the oil is added.
g. Check the oil level under the same conditions and at the same location as in Steps 6c and 6d.
    - Measure the distance from the oil level to the UPPER mark on the oil level dipstick and record.
    - Measure the distance between the two scribe marks and record.
    - Divide the first measurement by the second.
    - Divide the distance driven during the oil test by the result. This quantity is the approximate oil consumption rate in kilometers per liter or in miles per quart.
h. If the oil consumption rate is unacceptable, go to Step 7.

7. Check the positive crankcase ventilation (PCV) system. Make sure the system is not plugged.

8. Check for plugged oil drain-back holes in the cylinder heads and cylinder block.

9. If the condition still exists after performing the above steps, go to Step 10.

10. Perform a cylinder compression test or perform a cylinder leak detection test with Engine Cylinder Leak Detection/Air Pressurization Kit. This can help determine the source of oil consumption such as valves, piston rings or other areas.

11. **NOTE:** After determining if new parts should be installed, make sure correct parts are used.

    Check valve guides for excessive guide clearance. Install new all valve stem seals (6571) after verifying valve guide clearance.

12. Worn or damaged internal engine components can cause excessive oil consumption. Small deposits of oil on the tips of spark plugs can be a clue to internal oil consumption. If internal oil consumption still persists, proceed as follows:

a. Remove the engine from the vehicle and place it on an engine work stand. Remove the intake manifolds (9424), cylinder heads, oil pan (6675) and oil pump (6600).
b. Check piston ring clearance, ring gap and ring orientation. Repair as necessary.
c. Check for excessive bearing clearance. Repair as necessary.

13. Repeat the oil consumption test (Step 6) to confirm the oil consumption concern has been resolved.

Intake Manifold Vacuum Test

Bring the engine to normal operating temperature. Connect the Vacuum/Pressure Tester to the intake manifold. Run the engine at the specified idle speed.

The vacuum gauge should read between 51-74 kPa (15-22 in-Hg) depending upon the engine condition and the altitude at which the test is performed. Subtract 4.0193 kPa (1 in-Hg) from the specified reading for every 304.8 m (1,000 feet) of elevation above sea level.

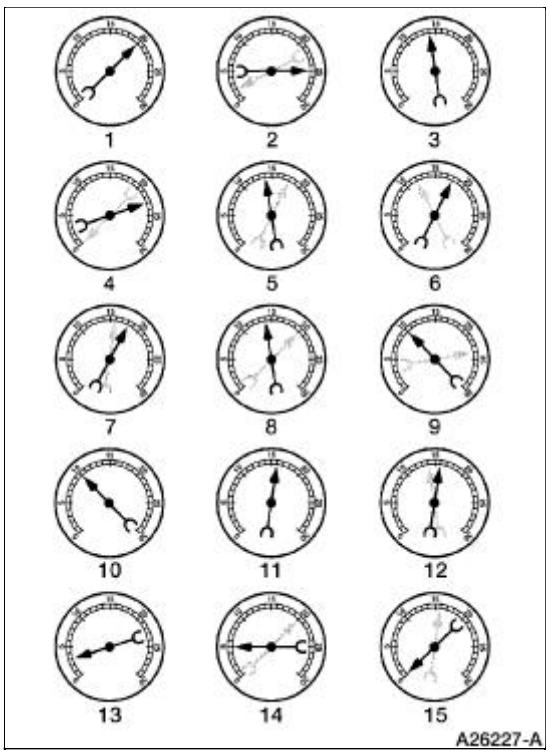
The reading should be steady. If necessary, adjust the gauge damper control (where used) if the needle is fluttering rapidly. Adjust the damper until the needle moves easily without excessive flutter.

Intake Manifold Vacuum Test—Interpreting Vacuum Gauge Readings

A careful study of the vacuum gauge reading while the engine is idling will help pinpoint trouble areas. Always conduct other appropriate tests before arriving at a final diagnostic decision. Vacuum gauge readings, although helpful, must be interpreted carefully.

Most vacuum gauges have a normal band indicated on the gauge face.

The following are potential gauge readings. Some are normal; others should be investigated further.



1. NORMAL READING: Needle between 51-74 kPa (15-22 in-Hg) and holding steady.

2. NORMAL READING DURING RAPID ACCELERATION AND DECELERATION: When the engine is rapidly accelerated (dotted needle), the needle will drop to a low reading (not to zero). When the throttle is suddenly released, the needle will snap back up to a higher than normal figure.

3. NORMAL FOR HIGH-LIFT CAMSHAFT WITH LARGE OVERLAP: The needle will register as low as 51 kPa (15 in-Hg) but will be relatively steady. Some oscillation is normal.

4. WORN RINGS OR DILUTED OIL: When the engine is accelerated (dotted needle), the needle drops to 0 kPa (0 in-Hg). Upon deceleration, the needle runs slightly above 74 kPa (22 in-Hg).

5. STICKING VALVES: When the needle (dotted) remains steady at a normal vacuum but occasionally flicks (sharp, fast movement) down and back about 13 kPa (4 in-Hg), one or more valves may be sticking.

6. BURNED OR WARPED VALVES: A regular, evenly-spaced, downscale flicking of the needle indicates one or more burned or warped valves. Insufficient hydraulic lash adjuster or hydraulic lash adjuster (HLA) clearance will also cause this reaction.

7. POOR VALVE SEATING: A small but regular downscale flicking can mean one or more valves are not seating.

8. WORN VALVE GUIDES: When the needle oscillates over about a 13 kPa (4 in-Hg) range at idle speed, the valve guides could be worn. As engine speed increases, the needle will become steady if guides are responsible.

9. WEAK VALVE SPRINGS: When the needle oscillation becomes more violent as engine rpm is increased, weak valve springs are indicated. The reading at idle could be relatively steady.

10. LATE VALVE TIMING: A steady but low reading could be caused by late valve timing.

11. IGNITION TIMING RETARDING: Retarded ignition timing will produce a steady but somewhat low reading.

12. INSUFFICIENT SPARK PLUG GAP: When spark plugs are gapped too close, a regular, small pulsation of the needle can occur.

13. INTAKE LEAK: A low, steady reading can be caused by an intake manifold or throttle body gasket leak.

14. BLOWN HEAD GASKET: A regular drop of fair magnitude can be caused by a blown head gasket or warped cylinder head-to-cylinder block surface.

15. RESTRICTED EXHAUST SYSTEM: When the engine is first started and is idled, the reading may be normal, but as the engine rpm is increased, the back pressure caused by a clogged muffler (5230), kinked tail pipe or other concerns will cause the needle to slowly drop to 0 kPa (0 in-Hg). The needle then may slowly rise. Excessive exhaust clogging will cause the needle to drop to a low point even if the engine is only idling.

16. When vacuum leaks are indicated, search out and correct the cause. Excess air leaking into the system will upset the fuel mixture and cause concerns such as rough idle, missing on acceleration or burned valves. If the leak exists in an accessory unit such as the power brake booster (2005), the unit will not function correctly. Always fix vacuum leaks.

Excessive Engine Oil Consumption

The amount of oil an engine uses will vary with the way the vehicle is driven in addition to normal engine-to-engine variation. This is especially true during the first 16,100 km (10,000 miles) when a new engine is being broken in or until certain internal engine components become conditioned. Vehicles used in heavy-duty operation may use more oil. The following are examples of heavy-duty operation:

- trailer towing applications
- severe loading applications
- sustained high speed operation

Engines need oil to lubricate the following internal components:

- cylinder block cylinder walls
- pistons and piston, pin and rings (6102)
- intake and exhaust valve stems
- intake and exhaust valve guides
- all internal engine components

When the pistons move downward, a thin film of oil is left on the cylinder walls. As the vehicle is operated, some oil is also drawn into the combustion chambers past the intake and exhaust valve stem seals and burned.

The following is a partial list of conditions that can affect oil consumption rates:

- engine duty cycle
- operator driving habits
- ambient temperature
- quality and viscosity of the oil

Operation under varying conditions can frequently be misleading. A vehicle that has been run for several thousand miles on short trips or in below-freezing ambient temperatures may have consumed a "normal" amount of oil. However, when checking the engine oil level, it may measure up to the FULL or MAX on the oil level dipstick due to dilution (condensation and fuel) in the engine crankcase. The vehicle might then be driven at high speeds on the highway where the condensation and fuel boil off. The next time the engine oil is checked, it may appear that a liter (quart) of oil was used in about 160 km (100 miles). This perceived 160 km (100 miles) per liter (quart) oil consumption rate causes customer concern even though the actual overall oil consumption rate is about 2,400 km (1,500 miles) per liter (quart).

Make sure the selected engine oil meets the current recommended API performance category with SAE viscosity grade as shown in the vehicle Owner's Guide. It is also important that the engine oil is changed at the intervals specified. Refer to the vehicle Owner's Guide.

Oil Pressure Test

1. Disconnect and remove the oil pressure sensor (9278) from the engine.
2. Connect the Oil Pressure Gauge to the oil pressure sender oil galley port.
3. Run the engine until normal operating temperature is reached.
4. Run the engine at the specified rpm and record the gauge reading.
5. The oil pressure should be within specifications; refer to the specification chart in the appropriate engine section.
6. If the pressure is not within specification, check the following possible sources:
    - insufficient oil
    - oil leakage
    - worn or damaged oil pump
    - oil pump screen cover and tube (6622)
    - excessive main bearing clearance

- excessive connecting rod bearing clearance

Valve Train Analysis—Engine Off—Valve Cover Removed

Check for damaged or severely worn parts and correct assembly. Make sure correct parts are used with the static engine analysis as follows.

Valve Train Analysis—Engine Off, Rocker Arm

- Check for loose mounting bolts, studs and nuts.
- Check for plugged oil feed in the rocker arms (6564) or cylinder head.

Valve Train Analysis—Engine Off, Camshaft Roller Followers and Hydraulic Lash Adjusters, Overhead Camshaft

- Check for loose mounting bolts on camshaft carriers.
- Check for plugged oil feed in the camshaft roller followers, lash adjusters or cylinder heads.

Valve Train Analysis—Engine Off, Camshaft—Engines

- Check for broken or damaged parts.

Valve Train Analysis—Engine Off, Push Rods

- Check for bent push rods (6565) and restricted oil passage.

Valve Train Analysis—Valve Springs

- Check for broken or damaged parts.

Valve Train Analysis—Engine Off, Valve Spring Retainer and Valve Spring Retainer Keys

- Check for correct seating of the valve spring retainer key (6518) on the valve stem and in valve spring retainer (6514).
- Check for correct seating on the valve stem.

Valve Train Analysis—Engine Off, Valves and Cylinder Head

- Check for plugged oil drain back holes.
- Check for worn or damaged valve tips.
- Check for missing or damaged guide-mounted valve stem seal.
- Check collapsed valve tappet gap.
- Check installed valve spring height.
- Check for missing or worn valve spring seats.
- Check for plugged oil metering orifice in cylinder head oil reservoir (if equipped).

Static checks (engine off) are to be made on the engine prior to the dynamic procedure.

Valve Train Analysis—Engine Running

- Start the engine and, while idling, check for correct operation of all parts. Check the following:

Valve Train Analysis—Engine Running, Valves and Cylinder Head

- Check for plugged oil drain back holes.
- Check for missing or damaged valve stem seals or guide mounted valve stem seals.
- Check for a plugged oil metering orifice in the cylinder head oil reservoir (4.6L engine only).

If insufficient oiling is suspected, check oil passages for blockage, then accelerate the engine to 1,200 rpm with the transmission in NEUTRAL and the engine at normal operating temperature. Oil should spurt from the rocker arm oil holes such that valve tips and camshaft roller followers are well oiled. With the valve covers (6582) off, some oil splash may overshoot camshaft roller followers.

Valve Train Analysis—Engine Running, Camshaft Lobe Lift—OHC Engines

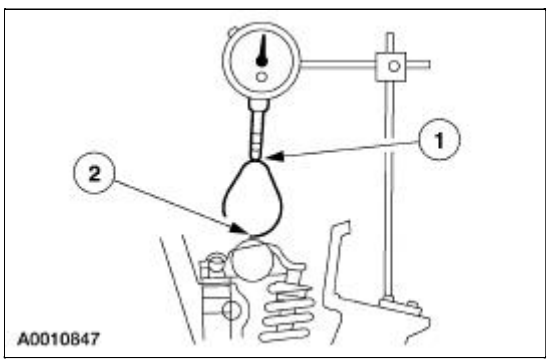
Check the lift of each camshaft lobe in consecutive order and make a note of the readings.

1. Remove the valve covers.

2. Remove the spark plugs.

3. Install the Dial Indicator Gauge with Holding Fixture so the rounded tip of indicator is on top of the camshaft lobe and on the same plane as the valve tappet.

4. Rotate the crankshaft using a breaker bar and socket attached to the crankshaft pulley retainer bolt. Rotate the crankshaft until the base circle of the camshaft lobe is reached.



5. Zero the dial indicator. Continue to rotate the crankshaft until the (1) high-lift point of the camshaft lobe is in the fully-raised position (highest indicator reading).

6. To check the accuracy of the original indicator reading, continue to rotate crankshaft until the (2) base circle is reached. The indicator reading should be zero. If zero reading is not obtained, repeat Steps 1 through 6.

7. **NOTE:** If the lift on any lobe is below specified service limits, install a new camshaft, and new camshaft roller followers.

   Remove the Dial Indicator Gauge with Holding Fixture.

8. Install the spark plugs.

9. Install the valve covers.

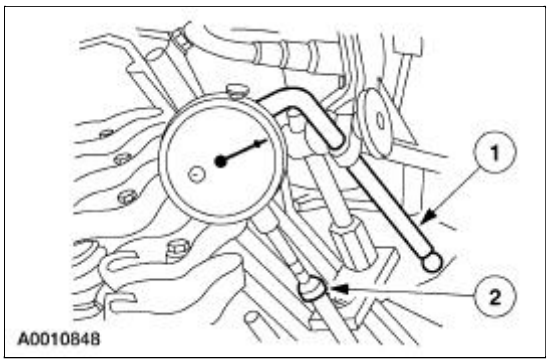
Valve Train Analysis—Engine Running, Camshaft Lobe Lift—Push Rod Engine

Check the lift of each lobe in consecutive order and make a note of the readings.

1. Remove the valve covers.

2. Remove the rocker arm seat bolts, rocker arm seat (6A528) and rocker arms.

Typical Engine With Push Rods



3. Make sure the valve tappet is seated against camshaft (6250). Install (1) Dial Indicator Gauge with Holding Fixture so the ball socket adapter of the indicator is on top of the valve tappet or (2) Dial Indicator Gauge Adapter is on top of push rod and in same plane as valve tappet push rod movement.

4. Remove the spark plugs.

5. Connect an auxiliary starter switch in the starting circuit. Crank the engine with ignition switch in OFF position. Bump crankshaft over until valve tappet is on base circle of camshaft lobe. At this point, valve tappet will be in its lowest position. If checking during engine assembly, turn crankshaft using a socket or ratchet.

6. Zero the dial indicator. Continue to rotate crankshaft slowly until valve tappet is in fully-raised position (highest indicator reading).

7. **NOTE:** If lift on any lobe is below specified service limits, install a new camshaft, and new valve tappets.

   Remove the Dial Indicator with Holding Fixture, Dial Indicator Gauge Adapter, and auxiliary starter switch.

8. Install rocker arm seats, rocker arms and rocker arm seat bolts.

9. Install valve covers.

10. Install spark plugs.

Valve Train Analysis—Engine Running, Valve Tappet

Valve tappet noise can be caused by any of the following:

- excessive valve tappet gap (collapsed)

- incorrectly functioning valve tappet
- air in lubrication system
- excessive valve guide wear
- low oil pressure

Excessive collapsed valve tappet gap can be caused by loose rocker arm seat bolts/nuts, incorrect initial adjustment or wear of valve tappet face, or worn roller valve tappets, push rod (6565), rocker arm (6564), rocker arm seat or valve tip. With valve tappet collapsed, check gap between the valve tip and the rocker arm to determine if any other valve train parts are damaged, worn or out of adjustment.

An incorrectly functioning valve tappet can be sticking, caused by contaminants or varnish inside the tappet. The tappet can have a check valve that is not functioning correctly, which can be caused by an obstruction, such as dirt or chips that prevent the check valve from closing, or a broken check valve spring. A tappet with a leakdown time out of specification can cause tappet noise. If no other cause for noisy valve tappets can be found, the leakdown rate should be checked and new valve tappets installed if found to be out of specification.

Assembled valve tappets can be tested with Hydraulic Tappet Leakdown Tester to check the leakdown rate. The leakdown rate specification is the time in seconds for the plunger to move a specified distance while under a 22.7 kg (50 lb) load.

Air bubbles in the lubrication system will prevent the valve tappet from supporting the valve spring load. This can be caused by too high or too low an oil level in the oil pan or by air being drawn into the system through a hole, crack or leaking gasket on the oil pump screen cover and tube.

General Specifications

Item	Specification
Lubricants and Sealants	
SAE 5W-20 Premium Synthetic Blend Engine Oil XO-5W20-QSP	WSS-M2C153-H
Motorcraft Premium Engine Coolant VC-4-A (in Oregon VC-5, in Canada CXC-10) [a]	ESE-M97B44-A (green color)
Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) [a]	WSS-M97B51-A1 (yellow color)
Motorcraft Silicone Gasket Remover ZC-30	—
Motorcraft Metal Surface Prep ZC-31	—
Silicone Gasket and Sealant F7AZ-19554-EA	WSE-M4G323-A4
Instant Adhesive E8AZ-19554-A	WSK-M2G402-A4
High Temperature Nickel Anti-Seize Lubricant XL-2	ESE-M12A4-A
Petroleum Jelly	WSD-M1C226-A

[a] Do not mix coolant types.

General Specifications

Item	Specification
Engine — 4.6L	
Displacement	4.6L (281 CID)
Number of cylinders	8
Bore	90.2 mm (3.55 in)
Stroke	90.0 mm (3.54 in)
Firing order	1-3-7-2-6-5-4-8
Oil pressure (@ 2000 rpm — hot)	275.8-413.7 kPa (40-60 psi)
Oil capacity (includes filter change)	5.7 L (6.0 qts)
Compression ratio	9.3:1
Cylinder Head and Valve Train	
Combustion chamber volume	51.5-52.5 cc (3.14-3.20 cu in)
Valve arrangement (front to rear) — LH	E-I-E-I-E-I-E-I
Valve arrangement (front to rear) — RH	I-E-I-E-I-E-I-E
Valve guide bore diameter	7.044-7.015 mm (0.2773-0.2762 in)
Valve stem diameter — intake	6.995-6.975 mm (0.2754-0.2746 in)
Valve stem diameter — exhaust	6.970-6.949 mm (0.2744-0.2736 in)
Valve stem-to-guide clearance — intake	0.020-0.069 mm (0.0008-0.0027 in)
Valve stem-to-guide clearance — exhaust	0.045-0.095 mm (0.0018-0.0037 in)
Valve head diameter — intake	44.5 mm (1.751 in)
Valve head diameter — exhaust	34.0 mm (1.338 in)

Valve face runout	0.05 mm (0.0019 in)
Valve face angle	45.25-45.75 degrees
Valve seat width	1.9-2.1 mm (0.0748-0.0827 in)
Valve seat runout (T.I.R.) max.	0.025 mm (0.0010 in)
Valve seat angle	45.50 degrees
Valve spring free length	49.55 mm (1.9508 in)
Valve spring squareness	2 degrees
Valve spring compression pressure	587.14 N @ 28.02 mm (131.994 lb @ 1.1032 in)
Valve spring installed height	39.7-40.3 mm (1.5630-1.5866 in)
Valve spring installed pressure — valve open	587.165 N @ 27.99 mm (132 lb @ 1.102 in)
Valve spring installed pressure — valve closed	244.652 N @ 39.98 mm (55 lb @ 1.574 in)
Roller follower ratio	1.75:1
Hydraulic Lash Adjuster	
Diameter	16.000-15.9888 mm (0.6299-0.6295 in)
Clearance-to-bore	0.018-0.069 mm (0.0007-0.0027 in)
Service limit	0.016 mm (0.0006 in)
Hydraulic leakdown rate	5-25 seconds [a]
Collapsed lash adjuster gap	0.085-0.450 mm (0.0033-0.0177 in)
Camshaft	
Theoretical valve lift @ 0 lash	12.0 mm (0.472 in)
Lobe lift	6.5 mm (0.2560 in)
Allowable lobe lift loss	0
Journal diameter (all)	26.962-26.936 mm (1.0615-1.0605 in)
Camshaft journal bore inside diameter (all)	27.012-26.987 mm (1.0635-1.0625 in)
Camshaft journal-to-bearing clearance	0.025-0.076 mm (0.0010-0.0030 in)
Runout	0.05 mm (0.002 in)
End play	0.09-0.19 mm (0.0035-0.0075 in)
Cylinder Block	
Cylinder bore diameter — grade 1	90.200-90.213 mm (3.5512-3.5517 in)
Cylinder bore diameter — grade 2	90.213-90.226 mm (3.5517-3.5522 in)
Cylinder bore diameter — grade 3	90.226-90.239 mm (3.5522-3.5527 in)
Cylinder bore maximum taper	0.006 mm (0.0002 in)
Cylinder bore maximum out-of-round	0.020 mm (0.0008 in)
Main bearing bore inside diameter	72.401-72.422 mm (2.850-2.851 in)
Crankshaft	
Main bearing journal diameter	63.0 mm (2.4803 in)
Main bearing journal maximum taper	0.020 mm (0.0007 in)
Main bearing journal maximum out-of-round	0.05 mm (0.002 in)
Main bearing journal-to-cylinder block clearance	0.027-0.065 mm (0.0011-0.0026 in)
Connecting rod journal diameter	52.988-53.003 mm (2.0861-2.0867 in)
Connecting rod journal maximum taper	0.015 mm (0.0006 in)

Connecting rod journal maximum out-of-round	0.05 mm (0.0020 in)
Crankshaft maximum end play	0.130-0.301 mm (0.0051-0.012 in)
Piston and Connecting Rod	
Piston diameter — coded red 1	90.177-90.197 mm (3.550-3.551 in)
Piston diameter — coded blue 2	90.190-90.210 mm (3.5507-3.5515 in)
Piston diameter — coded yellow 3	90.203-90.223 mm (3.513-3.5521 in)
Piston-to-cylinder bore clearance	0.012-0.0026 mm (0.0005-0.001 in)
Piston ring end gap — compression (top and bottom)	0.23-0.49 mm (0.010-0.020 in)
Piston ring end gap — oil ring (steel rail)	0.05-0.66 mm (0.006-0.026 in)
Piston ring groove width — compression (top)	1.520-1.550 mm (0.060-0.610 in)
Piston ring groove width — compression (bottom)	1.520-1.530 mm (0.060-0.0602 in)
Piston ring groove width — oil ring	6.996-7.224 mm (0.275-0.2844 in)
Piston ring width — compression	1.49-1.47 mm (0.0587-0.0579 in)
Piston ring width — oil ring rail (2)	0.473-0.447 mm (0.0186-0.0176 in), 0.483 mm (0.0190 in) max. at ID
Piston ring width — oil ring expander	2.038-1.960 mm (0.080-0.077 in)
Piston ring-to-groove clearance — compression	0.030-0.070 mm (0.0012-0.0028 in)
Piston ring-to-groove clearance — oil ring assembly	0.046-0.196 mm (0.0018-0.0077 in)
Piston pin bore diameter	22.0015-22.004 mm (0.866-0.8663 in)
Piston pin diameter	22.0 mm (0.866 in)
Piston pin length	61.8 mm (2.433 in)
Piston pin-to-piston fit	0.005-0.010 mm (0.0002-0.0004 in)
Connecting rod-to-pin clearance	0.015-0.040 mm (0.0006-0.0016 in)
Connecting rod pin bore diameter	21.959-21.979 mm (0.864-0.865 in)
Connecting rod length (center-to-center)	150.7 mm (5.93 in)
Connecting rod maximum allowed bend	0.038 mm per 25 mm (0.0015-0.984 in)
Connecting rod maximum allowed twist [b]	0.050 mm per 25 mm (0.0015-0.984 in)
Connecting rod bearing bore diameter	56.756-56.876 mm (2.234-2.24 in)
Connecting rod bearing-to-crankshaft clearance	0.027-0.069 mm (0.001-0.0027 in)
Connecting rod side clearance (assembled to crank) — standard	0.015-0.45 mm (0.0006-0.0177 in)
Connecting rod side clearance (assembled to crank) — service limit	0.05 mm (0.02 in) max.

[a] Time required for the plunger to leak down 1.6 mm of travel with 222 N force and leak-down fluid in the lash adjuster.

[b] The pin bore and crank bearing bore must be parallel and in the same vertical plane within the specified total difference when measured at the ends of a 203 mm bar, 105.5 mm on each side of rod centerline.

General Specifications

Item	Specification
Engine — 5.4L	

Displacement	5.4L (330 cu in)
Number of cylinders	8
Bore	90.2 mm (3.55 in)
Stroke	105.8 mm (4.17 in)
Firing order	1-3-7-2-6-5-4-8
Oil pressure (@ 2000 rpm — hot)	275.8-413.7 kPa (40-60 psi)
Oil capacity (includes filter change)	5.7 L (6.0 qts)
Compression ratio	9.0:1
Cylinder Head and Valve Train	
Combustion chamber volume	42.45-45.45 cc (2.59-2.77 cu in)
Valve arrangement (front to rear) — LH	E-I-E-I-E-I-E-I
Valve arrangement (front to rear) — RH	I-E-I-E-I-E-I-E
Valve guide bore diameter	7.044-7.015 mm (0.2773-0.2762 in)
Valve stem diameter — intake	6.995-6.975 mm (0.2754-0.2746 in)
Valve stem diameter — exhaust	6.970-6.949 mm (0.2744-0.2736 in)
Valve stem-to-guide clearance — intake	0.069-0.020 mm (0.0027-0.0008 in)
Valve stem-to-guide clearance — exhaust	0.095-0.045 mm (0.0037-0.0018 in)
Valve head diameter — intake	44.63-44.37 mm (1.7571-1.7469 in)
Valve head diameter — exhaust	36.01 mm (1.4177 in)
Valve face runout	0.05 mm (0.0020 in)
Valve face angle	45.75-45.25 degrees
Valve seat width — intake	1.3-1.5 mm (0.0512-0.0591 in)
Valve seat width — exhaust	2.1-1.9 mm (0.0827-0.0748 in)
Valve seat runout (T.I.R.)	0.025 mm (0.0010 in)
Valve seat angle	45.50 degrees
Valve spring free length	53.37 mm (2.10 in)
Valve spring squareness	2.0 degrees
Valve spring compression pressure	720-800 N (161.862-179.847 lb) @ 28.02 mm (1.10 in)
Valve spring installed height	42.9-42.3 mm (1.6890-1.6654 in)
Valve spring installed pressure — valve open	760 N @ 28.80 mm (170.855 lb @ 1.1339 in)
Valve spring installed pressure — valve closed	302 N @ 42.56 mm (67.8923 lb @ 1.6756 in)
Roller follower ratio	1.75:1
Hydraulic Lash Adjuster	
Diameter	16.000-15.988 mm (0.6299-0.6295 in)
Clearance-to-bore	0.018-0.069 mm (0.0007-0.0027 in)
Service limit	0.016 mm (0.0006 in)
Hydraulic leakdown rate	5-25 seconds [a]
Collapsed lash adjuster gap	0.085-0.450 mm (0.0335-0.0177 in)
Camshaft	
Theoretical valve lift @ 0 lash — intake	12.02 mm (0.4732 in)
Theoretical valve lift @ 0 lash — exhaust	12.67 mm (0.4988 in)

Lobe lift — intake	7.1104 mm (0.2799 in)
Lobe lift — exhaust	7.4979 mm (0.2952 in)
Allowable lobe lift loss	0
Journal diameter	26.962-26.936 mm (1.0615-1.0605 in)
Camshaft journal bore inside diameter (cap assembled)	27.012-26.987 mm (1.0635-1.0625 in)
Camshaft journal-to-bearing clearance	0.076-0.025 mm (0.0030-0.0010 in)
Runout [b]	0.03 mm (0.0012 in)
End play	0.0270-0.0190 mm (0.0011-0.0075 in)
Cylinder Block	
Cylinder bore diameter — grade 1	90.200-90.210 mm (3.5512-3.5516 in)
Cylinder bore diameter — grade 2	90.210-90.220 mm (3.5516-3.5520 in)
Cylinder bore diameter — grade 3	90.220-90.230 mm (3.5520-3.5524 in)
Cylinder bore maximum taper	0.006 mm (0.0002 in)
Cylinder bore maximum out-of-round	0.020 mm (0.0008 in)
Main bearing bore inside diameter	72.401-72.422 mm (2.850-2.851 in)
Crankshaft	
Main bearing journal diameter	67.483-67.503 mm (2.6568-2.6576 in)
Main bearing journal maximum taper (straightness)	0.004 mm (0.0002 in)
Main bearing journal maximum out-of-round	0.0075 mm (0.0003 in) between cross sections
Main bearing journal-to-cylinder block clearance	0.048-0.024 mm (0.0019-0.0009 in)
Connecting rod journal diameter	53.003-52.983 mm (2.0867-2.0859 in)
Connecting rod journal maximum taper	0.004 mm (0.0002 in)
Connecting rod journal maximum out-of-round	0.0075 mm (0.0003 in) between cross sections
Crankshaft maximum end play	0.075-0.377 mm (0.0030-0.0148 in)
Piston and Connecting Rod	
Piston diameter — grade 1 (at right angle to pin bore)	90.175-90.165 mm (3.5502-3.5498 in)
Piston diameter — grade 2 (at right angle to pin bore)	90.185-90.175 mm (3.5506-3.5502 in)
Piston diameter — grade 3 (at right angle to pin bore)	90.195-90.185 mm (3.5510-3.5506 in)
Piston-to-cylinder bore clearance (at grade size)	0.025-0.045 mm (0.0010-0.0018 in)
Piston ring end gap — top	0.13-0.28 mm (0.0051-0.0110 in)
Piston ring end gap — intermediate	0.25-0.40 mm (0.0098-0.0158 in)
Piston ring end gap — oil control	0.15-0.65 mm (0.0059-0.0256 in)
Piston ring groove width — top	1.53-1.55 mm (0.0602-0.0610 in)
Piston ring groove width — intermediate	1.52-1.54 mm (0.0598-0.0606 in)
Piston ring groove width — oil control	3.030-3.050 mm (0.1193-0.1201 in)
Piston ring width	1.49-1.46 mm (0.0587-0.0575 in)
Piston ring-to-groove clearance — top	0.030-0.050 mm (0.0012-0.0020 in)
Piston ring-to-groove clearance — intermediate	0.030-0.080 mm (0.0012-0.0031 in)
Piston pin bore diameter	22.008-22.014 mm (0.8665-0.8667 in)

Piston pin diameter	22.0005-22.0030 mm (0.8662-0.8663 in)
Piston pin length	61.8 mm (2.433 in)
Piston pin-to-piston fit (clearance)	0.005-0.0135 mm (0.0002-0.0005 in)
Connecting rod-to-pin clearance	0.009-0.0235 mm (0.0004-0.0093 in)
Connecting rod pin bore diameter	22.012-22.024 mm (0.8666-0.8671 in)
Connecting rod length (centerline bore-to-bore)	169.1 mm (6.6575 in)
Connecting rod maximum allowed bend	± 0.038 mm (0.0015 in)
Connecting rod maximum allowed twist	± 0.05 mm (0.0020 in)
Connecting rod bearing bore diameter (with assembled liners)	53.049-53.027 mm (2.0885-2.0877 in)
Connecting rod bearing-to-crankshaft clearance	0.064-0.026 mm (0.0025-0.0010 in)
Connecting rod side clearance	0.475-0.125 mm (0.0187-0.0049 in)

[a] Time required for the plunger to leak down 1.6 mm of travel with 222 N force and leak-down fluid in the lash adjuster.
[b] Full indicator measurement on all journals when supported on front and rear journals (4 places).

Torque Specifications

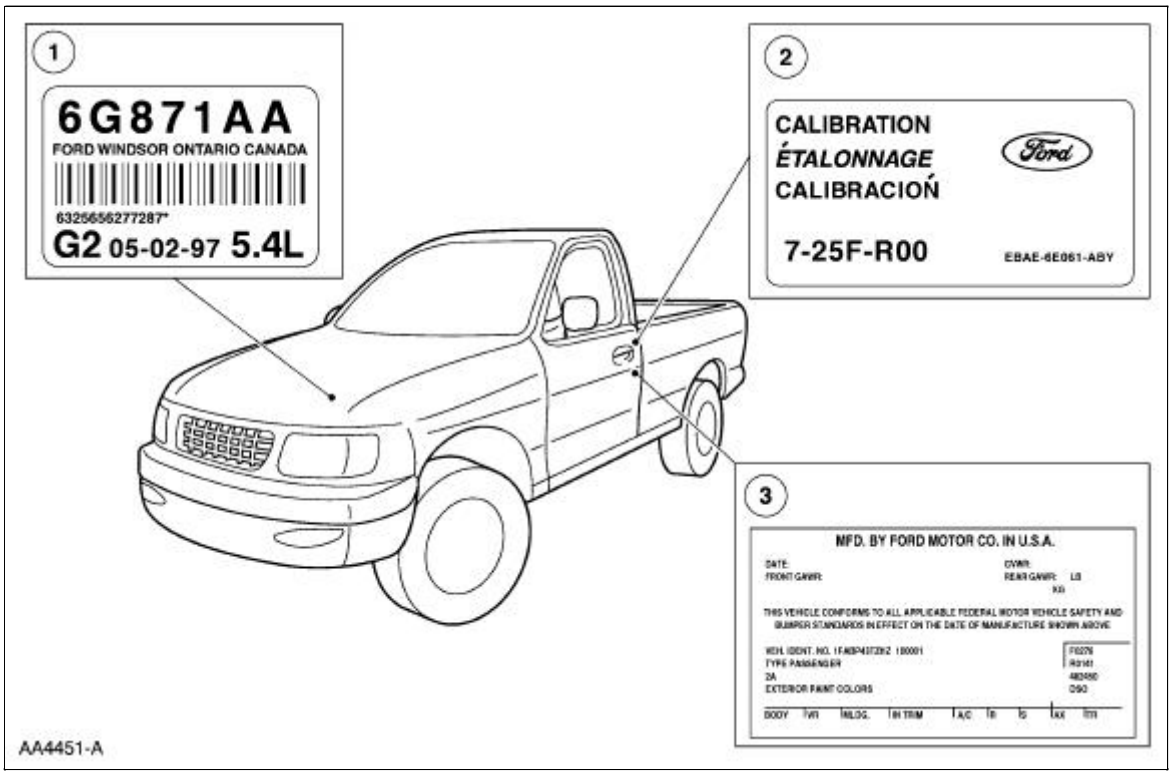
Description	Nm	lb-ft	lb-in
Accelerator cable bracket bolts	10	—	89
Brake booster vacuum hose bracket nut (4.6L)	10	—	89
Brake booster vacuum hose bracket bolt (5.4L)	10	—	89
Camshaft bearing cap bolts	10	—	89
Camshaft sprocket bolts [a]	—	—	—
Cylinder head temperature sensor (CHT)	26	19	—
Camshaft position sensor bolt	10	—	89
Crankshaft position sensor bolt	10	—	89
Connecting rod bolts [a]	—	—	—
Crankshaft damper pulley bolt [a]	—	—	—
Crankshaft main bearing bolts (cross-mounted) [a]	—	—	—
Crankshaft main bearing bolts (vertical) [a]	—	—	—
Cylinder heads bolts [a]	—	—	—
Differential pressure feedback EGR sensor nuts (5.4L)	10	—	89
Differential pressure feedback EGR sensor bracket nut (5.4L)	10	—	89
Differential pressure feedback EGR sensor bracket bolt (5.4L)	10	—	89
Drive belt idler pulley bolts	25	18	—
Engine front cover bolts [a]	—	—	—
Engine mount to cylinder block bolts	63	44	—
Engine mount LH through bolt	200	148	—
Engine mount RH nut	103	76	—
EGR valve to intake manifold bolts [a]	—	—	—
Exhaust manifold nuts	25	18	—

Exhaust manifold studs	12	9	—
Exhaust manifold to EGR valve tube fittings [a]	—	—	—
Exhaust manifold-to-Y-pipe nuts	40	30	—
Fan shroud bolts	9	—	80
Flywheel bolts	80	59	—
Frame crossmember nuts (under oil pan)	102	75	—
Fuel injection supply manifold bracket bolts	10	—	89
Generator upper mounting bracket bolts	10	—	89
Generator lower mounting bolts	25	18	—
Heater return tube studs (4.6L)	25	18	—
Heater return tube studs (5.4L)	40	30	—
Idle air control valve screws [a]	—	—	—
Ignition coil	6	—	53
Lower intake manifold to upper intake manifold bolts [a]	—	—	—
Upper intake manifold to cylinder head bolts [a]	—	—	—
Intake manifold tuning valve screws [a]	—	—	—
Knock sensor	20	15	—
Oil filter	16	12	—
Oil filter adapter bolts	25	18	—
Oil level indicator tube bolt	10	—	89
Oil pan bolts [a]	—	—	—
Oil pan drain plug	14	10	—
Oil pressure switch	14	10	—
Oil pump bolts	10	—	89
Oil pump screen and pickup tube bolts	10	—	89
Oil pump screen and pickup tube spacer	25	18	—
Oil pump screen and pickup tube spacer bolt	25	18	—
Power steering pump bolts	25	18	—
Power steering reservoir upper bracket-to-thermostat housing bolt	11	8	—
Power steering reservoir upper bracket-to-middle bracket bolts	17	13	—
Power steering reservoir middle bracket-to-lower bracket bolts	23	17	—
Power steering reservoir lower bracket-to-engine cylinder head bolts	80	59	—
Powertrain control module bolts	7	—	62
Powertrain control module bracket bolts	7	—	62
Rear main oil seal retainer bolts	10	—	89
Spark plugs	18	13	—
Thermostat housing bolts	10	—	89
Throttle body spacer-to-intake manifold bolts	10	—	89
Throttle body-to-throttle body spacer bolts [a]	—	—	—
Timing chain guide bolts	10	—	89

Timing chain hydraulic tensioner bolts	25	18	—
Torque converter-to-flexplate nuts	35	26	—
Transmission-to-engine bolts	48	35	—
Valve cover bolts	10	—	89
Water pump bolts	25	18	—
Water pump pulley bolts	25	18	—

[a] Refer to the procedure in this section.

Engine



Item	Description
1	Engine identification label
2	Emission calibration label
3	Vehicle identification label

Engine Component View

The concept of modularity allows engine designs to share commonization between concepts and engine hardware. The four modules are the:

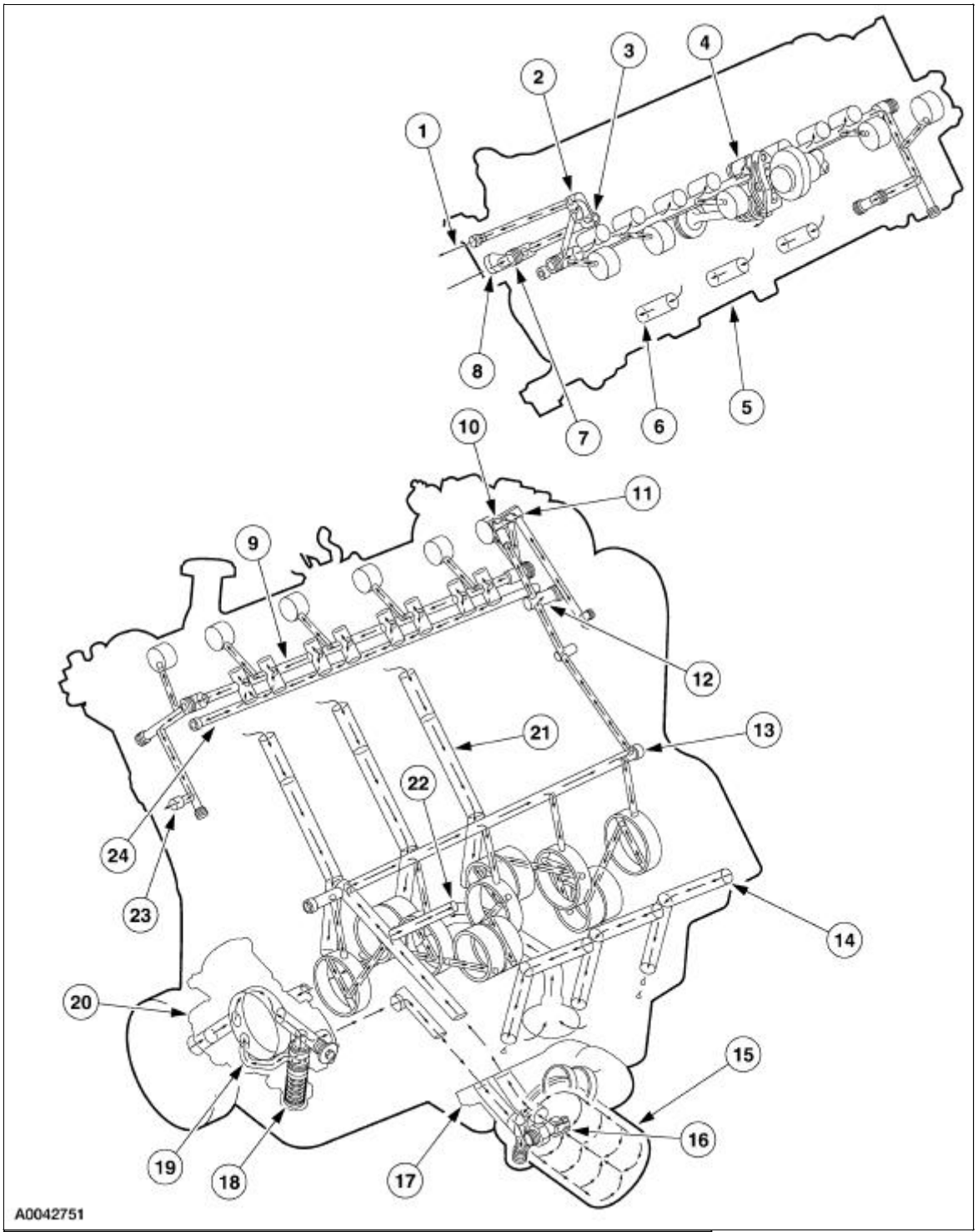
- intake module
- cylinder head module (RH)
- cylinder head module (LH)
- lower engine module

The modular engine concept supports efficiencies during repairs by allowing the removal and installation of these modules. While not all in-vehicle repairs can take advantage of the modular concept, most out-of-vehicle repairs benefit in reduction of time and labor needed to repair the engine.

The basic engine components consist of:

- single overhead camshafts
- two valves per cylinder
- sequential multiport fuel injection (SFI)
- aluminum cylinder heads
- a cast aluminum, 90-degree V-cylinder block (4.6L engines)
- a cast iron, 90-degree V-cylinder block (5.4L engines)
- individual ignition coils for each spark plug
- a two-piece intake manifold system with an aluminum upper and composite-material lower intake manifold with noise insulator (4.6L engines)
- a composite-material intake manifold with noise insulator and aluminum cross-over tube (5.4L engines)
- a large-bore throttle body

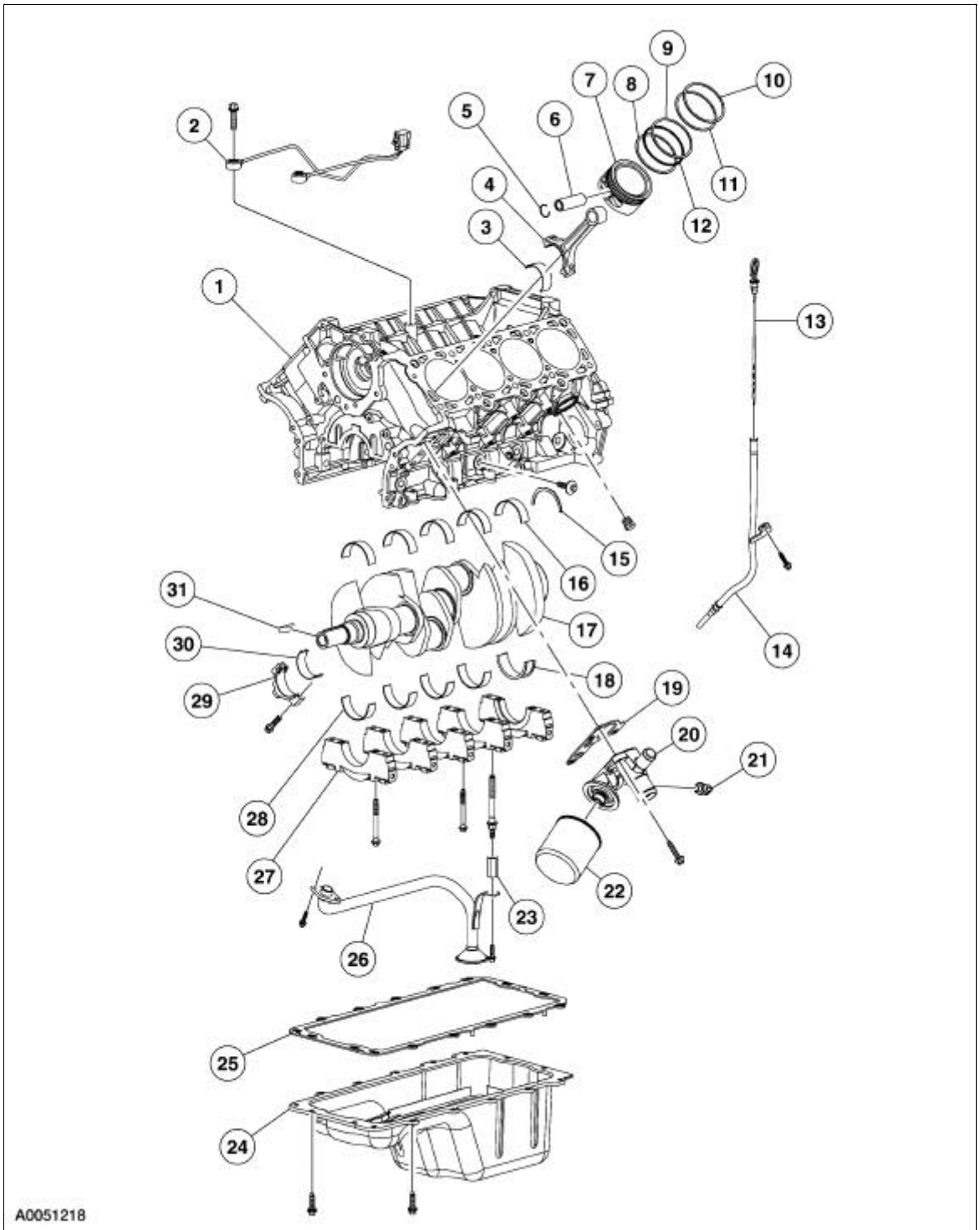
Engine Lubrication



Item	Part Number	Description
1	—	To hydraulic chain tensioner
2	—	Head gallery oil reservoir
3	—	Orifice and strainer
4	—	Metered oil travels through tappet and rocker arm and is splashed onto the cam lobe, roller bearings in rocker arm, and valve tip. Valve stem is lubricated by metered leakage past the lip of the stem seal.
5	6049	LH cylinder head
6	—	Oil drain to sump

7	—	Plant prelube access
8	—	From the left bank of the cylinder block
9	—	Tappet and cam bearing feed gallery (reduced pressure)
10	—	Orifice and strainer
11	—	Head gallery oil reservoir
12	—	Plant prelube access
13	—	Primary main gallery pressure (not restricted)
14	—	Oil drain to sump
15	6714	Oil bypass filter
16	9278	Oil pressure switch
17	6881	Oil filter adapter
18	Part of 6621	Oil pump integral relief valve
19	—	Bypass
20	6621	Oil pump
21	—	Oil drain to sump
22	—	To LH cylinder head
23	—	To hydraulic chain tensioner. Chain lubrication is metered through the tensioners
24	—	Tappet vent gallery (open to crankcase)

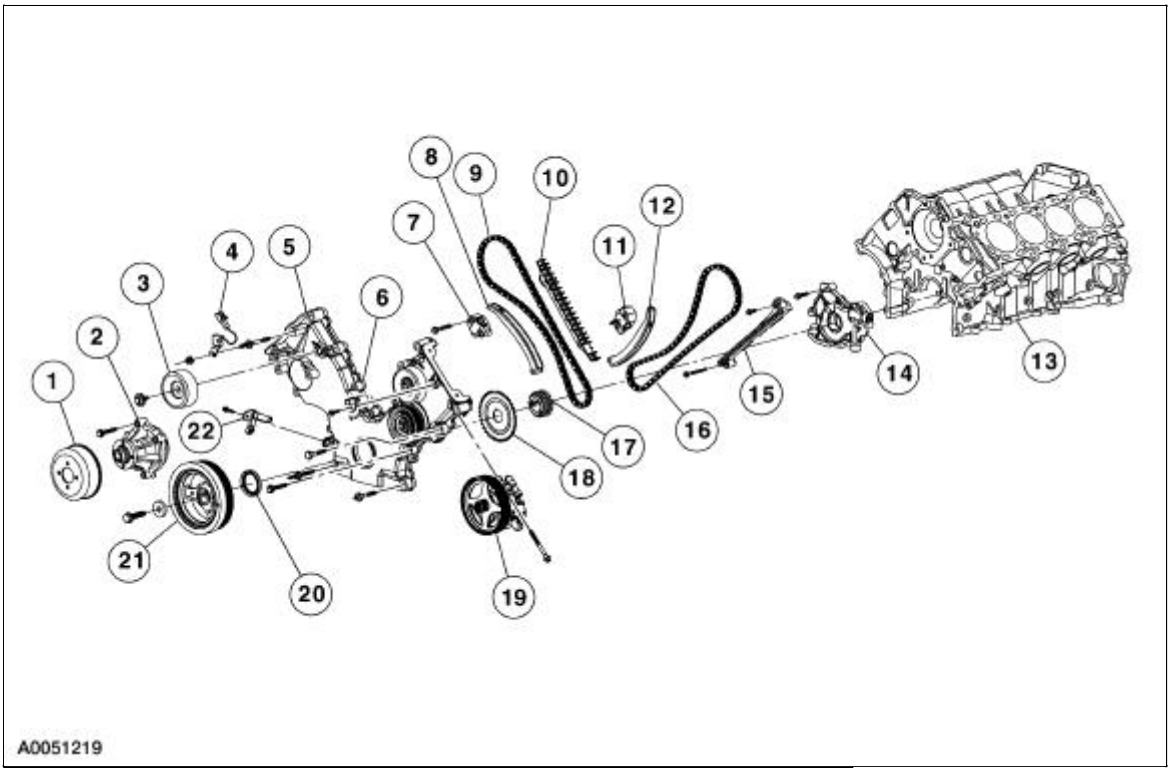
4.6L Romeo Engine — Lower End



Item	Part Number	Description
1	6010	Cylinder block
2	12A699	Knock sensor assembly
3	6211	Connecting rod bearing — upper (8 req'd)
4	—	Connecting rod assembly (8 req'd) (part of 6200)
5	6140	Piston pin retainer (16 req'd)
6	6135	Piston pin (8 req'd)
7	6110	Piston (8 req'd)
8	6159	Oil control ring — outer (8 req'd)

9	6159	Oil control ring — outer (8 req'd)
10	6150	Compression ring — upper (8 req'd)
11	6152	Compression ring — lower (8 req'd)
12	6161	Oil control ring — inner (8 req'd)
13	6750	Oil level indicator
14	6754	Oil level indicator tube
15	6A341	Crankshaft thrust washer
16	6333	Crankshaft main bearing — upper (5 req'd)
17	6303	Crankshaft
18	6A339	Crankshaft thrust bearing — lower
19	6A636	Oil filter adapter gasket
20	6881	Oil filter adapter
21	9278	Oil pressure switch
22	6714	Oil bypass filter
23	N806180	Spacer
24	6675	Oil pan
25	6710	Oil pan gasket
26	6622	Oil pump screen and pickup tube
27	6325	Crankshaft bearing cap (5 req'd)
28	6A338	Crankshaft main bearing — lower (4 req'd)
29	—	Connecting rod cap (8 req'd) (part of 6200)
30	6211	Connecting rod bearing — lower (8 req'd)
31	N806201	Key

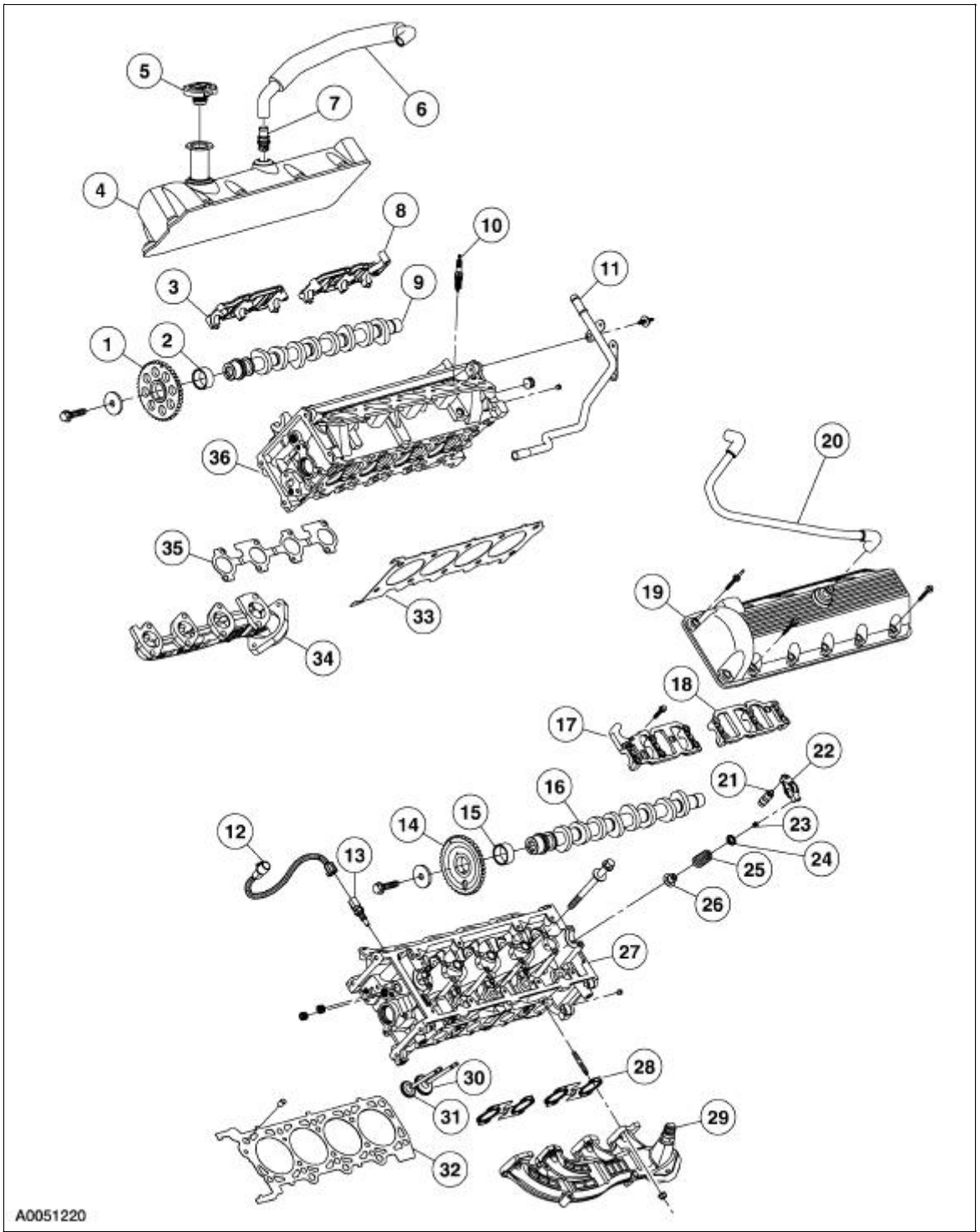
4.6L Romeo Engine — Front End



A0051219

Item	Part Number	Description
1	8A528	Water pump pulley
2	8501	Water pump
3	19A216	Idler pulley
4	18801	Radio ignition interference capacitor (2 req'd)
5	6C086	Engine front cover
6	6B288	Camshaft position sensor
7	6L266	Timing chain tensioner — RH
8	6L253	Timing chain tensioner arm — RH
9	6268	Timing chain — RH
10	6K297	Timing chain guide — RH
11	6L266	Timing chain tensioner — LH
12	6L253	Timing chain tensioner arm — LH
13	6010	Cylinder block
14	6621	Oil pump
15	6K297	Timing chain guide — LH
16	6268	Timing chain — LH
17	6306	Crankshaft sprocket
18	12A227	Ignition pulse wheel
19	3A696	Power steering pump assembly
20	6700	Crankshaft front oil seal
21	6316	Crankshaft pulley
22	6C315	Crankshaft position sensor

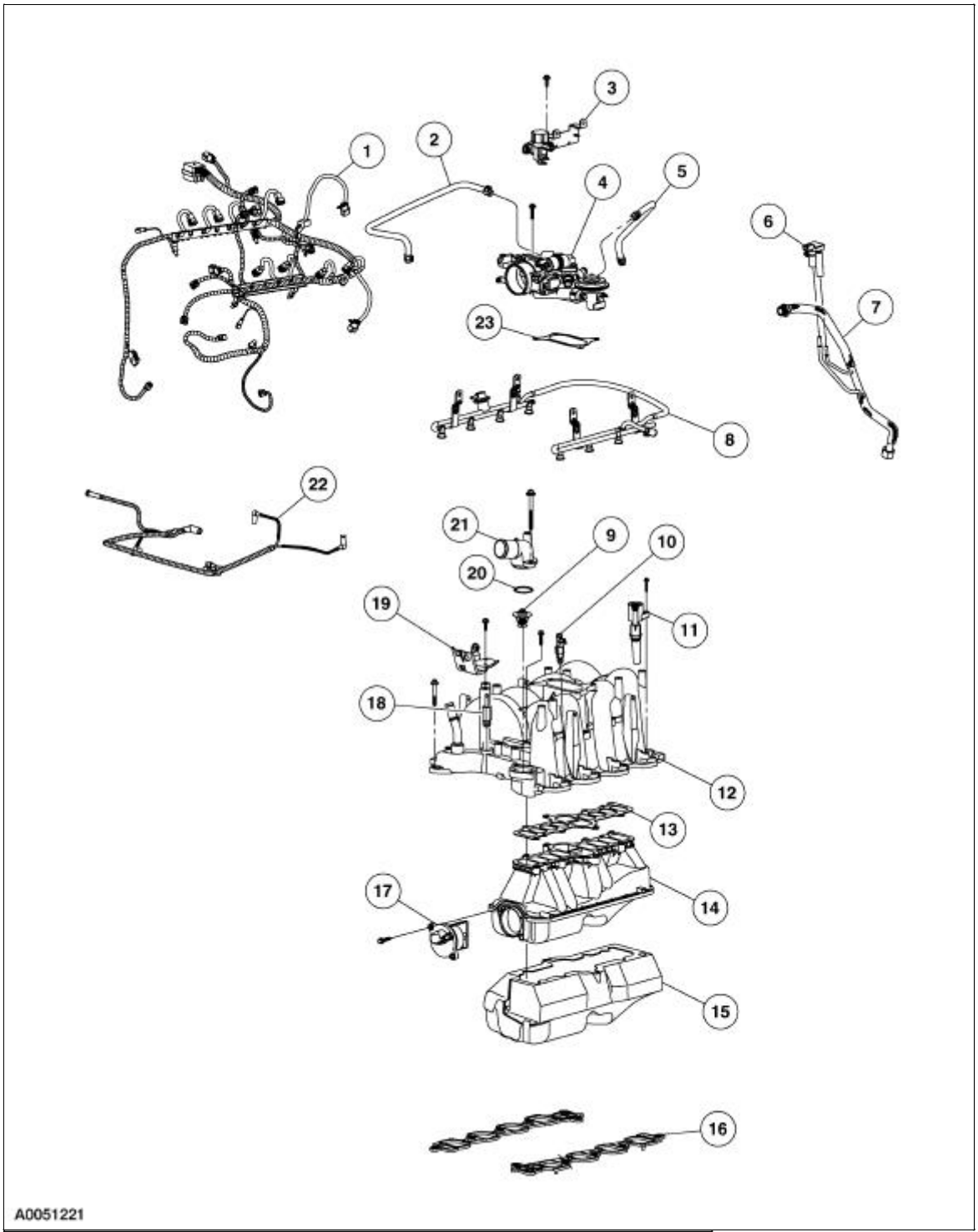
4.6L Upper End Components



Item	Part Number	Description
1	6256	Camshaft sprocket — RH
2	6265	Spacer
3	6B280	Camshaft bearing cap — RH, front
4	6582	Valve cover — RH
5	6766	Oil filler cap
6	6C324	Crankcase ventilation tube
7	6A666	Positive crankcase ventilation valve
8	6B280	Camshaft bearing cap — RH, rear

9	6250	Camshaft — RH
10	12405	Spark plug (8 req'd)
11	18663	Heater outlet tube
12	14B102	Jumper wire — CHT sensor
13	6G004	Cylinder head temperature sensor
14	6256	Camshaft sprocket — LH
15	6265	Spacer
16	6250	Camshaft — LH
17	6B280	Camshaft bearing cap — LH, front
18	6B280	Camshaft bearing cap — LH, rear
19	6A505	Valve cover — LH
20	6758	Crankcase ventilation tube
21	6C501	Hydraulic lash adjuster (16 req'd)
22	6529	Roller follower (16 req'd)
23	6518	Valve spring retainer key (32 req'd)
24	6514	Valve spring retainer (16 req'd)
25	6513	Valve spring (16 req'd)
26	6A517	Valve stem seal (16 req'd)
27	6050	Cylinder head — LH
28	9Y431	Exhaust manifold gasket — LH (2 req'd)
29	9429	Exhaust manifold — LH
30	6507	Intake valve (8 req'd)
31	6505	Exhaust valve (8 req'd)
32	6083	Cylinder head gasket — LH
33	6051	Cylinder head gasket — RH
34	9430	Exhaust manifold — RH
35	9448	Exhaust manifold gasket — RH
36	6049	Cylinder head — RH

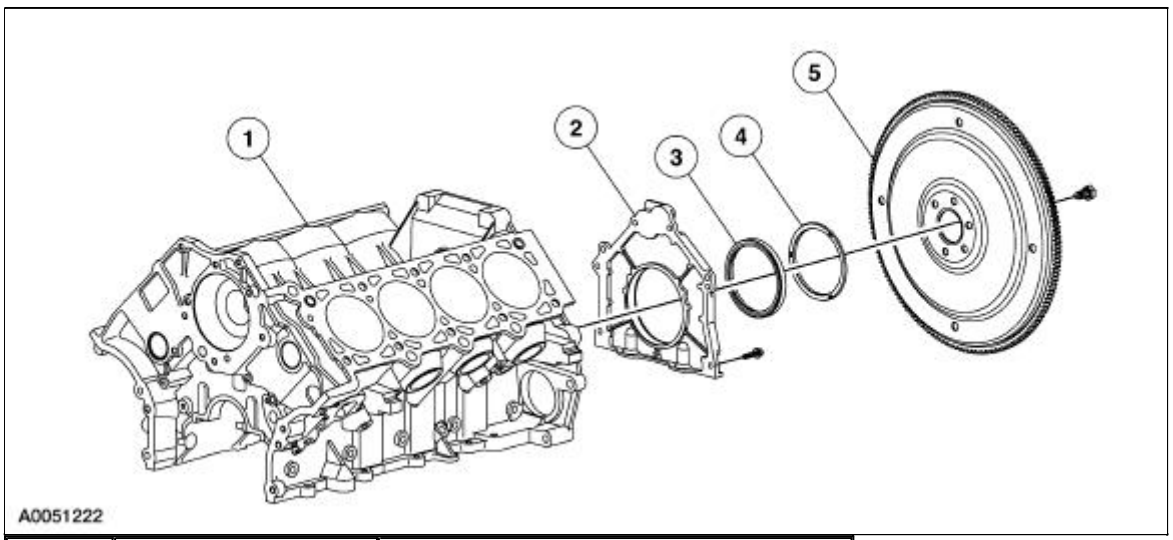
4.6L Engine Induction System Components



Item	Part Number	Description
1	12B637	Engine sensor control wiring harness
2	18465	Heated throttle body hose — inlet
3	9S429	Control and bracket — EGR vacuum
4	6E822	Throttle body and spacer assembly
5	18465	Heated throttle body hose — outlet
6	9J433	Differential pressure feedback EGR system
7	9D477	Exhaust manifold to EGR valve tube
8	9F792	Fuel injection supply manifold

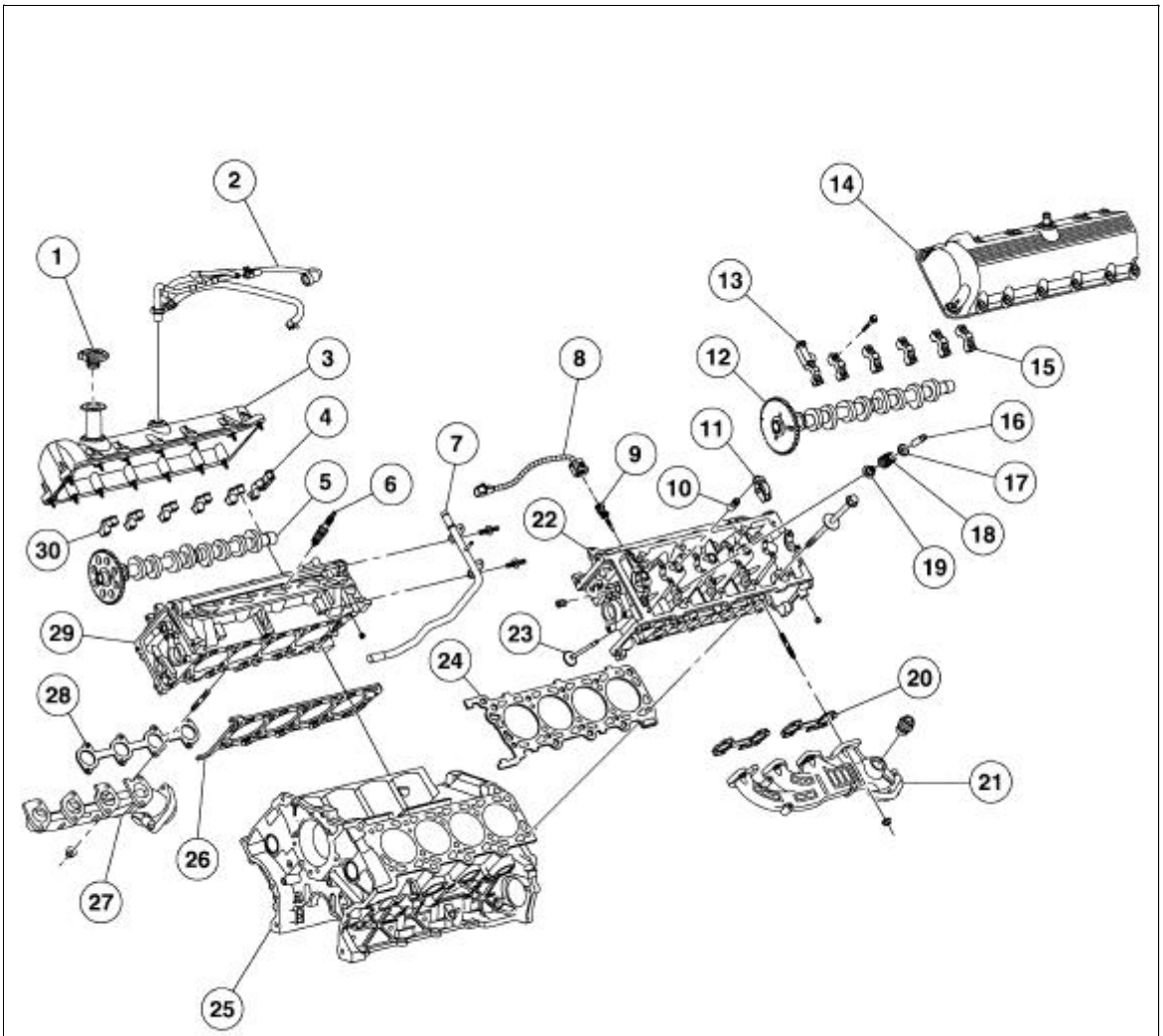
9	8575	Water thermostat
10	9F593	Fuel injector (8 req'd)
11	12A366	Ignition coil (8 req'd)
12	9424	Intake manifold — upper
13	9461	Intake manifold gasket— lower
14	9K461	Intake manifold — lower
15	6N041	Noise shield
16	9439	Intake manifold gasket — upper (2 req'd)
17	9L490	Intake manifold tuning valve
18	8597	Fitting — heated throttle body inlet
19	9728	Accelerator cable bracket
20	N806807	O-ring seal
21	8594	Water outlet housing
22	9E498	Vacuum harness
23	9L437	Throttle body adapter gasket

4.6L Engine Rear End Components



Item	Part Number	Description
1	6010	Cylinder block
2	6K318	Rear main seal retainer
3	6701	Rear main oil seal
4	6310	Rear main seal oil slinger
5	6375	Flexplate

5.4L Engine — Upper End

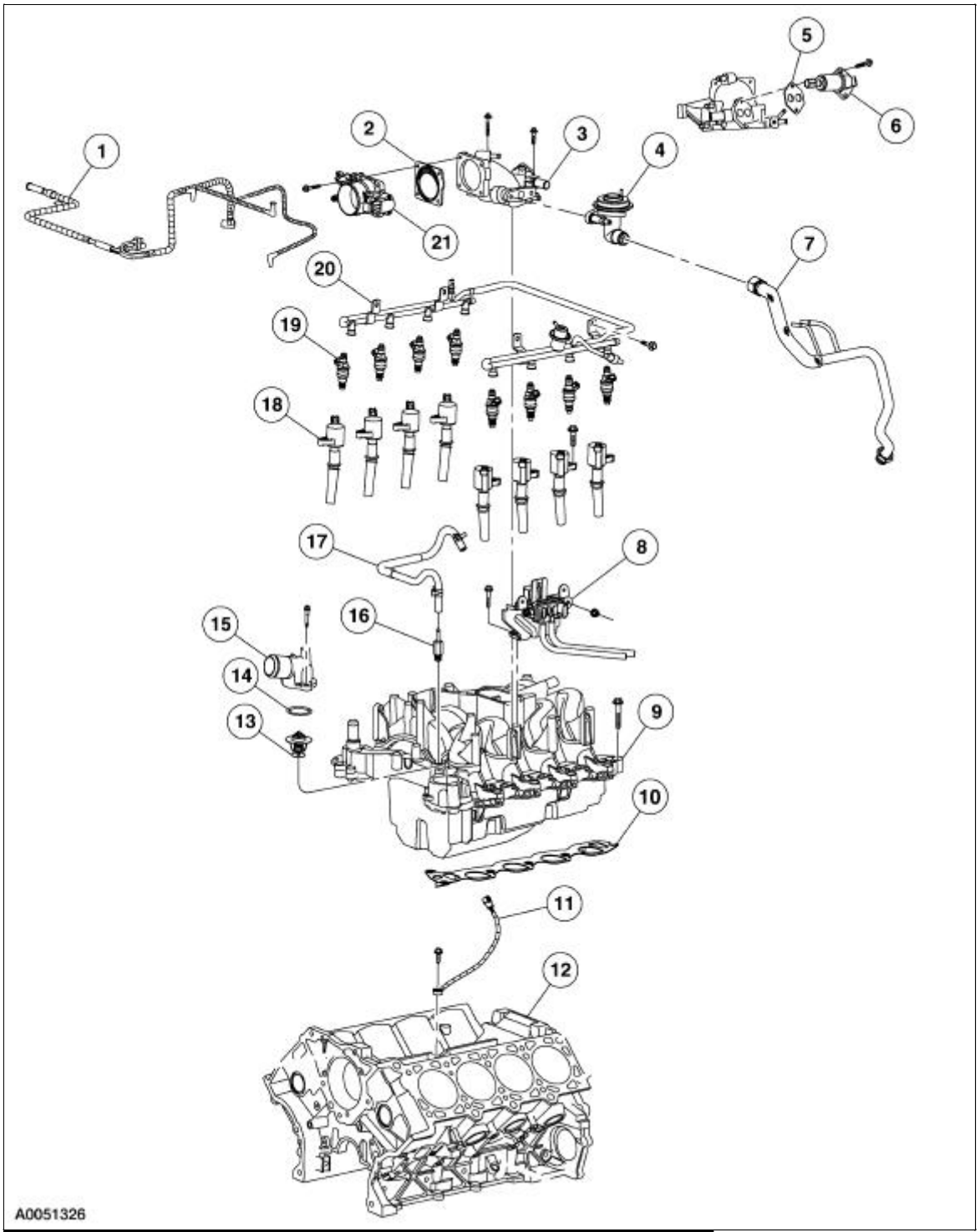


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Item	Part Number	Description
1	6766	Oil filler cap
2	6C324	Crankcase ventilation hose — with valve
3	6582	Valve cover — RH
4	6B284	Camshaft bearing cap
5	6251	Camshaft — RH
6	12405	Spark plug (8 req'd)
7	18663	Heater outlet tube
8	14B102	Cylinder head temperature sensor jumper harness
9	6G004	Cylinder head temperature sensor
10	6C501	Hydraulic lash adjuster (16 req'd)
11	6529	Roller follower (16 req'd)
12	6C255	Camshaft — LH
13	6B284	Camshaft bearing cap
14	6A505	Valve cover — LH

15	6B280	Camshaft bearing cap (5 req'd)
16	5618	Valve spring retainer key (32 req'd)
17	6514	Valve spring retainer (16 req'd)
18	6513	Valve spring (16 req'd)
19	6A517	Valve stem seal (16 req'd)
20	9Y431	Exhaust manifold gasket (2 req'd)
21	9431	Exhaust manifold — LH
22	6050	Cylinder head — LH
23	6505	Exhaust valve (8 req'd)
23	6507	Intake valve (8 req'd)
24	6083	Cylinder head gasket — LH
25	6010	Cylinder block
26	6051	Cylinder head gasket — RH
27	9430	Exhaust manifold — RH
28	9448	Exhaust manifold gasket — RH
29	6049	Cylinder head — RH
30	6B280	Camshaft bearing cap (5 req'd)

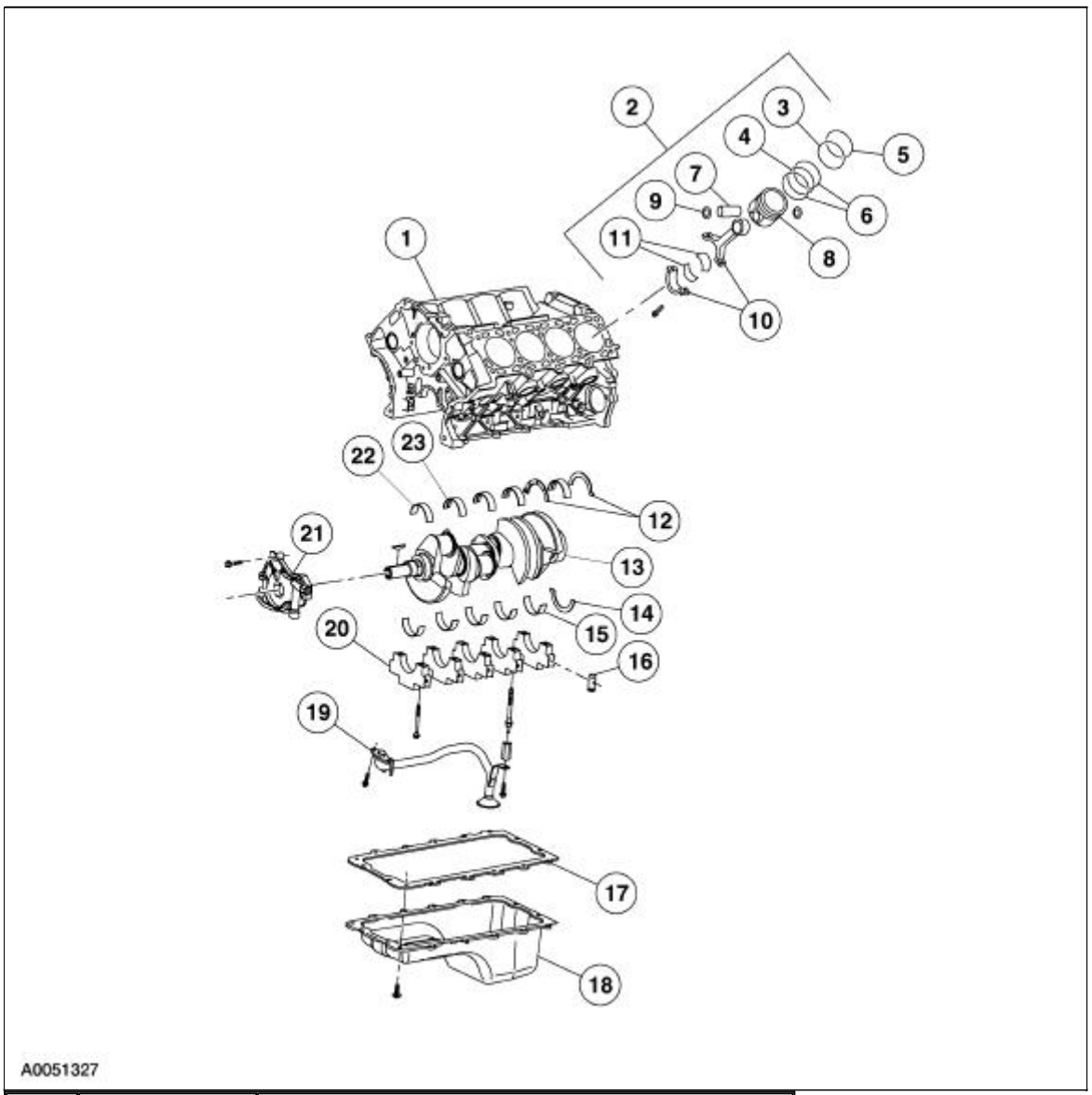
5.4L Engine Induction System



Item	Part Number	Description
1	9E498	Vacuum harness
2	9E936	Throttle body gasket
3	9A589	Throttle body adapter
4	9D460	EGR valve
5	9F670	Idle air control valve gasket
6	9F715	Idle air control valve
7	9D477	Exhaust manifold to EGR valve tube
8	9J472	Differential pressure feedback EGR system

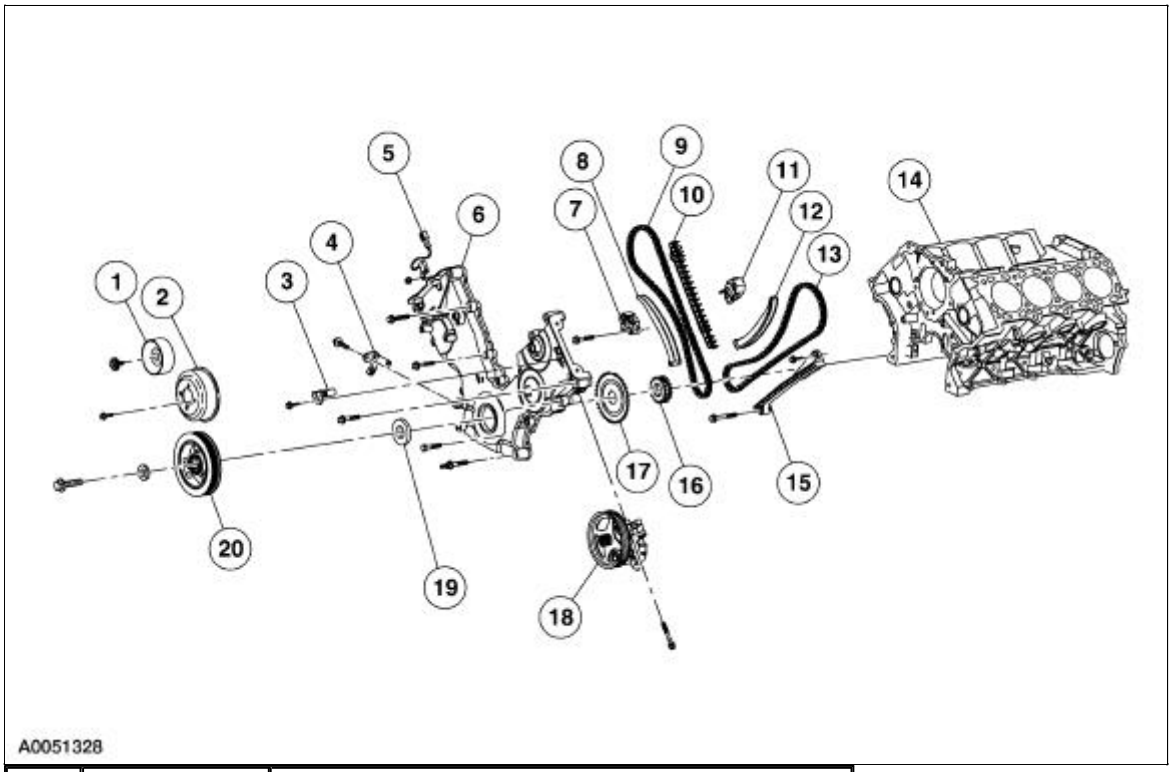
9	9424	Intake manifold
10	9439	Intake manifold gasket (2 req'd)
11	12A699	Knock sensor
12	6010	Cylinder block
13	8575	Water thermostat
14	N806807	O-ring seal
15	8594	Water outlet
16	8597	Fitting — heated throttle body inlet
17	18465	Heated throttle body hose — inlet
18	12A366	Ignition coil (8 req'd)
19	9F593	Fuel injector (8 req'd)
20	9F792	Fuel injection supply manifold
21	9E926	Throttle body

5.4L Engine — Lower End



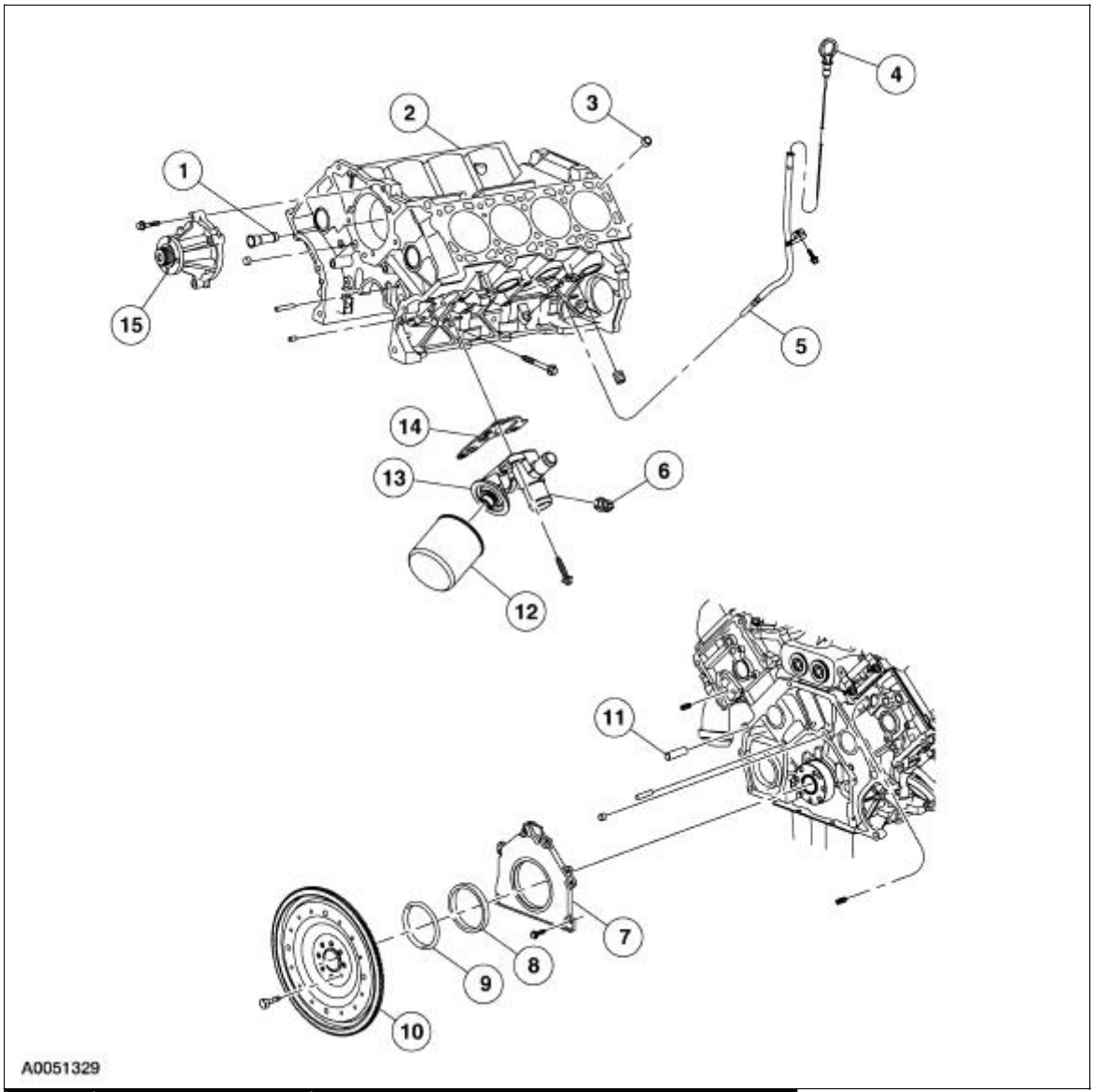
Item	Part Number	Description
1	6010	Cylinder block
2	6100	Piston and rod assembly (8 req'd)
3	6152	Lower compression ring (8 req'd)
4	6161	Inner oil control ring (8 req'd)
5	6150	Upper compression ring (8 req'd)
6	6159	Outer oil control ring (16 req'd)
7	6135	Piston pin (8 req'd)
8	6110	Piston (8 req'd)
9	6140	Piston pin retainer (16 req'd)
10	6200	Connecting rod assembly (8 req'd)
11	6211	Connecting rod bearing (16 req'd)
12	6A341	Crankshaft thrust washer — upper (2 req'd)
13	6303	Crankshaft
14	6K302	Crankshaft thrust washer — lower
15	6A338	Crankshaft bearing — lower (5 req'd)
16	6A346	Dowel (10 req'd)
17	6710	Oil pan gasket
18	6675	Oil pan
19	6622	Oil pump screen and pickup tube
20	6325	Crankshaft main bearing cap (5 req'd)
21	6621	Oil pump
22	6W337	Front crankshaft bearing — upper
23	6333	Crankshaft bearing — upper (4 req'd)

5.4L Engine — Front End



Item	Part Number	Description
1	19A216	Idler pulley (2 req'd)
2	8A528	Water pump pulley
3	6B288	Camshaft position sensor
4	6C315	Crankshaft position sensor
5	18801	Radio ignition interference capacitor (2 req'd)
6	6C086	Engine front cover
7	6L266	Timing chain tensioner — RH
8	6K255	Timing chain tensioner arm — RH
9	6268	Timing chain — RH
10	6M256	Timing chain guide — RH
11	6M269	Timing chain tensioner — LH
12	6M274	Timing chain tensioner arm — LH
13	6268	Timing chain — LH
14	6010	Cylinder block
15	6B274	Timing chain guide — LH
16	6306	Crankshaft sprocket
17	12A227	Ignition pulse wheel
18	3A696	Power steering pump
19	6700	Front crankshaft oil seal
20	6316	Crankshaft pulley

5.4L Engine — Exterior Components



Item	Part Number	Description
1	18B402	Heater water inlet connector
2	6010	Cylinder block
3	W704688	Hollow dowel (4 req'd)
4	6750	Oil level indicator
5	6K873	Oil level indicator tube
6	9278	Oil pressure switch
7	6K318	Rear main oil seal retainer plate
8	6701	Rear main oil seal
9	6310	Oil slinger
10	6375	Flexplate
11	N807198	Hollow dowel (2 req'd)
12	6714	Oil bypass filter
13	6K623	Oil filter adapter
14	6A636	Oil filter adapter gasket
15	8501	Water pump

Engine

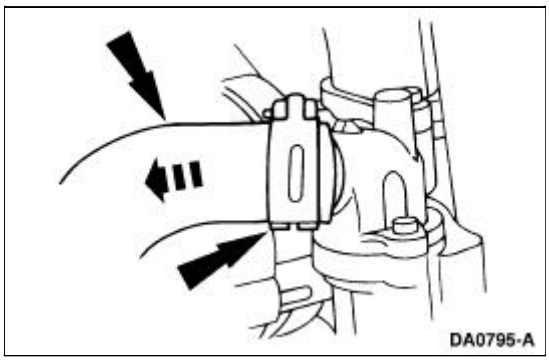
For basic engine mechanical concerns, refer to Section 303-00 . For driveability concerns, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Intake Manifold —4.6L

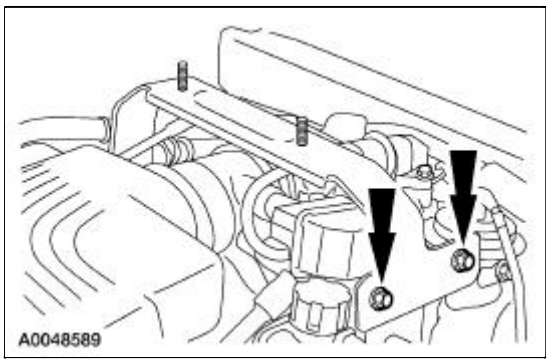
Removal

WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and can be ignited. Failure to follow these instructions may result in personal injury.

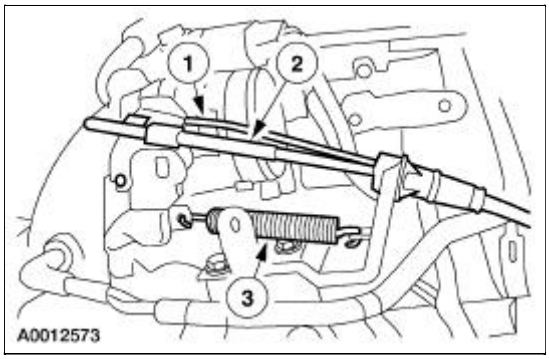
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the air cleaner outlet pipe. For additional information, refer to Section 303-12 .
3. Drain the engine cooling system. For additional information, refer to Section 303-03 .
4. Compress the hose clamp and disconnect the upper radiator hose.



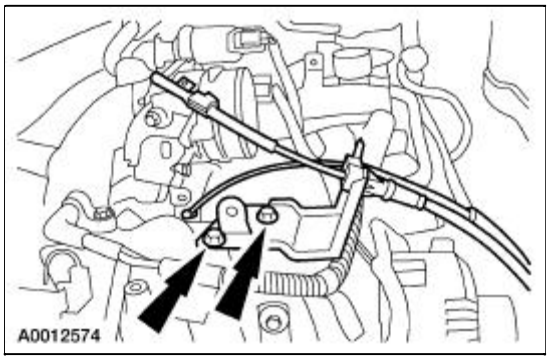
5. Remove the three bolts and the appearance cover mounting bracket.



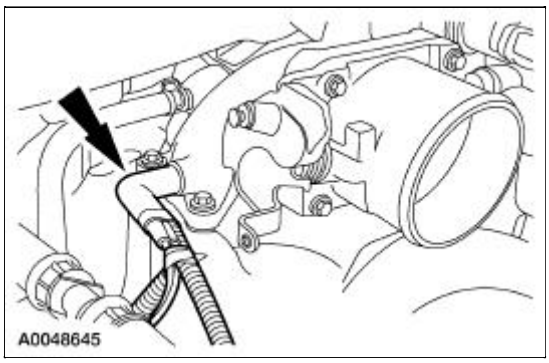
6. Disconnect the throttle body cam.
    1. Disconnect the accelerator cable.
    2. Disconnect the speed control actuator cable.
    3. Remove the accelerator return spring.



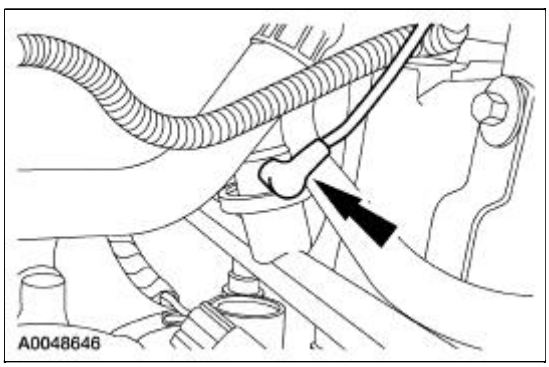
7. Remove the accelerator cable bracket bolts and position the bracket and cables aside.



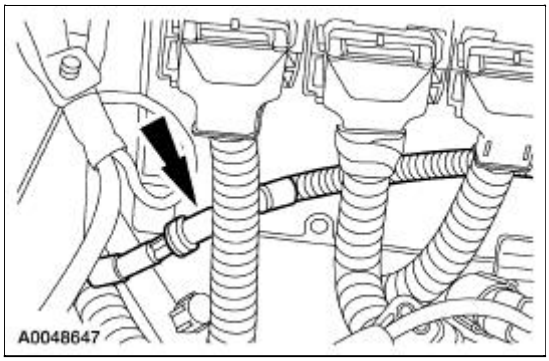
8. Disconnect the main vacuum harness.



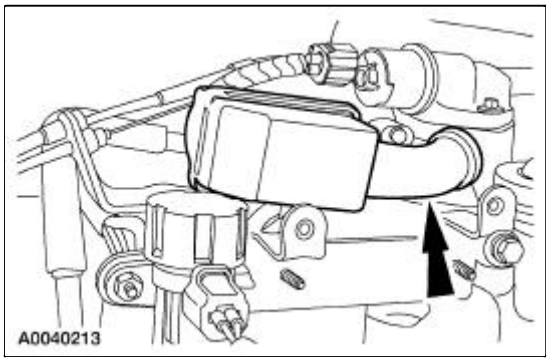
9. Disconnect the fuel pressure regulator vacuum hose.



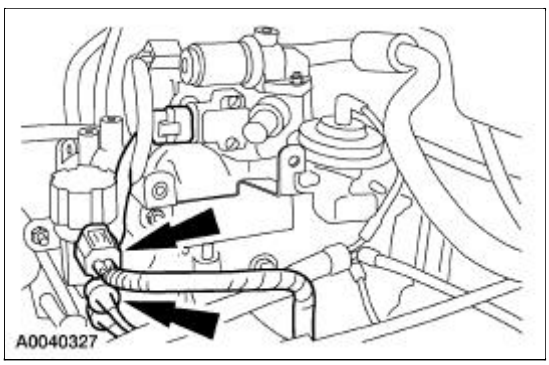
10. Disconnect the climate control vacuum hose.



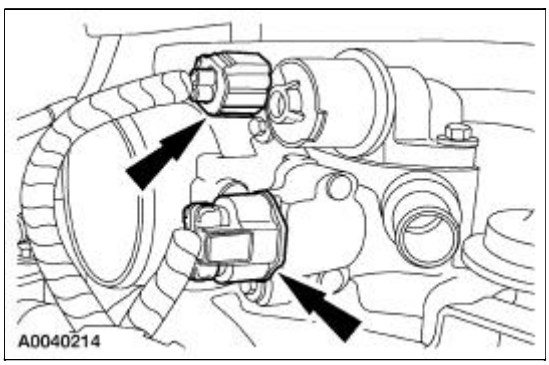
11. Remove the idle air control (IAC) fresh air hose.



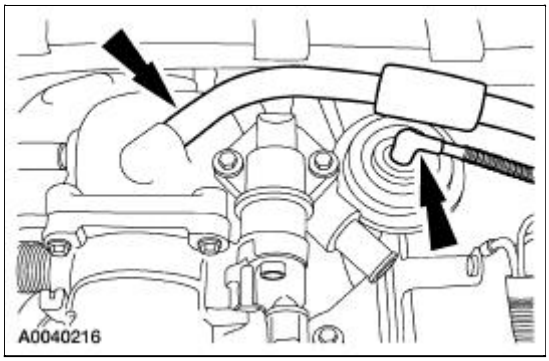
12. Disconnect the exhaust gas recirculation (EGR) vacuum regulator solenoid connections.



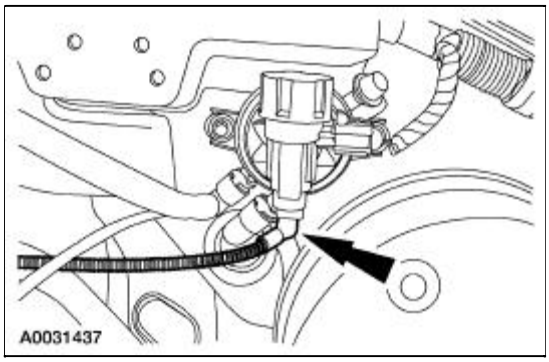
13. Disconnect the IAC and throttle position (TP) sensor electrical connectors.



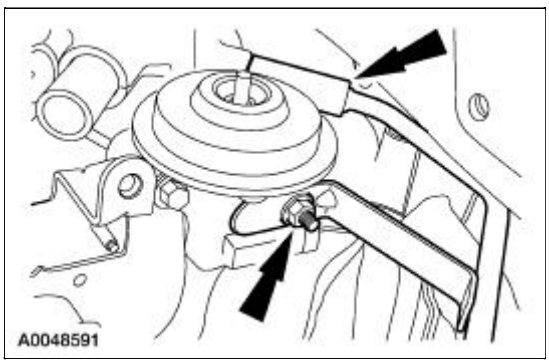
14. Disconnect the EGR valve vacuum hose and the evaporative emission canister purge valve hose and position them aside.



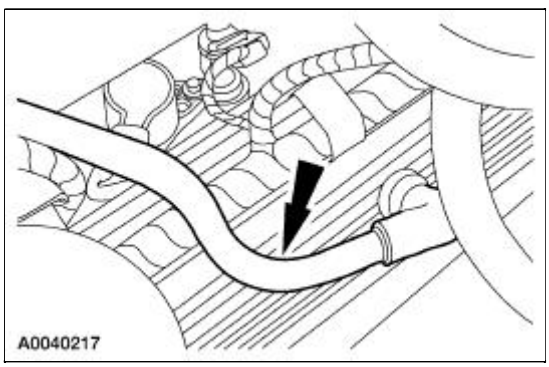
15. Disconnect the evaporative emission canister purge valve vacuum hose and remove the vacuum harness.



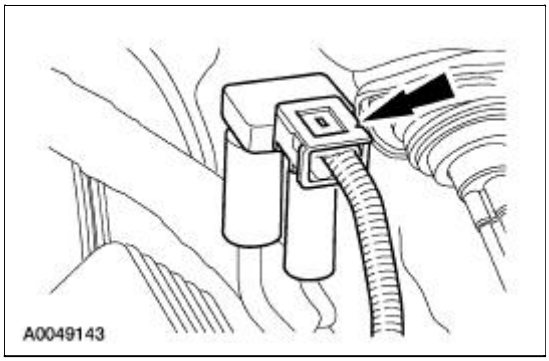
16. Remove the nut and disconnect the brake booster vacuum tube. Position the bracket and tube aside.



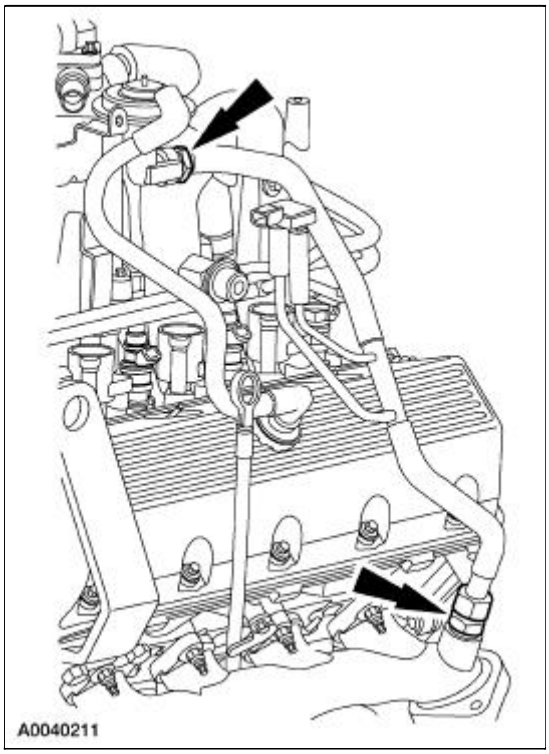
17. Position the crankcase ventilation hose aside.



18. Disconnect the differential pressure feedback EGR system electrical connector.

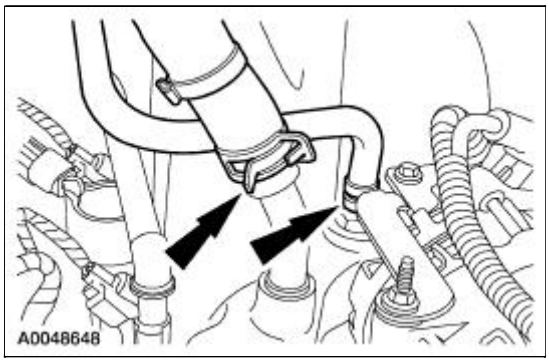


19. Position the exhaust manifold to EGR valve tube aside.
    - Disconnect the upper fitting.
    - Loosen the lower fitting.
    - Position the tube aside.

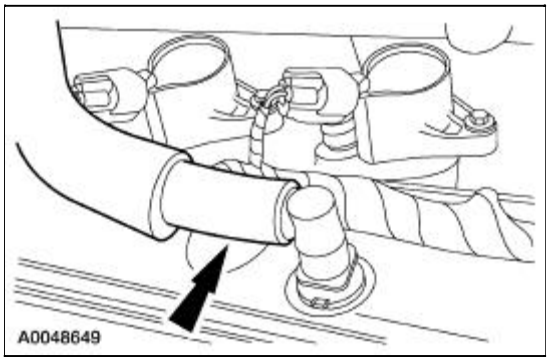


20. Disconnect the fuel hose spring lock coupling. For additional information, refer to Section 310-00 .

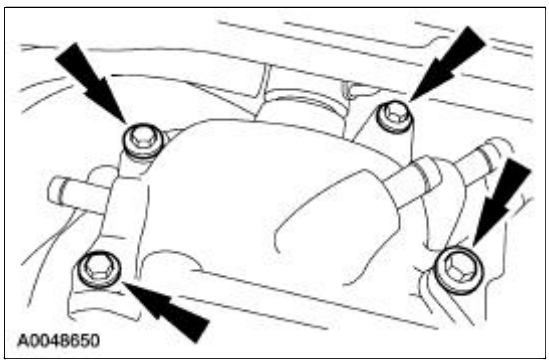
21. Disconnect the heater hose and the heated throttle body hose.



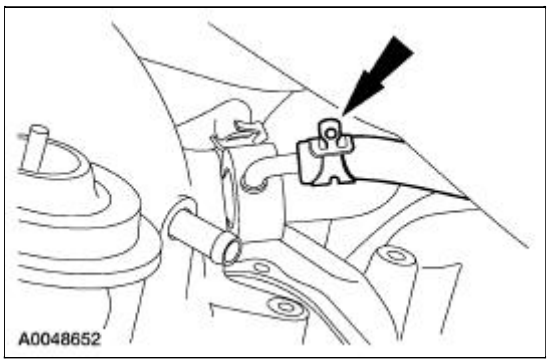
22. Disconnect the positive crankcase ventilation (PCV) hose.



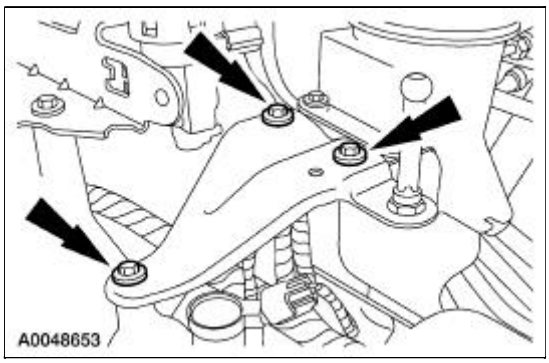
23. Remove the four bolts and move the throttle body adapter forward slightly.



24. Disconnect the heated throttle body hose and remove the throttle body adapter.
    - Discard the throttle body adapter-to-intake manifold gasket.
    - Inspect the throttle body and adapter for damage.

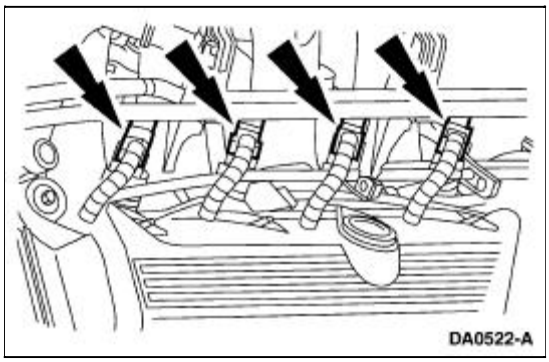


25. Remove the power steering reservoir upper mounting bracket.

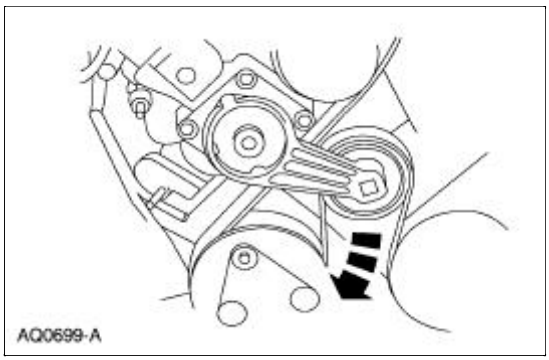


26. Disconnect and remove the eight ignition coils. For additional information, refer to Section 303-07A .

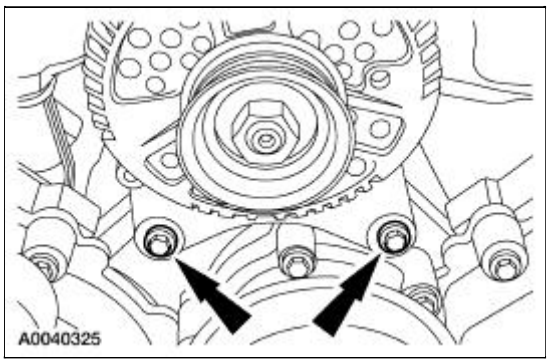
27. Disconnect the eight fuel injectors.



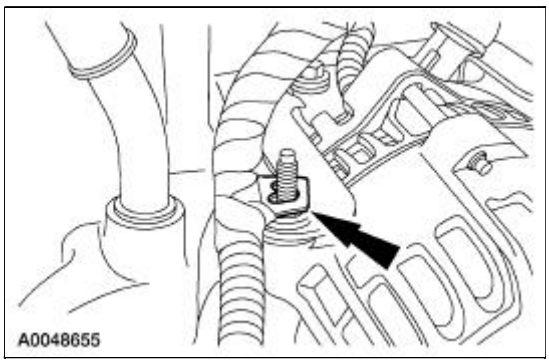
28. Rotate the belt tensioner clockwise and detach the drive belt from the generator pulley.



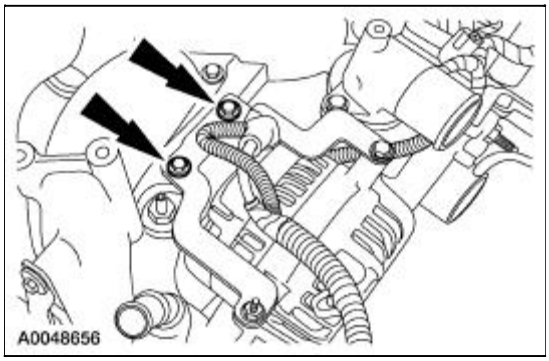
29. Loosen the generator lower mounting bolts.



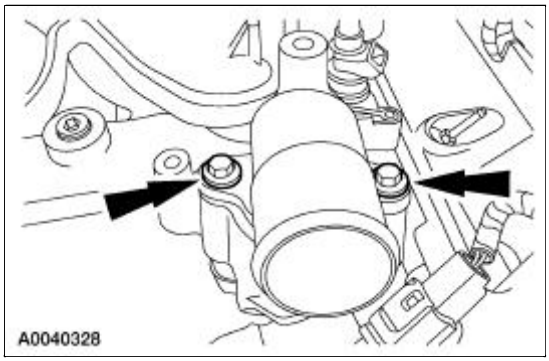
30. Disconnect the harness routing clip.



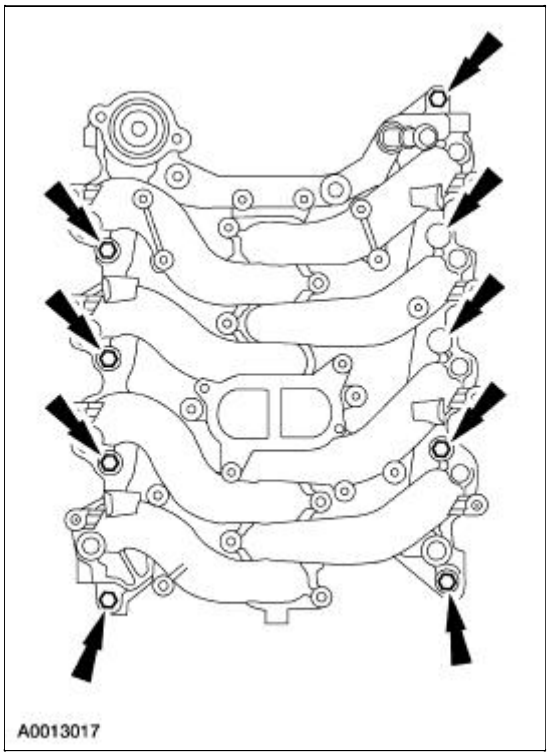
31. Remove the bolts and position the generator aside.



32. Remove the bolts, water thermostat housing and thermostat.
    - Discard the O-ring seal.

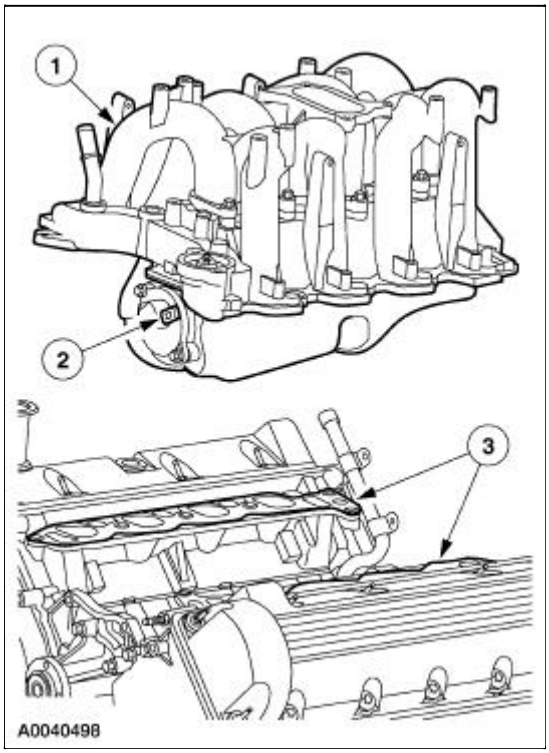


33. Remove the nine bolts.



34. Remove the intake manifold assembly.
    1. Lift the intake manifold.
    2. Disconnect the intake manifold tuning valve connector.

3. Remove the intake manifold and discard the gaskets.
   - Inspect the intake manifold assembly for damage.

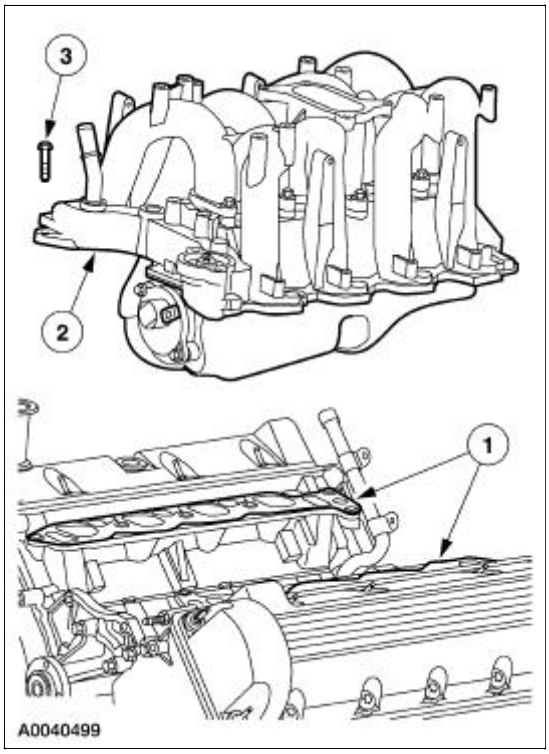


Installation

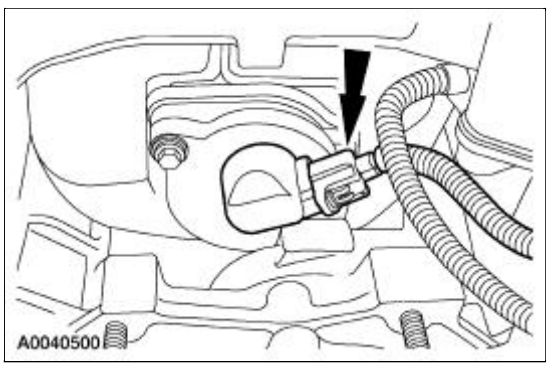
1. **CAUTION: Do not use metal scrapers, power abrasive discs or any abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraper only.**

   Clean all the sealing surfaces.

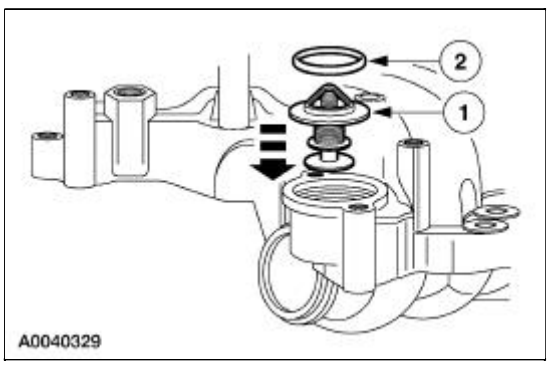
2. Install the upper intake manifold.
   1. Position the new intake manifold gaskets.
   2. Position the upper intake manifold.
   3. Loosely install nine bolts.



3. Connect the intake manifold tuning valve electrical connector.

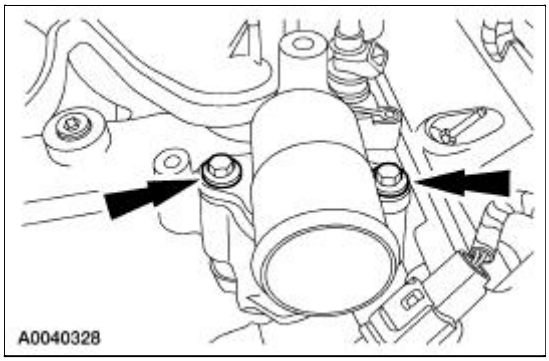


4. Install the water thermostat.
    1. Install the thermostat.
    2. Install a new O-ring seal.

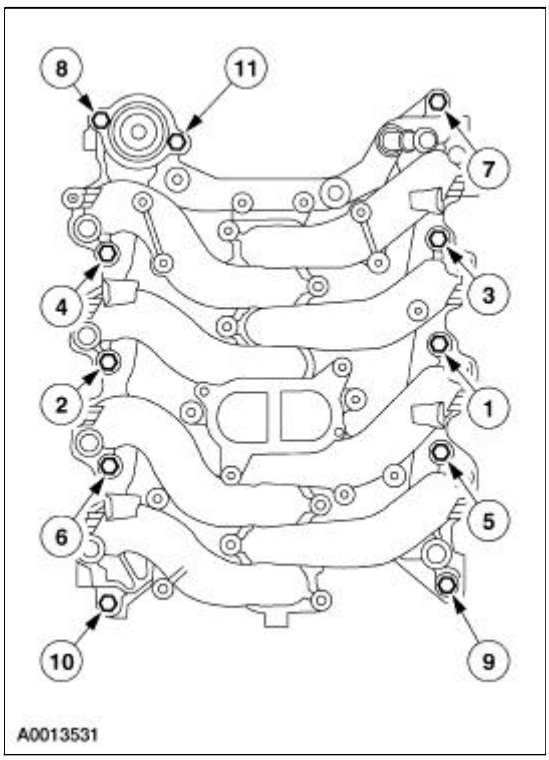


5. **NOTE:** The thermostat housing bolts are tightened in sequence with the intake manifold bolts.

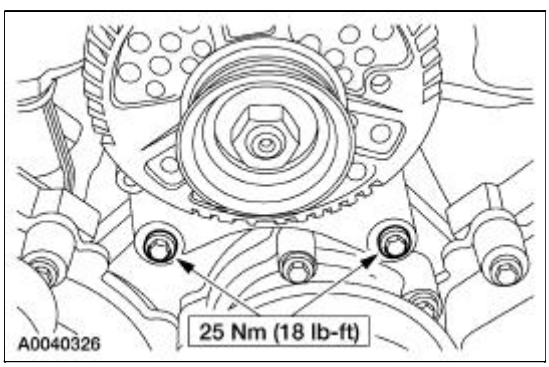
    Install the thermostat housing and loosely install the bolts.



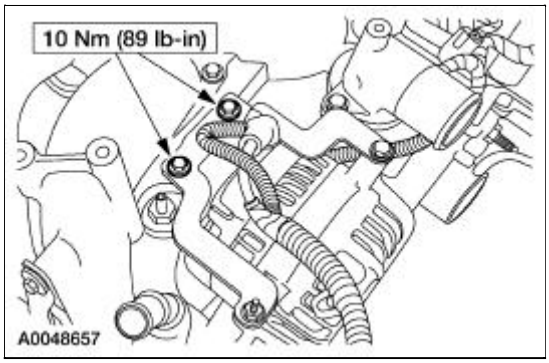
6. Tighten the 11 bolts in two stages in the sequence shown.
    - Stage 1: tighten to 2 Nm (18 lb-in).
    - Stage 2: tighten to 25Nm (18 lb-ft).



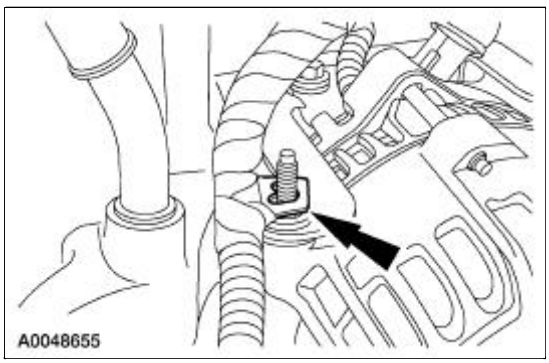
7. Position the generator and tighten the lower mounting bolts.



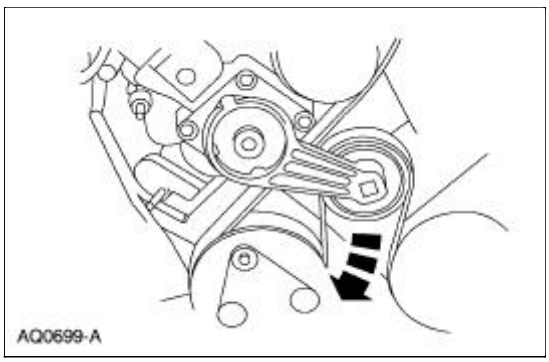
8. Install the generator upper mounting bracket bolts.



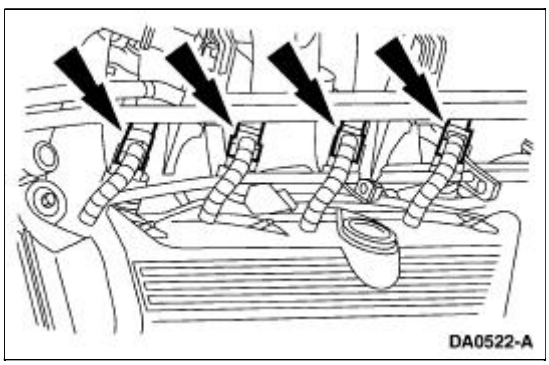
9. Install the harness routing clip.



10. Rotate the belt tensioner clockwise and install the drive belt. Refer to the decal on the radiator upper air deflector for belt routing.



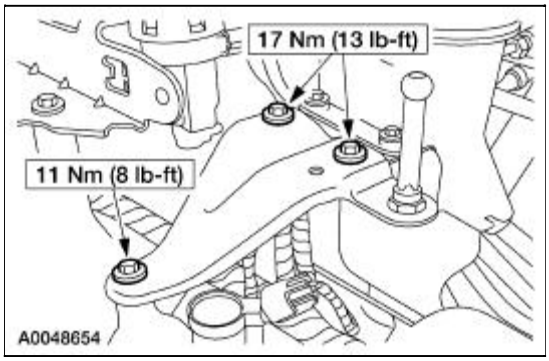
11. Connect the eight fuel injector electrical connectors.



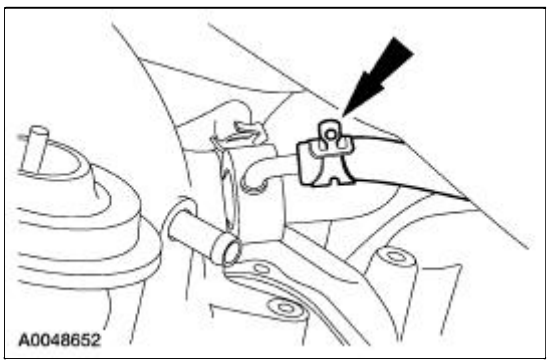
12. Install and connect eight ignition coils. For additional information, refer to Section 303-07A .

13. Connect the fuel hose spring lock coupling. For additional information, refer to Section 310-00 .

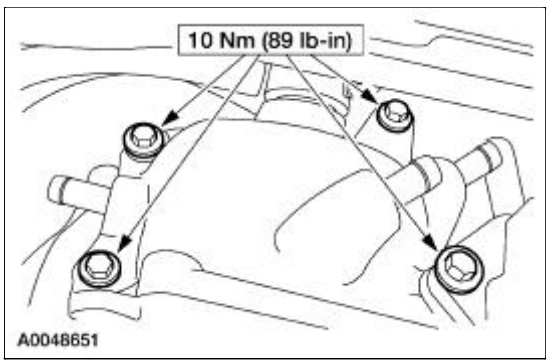
14. Install the power steering reservoir upper mounting bracket.



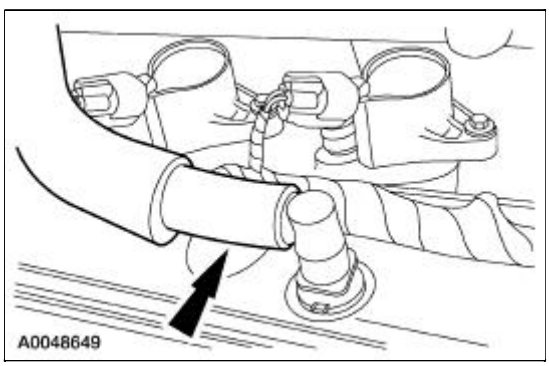
15. Roughly position the throttle body adapter in the vehicle and connect the heated throttle body hose.



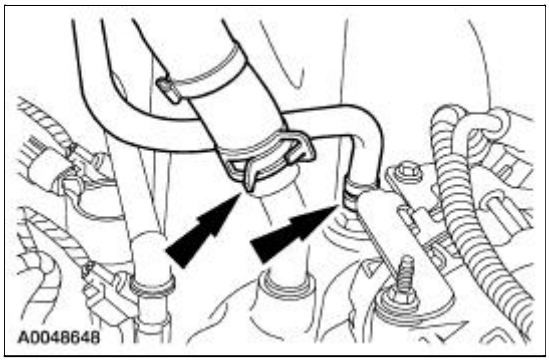
16. Install a new gasket and the throttle body adapter.



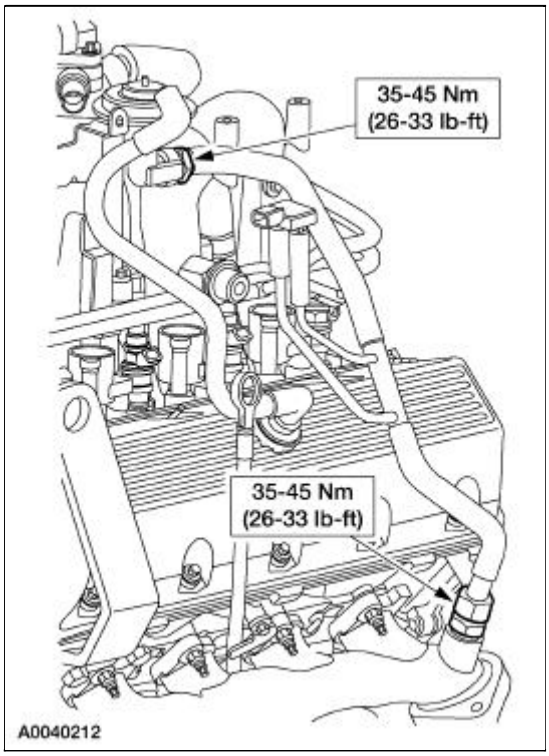
17. Connect the PCV hose.



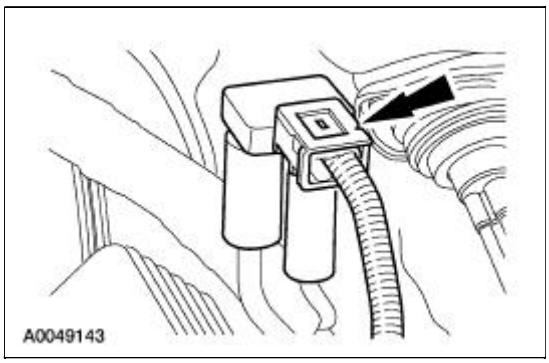
18. Connect the heater hose and heated throttle body hose.



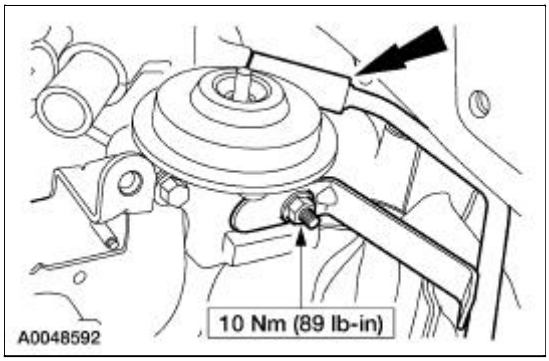
19. Install the exhaust manifold to EGR valve tube.
    - Hand-tighten the fittings.
    - Tighten the upper fitting.
    - Tighten the lower fitting.



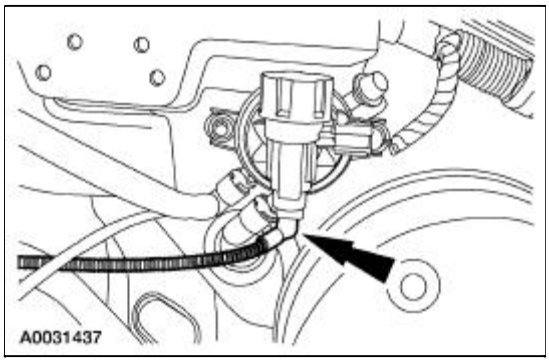
20. Connect the differential pressure feedback EGR system electrical connector.



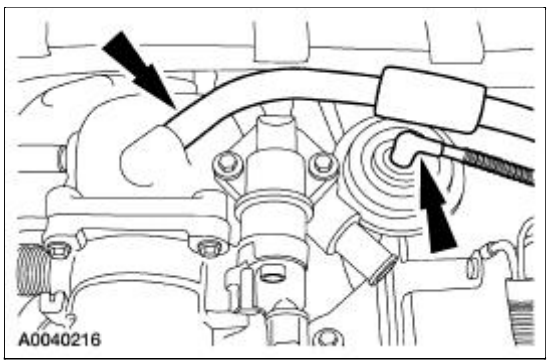
21. Connect the brake booster vacuum tube and bracket, and install the nut.



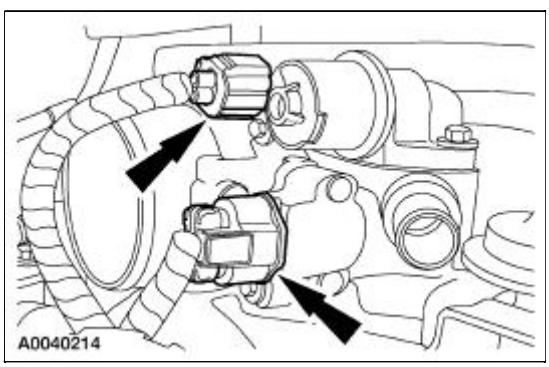
22. Roughly position the vacuum harness and connect the evaporative emission canister purge valve vacuum hose.



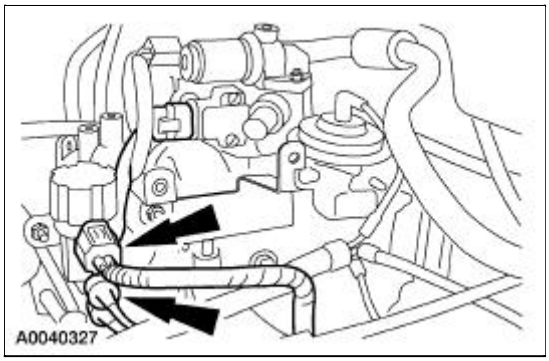
23. Connect the evaporative emission canister purge valve hose and the EGR valve vacuum hose.



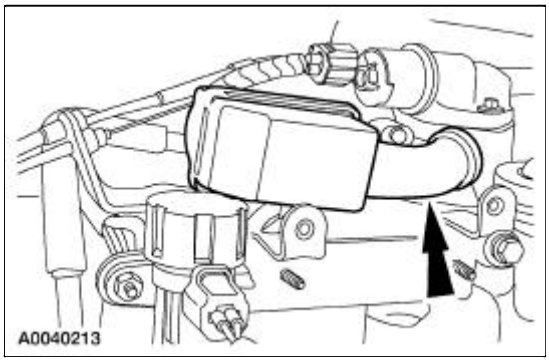
24. Connect the TP sensor and IAC electrical connectors.



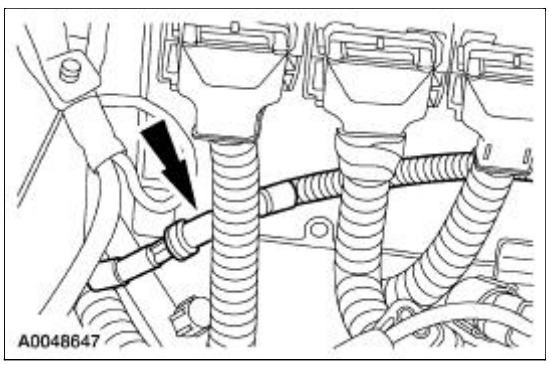
25. Connect the EGR vacuum regulator solenoid connections.



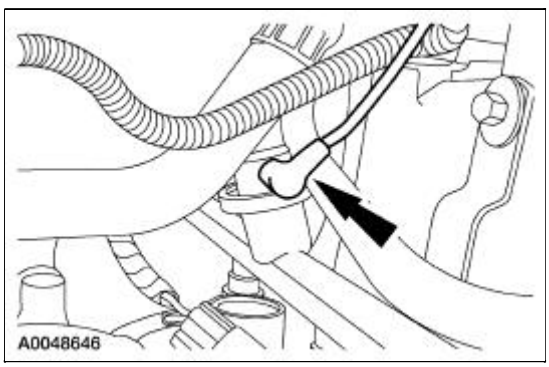
26. Install the IAC fresh air hose.



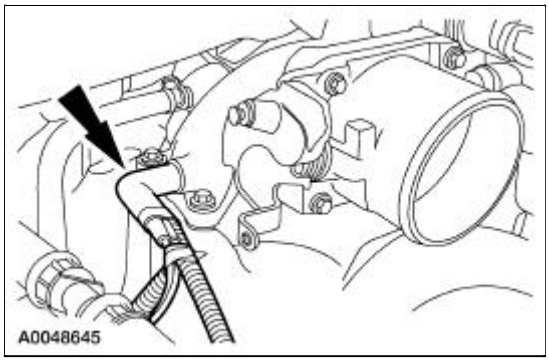
27. Connect the climate control vacuum hose.



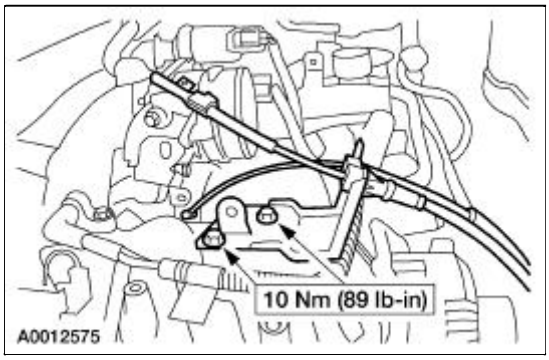
28. Connect the fuel pressure regulator vacuum hose.



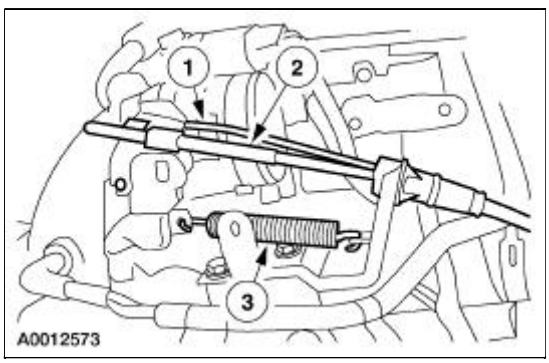
29. Connect the main vacuum harness.



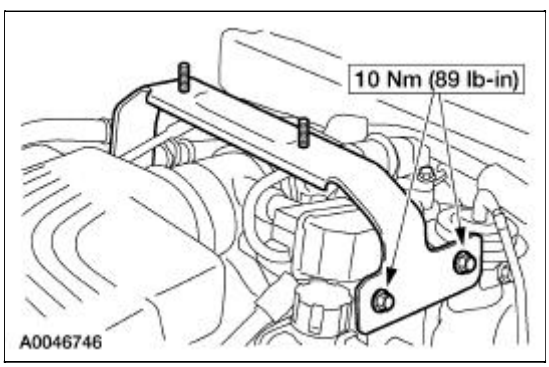
30. Install the accelerator cable bracket and the bolts.



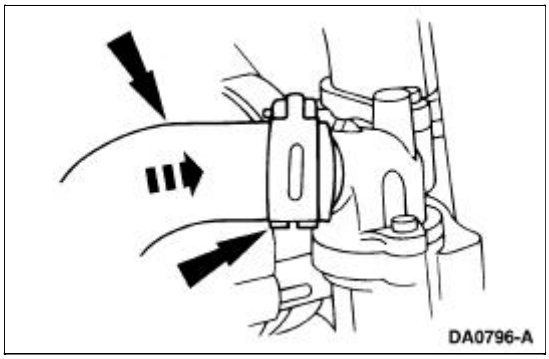
31. Connect the throttle body cam.
    1. Connect the accelerator cable.
    2. Connect the speed control actuator cable.
    3. Install the throttle return spring.



32. Install the appearance cover mounting bracket and the three bolts.



33. Connect the upper radiator hose and position the clamp.



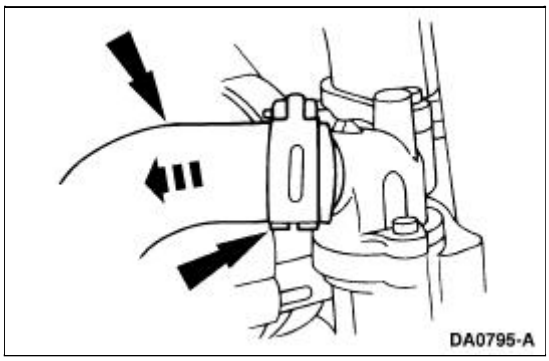
34. Install the air cleaner outlet pipe. For additional information, refer to Section 303-12 .
35. Connect the battery ground cable. For additional information, refer to Section 414-01 .
36. Fill and bleed the engine cooling system. For additional information, refer to Section 303-03 .

Intake Manifold —5.4L

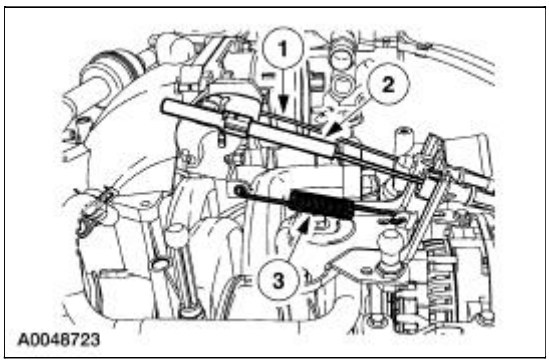
Removal

WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and can be ignited. Failure to follow these instructions may result in personal injury.

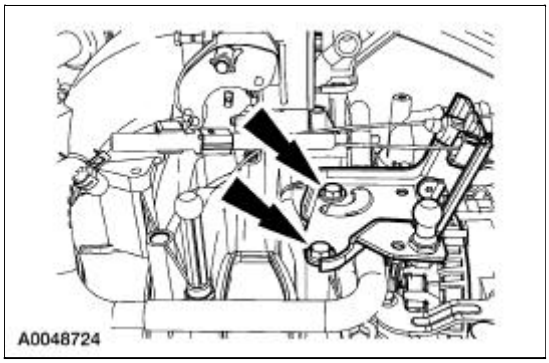
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the air cleaner outlet pipe. For additional information, refer to Section 303-12 .
3. Drain the engine cooling system. For additional information, refer to Section 303-03 .
4. Compress the hose clamp and disconnect the upper radiator hose.



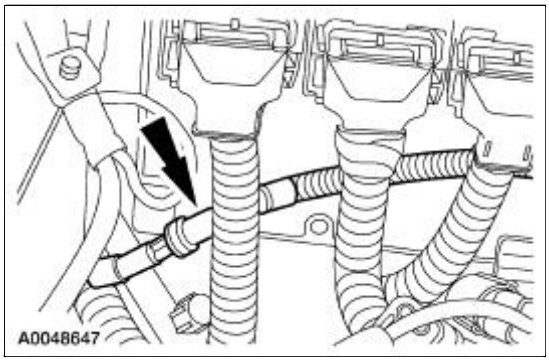
5. Disconnect the throttle body cam.
    1. Disconnect the accelerator cable.
    2. Disconnect the speed control actuator cable.
    3. Remove the accelerator return spring.



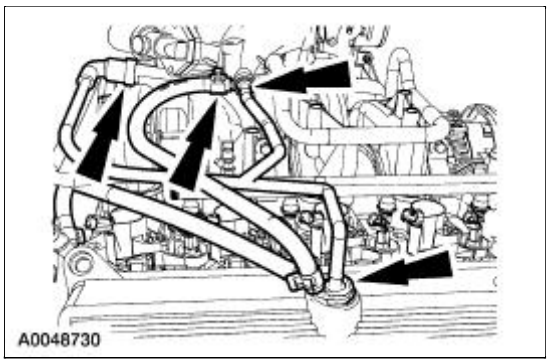
6. Remove the accelerator cable bracket bolts and position the bracket and cables aside.



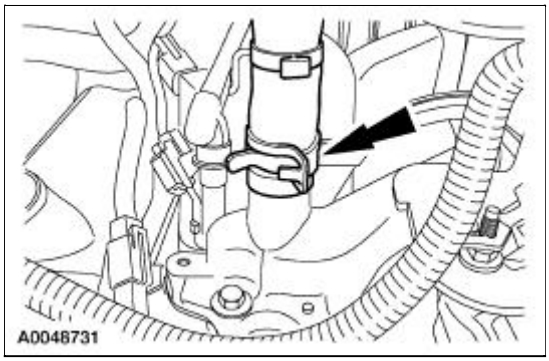
7. Disconnect the climate control vacuum hose.



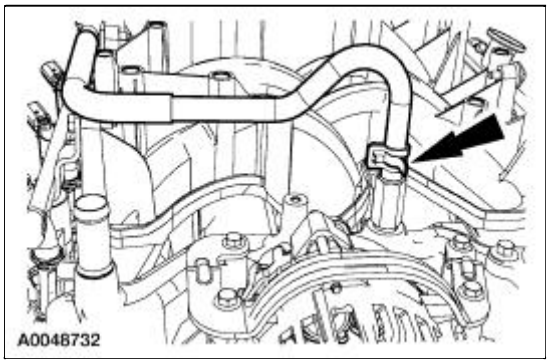
8. Position the heated positive crankcase ventilation (PCV) hose harness aside.
    - Disconnect the PCV hose from the throttle body adapter.
    - Disconnect the heated throttle body outlet hose from the throttle body adapter.
    - Disconnect the PCV hose from the intake manifold.
    - Remove the PCV valve.



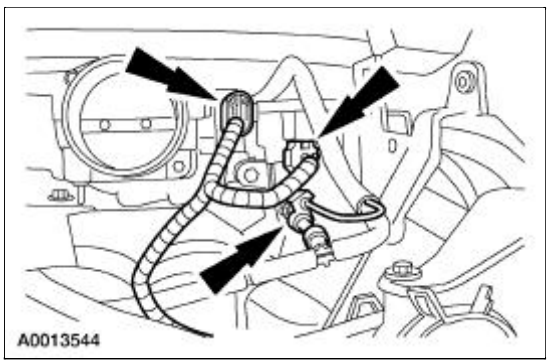
9. Disconnect the heater hose.



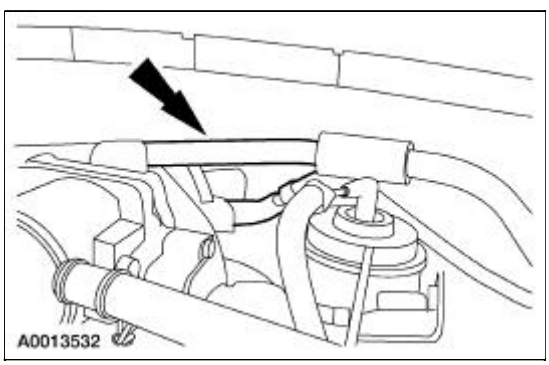
10. Disconnect the heated throttle body inlet hose.



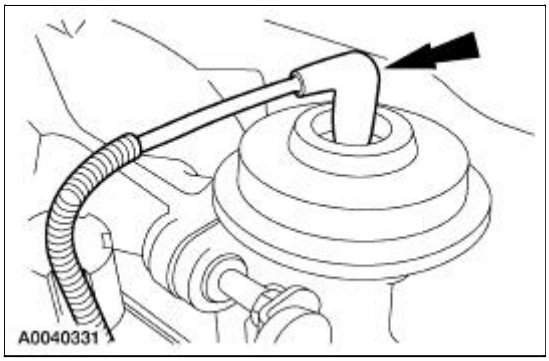
11. Disconnect the throttle position (TP) sensor electrical connector, and the exhaust gas recirculation (EGR) vacuum regulator solenoid electrical and vacuum connectors.



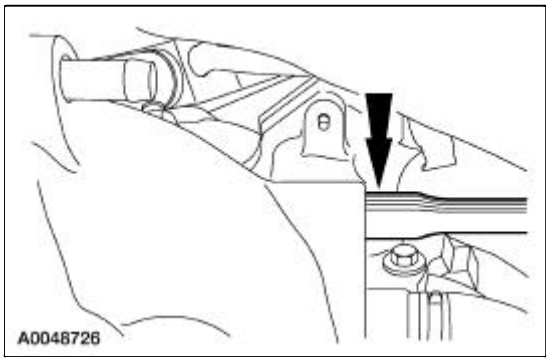
12. Disconnect the evaporative emission canister purge valve hose.



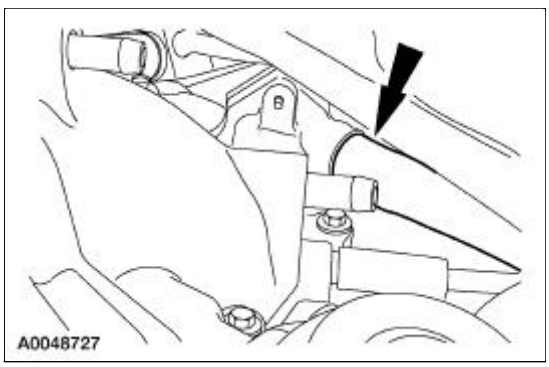
13. Disconnect the EGR valve vacuum hose.



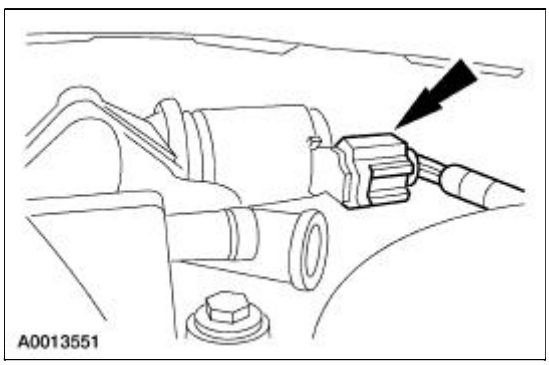
14. Disconnect the main vacuum harness from the throttle body adapter.



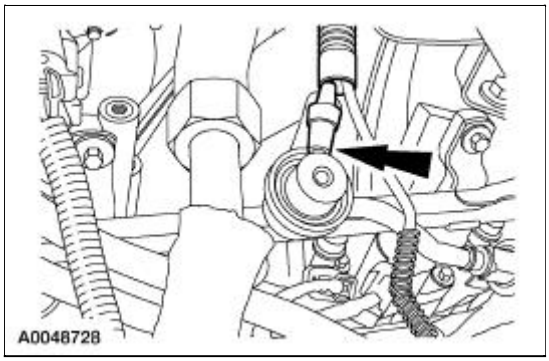
15. Remove the idle air control (IAC) valve fresh air tube.



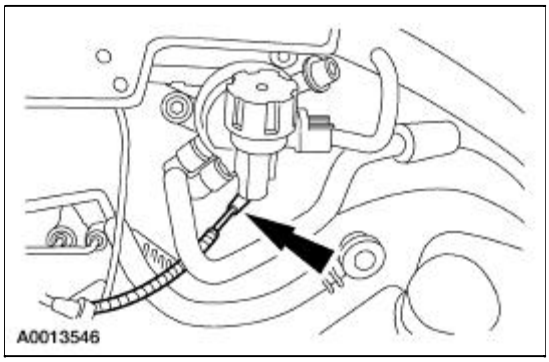
16. Disconnect the IAC electrical connector.



17. Disconnect the fuel pressure regulator vacuum hose.

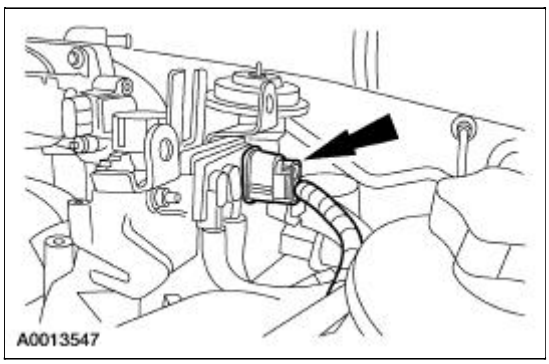


18. Disconnect the evaporative emission canister purge valve vacuum hose and remove the vacuum harness.

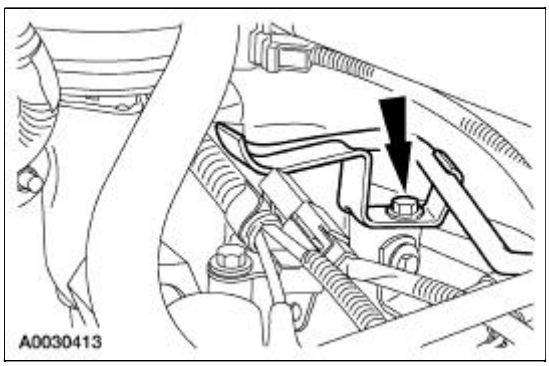


19. Disconnect the fuel hose spring lock coupling. For additional information, refer to Section 310-00 .

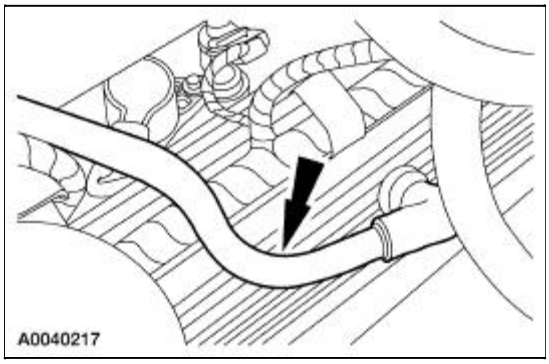
20. Disconnect the differential pressure feedback EGR system electrical connector.



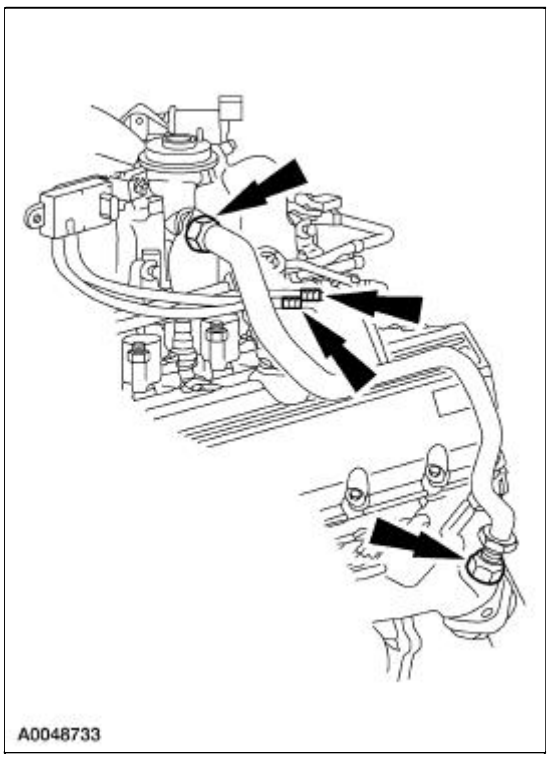
21. Remove the bolt and disconnect the brake booster vacuum tube. Position the bracket and tube aside.



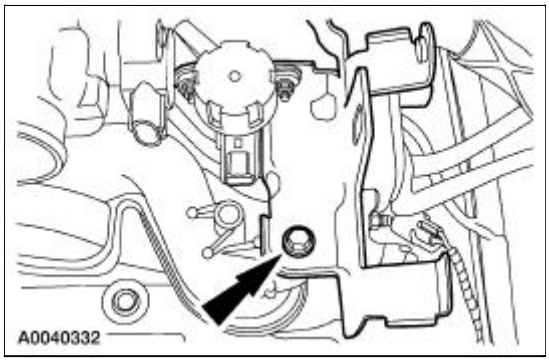
22. Position the crankcase ventilation tube aside.



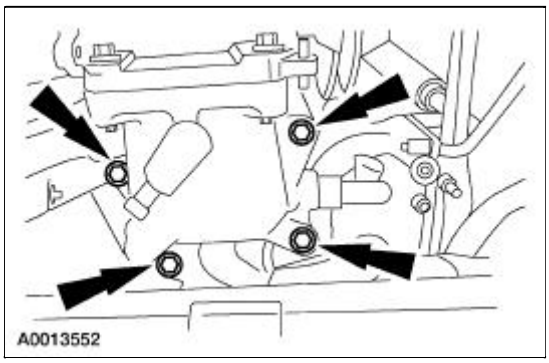
23. Position the exhaust manifold to EGR valve tube aside.
    - Disconnect the upper fitting.
    - Loosen the lower fitting.
    - Disconnect the two differential pressure feedback EGR system hoses.
    - Position the tube aside.



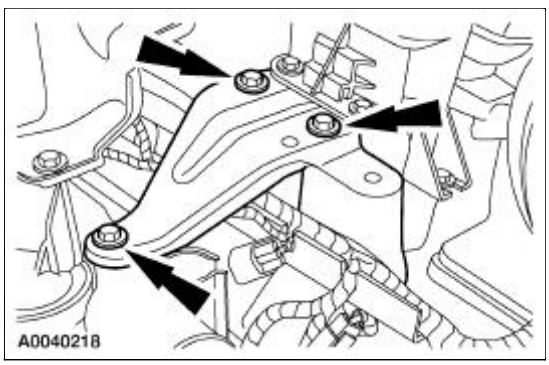
24. Remove the differential pressure feedback EGR system bracket bolt.



25. Remove the four bolts and the throttle body adapter.
    - Discard the throttle body adapter gasket.

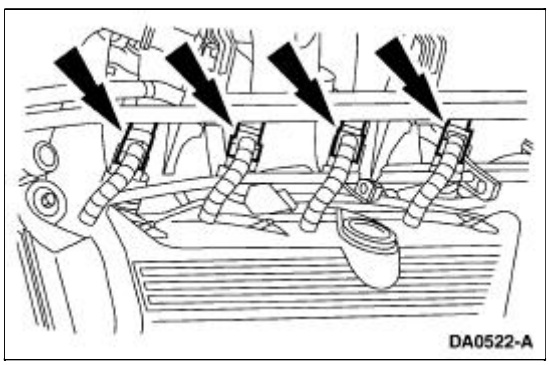


26. Remove the power steering reservoir upper mounting bracket.

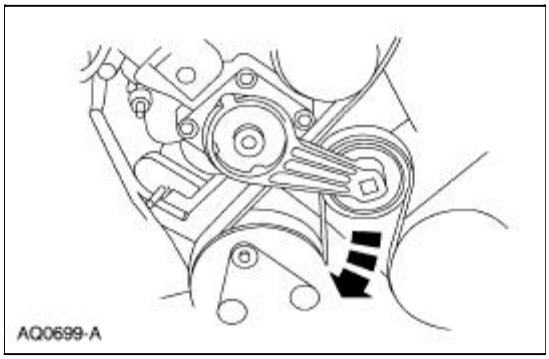


27. Disconnect and remove the eight ignition coils. For additional information, refer to Section 303-07A .

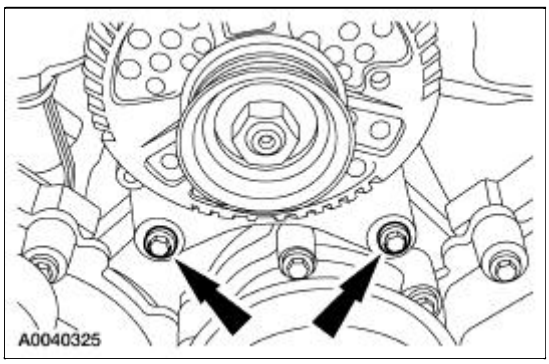
28. Disconnect the eight fuel injectors.



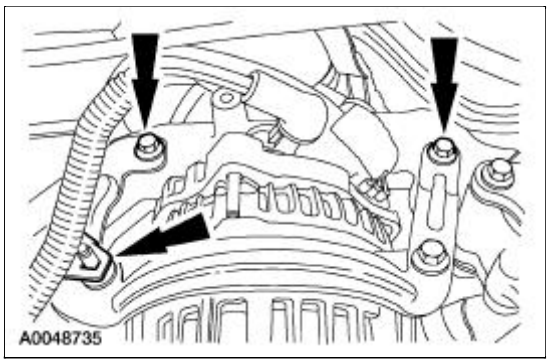
29. Rotate the belt tensioner clockwise and detach the drive belt from the generator pulley.



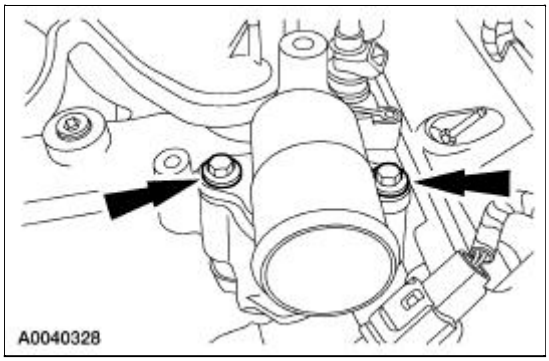
30. Loosen the generator lower mounting bolts.



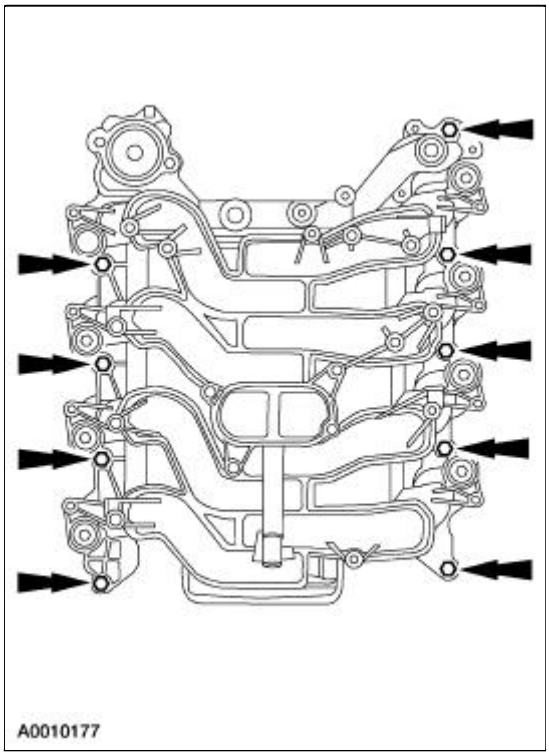
31. Position the generator aside.
    - Disconnect the harness routing clip.
    - Remove the generator upper mounting bracket bolts.



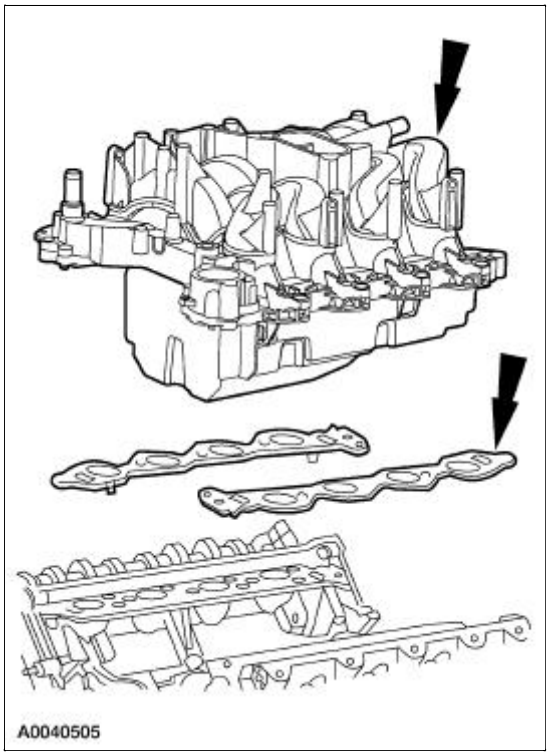
32. Remove the bolts, water thermostat housing and the thermostat.
    - Discard the O-ring seal.



33. Remove the nine bolts.



34. Remove the intake manifold.
    - Discard the intake manifold gaskets.



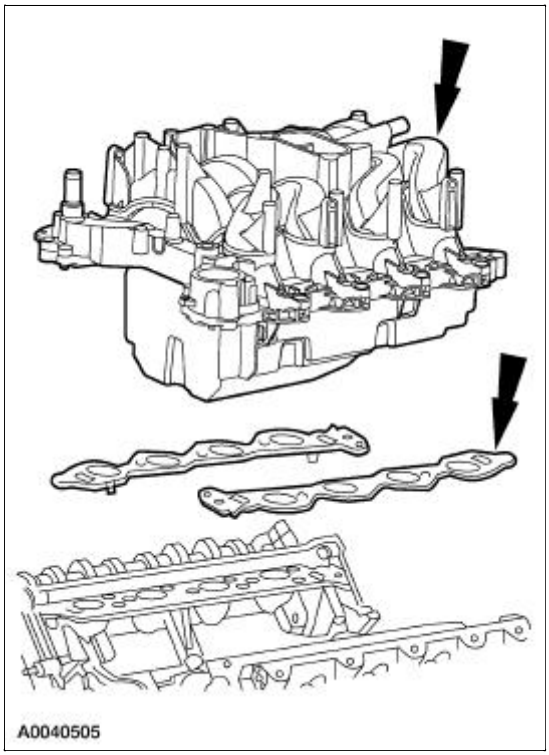
35. Inspect the intake manifold and throttle body for damage.

Installation

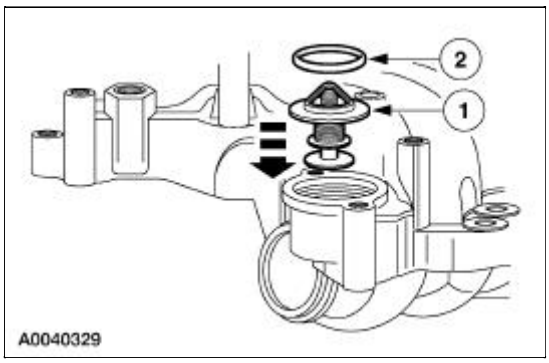
1. **CAUTION: Do not use metal scrapers, power abrasive discs or any abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraper only.**

   Clean all the sealing surfaces.

2. Install the intake manifold.
   - Position the new intake manifold gaskets.
   - Position the intake manifold.
   - Loosely install nine bolts.

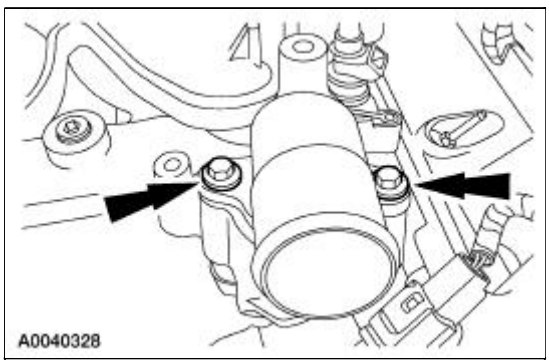


3. Install the water thermostat.
    1. Install the thermostat.
    2. Install a new O-ring seal.



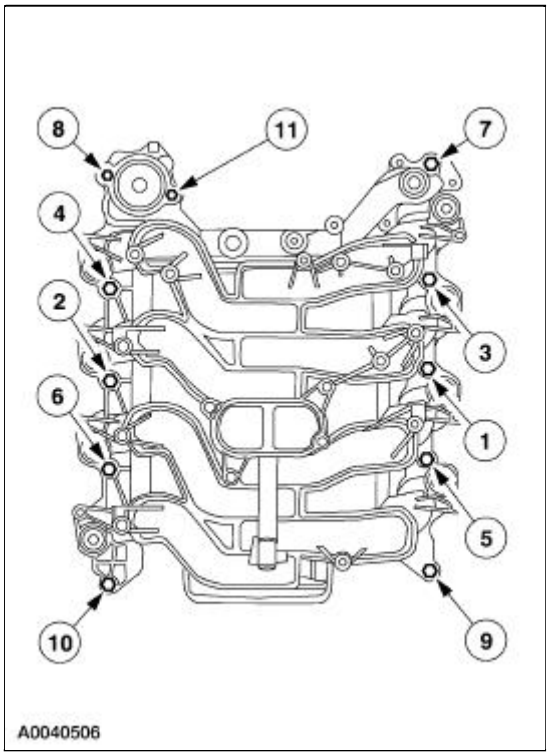
4. **NOTE:** The thermostat housing bolts are tightened in sequence with the intake manifold bolts.

    Install the thermostat housing and loosely install the bolts.

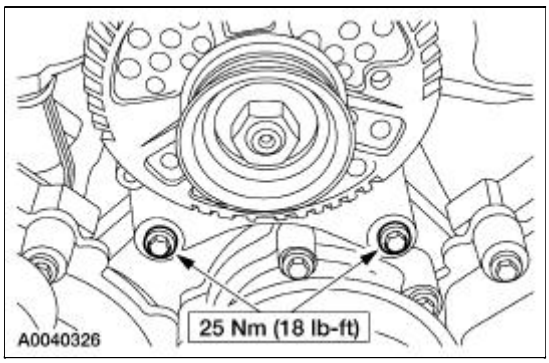


5. Tighten the 11 bolts in two stages in the sequence shown.
    - Stage 1: tighten to 2 Nm (18 lb-in).

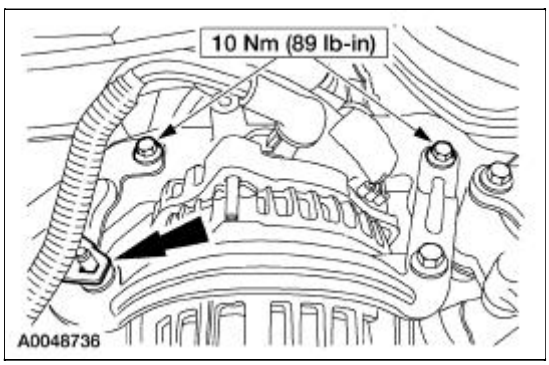
- Stage 2: tighten to 25Nm (18 lb-ft).



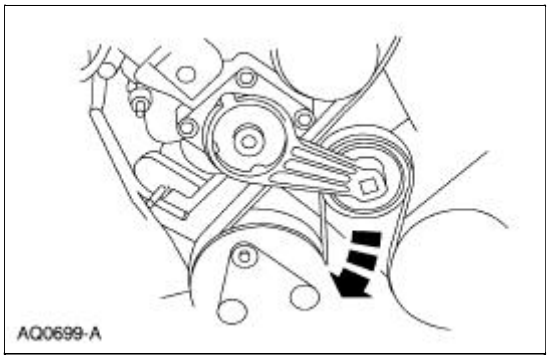
6. Position the generator on the lower mounting bolts and tighten the bolts.



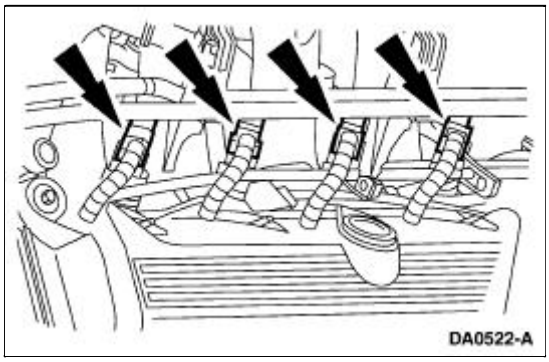
7. Install the generator upper mounting bracket bolts and harness routing clip.



8. Rotate the belt tensioner clockwise and install the drive belt. Refer to the decal on the radiator upper air deflector for belt routing.

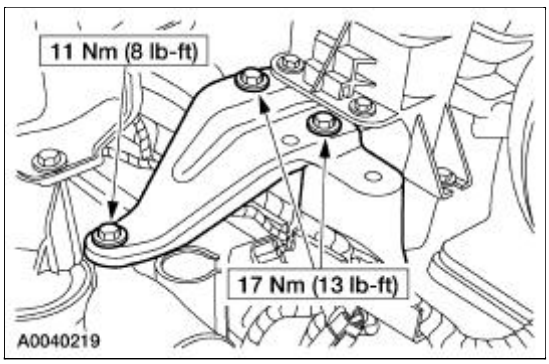


9. Connect the eight fuel injector electrical connectors.



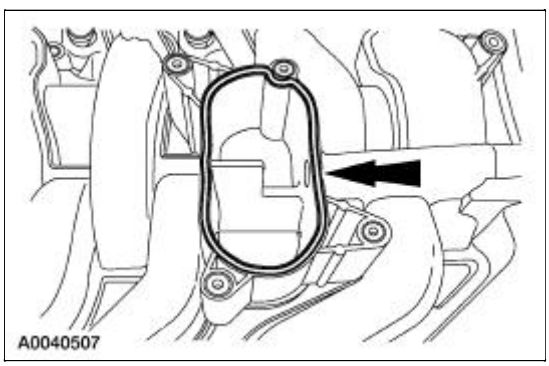
10. Install and connect eight ignition coils. For additional information, refer to Section 303-07A .

11. Install the power steering reservoir upper mounting bracket.

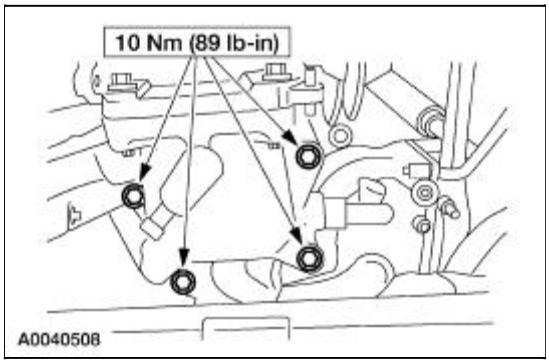


12. Connect the fuel hose spring lock coupling. For additional information, refer to Section 310-00 .

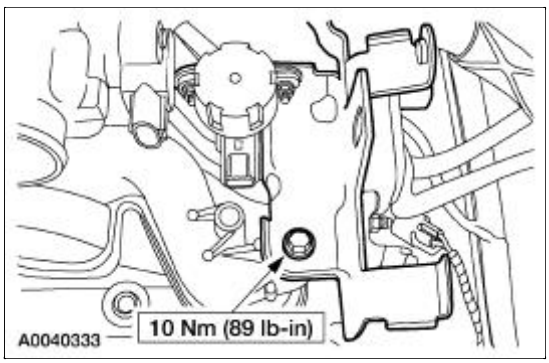
13. Install a new intake manifold-to-throttle body adapter gasket.



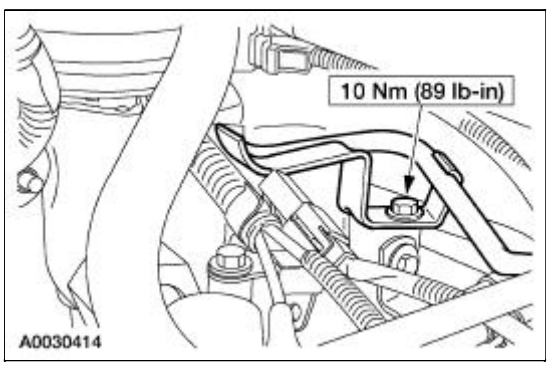
14. Install the throttle body adapter and the bolts.



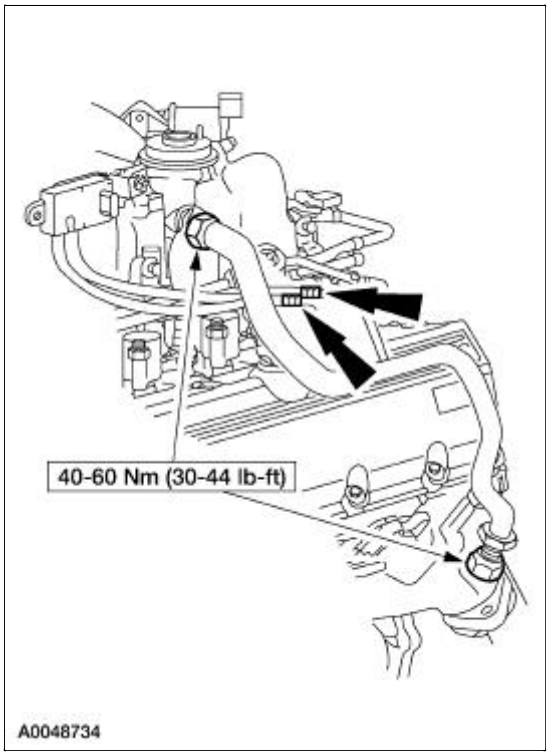
15. Install the differential pressure feedback EGR system bracket bolt.



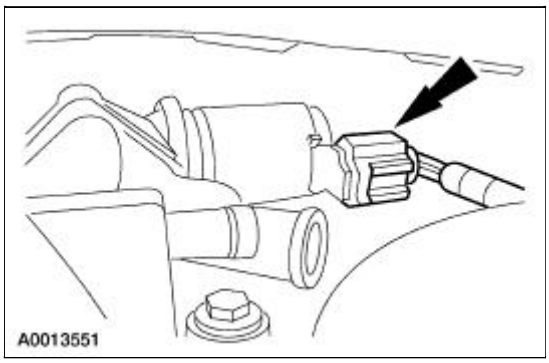
16. Connect the brake booster vacuum tube. Position the bracket and install the bolt.



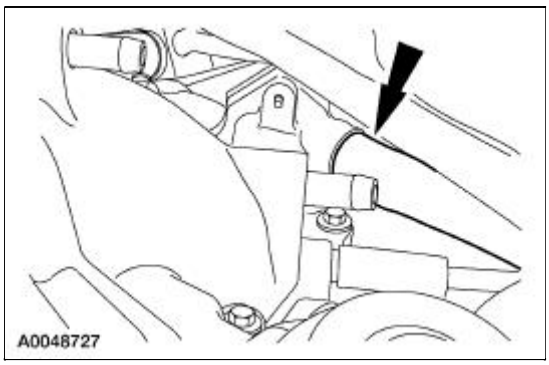
17. Install the exhaust manifold to EGR valve tube.
    - Hand-tighten the fittings.
    - Tighten the upper fitting.
    - Tighten the lower fitting.
    - Connect the two differential pressure feedback EGR system hoses.



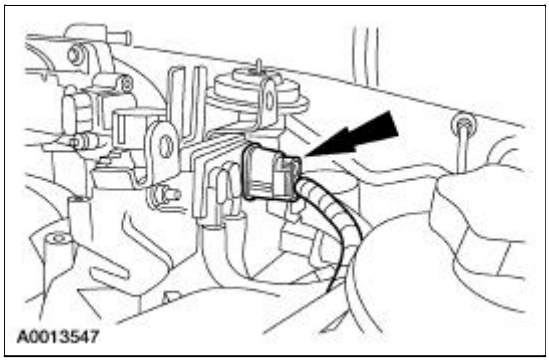
18. Connect the IAC electrical connector.



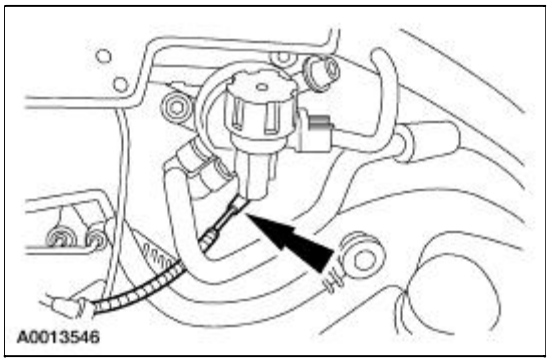
19. Install the IAC fresh air tube.



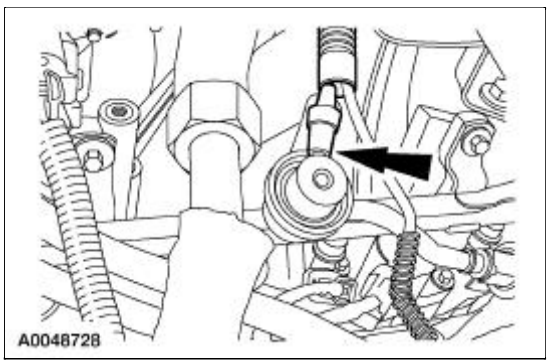
20. Connect the differential pressure feedback EGR system electrical connector.



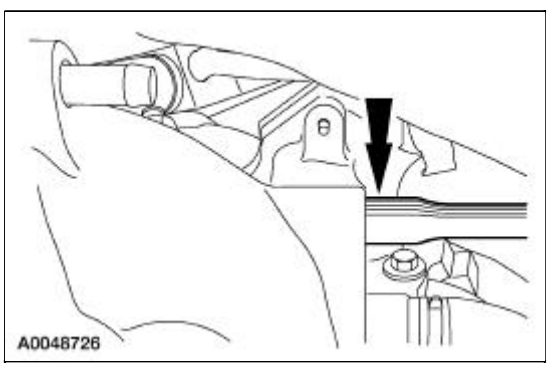
21. Roughly position the vacuum harness and connect the evaporative emission canister purge valve vacuum hose.



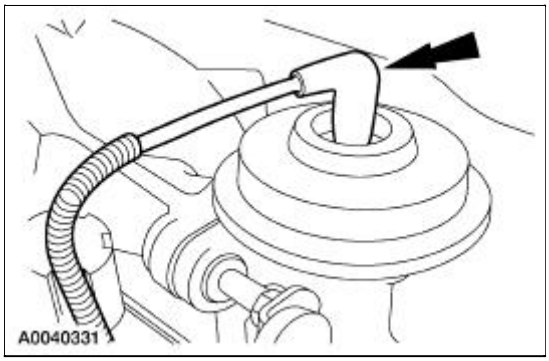
22. Connect the fuel pressure regulator vacuum hose.



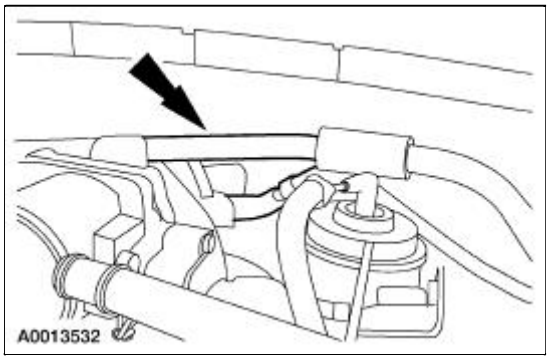
23. Connect the main vacuum harness.



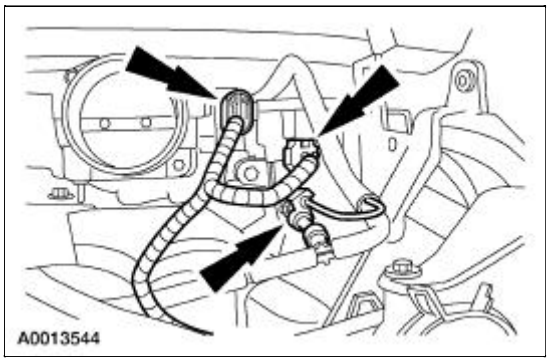
24. Connect the EGR valve vacuum hose.



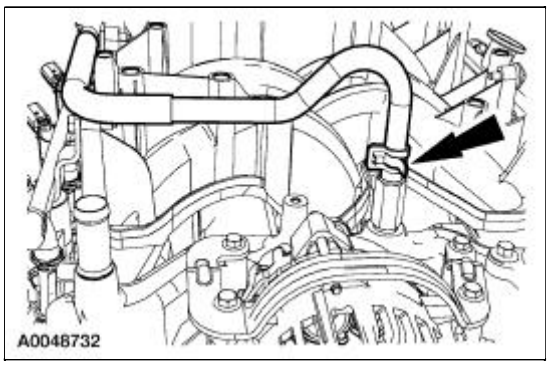
25. Connect the evaporative emission canister purge valve hose.



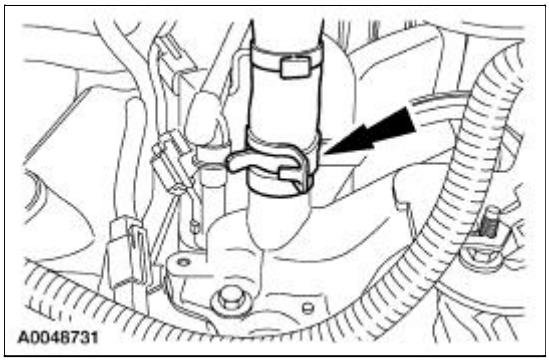
26. Connect the TP sensor electrical connector, and the EGR vacuum regulator solenoid electrical and vacuum connectors.



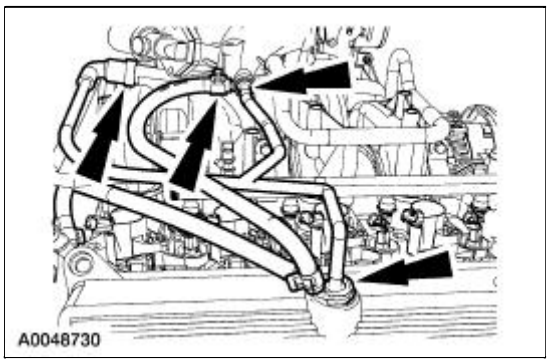
27. Connect the heated throttle body inlet hose.



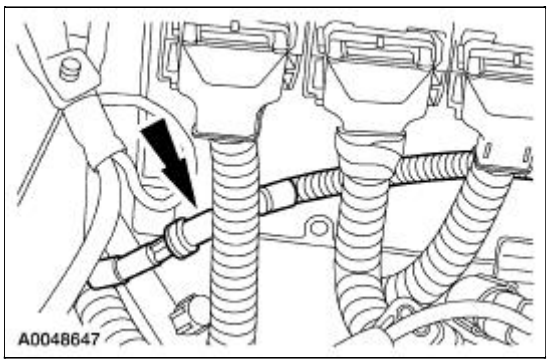
28. Connect the heater hose.



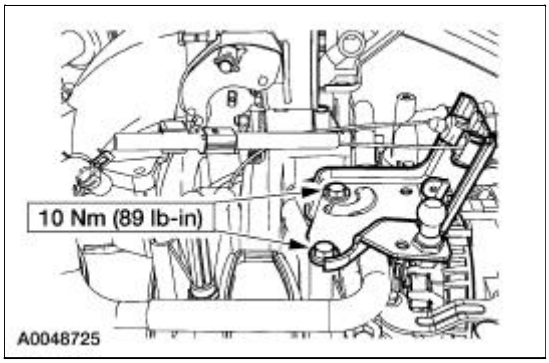
29. Install the heated PCV hose harness.
    - Install the PCV valve.
    - Connect the PCV hose to the intake manifold.
    - Connect the heated throttle body outlet hose.
    - Connect the PCV hose to the throttle body adapter.



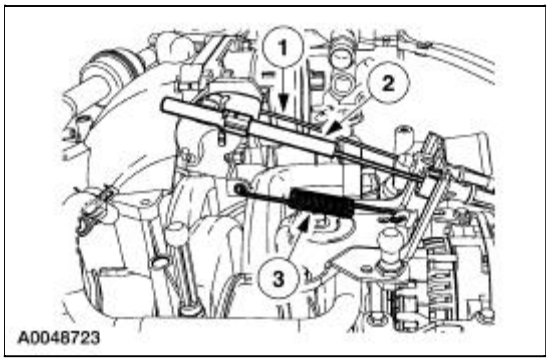
30. Connect the climate control vacuum hose.



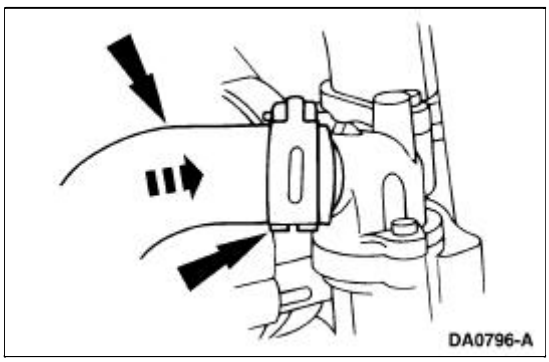
31. Install the accelerator cable bracket and the bolts.



32. Connect the throttle body cam.
    1. Connect the accelerator cable.
    2. Connect the speed control actuator cable.
    3. Install the throttle return spring.



33. Connect the upper radiator hose and position the clamp.



34. Install the air cleaner outlet pipe. For additional information, refer to Section 303-12 .

35. Connect the battery ground cable. For additional information, refer to Section 414-01 .

36. Fill and bleed the engine cooling system. For additional information, refer to Section 303-03 .

Valve Cover LH

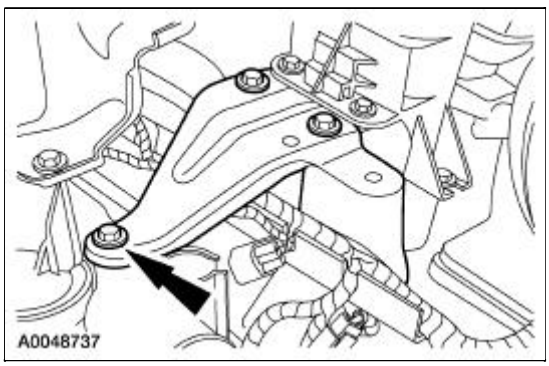
Material

Item	Specification
Motorcraft Silicone Gasket Remover ZC-30	—
Motorcraft Metal Surface Prep ZC-31	—
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
Instant Adhesive E8AZ-19554-A or equivalent	WSK-M2G402-A4

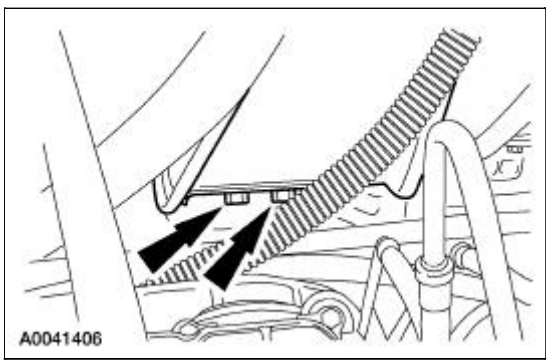
Removal

All vehicles

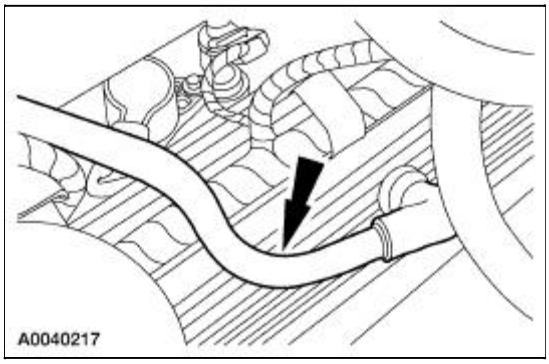
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the engine air cleaner (ACL) and the air cleaner outlet pipe. For additional information, refer to Section 303-12 .
3. Remove the power steering fluid reservoir bracket bolt.



4. Remove the bolts and position the power steering fluid reservoir and bracket aside.

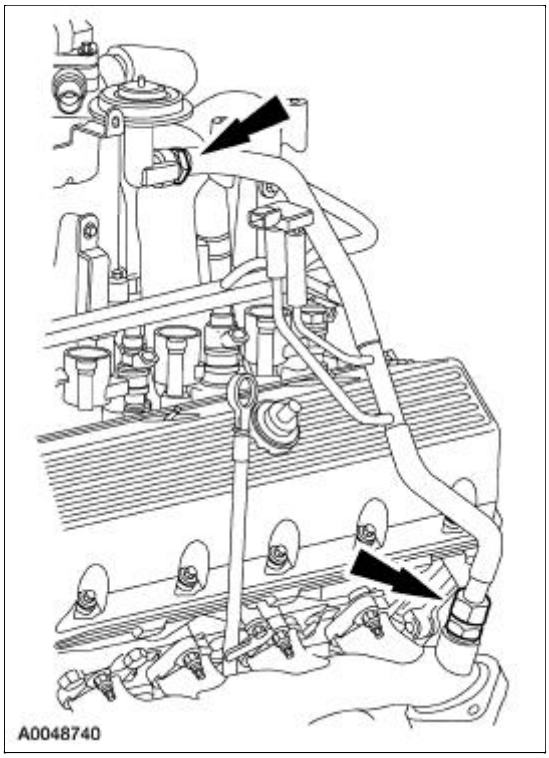


5. Remove the crankcase ventilation tube from the valve cover.



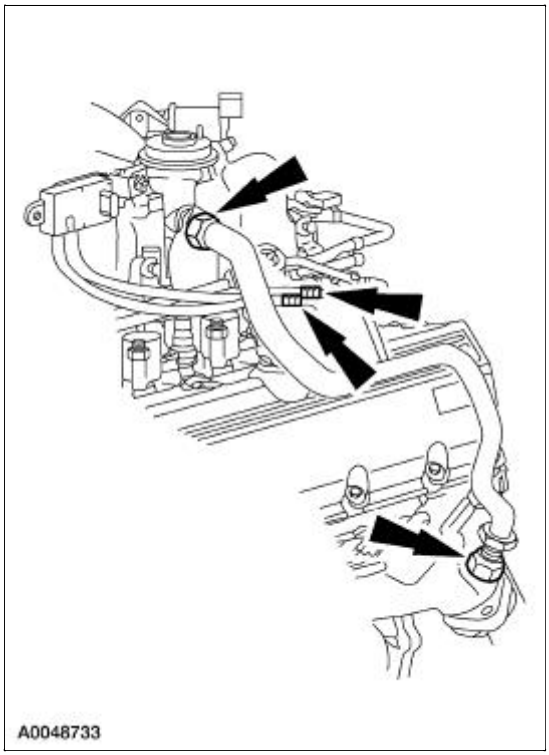
Romeo engine (4.6L)

6. Remove the exhaust manifold to exhaust gas recirculation (EGR) valve tube.
    - Disconnect the differential pressure feedback EGR system electrical connector.
    - Disconnect the upper and lower exhaust manifold to EGR valve tube fittings.



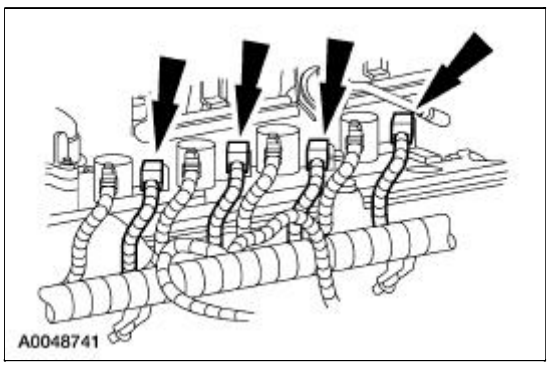
Windsor engine (5.4L)

7. Remove the exhaust manifold to EGR valve tube.
    - Disconnect the two differential pressure feedback EGR system hoses.
    - Disconnect the upper and lower exhaust manifold to EGR valve tube fittings.

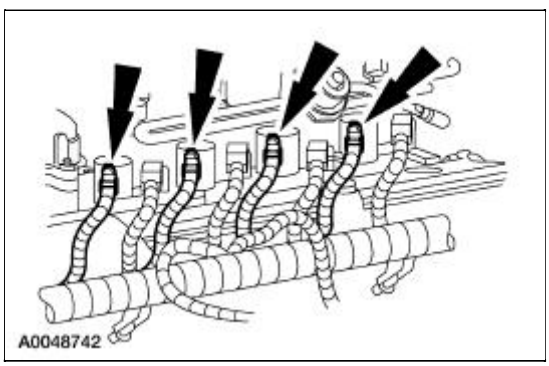


All vehicles

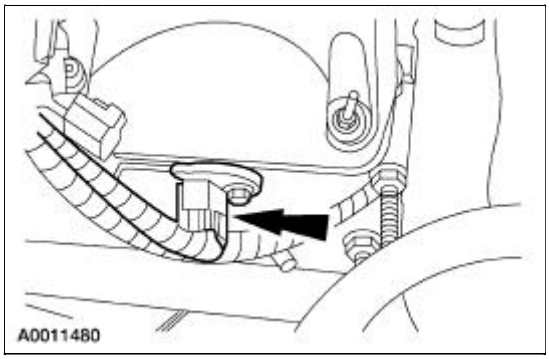
8. Disconnect the LH fuel injector electrical connections.



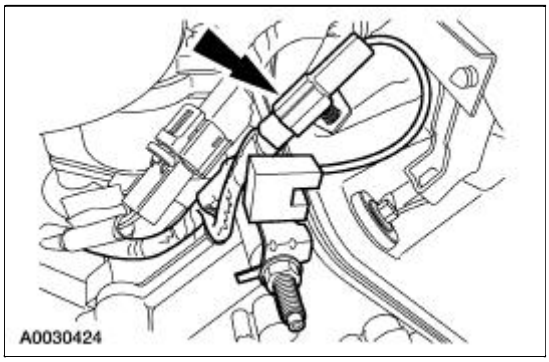
9. Disconnect the LH ignition coil electrical connections.



10. Disconnect the camshaft position (CMP) sensor.



11. Disconnect the LH radio interference capacitor.



12. Lift the engine control wiring harness off of the valve cover studs.

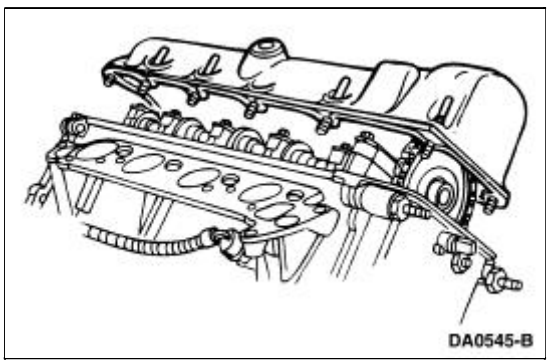
13. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

    NOTE: The intake manifold is removed for clarity.

    NOTE: The bolts are part of the valve cover and should not be removed.

    Remove the LH valve cover.

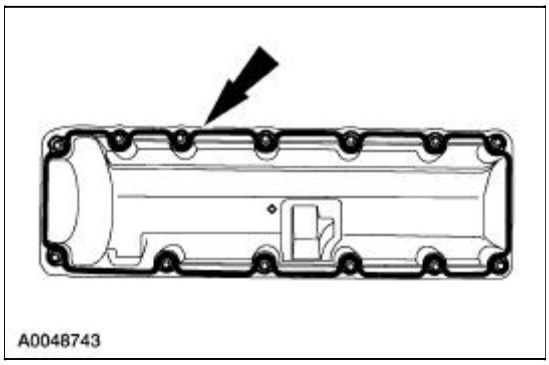
    - Fully loosen the bolts and remove the valve cover.
    - Clean the valve cover mating surface of the cylinder head with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
    - Inspect the valve cover gasket. If the gasket is damaged, remove and discard the gasket. Clean the valve cover gasket groove with soap and water or a suitable solvent.



Installation

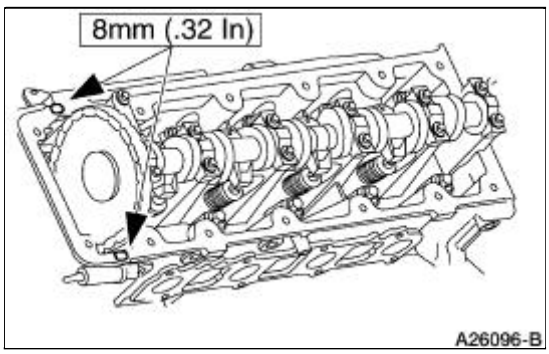
All vehicles

1. If a new gasket is being installed, apply instant adhesive completely around the gasket groove in the valve cover. Install the new valve cover gasket.

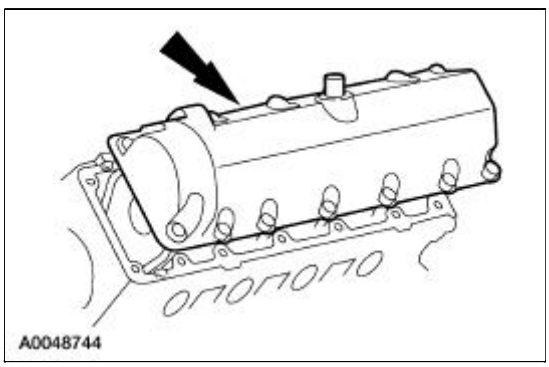


2. **NOTE:** If not secured within four minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

   Apply a bead of silicone gasket and sealant in two places where the engine front cover meets the cylinder head.

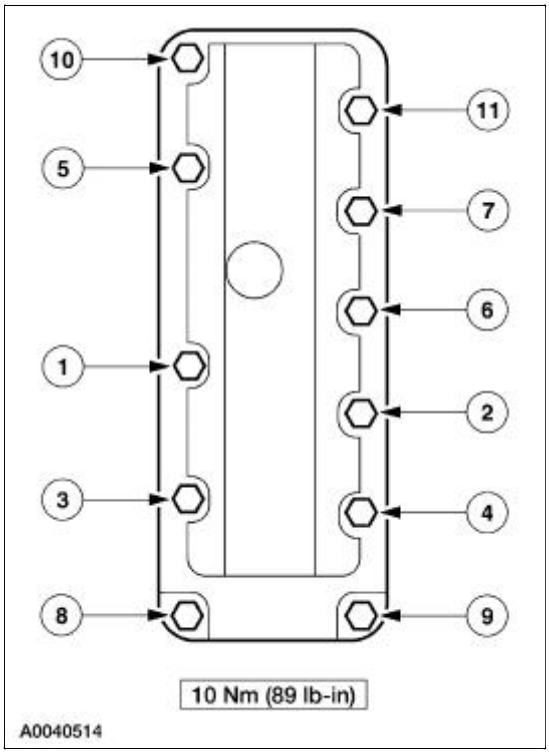


3. Position the valve cover and gasket on the cylinder head. Loosely install the bolts.



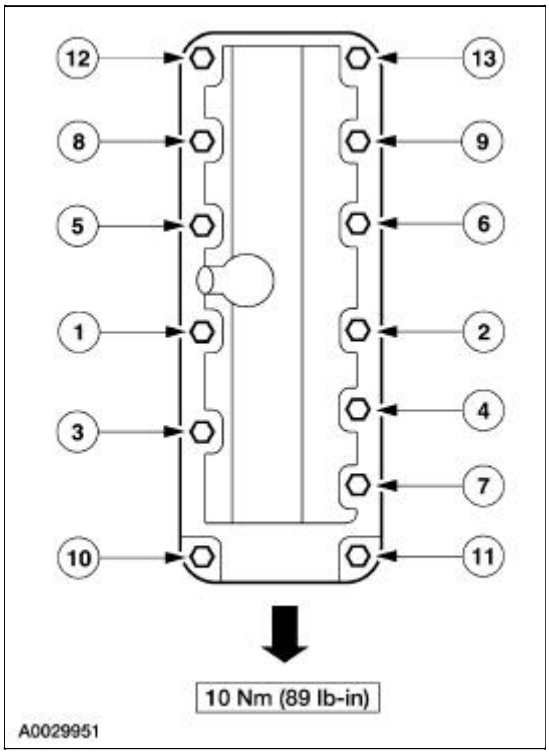
Romeo engine (4.6L)

4. Tighten the bolts in the sequence shown.



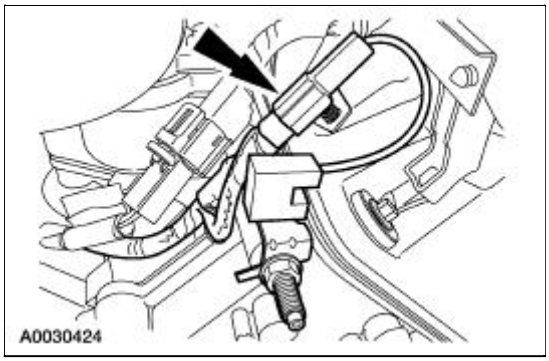
Windsor engine (5.4L)

5. Tighten the bolts in the sequence shown.

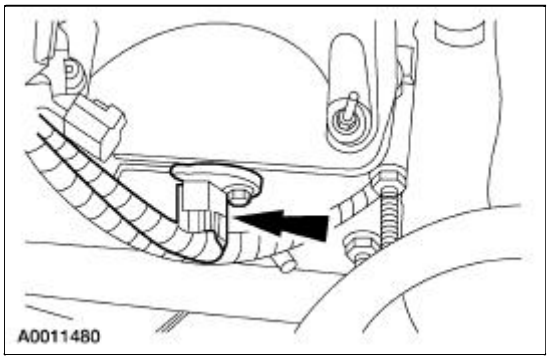


All vehicles

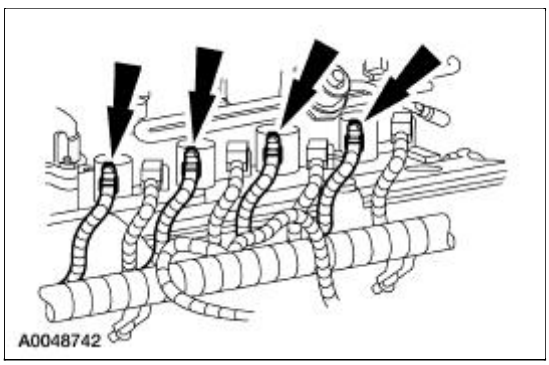
6. Position the engine control wiring harness onto the valve cover studs.
7. Connect the LH radio interference capacitor electrical connector.



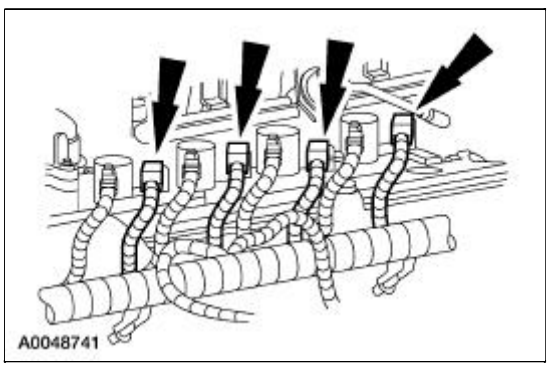
8. Connect the CMP electrical connector.



9. Connect the LH ignition coil electrical connectors.



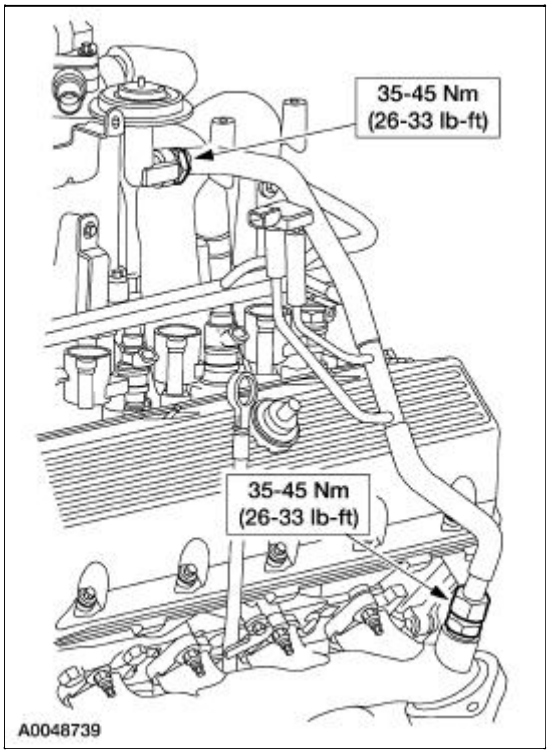
10. Connect the LH fuel injector electrical connectors.



Romeo engine (4.6L)

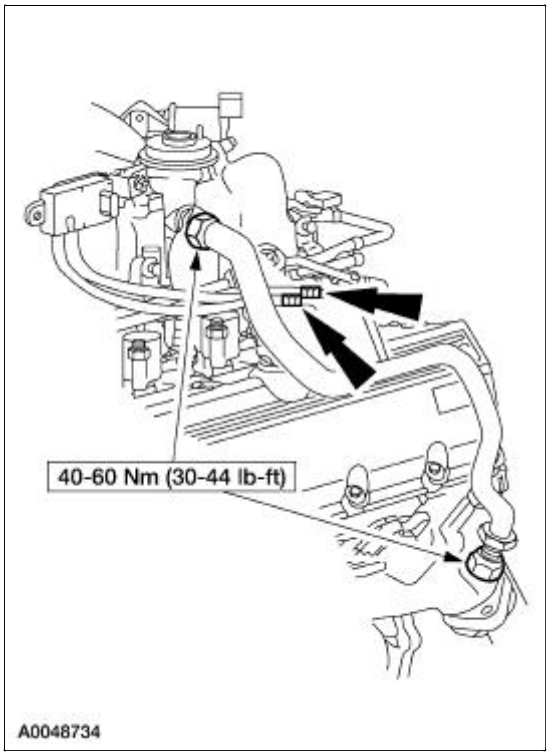
11. Install the exhaust manifold to EGR valve tube.
    - Connect the differential pressure feedback EGR system electrical connector.

- Tighten both fittings starting at the top in two stages.
  - Stage 1: hand-tighten.
  - Stage 2: tighten to 35-45 Nm (26-33 lb-ft).



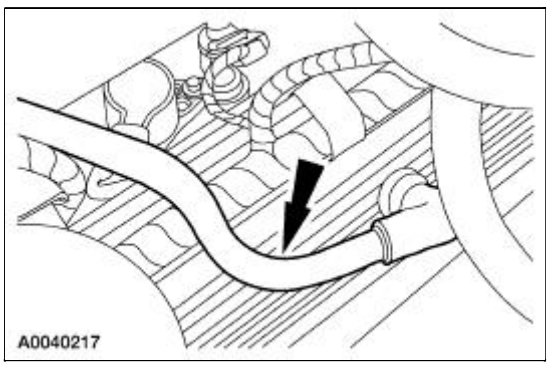
Windsor engine (5.4L)

12. Install the exhaust manifold to EGR valve tube.
    - Tighten both fittings starting at the top in two stages.
      - Stage 1: hand-tighten.
      - Stage 2: tighten to 40-60 Nm (30-44 lb-ft).
    - Connect the two differential pressure feedback EGR system hoses.



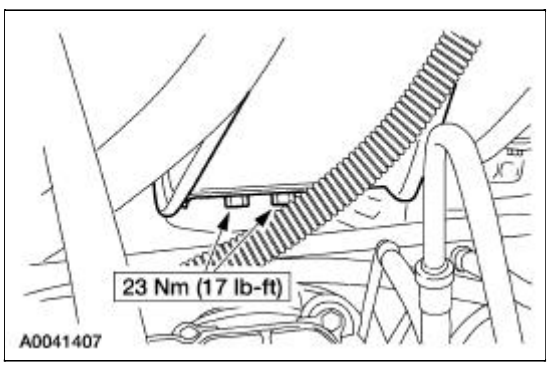
All vehicles

13. Connect the crankcase ventilation tube to the valve cover.

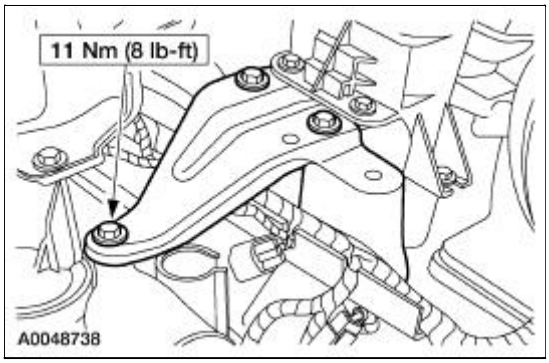


14. Install the ACL and air cleaner outlet pipe. For additional information, refer to Section 303-12 .

15. Position the power steering fluid reservoir and bracket. Install the bolts.



16. Install the power steering fluid reservoir bracket bolt.



17. Connect the battery ground cable. For additional information, refer to Section 414-01 .

Valve Cover RH

Material

Item	Specification
Motorcraft Silicone Gasket Remover ZC-30	—
Motorcraft Metal Surface Prep ZC-31	—
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
Instant Adhesive E8AZ-19554-A or equivalent	WSK-M2G402-A4

Removal

All vehicles

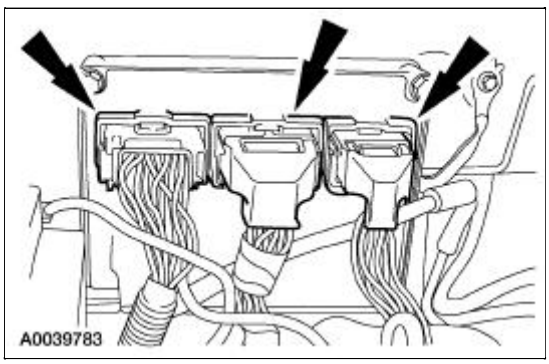
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Discharge and recover the air conditioning system. For additional information, refer to Section 412-03A .

Vehicles with auxiliary heat

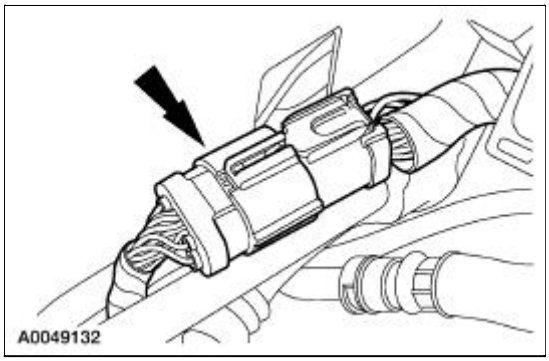
3. Drain the cooling system. For additional information, refer to Section 303-03 .

All vehicles

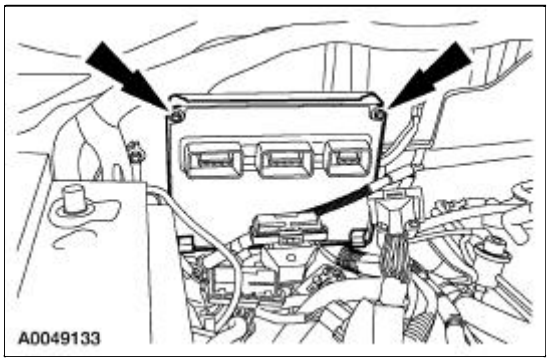
4. Disconnect the powertrain control module (PCM) electrical connectors.



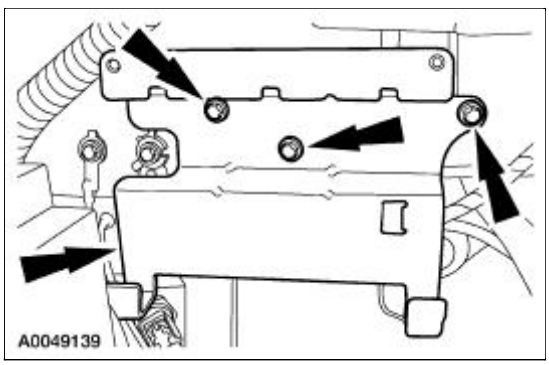
5. Disconnect the engine wiring harness electrical connector.



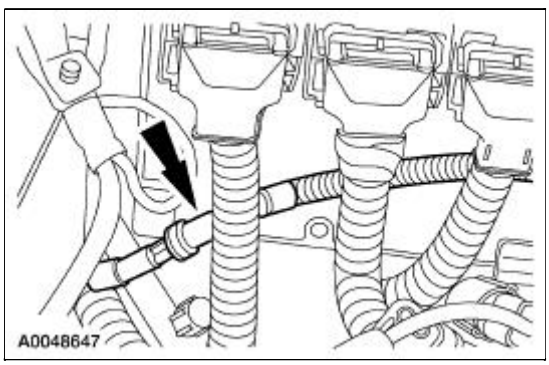
6. Remove the bolts and the PCM.



7. Remove the PCM mounting bracket.



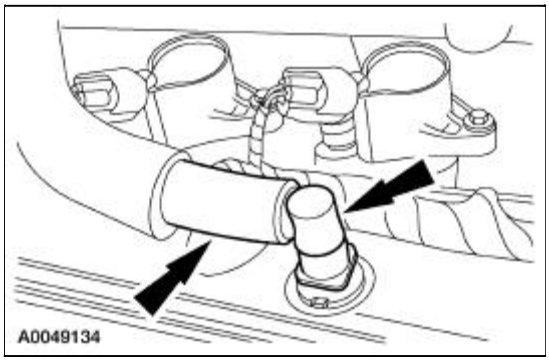
8. Disconnect the climate control vacuum hose and position it aside.



Romeo engine (4.6L)

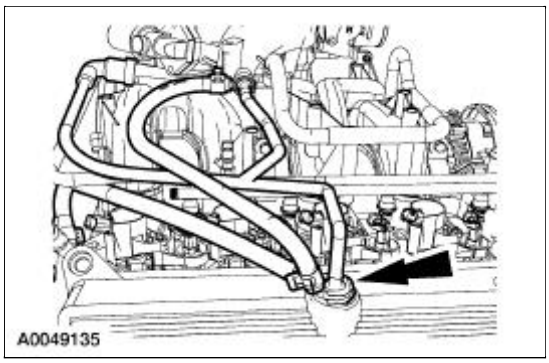
9. **NOTE:** Rotate the positive crankcase ventilation (PCV) valve to remove.

Disconnect the hose and position it aside, then remove the PCV valve from the valve cover.



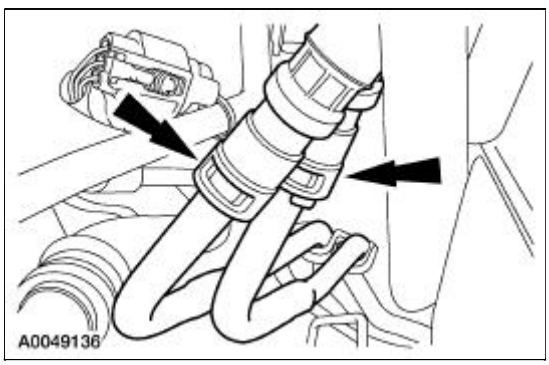
Windsor engine (5.4L)

10. Remove the PCV valve from the valve cover. Position the valve and hoses aside.



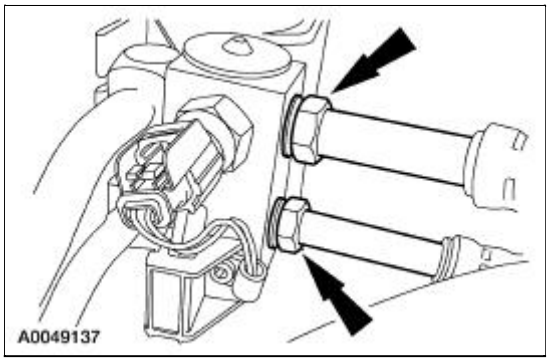
Vehicles with auxiliary heat

11. Disconnect the rear heater water lines.

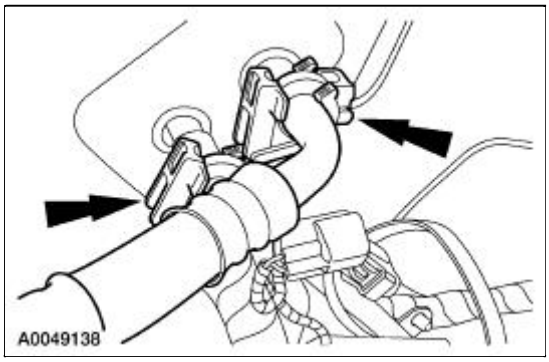


All vehicles

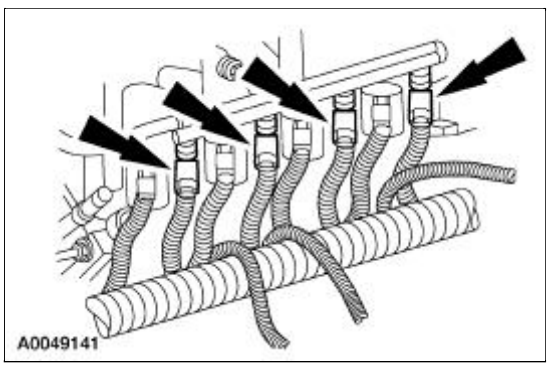
12. Disconnect the evaporator tubes from the manifold.



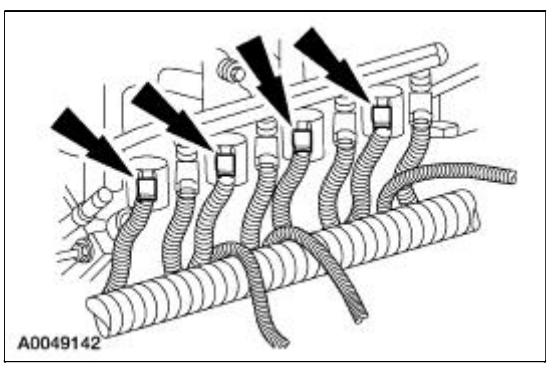
13. Disconnect the evaporator tubes from the evaporator.



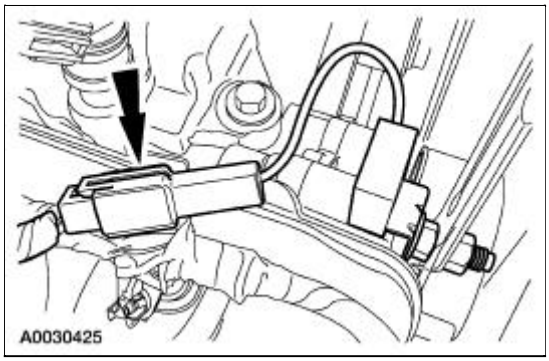
14. Disconnect the RH fuel injector electrical connections.



15. Disconnect the RH ignition coil electrical connections.



16. Disconnect the RH radio interference capacitor.



17. Lift the engine control wiring harness off of the valve cover studs and position it aside.

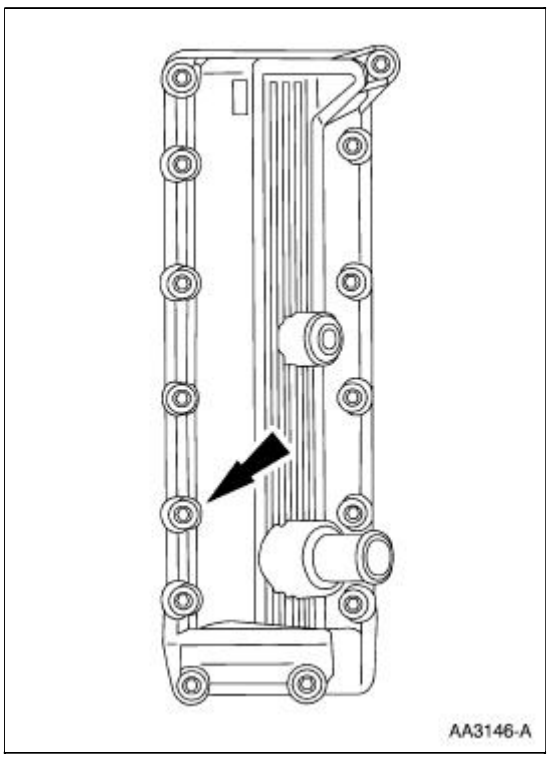
18. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

    NOTE: The bolts are part of the valve cover and cannot be removed.

    NOTE: Windsor engine shown; Romeo engine similar.

    Remove the RH valve cover.

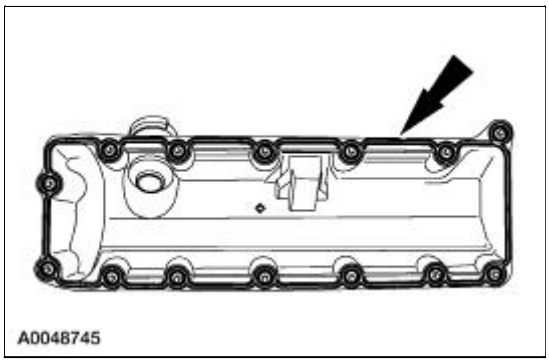
    - Fully loosen the bolts and remove the valve cover.
    - Clean the valve cover mating surface of the cylinder head with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
    - Inspect the valve cover gasket. If the gasket is damaged, remove and discard the gasket. Clean the valve cover gasket groove with soap and water or a suitable solvent.



Installation

All vehicles

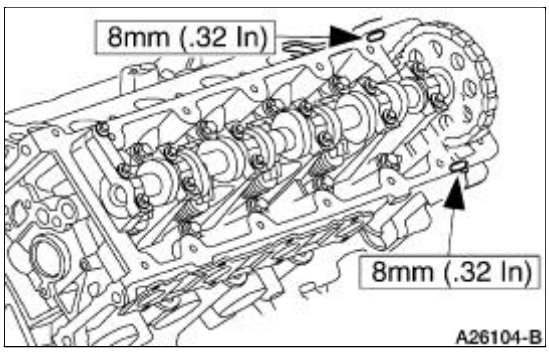
1. If a new gasket is being installed, apply instant adhesive completely around the gasket groove in the valve cover. Install the new valve cover gasket.



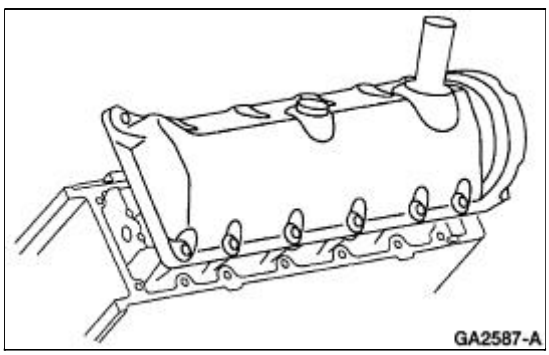
2. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

   NOTE: If not secured within four minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

   Apply the silicone gasket and sealant in two places where the engine front cover meets the cylinder head.

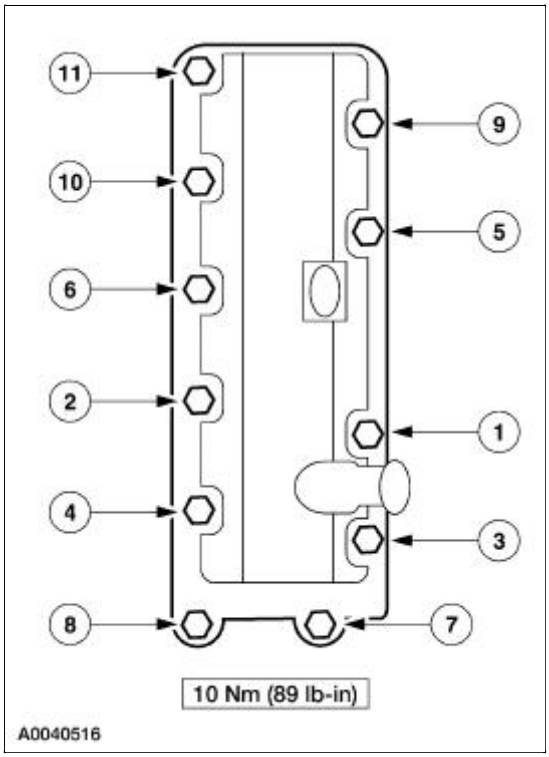


3. Position the valve cover on the cylinder head and loosely install the valve cover bolts.



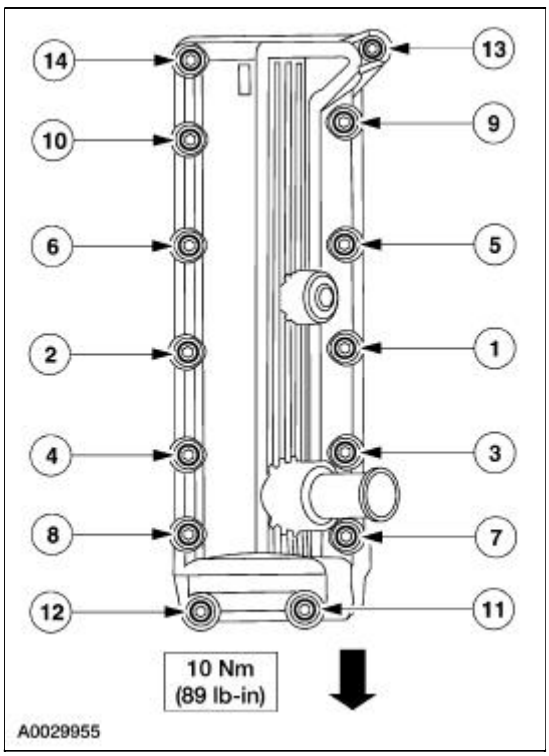
Romeo engine (4.6L)

4. Tighten the bolts in the sequence shown.



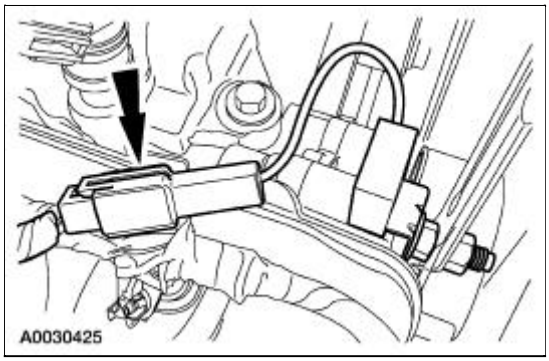
Windsor engine (5.4L)

5. Tighten the bolts in the sequence shown.

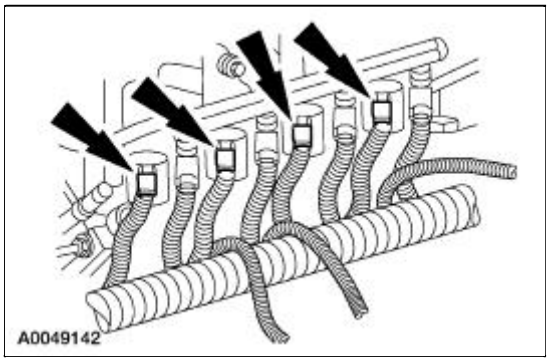


All vehicles

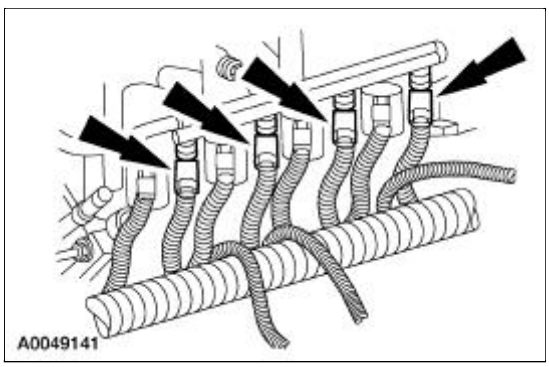
6. Position the engine control wiring harness on the valve cover studs.
7. Connect the RH radio interference capacitor electrical connector.



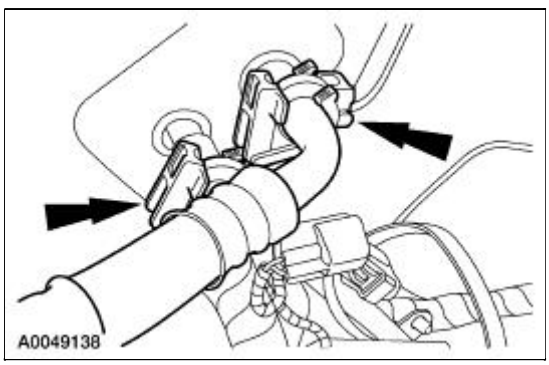
8. Connect the RH ignition coil electrical connectors.



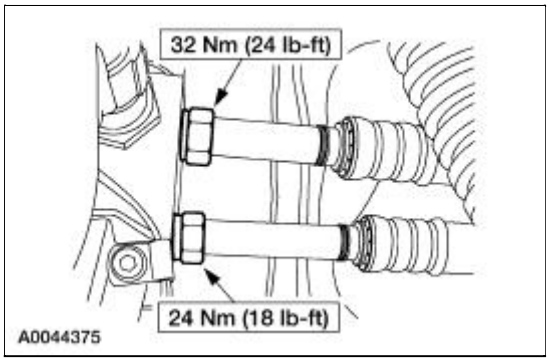
9. Connect the RH fuel injector electrical connectors.



10. Connect the evaporator tubes to the evaporator.

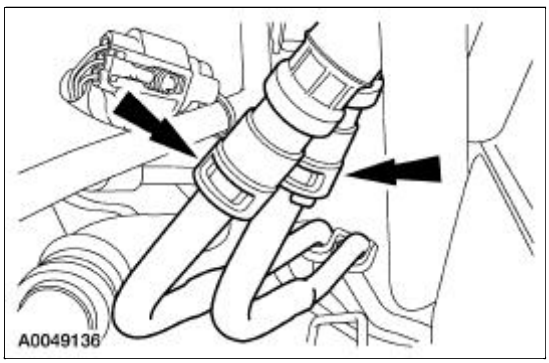


11. Connect the evaporator tubes to the manifold.



Vehicles with auxiliary heat

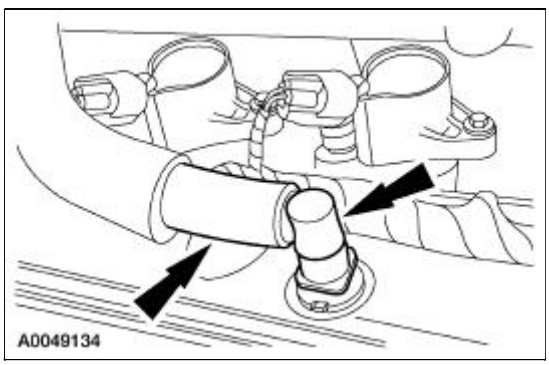
12. Connect the rear heater water lines.



Romeo engine (4.6L)

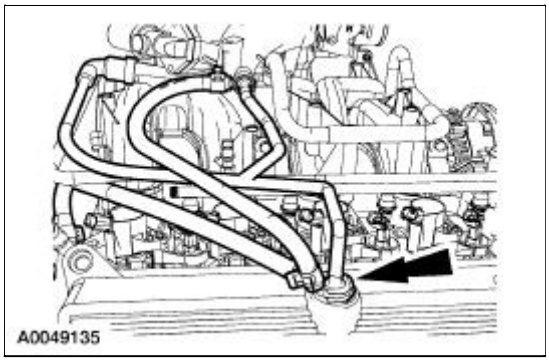
13. **NOTE:** Rotate the PCV valve to lock it in place.

    Install the PCV valve in the valve cover and connect the hose.



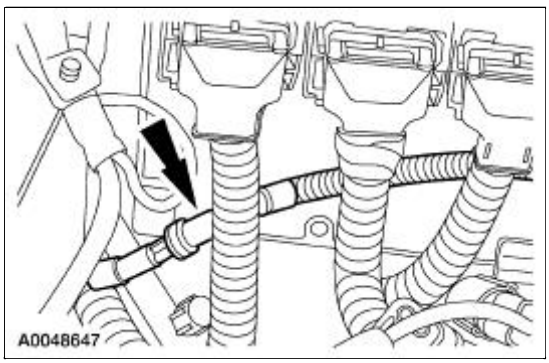
Windsor engine (5.4L)

14. Install the PCV valve in the valve cover.

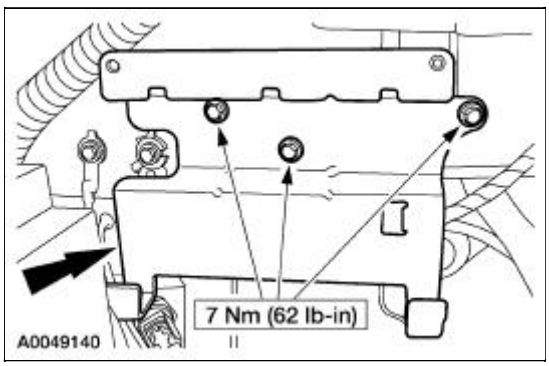


All vehicles

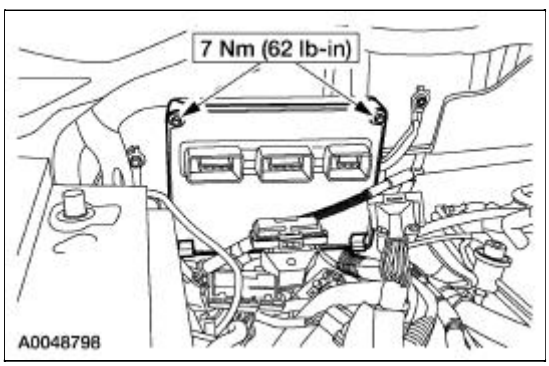
15. Connect the climate control vacuum hose.



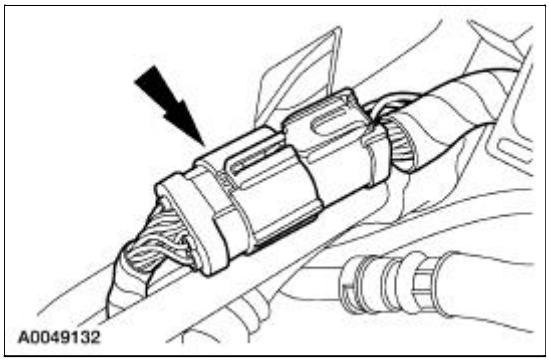
16. Install the PCM mounting bracket.



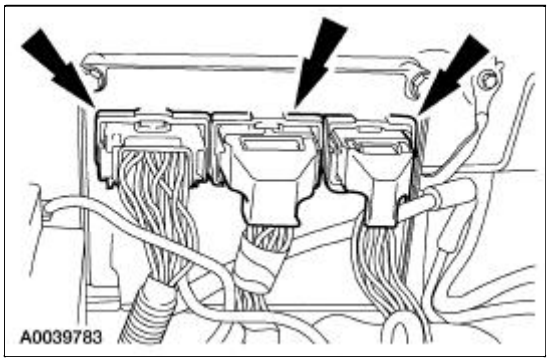
17. Position the PCM and install the bolts.



18. Connect the engine wiring harness electrical connector located near the battery.



19. Connect the PCM electrical connectors.



20. Connect the battery ground cable. For additional information, refer to Section 414-01 .

21. Recharge the air conditioning system. For additional information, refer to Section 412-03A .

Vehicles with auxiliary heat

22. Fill the engine cooling system. For additional information, refer to Section 303-03 .

Crankshaft Pulley

Special Tool(s)

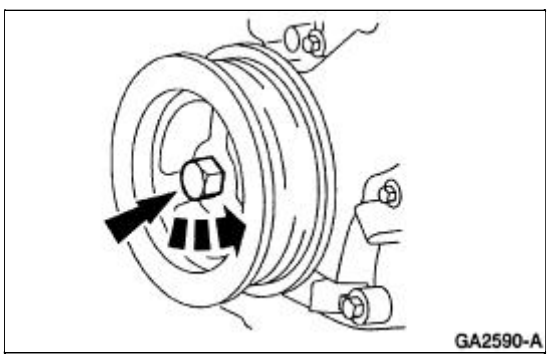
 ST1286-A	Remover, Crankshaft Vibration Damper 303-009 (T58P-6316-D)
 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)

Material

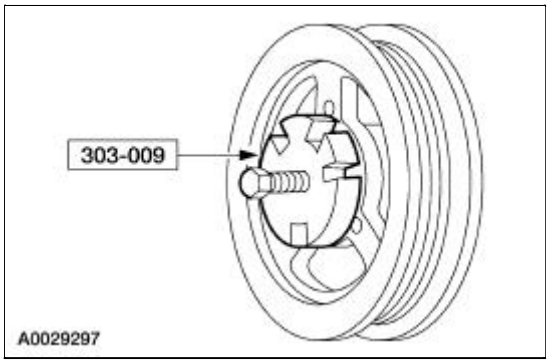
Item	Specification
Motorcraft Silicone Gasket Remover ZC-30	—
Motorcraft Metal Surface Prep ZC-31	—
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4

Removal

1. Remove the engine cooling fan (8K620) and fan shroud (8146). For additional information, refer to Section 303-03 .
2. Remove the drive belt (8620). For additional information, refer to Section 303-05 .
3. Remove the crankshaft pulley bolt (6A340).


GA2590-A

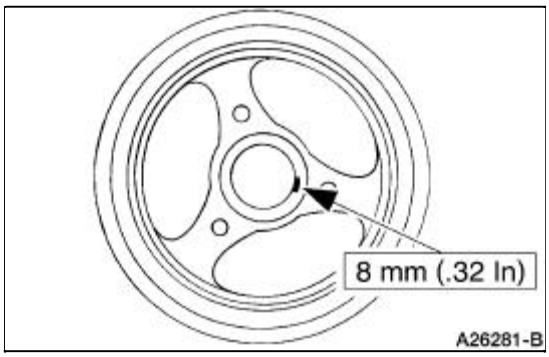
4. Use the special tool to remove the crankshaft pulley (6312).



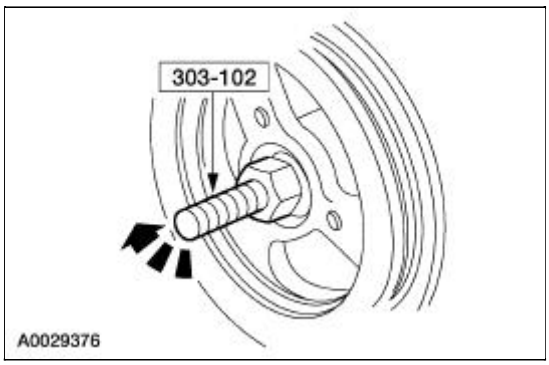
Installation

1. **NOTE:** If not secured within four minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

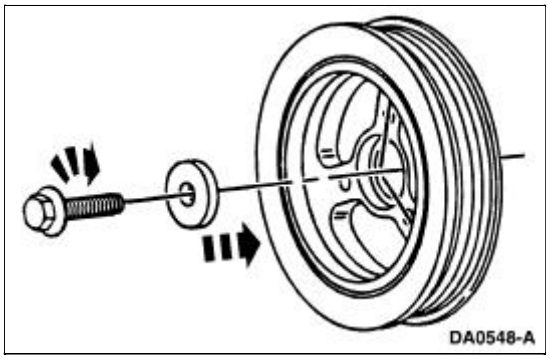
   Apply silicone gasket and sealant to the Woodruff key slot on the crankshaft pulley.



2. Use the special tool to install the crankshaft pulley.



3. Install the bolt and washer. Tighten the bolt in four stages.
   - Stage 1: tighten to 90 Nm (66 lb-ft).
   - Stage 2: loosen the bolt.
   - Stage 3: tighten to 50 Nm (37 lb-ft).
   - Stage 4: tighten an additional 85-90 degrees.



4. Install the drive belt. For additional information, refer to Section 303-05 .

5. Install the engine cooling fan and the fan shroud. For additional information, refer to Section 303-03 .

Crankshaft Front Oil Seal

Special Tool(s)

 ST2197-A	Installer, Crankshaft Front Oil Seal 303-635
 ST1328-A	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A)
 ST1288-A	Remover, Crankshaft Front Oil Seal 303-107 (T74P-6700-A)
 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)

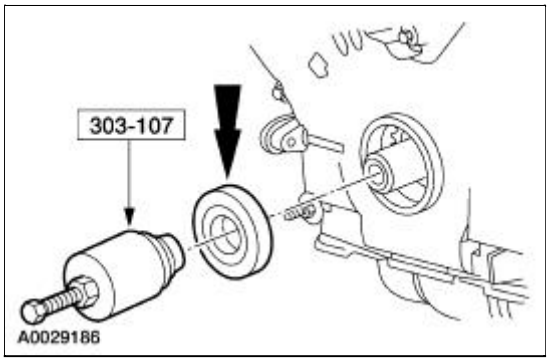
Material

Item	Specification
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

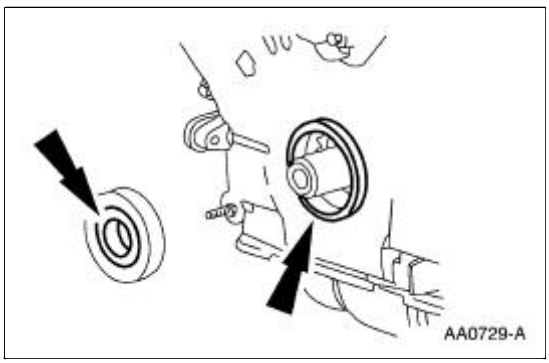
1. Remove the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.

2. Using the special tool, remove the crankshaft front oil seal.

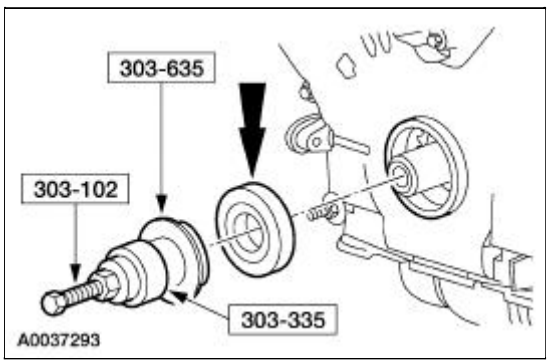


Installation

1. Lubricate the engine front cover and the crankshaft front oil seal inner lip with clean engine oil.



2. Using the special tools, install the crankshaft front oil seal into the engine front cover.



3. Install the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.

Engine Front Cover

Material

Item	Specification
Motorcraft Silicone Gasket Remover ZC-30	—
Motorcraft Metal Surface Prep ZC-31	—
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
SAE 5W-20 Premium Synthetic Blend Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

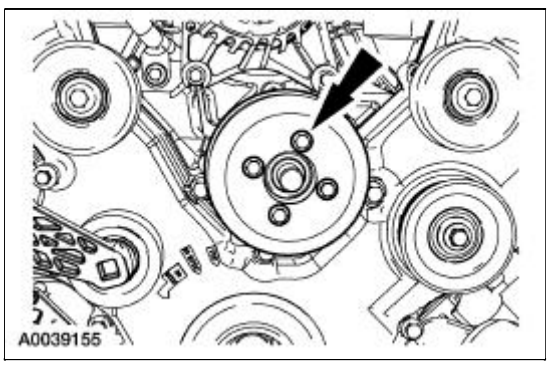
1. **CAUTION: The air suspension switch must be turned off prior to raising the vehicle. Failure to do so can result in unexpected inflation or deflation of the air springs, which could result in shifting of the vehicle during the repair operation.**

   If equipped, turn the air suspension switch off.

2. Remove both of the valve covers. For additional information, refer to Valve Cover LH and Valve Cover RH in this section.

3. Remove the cooling fan. For additional information, refer to Section 303-03 .

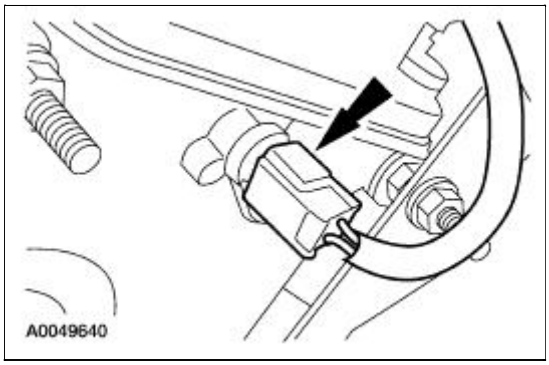
4. Remove the bolts and the coolant pump pulley.



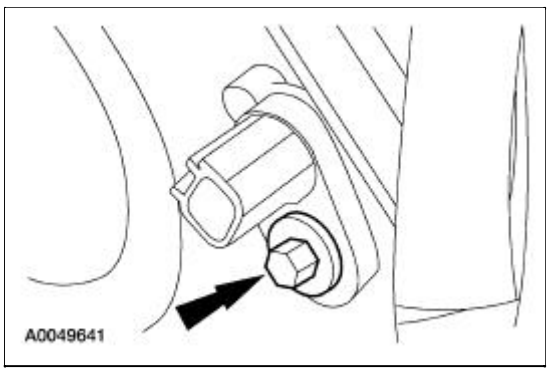
5. Remove the power steering pump. For additional information, refer to Section 211-02 .

6. Remove the crankshaft front oil seal. For additional information, refer to Crankshaft Front Oil Seal in this section.

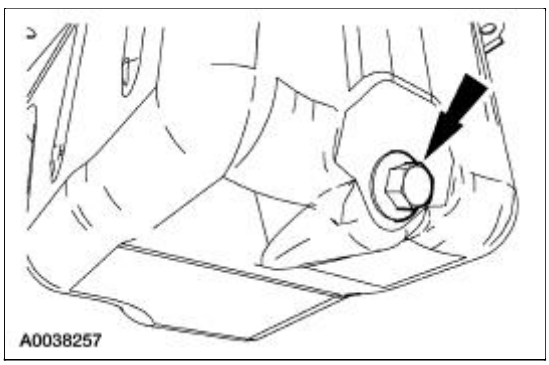
7. Disconnect the camshaft position (CMP) sensor electrical connector.



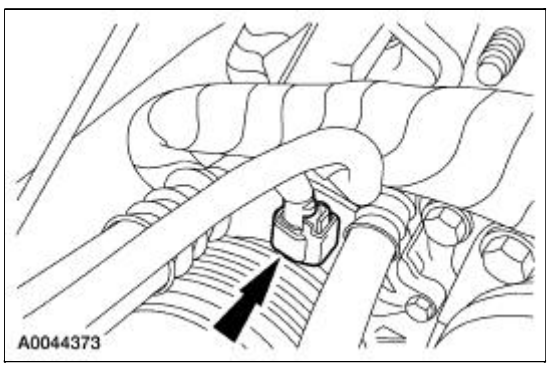
8. Remove the bolt and the CMP sensor.



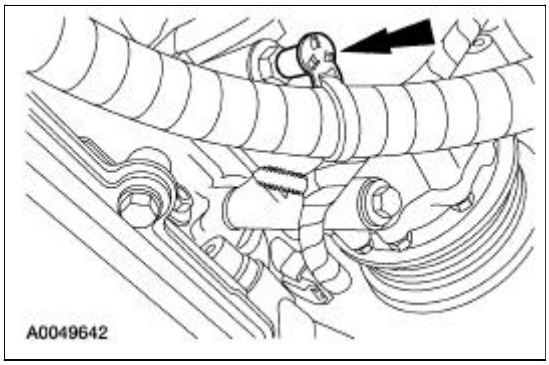
9. Raise and support the vehicle. For additional information, refer to Section 100-02 .
10. Remove the drain plug and drain the engine oil.



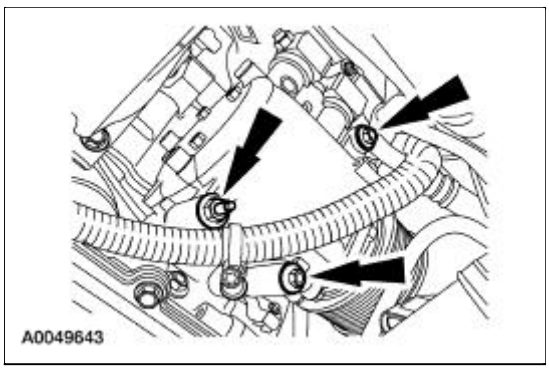
11. Disconnect the A/C compressor electrical connector.



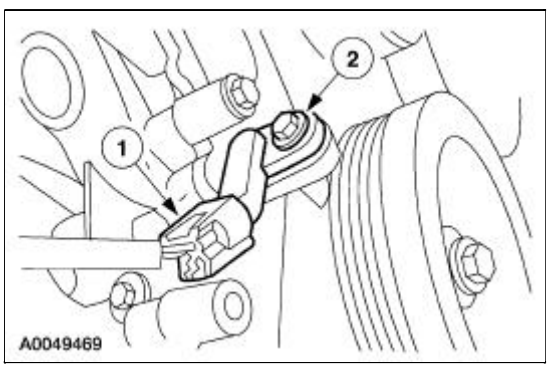
12. Disconnect the harness routing clip and position the harness aside.



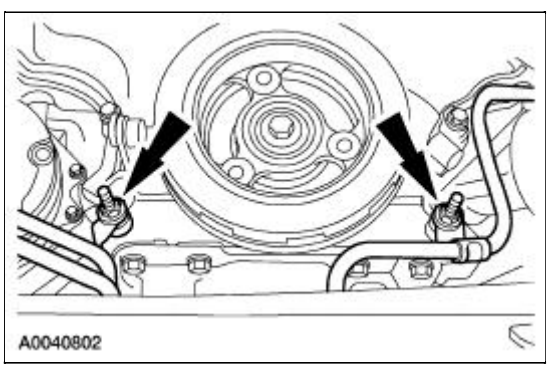
13. Remove the fasteners and position the A/C compressor aside.



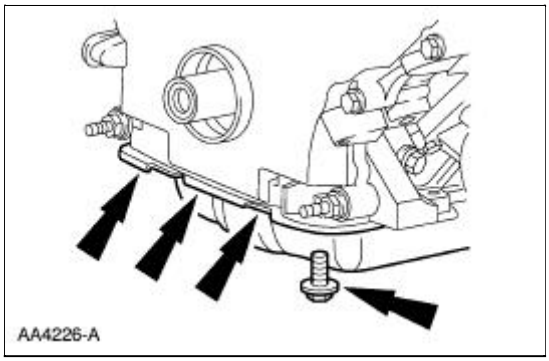
14. Remove the crankshaft position (CKP) sensor.
    1. Disconnect the electrical connector.
    2. Remove the bolt and the sensor.



15. Remove the nuts and detach the power steering and transmission cooler tube brackets.

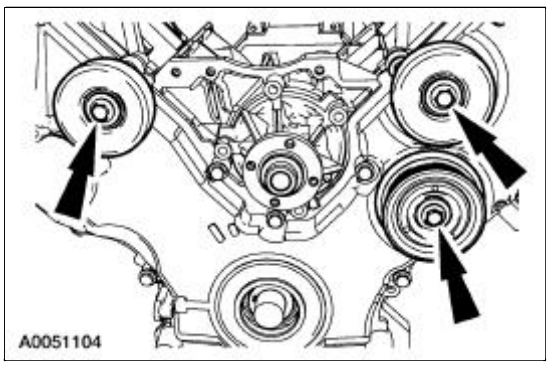


16. Remove the four bolts.

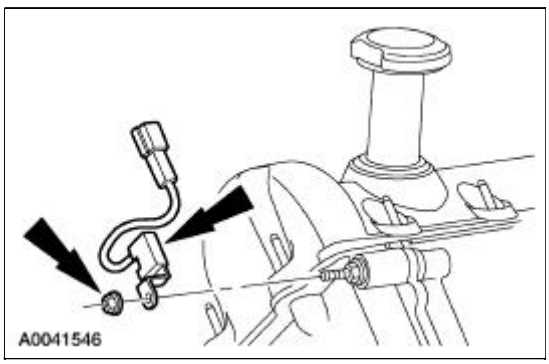


17. Lower the vehicle.

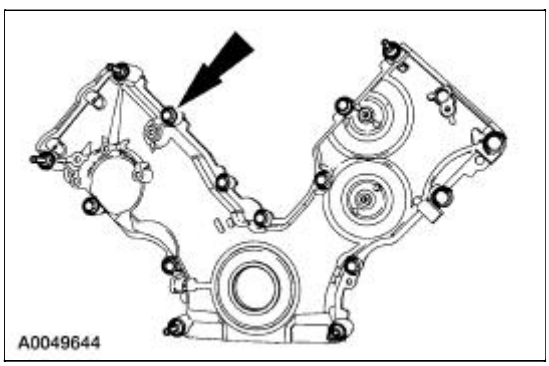
18. Remove the bolts and the drive belt idler pulleys.



19. Remove the nuts and the two radio interference capacitors.



20. Remove the 15 fasteners, the engine front cover and the gaskets.



21. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges**

which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

CAUTION: Cover the oil pan opening to prevent foreign material from falling into the oil pan.

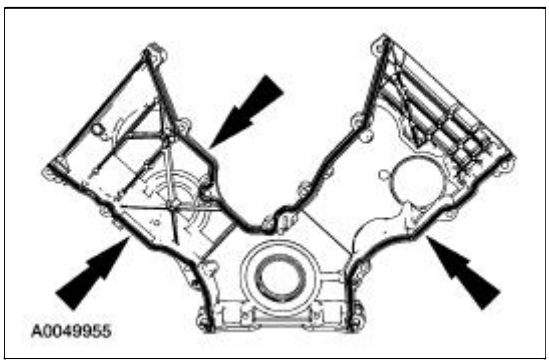
Inspect and clean the gasket mating surfaces.

- Clean the mating surfaces with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
- Inspect the mating surfaces.

Installation

All vehicles

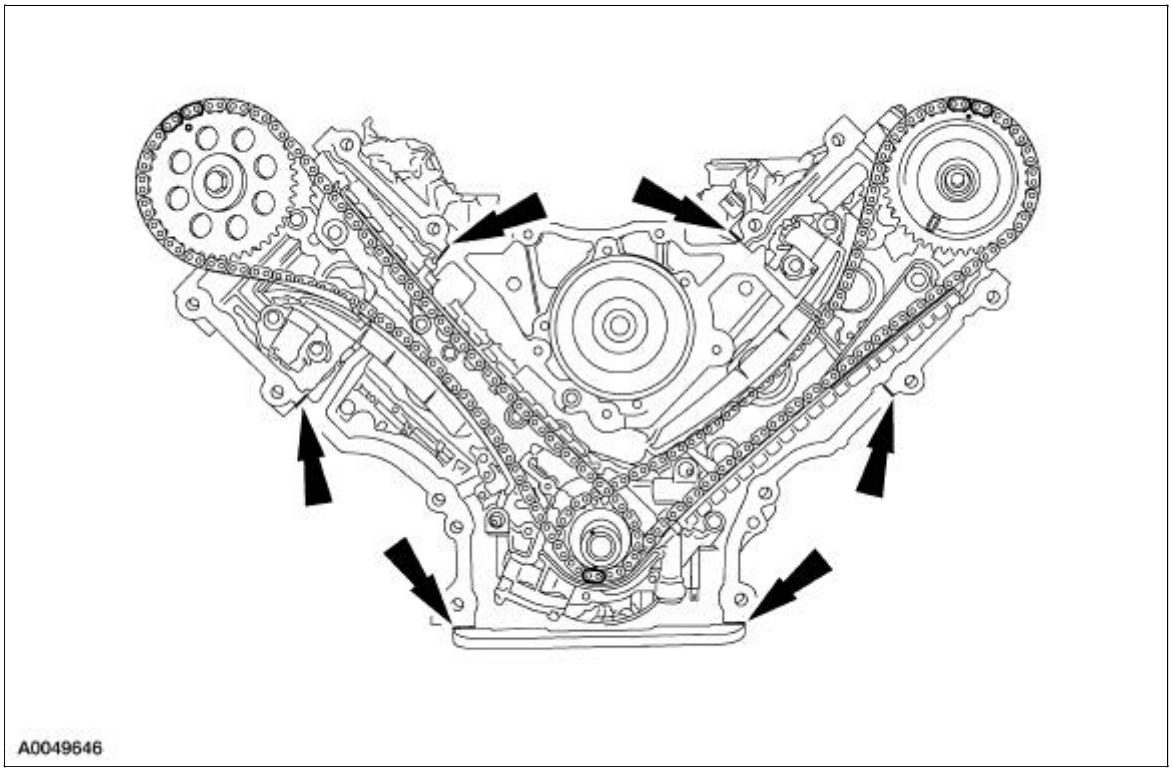
1. Install the gaskets on the engine front cover.



2. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

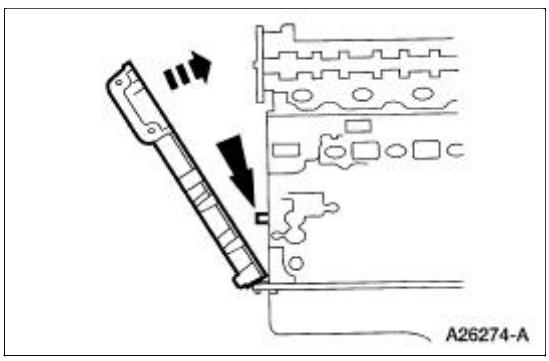
   NOTE: If not secured within four minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

   Apply a bead of silicone gasket and sealant at the cylinder head-to-cylinder block surface and the oil pan-to-cylinder block surface, at the locations shown.



3. **NOTE:** Make sure that the engine front cover gaskets are in place on the engine front cover before installation.

   Position the engine front cover on the front cover-to-cylinder block dowels and loosely install the bolts.

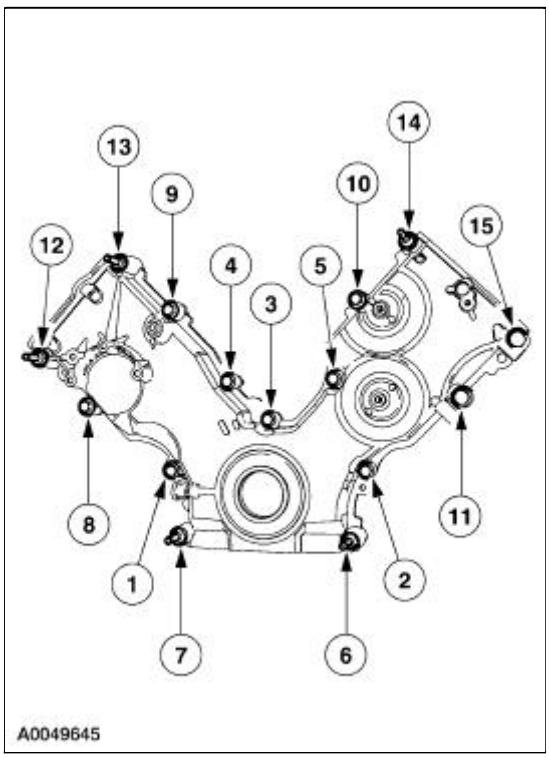


Romeo engine (4.6L)

4. Tighten the engine front cover fasteners in the sequence shown to 25 Nm (18 lb-ft).

Item	Part Number	Description
1	N806177	Bolt, Hex Flange Head Pilot, M8 x 53
2	N806177	Bolt, Hex Flange Head Pilot, M8 x 53
3	N806177	Bolt, Hex Flange Head Pilot, M8 x 53
4	N806177	Bolt, Hex Flange Head Pilot, M8 x 53
5	N806177	Bolts, Hex Flange Head Pilot, M8 x 53
6	N808586	Stud, Hex Shldr Pilot, M8 x 1.25 — M6 x 1 x 86.35
7	N808586	Stud, Hex Shldr Pilot, M8 x 1.25 — M6 x 1 x 86.35

8	N808586	Stud, Hex Shldr Pilot, M8 x 1.25 — M6 x 1 x 86.35
9	N806177	Bolt, Hex Flange Head Pilot, M8 x 53
10	N806177	Bolt, Hex Flange Head Pilot, M8 x 53
11	N806177	Bolt, Hex Flange Head Pilot, M8 x 53
12	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 1.25 x 91.1
13	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 1.25 x 91.1
14	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 1.25 x 91.1
15	N806177	Bolt, Hex Flange Head Pilot, M8 x 53

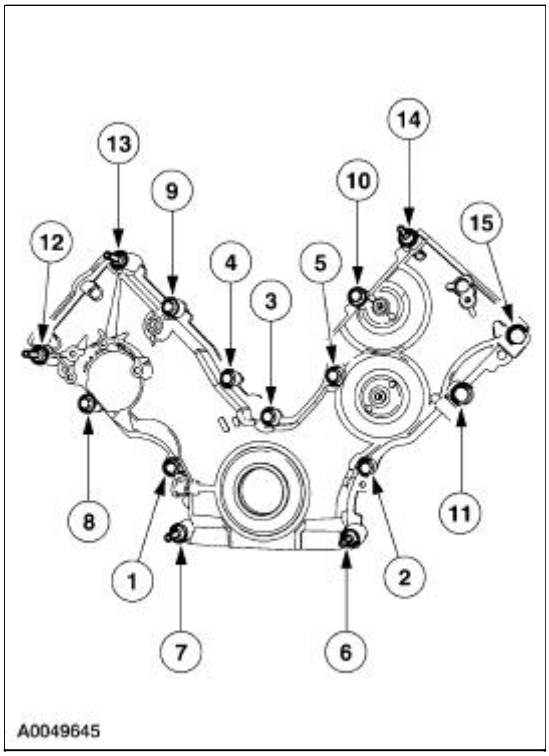


Windsor engine (5.4L)

5. Tighten the engine front cover fasteners in the sequence shown in three stages.
   Stage 1: tighten fasteners 1 through 5 to 25 Nm (18 lb-ft).
   Stage 2: tighten fasteners 6 and 7 to 48 Nm (35 lb-ft).
   Stage 3: tighten fasteners 8 through 15 to 48 Nm (35 lb-ft).

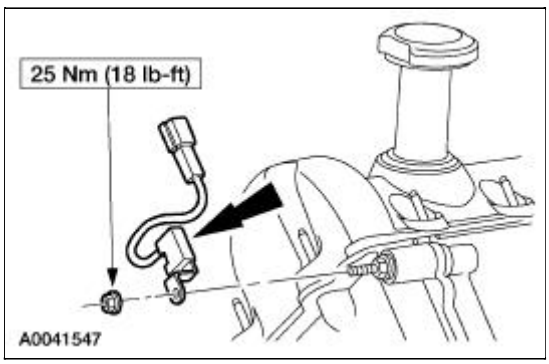
Item	Part Number	Description
1	N806177	Bolt, Hex Flange Head Pilot, M8 x 53
2	N806177	Bolt, Hex Flange Head Pilot, M8 x 53
3	N806177	Bolt, Hex Flange Head Pilot, M8 x 53
4	N806177	Bolt, Hex Flange Head Pilot, M8 x 53
5	N806177	Bolts, Hex Flange Head Pilot, M8 x 53
6	N808529	Stud, Hex Head Pilot, M10 x 103.1
7	N808529	Stud, Hex Head Pilot, M10 x 103.1
8	N808142	Screw and Washer, Hex Pilot, M10 x 1.5 x 57.5
9	N808142	Screw and Washer, Hex Pilot, M10 x 1.5 x 57.5

10	N808142	Screw and Washer, Hex Pilot, M10 x 1.5 x 57.5
11	W706604	Bolt, Hex Flange Head, M10 x 65
12	N808140	Stud and Washer, Hex Head Pilot, M10/M8 x 107
13	N808140	Stud and Washer, Hex Head Pilot, M10/M8 x 107
14	N808140	Stud and Washer, Hex Head Pilot, M10/M8 x 107
15	W706604	Bolt, Hex Flange Head, M10 x 65

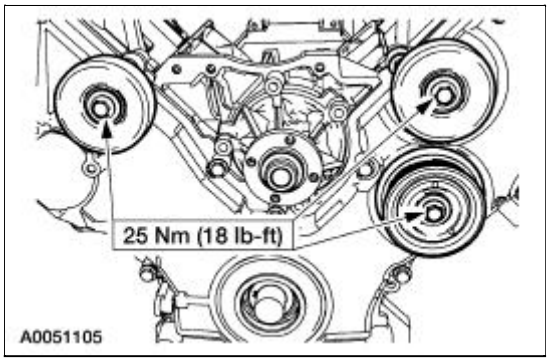


All vehicles

6. Position the two radio frequency interference capacitors and install the nuts.

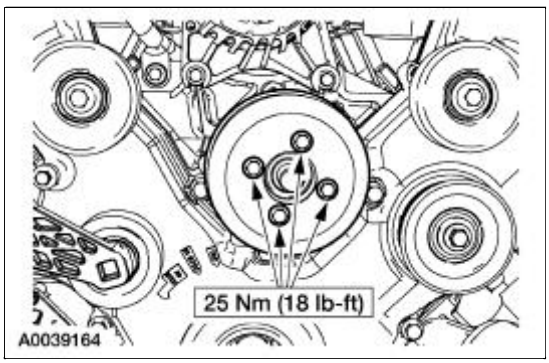


7. Position the drive belt idler pulleys and install the bolts.



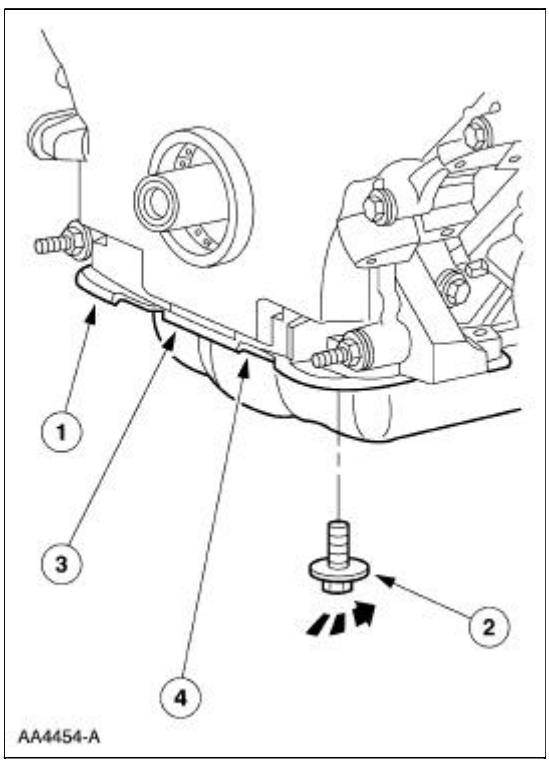
8. **NOTE:** Hold the water pump pulley with a suitable tool to prevent rotation.

   Position the coolant pump pulley and install the bolts.

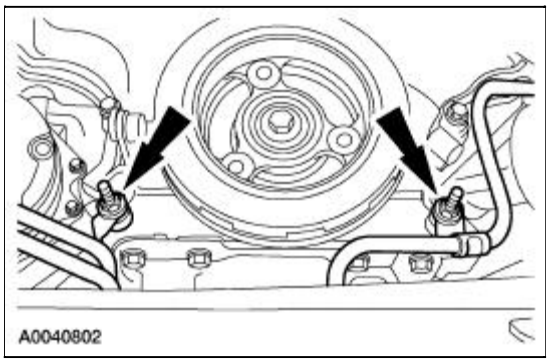


9. Raise and support the vehicle. For additional information, refer to Section 100-02 .

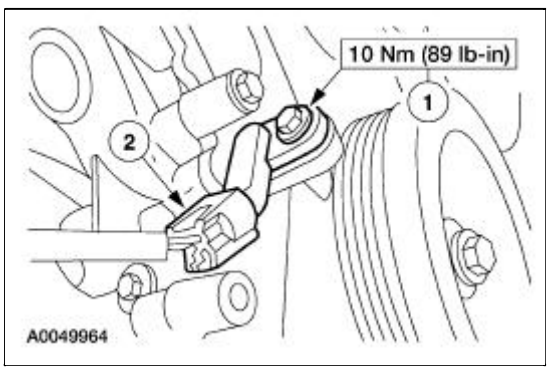
10. Loosely install the bolts, then tighten the bolts in two stages, in the sequence shown.
    - Stage 1: tighten to 20 Nm (15 lb-ft).
    - Stage 2: tighten an additional 90 degrees.



11. Position the transmission cooler tube and the power steering tube brackets. Install the nuts.
    - On 4.6L engine, tighten the nuts to 11 Nm (8 lb-ft).
    - On 5.4L engine, tighten the nuts to 40 Nm (30 lb-ft).



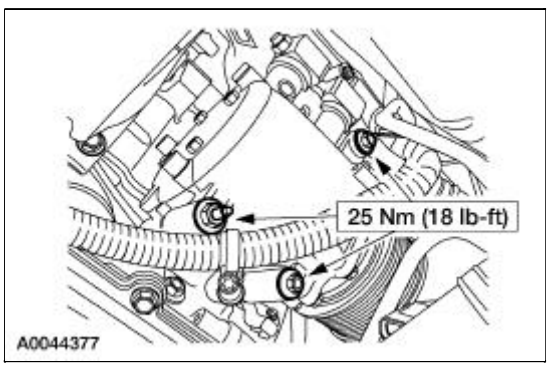
12. Install the CKP sensor.
    1. Install the sensor and bolt.
    2. Connect the electrical connector.



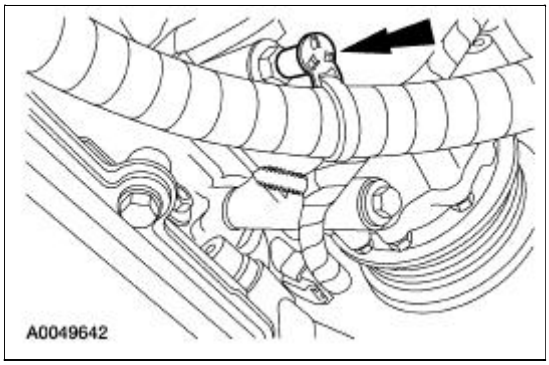
13. Install a new crankshaft front oil seal. For additional information, refer to Crankshaft Front Oil Seal in this section.

14. Install the power steering pump. For additional information, refer to Section 211-02 .

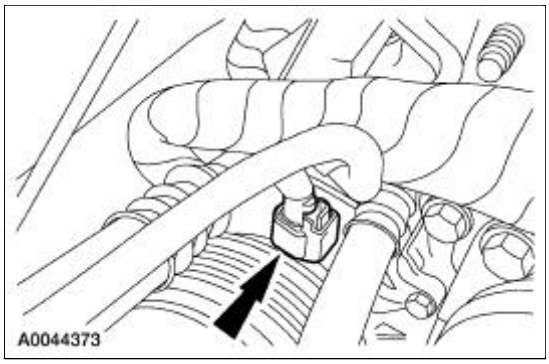
15. Position the A/C compressor and install the fasteners.



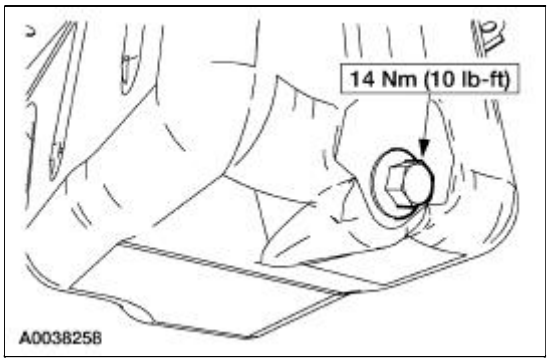
16. Install the harness routing clip.



17. Connect the A/C compressor electrical connector.



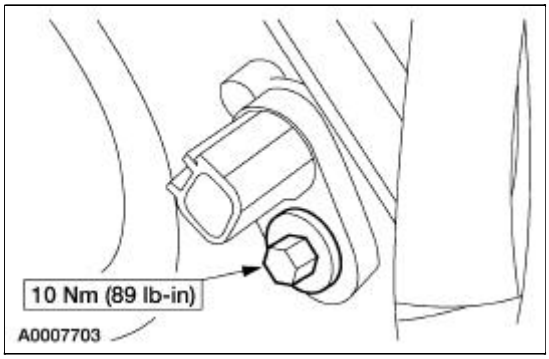
18. Install the drain plug.



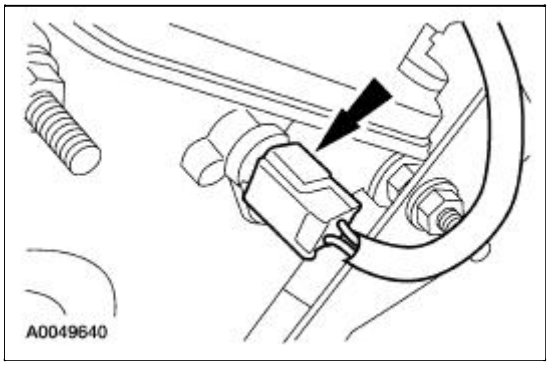
19. Install a new engine oil filter.

20. Lower the vehicle.

21. Install the CMP sensor and bolt.



22. Connect the CMP sensor electrical connector.



23. Install the cooling fan. For additional information, refer to Section 303-03 .

24. **CAUTION: Fill the engine with clean engine oil before starting the engine to fill the cooling system or charge the A/C system.**

    Install the LH and RH valve covers. For additional information, refer to Valve Cover LH and Valve Cover RH in this section.

25. Fill the engine with clean engine oil.

26. If equipped, turn on the air suspension switch.

Timing Drive Components —Windsor Engine (5.4L)

Special Tool(s)

 ST1335-A	Holding Tool, Crankshaft 303-448 (T93P-6303-A)
	Aligner, Camshaft Position 303-557 (T96T-6256-B)
 ST2565-A	Alignment Set, Camshaft 303-S568 (T96T-6256-AR)

Material

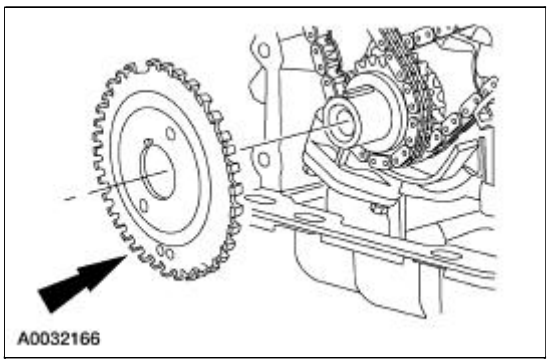
Item	Specification
Hydraulic Chain Tensioner Retaining Clip	1L3Z-6P250-AA

Removal

CAUTION: Since the engine is not free-wheeling, the timing procedures must be followed exactly or piston and valve damage can occur.

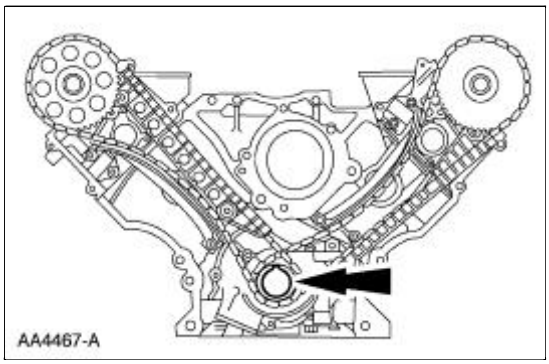
1. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.

2. Remove the crankshaft sensor ring from the crankshaft.

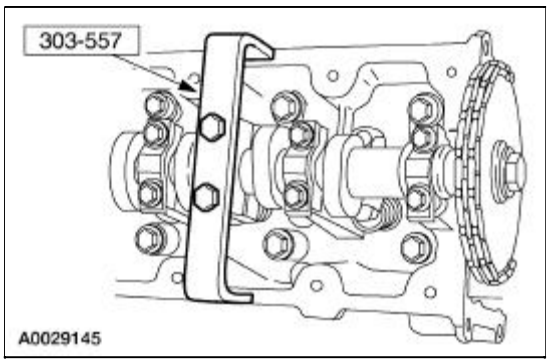

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3. **CAUTION: Unless otherwise instructed, at no time when the timing chains are removed and the cylinder heads are installed is the crankshaft or camshaft to be rotated. Severe piston and valve damage will occur.**

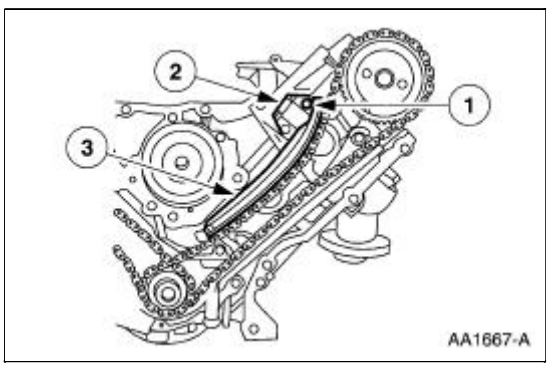
   Position the crankshaft with the keyway at the 12 o'clock position.



4. Install and fully tighten the special tools on both camshafts.



5. Remove the timing chain tensioning system from both timing chains.
   1. Remove the bolts.
   2. Remove the timing chain tensioners.
   3. Remove the timing chain tensioner arms.

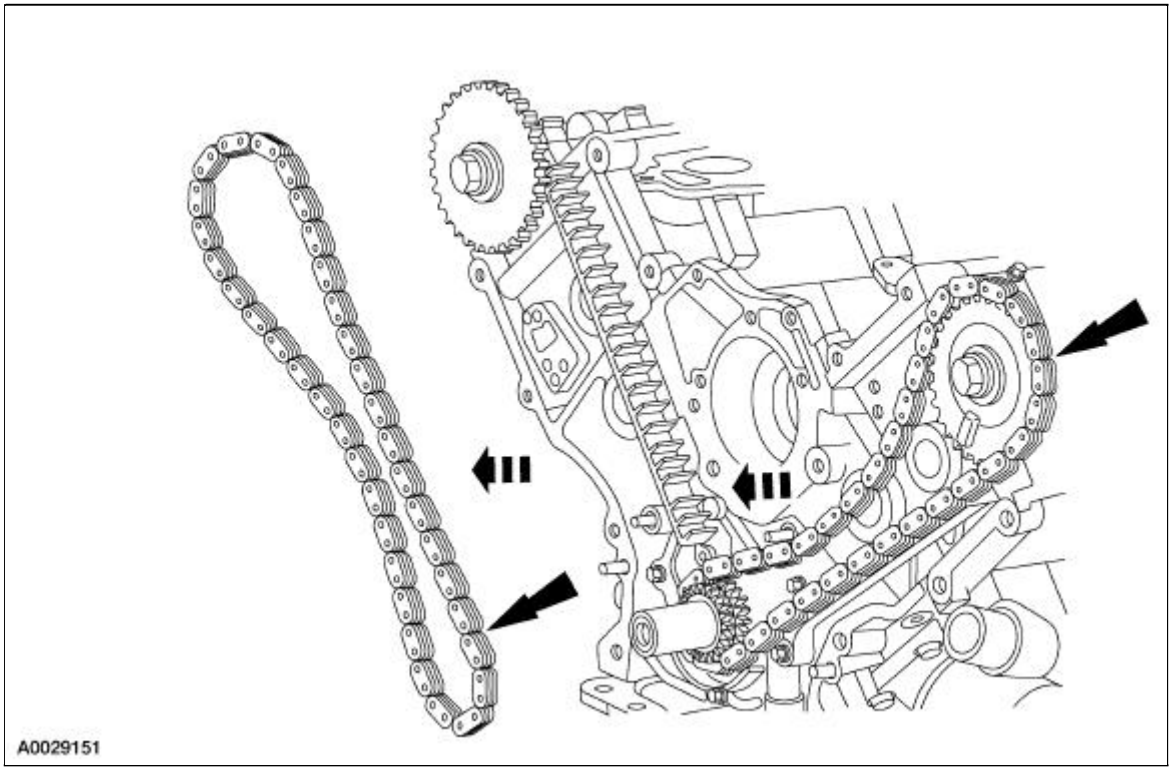


6. **CAUTION: Unless otherwise instructed, at no time when the timing chains are removed and the cylinders heads are installed is the crankshaft or camshaft to be rotated. Severe piston and valve damage will occur.**

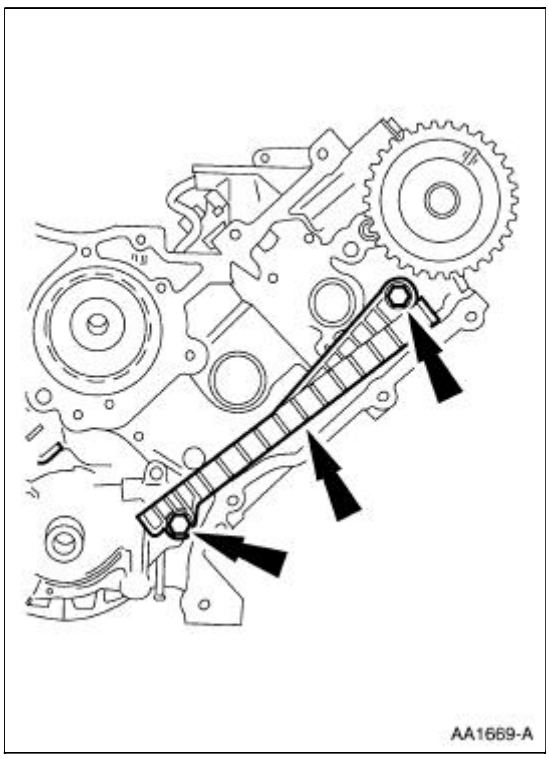
   Remove the RH and LH timing chains and the crankshaft sprocket.

   - Remove the RH timing chain from the camshaft sprocket.
   - Remove the RH timing chain from the crankshaft sprocket.

- Remove the LH timing chain from the camshaft sprocket.
- Remove the LH timing chain and crankshaft sprocket.



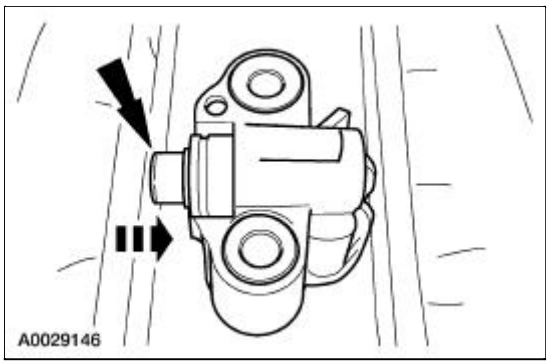
7. Remove both timing chain guides.
    - Remove the bolts.
    - Remove both timing chain guides.



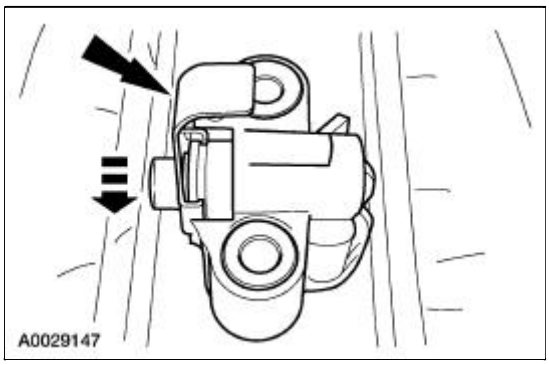
Installation

1. **CAUTION: Timing chain procedures must be followed exactly or damage to valves and pistons will result.**

   Compress the tensioner plunger, using a vise.

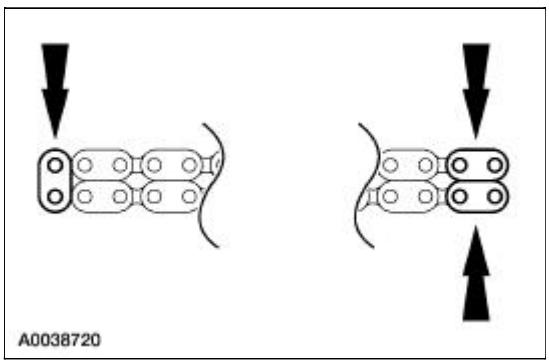


2. Install a retaining clip on the tensioner to hold the plunger in during installation.

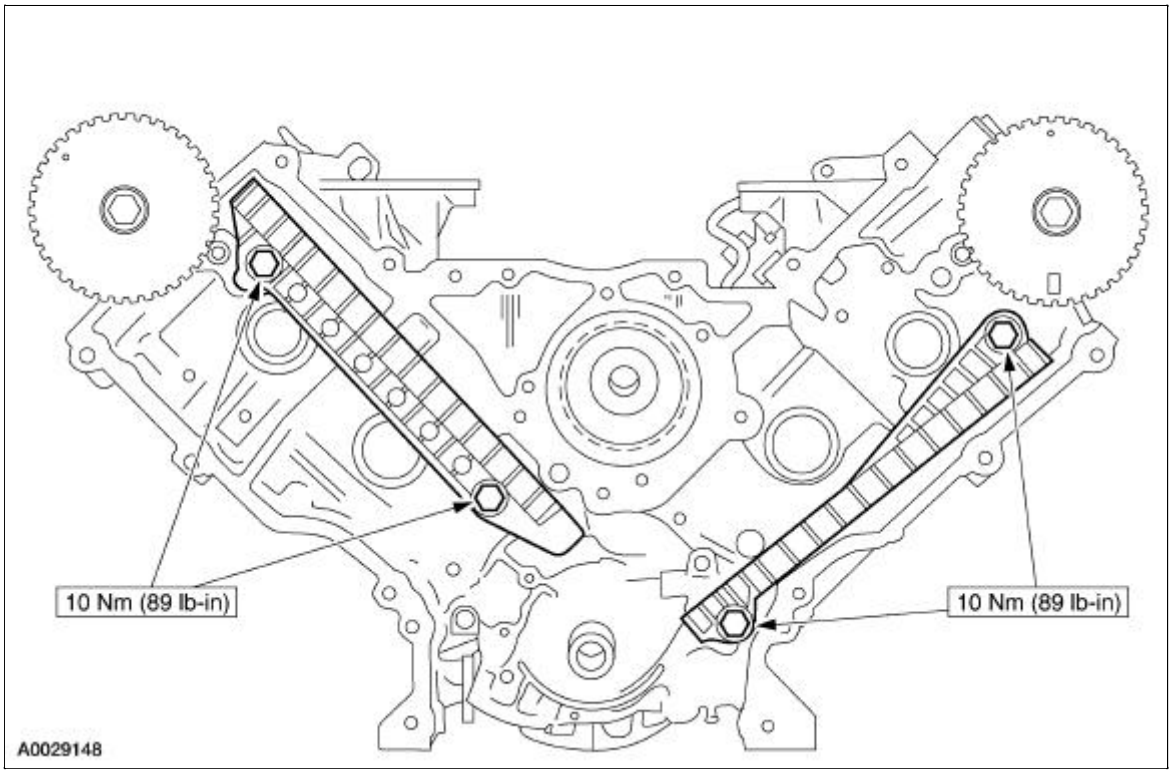


3. Remove the tensioner from the vise.

4. If the copper links are not visible, mark two links on one end and one link on the other end, and use as timing marks.

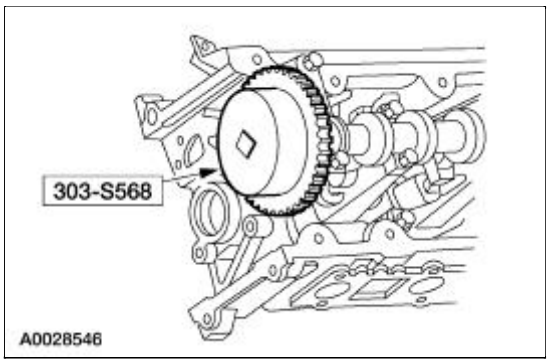


5. Install the timing chain guides.



6. **CAUTION: Do not turn the engine over with the Camshaft Alignment Set or damage to the camshaft sprocket or the bolt can occur.**

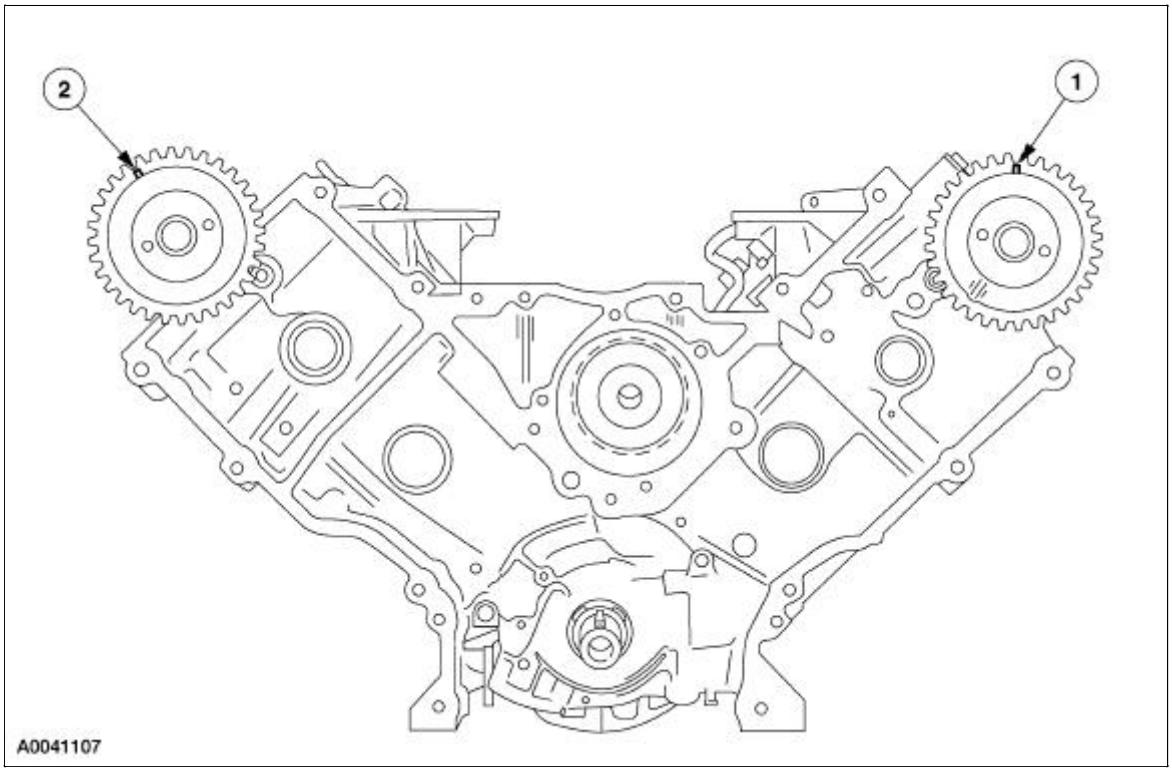
   Install the special tool.



7. **NOTE:** Slightly loosen the Camshaft Position Aligner tools to allow slight camshaft movement.

   Pre-position the camshafts.
   1. Rotate the LH camshaft with the Camshaft Alignment Set until the timing mark is approximately at 12 o'clock.
   2. Rotate the RH camshaft with the Camshaft Alignment Set until the timing mark is approximately at 11 o'clock.

   - Tighten the Camshaft Position Aligner tools to maintain camshaft pre-positioning.

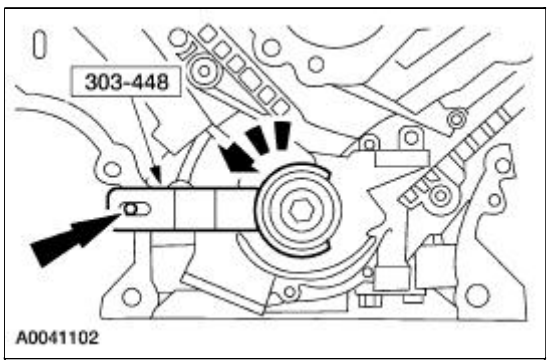


8. **CAUTION: Unless otherwise instructed, at no time when the timing chains are removed and the cylinder heads are installed is the crankshaft or camshaft to be rotated. Severe piston and valve damage will occur.**

   CAUTION: Rotate the crankshaft counterclockwise only. Do not rotate past position shown or severe piston and valve damage can occur.

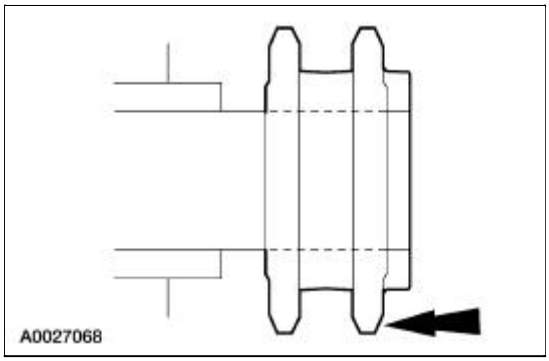
   NOTE: The number one cylinder is at top dead center (TDC) when the stud on the engine block fits into the slot in the handle of the special tool.

   Position the crankshaft so the number one cylinder is at TDC with the special tool.

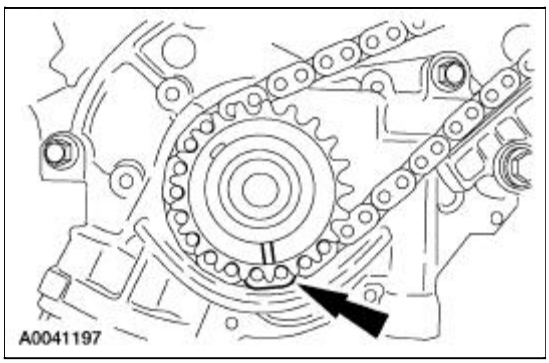


9. Remove the Crankshaft Holding Tool.

10. Install the crankshaft sprocket, making sure the flange faces forward.



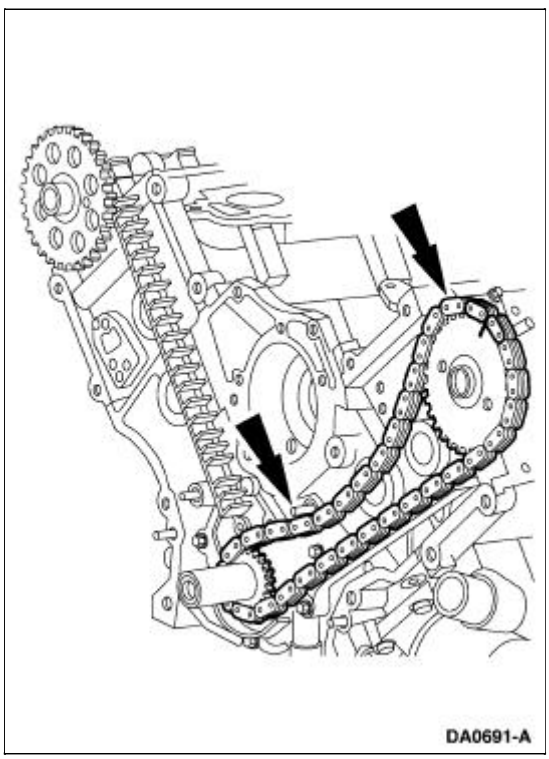
11. Position the lower end of the LH (inner) timing chain on the crankshaft sprocket, aligning the timing mark on the outer flange of the crankshaft sprocket with the single copper (marked) link on the chain.



12. **NOTE:** Make sure the upper half of the timing chain is below the tensioner arm dowel.

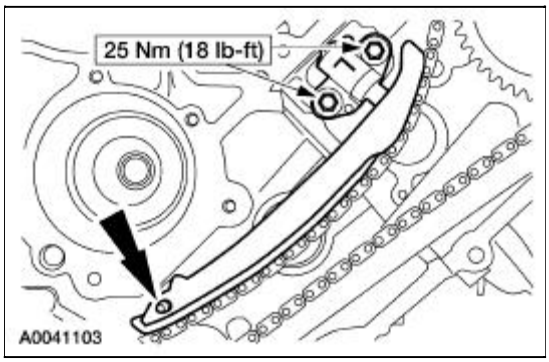
    NOTE: If necessary, use the Camshaft Alignment Set to adjust the camshaft sprocket slightly to obtain timing mark alignment.

    Position the timing chain on the camshaft sprocket with the camshaft sprocket timing mark positioned between the two copper (marked) chain links.

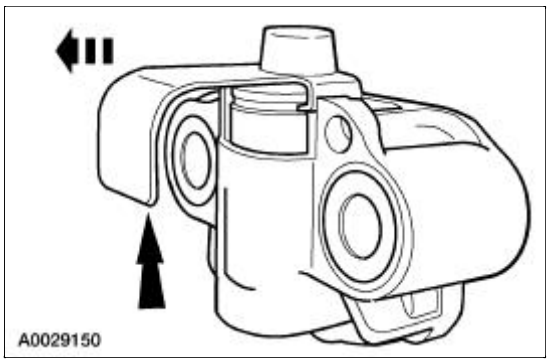


13. **NOTE:** The LH timing chain tensioner arm has a bump near the dowel hole, for identification.

    Position the LH timing chain tensioner arm on the dowel pin and install the LH timing chain tensioner.

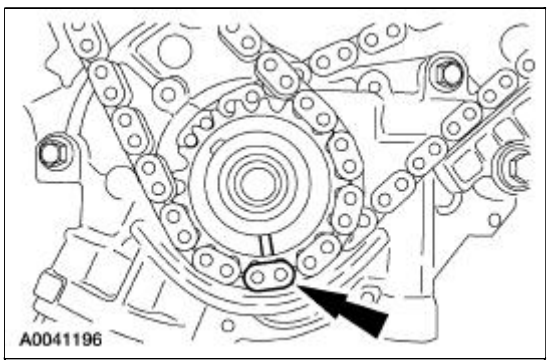


14. Remove the retaining clip from the LH timing chain tensioner.



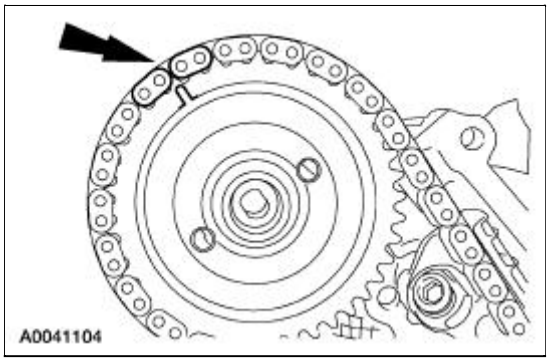
15. **NOTE:** The lower half of the timing chain must be positioned above the tensioner arm dowel.

    Position the lower end of the RH (outer) timing chain on the crankshaft sprocket, aligning the timing mark on the sprocket with the single copper (marked) link on the timing chain.

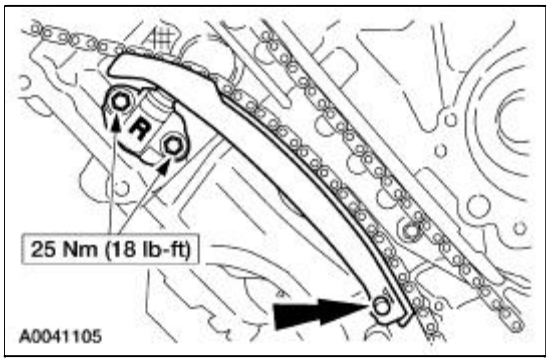


16. **NOTE:** If necessary, use the Camshaft Alignment Set to adjust the camshaft sprocket slightly to obtain timing mark alignment.

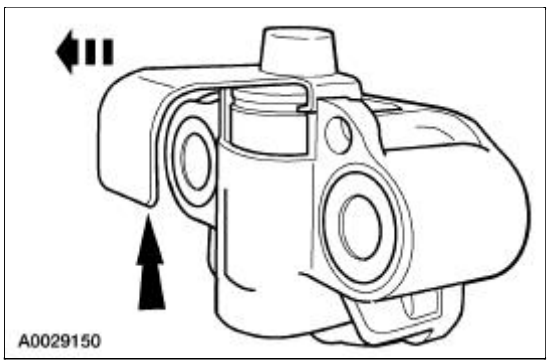
    Position the RH timing chain on the camshaft sprocket. Make sure the camshaft sprocket timing mark is positioned between the two copper (marked) chain links.



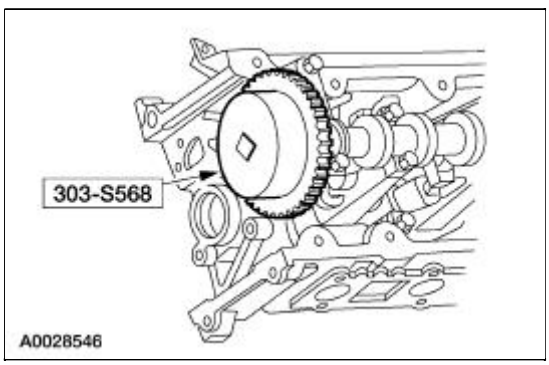
17. Position the RH timing chain tensioner arm on the dowel pin and install the RH timing chain tensioner.



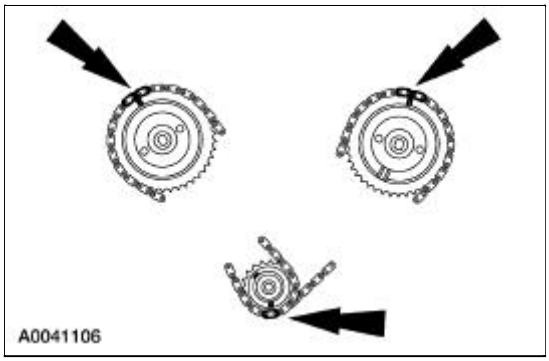
18. Remove the retaining clip from the RH timing chain tensioner.



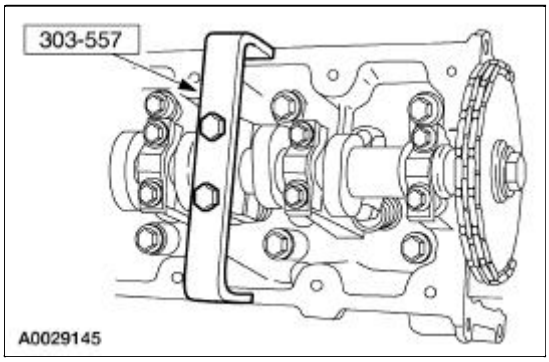
19. Remove the special tool.



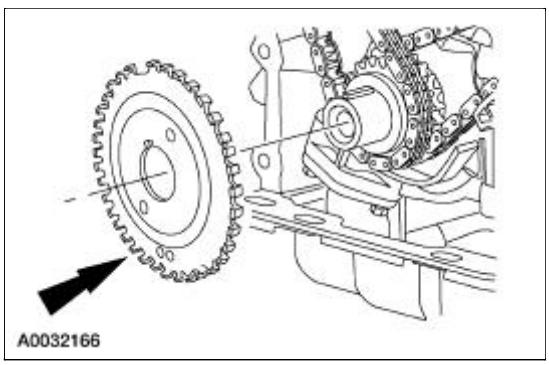
20. As a post-check, verify correct alignment of all timing marks.



21. Remove the special tool.



22. Position the crankshaft sensor ring on the crankshaft.



23. Install the engine front cover. For additional information, refer to Engine Front Cover in this section.

Timing Drive Components —Romeo Engine (4.6L)

Special Tool(s)

 ST1329-A	Aligner, Camshaft 303-380 (T91P-6256-A)
 ST1334-A	Aligner, Camshaft Pulley 303-413 (T92P-6256-A)
 ST1335-A	Holding Tool, Crankshaft 303-448 (T93P-6303-A)

Material

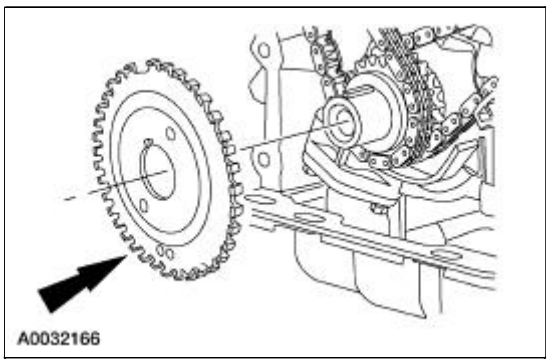
Item	Specification
Hydraulic Chain Tensioner Retaining Clip	1L3Z-6P250-AA

Removal

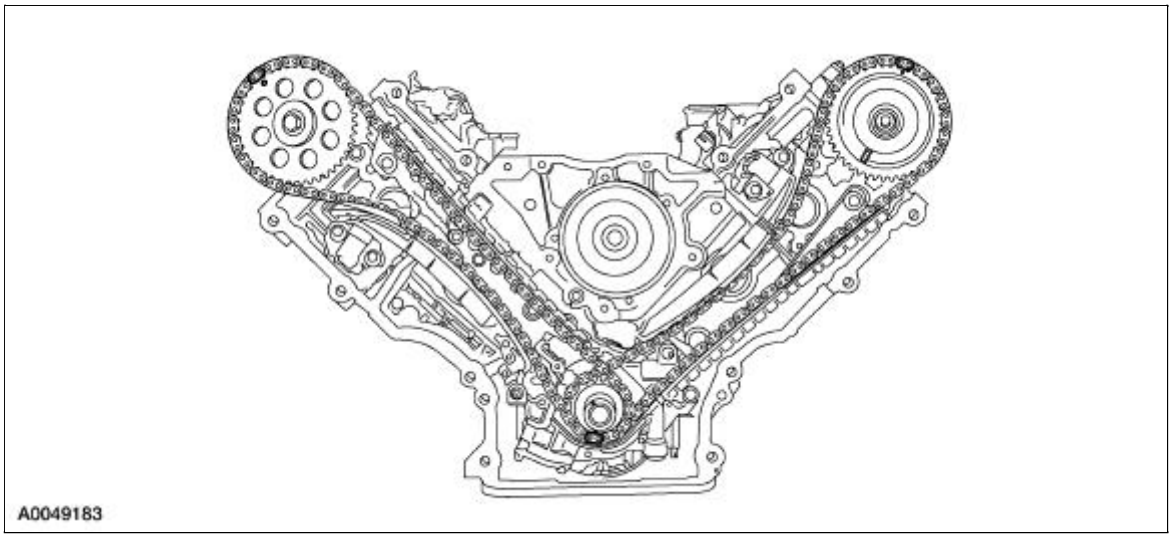
CAUTION: Since the engine is not free-wheeling, timing procedures must be followed exactly or piston and valve damage can occur.

1. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.

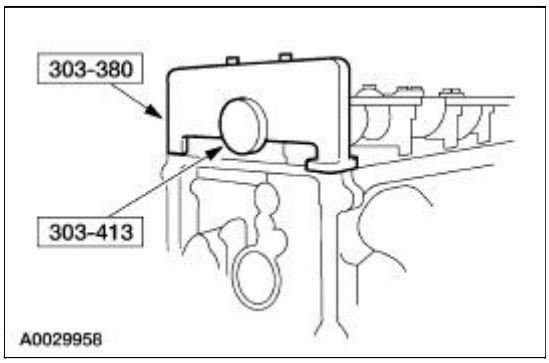
2. Remove the crankshaft sensor ring from the crankshaft.



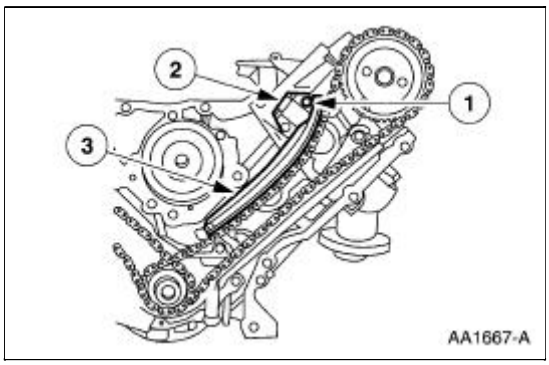
3. Rotate the crankshaft until the timing mark on the RH camshaft sprocket is approximately at the 11 o'clock position and the timing mark on the LH camshaft sprocket is approximately at the 12 o'clock position.



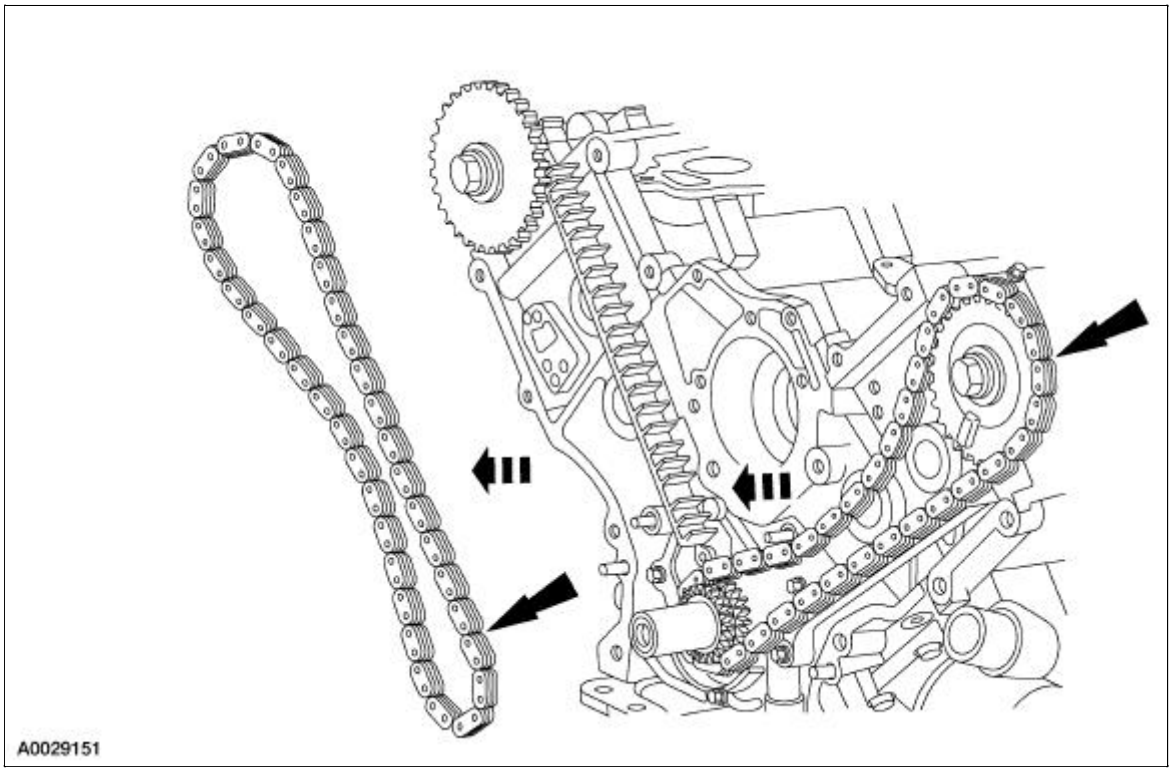
4. Install the special tools on the camshaft.



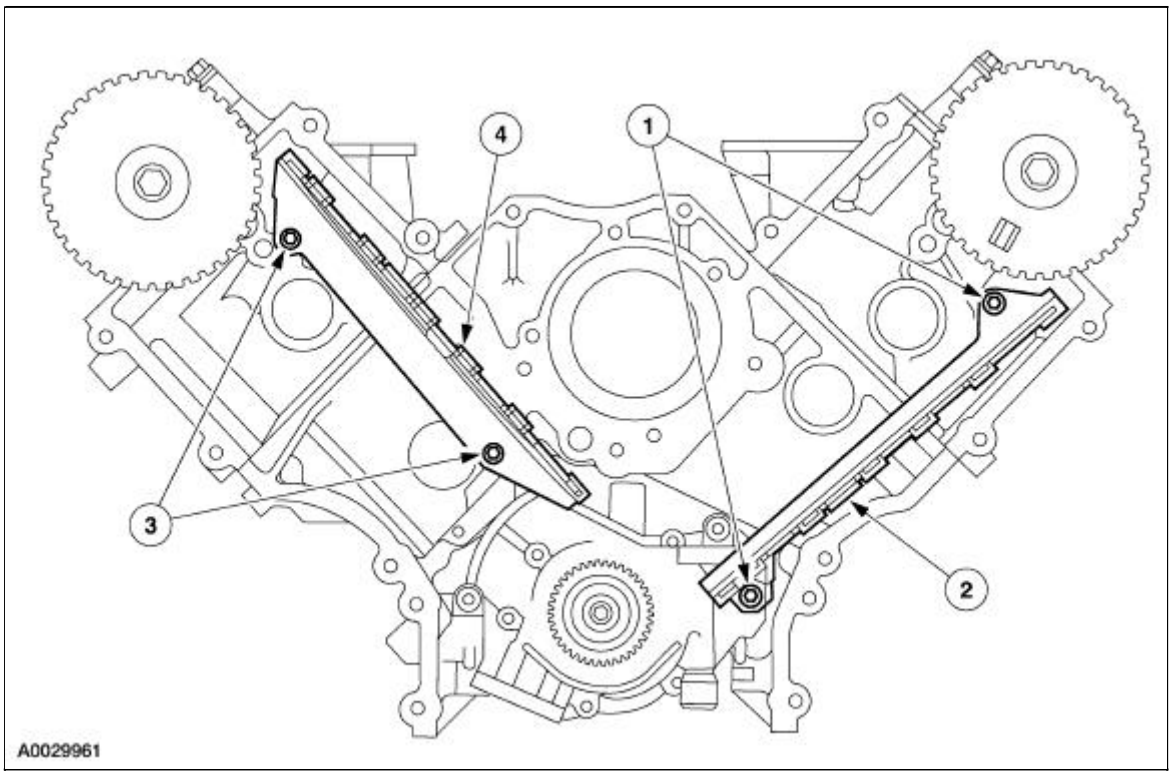
5. Remove the timing chain tensioning system from both timing chains.
    1. Remove the bolts.
    2. Remove the timing chain tensioners.
    3. Remove the timing chain tensioner arms.



6. Remove the timing chains and crankshaft sprocket.



7. Remove the timing chain guides.
    1. Remove the bolts.
    2. Remove the LH timing chain guide.
    3. Remove the bolts.
    4. Remove the RH timing chain guide.

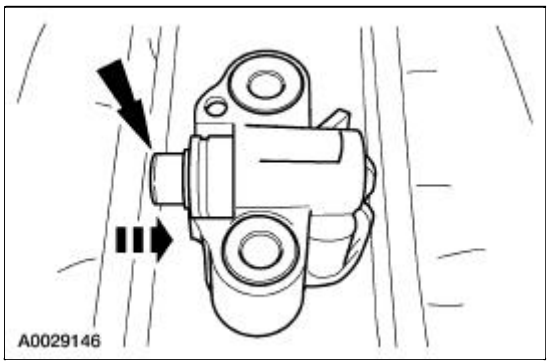


Installation

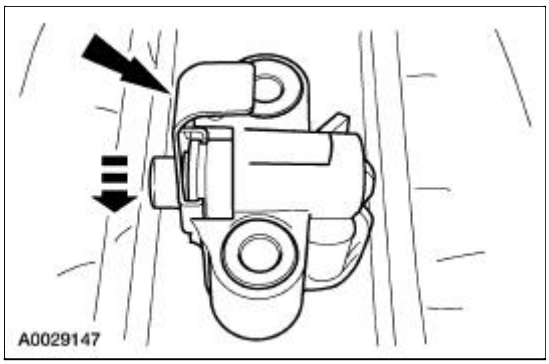
1. **CAUTION: Timing chain procedures must be followed exactly or damage to valves**

and pistons will result.

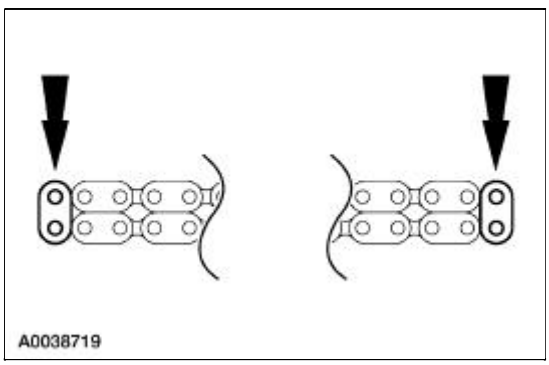
Compress the tensioner plunger, using a vise.



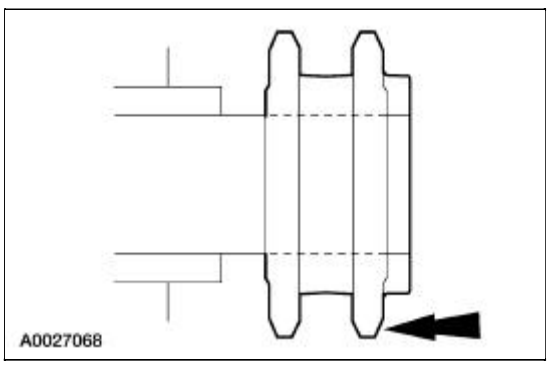
2. Install a retaining clip on the tensioner to hold the plunger in during installation.



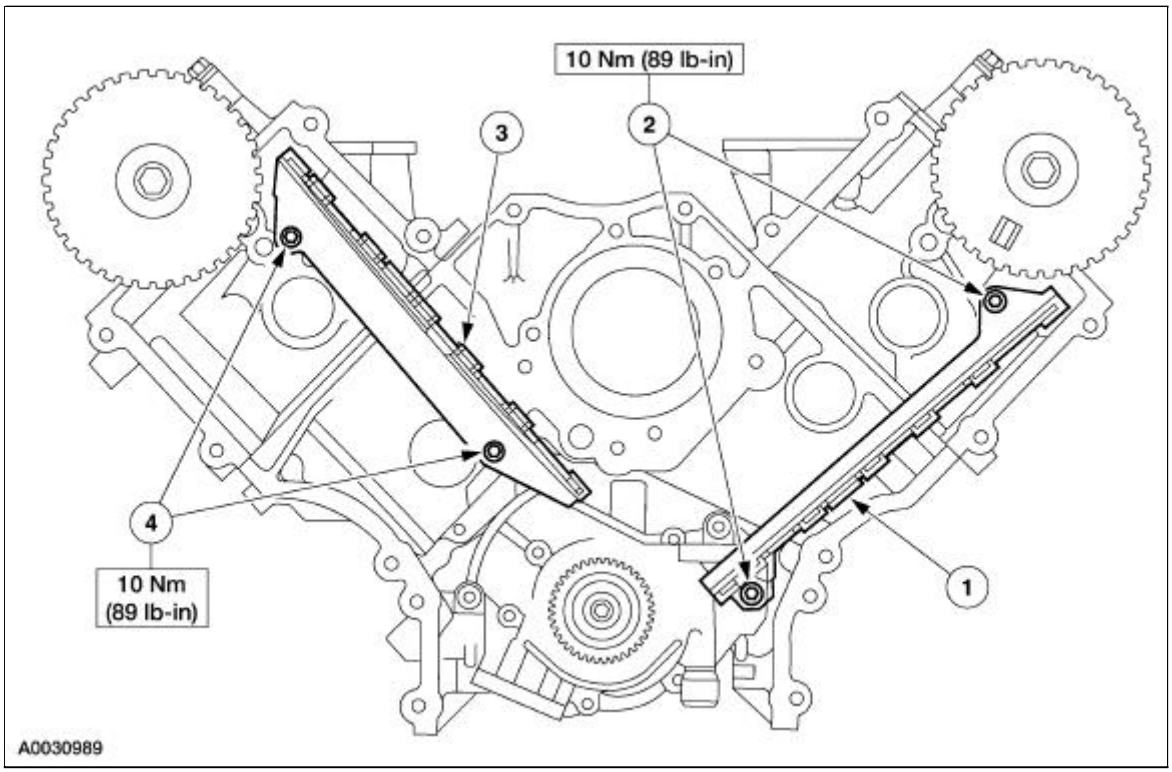
3. If the copper links are not visible, mark one link on one end and one link on the other end, and use as timing marks.



4. Install the crankshaft sprocket, making sure the flange faces forward.



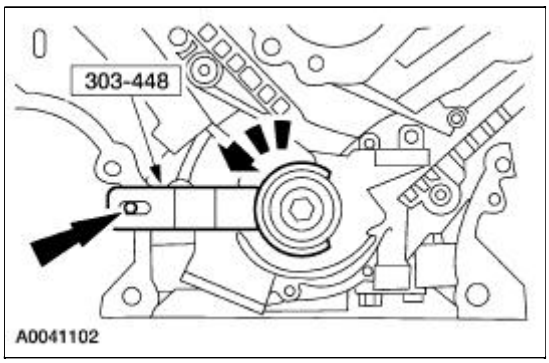
5. Install the timing chain guide.
    1. Position LH timing chain guide.
    2. Install and tighten the bolts.
    3. Position the RH timing chain guide.
    4. Install and tighten the RH bolts.



6. **CAUTION: Unless otherwise instructed, do not rotate either the crankshaft or the camshafts, when the timing chains are removed and the cylinder heads are installed. Severe piston and valve damage will occur.**

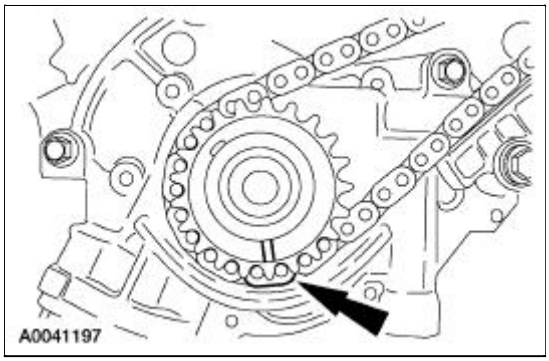
    NOTE: The number one cylinder is at top dead center (TDC) when the stud on the engine block fits into the slot in the handle of the special tool.

    Using the special tool, position the crankshaft so the number one cylinder is at TDC.

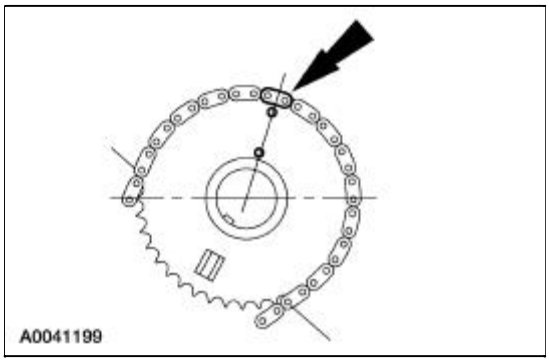


7. Remove the Crankshaft Holding Tool.

8. Position the LH (inner) timing chain on the crankshaft sprocket, aligning the copper (marked) link with the timing mark on the sprocket.

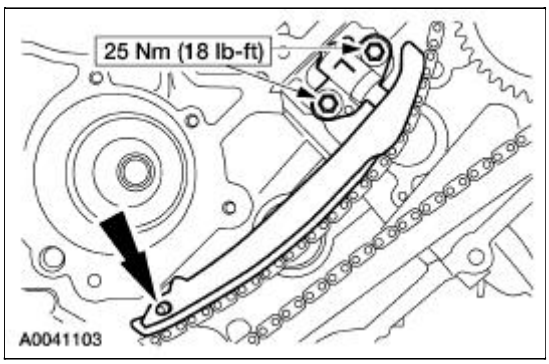


9. Install the LH timing chain on the camshaft sprocket, aligning the copper (marked) link with the timing marks on the sprocket.

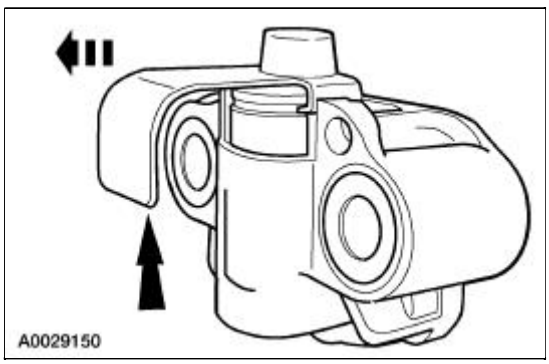


10. **NOTE:** The LH timing chain tensioner arm has a bump near the dowel hole for identification.

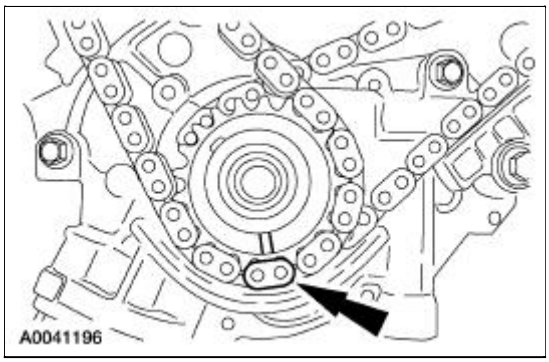
    Position the LH timing chain tensioner arm on the dowel pin and install the LH timing chain tensioner.



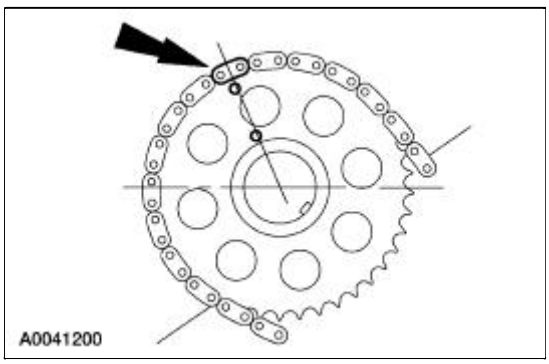
11. Remove the retaining clip from the LH timing chain tensioner.



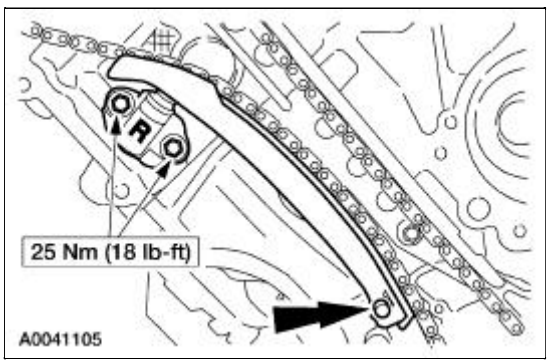
12. Position the RH (outer) timing chain on the crankshaft sprocket, aligning the copper (marked) link with the timing mark on the sprocket.



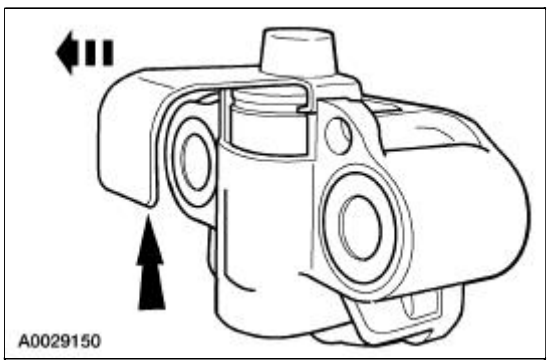
13. Install the RH timing chain on the camshaft sprocket, aligning the copper (marked) link with the timing marks on the sprocket.



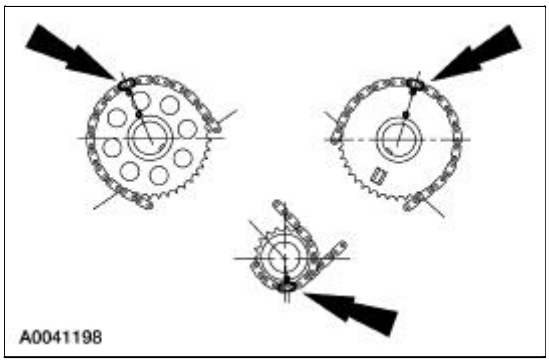
14. Position the RH timing chain tensioner arm on the dowel pin and install the RH timing chain tensioner.



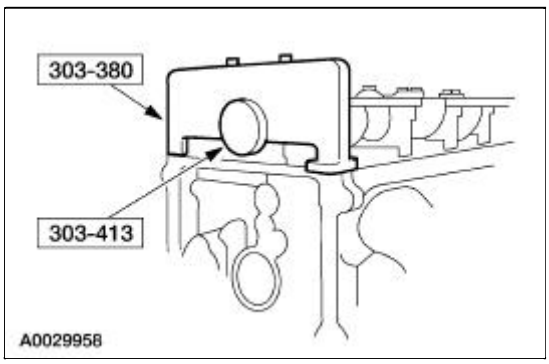
15. Remove the retaining clip from the RH timing chain tensioner.



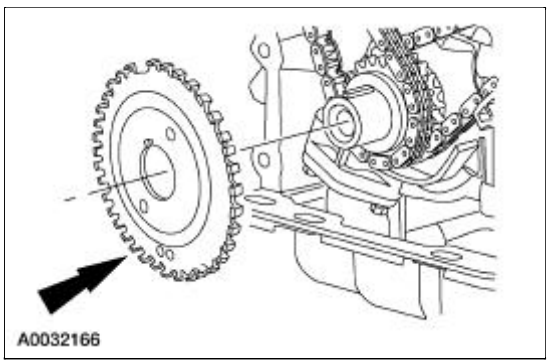
16. Make sure that the copper (marked) chain links are lined up with the dots on the crankshaft sprockets and the camshaft sprocket.



17. Remove special tools from the camshaft.



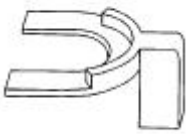
18. Install the crankshaft sensor ring on the crankshaft.



19. Install the engine front cover. For additional information, refer to Engine Front Cover in this section.

Valve Springs

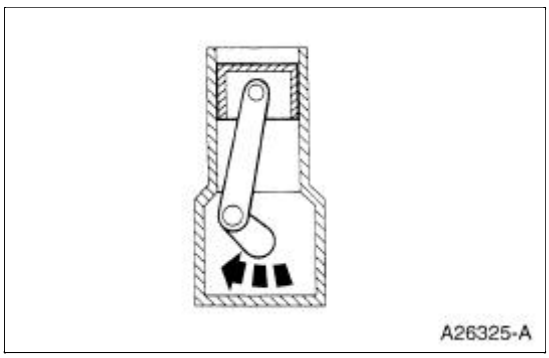
Special Tool(s)

 ST1330-A	Compressor, Valve Spring 303-567 (T97P-6565-AH)
 ST1331-A	Compressor Spacer, Valve Spring 303-382 (T91P-6565-AH)

Removal

1. Remove the camshaft roller followers. For additional information, refer to Camshaft Roller Follower in this section.

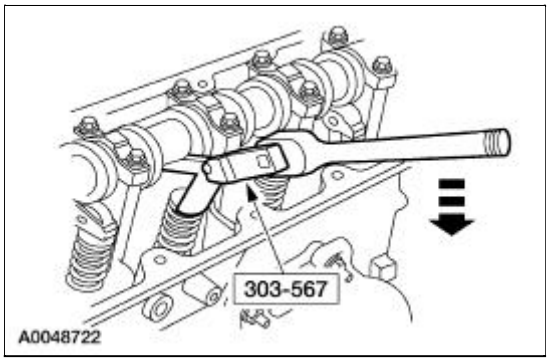
2. Position the piston at the top of the stroke.


A26325-A

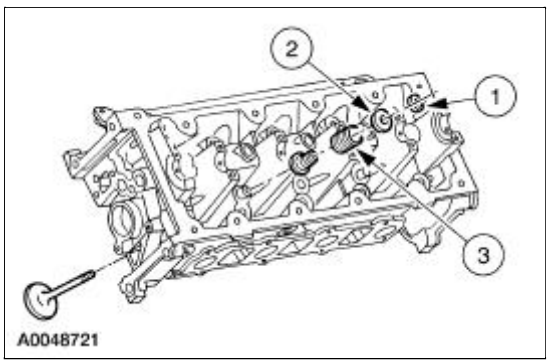
3. Remove the spark plug and install compressed air in the cylinder to hold both valves in position.

CAUTION: If air pressure has forced the piston to the bottom of the cylinder, any loss of air pressure will allow the valve to fall into the cylinder. If air pressure must be removed, support the valve prior to removal.

4. Use the special tool to compress the valve springs.

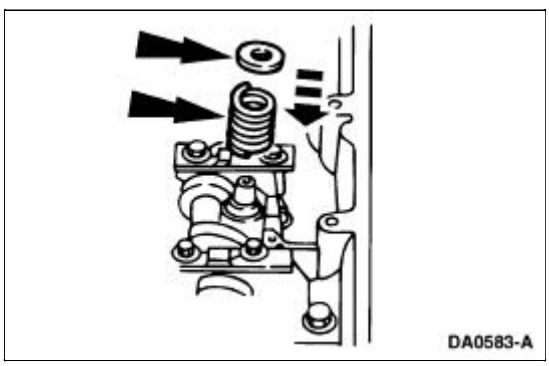


5. Remove the valve springs.
    1. Remove the valve spring retainer keys.
    2. Remove the valve spring retainers.
    3. Remove the valve springs.

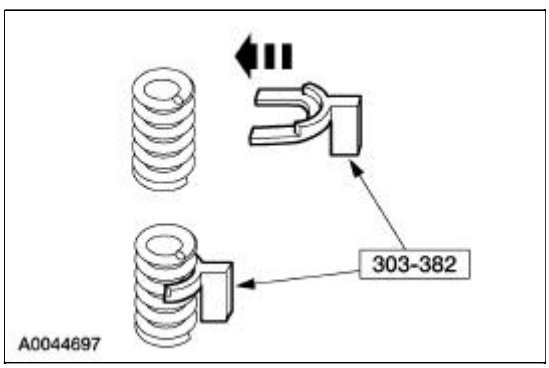


Installation

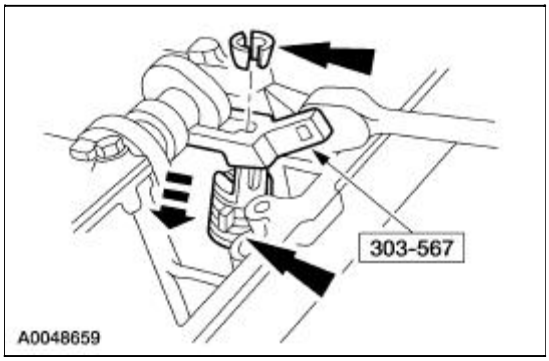
1. Position the valve spring and the valve spring retainers.



2. Install the special tool between the valve spring coils to prevent valve stem seal damage.



3. Use the special tool to compress the valve spring. Install the valve spring retainer keys.



4. Install the camshaft roller followers. For additional information, refer to Camshaft Roller Follower in this section.

5. Install the spark plug.

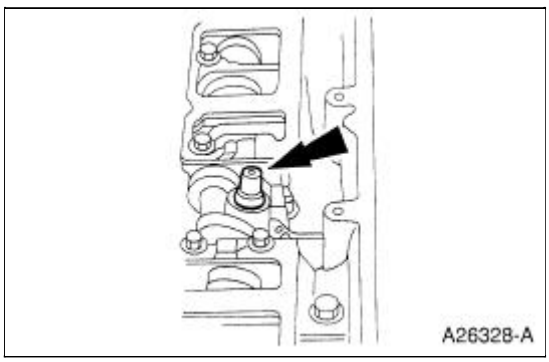
Valve Seals

Special Tool(s)

 ST1332-A	Installer, Valve Stem Oil Seal 303-383 (T91P-6571-A)
 ST1330-A	Compressor, Valve Spring 303-567 (T97P-6565-AH)

Removal

1. Remove the valve springs. For additional information, refer to Valve Springs in this section.
2. Remove the valve stem seals.

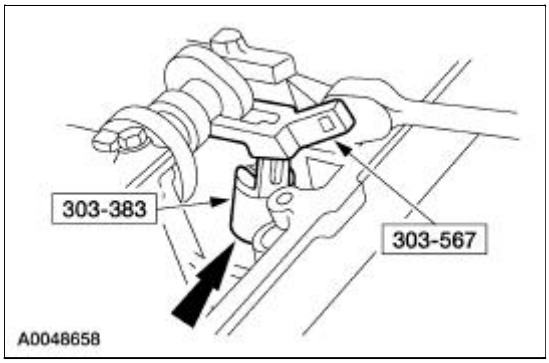


Installation

1. **NOTE:** The valve stem seal must be bottomed on the valve seat.

   NOTE: Make sure that the garter spring is present in the valve stem seal.

   Use the special tools to install the valve stem seals.



2. Install the valve springs. For additional information, refer to Valve Springs in this section.

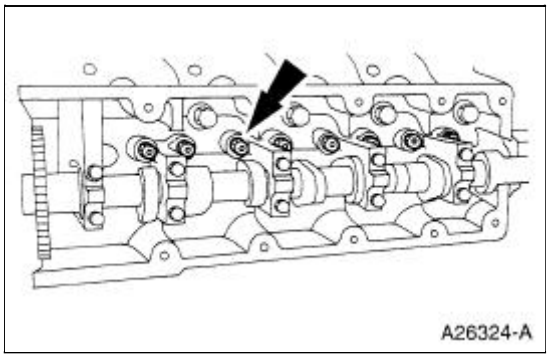
Hydraulic Lash Adjuster

Removal

1. Remove the camshaft roller followers. For additional information, refer to Camshaft Roller Follower in this section.

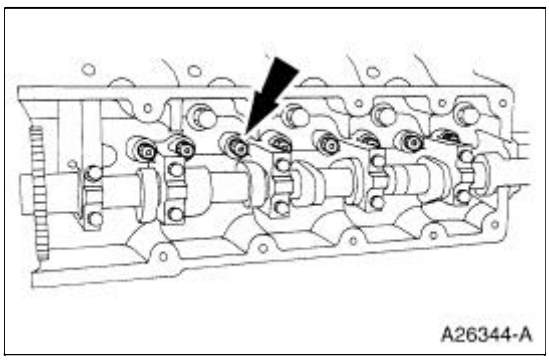
2. **NOTE:** The valve tappets are positional. Mark each valve tappet for installation in its original location.

   Remove the valve tappets (6500).



Installation

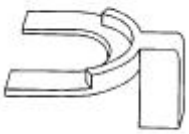
1. Install the valve tappets in their original locations.



2. Install the camshaft roller followers. For additional information, refer to Camshaft Roller Follower in this section.

Camshaft Roller Follower

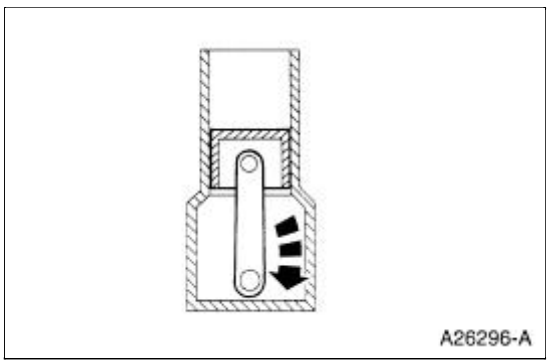
Special Tool(s)

 ST1330-A	Compressor, Valve Spring 303-567 (T97P-6565-AH)
 ST1331-A	Compressor Spacer, Valve Spring 303-382 (T91P-6565-AH)

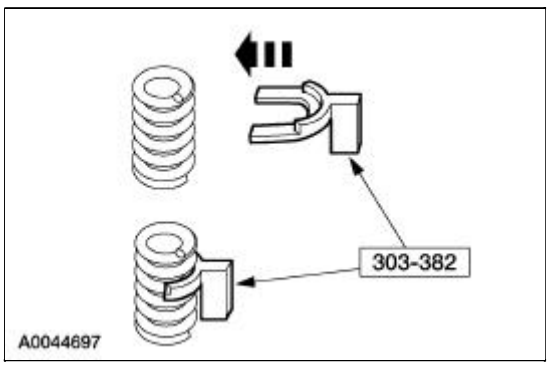
Removal

1. Remove the valve cover. For additional information, refer to Valve Cover LH , or Valve Cover RH in this section.

2. Position the piston of the cylinder being repaired at the bottom of the stroke.



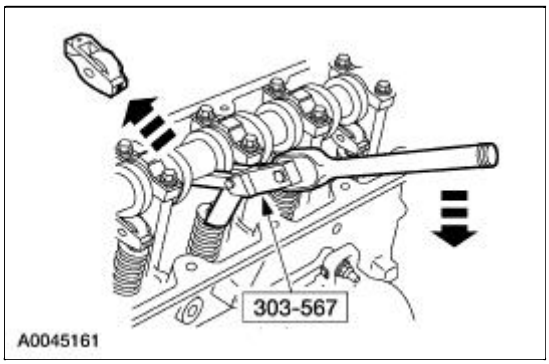
3. Install the special tool between the valve spring coils to prevent valve stem seal damage.



4. **NOTE:** The camshaft roller followers must be installed in their original locations. Record the

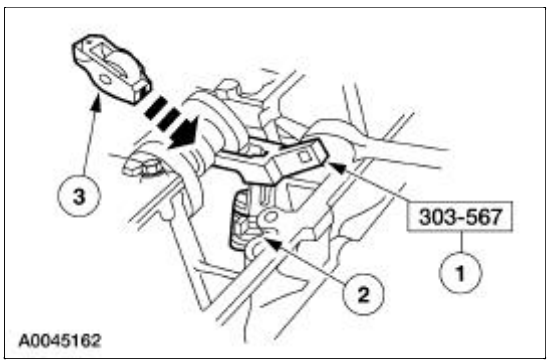
camshaft roller follower locations.

Use the special tool to compress the valve springs and remove the camshaft roller followers.

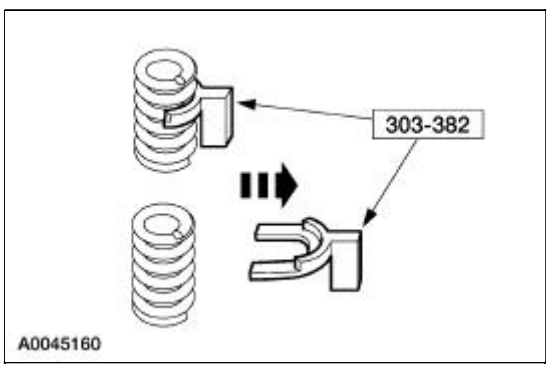


Installation

1. Install the camshaft roller followers.
    1. Install the special tool.
    2. Compress the valve springs.
    3. Install the camshaft roller followers in their original locations.



2. Remove the special tool.



3. Install the valve covers. For additional information, refer to Valve Cover LH , or Valve Cover RH in this section.

Camshaft

Material

Item	Specification
Motorcraft Silicone Gasket Remover ZC-30	—
Motorcraft Metal Surface Prep ZC-31	—
SAE 5W-20 Premium Synthetic Blend Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

All engines

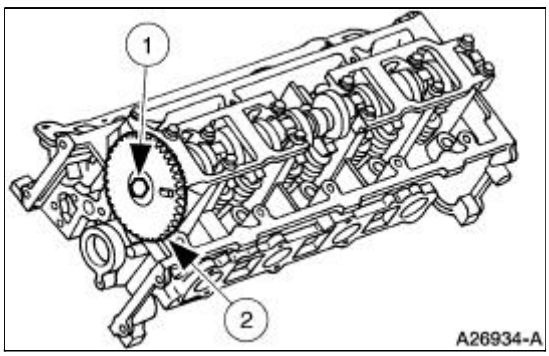
1. Remove the timing chains. For additional information, refer to Timing Drive Components—Romeo Engine (4.6L) or Timing Drive Components—Windsor Engine (5.4L) in this section.

CAUTION: At no time, when the timing chains are removed and the cylinder heads are installed may the crankshaft or camshaft be rotated. Severe piston and valve damage will occur.

2. Remove the camshaft roller followers. For additional information, refer to Camshaft Roller Follower in this section.

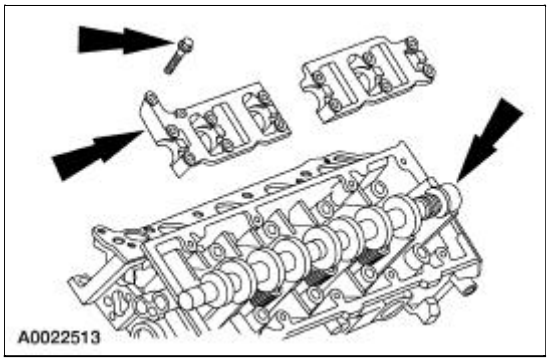
Romeo engine (4.6L)

3. Remove the camshaft sprocket.
    1. Remove the bolt.
    2. Remove the camshaft sprocket.

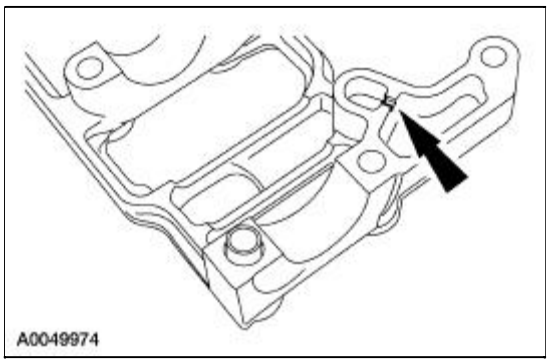


4. **NOTE:** The camshaft bearing caps must be installed in their original location. Record camshaft bearing cap location.

    Remove the bolts, the bearing caps and the camshaft.



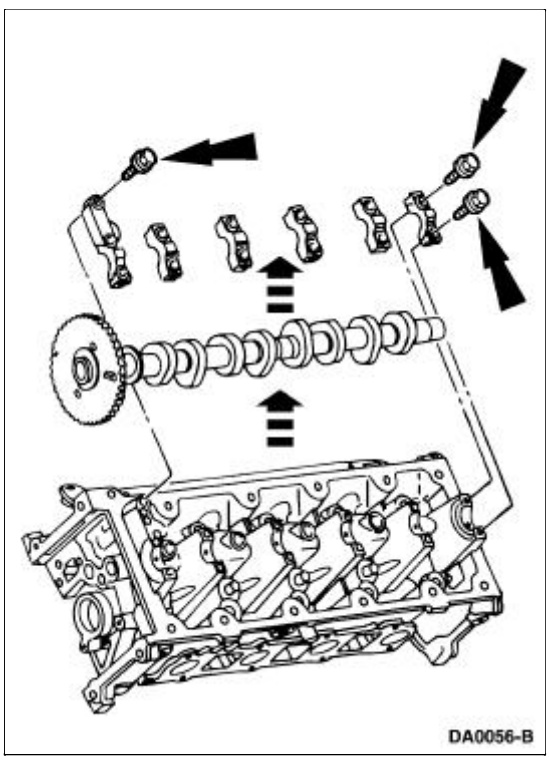
5. Clean and inspect the camshaft bearing caps.
    - One of the bearing caps contains an oil flow restriction groove. Make sure the groove is free of foreign material.



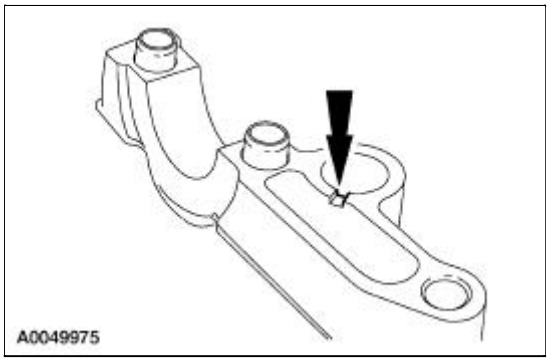
Windsor engine (5.4L)

6. **NOTE:** The camshaft bearing caps must be installed in their original location. Record camshaft bearing cap location.

    Remove the bolts, the bearing caps and the camshaft.



7. Clean and inspect the camshaft bearing caps.
    - One of the bearing caps contains an oil flow restriction groove. Make sure the groove is free of foreign material.



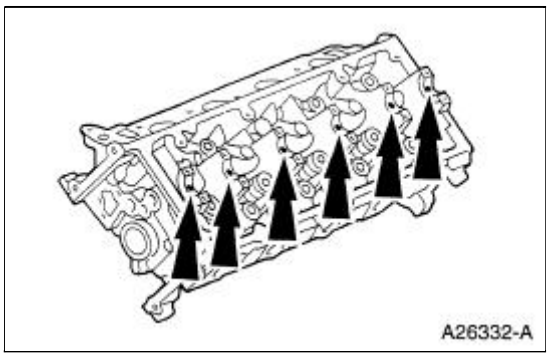
Installation

All engines

1. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

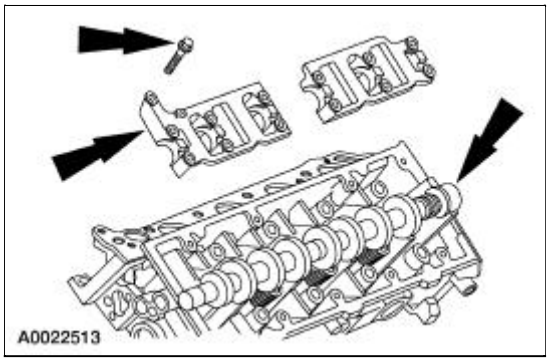
   Clean the valve cover mating surface of the cylinder head with silicone gasket remover and metal surface prep. Follow the directions on the packaging.

2. Lubricate the camshaft journals with clean engine oil.

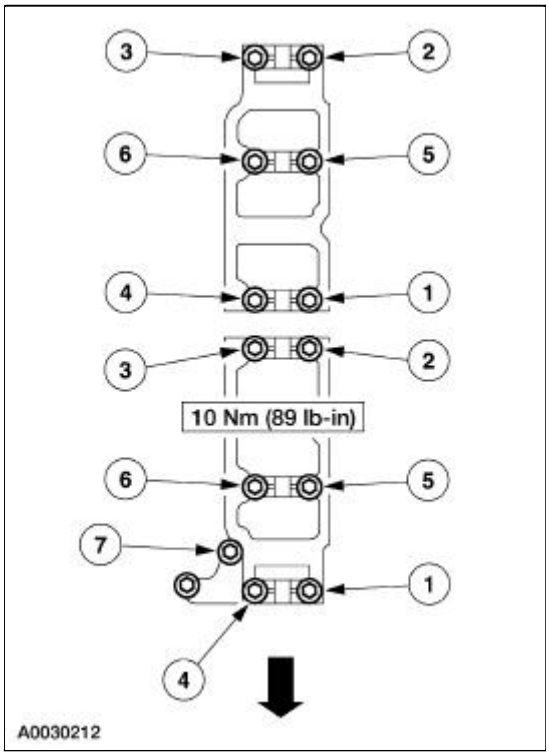


Romeo engine (4.6L)

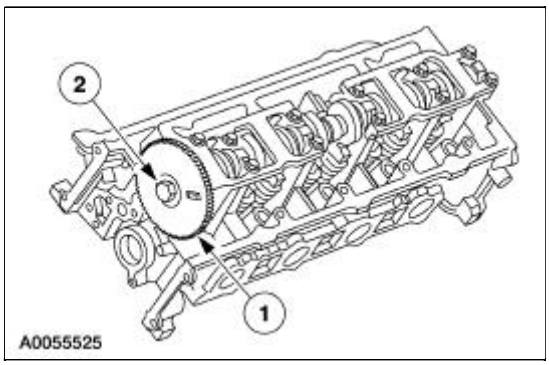
3. Install the camshaft and the camshaft bearing caps in their original locations.
    - Lubricate the camshaft bearing caps with clean engine oil.
    - Position the camshaft bearing caps.
    - Install the bolts loosely.



4. Tighten the bolts in the sequence shown.

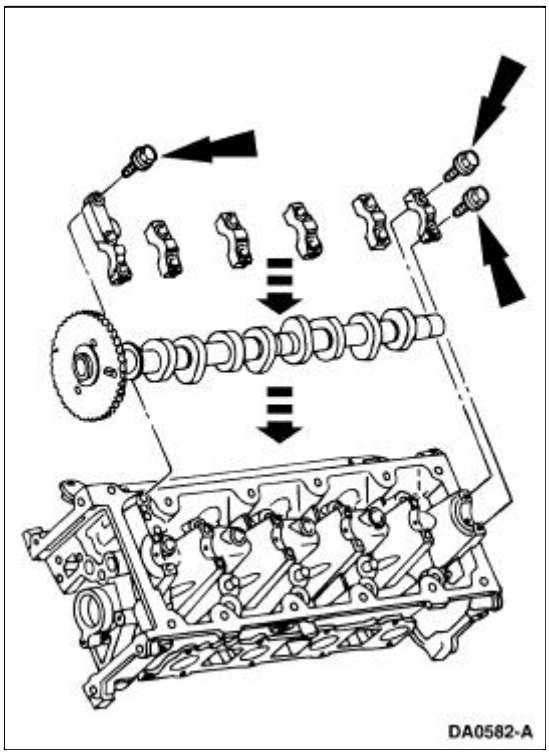


5. Install the camshaft sprocket.
    1. Install the sprocket.
    2. Install and tighten the bolt.
        - Tighten in two stages.
        - Stage 1: Tighten to 40 Nm (30 lb-ft).
        - Stage 2: Tighten an additional 90 degrees.

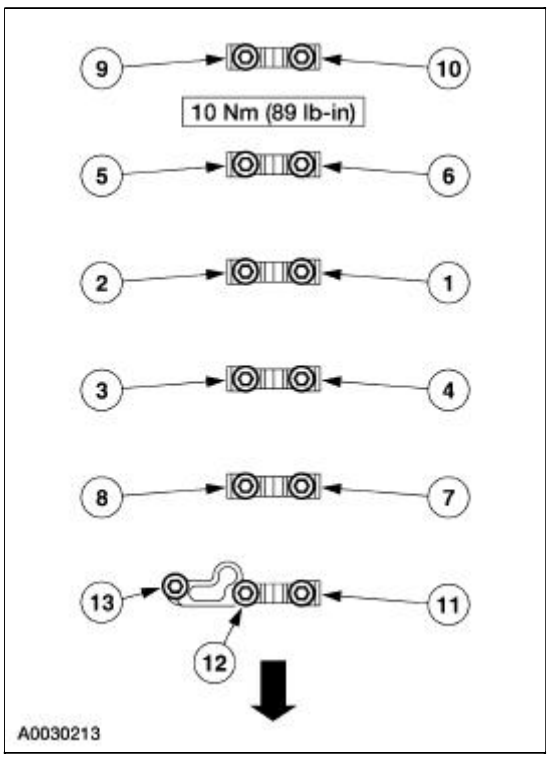


Windsor engine (5.4L)

6. Install the camshaft and the camshaft bearing caps in their original locations.
    - Lubricate the camshaft bearing caps with clean engine oil.
    - Position the camshaft bearing caps.
    - Install the bolts loosely.



7. Tighten the bolts in the sequence shown.



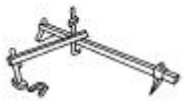
All engines

8. Install the camshaft roller followers. For additional information, refer to Camshaft Roller Follower in this section.

9. Install the timing chains. For additional information, refer to Timing Drive Components—Romeo Engine (4.6L) or Timing Drive Components—Windsor Engine (5.4L) in this section.

Exhaust Manifold RH —4.6L

Special Tool(s)

 ST2334-A	Support Bracket, Engine 303-639
 ST2176-B	Heavy Duty Engine Support 303-F070

Removal

All vehicles

1. **CAUTION: The air suspension switch must be turned off prior to raising the vehicle. Failure to do so can result in unexpected inflation or deflation of the air springs, which could result in shifting of the vehicle during the repair operation.**

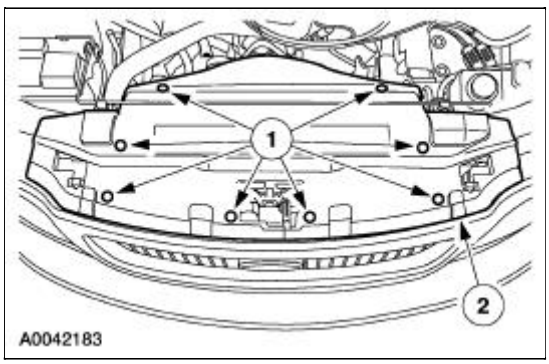
   If equipped, turn the air suspension switch off.

2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

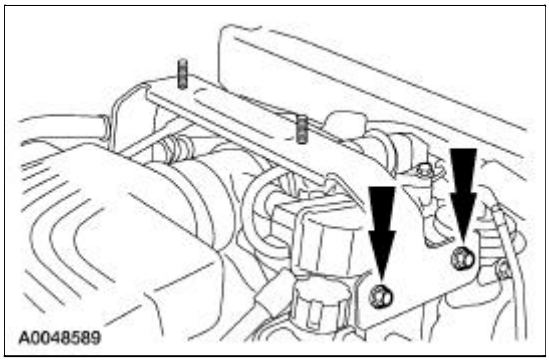
3. Remove the air cleaner outlet pipe. For additional information, refer to Section 303-12 .

4. Partially drain the engine cooling system. For additional information, refer to Section 303-03 .

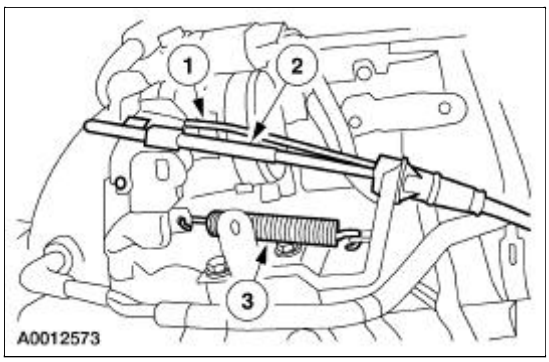
5. Remove the upper air deflector.
   1. Remove the pin-type retainers.
   2. Remove the upper air deflector.



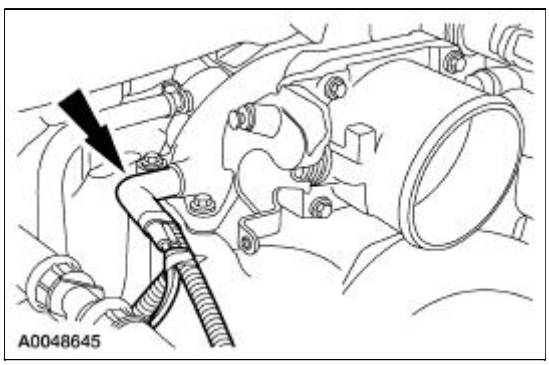
6. Remove the three bolts and the appearance cover mounting bracket.



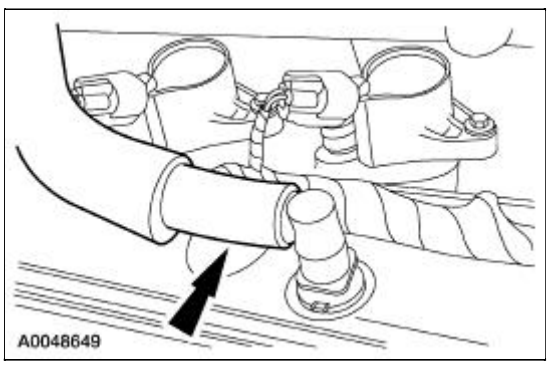
7. Disconnect the throttle body cam.
    1. Disconnect the accelerator cable.
    2. Disconnect the speed control actuator cable.
    3. Remove the accelerator return spring.



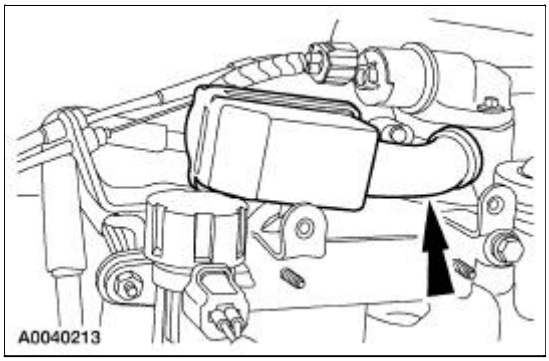
8. Disconnect the main vacuum harness.



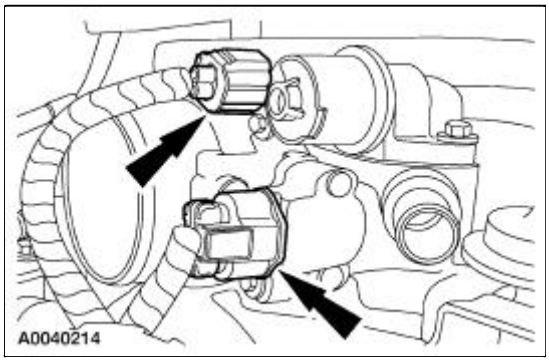
9. Disconnect the positive crankcase ventilation (PCV) hose.



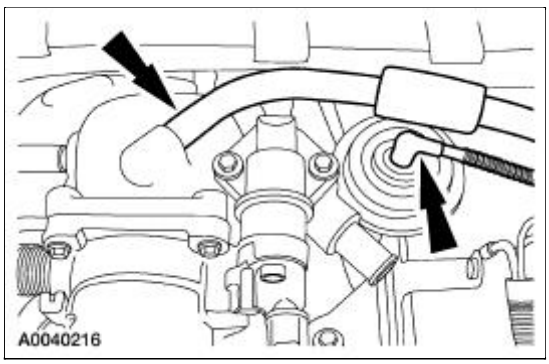
10. Remove the idle air control (IAC) fresh air hose.



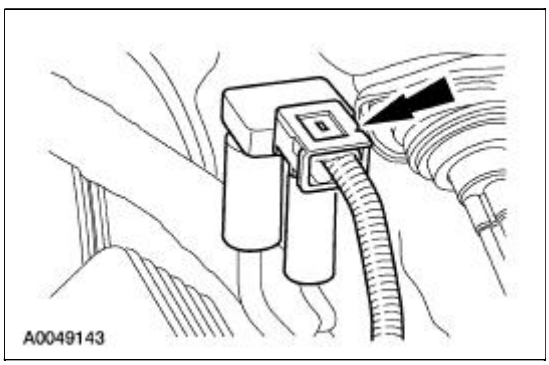
11. Disconnect the IAC and throttle position (TP) sensor electrical connectors.



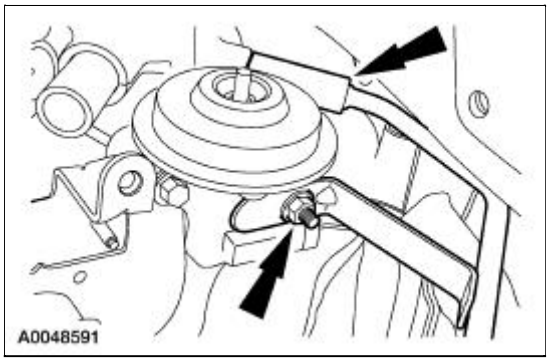
12. Disconnect the exhaust gas recirculation (EGR) valve vacuum hose and the evaporative emission canister purge valve hose and position them aside.



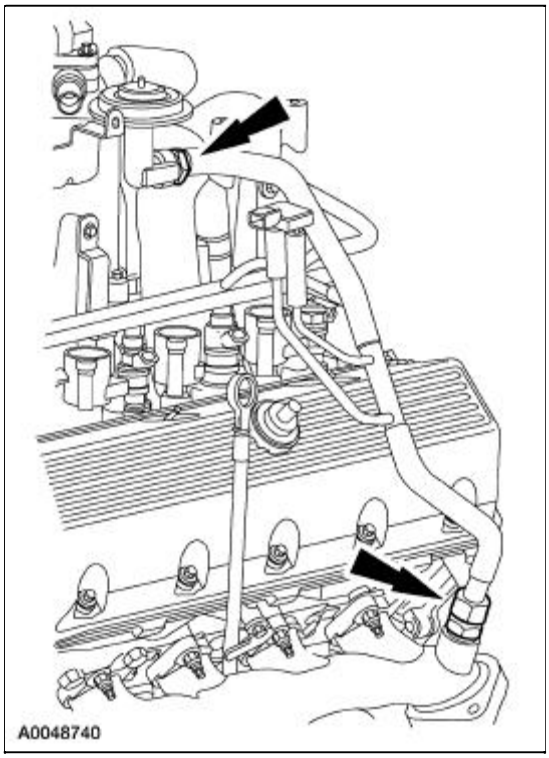
13. Disconnect the differential pressure feedback EGR system electrical connector.



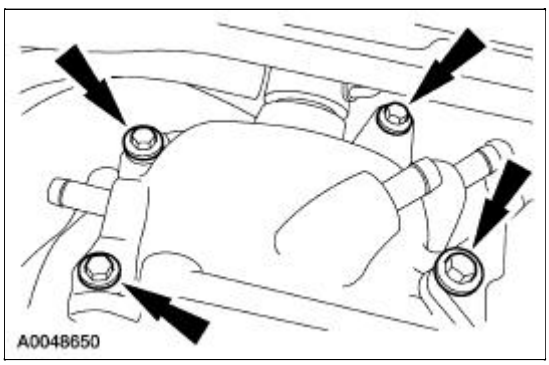
14. Remove the nut and disconnect the brake booster vacuum tube. Position the bracket and tube aside.



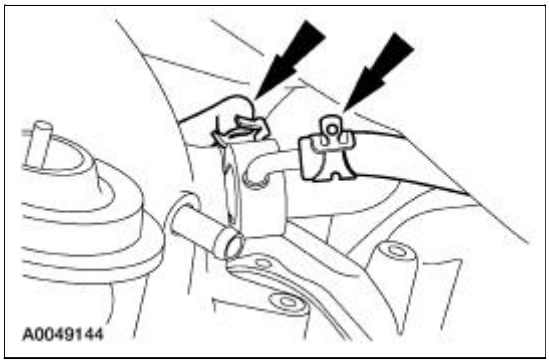
15. Disconnect the exhaust manifold to EGR valve tube fittings and remove the tube.



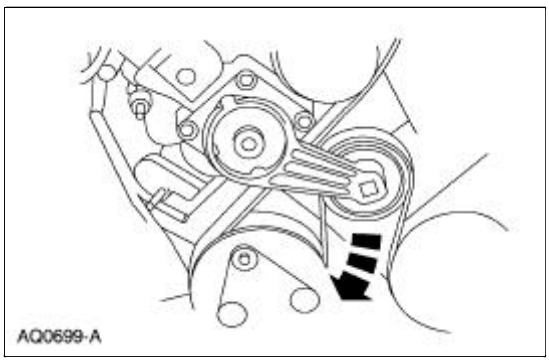
16. Remove the four bolts and move the throttle body adapter forward slightly.



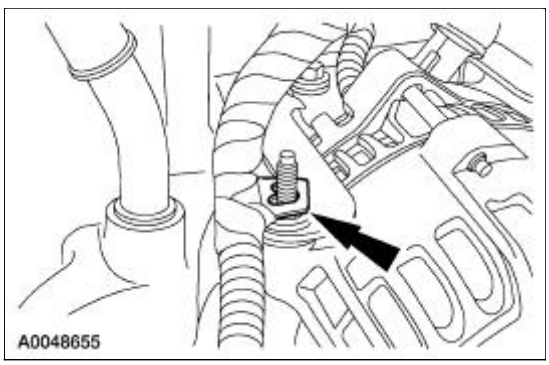
17. Disconnect the heated throttle body hoses. Remove the throttle body adapter and PCV hose from the vehicle.
    - Discard the throttle body adapter-to-intake manifold gasket.
    - Inspect the throttle body and adapter for damage.



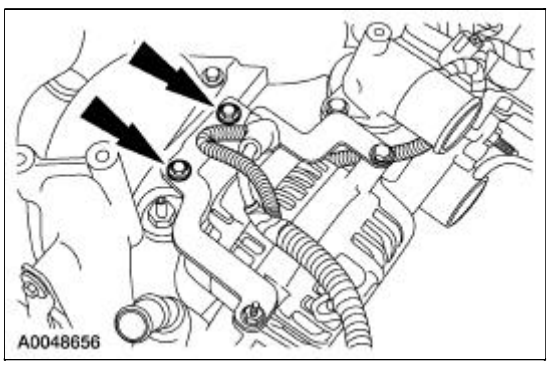
18. Rotate the belt tensioner clockwise and detach the drive belt from the generator pulley.



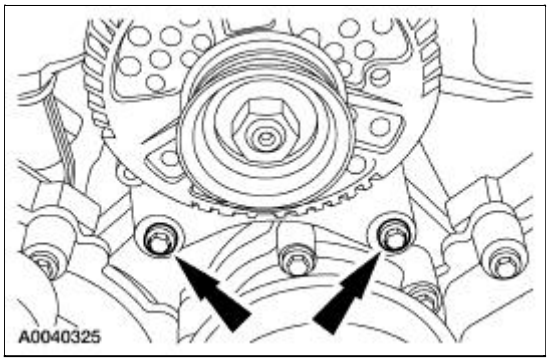
19. Disconnect the harness routing clip.



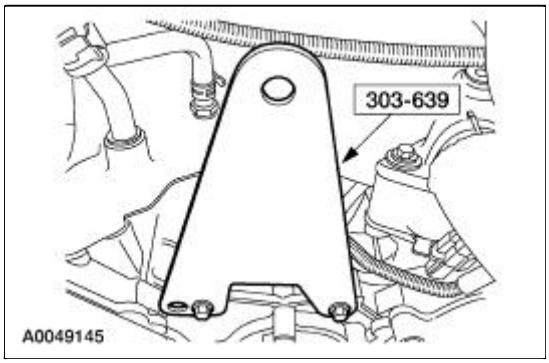
20. Remove the two bolts.



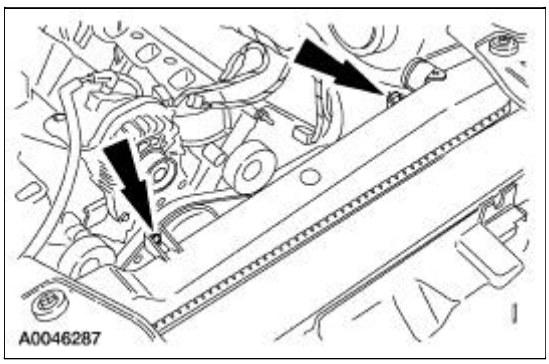
21. Remove the generator lower mounting bolts and position the generator aside.



22. Install the special tool.



23. Remove the fan shroud mounting bolts.

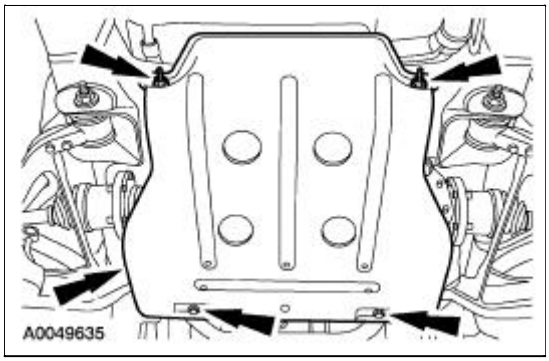


24. Remove the RH front wheel and tire. For additional information, refer to Section 204-04 .

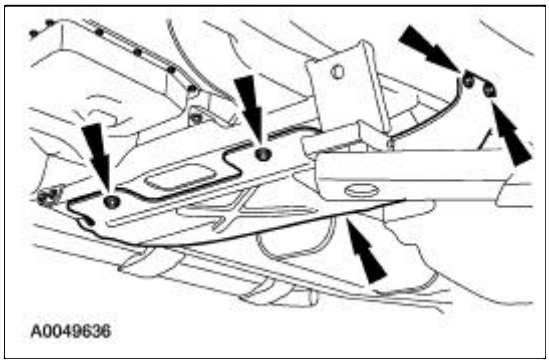
25. Remove the front fender splash shield.

4x4 vehicles

26. Remove the fasteners and the engine skid shield.



27. Remove the six bolts and the transmission skid shield.

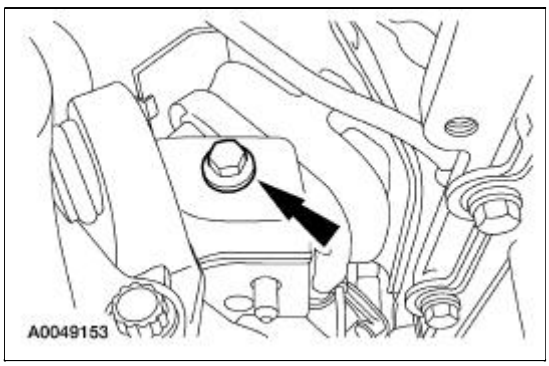


All vehicles

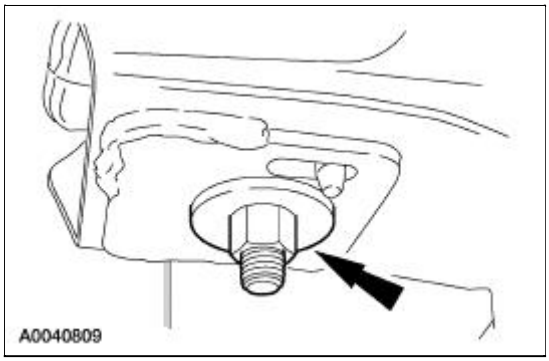
28. Remove the dual converter Y-pipe. For additional information, refer to Section 309-00 .

29. **NOTE:** The caged nut on the frame may break during bolt removal. If necessary, install a new nut.

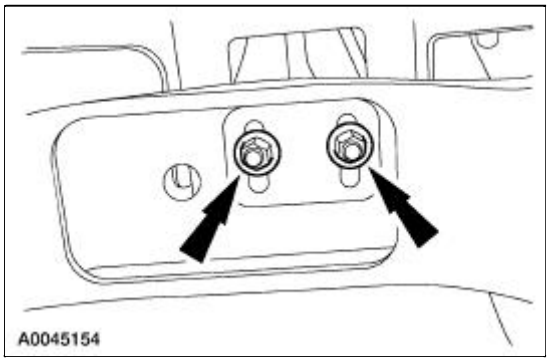
    Remove the LH engine mount bolt.



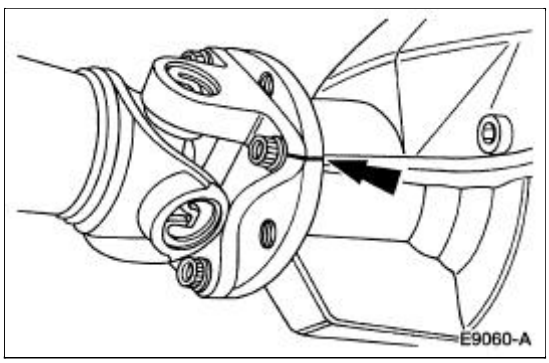
30. Remove the RH engine mount nut.



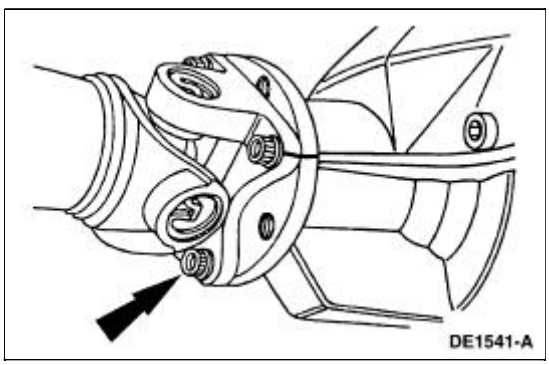
31. Loosen the rear transmission mount nuts.



32. Index-mark the driveshaft flange yoke and the pinion flange.

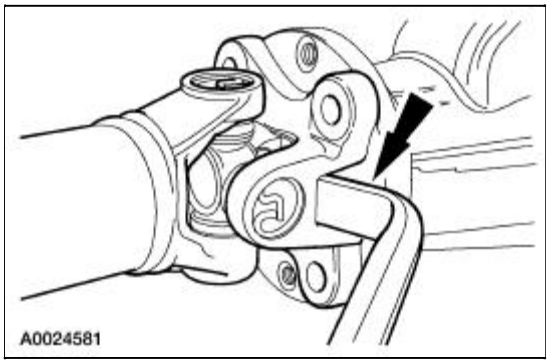


33. Remove the four bolts.



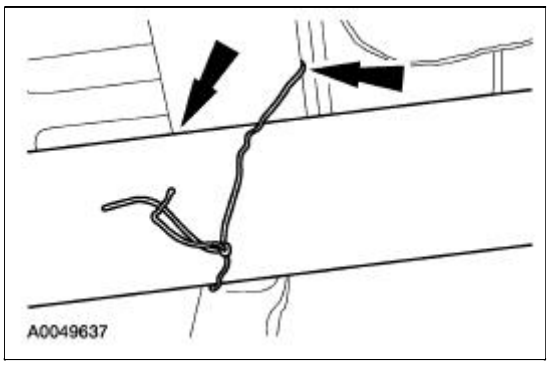
34. **CAUTION: The driveshaft flange yoke fits tightly on the pinion flange pilot. Never hammer on the driveshaft or any of its components to disconnect the yoke from the flange. Pry only in the area shown, with a suitable tool, to disconnect the yoke from the flange.**

Using a suitable tool as shown, disconnect the driveshaft flange yoke from the pinion flange.



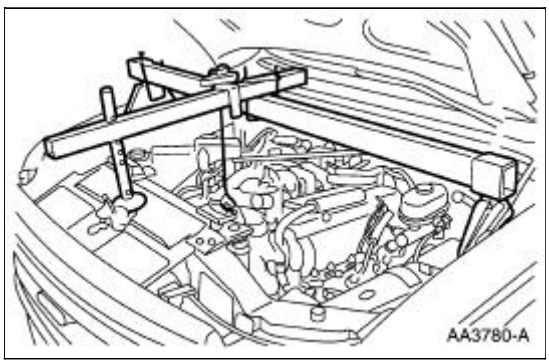
35. **CAUTION: The driveshaft alignment bushing can be damaged if the driveshaft is allowed to hang unsupported.**

    Wire the driveshaft to the frame crossmember to support it at the same height as when it was installed.



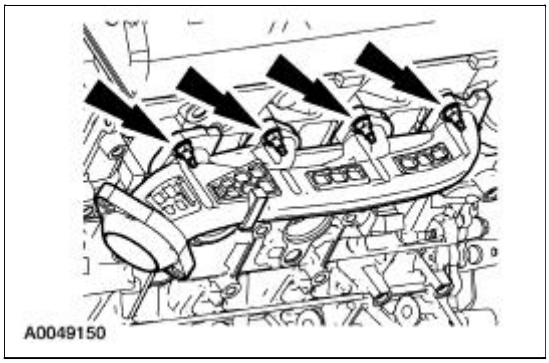
36. Lower the vehicle.

37. Install the special tool and raise the engine.



38. Raise and support the vehicle. For additional information, refer to Section 100-02 .

39. Remove the eight nuts, the exhaust manifold and the gasket.
    - Discard the exhaust manifold gasket.

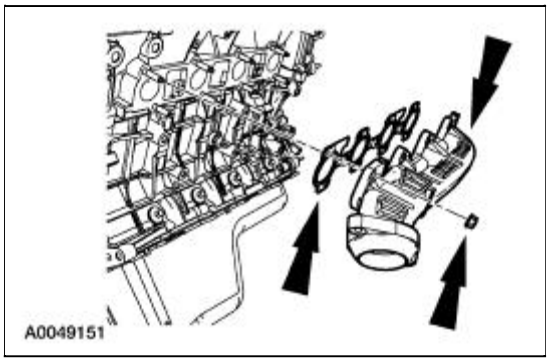


40. Clean and inspect the exhaust manifold. For additional information, refer to Section 303-00 .

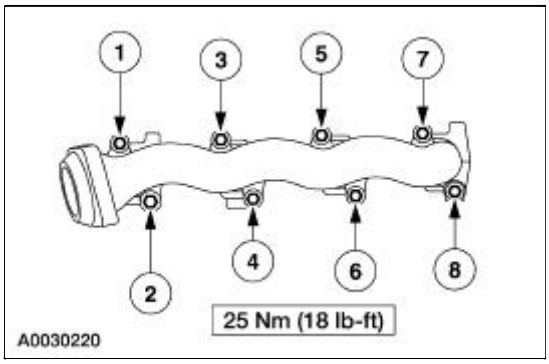
Installation

All vehicles

1. Position the exhaust manifold gasket and the exhaust manifold, and loosely install the nuts.



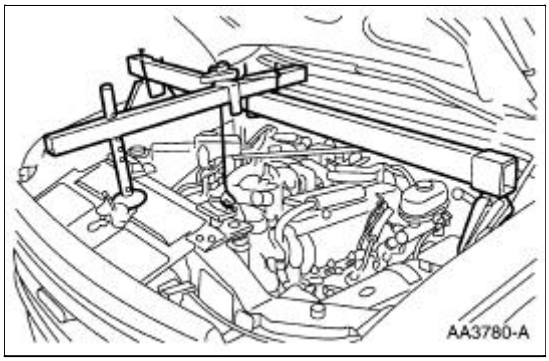
2. Tighten the nuts in the sequence shown.



3. Lower the vehicle.

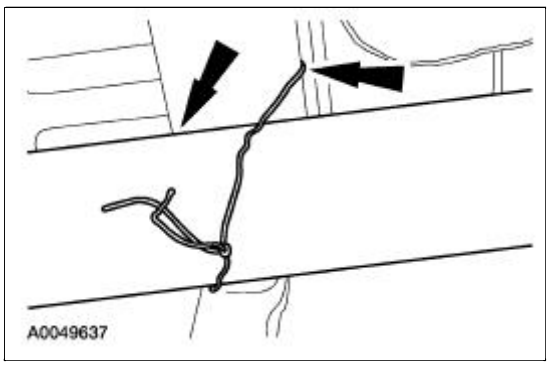
4. **NOTE:** Make sure the engine mounts align with, and settle into, the frame brackets as the engine is lowered.

   Lower the engine and remove the special tool.

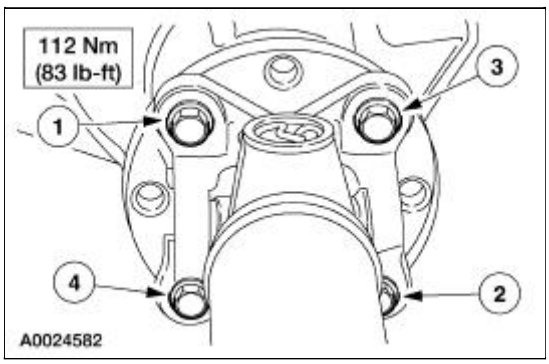


5. Raise and support the vehicle. For additional information, refer to Section 100-02 .

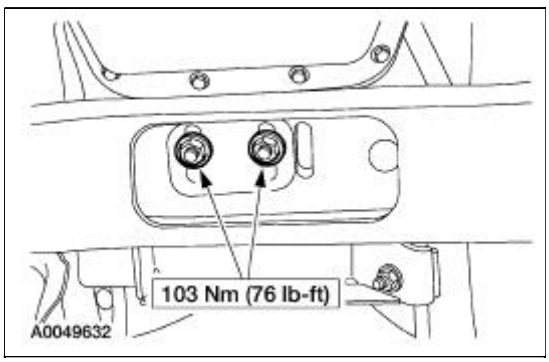
6. Remove the driveshaft support wire.



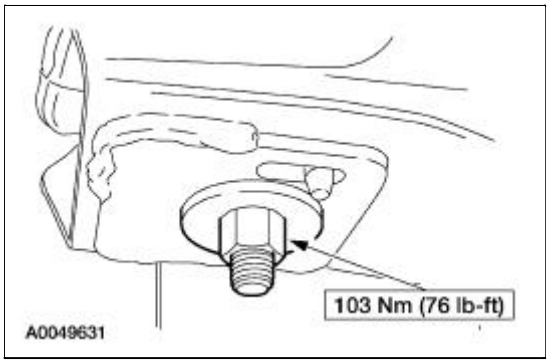
7. Align the index marks and install the driveshaft flange yoke to the pinion flange. Tighten the bolts in the sequence shown.



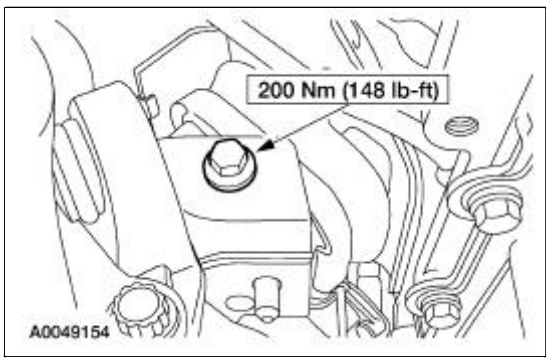
8. Tighten the rear transmission mount nuts.



9. Install the RH engine mount nut.



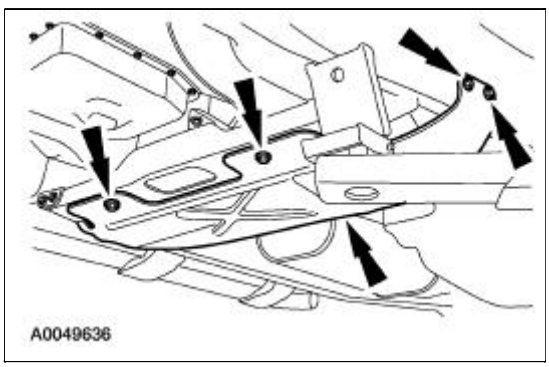
10. Install the LH engine mount bolt.



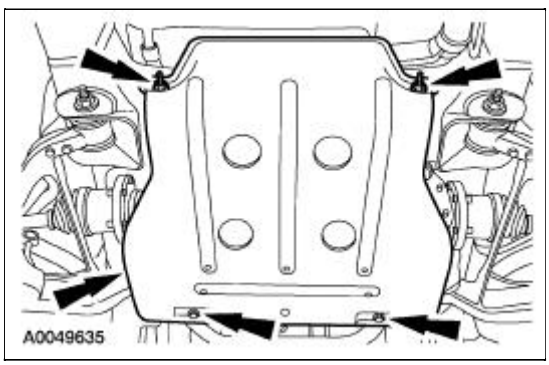
11. Install the dual converter Y-pipe. For additional information, refer to Section 309-00 .

4x4 vehicles

12. Position the transmission skid shield and install the six bolts.

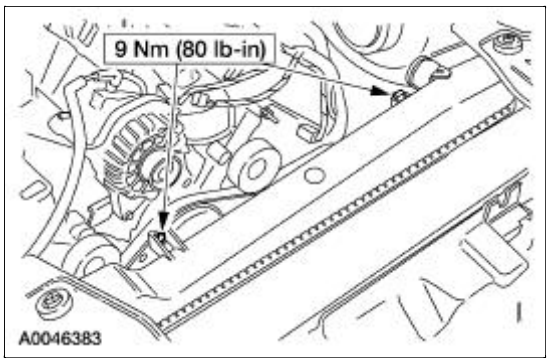


13. Position the engine skid shield and install the fasteners.

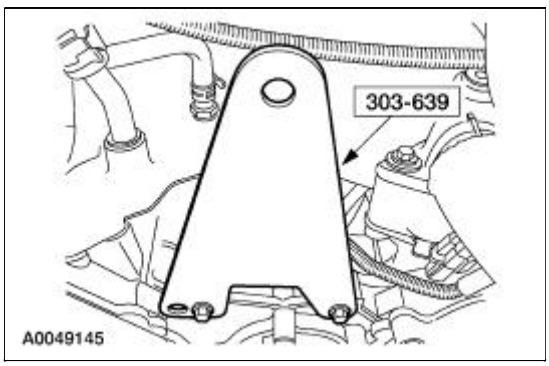


All vehicles

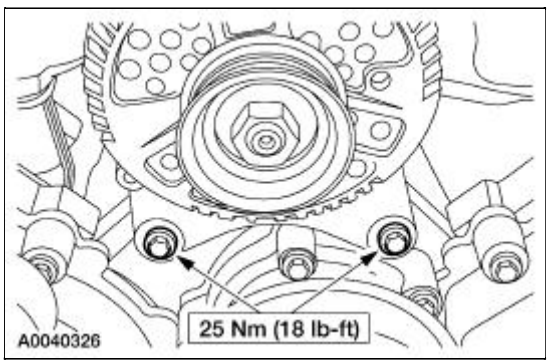
14. Install the front fender splash shield.
15. Install the RH front wheel and tire. For additional information, refer to Section 204-04 .
16. Position the fan shroud and install the mounting bolts.



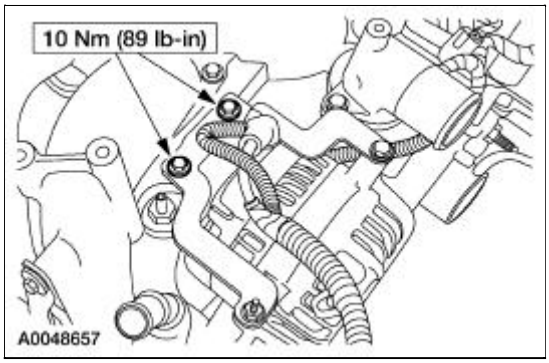
17. Remove the special tool.



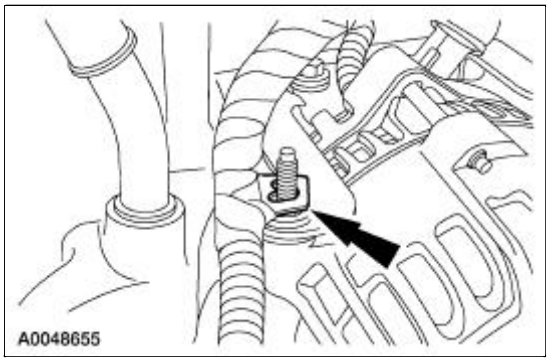
18. Position the generator and install the lower mounting bolts.



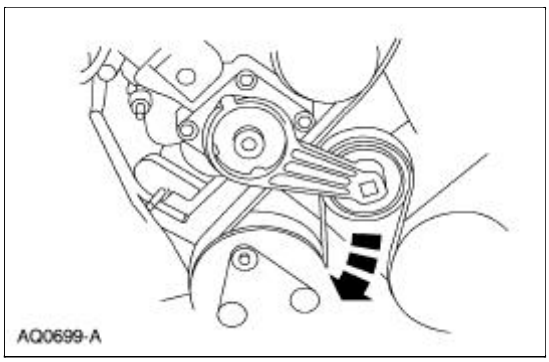
19. Install the generator upper mounting bracket bolts.



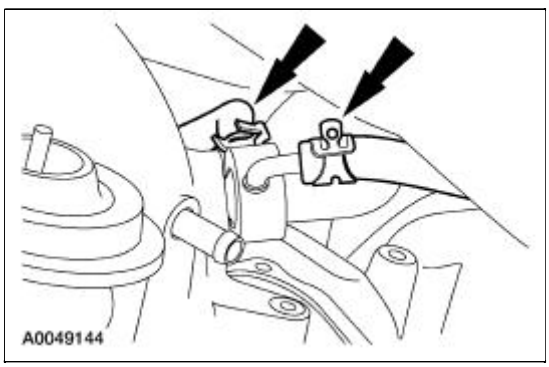
20. Install the harness routing clip.



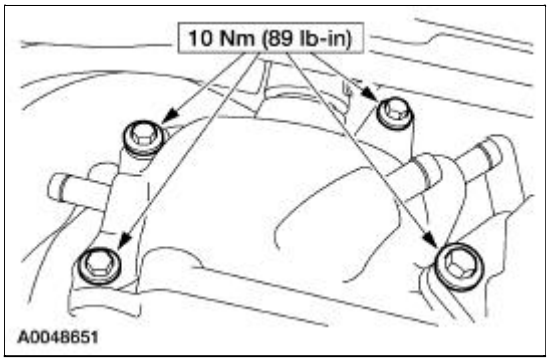
21. Rotate the belt tensioner clockwise and install the drive belt. Refer to the decal on the radiator upper air deflector for belt routing.



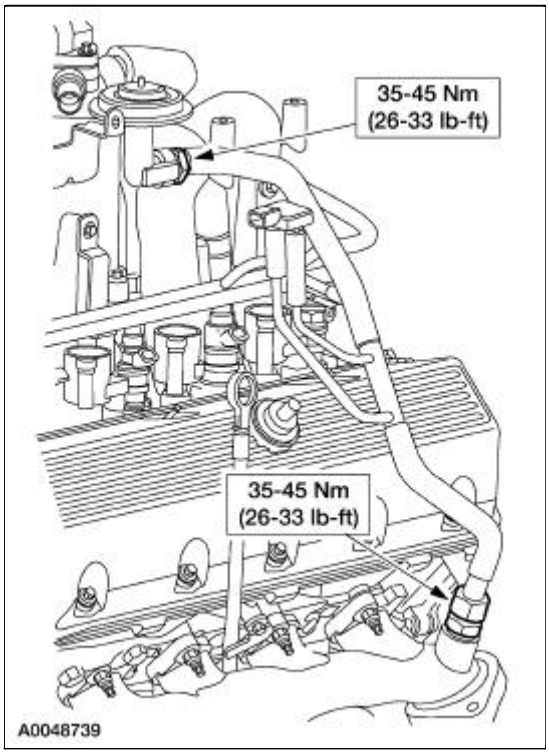
22. Roughly position the throttle body adapter and PCV hose in the vehicle and connect the heated throttle body hoses.



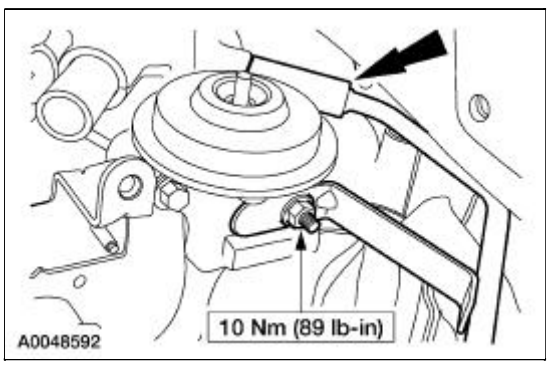
23. Install a new gasket and the throttle body adapter.



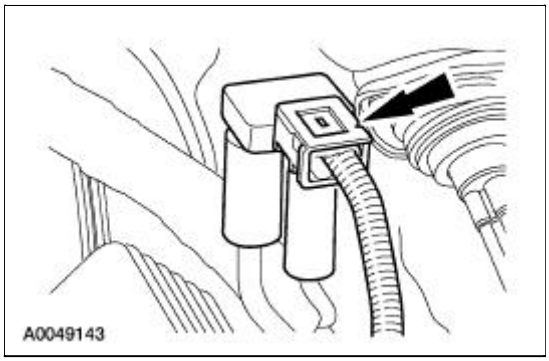
24. Position the exhaust manifold to EGR valve tube and tighten the fittings.



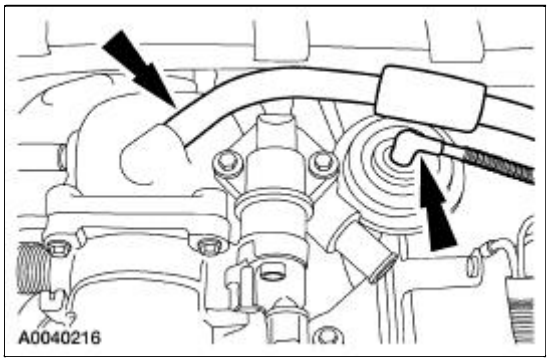
25. Connect the brake booster vacuum tube and bracket. Install the nut.



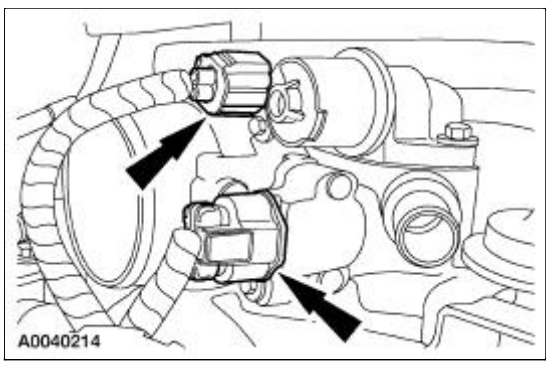
26. Connect the differential pressure feedback EGR system electrical connector.



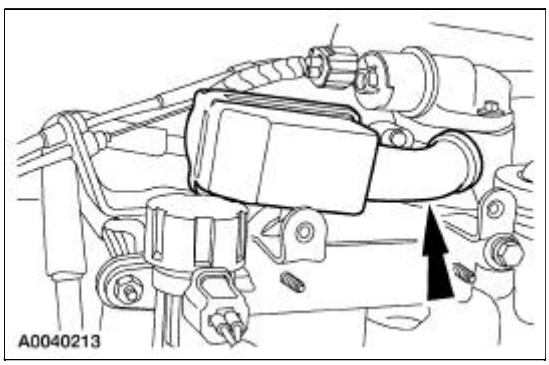
27. Connect the evaporative emission canister purge valve hose and the EGR valve vacuum hose.



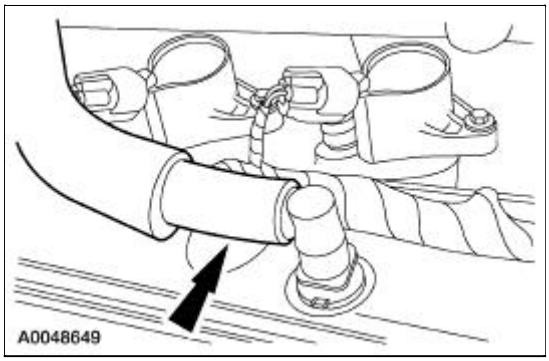
28. Connect the TP sensor and IAC electrical connectors.



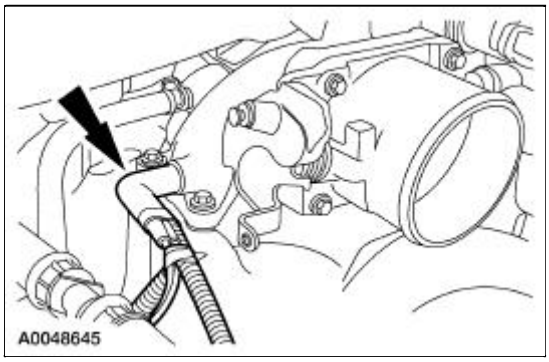
29. Install the IAC fresh air hose.



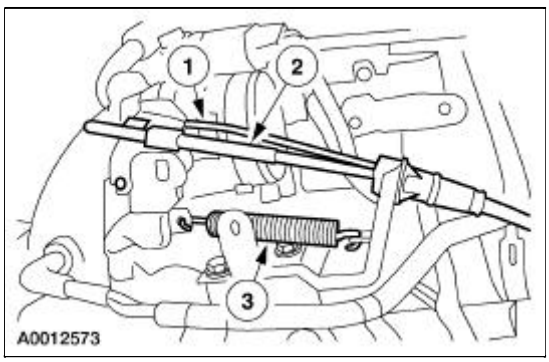
30. Connect the PCV hose.



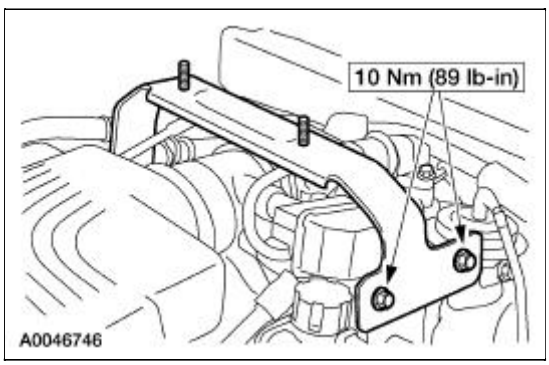
31. Connect the main vacuum harness.



32. Connect the throttle body cam.
    1. Connect the accelerator cable.
    2. Connect the speed control actuator cable.
    3. Install the throttle return spring.

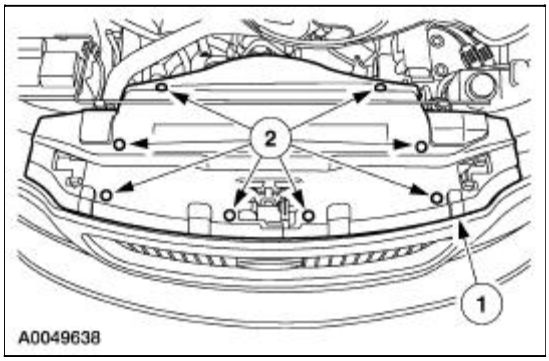


33. Install the appearance cover mounting bracket and the three bolts.



34. Install the upper air deflector.
    1. Position the upper air deflector.

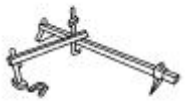
2. Install the pin-type retainers.



35. Install the air cleaner outlet pipe. For additional information, refer to Section 303-12 .
36. Connect the battery ground cable. For additional information, refer to Section 414-01 .
37. Fill and bleed the engine cooling system. For additional information, refer to Section 303-03 .
38. If equipped, turn on the air suspension switch.

Exhaust Manifold RH —5.4L

Special Tool(s)

 ST2334-A	Support Bracket, Engine 303-639
 ST2176-B	Heavy Duty Engine Support 303-F070

Removal

All vehicles

1. **CAUTION: The air suspension switch must be turned off prior to raising the vehicle. Failure to do so can result in unexpected inflation or deflation of the air springs, which could result in shifting of the vehicle during the repair operation.**

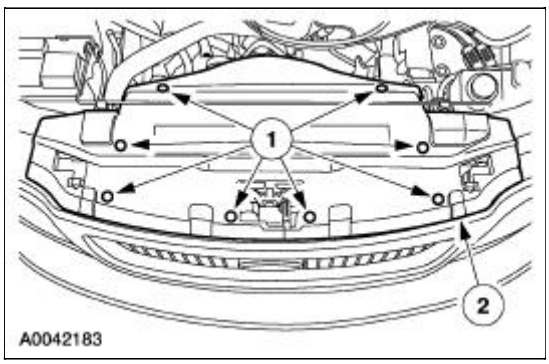
   If equipped, turn the air suspension switch off.

2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3. Remove the air cleaner outlet pipe. For additional information, refer to Section 303-12 .

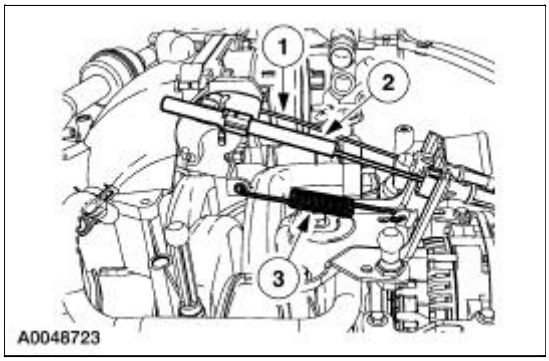
4. Partially drain the engine cooling system. For additional information, refer to Section 303-03 .

5. Remove the upper air deflector.
   1. Remove the pin-type retainers.
   2. Remove the upper air deflector.

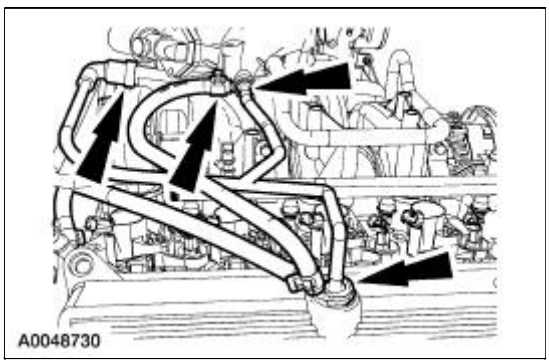


6. Disconnect the throttle body cam.
   1. Disconnect the accelerator cable.

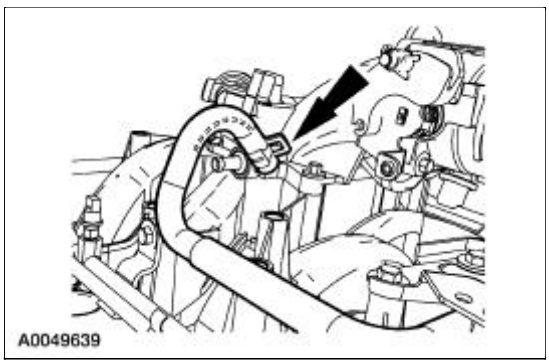
2. Disconnect the speed control actuator cable.
3. Remove the accelerator return spring.



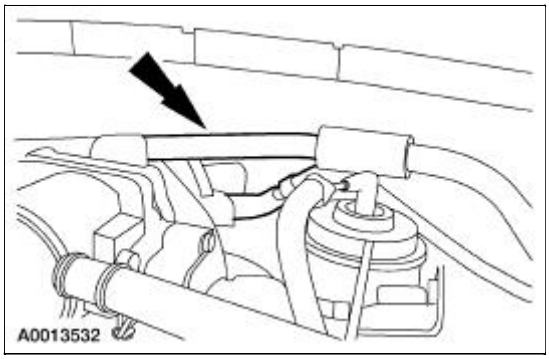
7. Position the heated positive crankcase ventilation (PCV) hose harness aside.
   - Disconnect the PCV hose from the throttle body adapter.
   - Disconnect the heated throttle body outlet hose from the throttle body adapter.
   - Disconnect the PCV hose from the intake manifold.
   - Remove the PCV valve and position the harness aside.



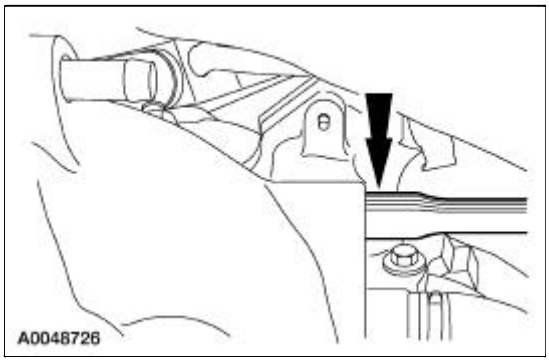
8. Disconnect the heated throttle body inlet hose from the throttle body adapter.



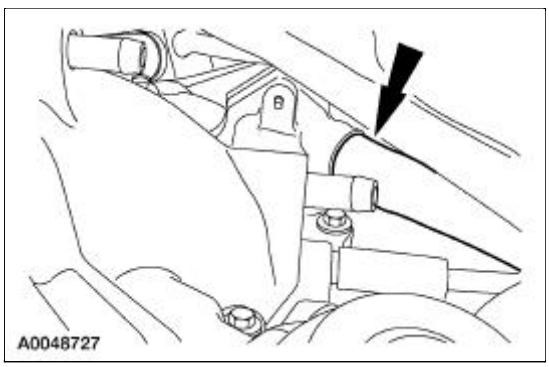
9. Disconnect the evaporative emission canister purge valve hose.



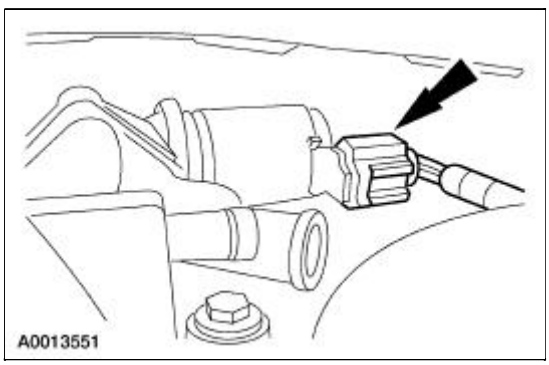
10. Disconnect the main vacuum harness from the throttle body adapter.



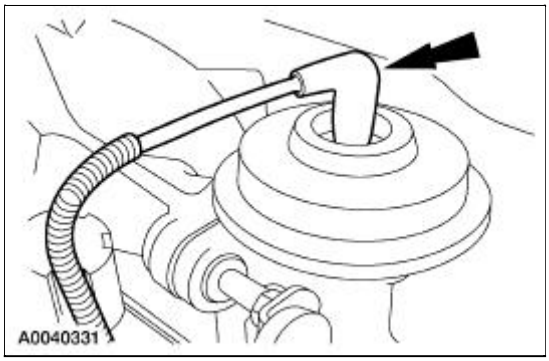
11. Remove the idle air control (IAC) valve fresh air tube.



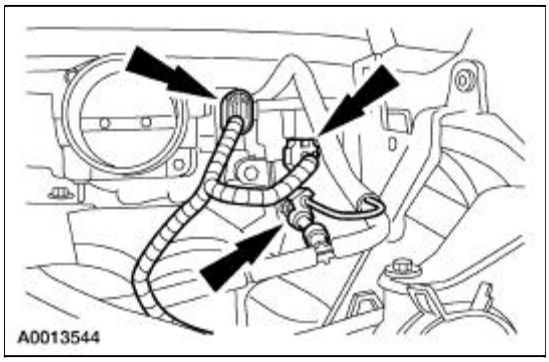
12. Disconnect the IAC electrical connector.



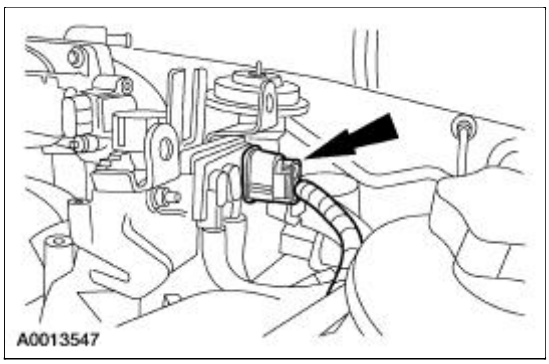
13. Disconnect the EGR valve vacuum hose.



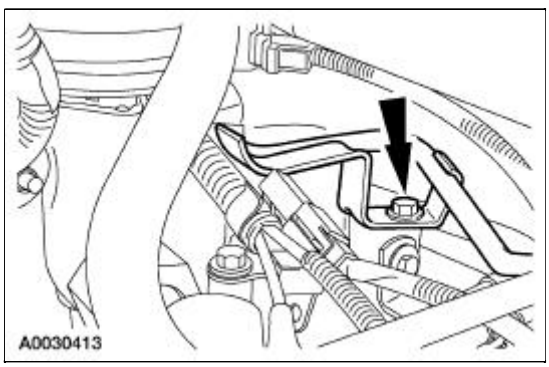
14. Disconnect the throttle position (TP) sensor electrical connector, and the exhaust gas recirculation (EGR) vacuum regulator solenoid electrical and vacuum connectors.



15. Disconnect the differential pressure feedback EGR system electrical connector.

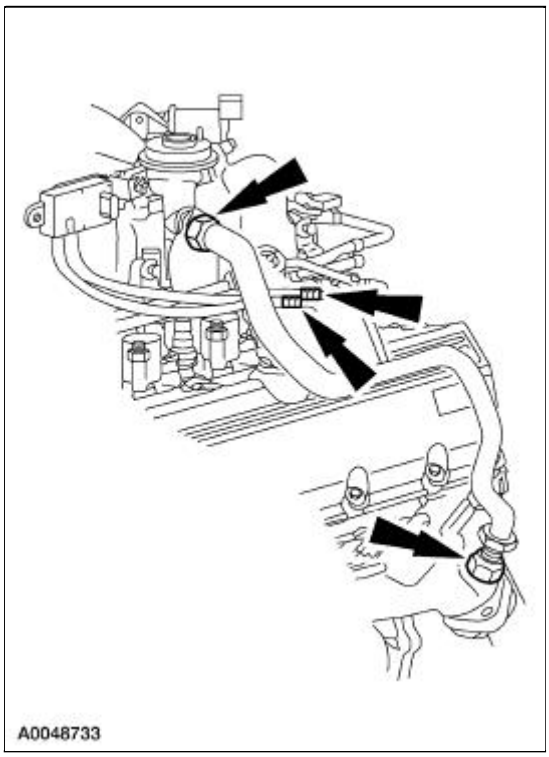


16. Remove the bolt and disconnect the brake booster vacuum tube. Position the bracket and tube aside.

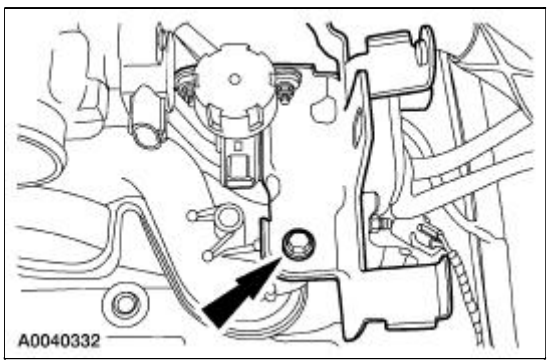


17. Remove the exhaust manifold to EGR valve tube.
    - Disconnect the upper fitting.

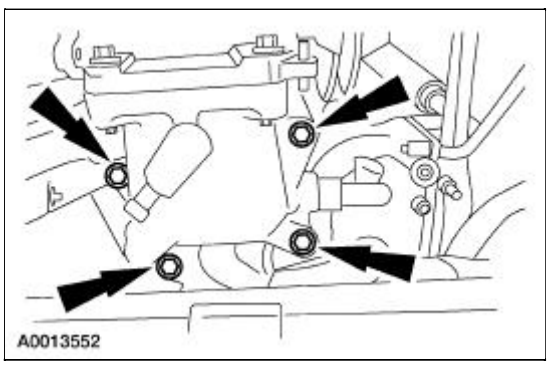
- Disconnect the two differential pressure feedback EGR system hoses.
- Disconnect the lower fitting and remove the tube.



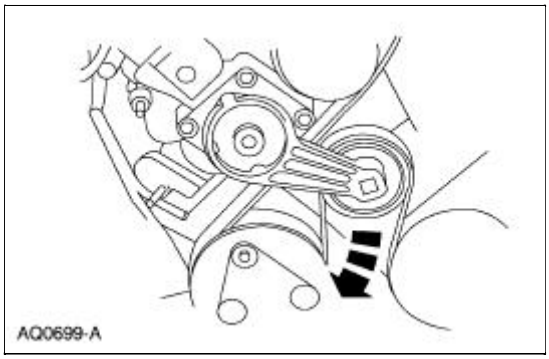
18. Remove the differential pressure feedback EGR system bracket bolt.



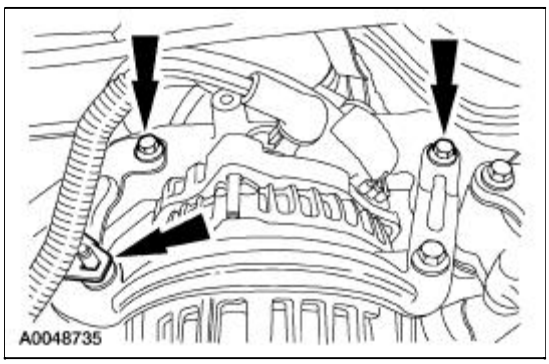
19. Remove the four bolts and remove the throttle body adapter.
    - Discard the throttle body adapter gasket.



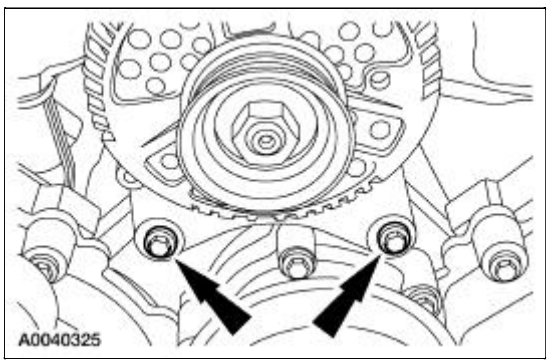
20. Rotate the belt tensioner clockwise and detach the drive belt from the generator pulley.



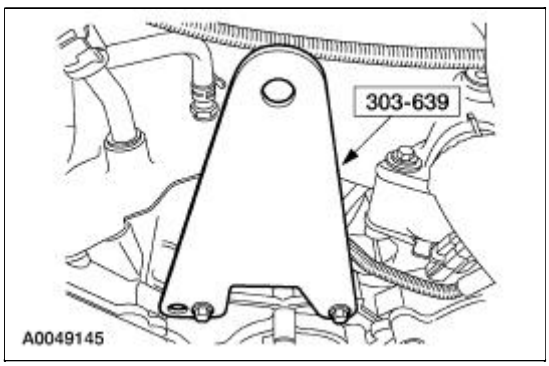
21. Disconnect the generator upper mounting bracket.
    - Disconnect the harness routing clip.
    - Remove the two bolts.



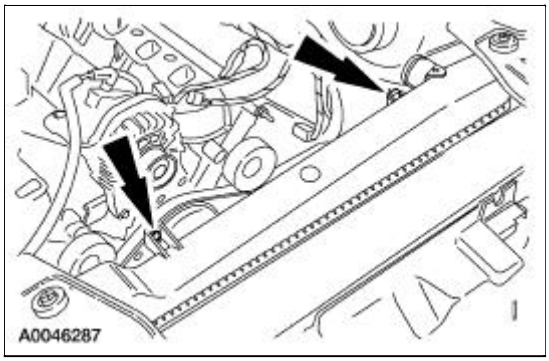
22. Remove the generator lower mounting bolts and position the generator aside.



23. Install the special tool.



24. Remove the fan shroud mounting bolts.

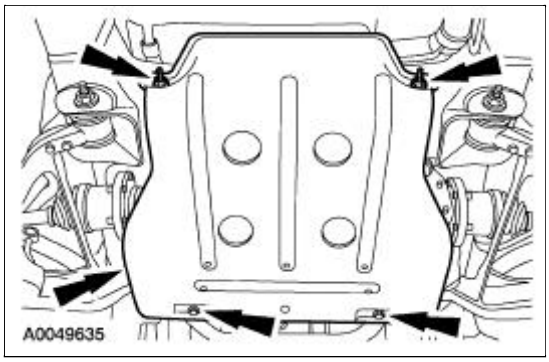


25. Remove the RH front wheel and tire. For additional information, refer to Section 204-04 .

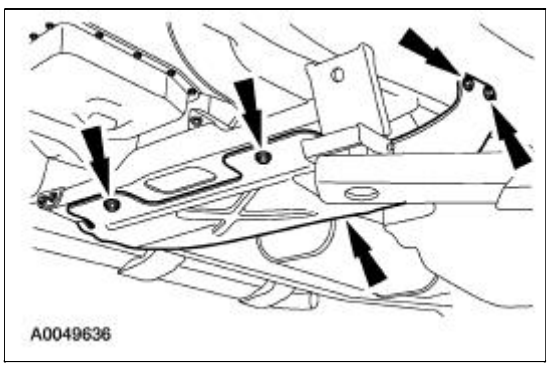
26. Remove the front fender splash shield.

4x4 vehicles

27. Remove the fasteners and the engine skid shield.



28. Remove the six bolts and the transmission skid shield.

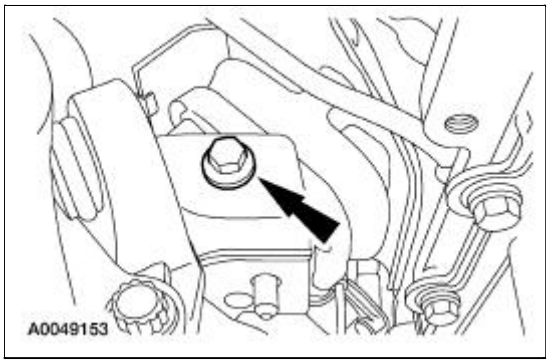


All vehicles

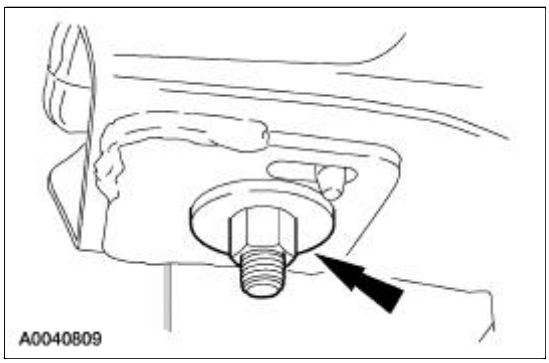
29. Remove the dual converter Y-pipe. For additional information, refer to Section 309-00 .

30. **NOTE:** The caged nut on the frame may break during bolt removal. If necessary, install a new nut.

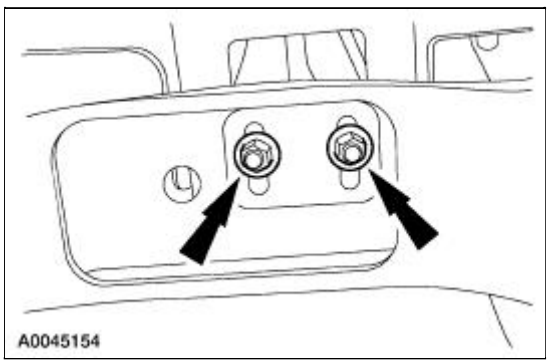
    Remove the LH engine mount bolt.



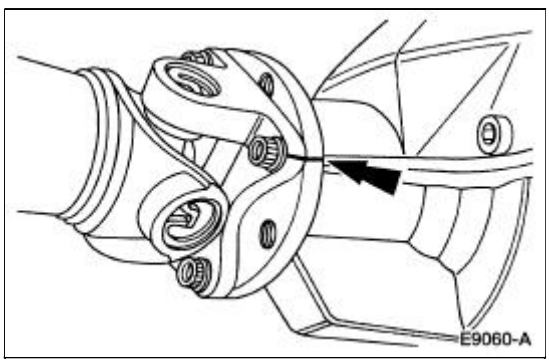
31. Remove the RH engine mount nut.



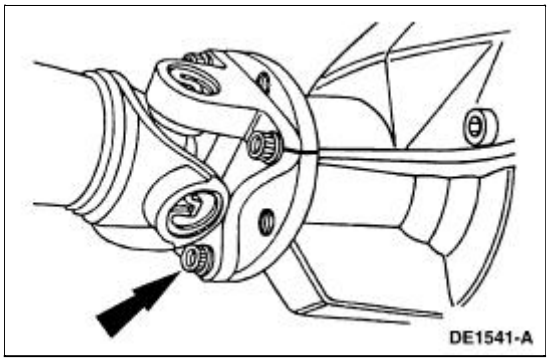
32. Loosen the rear transmission mount nuts.



33. Index-mark the driveshaft flange yoke and the pinion flange.

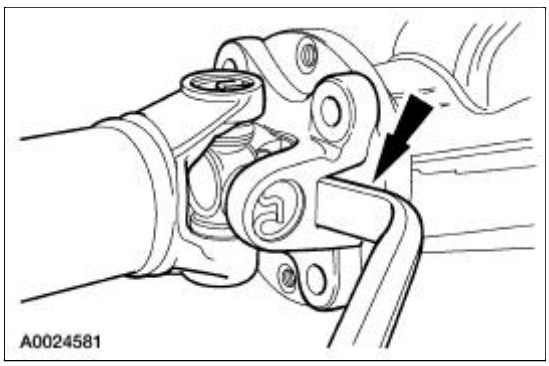


34. Remove the four bolts.



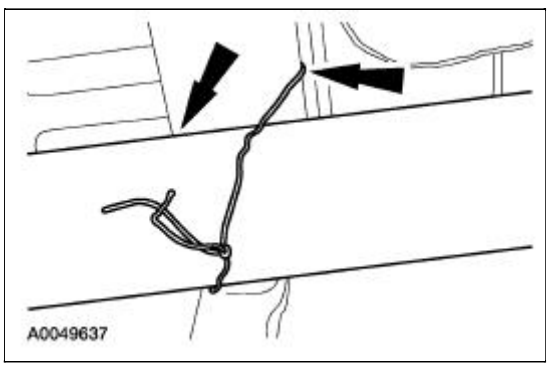
35. **CAUTION: The driveshaft flange yoke fits tightly on the pinion flange pilot. Never hammer on the driveshaft or any of its components to disconnect the yoke from the flange. Pry only in the area shown, with a suitable tool, to disconnect the yoke from the flange.**

    Using a suitable tool as shown, disconnect the driveshaft flange yoke from the pinion flange.



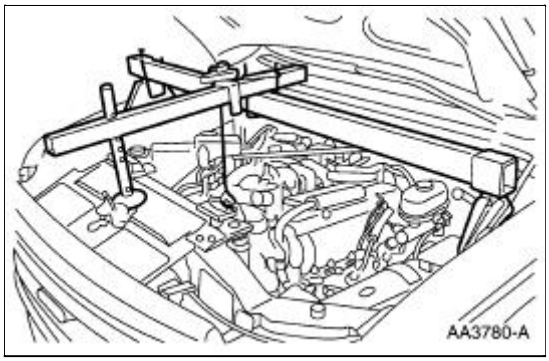
36. **CAUTION: The driveshaft alignment bushing can be damaged if the driveshaft is allowed to hang unsupported.**

    Wire the driveshaft to the frame crossmember to support it at the same height as when it was installed.



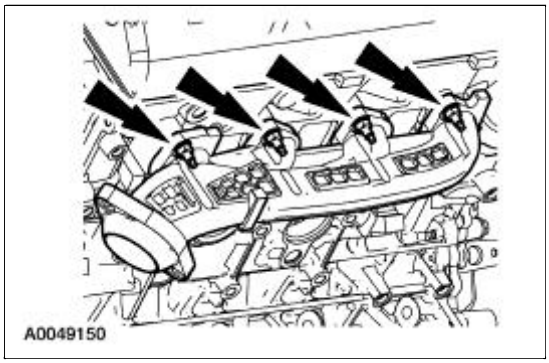
37. Lower the vehicle.

38. Install the special tool and raise the engine.



39. Raise and support the vehicle. For additional information, refer to Section 100-02 .

40. Remove the eight nuts, the exhaust manifold and the gasket.
    - Discard the exhaust manifold gasket.

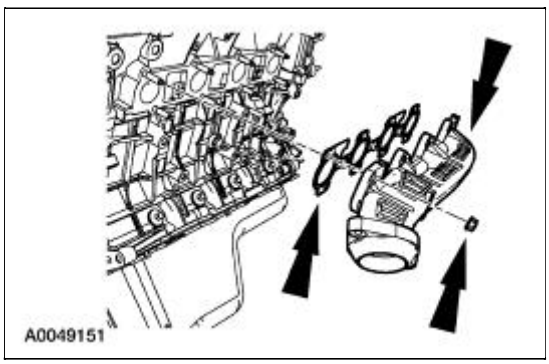


41. Clean and inspect the exhaust manifold. For additional information, refer to Section 303-00 .

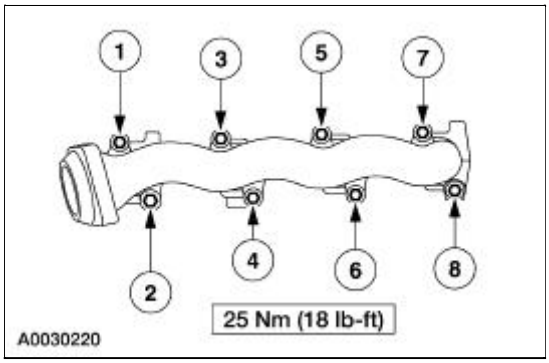
Installation

All vehicles

1. Position the exhaust manifold gasket and the exhaust manifold. Loosely install the nuts.



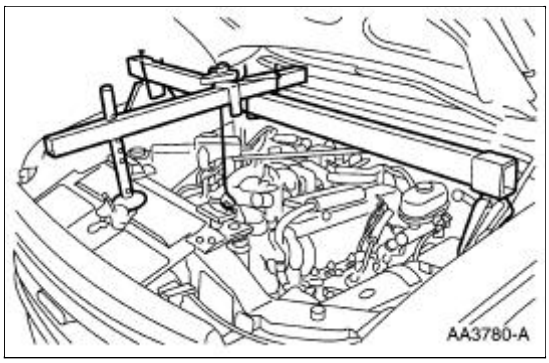
2. Tighten the nuts in the sequence shown.



3. Lower the vehicle.

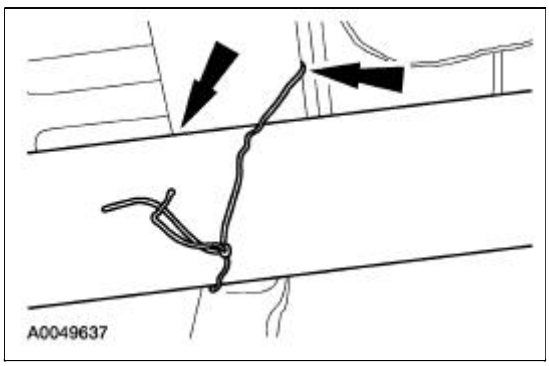
4. **NOTE:** Make sure the engine mounts align with, and settle into, the frame brackets as the engine is lowered.

   Lower the engine and remove the special tool.

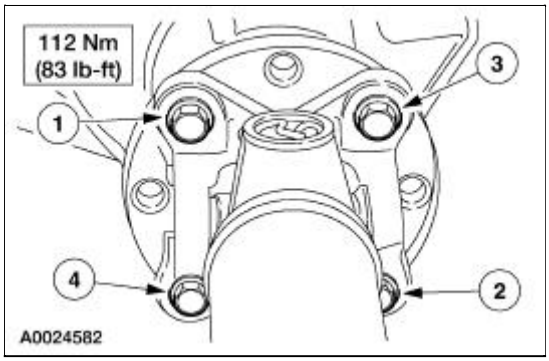


5. Raise and support the vehicle. For additional information, refer to Section 100-02 .

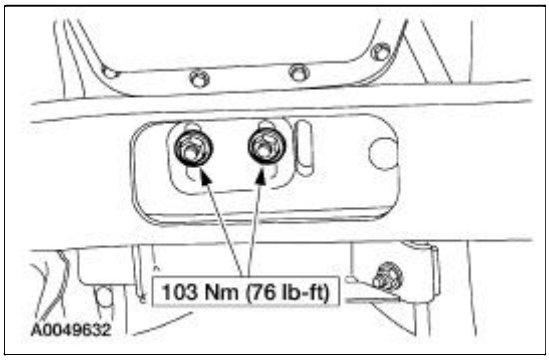
6. Remove the driveshaft support wire.



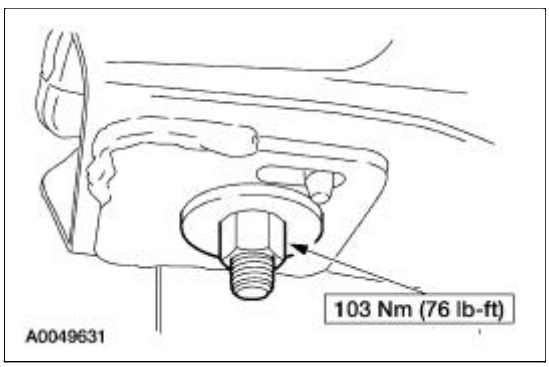
7. Align the index marks and install the driveshaft flange yoke to the pinion flange. Tighten the bolts in the sequence shown.



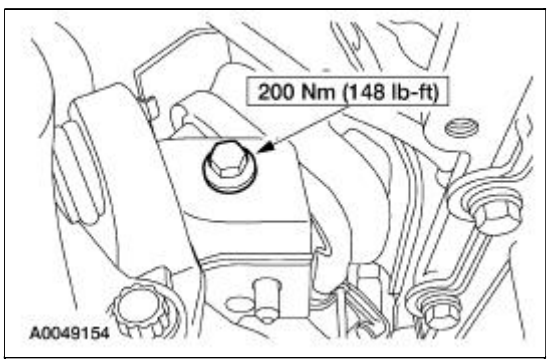
8. Tighten the rear transmission mount nuts.



9. Install the RH engine mount nut.



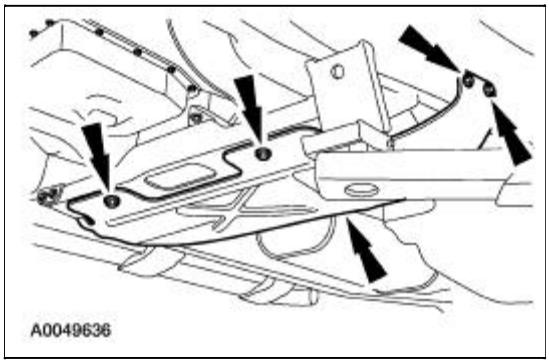
10. Install the LH engine mount bolt.



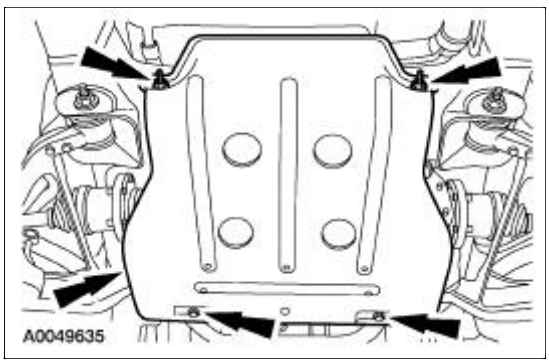
11. Install the dual converter Y-pipe. For additional information, refer to Section 309-00 .

4x4 vehicles

12. Position the transmission skid shield and install the six bolts.

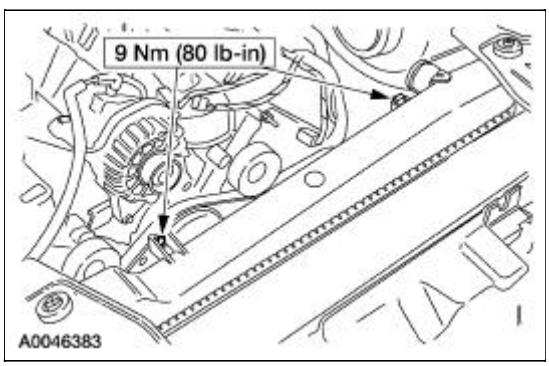


13. Position the engine skid shield and install the fasteners.

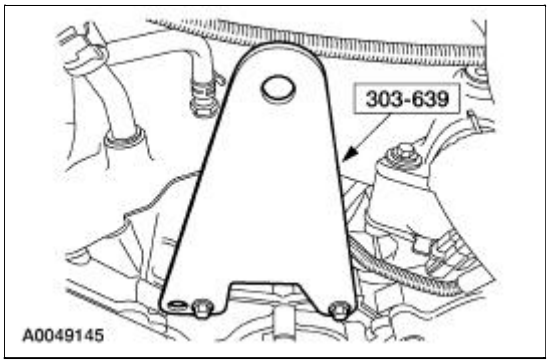


All vehicles

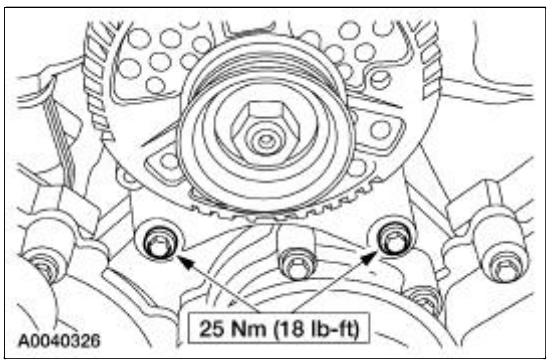
14. Install the front fender splash shield.
15. Install the RH front wheel and tire. For additional information, refer to Section 204-04 .
16. Position the fan shroud and install the mounting bolts.



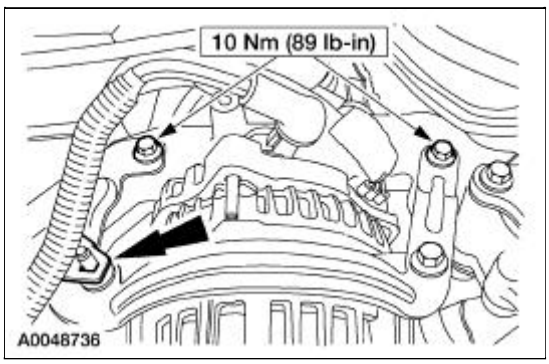
17. Remove the special tool.



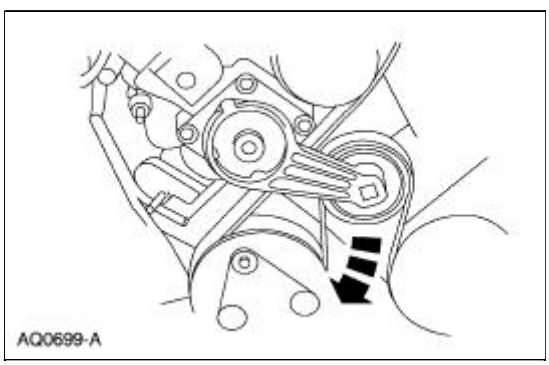
18. Position the generator and install the lower mounting bolts.



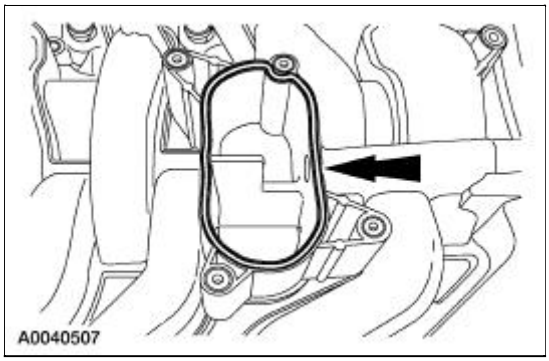
19. Install the generator upper mounting bracket bolts and harness routing clip.



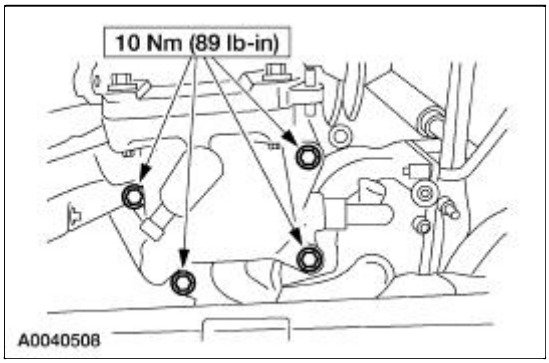
20. Rotate the belt tensioner clockwise and install the drive belt. Refer to the decal on the radiator upper air deflector for belt routing.



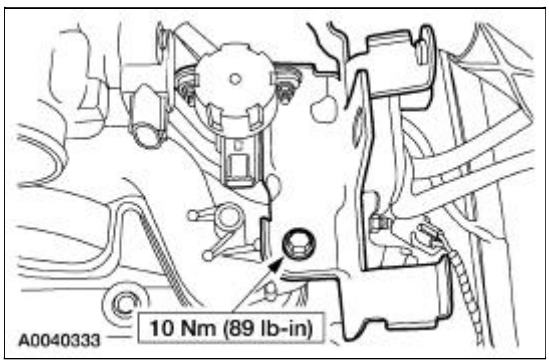
21. Install a new intake manifold-to-throttle body adapter gasket.



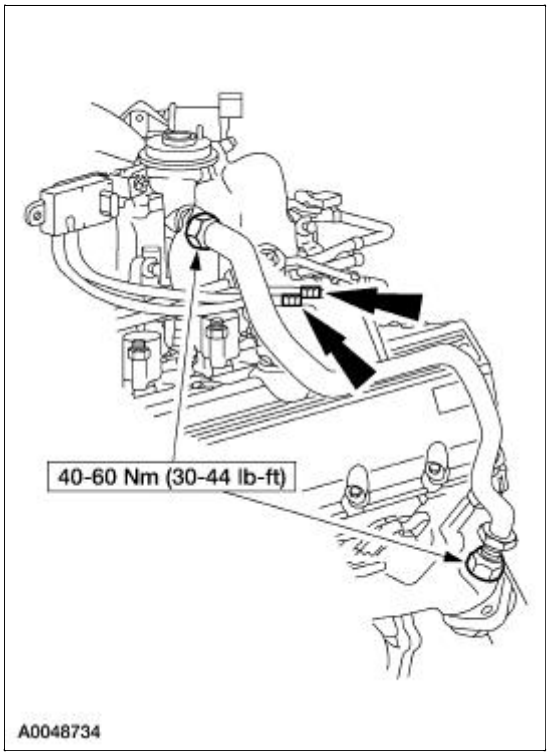
22. Install the throttle body adapter and the four bolts.



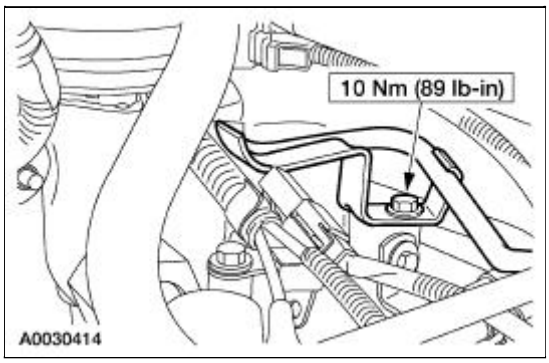
23. Install the differential pressure feedback EGR system bracket bolt.



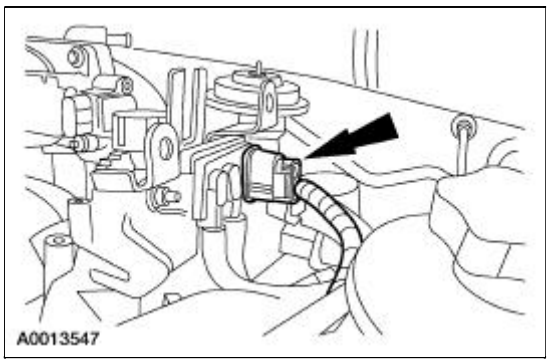
24. Install the exhaust manifold to EGR valve tube.
    - Position the tube and hand-tighten the fittings.
    - Tighten the upper fitting.
    - Tighten the lower fitting.
    - Connect the two differential pressure feedback EGR system hoses.



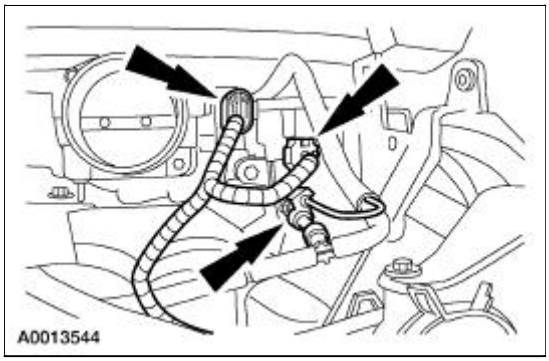
25. Connect the brake booster vacuum tube and position the bracket. Install the bolt.



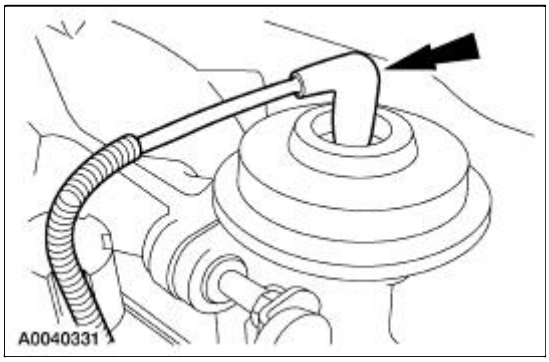
26. Connect the differential pressure feedback EGR system electrical connector.



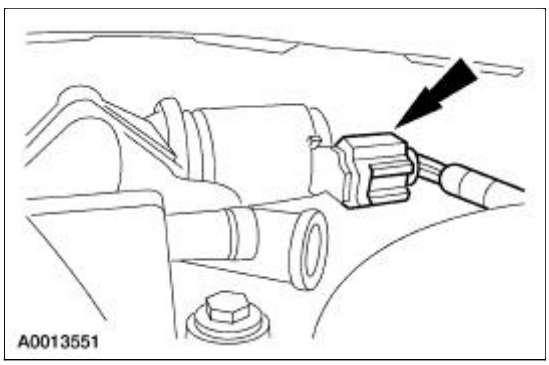
27. Connect the TP sensor electrical connector, and the EGR vacuum regulator solenoid electrical and vacuum connectors.



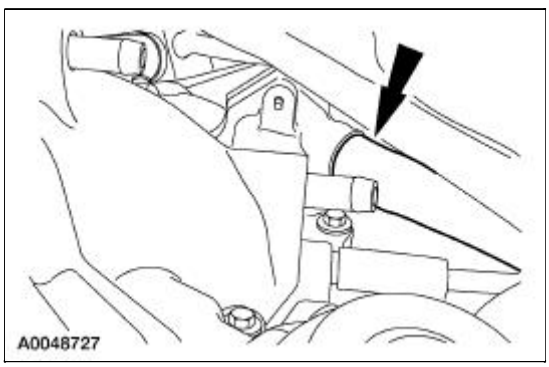
28. Connect the EGR valve vacuum hose.



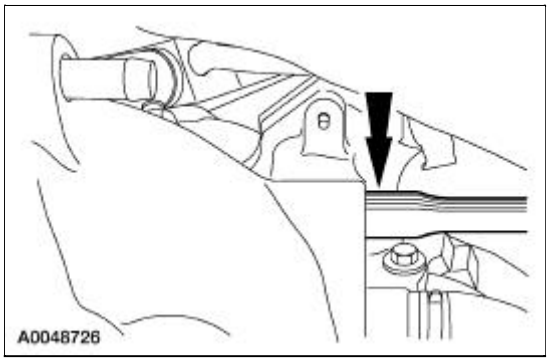
29. Connect the IAC electrical connector.



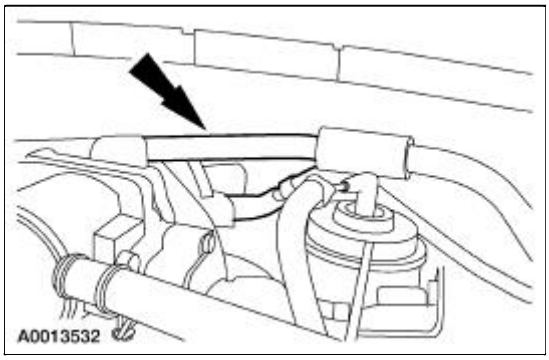
30. Install the IAC fresh air tube.



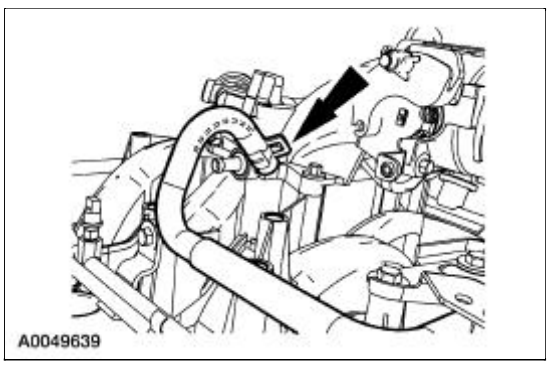
31. Connect the main vacuum harness.



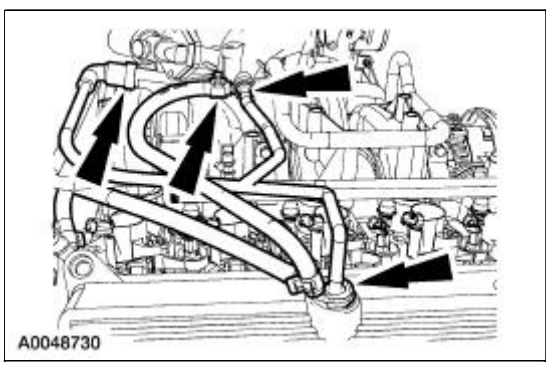
32. Connect the evaporative emission canister purge valve hose.



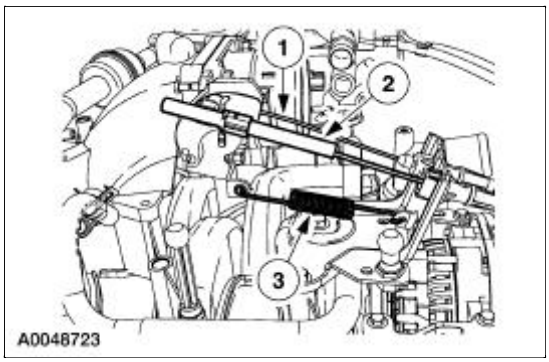
33. Connect the heated throttle body inlet hose to the throttle body adapter.



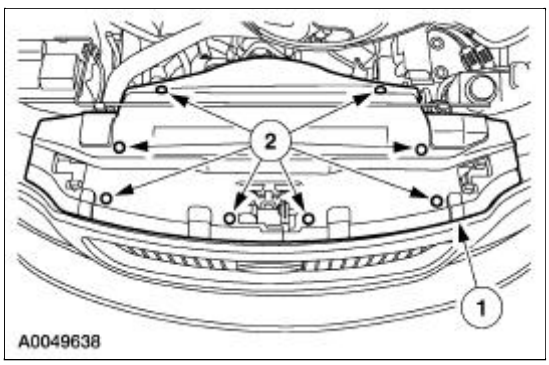
34. Install the heated PCV hose harness.
    - Install the PCV valve.
    - Connect the PCV hose to the intake manifold.
    - Connect the heated throttle body outlet hose.
    - Connect the PCV hose to the throttle body adapter.



35. Connect the throttle body cam.
    1. Connect the accelerator cable.
    2. Connect the speed control actuator cable.
    3. Install the throttle return spring.



36. Install the upper air deflector.
    1. Position the upper air deflector.
    2. Install the pin-type retainers.



37. Install the air cleaner outlet pipe. For additional information, refer to Section 303-12 .

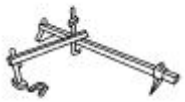
38. Connect the battery ground cable. For additional information, refer to Section 414-01 .

39. Fill and bleed the engine cooling system. For additional information, refer to Section 303-03 .

40. If equipped, turn on the air suspension switch.

Exhaust Manifold LH —4.6L

Special Tool(s)

 ST2334-A	Support Bracket, Engine 303-639
 ST2176-B	Heavy Duty Engine Support 303-F070

Removal

All vehicles

1. **CAUTION: The air suspension switch must be turned off prior to raising the vehicle. Failure to do so can result in unexpected inflation or deflation of the air springs, which could result in shifting of the vehicle during the repair operation.**

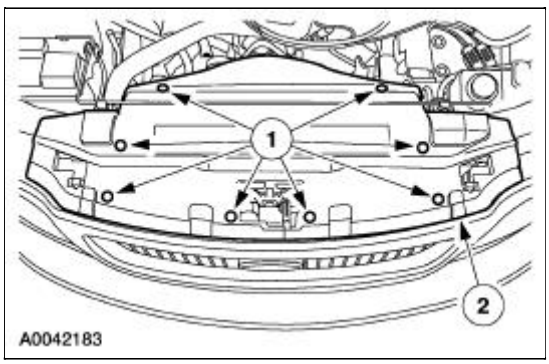
   If equipped, turn the air suspension switch off.

2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

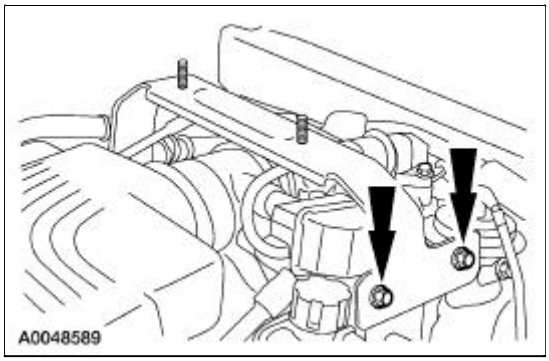
3. Remove the air cleaner outlet pipe. For additional information, refer to Section 303-12 .

4. Partially drain the engine cooling system. For additional information, refer to Section 303-03 .

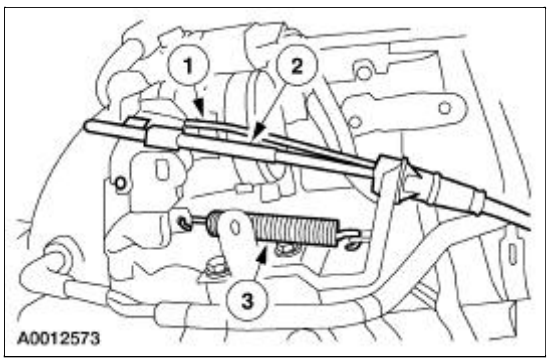
5. Remove the upper air deflector.
   1. Remove the pin-type retainers.
   2. Remove the upper air deflector.



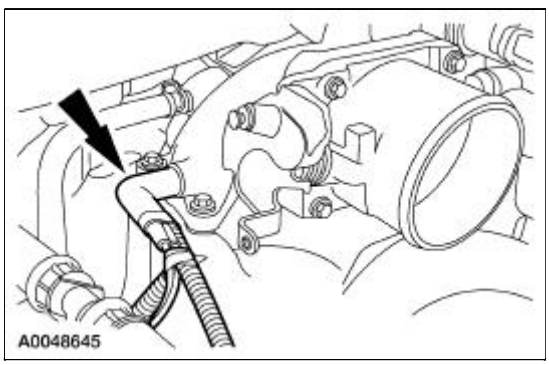
6. Remove the three bolts and the appearance cover mounting bracket.



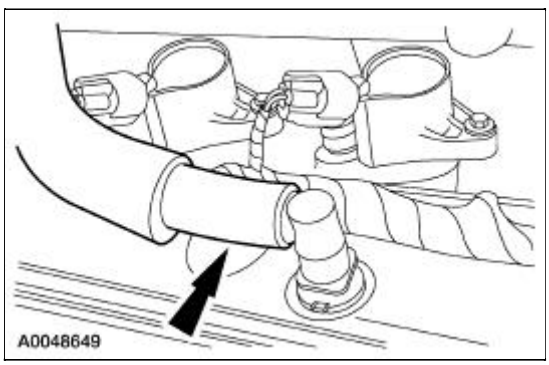
7. Disconnect the throttle body cam.
    1. Disconnect the accelerator cable.
    2. Disconnect the speed control actuator cable.
    3. Remove the accelerator return spring.



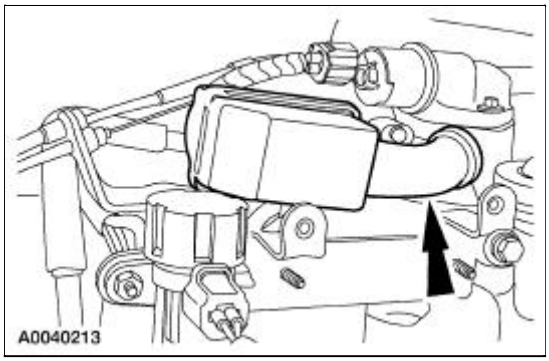
8. Disconnect the main vacuum harness.



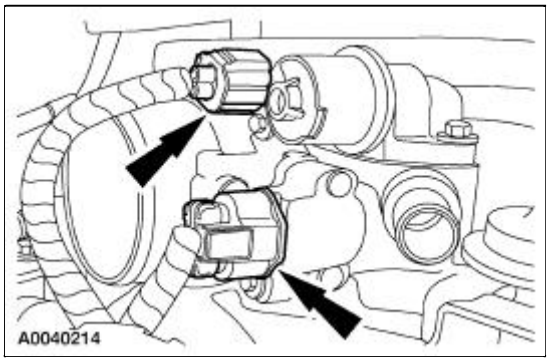
9. Disconnect the positive crankcase ventilation (PCV) hose.



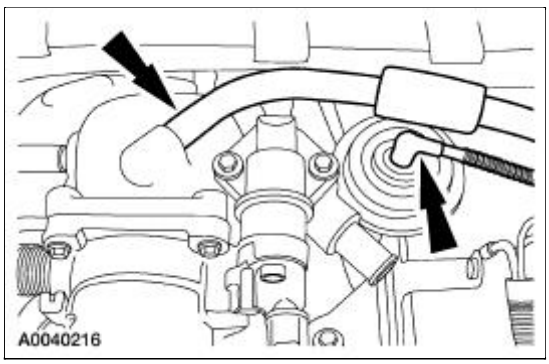
10. Remove the idle air control (IAC) fresh air hose.



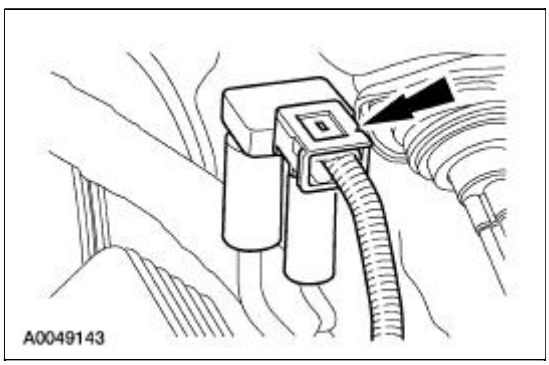
11. Disconnect the IAC and throttle position (TP) sensor electrical connectors.



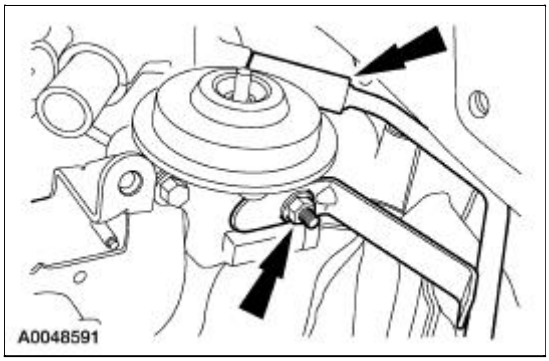
12. Disconnect the exhaust gas recirculation (EGR) valve vacuum hose and the evaporative emission canister purge valve hose and position them aside.



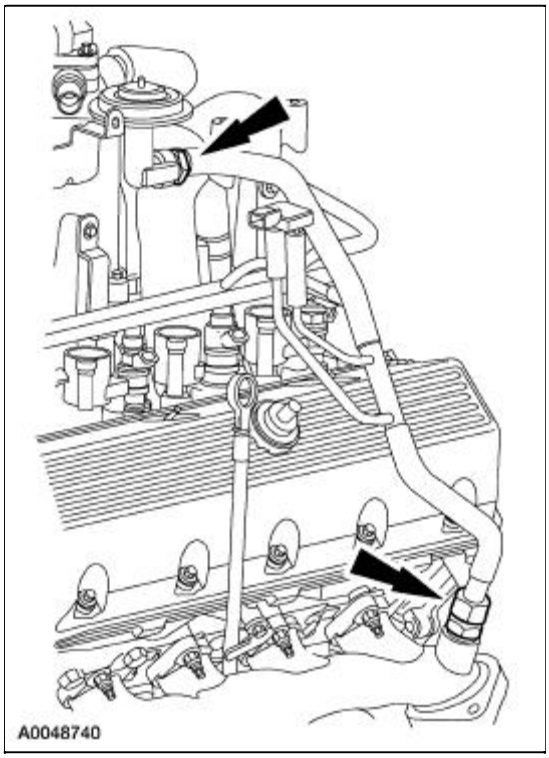
13. Disconnect the differential pressure feedback EGR system electrical connector.



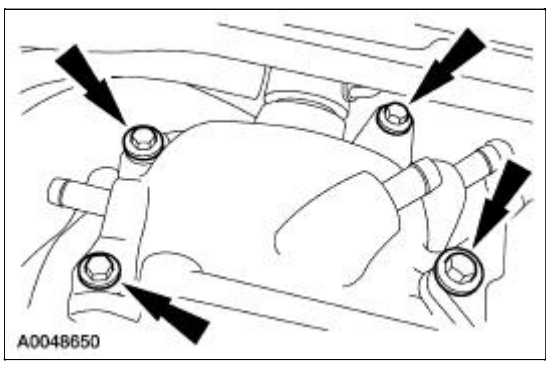
14. Remove the nut and disconnect the brake booster vacuum tube. Position the bracket and tube aside.



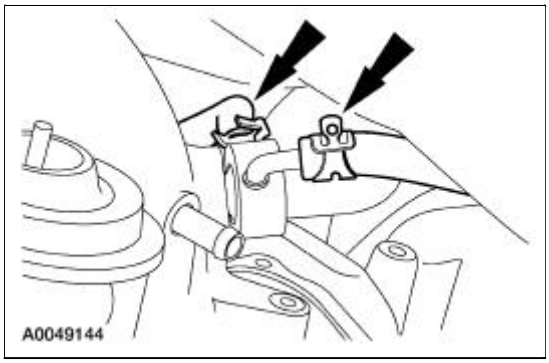
15. Disconnect the exhaust manifold to EGR valve tube fittings and remove the tube.



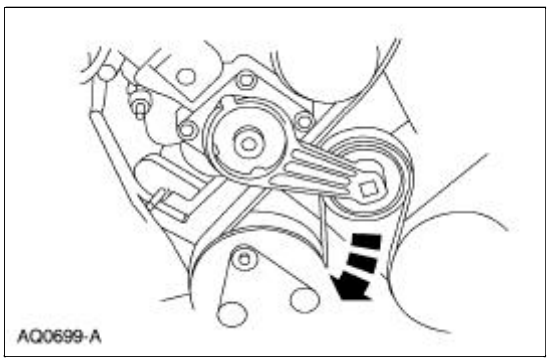
16. Remove the four bolts and move the throttle body adapter forward slightly.



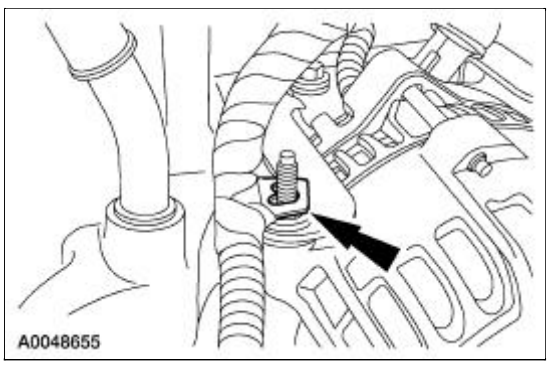
17. Disconnect the heated throttle body hoses and remove the throttle body adapter and PCV hose from the vehicle.
    - Discard the throttle body adapter-to-intake manifold gasket.
    - Inspect the throttle body and adapter for damage.



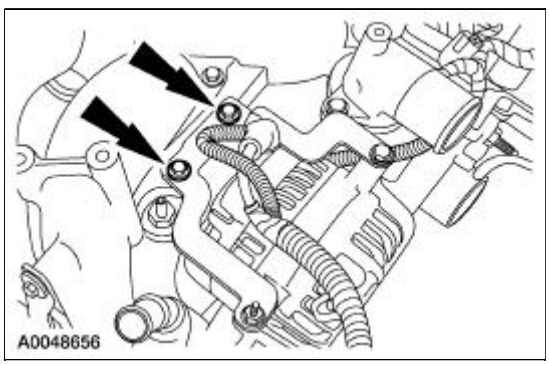
18. Rotate the belt tensioner clockwise and detach the drive belt from the generator pulley.



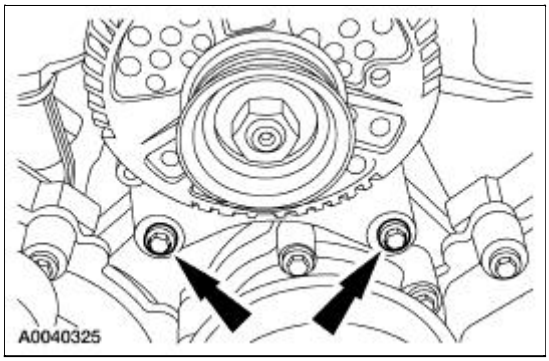
19. Disconnect the harness routing clip.



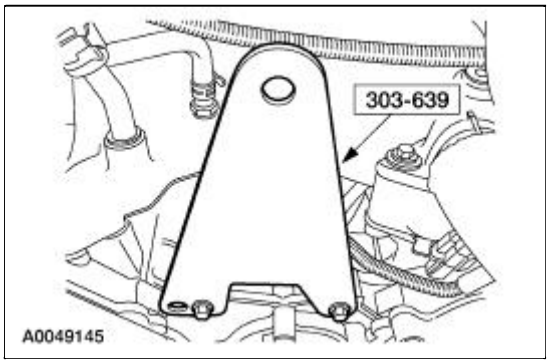
20. Remove the two bolts.



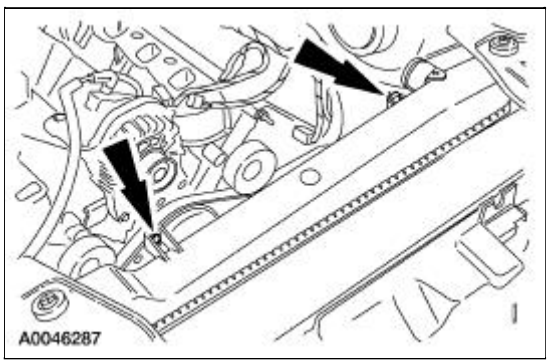
21. Remove the generator lower mounting bolts and position the generator aside.



22. Install the special tool.



23. Remove the fan shroud mounting bolts.

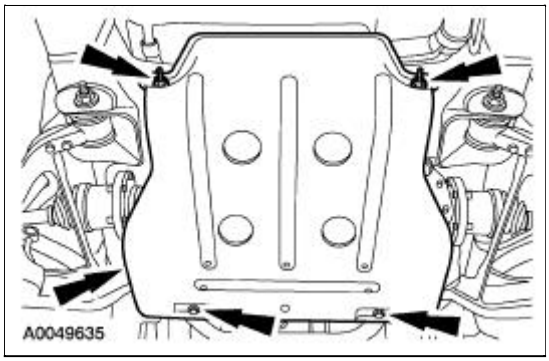


24. Remove the LH front wheel and tire. For additional information, refer to Section 204-04 .

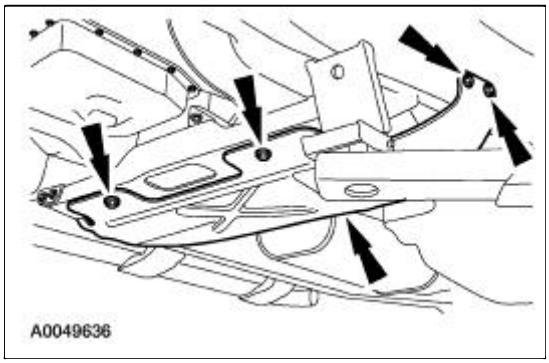
25. Remove the front fender splash shield.

4x4 vehicles

26. Remove the fasteners and the engine skid shield.



27. Remove the six bolts and the transmission skid shield.

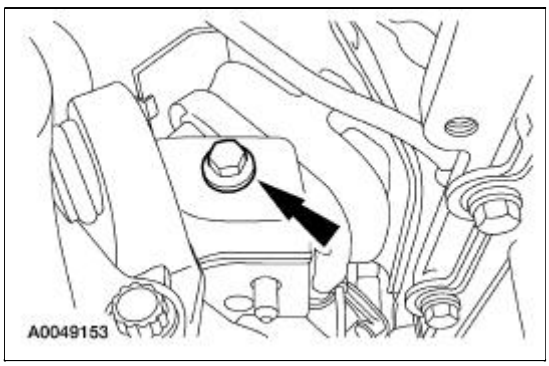


All vehicles

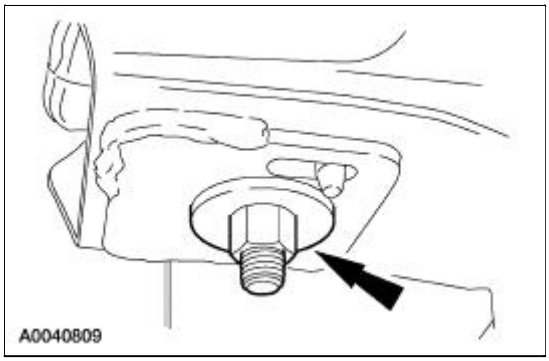
28. Remove the dual converter Y-pipe. For additional information, refer to Section 309-00 .

29. **NOTE:** The caged nut on the frame may break during bolt removal. If necessary, install a new nut.

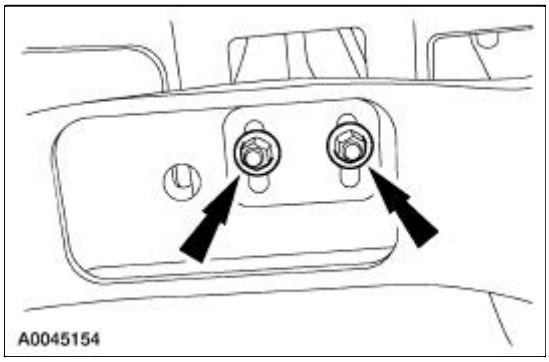
    Remove the LH engine mount bolt.



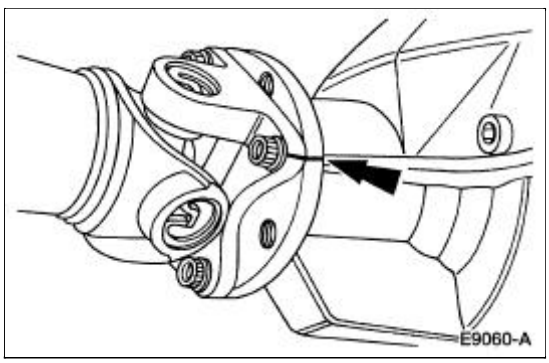
30. Remove the RH engine mount nut.



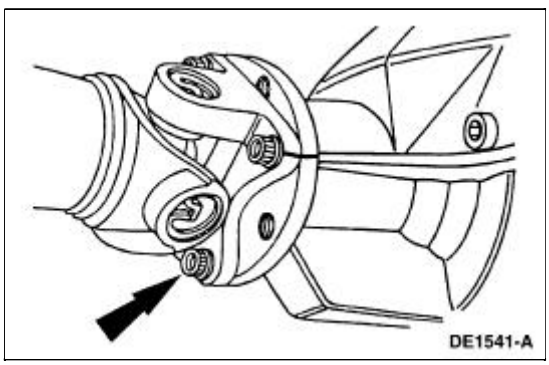
31. Loosen the rear transmission mount nuts.



32. Index-mark the driveshaft flange yoke and the pinion flange.

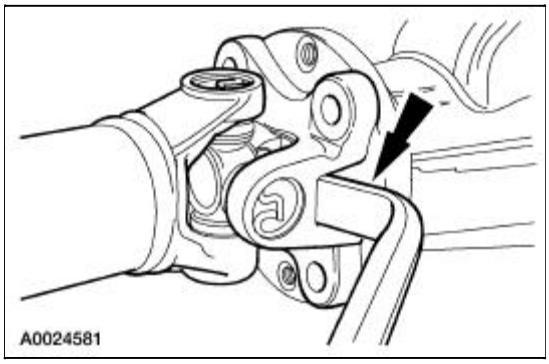


33. Remove the four bolts.



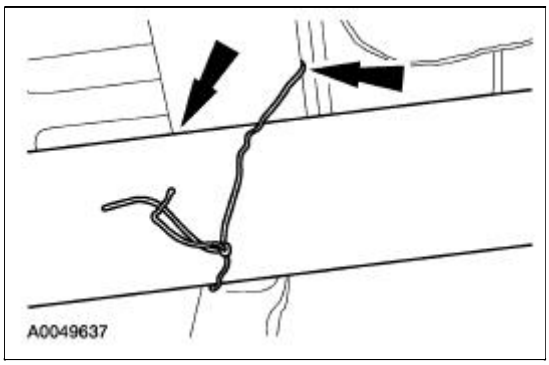
34. **CAUTION: The driveshaft flange yoke fits tightly on the pinion flange pilot. Never hammer on the driveshaft or any of its components to disconnect the yoke from the flange. Pry only in the area shown, with a suitable tool, to disconnect the yoke from the flange.**

Using a suitable tool as shown, disconnect the driveshaft flange yoke from the pinion flange.



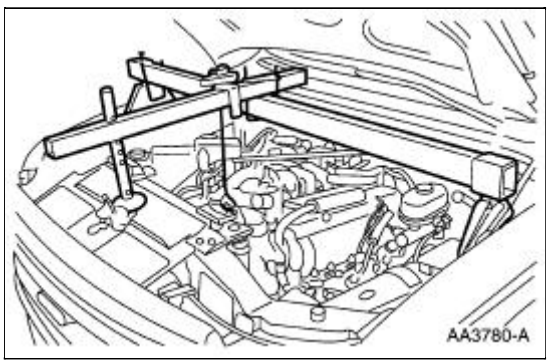
35. **CAUTION: The driveshaft alignment bushing can be damaged if the driveshaft is allowed to hang unsupported.**

    Wire the driveshaft to the frame crossmember to support it at the same height as when it was installed.



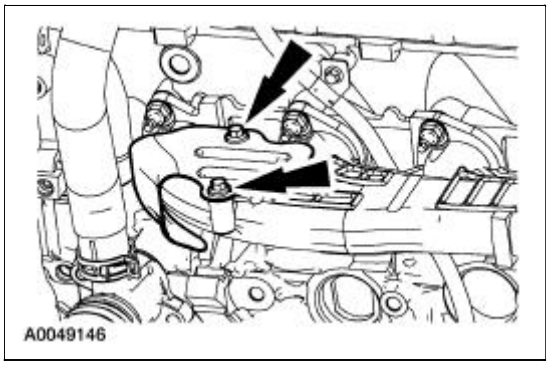
36. Lower the vehicle.

37. Install the special tool and raise the engine.

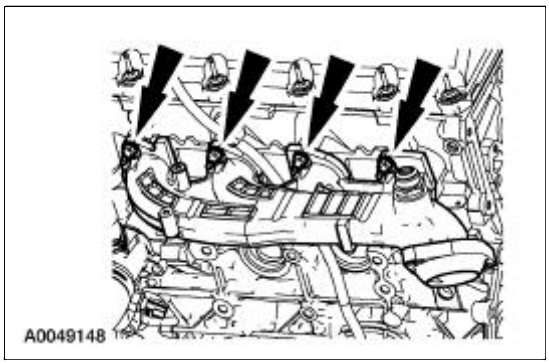


38. Raise and support the vehicle. For additional information, refer to Section 100-02 .

39. Remove the bolts and the heat shield.



40. Remove the eight nuts, the exhaust manifold and the gaskets.
    - Discard the exhaust manifold gaskets.

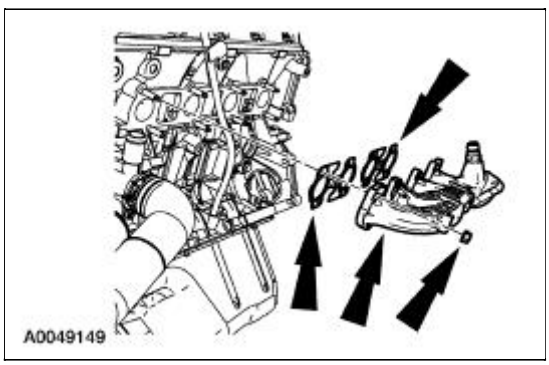


41. Clean and inspect the exhaust manifold. For additional information, refer to Section 303-00 .

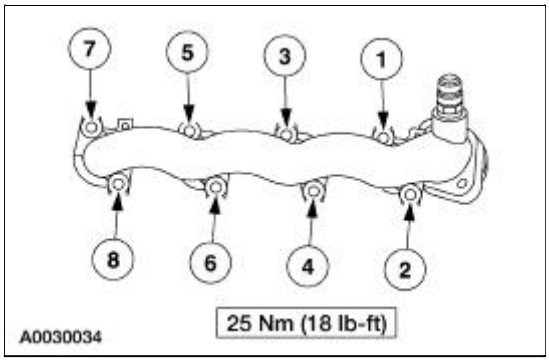
Installation

All vehicles

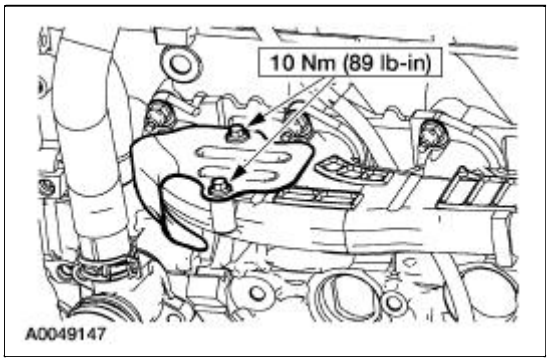
1. Position the exhaust manifold gaskets and the exhaust manifold. Loosely install the nuts.



2. Tighten the nuts in the sequence shown.



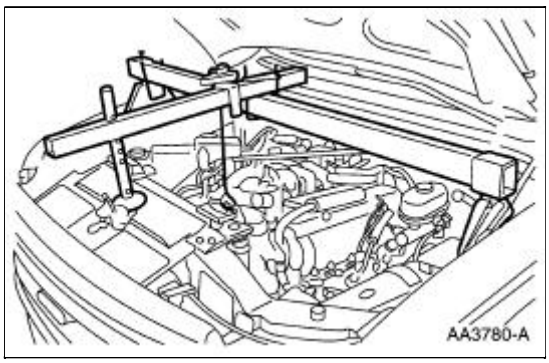
3. Install the heat shield and bolts.



4. Lower the vehicle.

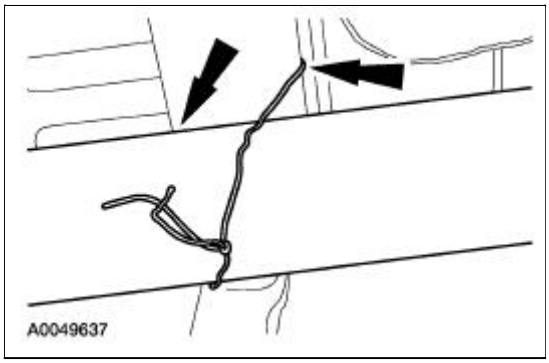
5. **NOTE:** Make sure the engine mounts align with, and settle into, the frame brackets as the engine is lowered.

   Lower the engine and remove the special tool.

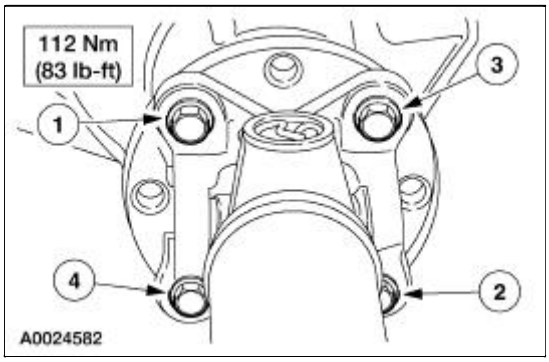


6. Raise and support the vehicle. For additional information, refer to Section 100-02 .

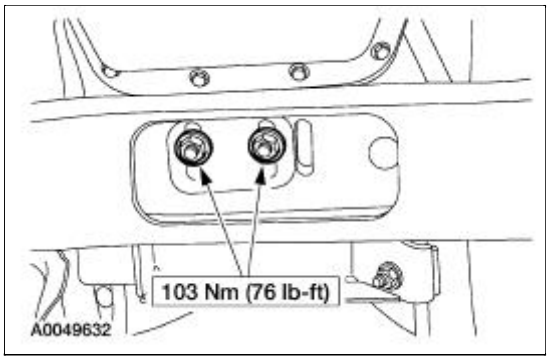
7. Remove the driveshaft support wire.



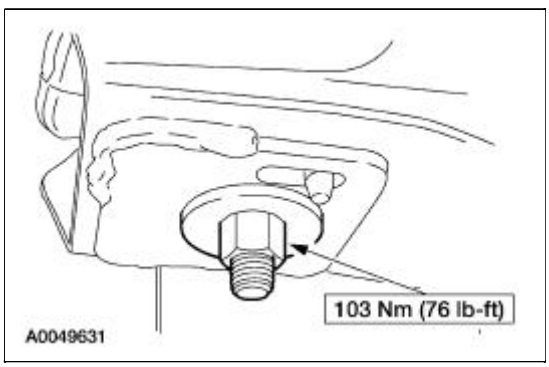
8. Align the index marks and install the driveshaft flange yoke to the pinion flange. Tighten the bolts in the sequence shown.



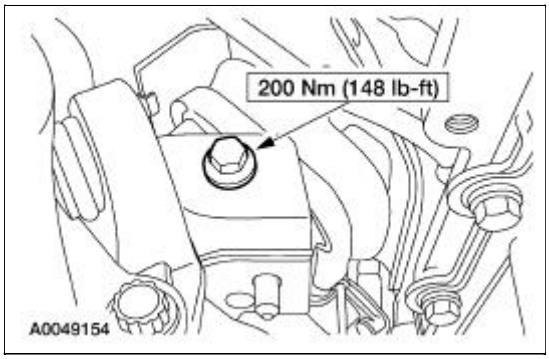
9. Tighten the rear transmission mount nuts.



10. Install the RH engine mount nut.



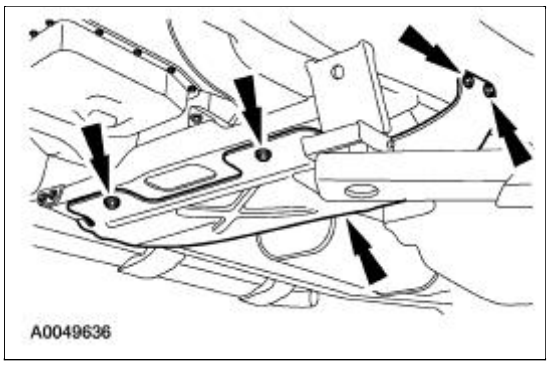
11. Install the LH engine mount bolt.



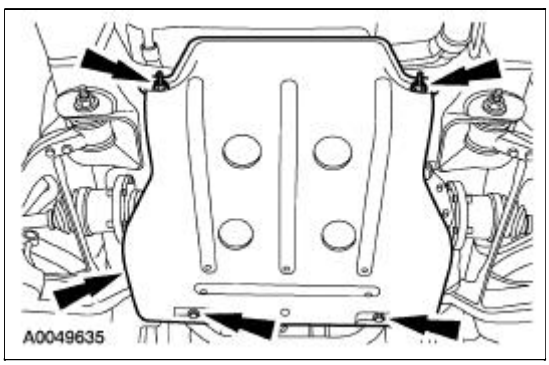
12. Install the dual converter Y-pipe. For additional information, refer to Section 309-00 .

4x4 vehicles

13. Position the transmission skid shield and install the six bolts.

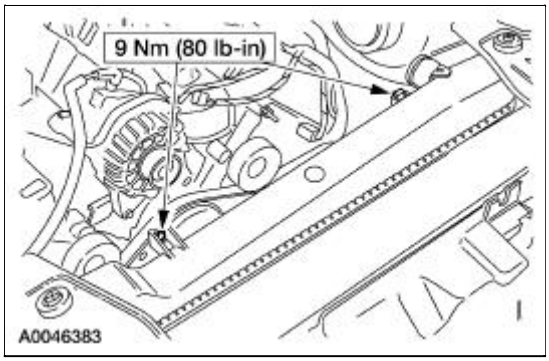


14. Position the engine skid shield and install the fasteners.

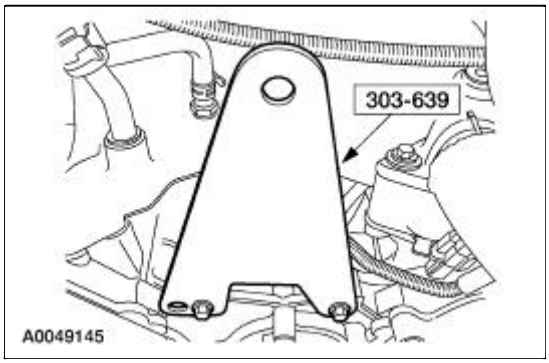


All vehicles

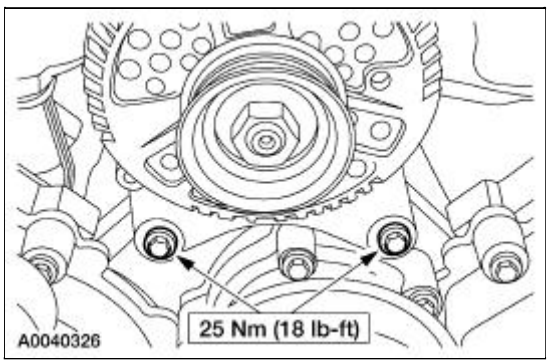
15. Install the front fender splash shield.
16. Install the LH front wheel and tire. For additional information, refer to Section 204-04 .
17. Position the fan shroud and install the mounting bolts.



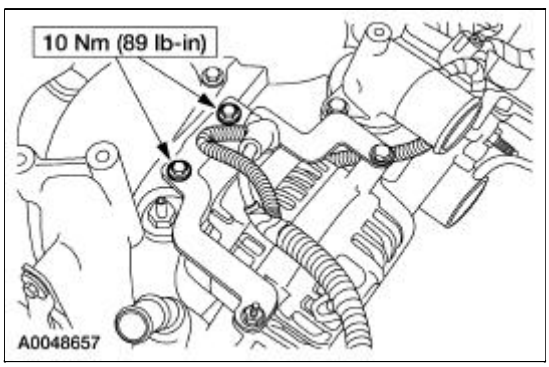
18. Remove the special tool.



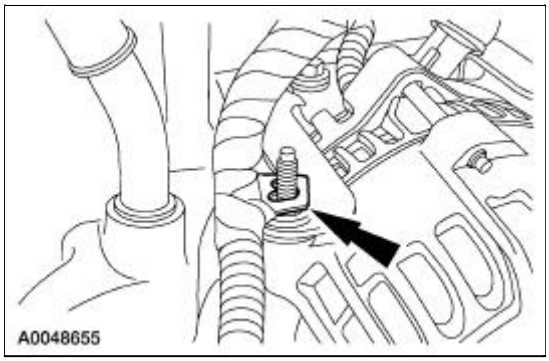
19. Position the generator and install the lower mounting bolts.



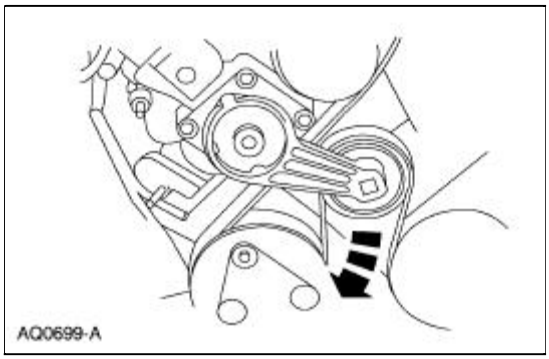
20. Install the generator upper mounting bracket bolts.



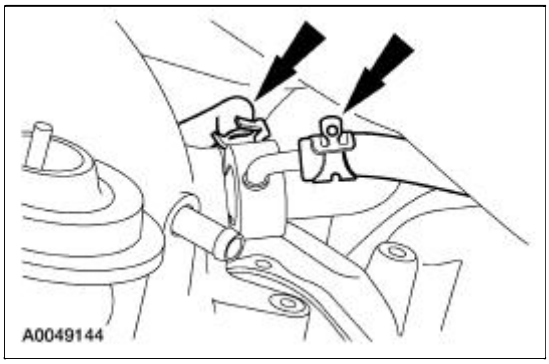
21. Install the harness routing clip.



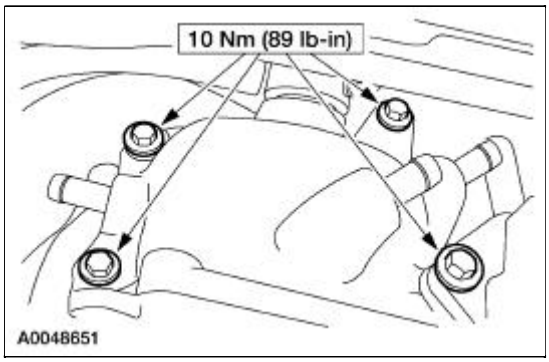
22. Rotate the belt tensioner clockwise and install the drive belt. Refer to the decal on the radiator upper air deflector for belt routing.



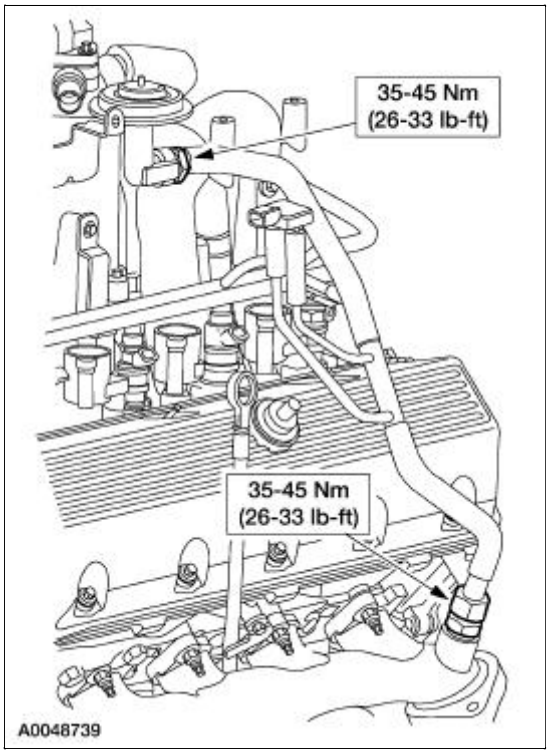
23. Roughly position the throttle body adapter and PCV hose in the vehicle and connect the heated throttle body hoses.



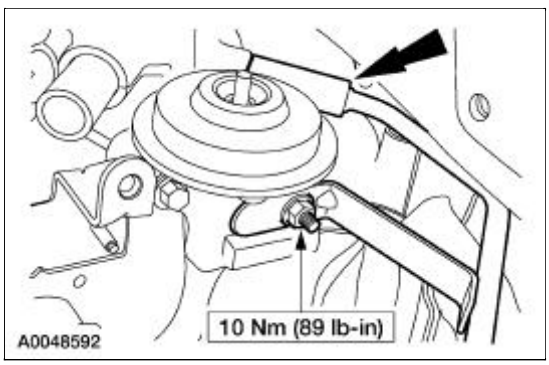
24. Install a new gasket and the throttle body adapter.



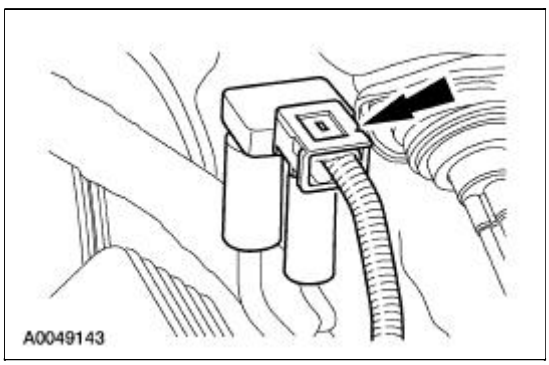
25. Position the exhaust manifold to EGR valve tube and tighten the fittings.



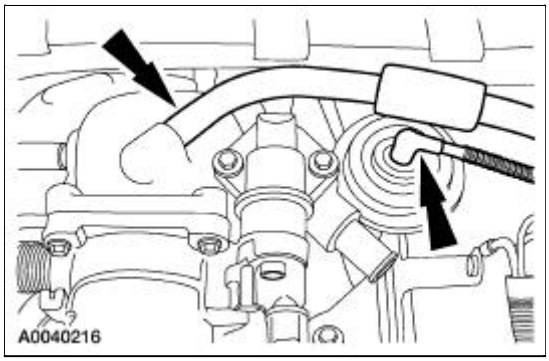
26. Connect the brake booster vacuum tube and bracket. Install the nut.



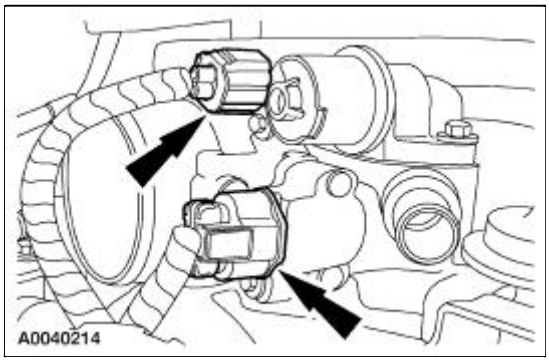
27. Connect the differential pressure feedback EGR system electrical connector.



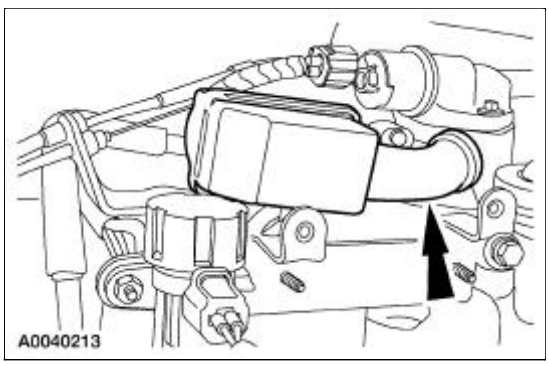
28. Connect the evaporative emission canister purge valve hose and the EGR valve vacuum hose.



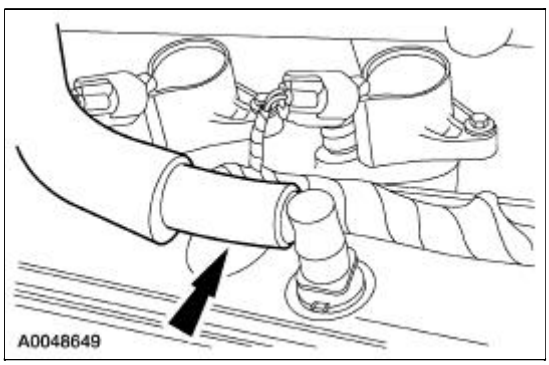
29. Connect the TP sensor and IAC electrical connectors.



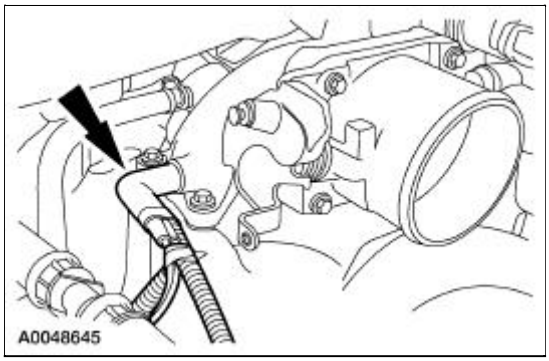
30. Install the IAC fresh air hose.



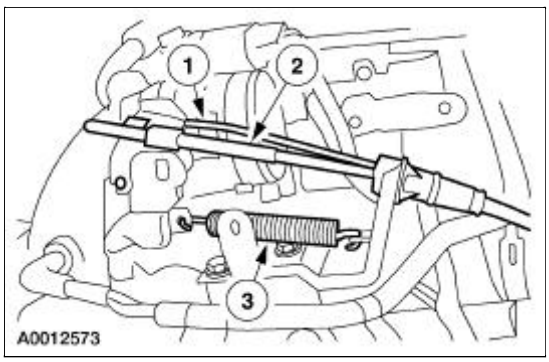
31. Connect the PCV hose.



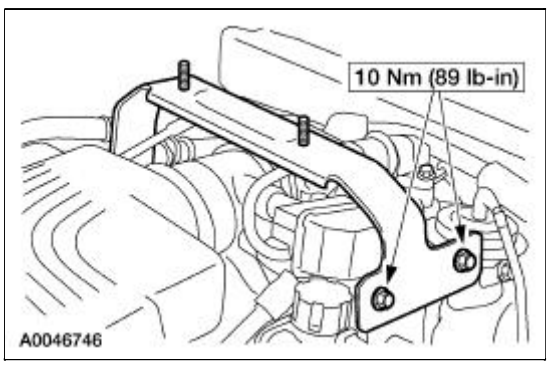
32. Connect the main vacuum harness.



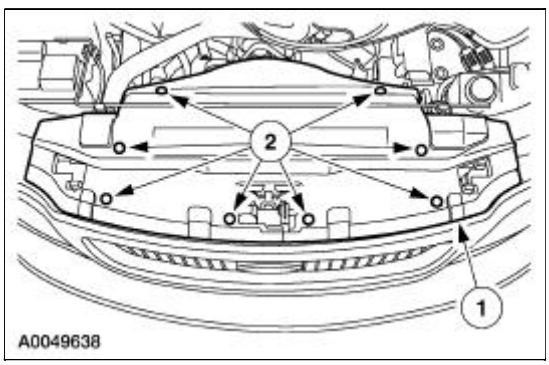
33. Connect the throttle body cam.
    1. Connect the accelerator cable.
    2. Connect the speed control actuator cable.
    3. Install the throttle return spring.



34. Install the appearance cover mounting bracket and the three bolts.



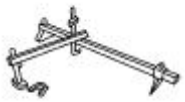
35. Install the upper air deflector.
    1. Position the upper air deflector.
    2. Install the pin-type retainers.



36. Install the air cleaner outlet pipe. For additional information, refer to Section 303-12 .
37. Connect the battery ground cable. For additional information, refer to Section 414-01 .
38. Fill and bleed the engine cooling system. For additional information, refer to Section 303-03 .
39. If equipped, turn on the air suspension switch.

Exhaust Manifold LH —5.4L

Special Tool(s)

 ST2334-A	Support Bracket, Engine 303-639
 ST2176-B	Heavy Duty Engine Support 303-F070

Removal

All vehicles

1. **CAUTION: The air suspension switch must be turned off prior to raising the vehicle. Failure to do so can result in unexpected inflation or deflation of the air springs, which could result in shifting of the vehicle during the repair operation.**

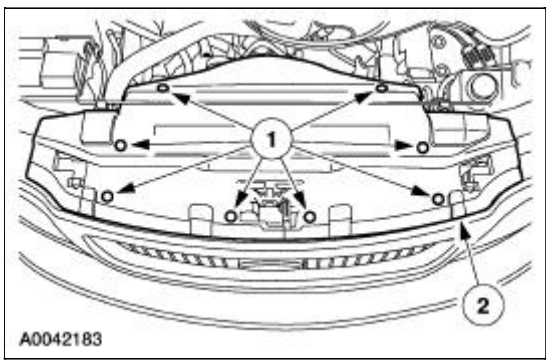
   If equipped, turn the air suspension switch off.

2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3. Remove the air cleaner outlet pipe. For additional information, refer to Section 303-12 .

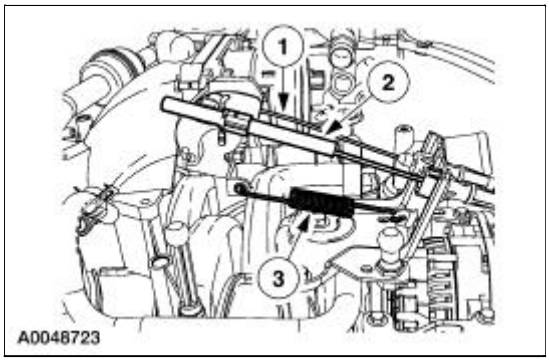
4. Partially drain the engine cooling system. For additional information, refer to Section 303-03 .

5. Remove the upper air deflector.
   1. Remove the pin-type retainers.
   2. Remove the upper air deflector.

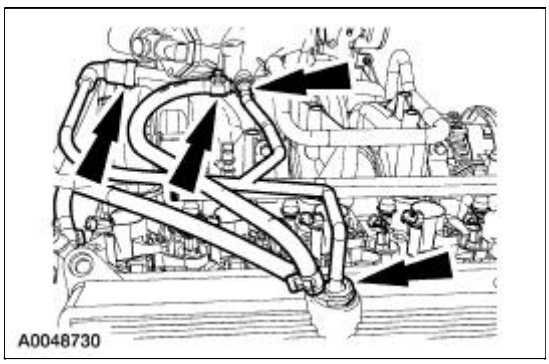


6. Disconnect the throttle body cam.
   1. Disconnect the accelerator cable.

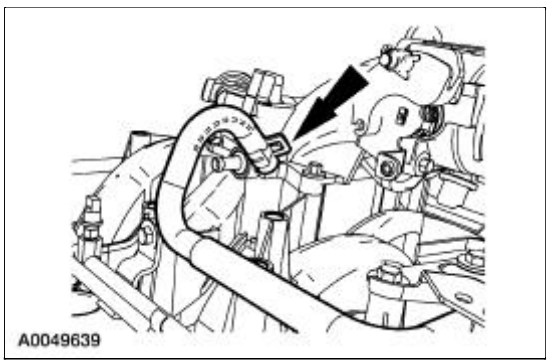
2. Disconnect the speed control actuator cable.
3. Remove the accelerator return spring.



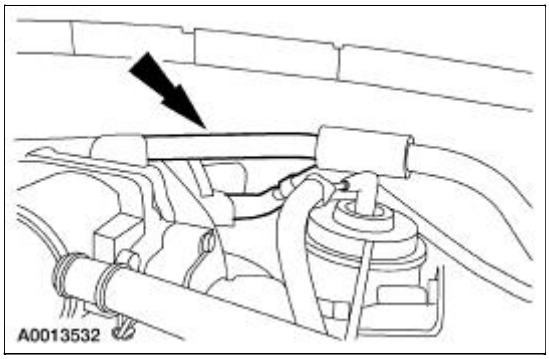
7. Position the heated positive crankcase ventilation (PCV) hose harness aside.
   - Disconnect the PCV hose from the throttle body adapter.
   - Disconnect the heated throttle body outlet hose from the throttle body adapter.
   - Disconnect the PCV hose from the intake manifold.
   - Remove the PCV valve and position the harness aside.



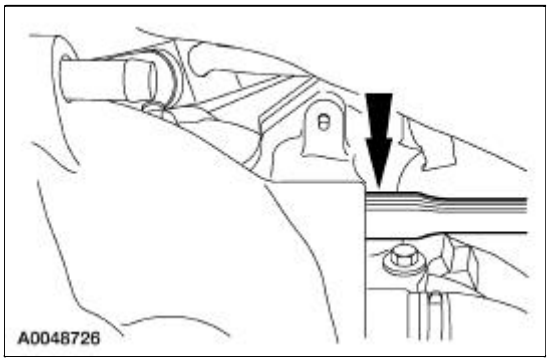
8. Disconnect the heated throttle body inlet hose from the throttle body adapter.



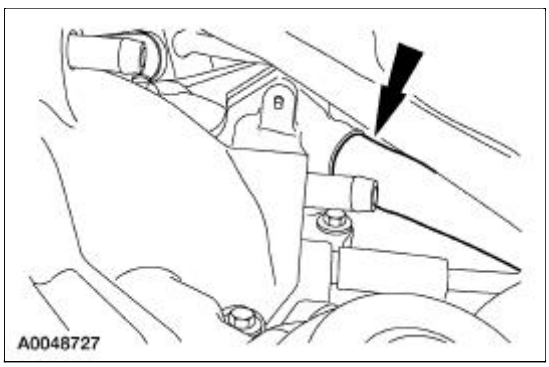
9. Disconnect the evaporative emission canister purge valve hose.



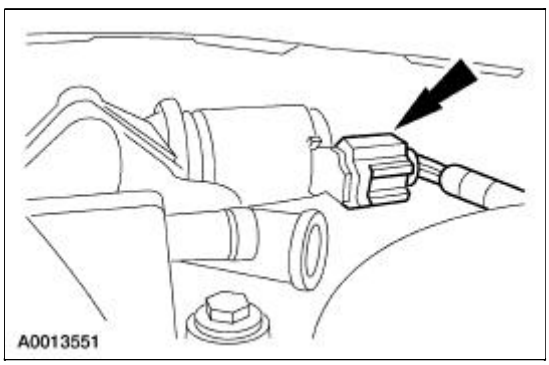
10. Disconnect the main vacuum harness from the throttle body adapter.



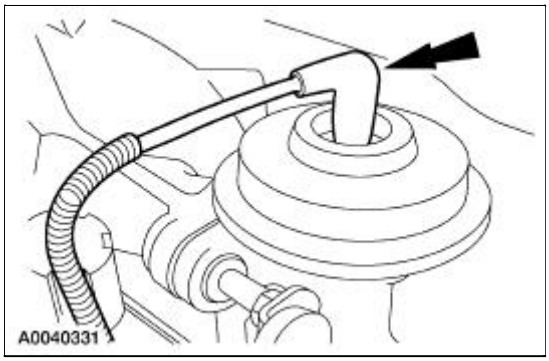
11. Remove the idle air control (IAC) valve fresh air tube.



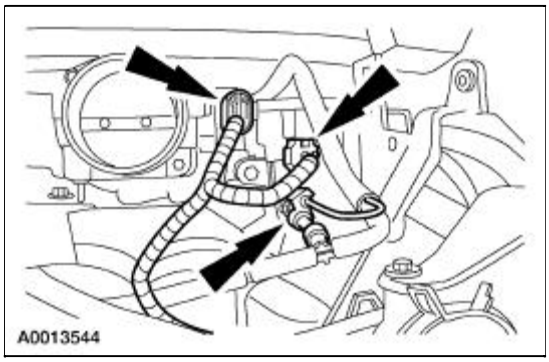
12. Disconnect the IAC electrical connector.



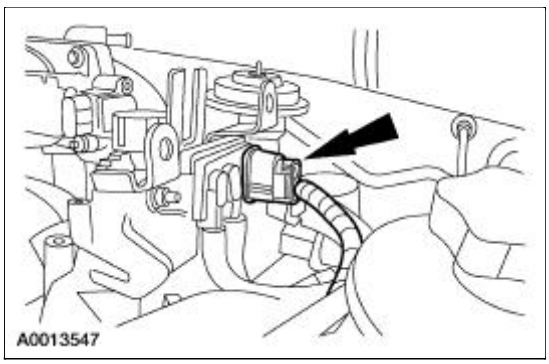
13. Disconnect the EGR valve vacuum hose.



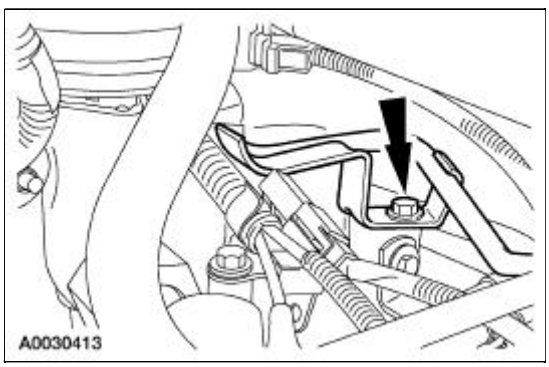
14. Disconnect the throttle position (TP) sensor electrical connector, and the exhaust gas recirculation (EGR) vacuum regulator solenoid electrical and vacuum connectors.



15. Disconnect the differential pressure feedback EGR system electrical connector.

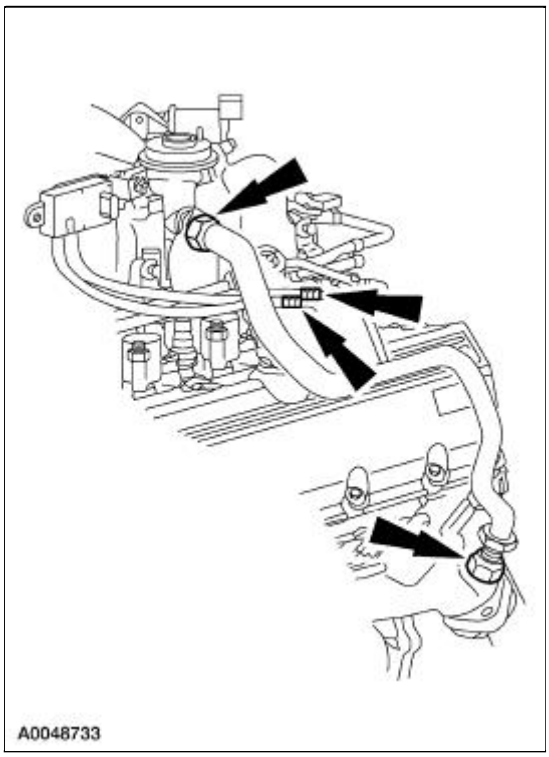


16. Remove the bolt and disconnect the brake booster vacuum tube. Position the bracket and tube aside.

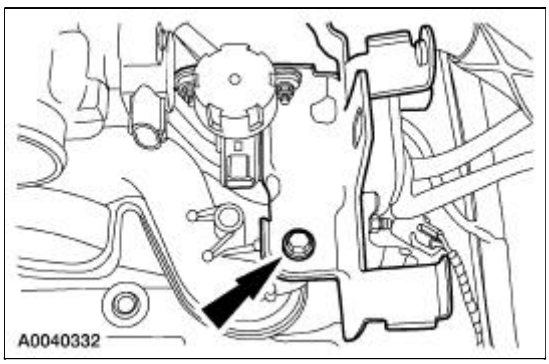


17. Remove the exhaust manifold to EGR valve tube.
    - Disconnect the upper fitting.

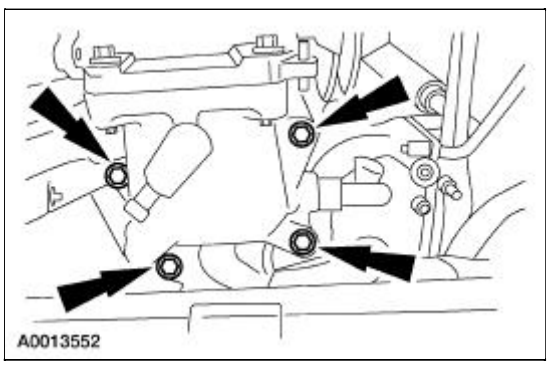
- Disconnect the two differential pressure feedback EGR system hoses.
- Disconnect the lower fitting and remove the tube.



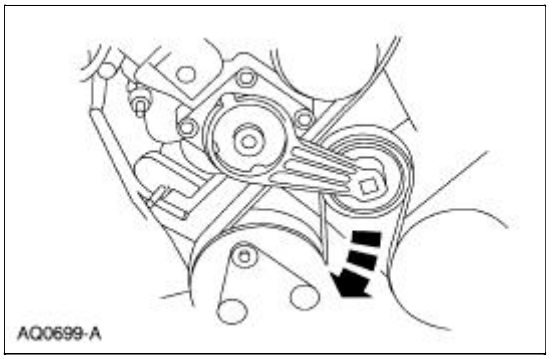
18. Remove the differential pressure feedback EGR system bracket bolt.



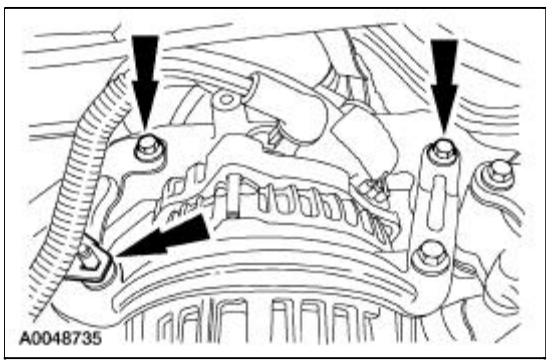
19. Remove the four bolts and remove the throttle body adapter.
    - Discard the throttle body adapter gasket.



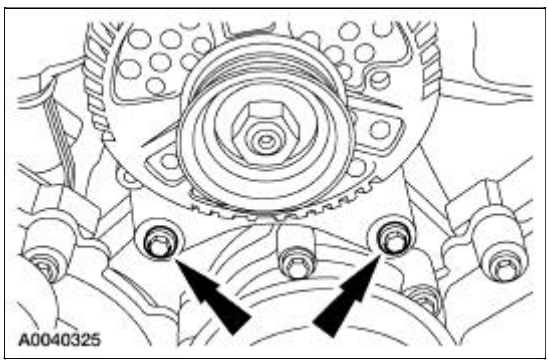
20. Rotate the belt tensioner clockwise and detach the drive belt from the generator pulley.



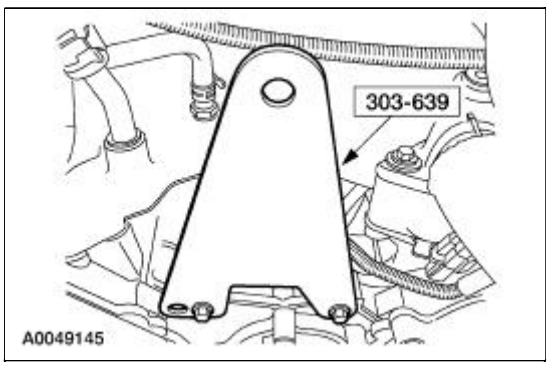
21. Disconnect the generator upper mounting bracket.
    - Disconnect the harness routing clip.
    - Remove the two bolts.



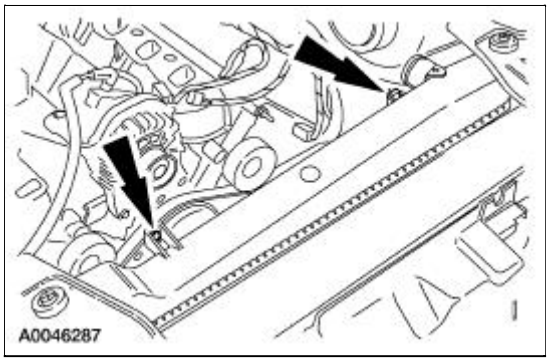
22. Remove the generator lower mounting bolts and position the generator aside.



23. Install the special tool.



24. Remove the fan shroud mounting bolts.

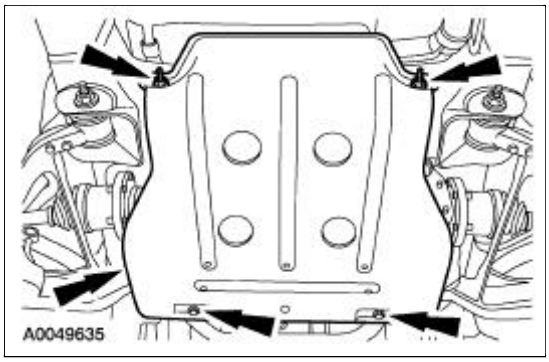


25. Remove the LH front wheel and tire. For additional information, refer to Section 204-04 .

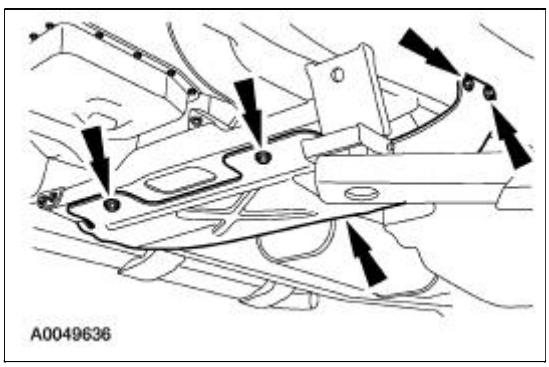
26. Remove the front fender splash shield.

4x4 vehicles

27. Remove the fasteners and the engine skid shield.



28. Remove the six bolts and the transmission skid shield.

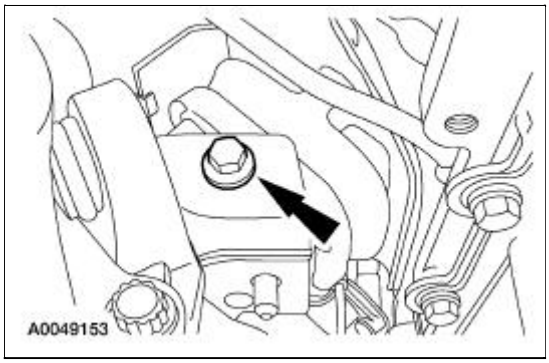


All vehicles

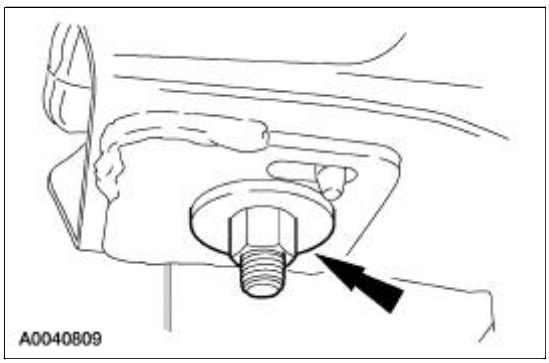
29. Remove the dual converter Y-pipe. For additional information, refer to Section 309-00 .

30. **NOTE:** The caged nut on the frame may break during bolt removal. If necessary, install a new nut.

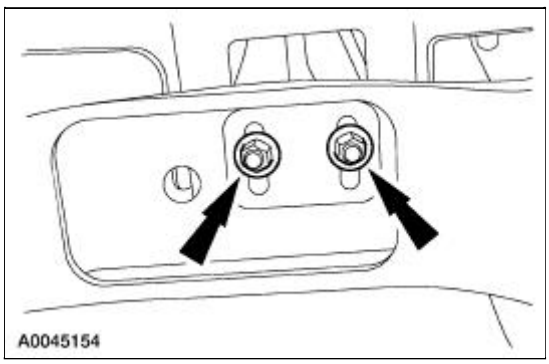
    Remove the LH engine mount bolt.



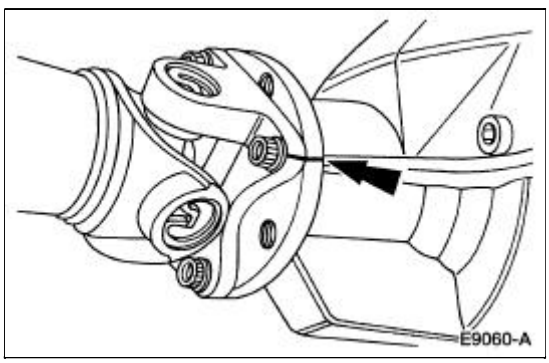
31. Remove the RH engine mount nut.



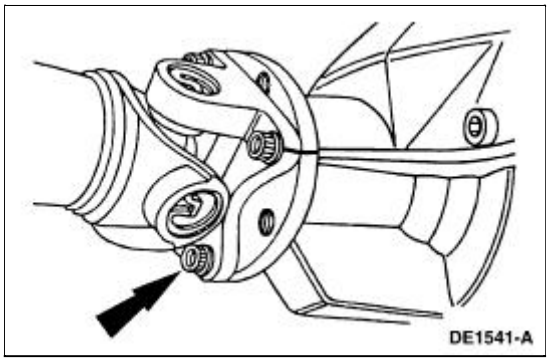
32. Loosen the rear transmission mount nuts.



33. Index-mark the driveshaft flange yoke and the pinion flange.

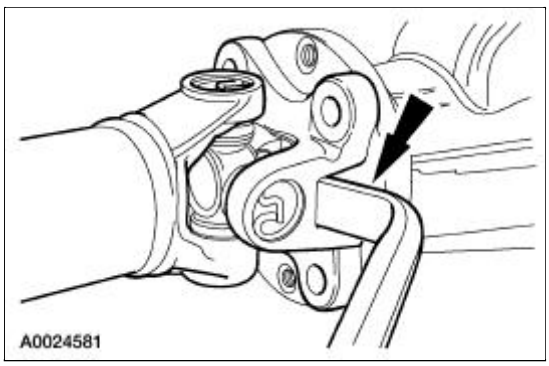


34. Remove the four bolts.



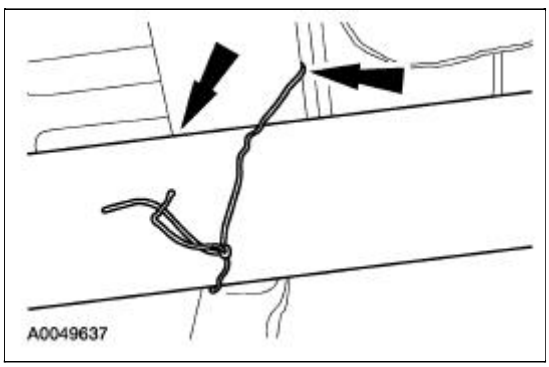
35. **CAUTION: The driveshaft flange yoke fits tightly on the pinion flange pilot. Never hammer on the driveshaft or any of its components to disconnect the yoke from the flange. Pry only in the area shown, with a suitable tool, to disconnect the yoke from the flange.**

    Using a suitable tool as shown, disconnect the driveshaft flange yoke from the pinion flange.



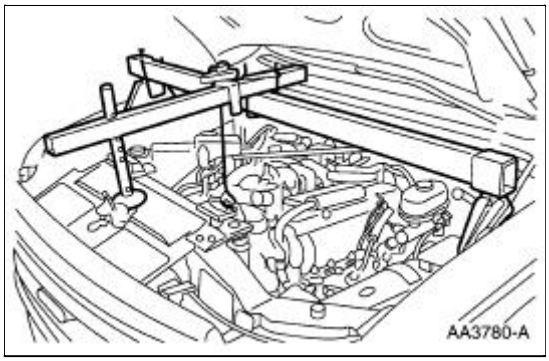
36. **CAUTION: The driveshaft alignment bushing can be damaged if the driveshaft is allowed to hang unsupported.**

    Wire the driveshaft to the frame crossmember to support it at the same height as when it was installed.



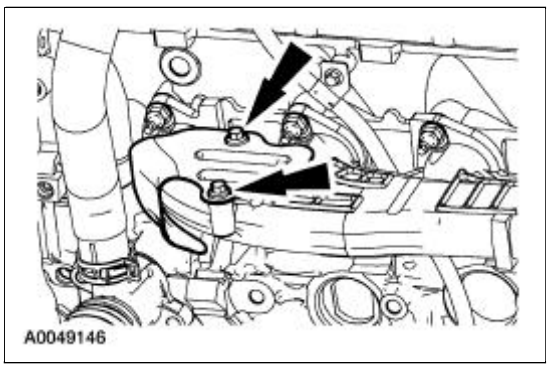
37. Lower the vehicle.

38. Install the special tool and raise the engine.

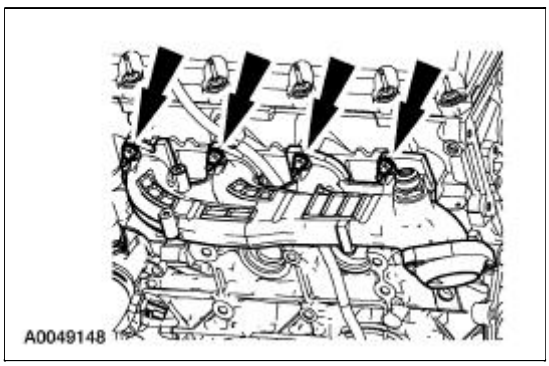


39. Raise and support the vehicle. For additional information, refer to Section 100-02 .

40. Remove the bolts and the heat shield.



41. Remove the eight nuts, the exhaust manifold and the gaskets.
    - Discard the exhaust manifold gaskets.

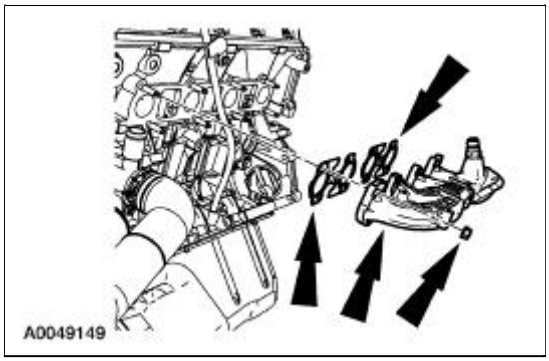


42. Clean and inspect the exhaust manifold. For additional information, refer to Section 303-00 .

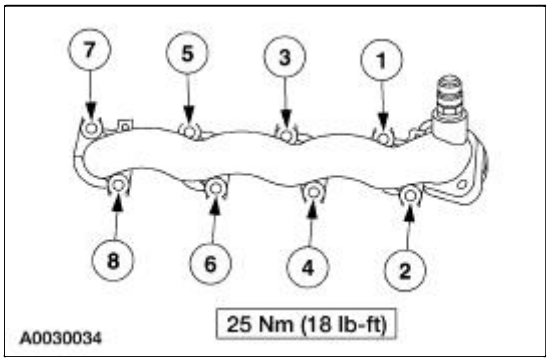
Installation

All vehicles

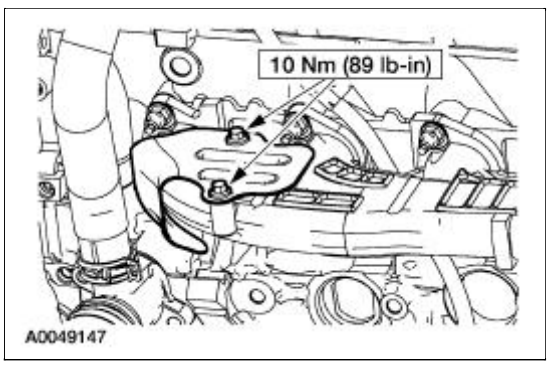
1. Position the exhaust manifold gaskets and the exhaust manifold. Loosely install the nuts.



2. Tighten the nuts in the sequence shown.



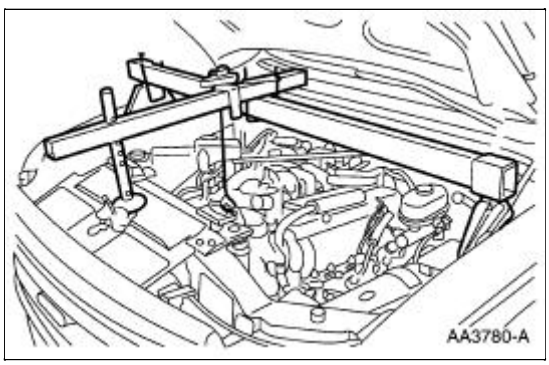
3. Install the heat shield and bolts.



4. Lower the vehicle.

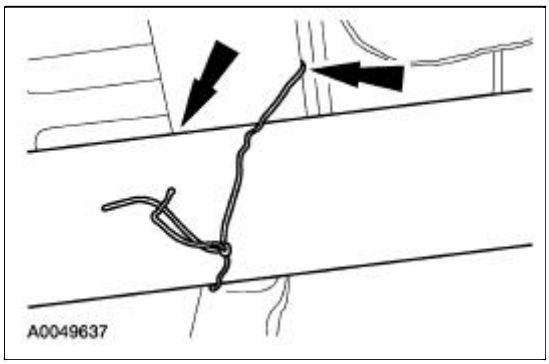
5. **NOTE:** Make sure the engine mounts align with, and settle into, the frame brackets as the engine is lowered.

   Lower the engine and remove the special tool.

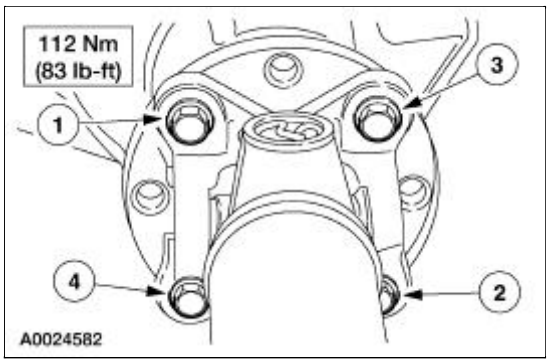


6. Raise and support the vehicle. For additional information, refer to Section 100-02 .

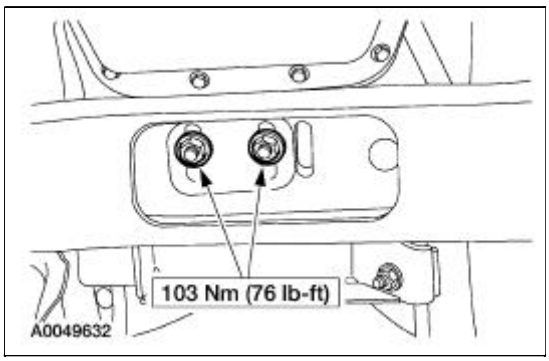
7. Remove the driveshaft support wire.



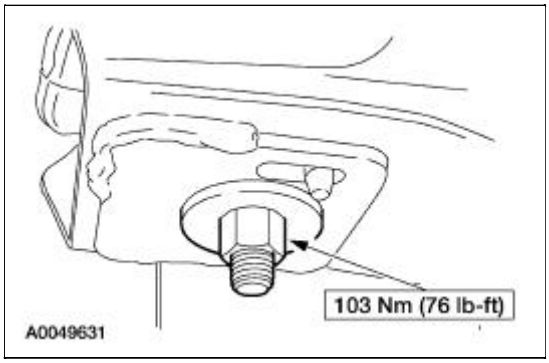
8. Align the index marks and install the driveshaft flange yoke to the pinion flange. Tighten the bolts in the sequence shown.



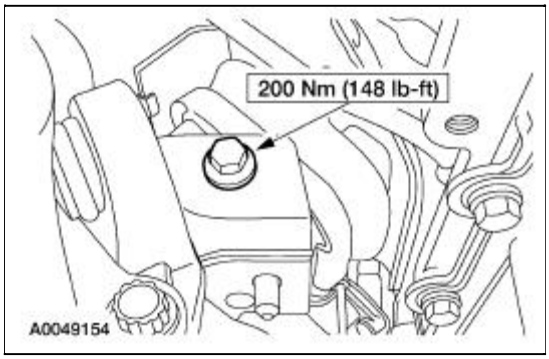
9. Tighten the rear transmission mount nuts.



10. Install the RH engine mount nut.



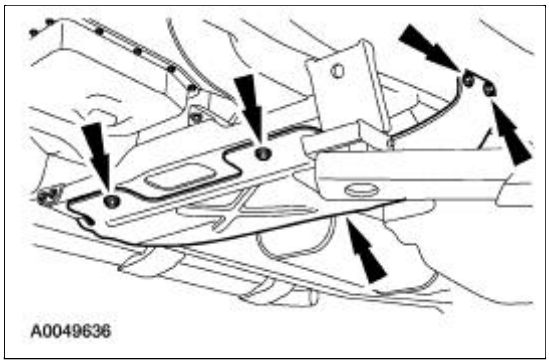
11. Install the LH engine mount bolt.



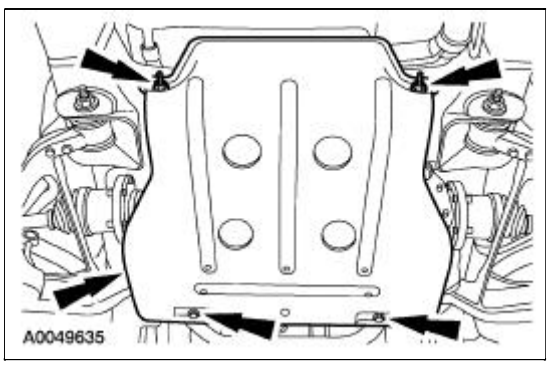
12. Install the dual converter Y-pipe. For additional information, refer to Section 309-00 .

4x4 vehicles

13. Position the transmission skid shield and install the six bolts.

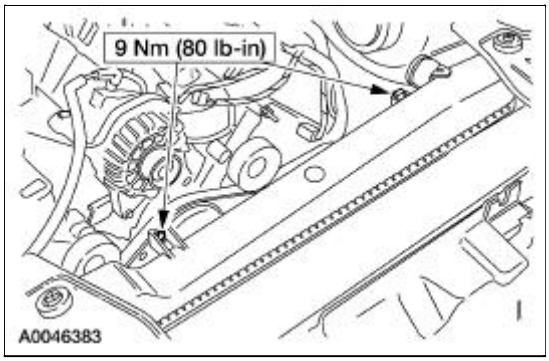


14. Position the engine skid shield and install the fasteners.

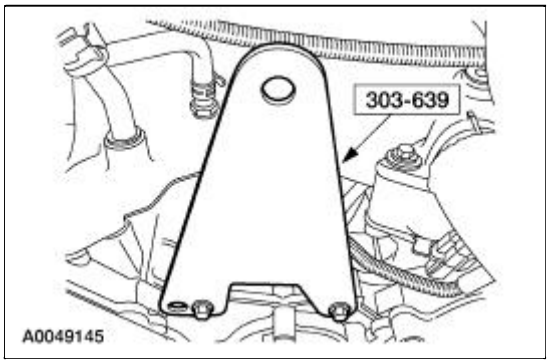


All vehicles

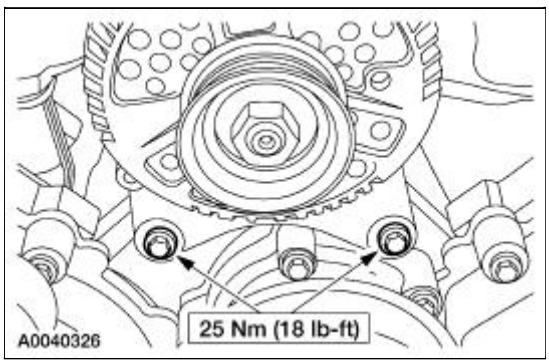
15. Install the front fender splash shield.
16. Install the LH front wheel and tire. For additional information, refer to Section 204-04 .
17. Position the fan shroud and install the mounting bolts.



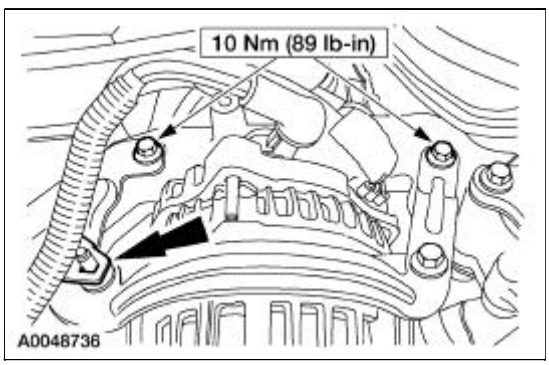
18. Remove the special tool.



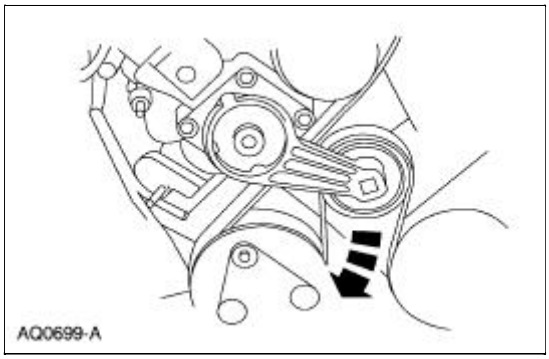
19. Position the generator and install the lower mounting bolts.



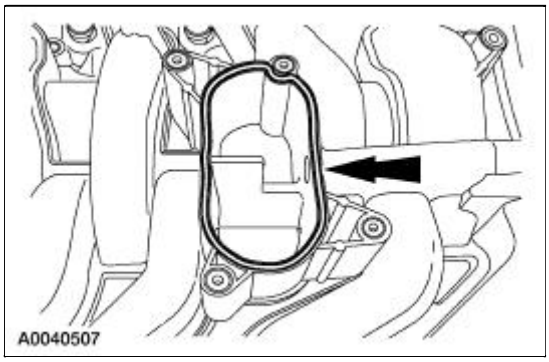
20. Install the generator upper mounting bracket bolts and harness routing clip.



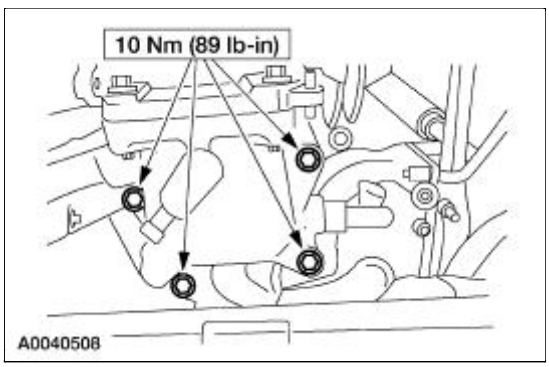
21. Rotate the belt tensioner clockwise and install the drive belt. Refer to the decal on the radiator upper air deflector for belt routing.



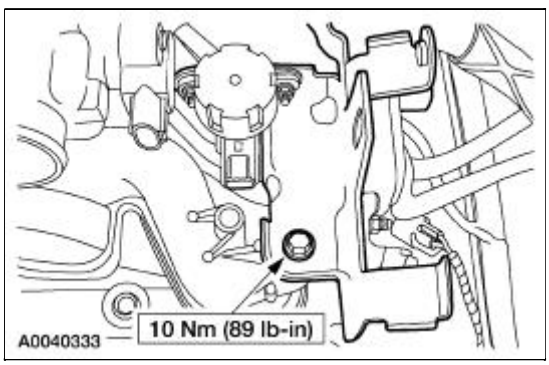
22. Install a new intake manifold-to-throttle body adapter gasket.



23. Install the throttle body adapter and the four bolts.

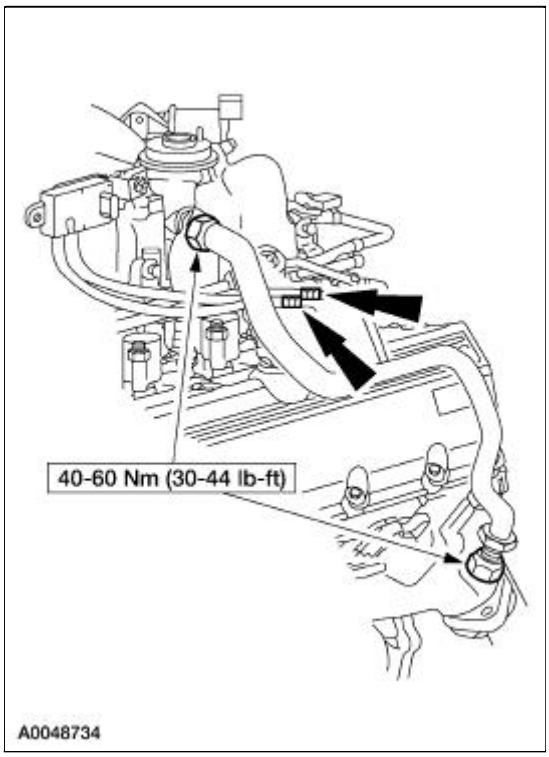


24. Install the differential pressure feedback EGR system bracket bolt.

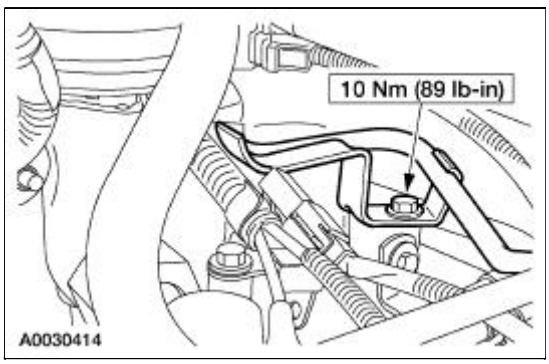


25. Install the exhaust manifold to EGR valve tube.
    - Position the tube and hand-tighten the fittings.
    - Tighten the upper fitting.

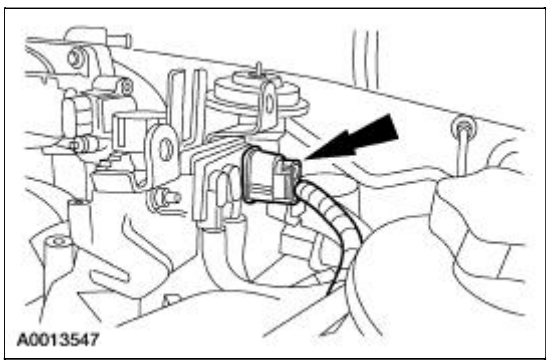
- Tighten the lower fitting.
- Connect the two differential pressure feedback EGR system hoses.



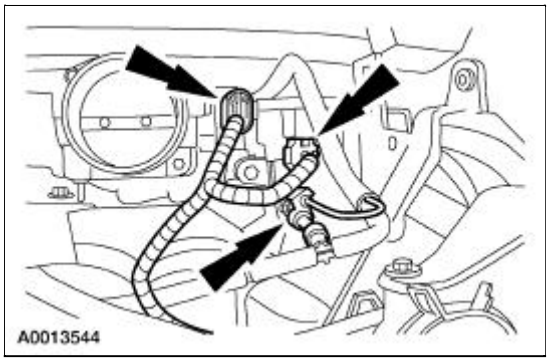
26. Connect the brake booster vacuum tube and position the bracket. Install the bolt.



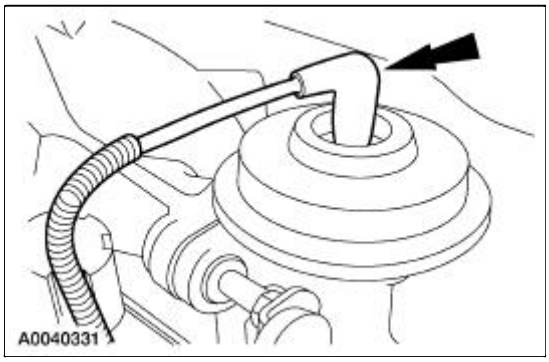
27. Connect the differential pressure feedback EGR system electrical connector.



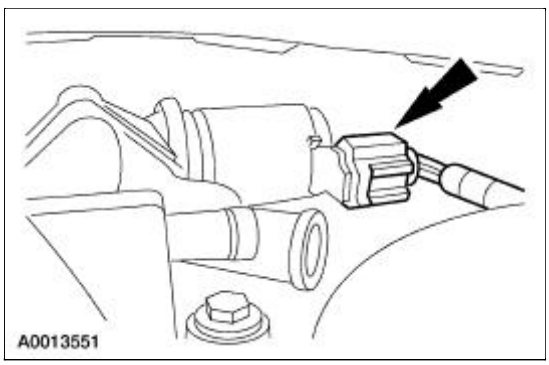
28. Connect the TP sensor electrical connector, and the EGR vacuum regulator solenoid electrical and vacuum connectors.



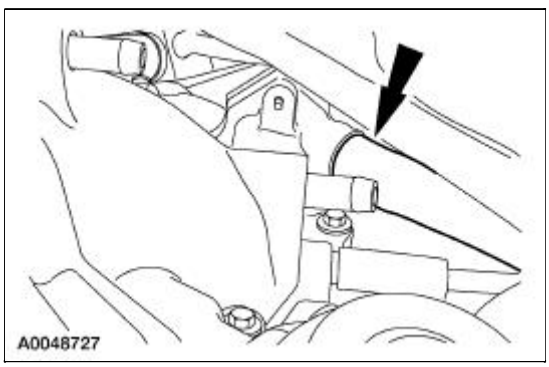
29. Connect the EGR valve vacuum hose.



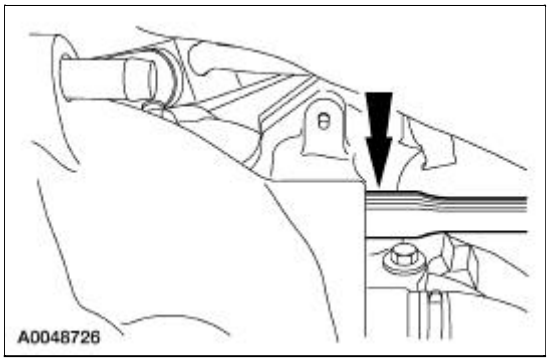
30. Connect the IAC electrical connector.



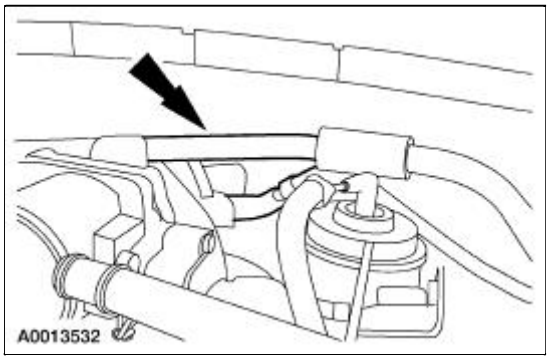
31. Install the IAC fresh air tube.



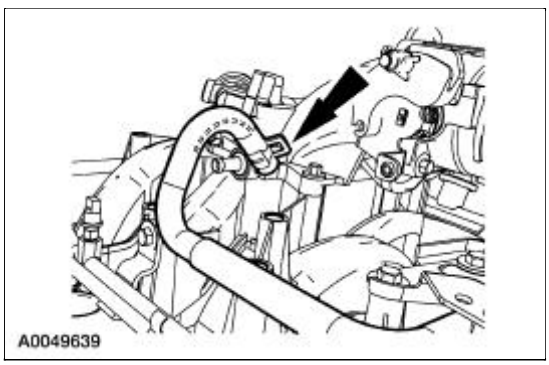
32. Connect the main vacuum harness.



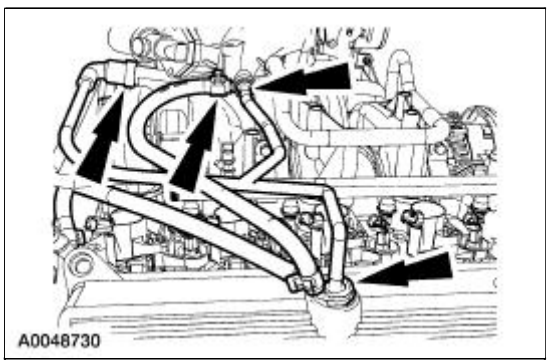
33. Connect the evaporative emission canister purge valve hose.



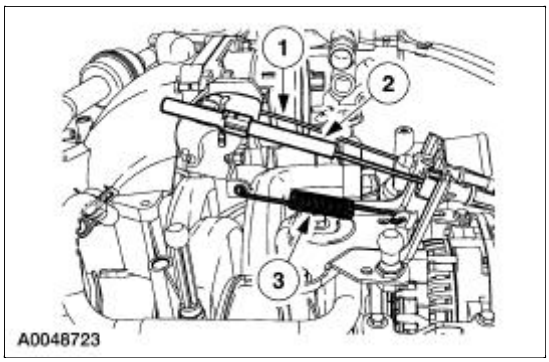
34. Connect the heated throttle body inlet hose to the throttle body adapter.



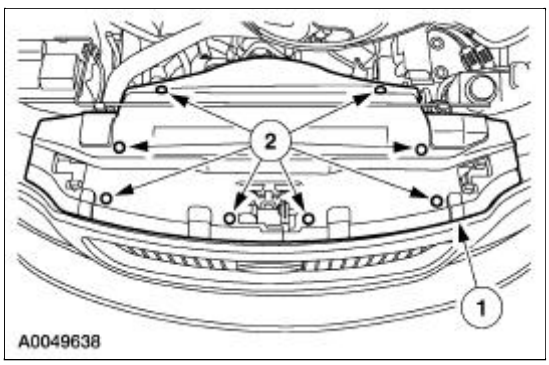
35. Install the heated PCV hose harness.
    - Install the PCV valve.
    - Connect the PCV hose to the intake manifold.
    - Connect the heated throttle body outlet hose.
    - Connect the PCV hose to the throttle body adapter.



36. Connect the throttle body cam.
    1. Connect the accelerator cable.
    2. Connect the speed control actuator cable.
    3. Install the throttle return spring.



37. Install the upper air deflector.
    1. Position the upper air deflector.
    2. Install the pin-type retainers.



38. Install the air cleaner outlet pipe. For additional information, refer to Section 303-12 .

39. Connect the battery ground cable. For additional information, refer to Section 414-01 .

40. Fill and bleed the engine cooling system. For additional information, refer to Section 303-03 .

41. If equipped, turn on the air suspension switch.

Oil Filter Adapter —4x2

Material

Item	Specification
SAE 5W-20 Premium Synthetic Blend Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal and Installation

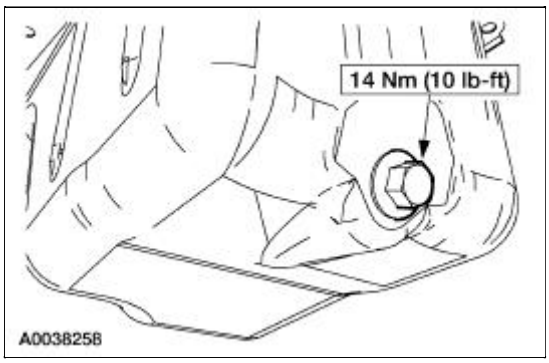
1. **CAUTION: The air suspension switch must be turned off prior to raising the vehicle. Failure to do so can result in unexpected inflation or deflation of the air springs, which could result in shifting of the vehicle during the repair operation.**

   If equipped, turn the air suspension switch off.

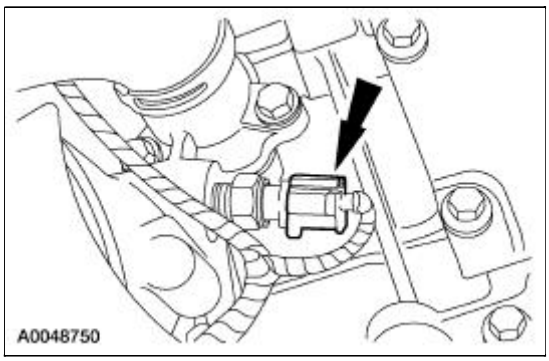
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .

3. Drain the engine cooling system. For additional information, refer to Section 303-03 .

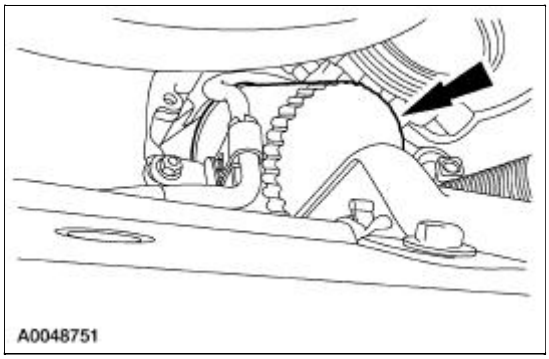
4. Remove the drain plug and drain the engine oil.



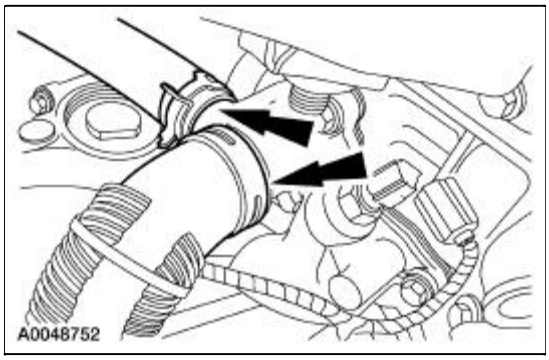
5. Disconnect the oil pressure switch electrical connector.



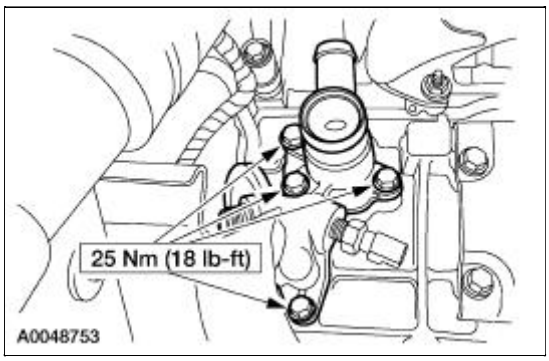
6. Remove the oil filter.



7. Disconnect the lower radiator hose and the degas bottle hose from the oil filter adapter.



8. Remove the bolts and the oil filter adapter, and discard the gasket.



9. To install, reverse the removal procedure.

Oil Filter Adapter —4x4

Material

Item	Specification
SAE 5W-20 Premium Synthetic Blend Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

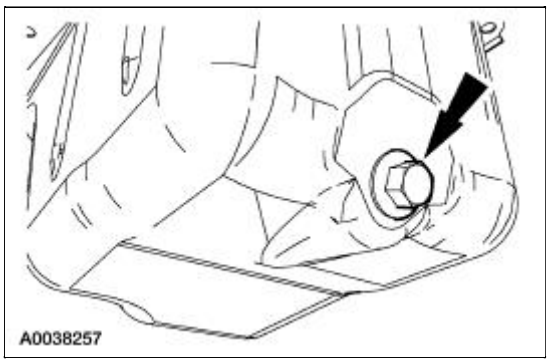
1. **CAUTION: The air suspension switch must be turned off prior to raising the vehicle. Failure to do so can result in unexpected inflation or deflation of the air springs, which could result in shifting of the vehicle during the repair operation.**

   If equipped, turn the air suspension switch off.

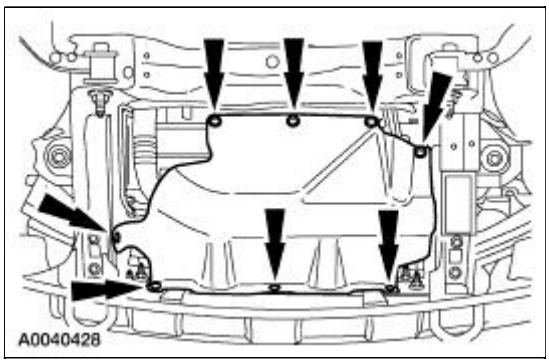
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .

3. Drain the engine cooling system. For additional information, refer to Section 303-03 .

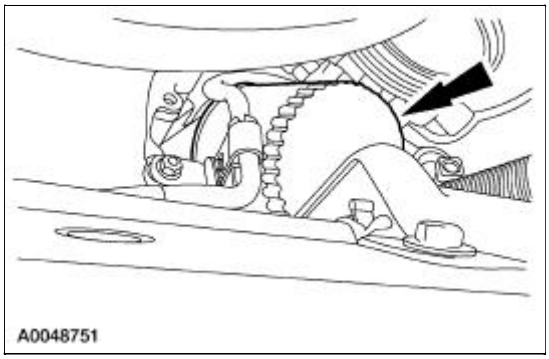
4. Remove the drain plug and drain the engine oil.



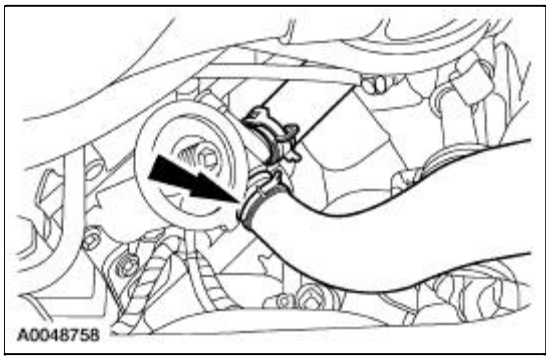
5. Remove the pin-type retainers and the radiator lower air deflector.



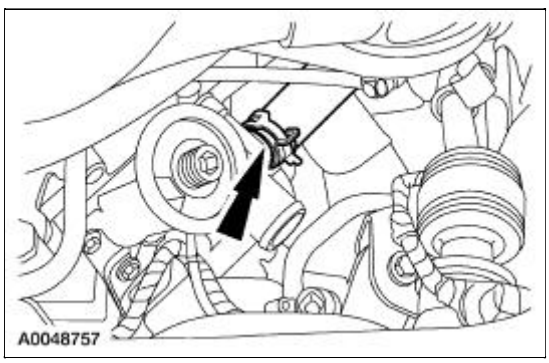
6. Remove the oil filter.



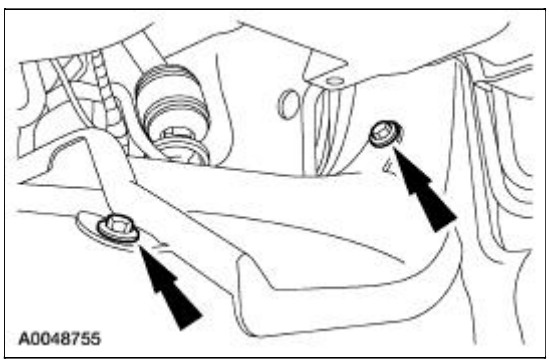
7. Disconnect the lower radiator hose from the oil filter adapter.



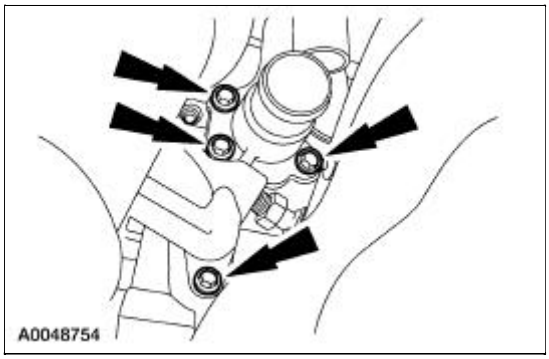
8. Disconnect the degas bottle hose from the oil filter adapter.



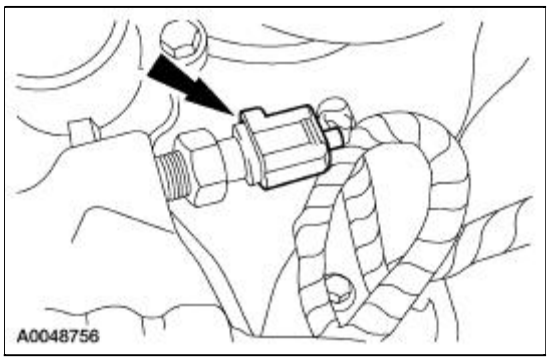
9. Remove the bolts and the oil filter drip shield.



10. Remove the four bolts and lower the oil filter adapter slightly.



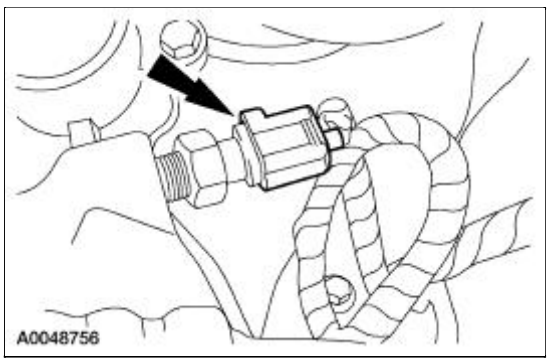
11. Disconnect the oil pressure switch electrical connector and remove the oil filter adapter.
    - Discard the oil filter adapter gasket.



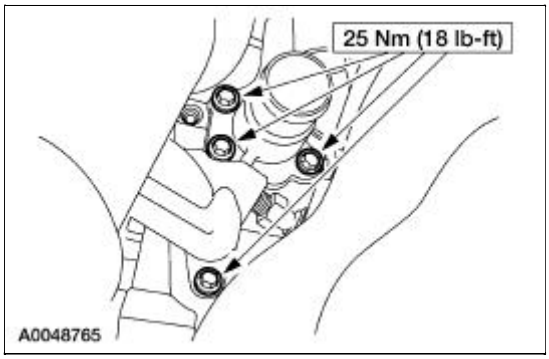
Installation

1. Clean and inspect the cylinder block and oil filter adapter mating surfaces.

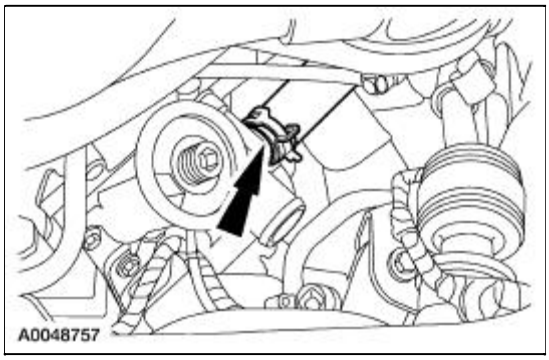
2. Roughly position the oil filter adapter in the vehicle and connect the oil pressure switch electrical connector.



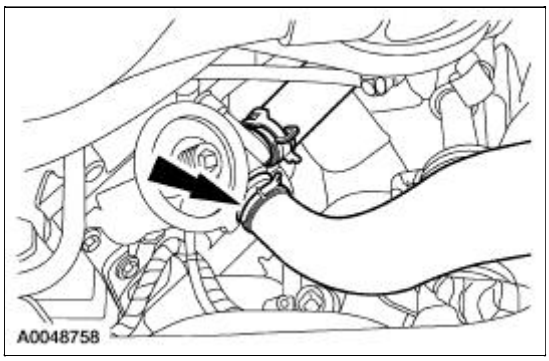
3. Position a new oil filter adapter gasket and the oil filter adapter, and install the four bolts.



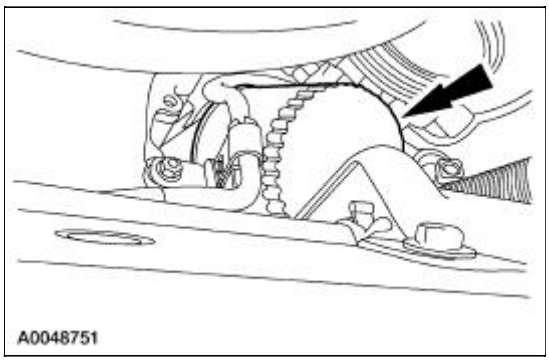
4. Install the degas bottle hose on the oil filter adapter.



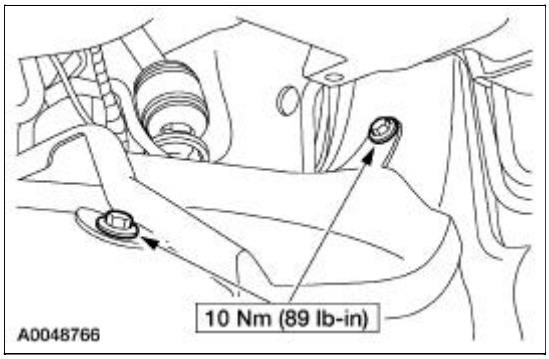
5. Install the lower radiator hose on the oil filter adapter.



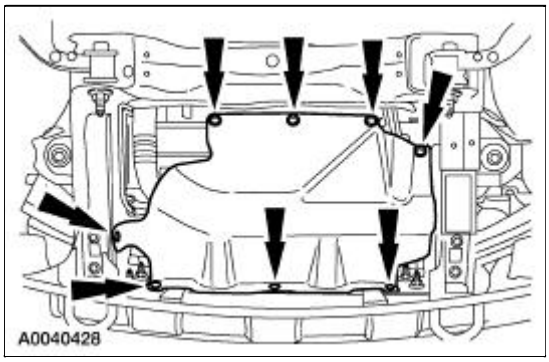
6. Lubricate the seal with clean engine oil and install a new oil filter.



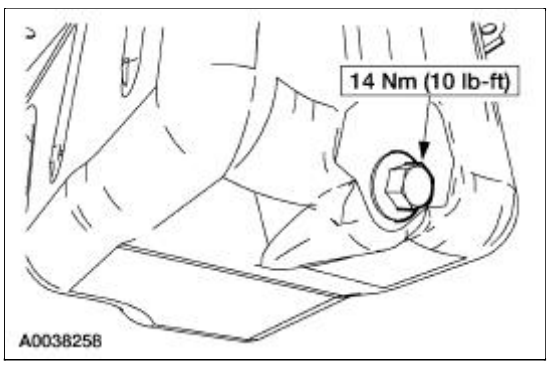
7. Install the oil filter drip shield.



8. Position the radiator lower air deflector and install the pin-type retainers.



9. Install the drain plug.



10. Lower the vehicle.
11. Fill the engine with clean engine oil.
12. Fill the engine cooling system. For additional information, refer to Section 303-03 .
13. Start the engine and inspect for leaks.
14. If equipped, turn on the air suspension switch.

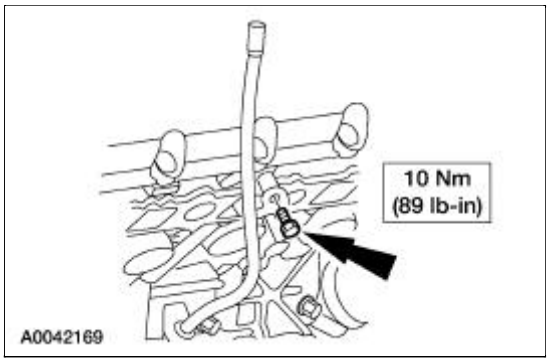
Oil Level Indicator and Tube

Material

Item	Specification
SAE 5W-20 Premium Synthetic Blend Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal and Installation

1. Remove LH exhaust manifold. For additional information, refer to Exhaust Manifold LH—4.6L in this section.
2. Remove the oil level indicator.
3. Remove the bolt.

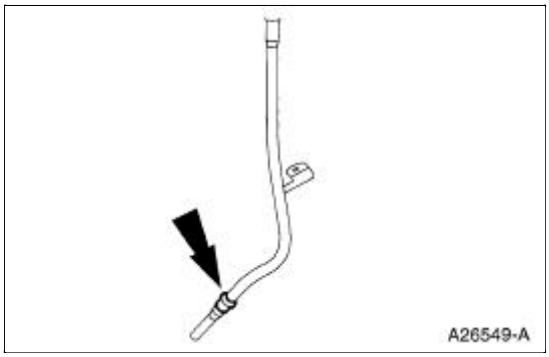


4. Remove the oil level indicator tube.



5. **NOTE:** Lubricate the new O-ring seal with clean engine oil.

   Install a new O-ring seal.



6. To install, reverse the removal procedure.

Oil Pan —4x2

Material

Item	Specification
Motorcraft Silicone Gasket Remover ZC-30	—
Motorcraft Metal Surface Prep ZC-31	—
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
SAE 5W-20 Premium Synthetic Blend Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

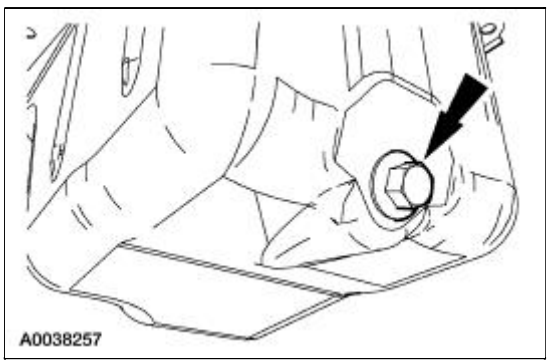
Removal

1. **CAUTION: The air suspension switch must be turned off prior to raising the vehicle. Failure to do so can result in unexpected inflation or deflation of the air springs, which could result in shifting of the vehicle during the repair operation.**

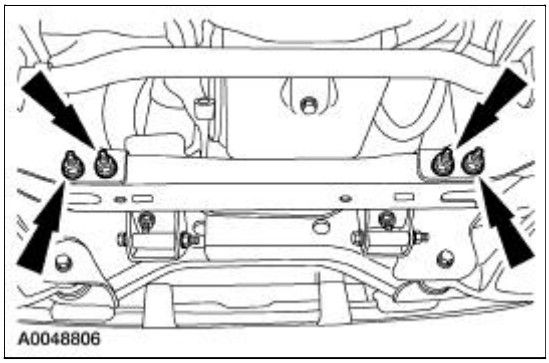
   If equipped, turn the air suspension switch off.

2. Raise the vehicle on the hoist. For additional information, refer to Section 100-02 .

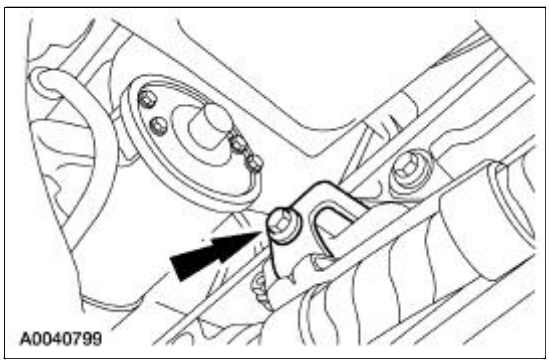
3. Drain the engine oil.



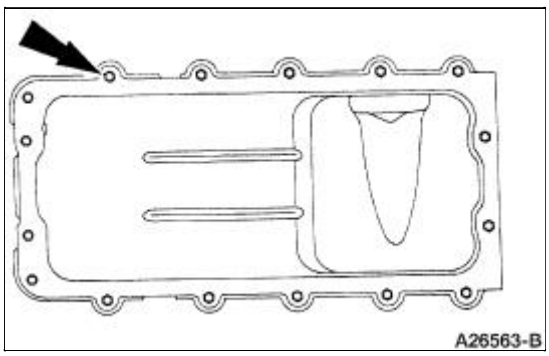
4. Remove the bolts and the frame crossmember.



5. Remove the bolt and detach the wire harness bracket.



6. Remove the bolts and the oil pan.



7. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs, or other abrasive means to clean the sealing surfaces. These may cause scratches and gouges resulting in leak paths. Use a plastic scraper to clean the sealing surfaces.**

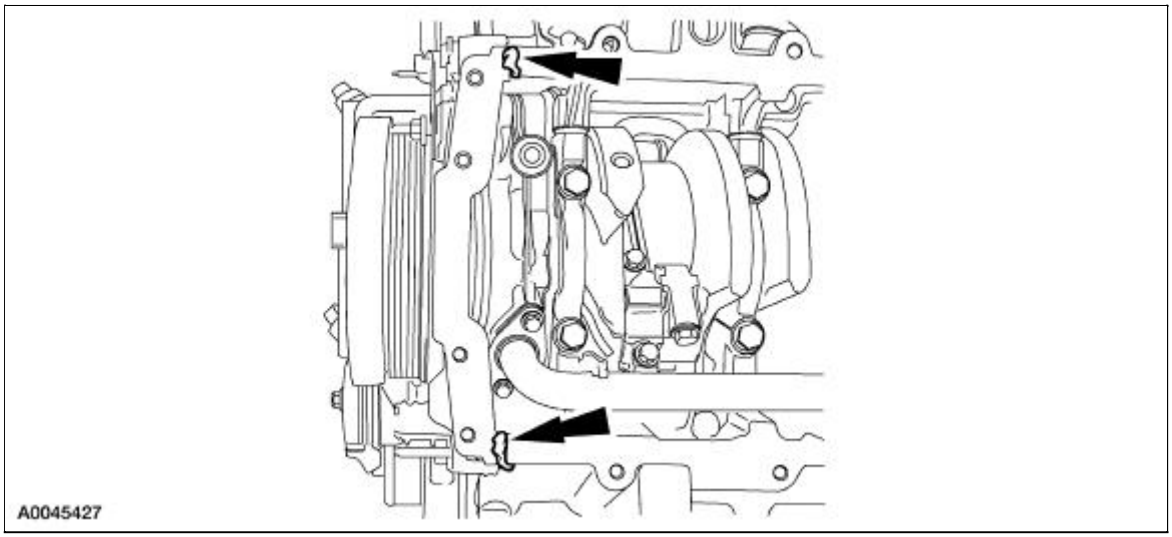
   Remove and discard the oil pan gasket. Clean the sealing surfaces.

   - Clean the sealing surfaces with silicone gasket remover and metal surface prep. Follow the directions on the packaging.

Installation

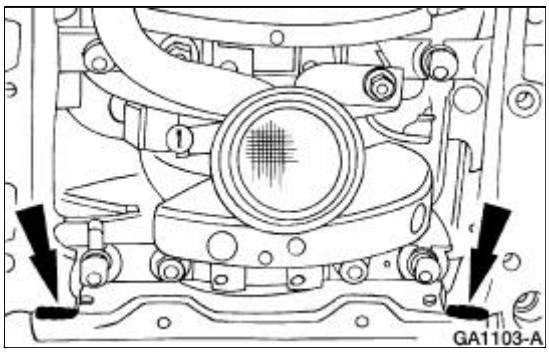
1. **NOTE:** If not secured within four minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

   Apply silicone gasket and sealant at the engine front cover to cylinder block mating surface.

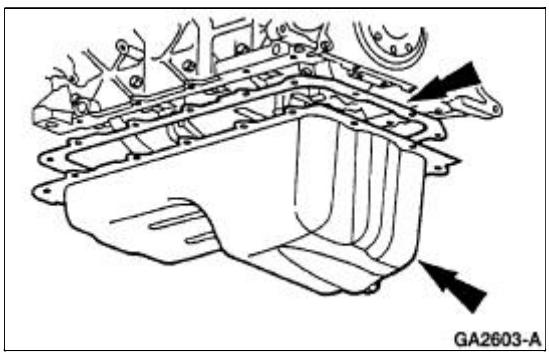


2. **NOTE:** If not secured within four minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

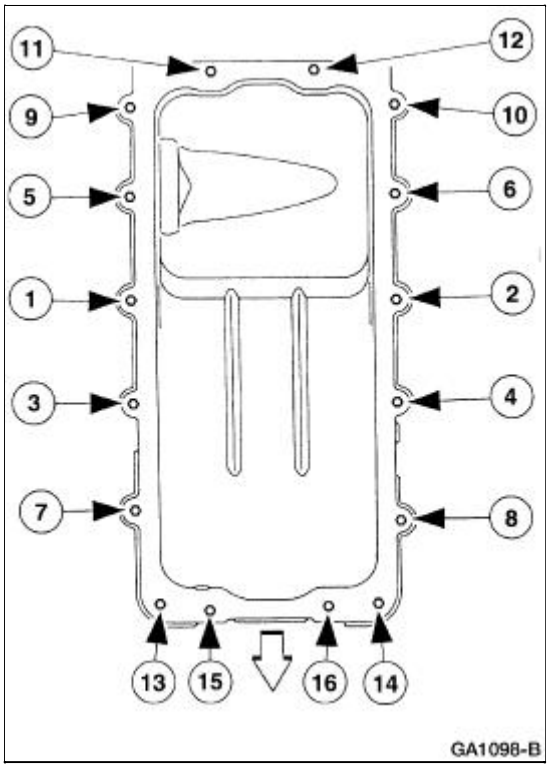
   Apply silicone gasket and sealant at the rear oil seal retainer to cylinder block sealing surface.



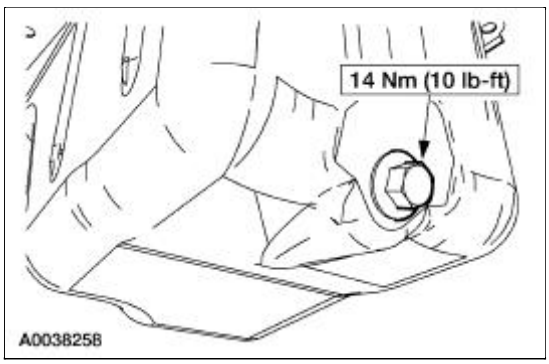
3. Position the new oil pan gasket and the oil pan, and loosely install the bolts.



4. Tighten the bolts in three stages, in the sequence shown.
   - Stage 1: tighten to 2 Nm (18 lb-in).
   - Stage 2: tighten to 20 Nm (15 lb-ft).
   - Stage 3: tighten an additional 60 degrees.

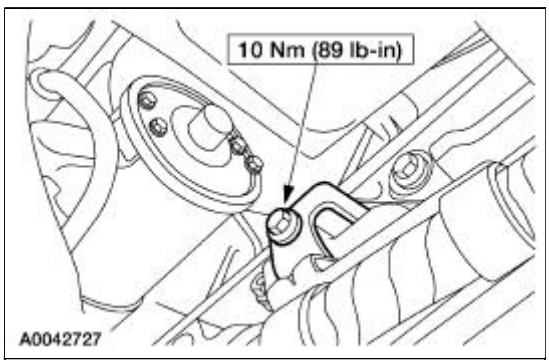


5. Install the drain plug.

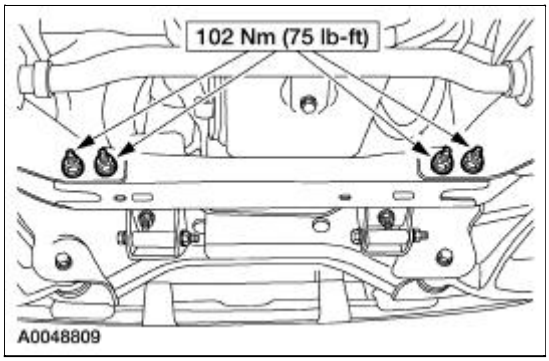


6. Install a new oil filter.

7. Position the wire harness bracket and install the bolt.



8. Position the frame crossmember and install the bolts.



9. Lower the vehicle.
10. Fill the engine with clean engine oil.
11. Start the engine and inspect for leaks.
12. If equipped, turn on the air suspension switch.

Oil Pan —4x4

Material

Item	Specification
Motorcraft Silicone Gasket Remover ZC-30	—
Motorcraft Metal Surface Prep ZC-31	—
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
SAE 5W-20 Premium Synthetic Blend Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

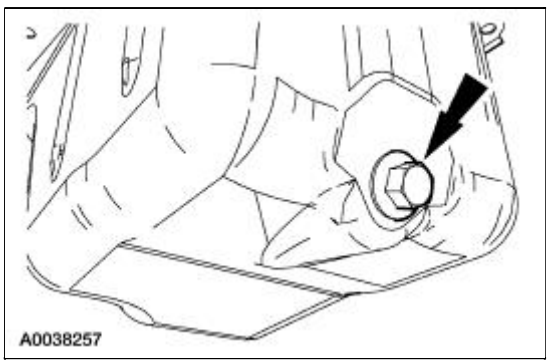
Removal

1. **CAUTION: The air suspension switch must be turned off prior to raising the vehicle. Failure to do so can result in unexpected inflation or deflation of the air springs, which could result in shifting of the vehicle during the repair operation.**

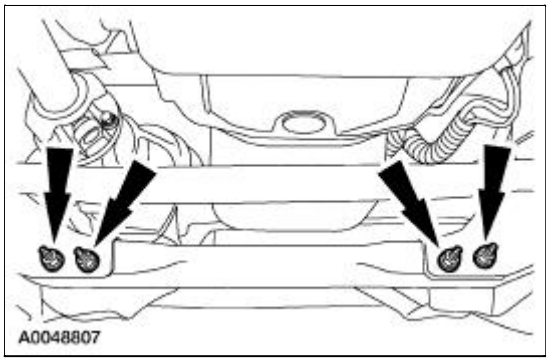
   If equipped, turn the air suspension switch off.

2. Raise the vehicle on the hoist. For additional information, refer to Section 100-02 .

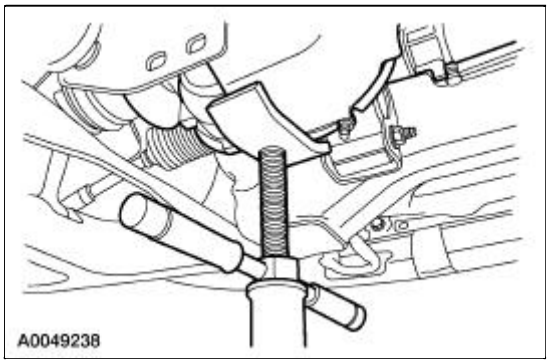
3. Drain the engine oil.



4. Remove the bolts and the frame crossmember.

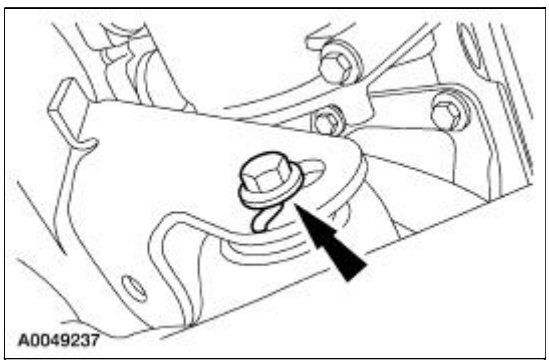


5. Support the front axle housing with a jack stand.



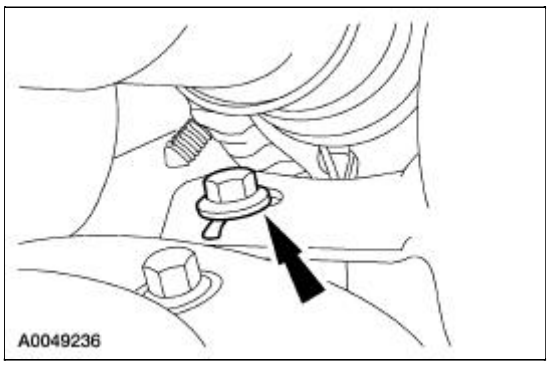
6. **NOTE:** Mark the bolt and bracket so that alignment can be maintained on installation.

   Remove the front axle housing RH mounting bolt.



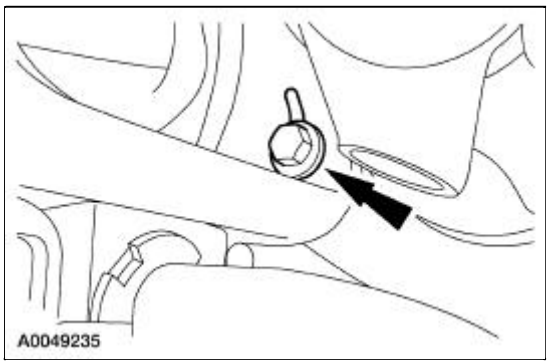
7. **NOTE:** Mark the bolt and bracket so that alignment can be maintained on installation.

   Remove the front axle housing LH front mounting bolt.



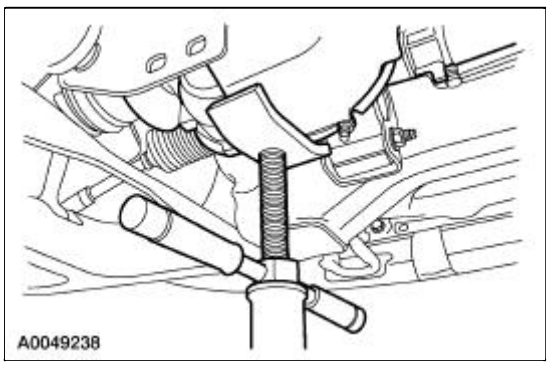
8. **NOTE:** Mark the bolt and bracket so that alignment can be maintained on installation.

   Remove the front axle housing LH rear mounting bolt.

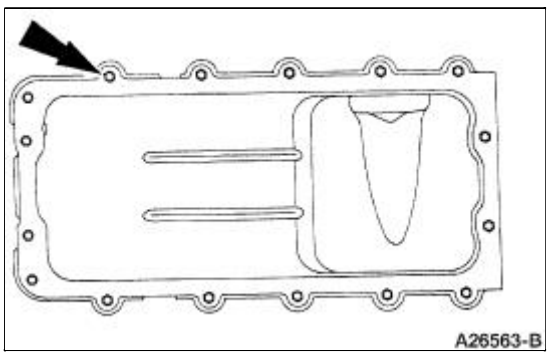


9. **CAUTION: Use care when lowering the front axle housing, or the vacuum lines to the axle solenoid may become disconnected or damaged.**

   Lower the axle to allow clearance for the oil pan to be removed.



10. Remove the bolts and the oil pan.



11. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs, or other abrasive means to clean the sealing surfaces. These may cause scratches and gouges resulting in leak paths. Use a plastic scraper to clean the sealing surfaces.**

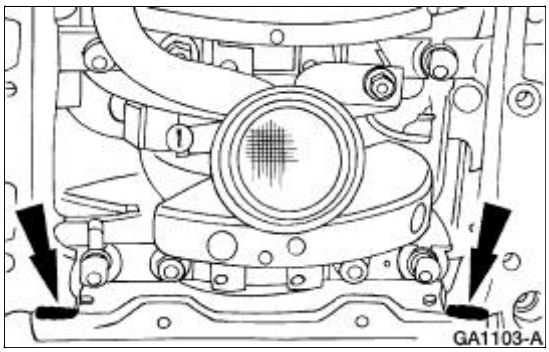
    Remove and discard the oil pan gasket. Clean the sealing surfaces.

    - Clean the sealing surfaces with silicone gasket remover and metal surface prep. Follow the directions on the packaging.

Installation

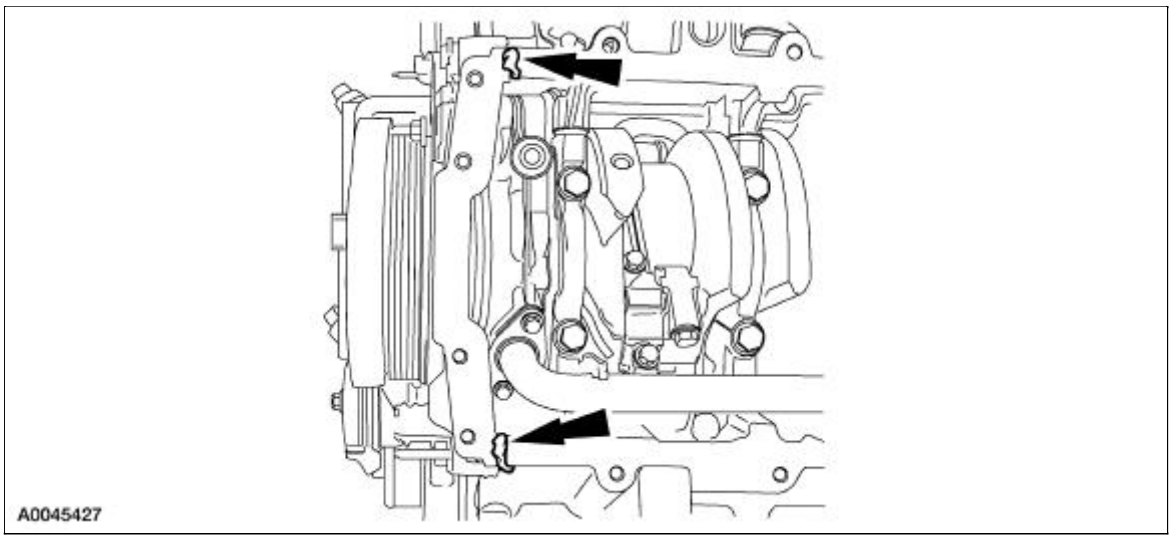
1. **NOTE:** If not secured within four minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

   Apply silicone gasket and sealant at the rear oil seal retainer to cylinder block sealing surface.

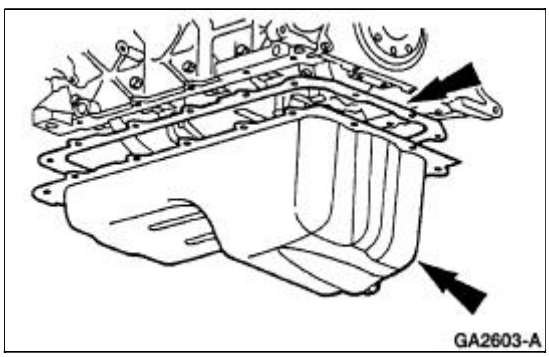


2. **NOTE:** If not secured within four minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

   Apply silicone gasket and sealant at the engine front cover to cylinder block mating surface.

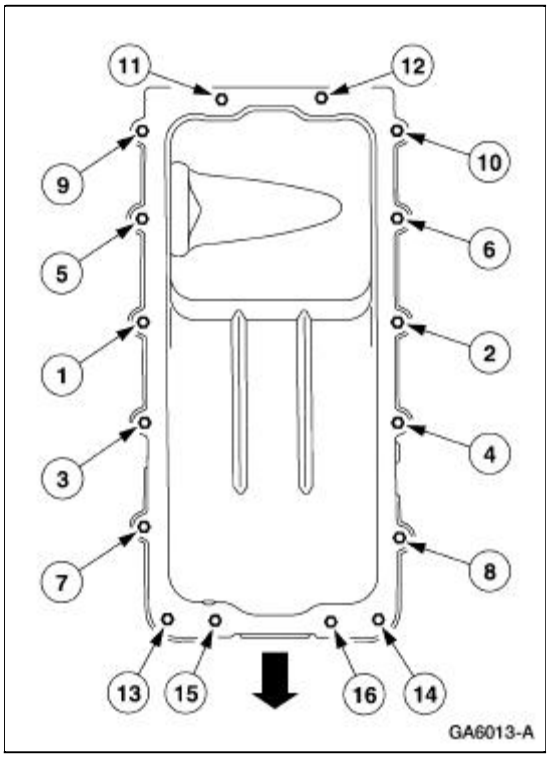


3. Position the new oil pan gasket and the oil pan and loosely install the bolts.

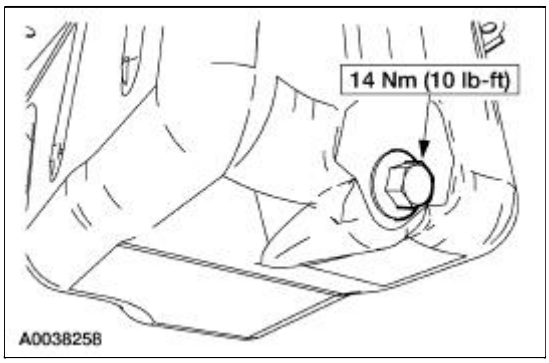


4. Tighten the bolts in three stages in the sequence shown.
   - Stage 1: tighten to 2 Nm (18 lb-in).
   - Stage 2: tighten to 20 Nm (15 lb-ft).

- Stage 3: tighten an additional 60 degrees.



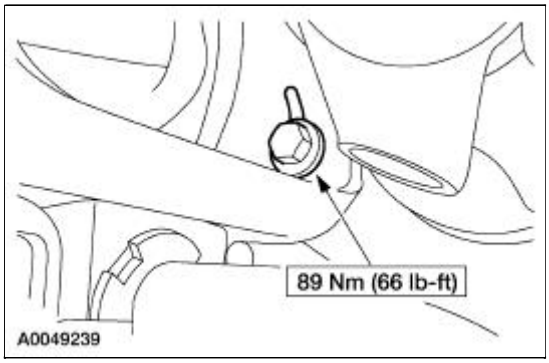
5. Install the drain plug.



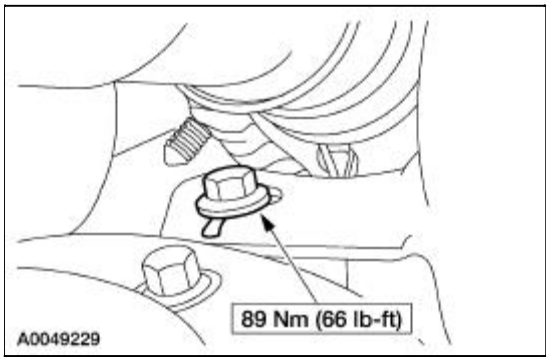
6. Install a new oil filter.

7. Position the front axle housing and loosely install the three bolts, aligning the bolt location marks made during removal.

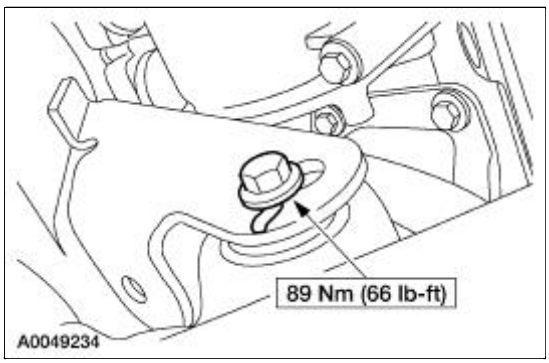
8. Tighten the front axle housing LH rear mounting bolt.



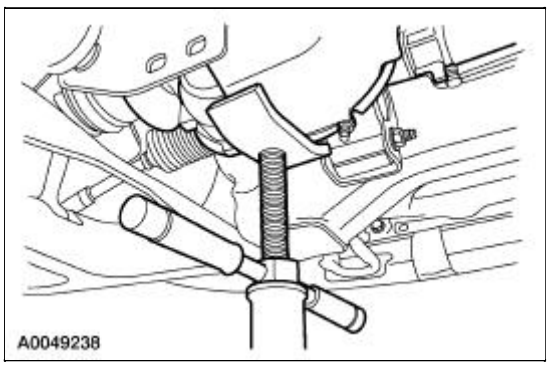
9. Tighten the front axle housing LH front mounting bolt.



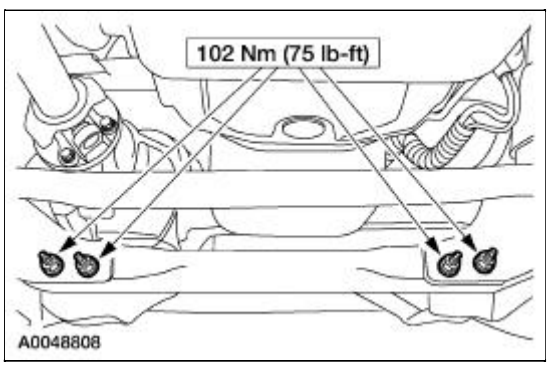
10. Tighten the front axle housing RH mounting bolt.



11. Remove the jack stand.



12. Position the frame crossmember and install the bolts.



13. Lower the vehicle.

14. Fill the engine with clean engine oil.
15. Start the engine and inspect for leaks.
16. If equipped, turn on the air suspension switch.

Oil Pump

Material

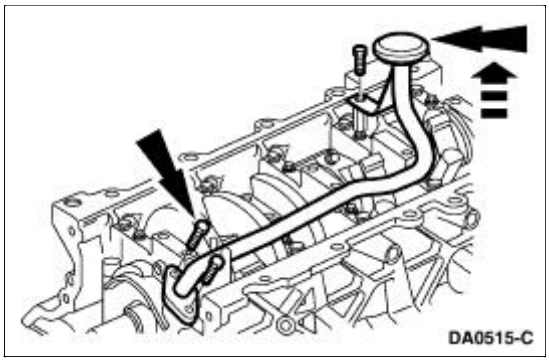
Item	Specification
SAE 5W-20 Premium Synthetic Blend Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

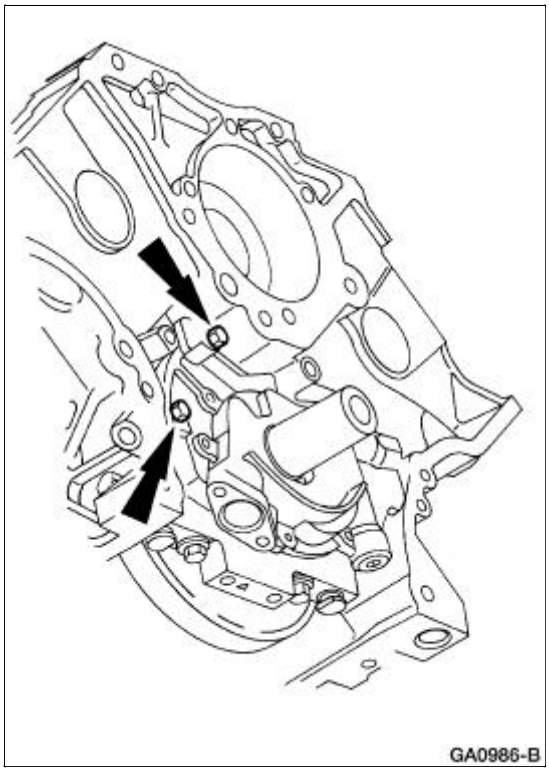
1. Remove the timing chains. For additional information, refer to Timing Drive Components—Windsor Engine (5.4L) or Timing Drive Components—Romeo Engine (4.6L) in this section.

2. Remove the oil pan. For additional information, refer to Oil Pan—4x2 or Oil Pan—4x4 in this section.

3. Remove the three bolts and the oil pump screen and pickup tube.



4. Remove the oil pump.
   - Remove the three bolts.
   - Remove the oil pump.

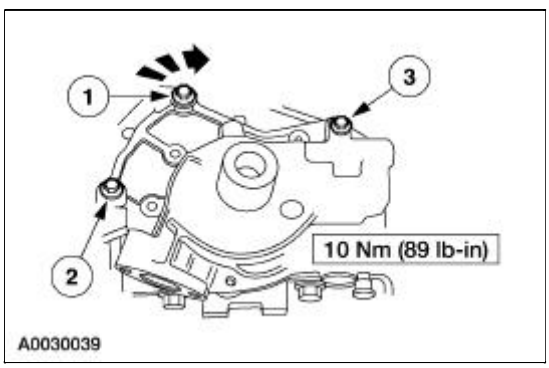


Installation

1. **NOTE:** Lubricate the new O-ring seal with clean engine oil.

   Clean and inspect the mating surfaces and install a new O-ring seal.

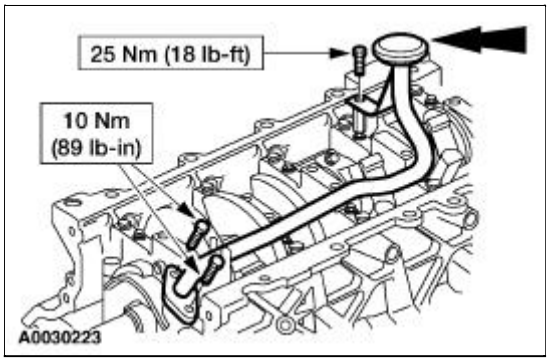
2. Install the oil pump and loosely install the bolts.
   - Position the oil pump.
   - Loosely install the bolts.
   - Tighten the bolts in the sequence shown.



3. **CAUTION: Make sure the O-ring is in place and not damaged. A missing or damaged O-ring can cause foam in the lubrication system, low oil pressure and severe engine damage.**

   NOTE: Install a new O-ring and lubricate with clean engine oil.

   Position the oil pump screen and pickup tube and install the bolts.



4. Install the timing chains. For additional information, refer to Timing Drive Components—Windsor Engine (5.4L) or Timing Drive Components—Romeo Engine (4.6L) in this section.

5. **CAUTION: The oil pump must be primed prior to starting the engine.**

   Install the oil pan. For additional information, refer to Oil Pan—4x2 or Oil Pan—4x4 in this section.

Oil Pump Screen and Pickup Tube

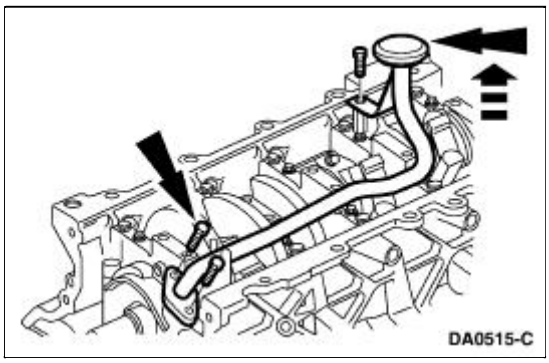
Material

Item	Specification
SAE 5W-20 Premium Synthetic Blend Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

1. Remove the oil pan. For additional information, refer to Oil Pan—4x2 or Oil Pan—4x4 in this section.

2. Remove the three bolts and the oil pump screen and pickup tube.

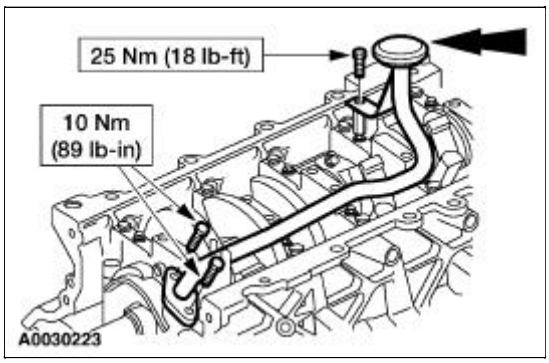


Installation

1. **NOTE:** Lubricate the new O-ring seal with clean engine oil.

   Clean and inspect the mating surfaces and install a new O-ring seal.

2. Install the oil pump screen and pickup tube and install the bolts.



3. **CAUTION: The oil pump must be primed prior to starting the engine.**

   Install the oil pan. For additional information, refer to Oil Pan—4x2 or Oil Pan—4x4 in this

section.

Flexplate

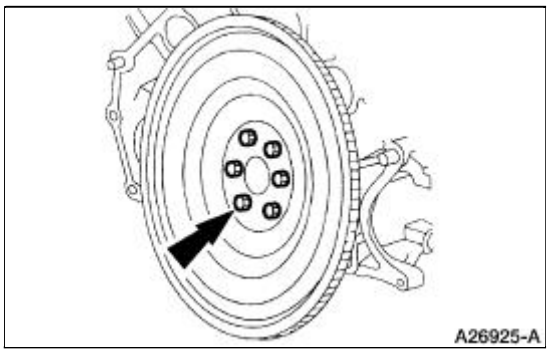
Removal

All vehicles

1. Remove the transmission. For additional information, refer to Section 307-01A (4R100) or Section 307-01B (4R70W).

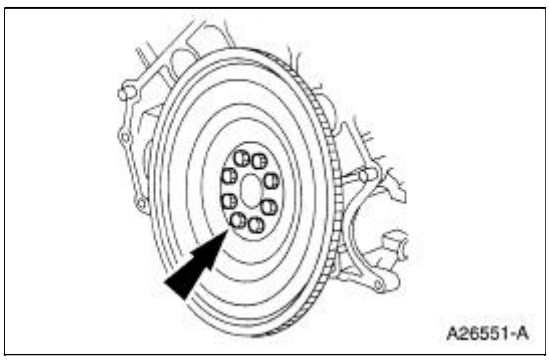
Romeo engine (4.6L)

2. Remove the bolts and the flexplate.



Windsor engine (5.4L)

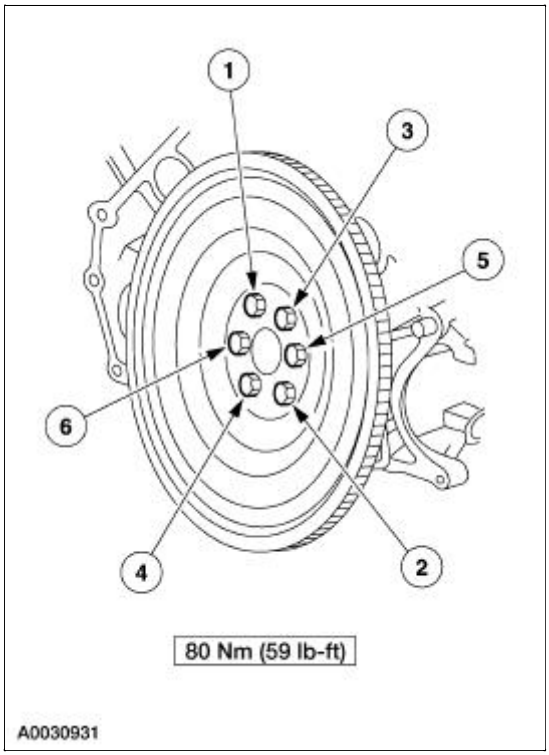
3. Remove the bolts and the flexplate.



Installation

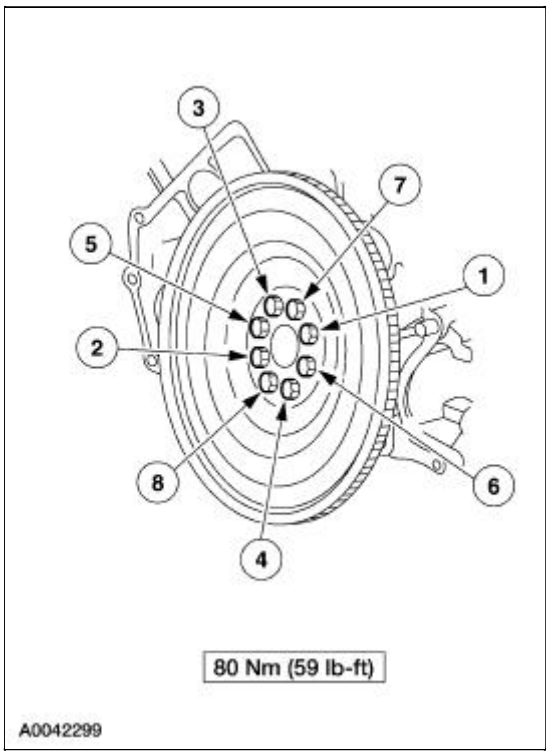
Romeo engine (4.6L)

1. Position the flexplate and install the bolts.
   Tighten the bolts in two stages:
   - Stage 1: loosely install the bolts.
   - Stage 2: tighten the bolts in sequence shown.



Windsor engine (5.4L)

2. Position the flexplate and install the bolts.
   Tighten the bolts in two stages:
   - Stage 1: loosely install the bolts.
   - Stage 2: tighten the bolts in sequence shown.

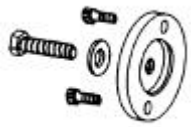
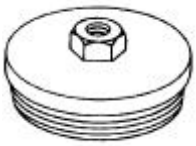
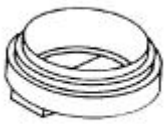


All vehicles

3. Install the transmission. For additional information, refer to Section 307-01A (4R100) or Section 307-01B (4R70W).

Crankshaft Rear Oil Seal

Special Tool(s)

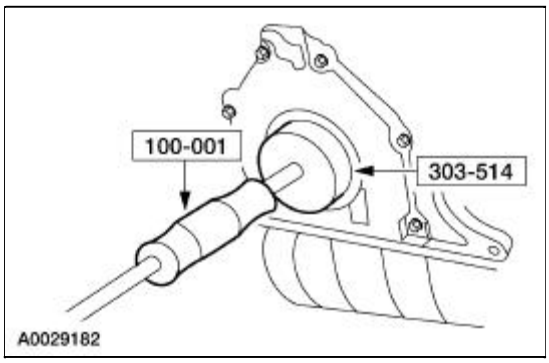
 ST1480-A	Installer, Crankshaft Rear Oil Seal 303-518 (T95P-6701-DH)
 ST1382-A	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)
 ST1479-A	Installer, Crankshaft Rear Oil Seal 303-516 (T95P-6701-BH)
 ST1481-A	Remover, Crankshaft Rear Oil Slinger 303-514 (T95P-6701-AH)
 ST1482-A	Installer, Crankshaft Rear Oil Slinger 303-517 (T95P-6701-CH)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)

Material

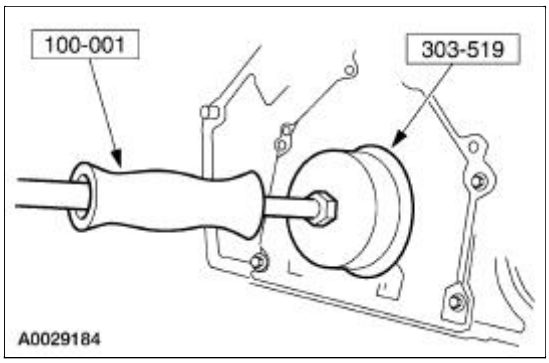
Item	Specification
SAE 5W-20 Premium Synthetic Blend Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

1. Remove the flexplate (6375). For additional information, refer to Flexplate in this section.
2. Use the special tools to remove the crankshaft rear oil seal slinger.



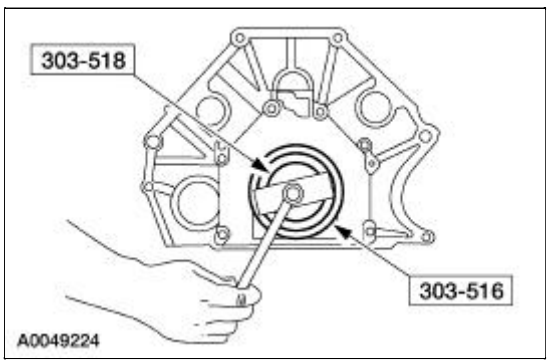
3. Use the special tools to remove the crankshaft rear oil seal.



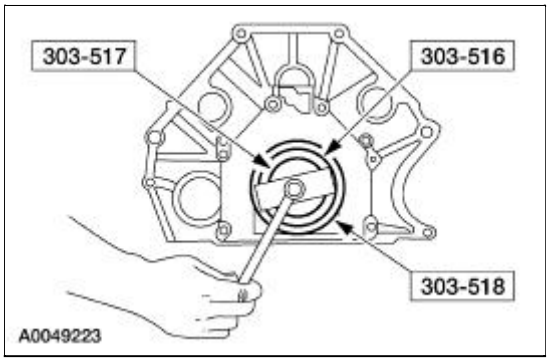
Installation

1. **NOTE:** Lubricate the inner lip of the crankshaft rear seal with clean engine oil.

   Use the special tools to install the rear oil seal.



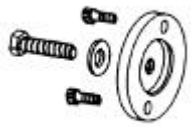
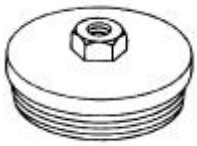
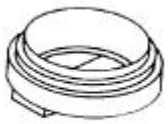
2. Using the special tools, install the crankshaft rear oil slinger.



3. Install the flexplate. For additional information, refer to Flexplate in this section.

Crankshaft Rear Seal with Retainer Plate

Special Tool(s)

 ST1480-A	Installer, Crankshaft Rear Oil Seal 303-518 (T95P-6701-DH)
 ST1382-A	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)
 ST1479-A	Installer, Crankshaft Rear Oil Seal 303-516 (T95P-6701-BH)
 ST1481-A	Remover, Crankshaft Rear Oil Slinger 303-514 (T95P-6701-AH)
 ST1482-A	Installer, Crankshaft Rear Oil Slinger 303-517 (T95P-6701-CH)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)

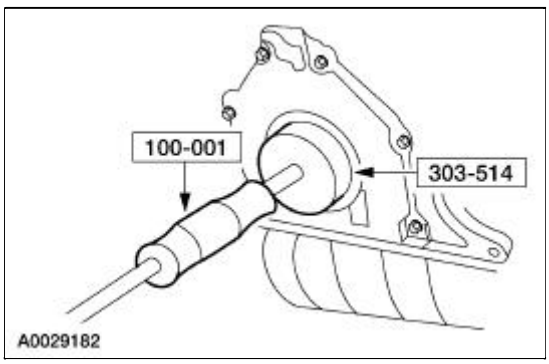
Material

Item	Specification
Motorcraft Silicone Gasket Remover ZC-30	—
Motorcraft Metal Surface Prep	—

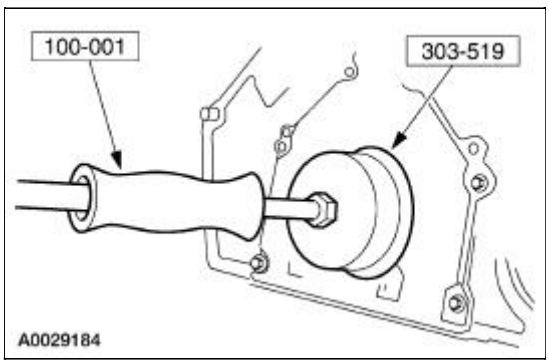
ZC-31	
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
SAE 5W-20 Premium Synthetic Blend Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

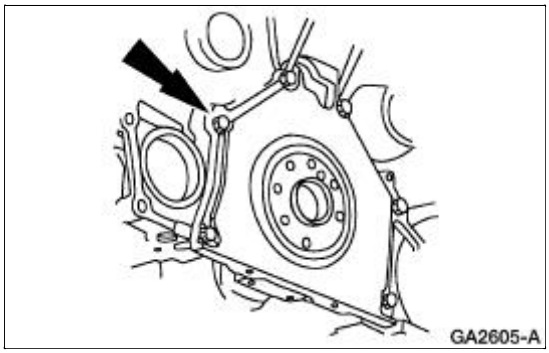
1. Remove the transmission. For additional information, refer to Section 307-01A (4R100) or Section 307-01B (4R70W).
2. Remove the oil pan (6675). For additional information, refer to Oil Pan—4x2 or Oil Pan—4x4 in this section.
3. Remove the flexplate (6375). For additional information, refer to Flexplate in this section.
4. Use the special tools to remove the crankshaft rear oil slinger.



5. Use the special tools to remove the crankshaft rear oil seal.



6. Remove the six bolts and the crankcase rear oil seal retainer.



Installation

1. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

   NOTE: Clean the sealing surfaces with silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

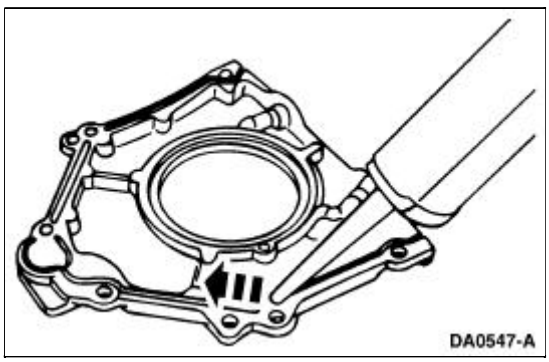
   Clean and inspect the mating surfaces.

2. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

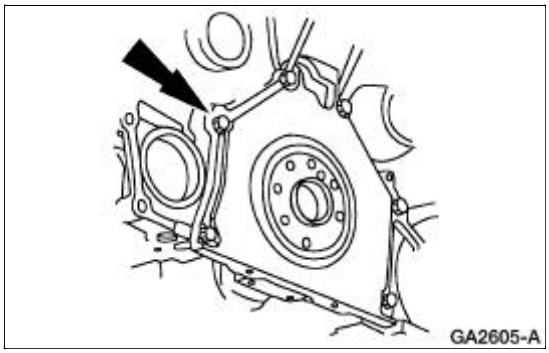
   NOTE: If not secured within four minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

   NOTE: The silicone must be applied on the groove along the retainer plate.

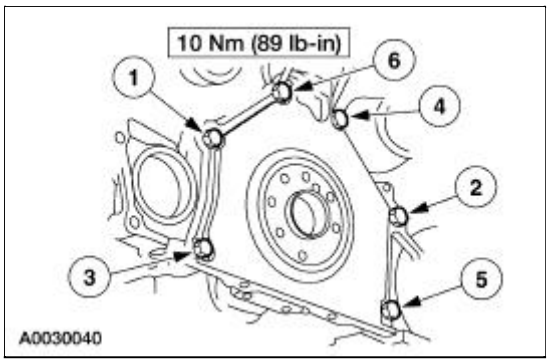
   Apply a 4 mm (0.16 in) bead of silicone gasket and sealant around the rear oil seal retainer sealing surface.



3. Install the rear oil seal retainer and loosely install the six bolts.

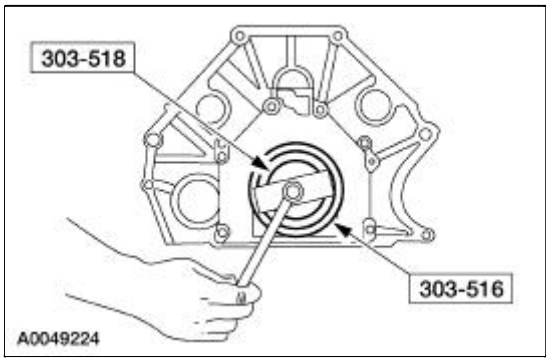


4. Tighten the bolts in the sequence shown.

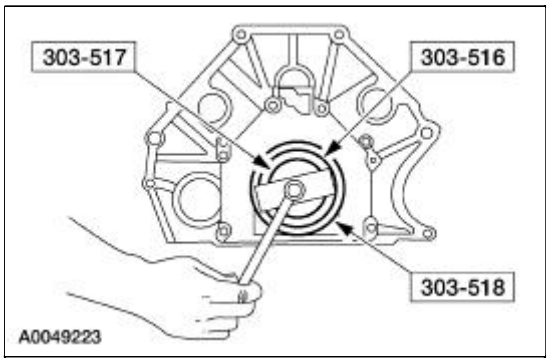


5. **NOTE:** Lubricate the inner lip of the crankshaft rear seal with clean engine oil.

   Use the special tools to install the rear oil seal.



6. Using the special tools, install the crankshaft rear oil slinger.



7. Install the flexplate. For additional information, refer to Flexplate in this section.

8. Install the oil pan. For additional information, refer to Oil Pan—4x2 or Oil Pan—4x4 in this section.

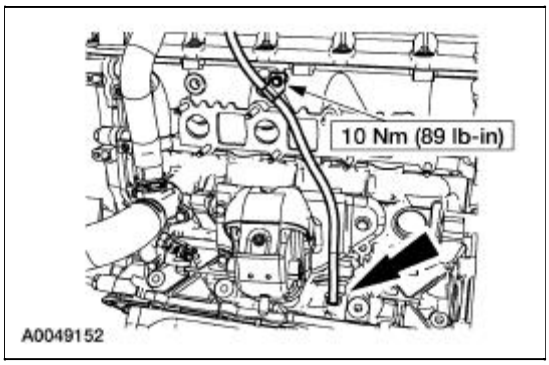
9. Install the transmission. For additional information, refer to Section 307-01A (4R100) or Section 307-01B (4R70W).

Engine Mount LH

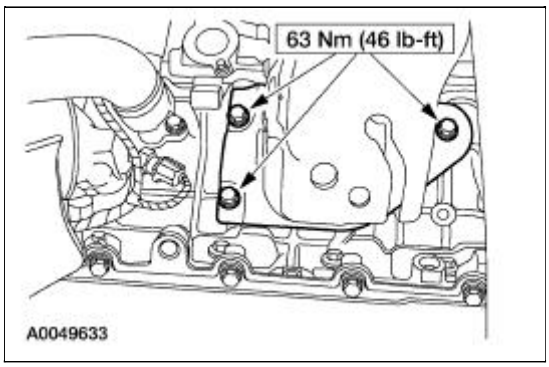
Removal and Installation

1. Remove the exhaust manifold LH. For additional information, refer to Exhaust Manifold LH—4.6L or Exhaust Manifold LH—5.4L in this section.

2. Remove the bolt and the oil level indicator tube.



3. Remove the bolts and remove the engine mount.



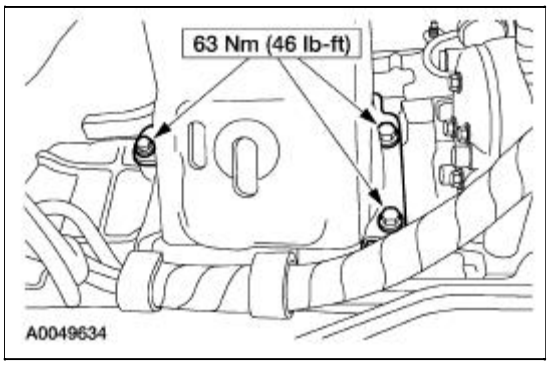
4. To install, reverse the removal procedure.

Engine Mount RH

Removal and Installation

1. Remove the exhaust manifold RH. For additional information, refer to Exhaust Manifold RH—4.6L or Exhaust Manifold RH—5.4L in this section.

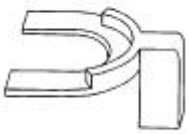
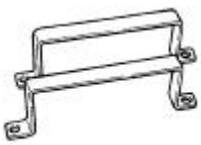
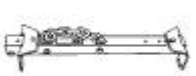
2. Remove the bolts and remove the engine mount.



3. To install, reverse the removal procedure.

Cylinder Heads —5.4L

Special Tool(s)

 ST1330-A	Compressor, Valve Spring 303-567 (T97P-6565-AH)
 ST1331-A	Compressor Spacer, Valve Spring 303-382 (T91P-6565-AH)
 ST1286-A	Remover, Crankshaft Vibration Damper 303-009 (T58P-6316-D)
 ST1730-A	Remover, Crankshaft Front Oil Seal 303-107 (T74P-6700-A)
 ST1668-A	Remover/Installer, Cylinder Head 303-572 (T97T-6000-A)
 ST2443-A	Lifting Bracket Set, Engine 303-DS086 (D93P-6001-A)
 ST1377-A	Modular Engine Lift Bracket 303-F047 (014-00073) or equivalent

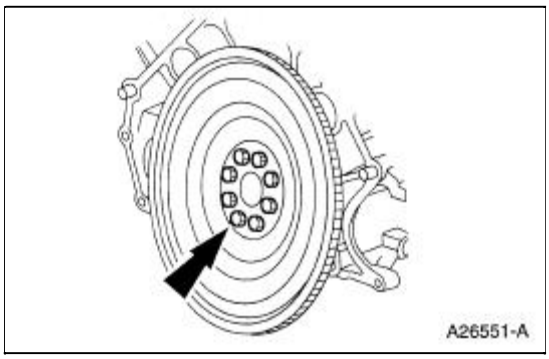
Material

Item	Specification
Motorcraft Silicone Gasket Remover ZC-30	—
Motorcraft Metal Surface Prep ZC-31	—

Removal

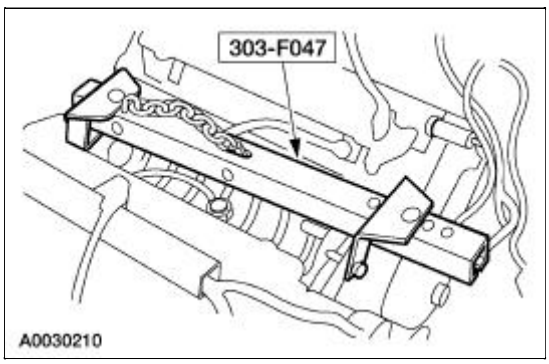
All cylinder heads

1. Remove the engine. For additional information, Engine in this section.
2. Remove the bolts and the flexplate or the flywheel.

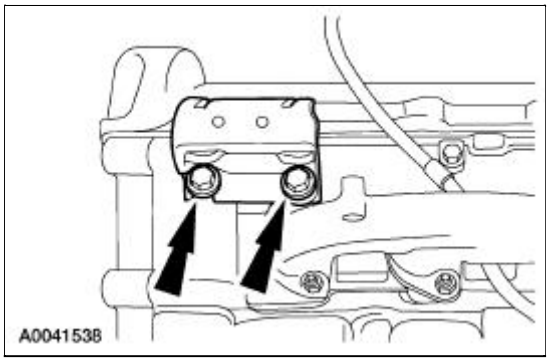


3. **CAUTION: To prevent damage to the oil pan, use care when lowering the engine.**

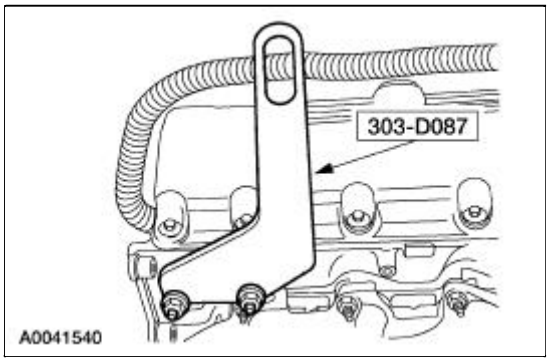
   Lower the engine onto wooden blocks.
4. Remove the special tool.



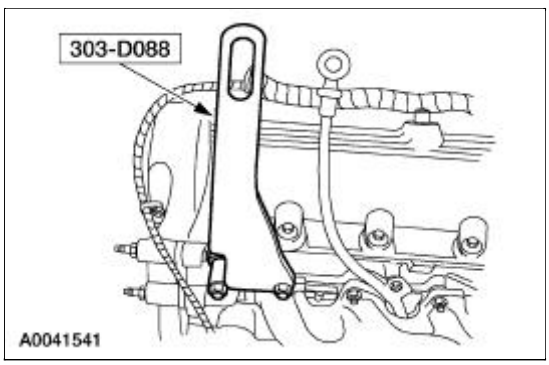
5. Remove the power steering reservoir lower mounting bracket.



6. Install the special tool.

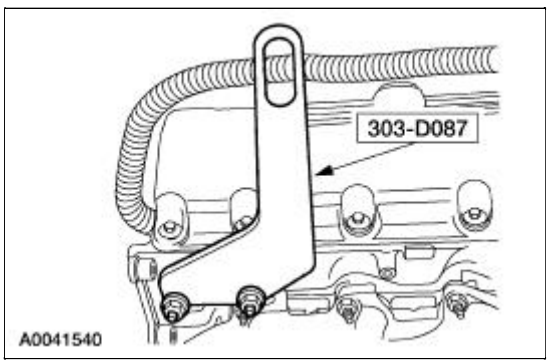


7. Install the special tool.

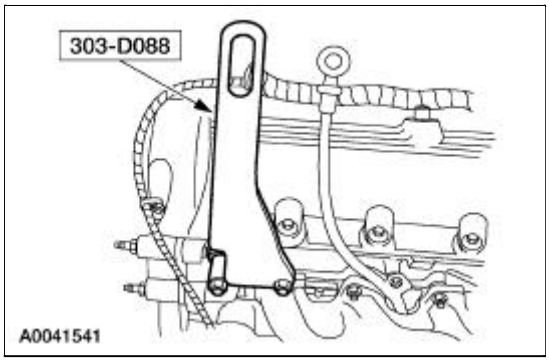


8. Mount the engine on a suitable work stand.

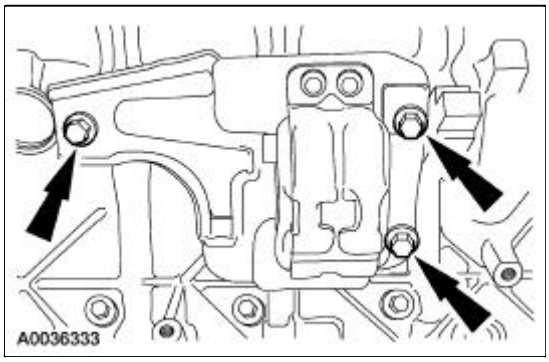
9. Remove the special tool.



10. Remove the special tool.

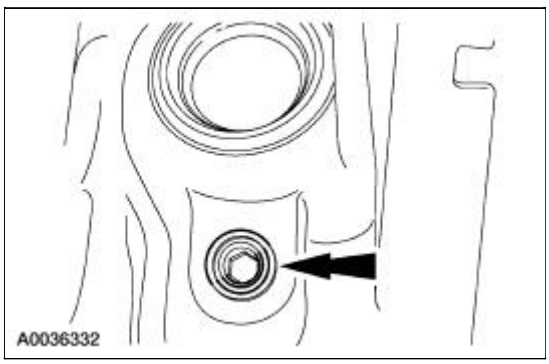


11. Remove the RH engine mount.

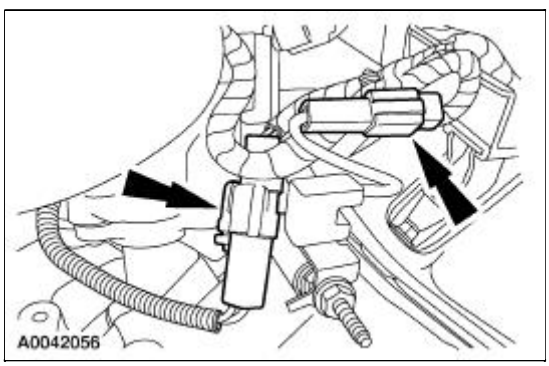


12. **NOTE:** LH shown, RH similar.

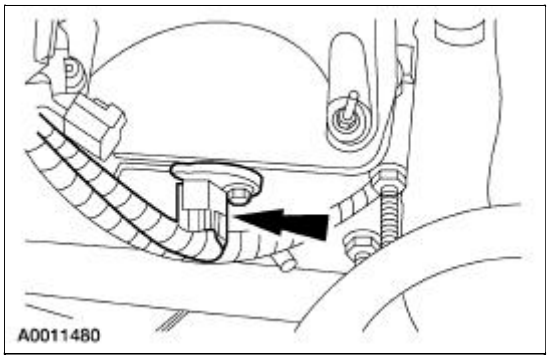
    Remove the cylinder block drain plugs, and drain the coolant in a suitable container.



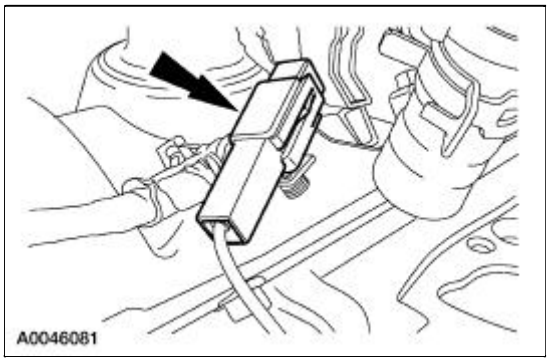
13. Disconnect the LH radio frequency interference capacitor and cylinder head temperature (CHT) sensor electrical connectors.



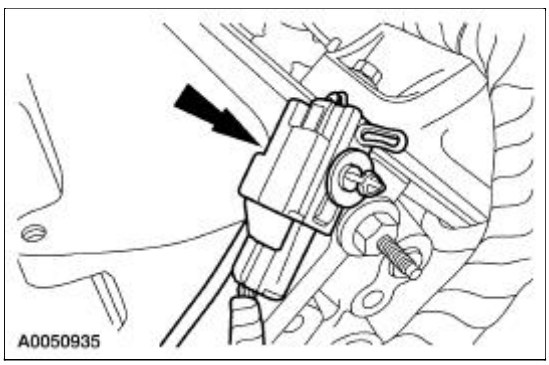
14. Disconnect the camshaft position (CMP) sensor electrical connector.



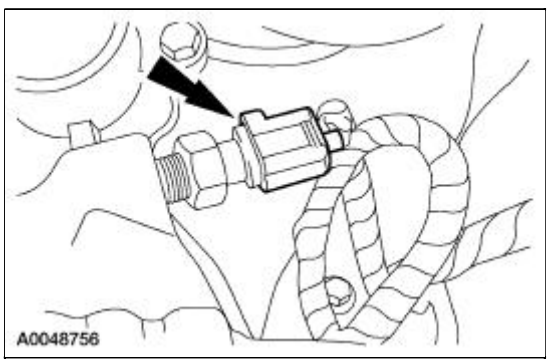
15. Disconnect the RH radio frequency interference capacitor electrical connector.



16. Disconnect the knock sensor electrical connector.



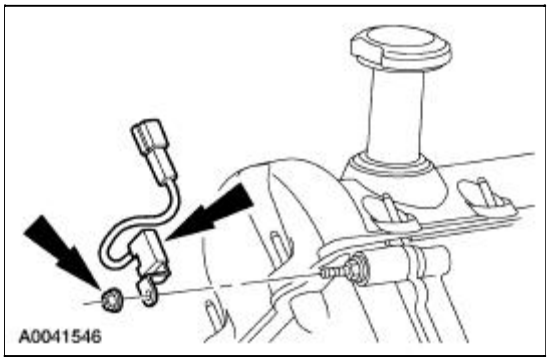
17. Disconnect the oil pressure switch electrical connector.



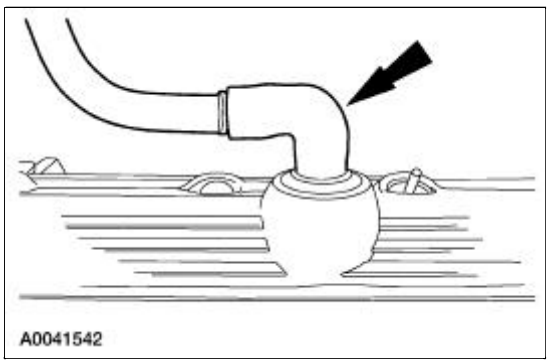
18. Detach all of the harness routing clips and connector retainers. Remove the engine control sensor wiring harness.

19. **NOTE:** RH shown, LH similar.

Remove the nuts, and the two radio interference capacitors.



20. Remove the crankcase ventilation tube from the LH valve cover.

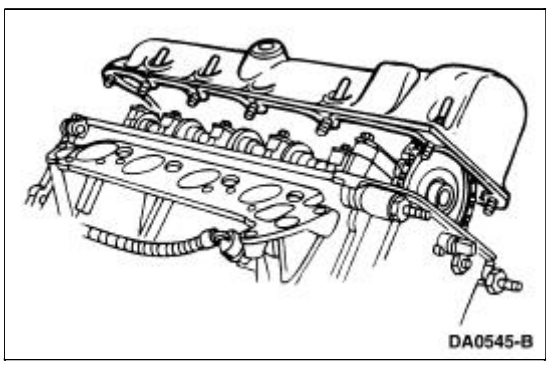


21. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

NOTE: The bolts are part of the valve cover and should not be removed.

Remove the LH valve cover.

- Fully loosen the bolts and remove the valve cover.
- Clean the valve cover mating surface of the cylinder head with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
- Inspect the valve cover gasket. If the gasket is damaged, remove and discard the gasket. Clean the valve cover gasket groove with soap and water or a suitable solvent.

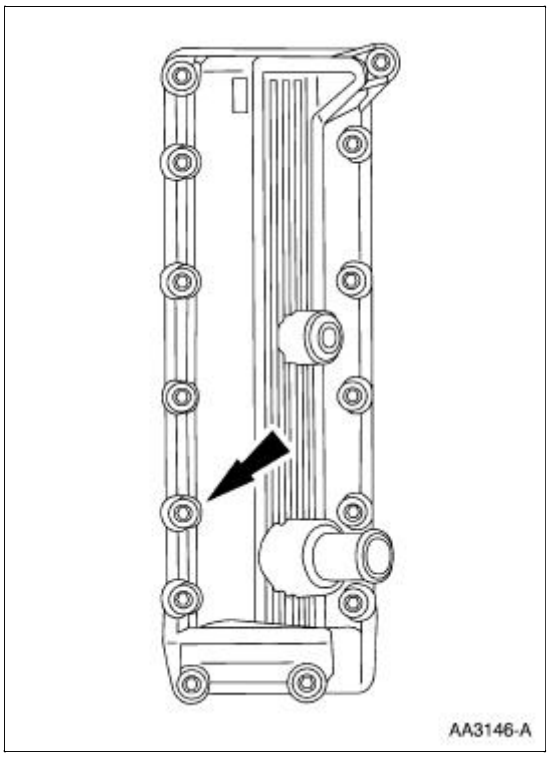


22. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

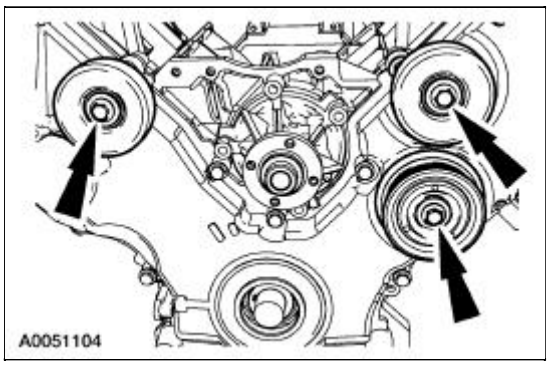
NOTE: The bolts are part of the valve cover and should not be removed.

Remove the RH valve cover.

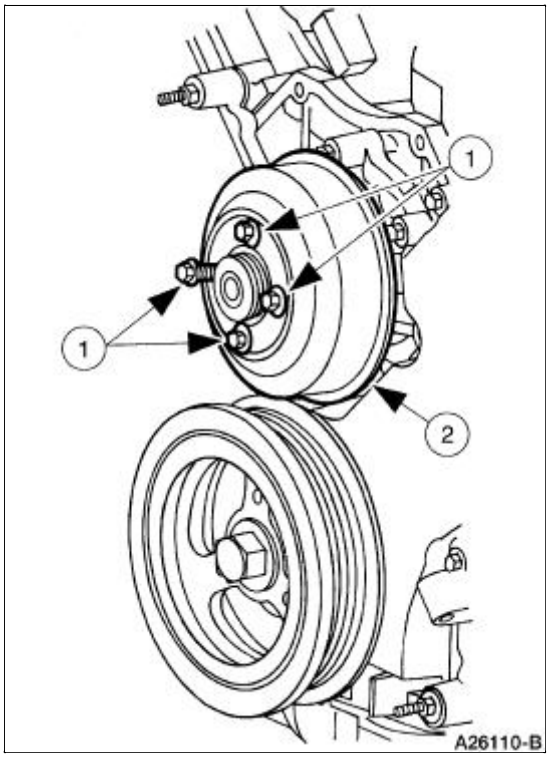
- Fully loosen the bolts and remove the valve cover.
- Clean the valve cover mating surface of the cylinder head with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
- Inspect the valve cover gasket. If the gasket is damaged, remove and discard the gasket. Clean the valve cover gasket groove with soap and water or a suitable solvent.



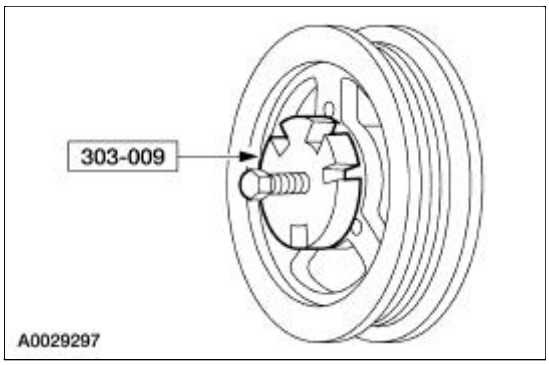
23. Remove the bolts and the belt idler pulleys.



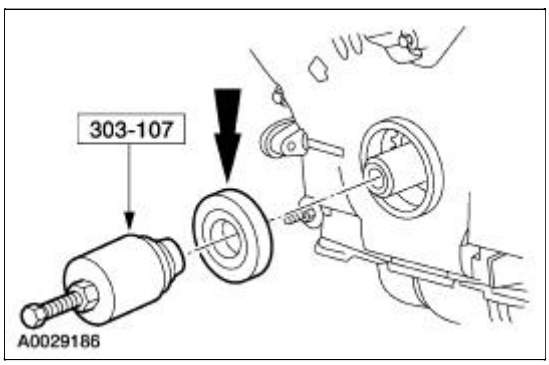
24. Remove the coolant pump pulley.
    1. Remove the bolts.
    2. Remove the coolant pump pulley.



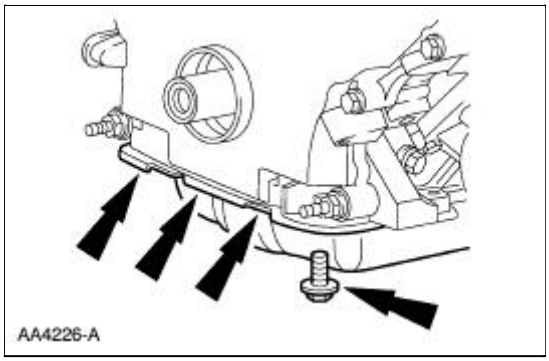
25. Remove and discard the crankshaft pulley bolt.
Use the special tool to remove the crankshaft pulley.



26. Use the special tool to remove the crankshaft front oil seal.

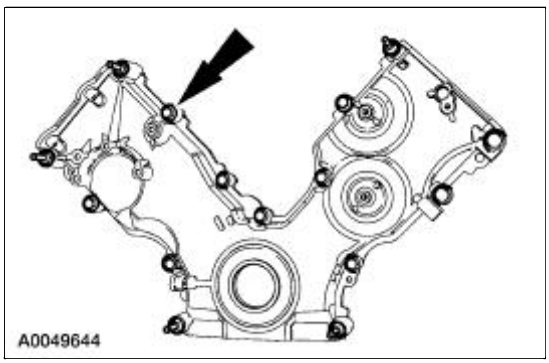


27. Remove the four bolts.

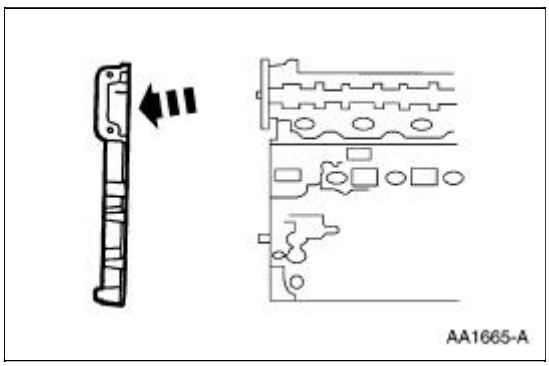


28. **NOTE:** Correct fastener location is essential for assembly procedure. Record fastener location.

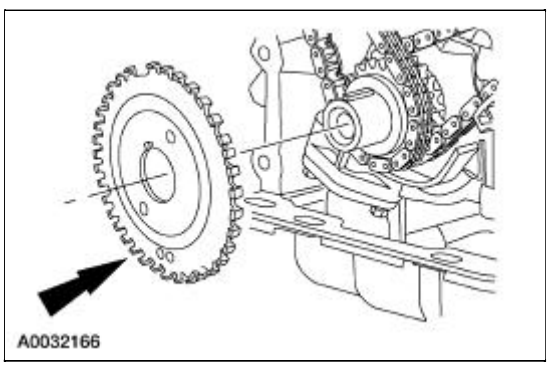
    Remove the fasteners.



29. Remove the engine front cover from the cylinder block.



30. Remove the crankshaft sensor ring from the crankshaft.

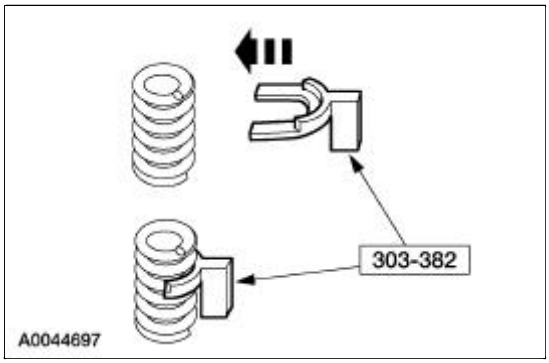


31. **CAUTION: Use care when removing the spark plugs.**

NOTE: Use compressed air to remove any foreign material from the spark plug well before removing the spark plugs.

Remove the eight spark plugs.

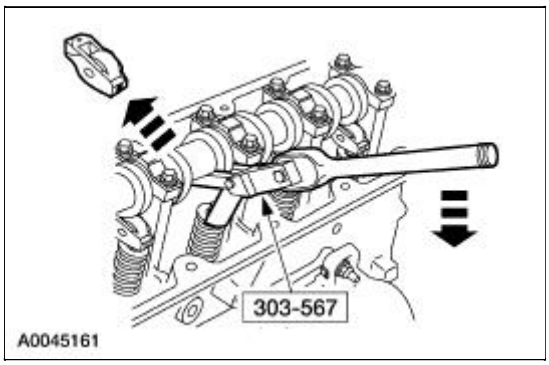
32. Install the special tool between the valve spring coils to prevent valve stem seal damage.



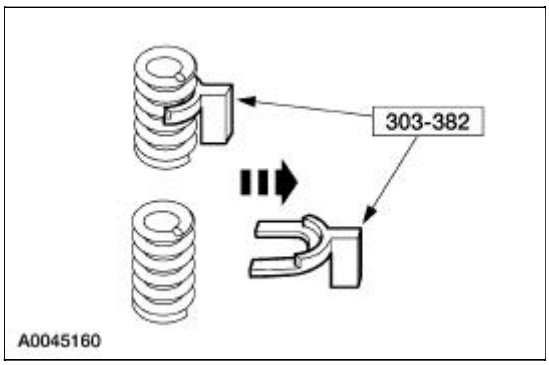
33. **NOTE:** The camshaft roller followers must be reinstalled in their original locations. Record the camshaft roller follower locations.

NOTE: Position the cam lobe away from the camshaft roller follower prior to removing each camshaft roller follower.

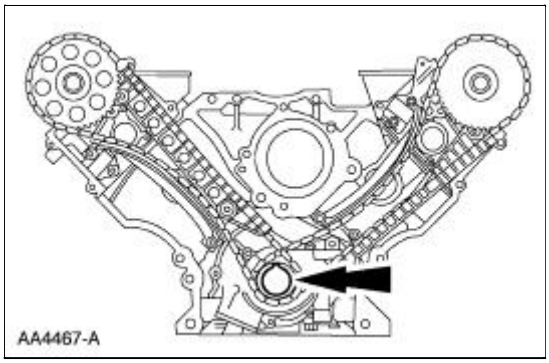
Use the special tool to compress the valve springs, and remove the camshaft roller followers.



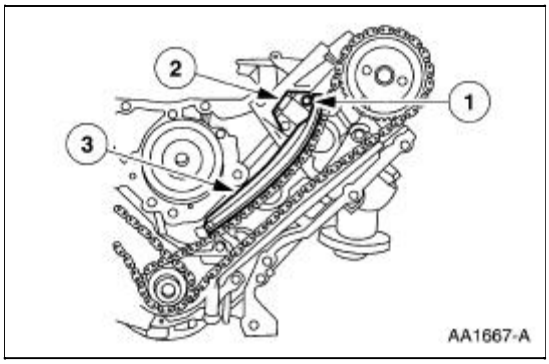
34. Remove the special tool.



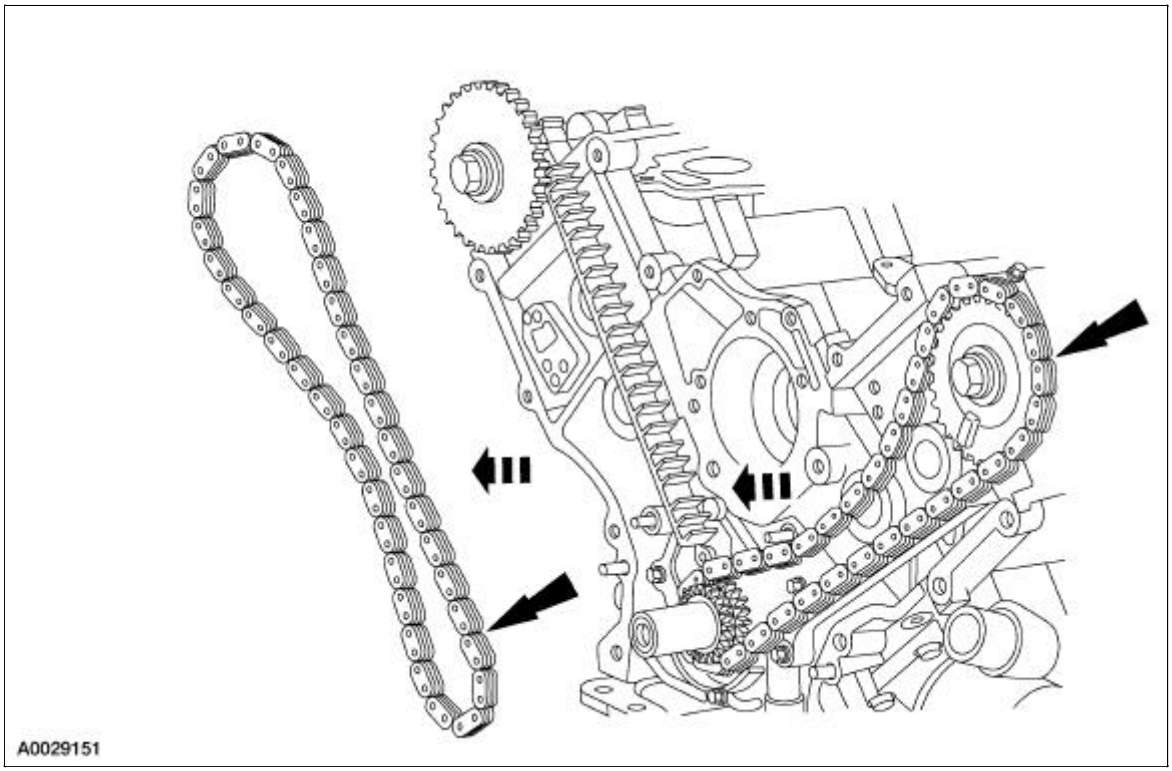
35. Position the crankshaft with the keyway at the 12 o'clock position.



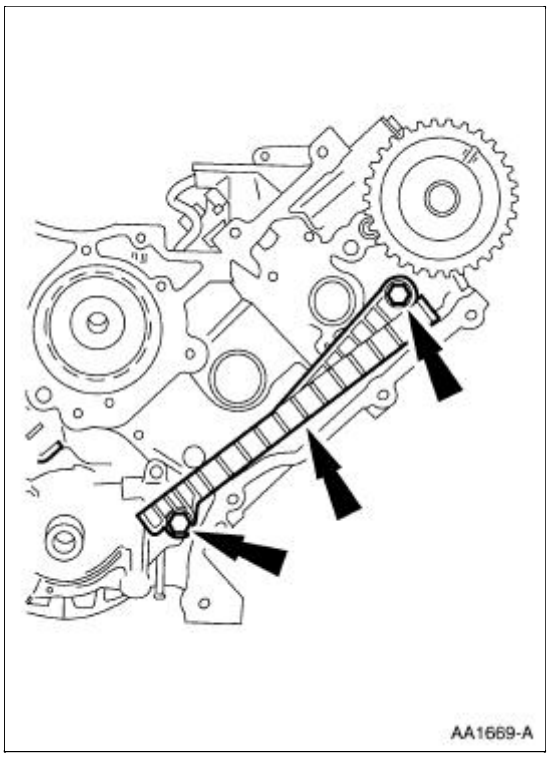
36. Remove the timing chain tensioning system from both timing chains.
    1. Remove the bolts.
    2. Remove the timing chain tensioners.
    3. Remove the timing chain tensioner arms.



37. Remove the RH and LH timing chains and the crankshaft sprocket.
    - Remove the RH timing chain from the camshaft sprocket.
    - Remove the RH timing chain from the crankshaft sprocket.
    - Remove the LH timing chain from the camshaft sprocket.
    - Remove the LH timing chain and crankshaft sprocket.

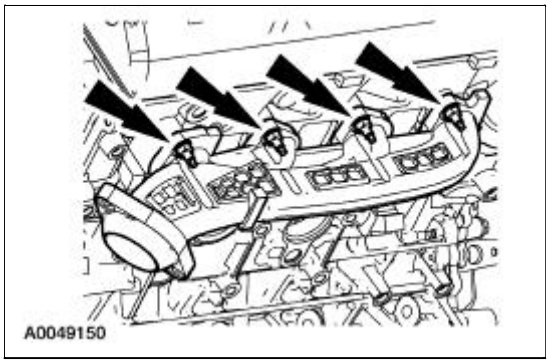


38. Remove both timing chain guides.
    - Remove the bolts.
    - Remove both timing chain guides.



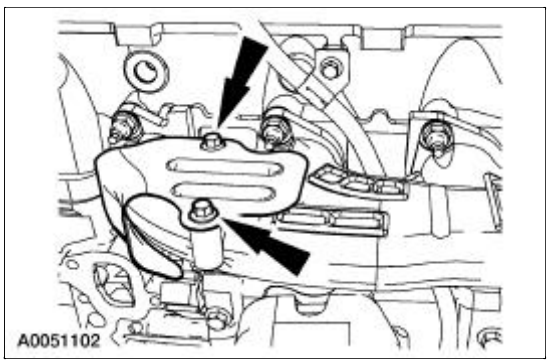
RH cylinder head

39. Remove the eight nuts, the RH exhaust manifold and the gasket.
    - Discard the RH exhaust manifold gasket.

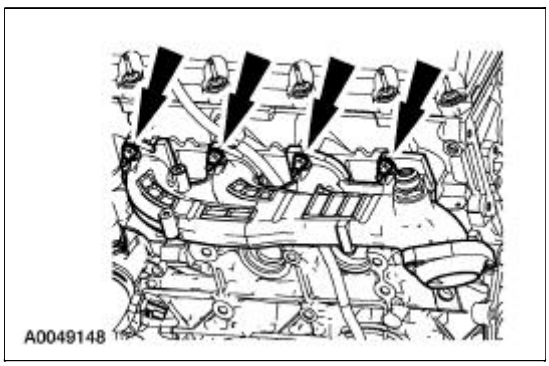


LH cylinder head

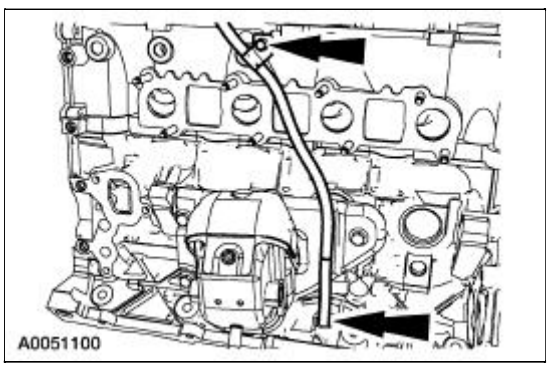
40. Remove the bolts and the heat shield.



41. Remove the eight nuts, the LH exhaust manifold and the gasket.
    - Discard the LH exhaust manifold gasket.



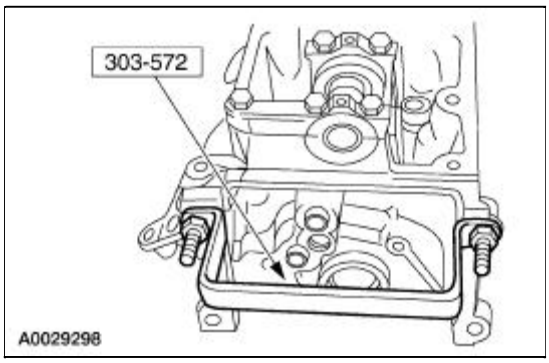
42. Remove the bolt and the oil level indicator tube.



All cylinder heads

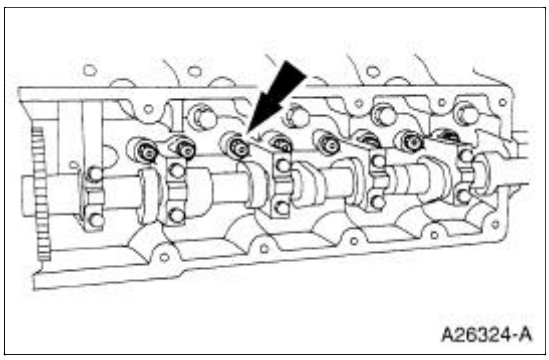
43. Clean and inspect the exhaust manifolds. For additional information, refer to Section 303-00 .

44. Install the special tools on both ends of the cylinder head.



45. **NOTE:** The hydraulic lash adjusters must be reinstalled in their original locations. Record the hydraulic lash adjuster locations.

    Remove the hydraulic lash adjusters.



RH cylinder head

46. **CAUTION: The cylinder head must be cool before removing it from the engine. Cylinder head warpage can result if a warm or hot cylinder head is removed.**

    CAUTION: Place clean shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine.

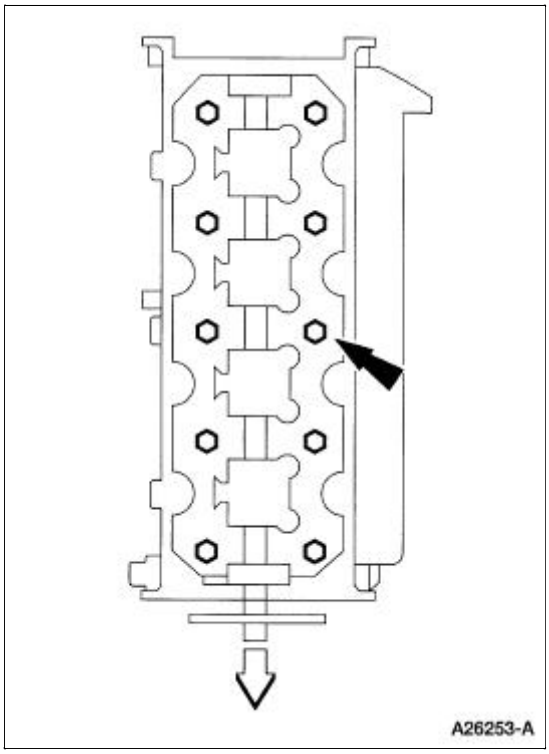
    CAUTION: The cylinder head bolts must be discarded and new bolts installed. They are tighten-to-yield designed and cannot be reused.

    CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.

    CAUTION: Aluminum surfaces are soft and can be scratched easily. Never place the cylinder head gasket surface, unprotected, on a bench surface.

    Remove the bolts and the RH cylinder head.

    - Discard the cylinder head gasket.
    - Discard the cylinder head bolts.



LH cylinder head

47. **CAUTION: The cylinder head must be cool before removing it from the engine. Cylinder head warpage can result if a warm or hot cylinder head is removed.**

CAUTION: Place clean shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine.

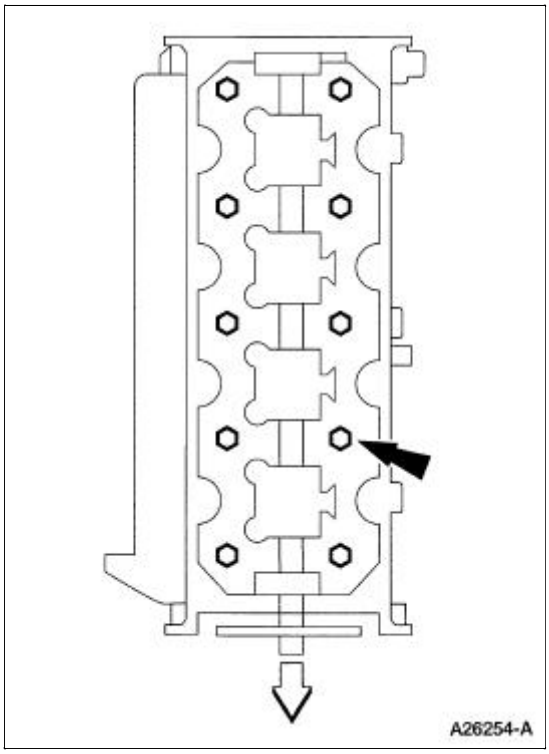
CAUTION: The cylinder head bolts must be discarded and new bolts installed. They are tighten-to-yield designed and cannot be reused.

CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.

CAUTION: Aluminum surfaces are soft and can be scratched easily. Never place the cylinder head gasket surface, unprotected, on a bench surface.

Remove the bolts and the LH cylinder head.

- Discard the cylinder head gasket.
- Discard the cylinder head bolts.



All cylinder heads

48. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.**

    CAUTION: Observe all warnings or cautions and follow all application directions contained on the packaging of the silicone gasket remover and the metal surface prep.

    NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

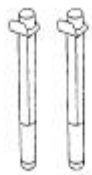
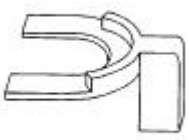
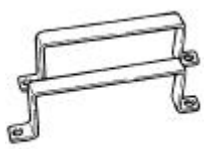
    Clean the cylinder head-to-cylinder block mating surfaces of both the cylinder head and the cylinder block.
    1. Remove any large deposits of silicone or gasket material with a plastic scraper.
    2. Apply silicone gasket remover, following package directions, and allow to set for several minutes.
    3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
    4. Apply metal surface prep, following package directions, to remove any remaining traces of oil or coolant, and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.

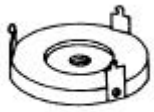
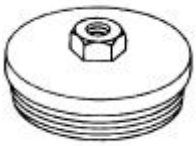
49. **NOTE:** The straightedge used must be flat within 0.0051 mm (0.0002 in) per foot of tool length.

    Support the cylinder head on a bench with the head gasket side up. Inspect all areas of the deck face with a straightedge, paying particular attention to the oil pressure feed area. The cylinder head must not have depressions deeper than 0.0254 mm (0.001 in) across a 38.1 mm (1.5 in) square area, or scratches more than 0.0254 mm (0.001 in).

Engine

Special Tool(s)

 ST1286-A	Remover, Crankshaft Vibration Damper 303-009 (T58P-6316-D)
 ST1335-A	Holding Tool, Crankshaft 303-448 (T93P-6303-A)
 ST1337-A	Installer, Connecting Rod 303-442 (T93P-6136-A)
 ST1730-A	Remover, Crankshaft Front Oil Seal 303-107 (T74P-6700-A)
 ST1330-A	Compressor, Valve Spring 303-567 (T97P-6565-AH)
 ST1331-A	Compressor Spacer, Valve Spring 303-382 (T91P-6565-AH)
 ST1668-A	Remover/Installer, Cylinder Head 303-572 (T97T-6000-A)
	Remover, Crankshaft Rear Oil Slinger

 ST1481-A	303-514 (T95P-6701-AH)
 ST1382-A	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
 ST2443-A	Lift Bracket Set, Engine 303-DS086 (D93P-6001-A)

Material

Item	Specification
Motorcraft Silicone Gasket Remover ZC-30	—
Motorcraft Metal Surface Prep ZC-31	—

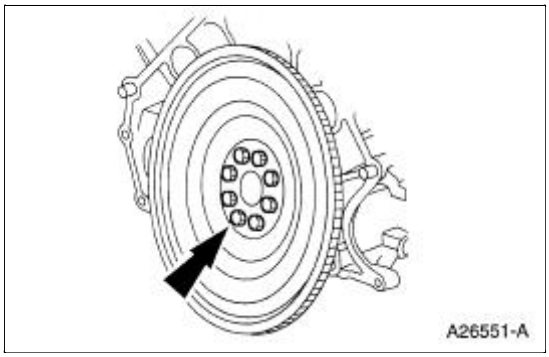
Disassembly

All vehicles

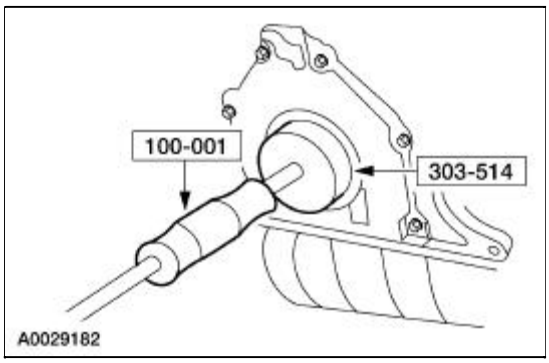
NOTE: The crankshaft rear oil seal, the oil seal slinger and the oil seal retainer plate must be removed before mounting the engine on the engine stand.

1. **NOTE:** 5.4L engine shown, 4.6L engine similar.

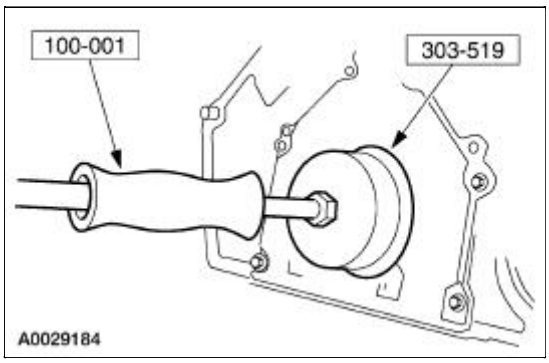
   Remove the bolts and the flexplate.



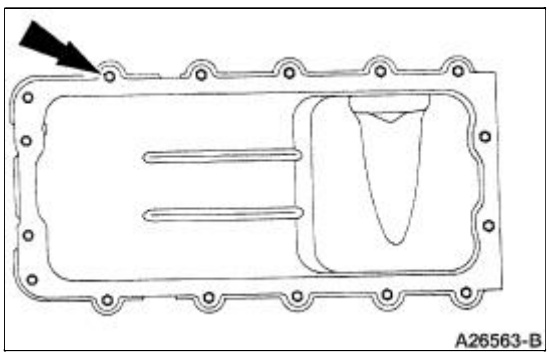
2. Using the special tools, remove the crankshaft rear oil slinger.



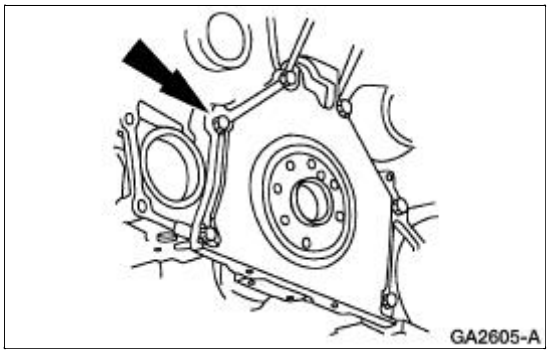
3. Using the special tools, remove the crankshaft rear oil seal.



4. Remove the bolts, oil pan and oil pan gasket.
    - Clean and inspect the sealing surfaces.



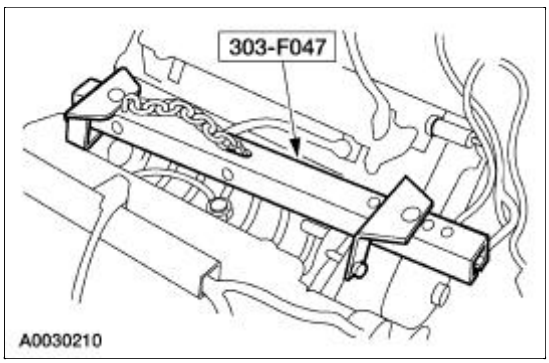
5. Remove the bolts and the crankshaft rear oil seal retainer plate.
    - Clean and inspect the sealing surfaces.



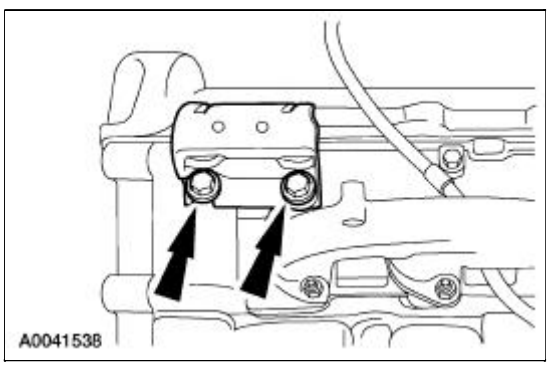
6. **CAUTION: Use care when lowering the engine, to prevent damage to the oil pump screen and pickup tube.**

   Lower the engine onto wooden blocks.

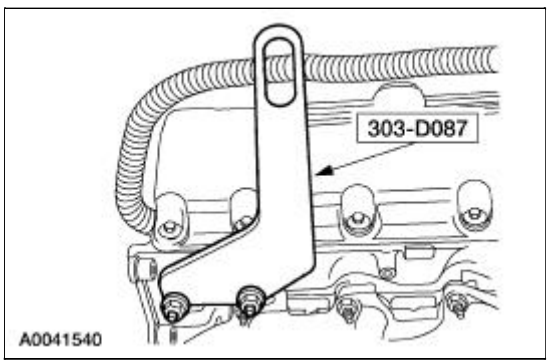
7. Remove the special tool.



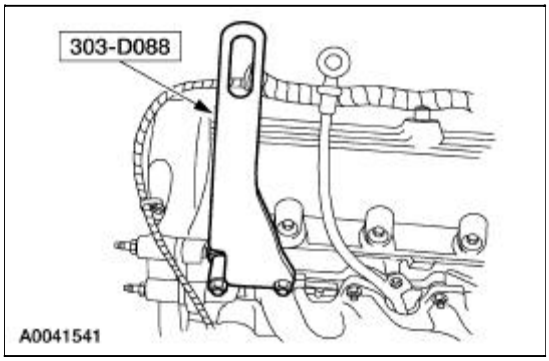
8. Remove the power steering reservoir lower mounting bracket.



9. Install the special tool.

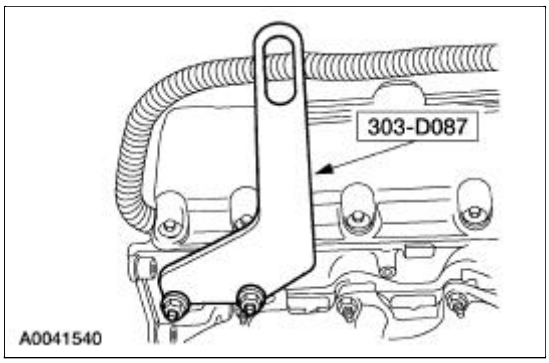


10. Install the special tool.

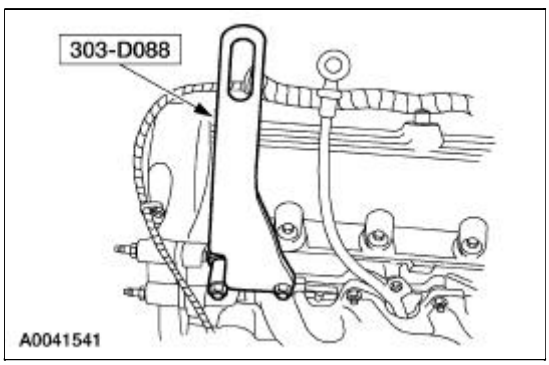


11. Mount the engine on a suitable work stand.

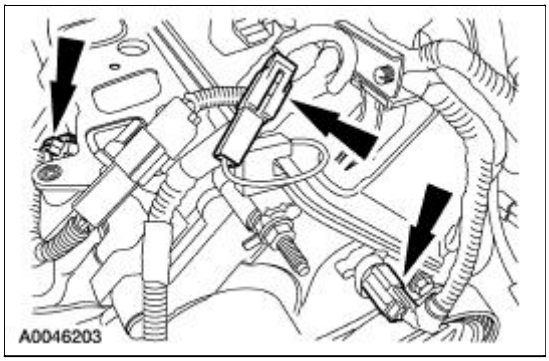
12. Remove the special tool.



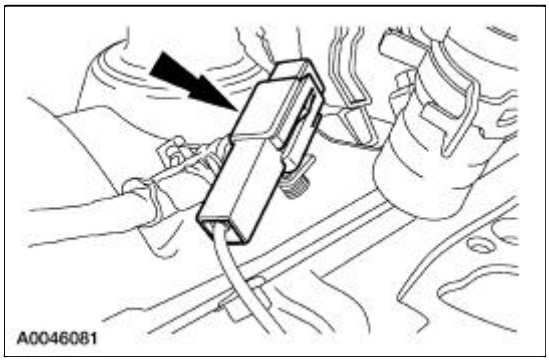
13. Remove the special tool.



14. Disconnect the following electrical connectors.
    - The camshaft position (CMP) sensor.
    - The LH radio interference capacitor.
    - The cylinder head temperature (CHT) sensor.

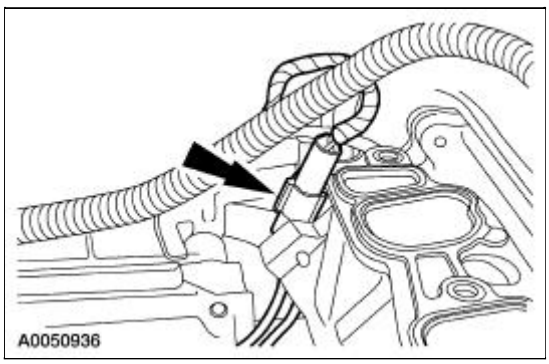


15. Disconnect the RH radio interference capacitor electrical connector.



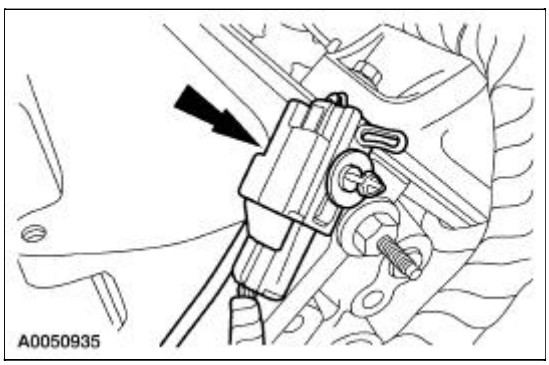
4.6L engines

16. Disconnect the knock sensor electrical connector.



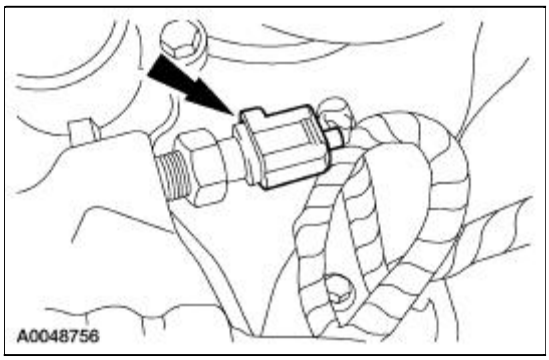
5.4L engines

17. Disconnect the knock sensor electrical connector.



All vehicles

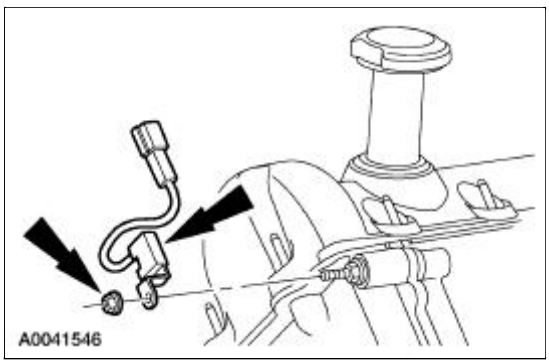
18. Disconnect the oil pressure switch electrical connector.



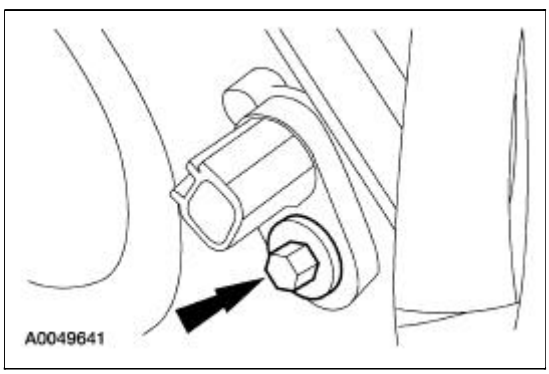
19. Detach all of the harness routing clips and connector retainers. Remove the engine control sensor wiring harness.

20. **NOTE:** RH shown, LH similar.

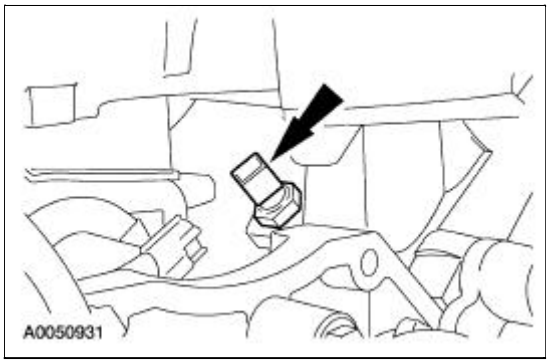
    Remove the nuts and the two radio interference capacitors.



21. Remove the bolt and the CMP sensor.

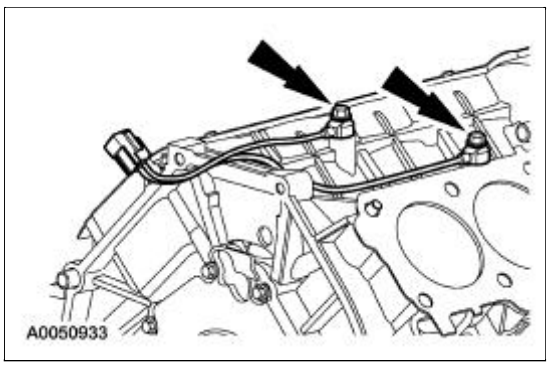


22. Remove the CHT sensor.



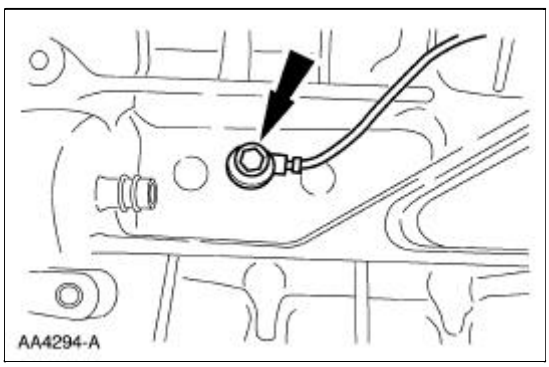
4.6L engines

23. Remove the bolts and the knock sensors.



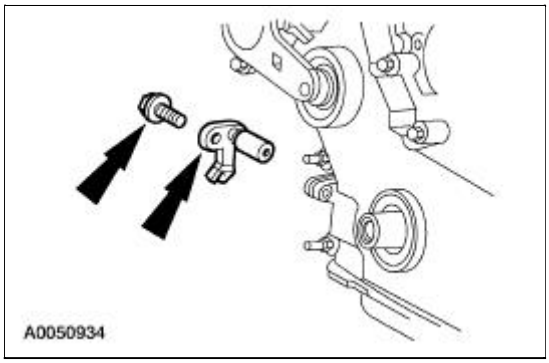
5.4L engines

24. Remove the bolt and the knock sensor.

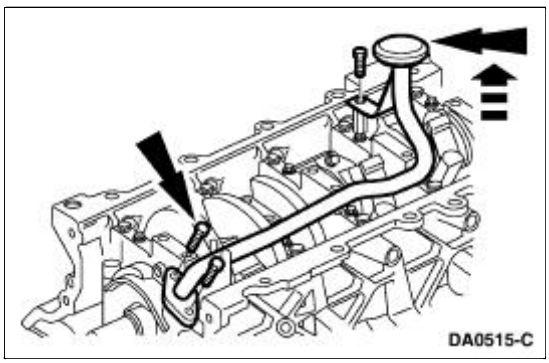


All vehicles

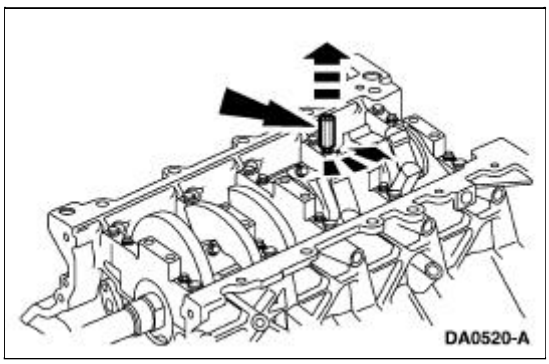
25. Remove the bolt and the crankshaft position (CKP) sensor.



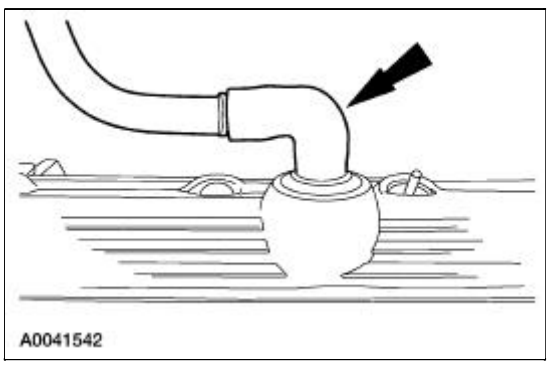
26. Remove the bolts and the oil pump screen and pickup tube.



27. Remove the oil pump screen and pickup tube spacer.



28. Remove the crankcase ventilation tube from the LH valve cover.

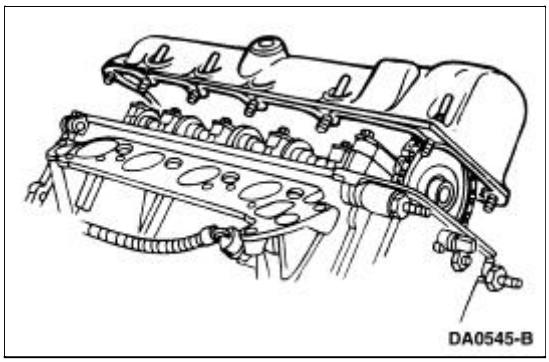


29. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

NOTE: The bolts are part of the valve cover and should not be removed.

Remove the LH valve cover.

- Fully loosen the bolts and remove the valve cover.
- Clean the valve cover mating surface of the cylinder head with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
- Inspect the valve cover gasket. If the gasket is damaged, remove and discard the gasket. Clean the valve cover gasket groove with soap and water or a suitable solvent.



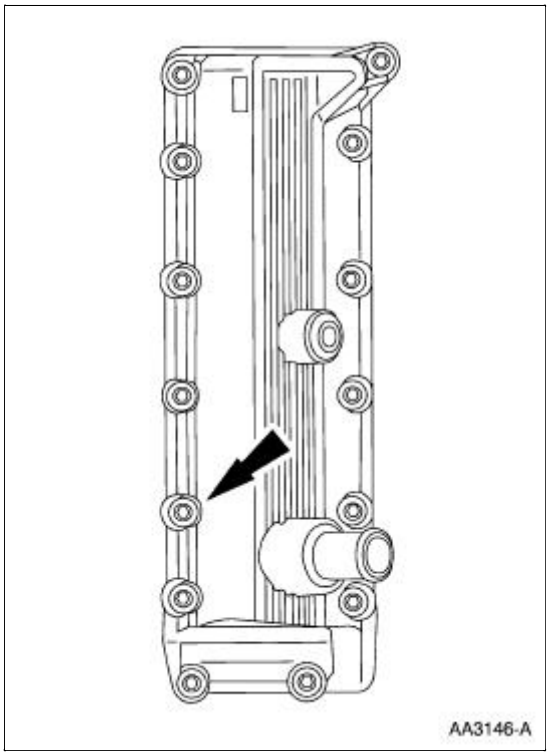
30. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

NOTE: The bolts are part of the valve cover and should not be removed.

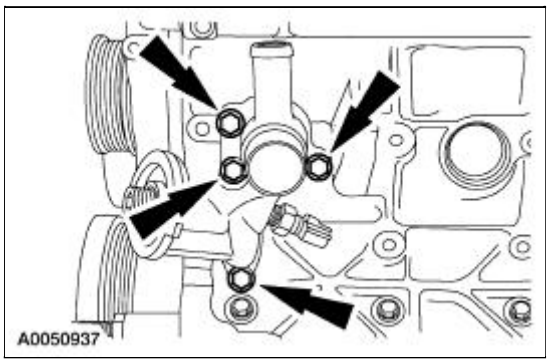
NOTE: Windsor engine shown; Romeo engine similar.

Remove the RH valve cover.

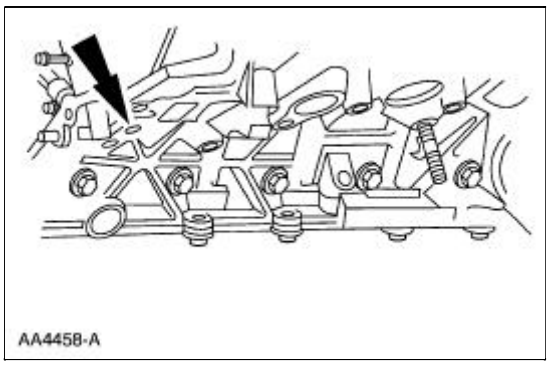
- Fully loosen the bolts and remove the valve cover.
- Clean the valve cover mating surface of the cylinder head with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
- Inspect the valve cover gasket. If the gasket is damaged, remove and discard the gasket. Clean the valve cover gasket groove with soap and water or a suitable solvent.



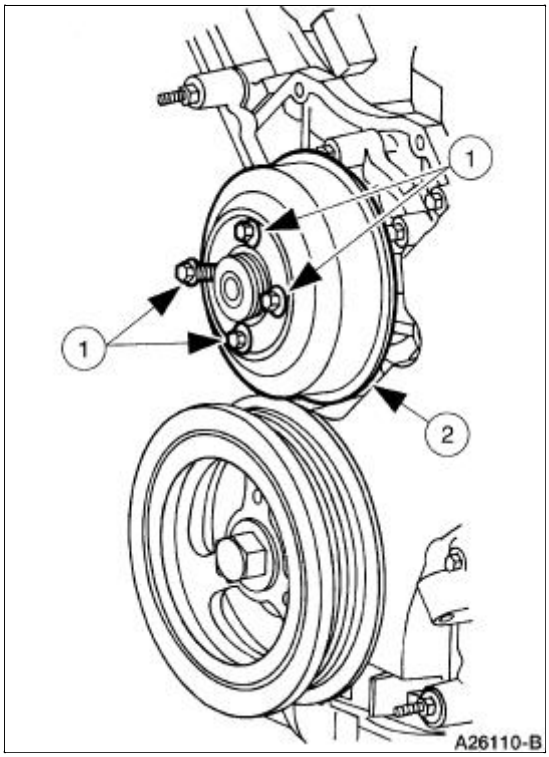
31. Remove the bolts, the oil filter adapter and the oil filter adapter gasket.



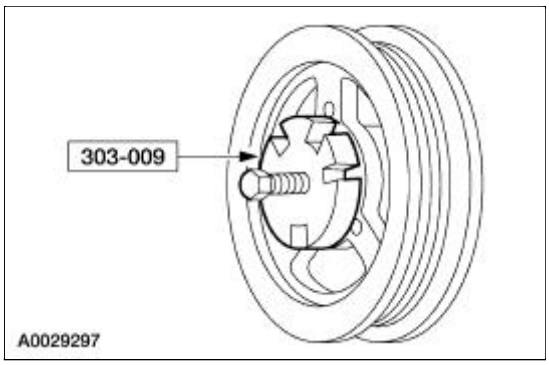
32. Clean the oil filter adapter gasket surface at the cylinder block.



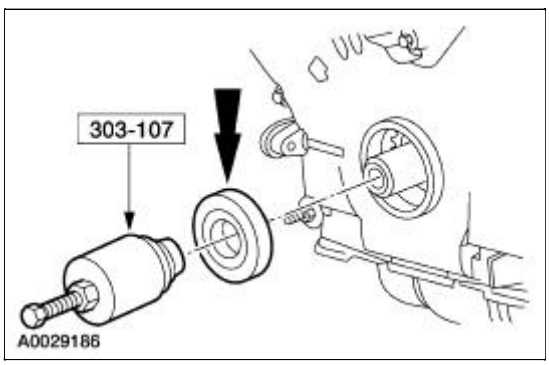
33. Remove the coolant pump pulley.
    1. Remove the bolts.
    2. Remove the coolant pump pulley.



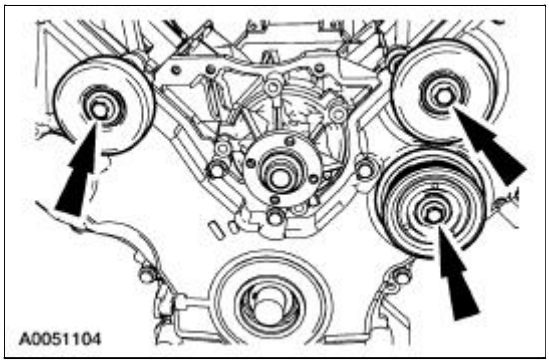
34. Remove and discard the crankshaft pulley bolt. Use the special tool to remove the crankshaft pulley.



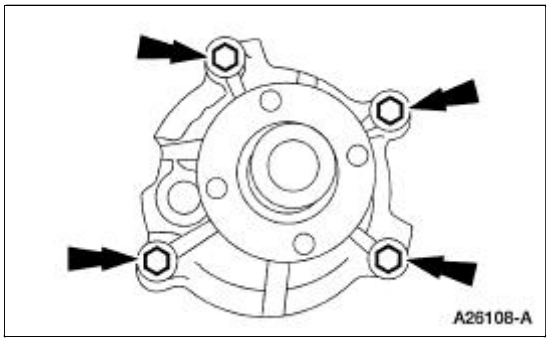
35. Use the special tool to remove the crankshaft front oil seal.



36. Remove the bolts and the belt idler pulleys.

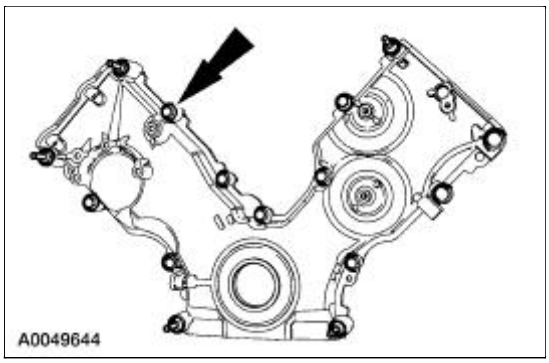


37. Remove the bolts and the coolant pump.

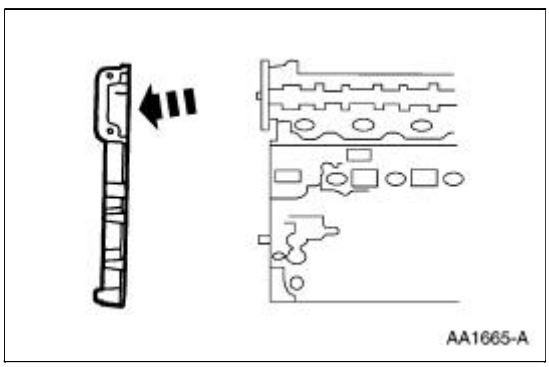


38. **NOTE:** Correct fastener location is essential for assembly procedure. Record fastener location.

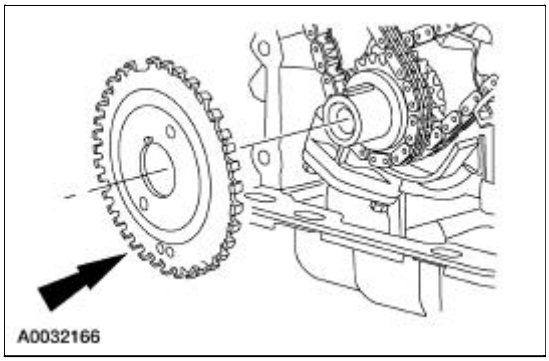
    Remove the fasteners.



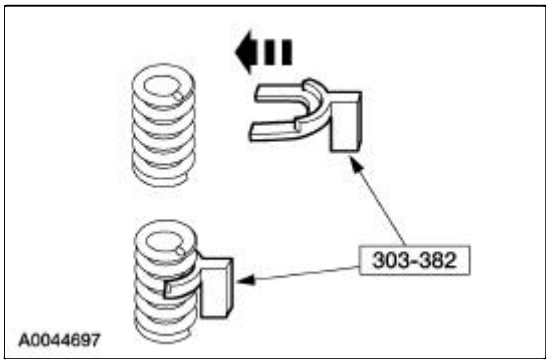
39. Remove the engine front cover from the cylinder block.



40. Remove the crankshaft sensor ring from the crankshaft.

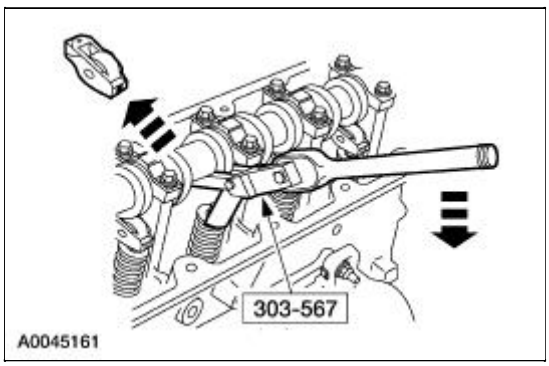


41. Install the special tool between the valve spring coils to prevent valve stem seal damage.

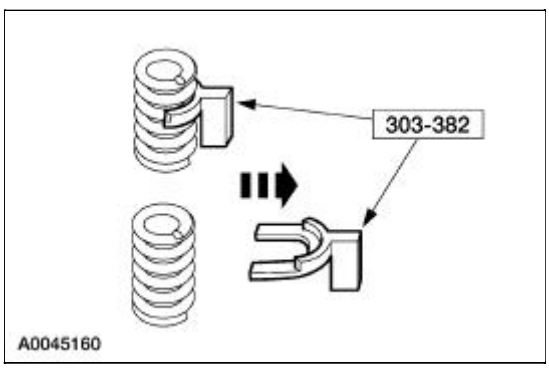


42. **NOTE:** The camshaft roller followers must be reinstalled in their original locations. Record the camshaft roller follower locations.

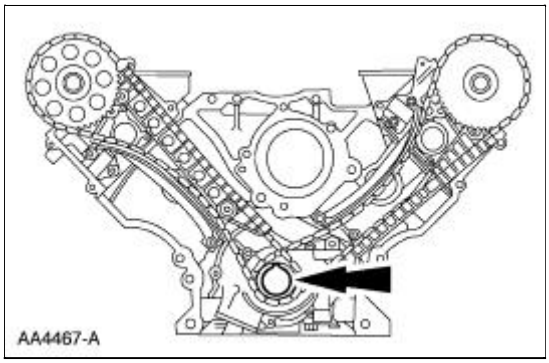
    Use the special tool to compress the valve springs, and remove the camshaft roller followers.



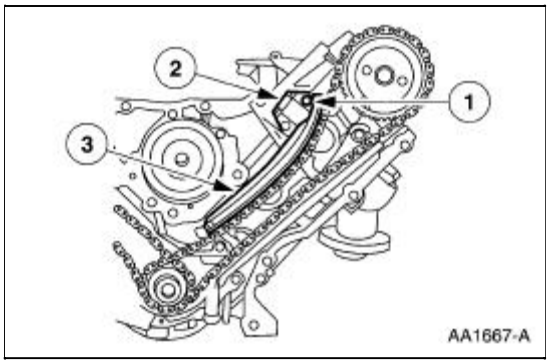
43. Remove the special tool.



44. Position the crankshaft with the keyway at the 12 o'clock position.



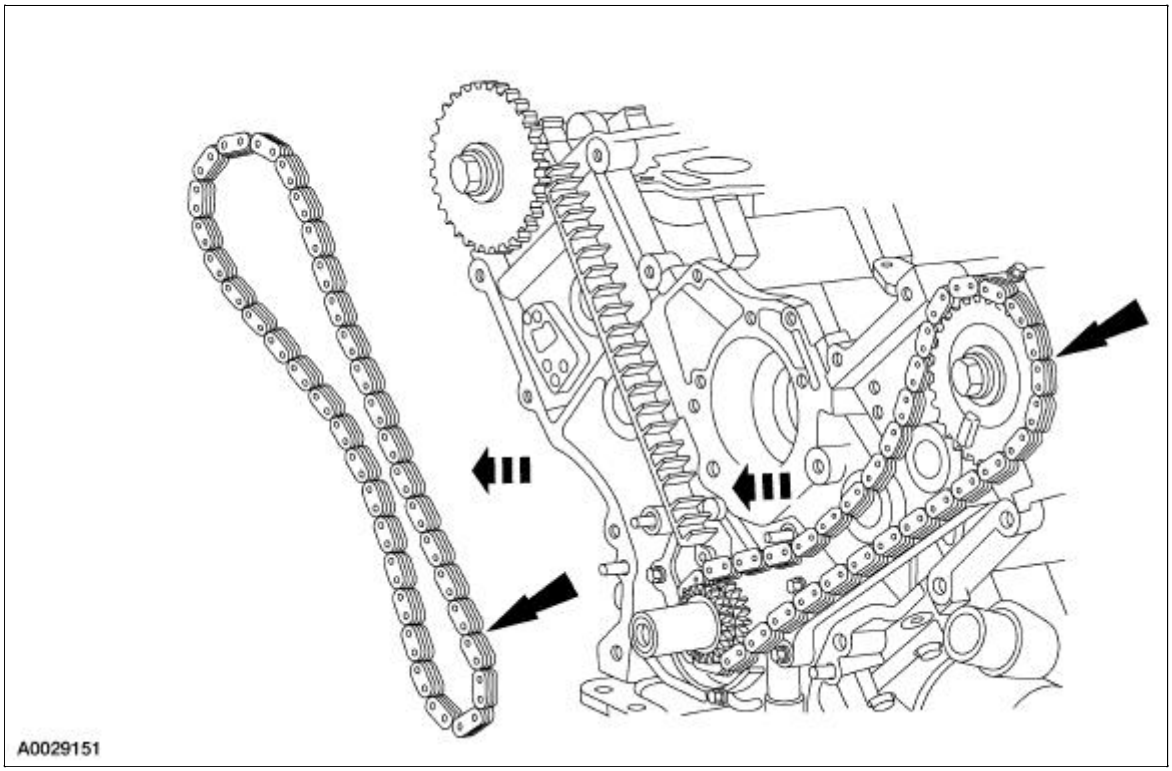
45. Remove the timing chain tensioning system from both timing chains.
    1. Remove the bolts.
    2. Remove the timing chain tensioners.
    3. Remove the timing chain tensioner arms.



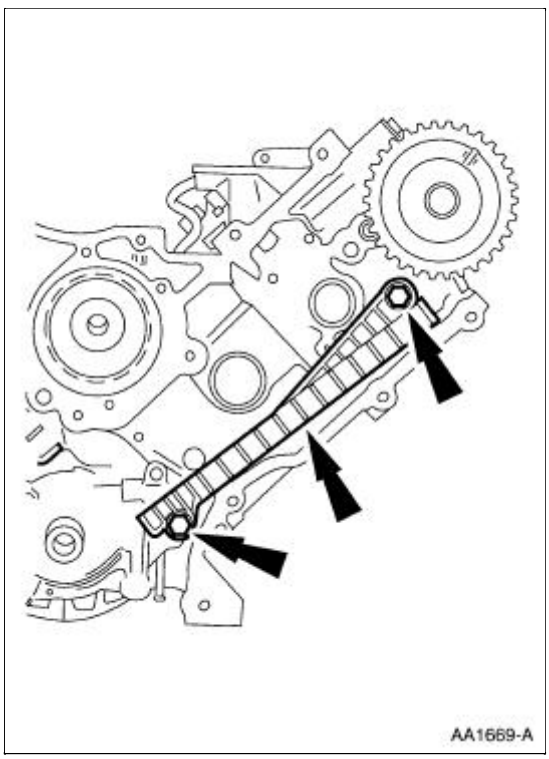
46. **CAUTION: Unless otherwise instructed, at no time when the timing chains are removed and the cylinders heads are installed is the crankshaft or camshaft to be rotated. Severe piston and valve damage will occur.**

    Remove the RH and LH timing chains and the crankshaft sprocket.

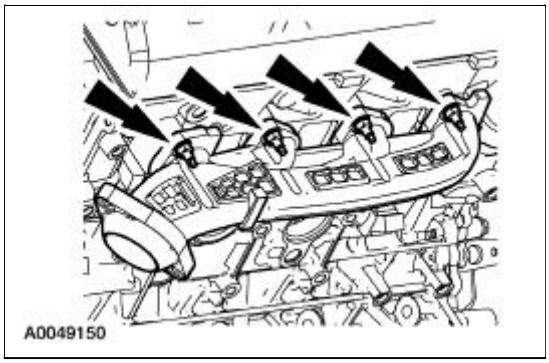
    - Remove the RH timing chain from the camshaft sprocket.
    - Remove the RH timing chain from the crankshaft sprocket.
    - Remove the LH timing chain from the camshaft sprocket.
    - Remove the LH timing chain and the crankshaft sprocket.



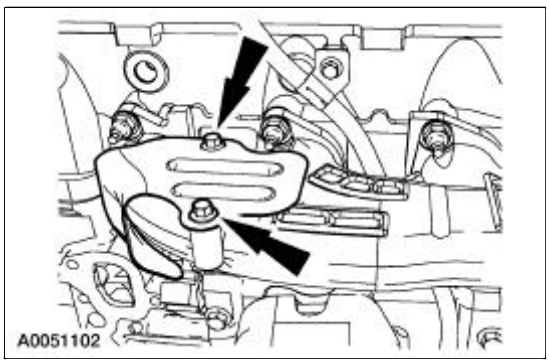
47. Remove both timing chain guides.
    - Remove the bolts.
    - Remove both timing chain guides.



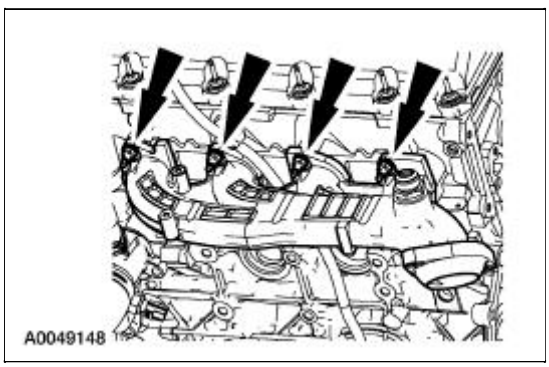
48. Remove the eight nuts, the RH exhaust manifold and the gasket.
    - Discard the RH exhaust manifold gasket.



49. Remove the bolts and the heat shield.

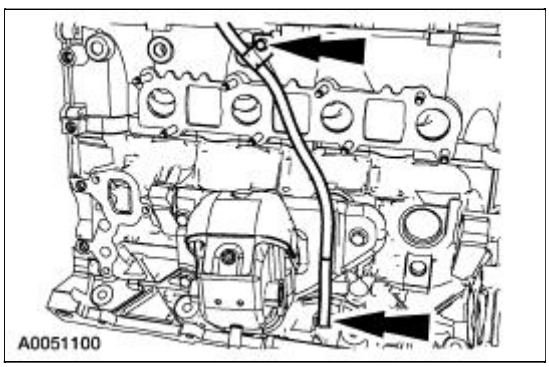


50. Remove eight nuts, the LH exhaust manifold and the gaskets.
    - Discard the LH exhaust manifold gaskets.

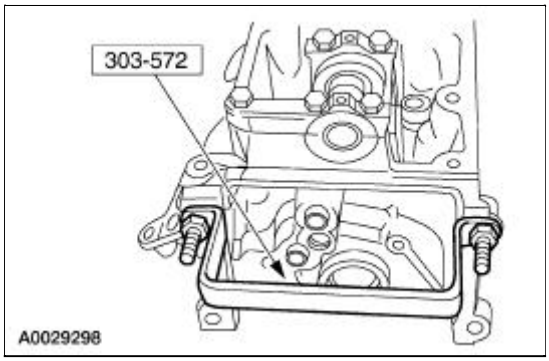


51. Clean and inspect the exhaust manifolds. For additional information, refer to Section 303-00 .

52. Remove the bolt and the oil level indicator tube.



53. Install the special tools on both ends of the cylinder head.



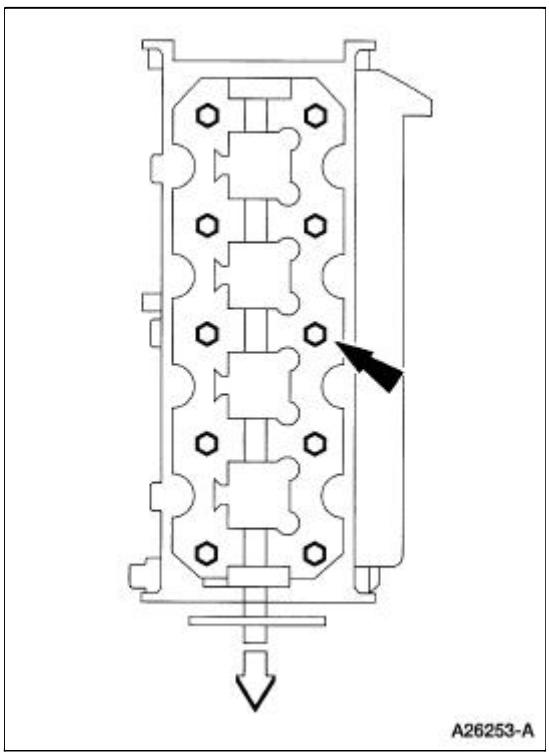
54. **CAUTION: New cylinder head bolts must be installed. They are tighten-to-yield designed and cannot be reused.**

CAUTION: Place cylinder head on a cardboard or wood surface to prevent damage to the joint face.

CAUTION: Aluminum surfaces are soft and can be scratched easily. Never place the cylinder head gasket surface, unprotected, on a bench surface.

NOTE: RH is shown; LH is similar.

Remove the bolts and discard. Remove the cylinder heads.

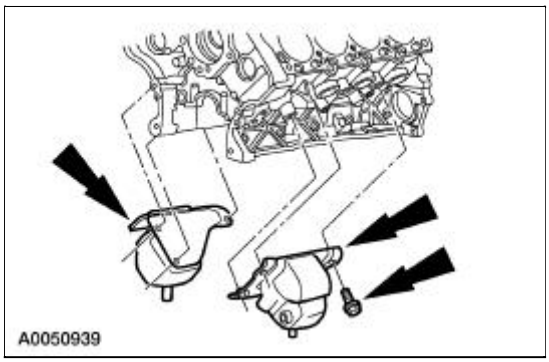


55. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraper to remove all traces of the head gasket.**

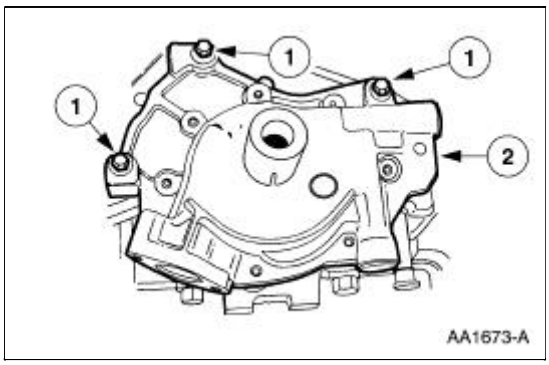
NOTE: If the cylinder head will be disassembled, it will be cleaned during that process.

Discard the cylinder head gaskets. Clean the sealing surfaces of the cylinder head and engine block with silicone gasket remover and metal surface prep. Follow the directions on the packaging.

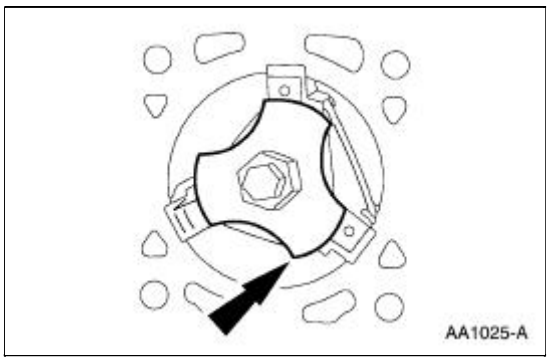
56. Remove the six bolts and the two engine mounts.



57. Remove the oil pump.
    1. Remove the bolts.
    2. Remove the oil pump.

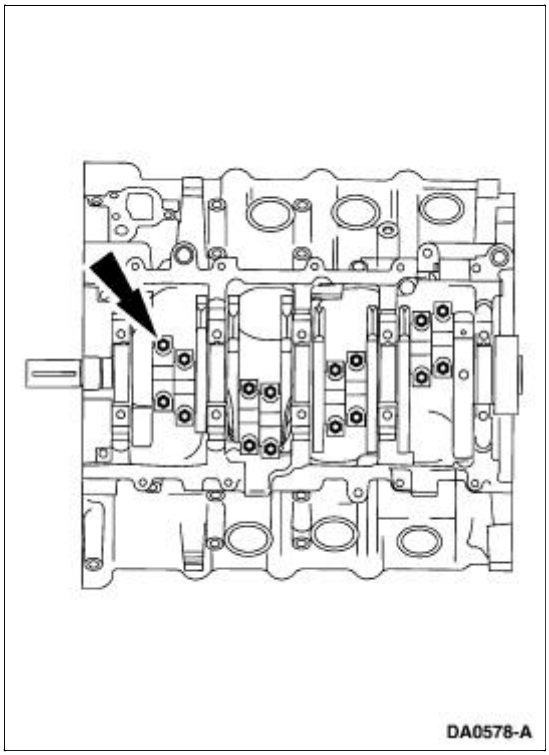


58. Before removing the pistons, inspect the top of the cylinder bores. If necessary, remove the ridge or carbon deposits from each cylinder using a cylinder ridge reamer. Follow the manufacturer's instructions.



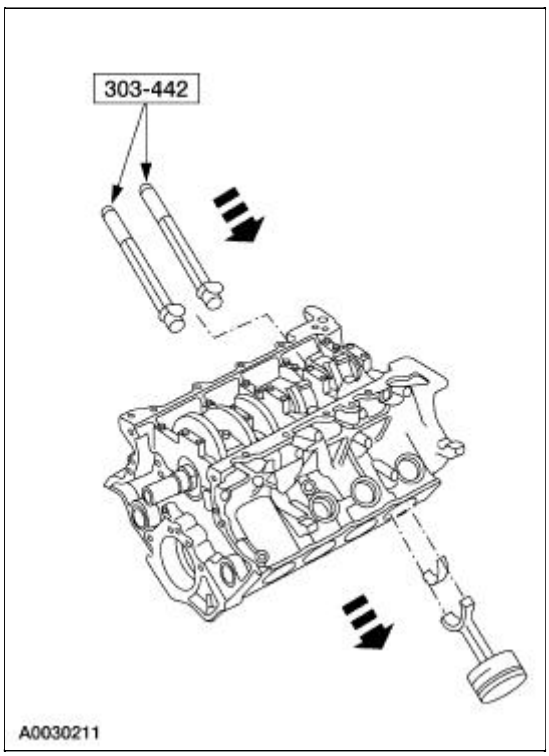
59. **CAUTION: Verify that the connecting rods and rod caps have orientation numbers cast into them. If not, number the connecting rods and rod caps for correct orientation.**

Remove the bolts and the connecting rod cap. Discard the bolts.



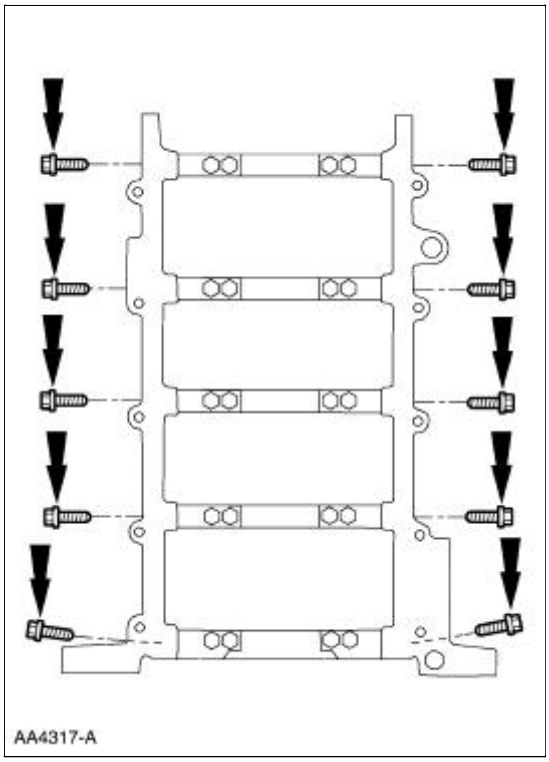
60. **CAUTION: Do not scratch the cylinder walls or crankshaft journals with the connecting rod.**

    Use the special tool to push the piston through the top of the cylinder block.

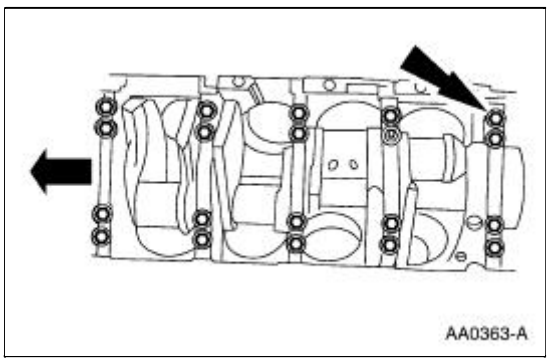


4.6L engines

61. Remove and discard the crankshaft bearing cap side bolts.

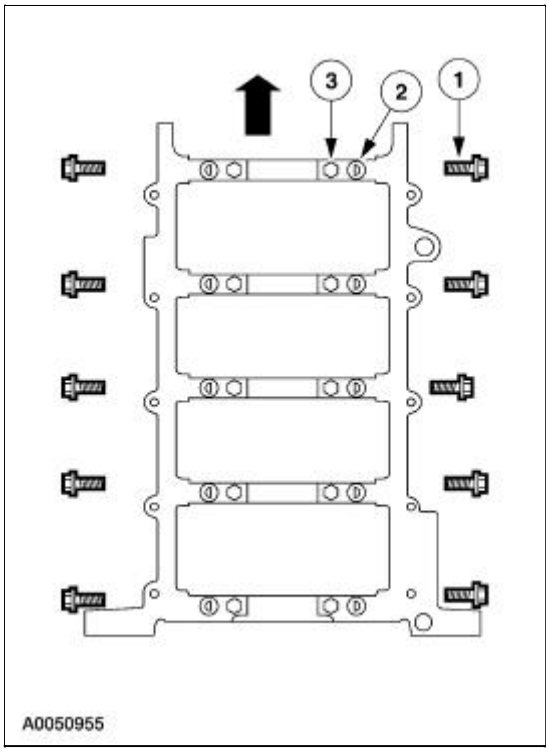


62. Remove and discard the crankshaft bearing cap bolts.



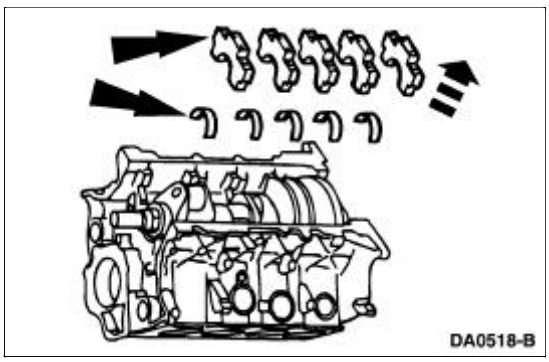
5.4L engines

63. Remove the fasteners.
    1. Remove and discard the crankshaft bearing cap side bolts.
    2. Remove the dowels.
    3. Remove and discard the crankshaft bearing cap bolts.

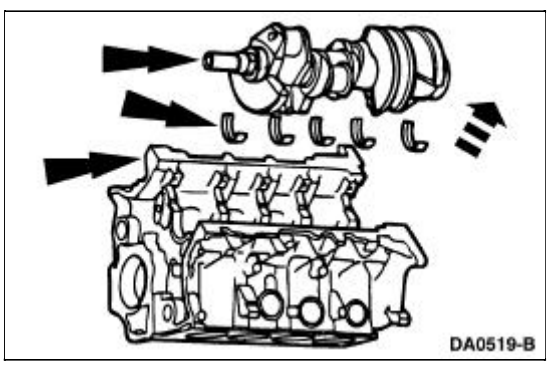


All vehicles

64. Remove the five main bearing caps, the lower crankshaft main bearings and, if equipped, the lower thrust washer.

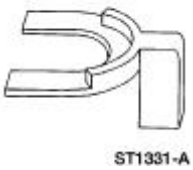


65. Remove the crankshaft, the upper crankshaft main bearings and the upper thrust washer(s) from the cylinder block.



Cylinder Head

Special Tool(s)

 ST1330-A	Compressor, Valve Spring 303-567 (T97P-6565-AH)
 ST1331-A	Compressor Spacer, Valve Spring 303-382 (T91P-6565-AH)
 ST1332-A	Installer, Valve Stem Oil Seal 303-383 (T91P-6571-A)
	Aligner, Camshaft Position 303-557 (T96T-6256-B)

Material

Item	Specification
Motorcraft Silicone Gasket Remover ZC-30	—
Motorcraft Metal Surface Prep ZC-31	—
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP	WSS-M2C153-H

Disassembly

CAUTION: Cylinder head machining or milling is not authorized by the Ford Motor Company. Cylinder head flatness must be within 0.0254 mm (0.001 in) across a 38.1 mm (1.5 in) square area.

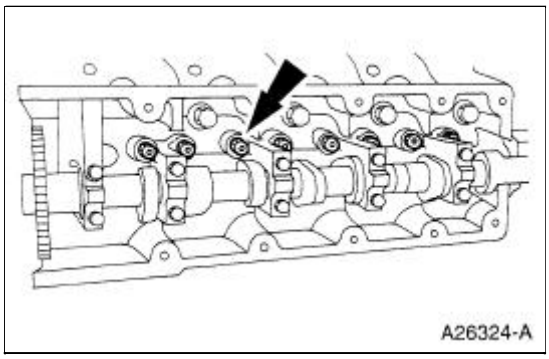
CAUTION: Place the cylinder head on a cardboard or wood surface to prevent damage to

the joint face.

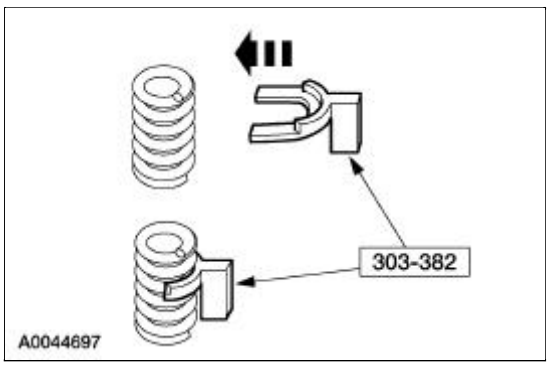
All cylinder heads

1. **NOTE:** The hydraulic lash adjusters must be reinstalled in their original locations. Record the hydraulic lash adjuster locations.

   Remove the hydraulic lash adjusters.

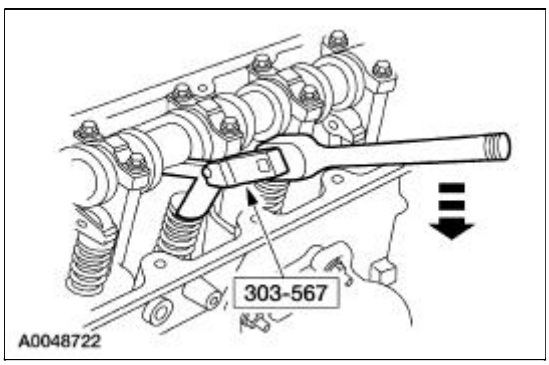


2. Install the special tool between the valve spring coils to prevent valve stem seal damage.



3. **NOTE:** Windsor engine shown; Romeo engine similar.

   Use the special tool to compress the valve springs.

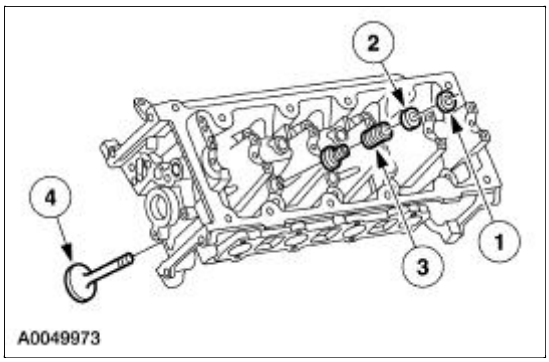


4. **CAUTION: Keep the valves and valve spring retainer keys in order so they can be reinstalled in their original locations.**

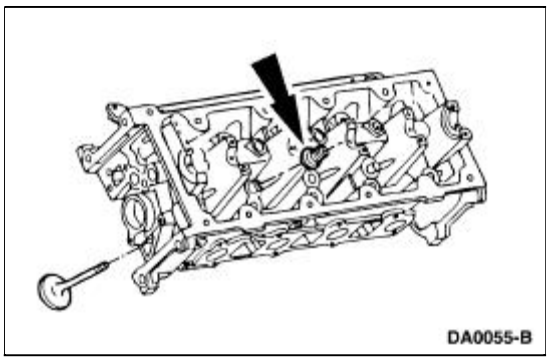
   NOTE: Shown without camshaft for clarity.

   Remove the valves.

1. Remove the valve spring retainer keys.
2. Remove the valve spring retainers.
3. Remove the valve springs.
4. Remove the valves.



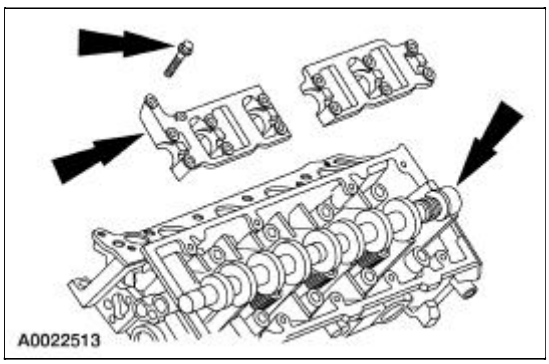
5. Remove the valve stem seals.



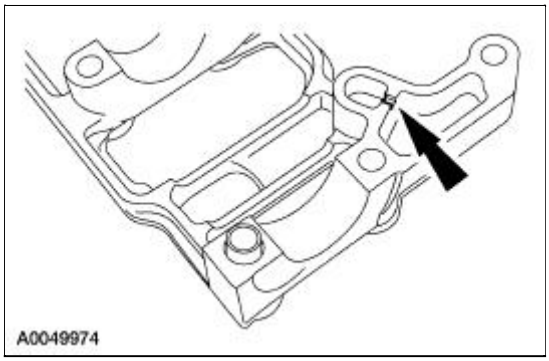
Romeo cylinder heads (4.6L)

6. **NOTE:** The camshaft bearing caps must be reinstalled in their original locations. Record the camshaft bearing cap locations.

   Remove the bolts, the bearing caps and the camshaft.



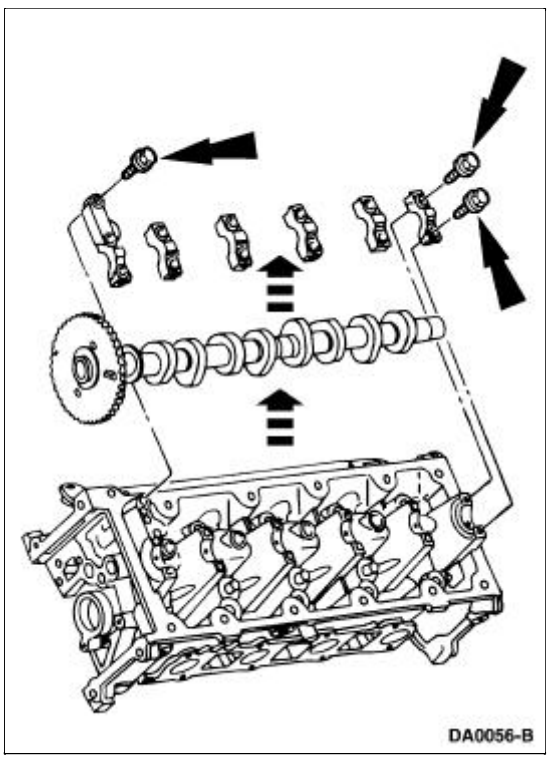
7. Clean and inspect the camshaft bearing caps.
   - One of the bearing caps contains an oil flow restriction groove. Make sure the groove is free of foreign material.



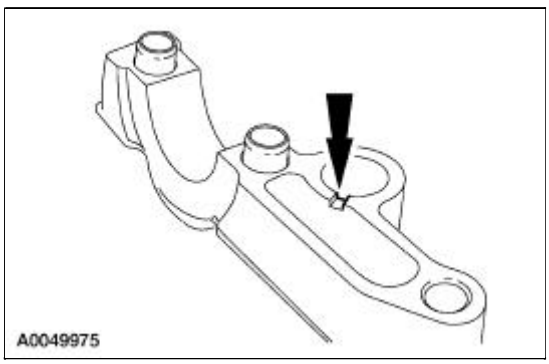
Windsor cylinder heads (5.4L)

8. **NOTE:** The camshaft bearing caps must be reinstalled in their original locations. Record the camshaft bearing cap locations.

   Remove the bolts, the bearing caps and the camshaft.



9. Clean and inspect the camshaft bearing caps.
   - One of the bearing caps contains an oil flow restriction groove. Make sure the groove is free of foreign material.



All cylinder heads

10. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.**

    CAUTION: Observe all warnings or cautions and follow all application directions contained on the packaging of the silicone gasket remover and the metal surface prep.

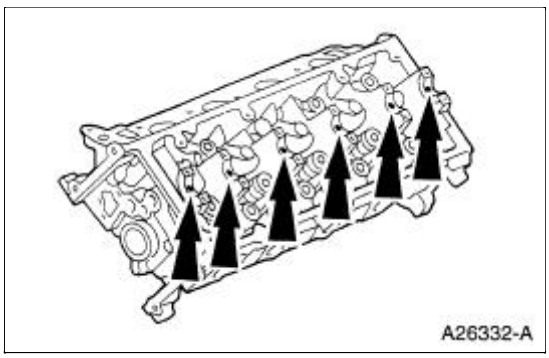
    NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

    Clean the cylinder head sealing surfaces.
    1. Remove any large deposits of silicone or gasket material with a plastic scraper.
    2. Apply silicone gasket remover, following package directions, and allow to set for several minutes.
    3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
    4. Apply metal surface prep, following package directions, to remove any remaining traces of oil or coolant, and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.

Assembly

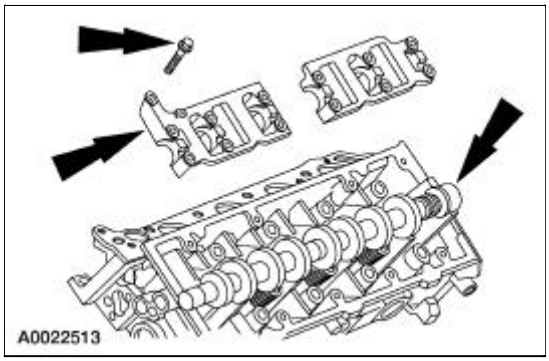
All cylinder heads

1. Lubricate the camshaft journals with clean engine oil.

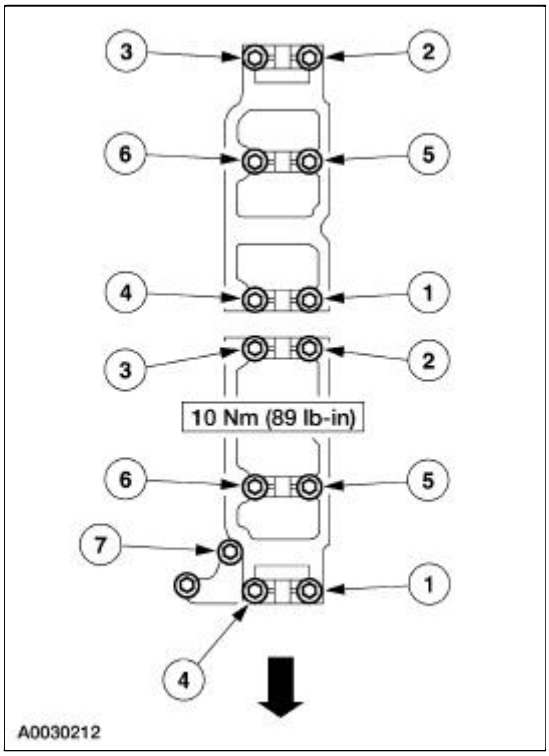


Romeo cylinder heads (4.6L)

2. Install the camshaft and the camshaft bearing caps in their original locations.
    - Lubricate the camshaft bearing caps with clean engine oil.
    - Position the camshaft bearing caps.
    - Install the bolts loosely.

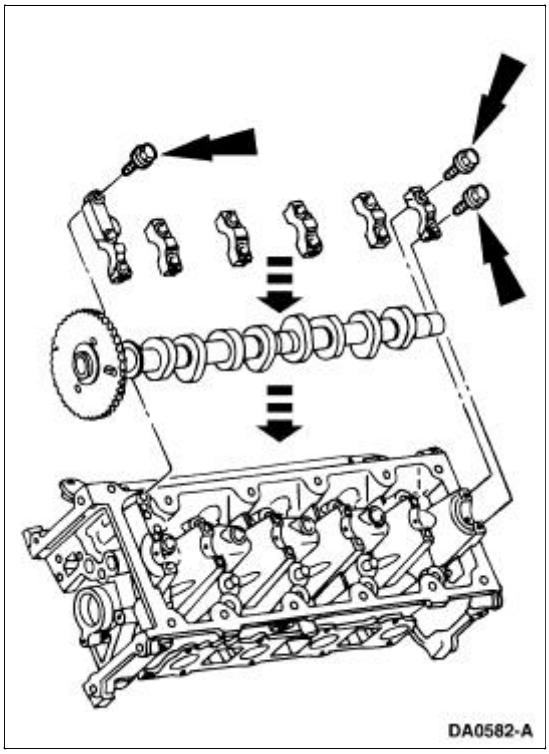


3. Tighten the bolts in the sequence shown.

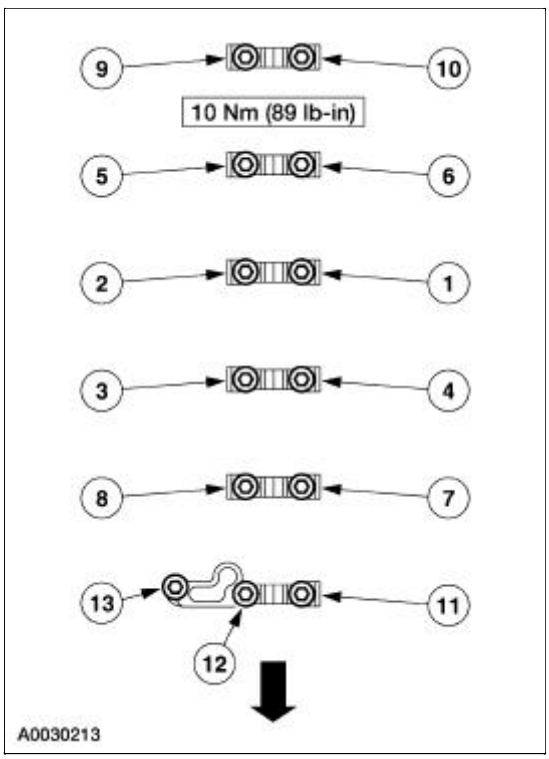


Windsor cylinder heads (5.4L)

4. Install the camshaft and the camshaft bearing caps in their original locations.
    - Lubricate the camshaft bearing caps with clean engine oil.
    - Position the camshaft bearing caps.
    - Install the bolts loosely.



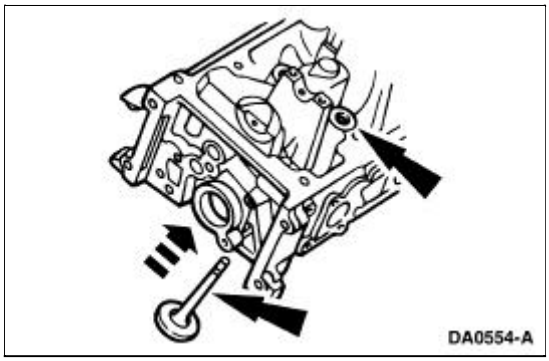
5. Tighten the bolts in the sequence shown.



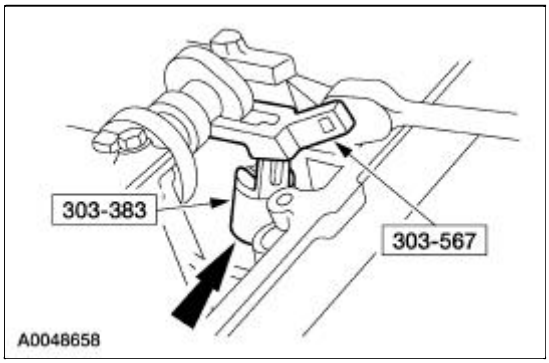
All cylinder heads

6. **NOTE:** Lubricate the valve stems using clean engine oil.

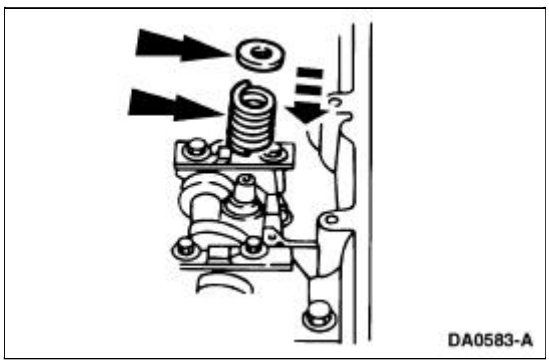
   Install the valves in the valve guides located in the cylinder head.



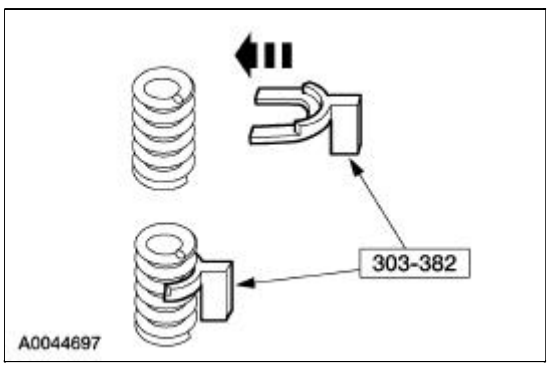
7. Use the special tools to install the valve stem seals.



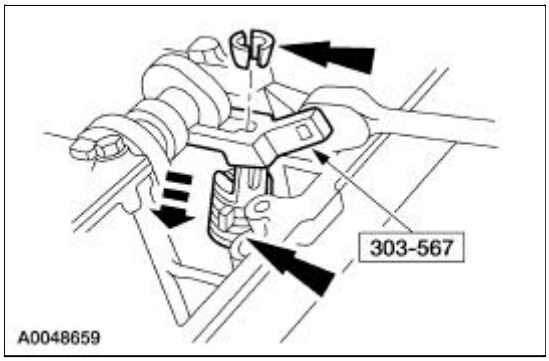
8. Install the valve springs and the valve spring retainers onto the valves.



9. Install the special tool between the valve spring coils to prevent valve stem seal damage.

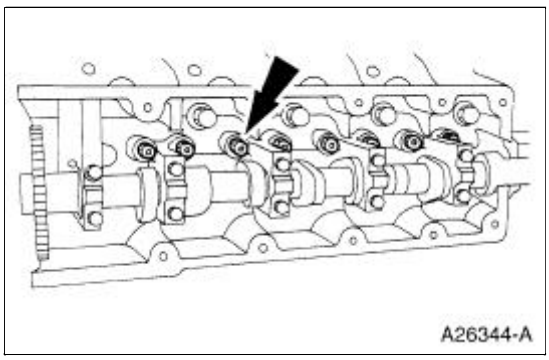


10. Use the special tool to compress the valve springs. Install the valve spring retainer keys.

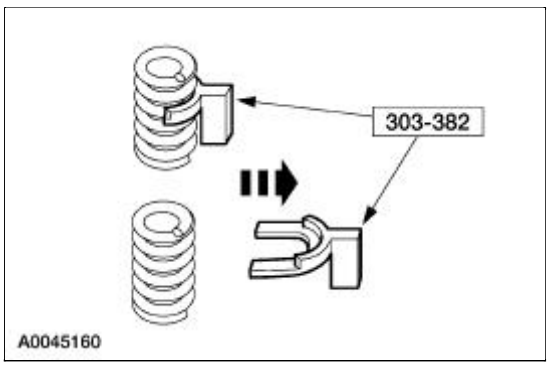


11. **NOTE:** Lubricate the hydraulic lash adjusters using clean engine oil.

    Install the hydraulic lash adjusters in their original locations.



12. Remove the special tool, unless the cylinder head is to be installed in-vehicle.



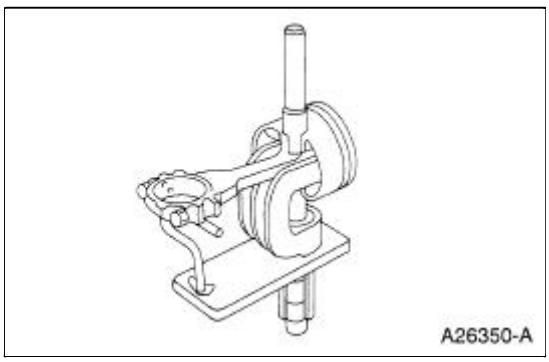
Piston —Pin Connecting Rod, Press Fit

Material

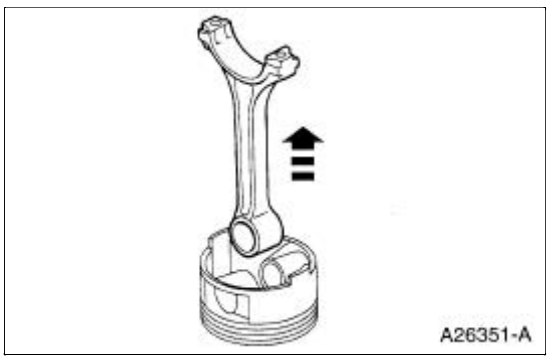
Item	Specification
SAE 5W-20 Premium Synthetic Blend Engine Oil XO-5W20-QSP	WSS-M2C153-H

Disassembly

1. Press the piston pin out from the connecting rod and piston assembly.



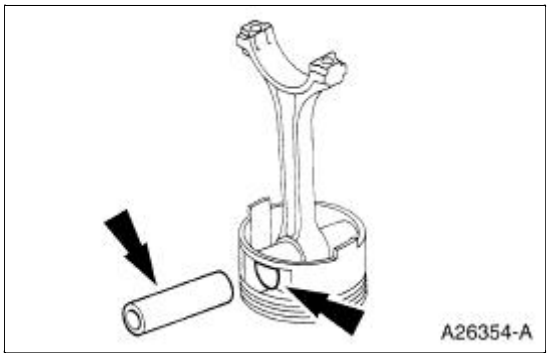
2. Remove the connecting rod (6200) from the piston (6108).



3. Clean and inspect the connecting rod and piston. For additional information, refer to Section 303-00 .

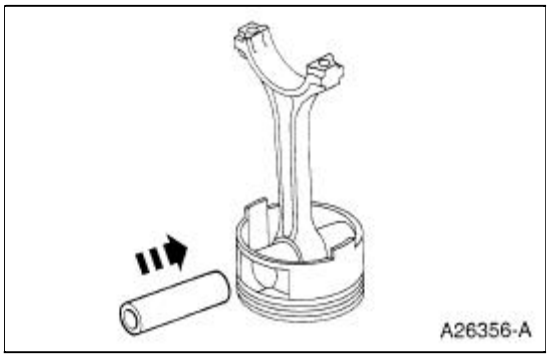
Assembly

1. Lubricate the piston pin (6135) and piston pin bore with clean engine oil.

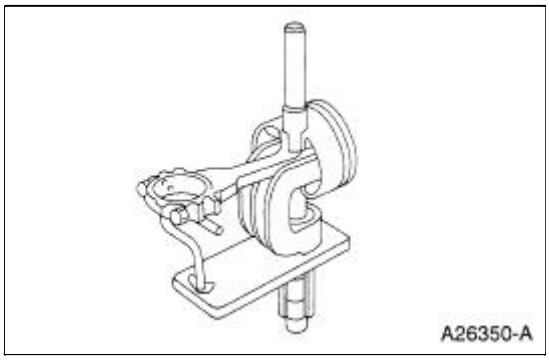


2. **NOTE:** The connecting rod can be installed in either direction.

   Position the piston pin in the bore aligned with the connecting rod bore.



3. Press the piston pin into the piston and rod assembly.



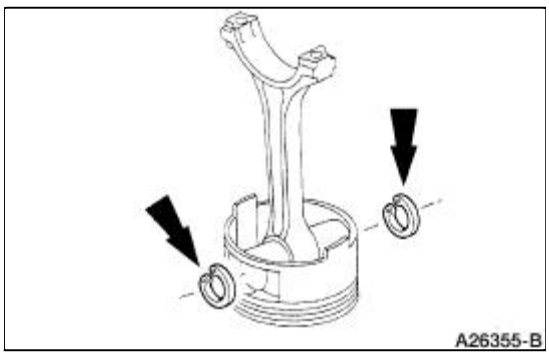
Piston —Pin Connecting Rod, Floating Pin

Material

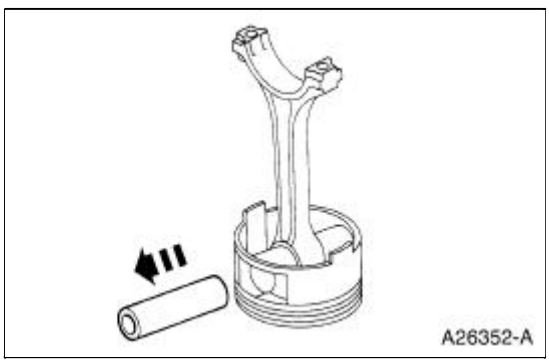
Item	Specification
SAE 5W-20 Premium Synthetic Blend Engine Oil XO-5W20-QSP	WSS-M2C153-H

Disassembly

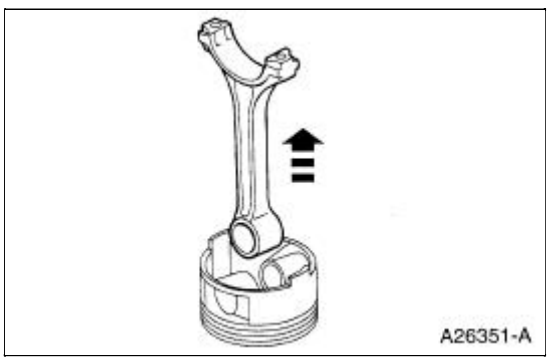
1. Remove the clips.



2. Remove the piston pin (6135) from the piston (6108) and connecting rod assembly.



3. Remove the connecting rod (6200) from the piston.

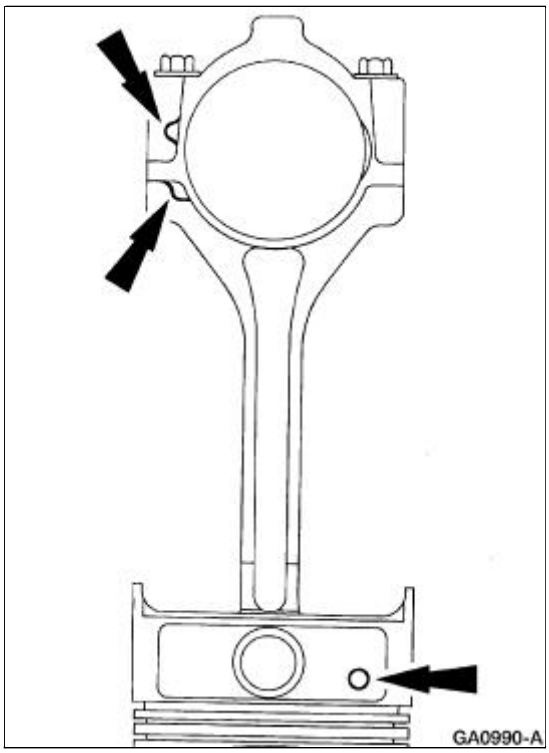


4. Clean and inspect the piston and connecting rod. For additional information, refer to Section 303-00 .

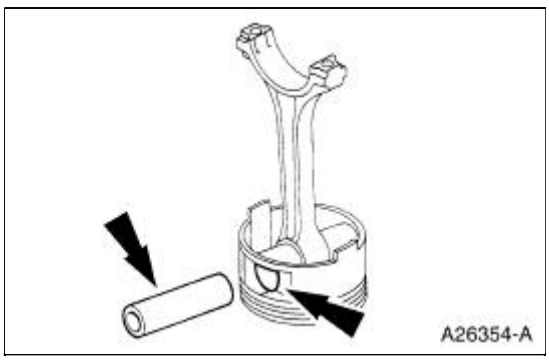
Assembly

1. **NOTE:** Connecting rod must be installed into piston with identification markings toward front.

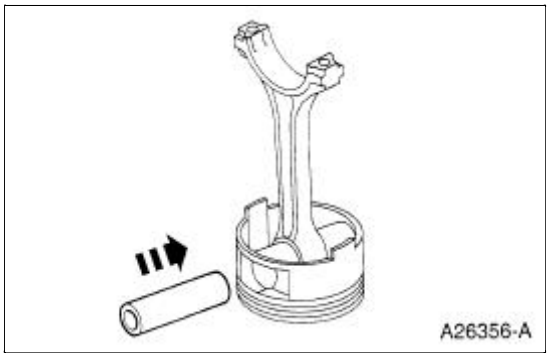
   Position the connecting rod in the piston.



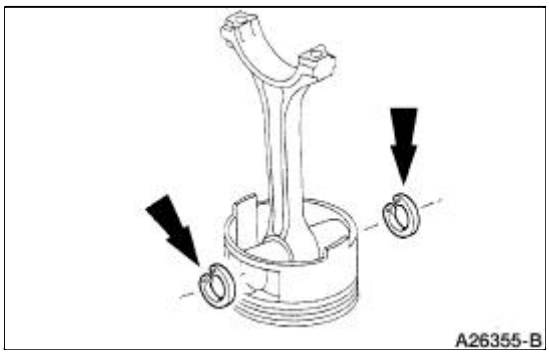
2. Lubricate the piston pin and pin bore with clean engine oil.



3. Install the piston pin in the piston and connecting rod assembly.



4. Install the piston pin retaining clips in the piston.



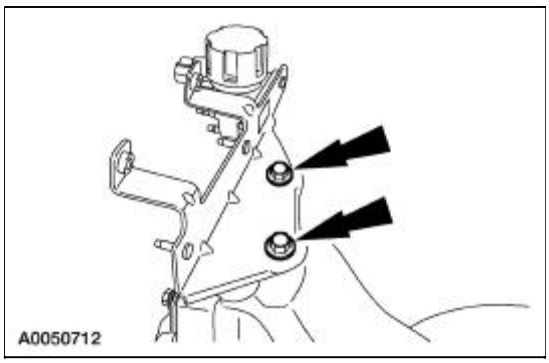
Intake Manifold Assembly —4.6L

Material

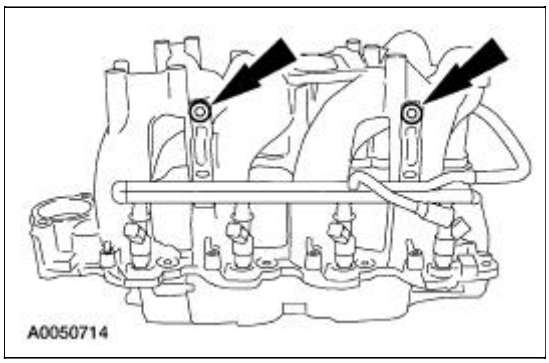
Item	Specification
Motorcraft Silicone Gasket Remover ZC-30	—
Motorcraft Metal Surface Prep ZC-31	—

Disassembly

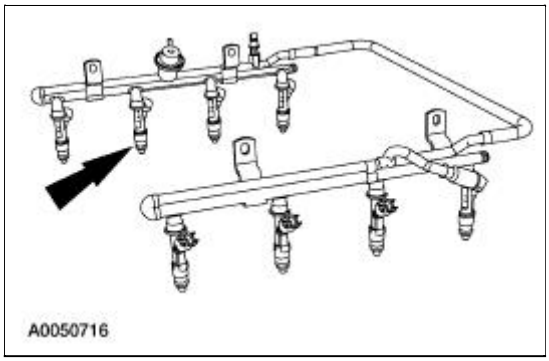
1. Remove the bolts and the exhaust gas recirculation (EGR) vacuum regulator solenoid bracket.



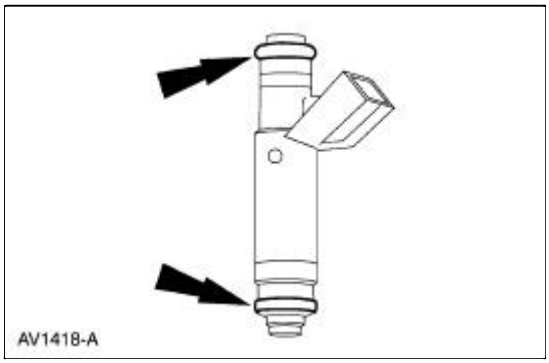
2. Remove the four bolts and the fuel injection supply manifold.



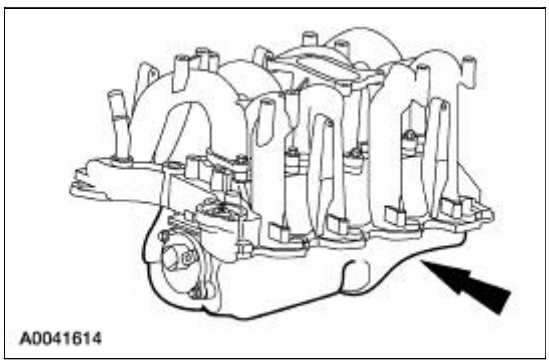
3. Remove the eight fuel injectors from the fuel injection supply manifold.



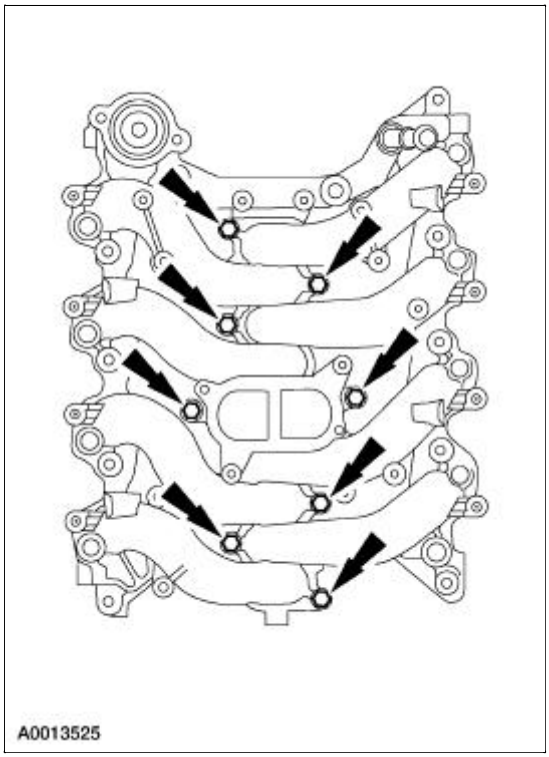
4. Inspect the two O-ring seals from each fuel injector. Install new O-ring seals as needed.



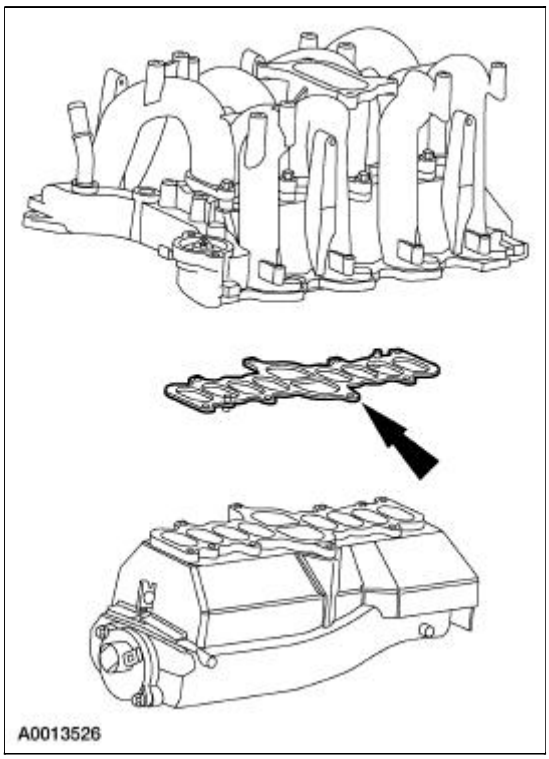
5. Remove the engine noise shield.



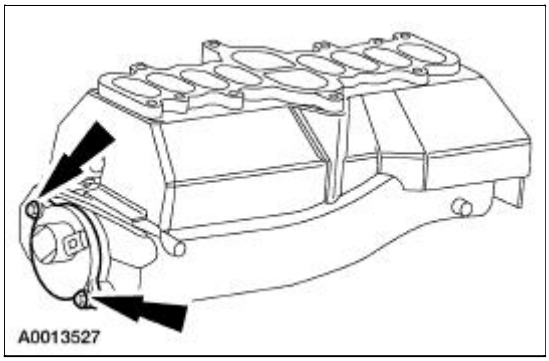
6. Remove the bolts.



7. Separate the upper and lower intake manifolds and discard the lower intake manifold gasket.



8. Remove the bolts and the intake manifold turning valve.



9. **CAUTION: If the engine has been internally damaged and metal or other foreign material has entered the manifold, it is recommended the manifold be discarded.**

   NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the sealing surfaces.

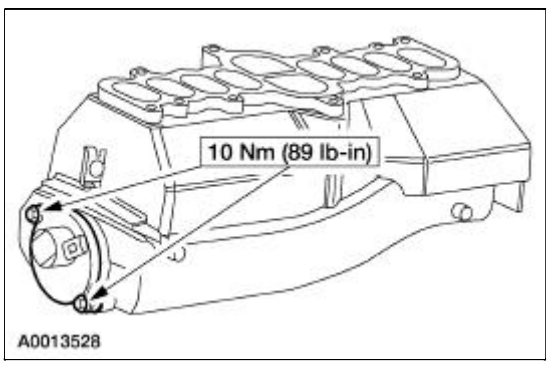
   Inspect all external and internal surfaces of the upper intake manifold.

   - Inspect for cracks or other damage.
   - Inspect for foreign material inside of the manifold.
   - Clean the upper intake manifold sealing surfaces with silicone gasket remover and metal surface prep. Follow the directions on the packaging.

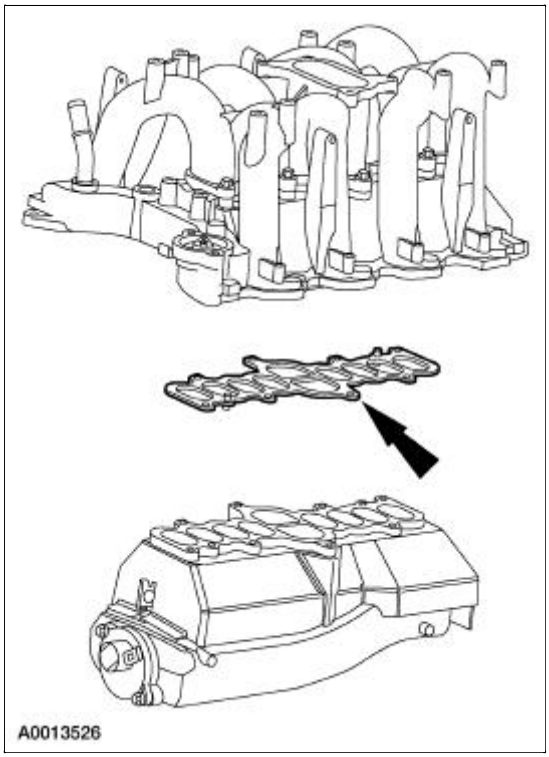
10. Allow the intake manifolds to dry completely.

Assembly

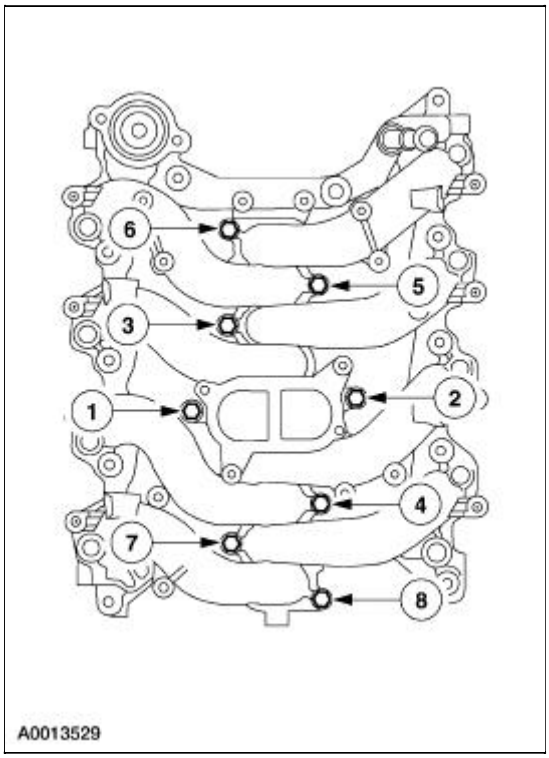
1. Position the intake manifold turning valve. Install the bolts.



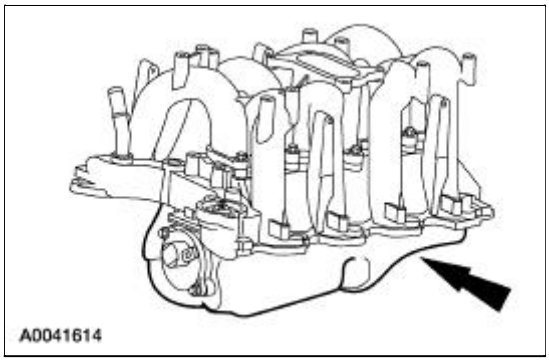
2. Position a new lower intake manifold gasket, and the upper intake manifold, on the lower intake manifold. Loosely install the bolts.



3. Tighten the bolts in two stages in the sequence shown.
    - Stage 1: tighten to 2 Nm (18 lb-in).
    - Stage 2: tighten to 10 Nm (89 lb-in).

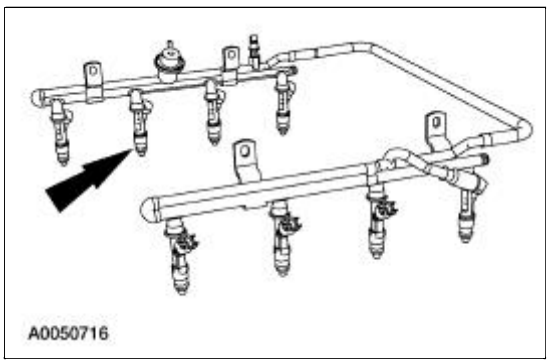


4. Install the engine noise shield.

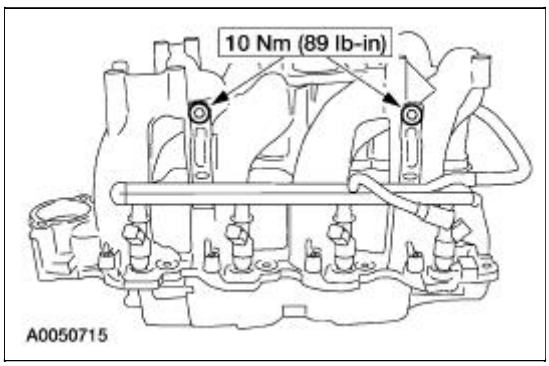


5. **NOTE:** Lubricate the O-ring seals with clean engine oil, to aid installation.

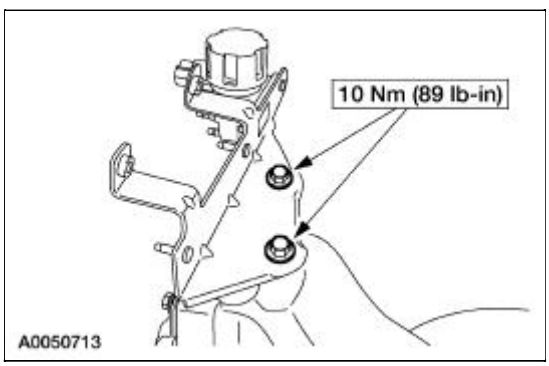
   Install the eight fuel injectors into the fuel injection supply manifold.



6. Position the fuel injection supply manifold. Install the four bolts.



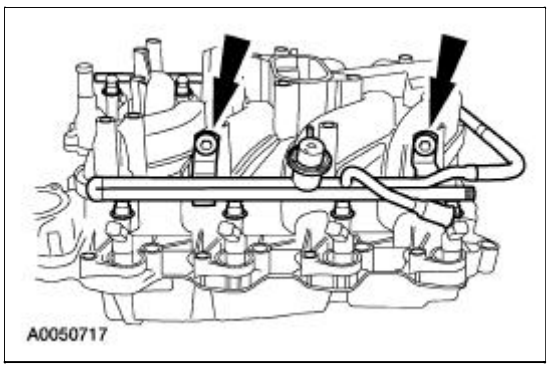
7. Position the EGR vacuum regulator solenoid bracket. Install the bolts.



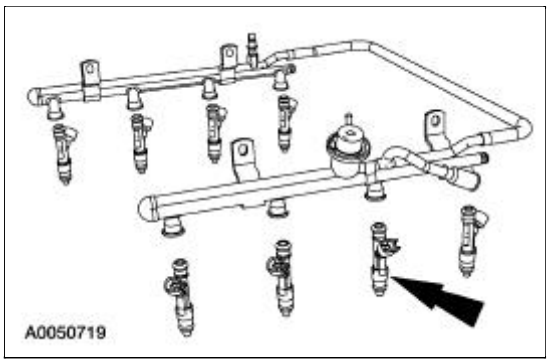
Intake Manifold Assembly —5.4L

Disassembly

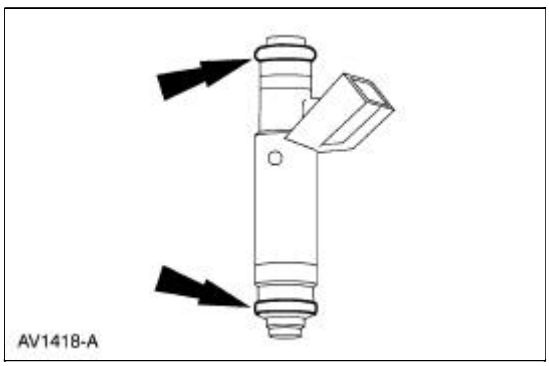
1. Remove the four bolts and the fuel injection supply manifold.



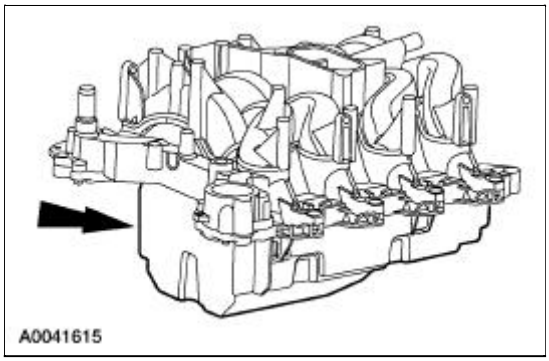
2. Remove the eight fuel injectors from the fuel injection supply manifold.



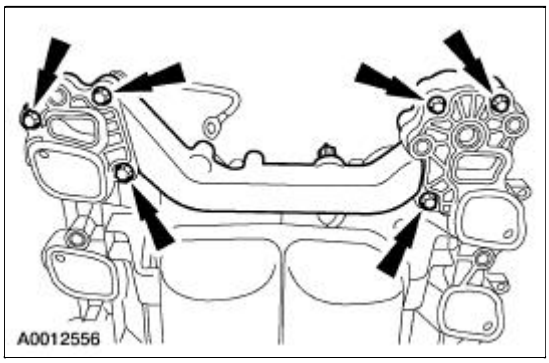
3. Inspect the two O-ring seals from each fuel injector. Install new O-ring seals as needed.



4. Remove the engine noise shield.



5. Remove the bolts and the water crossover tube.
    - Inspect and install new gaskets as necessary.

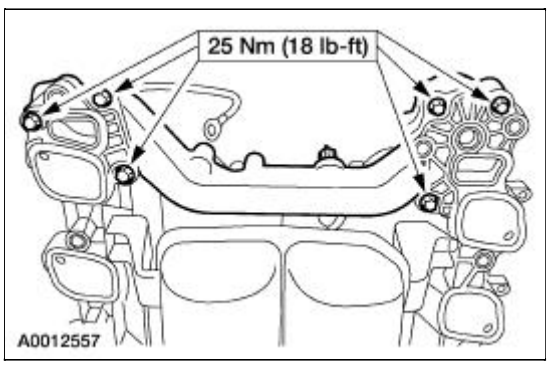


6. **CAUTION: If the engine has been internally damaged and metal or other foreign material has entered the manifold, it is recommended that the manifold be discarded.**

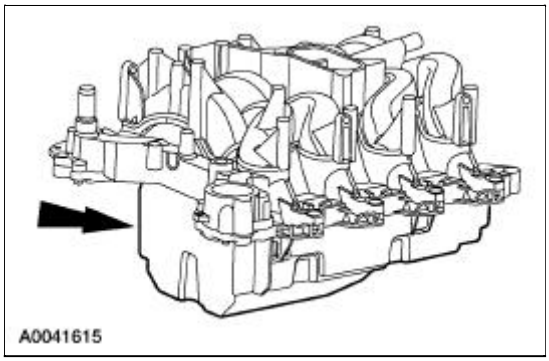
    Inspect all external and internal surfaces of the intake manifold.
    - Inspect for cracks or other damage.
    - Inspect for foreign material inside of the manifold.
    - Clean the intake manifold with a suitable cleaner.

Assembly

1. Position the water crossover tube. Install the bolts.

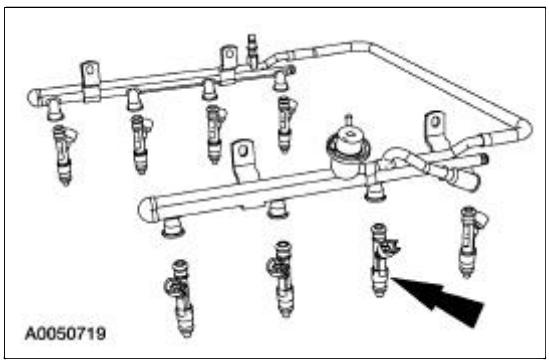


2. Install the engine noise shield.

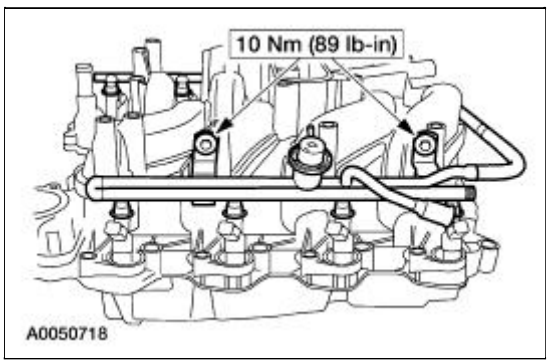


3. **NOTE:** Lubricate the O-ring seals with clean engine oil, to aid installation.

   Install the eight fuel injectors into the fuel injection supply manifold.

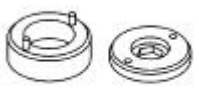
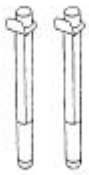
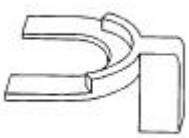


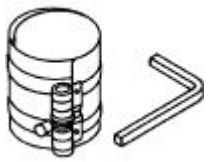
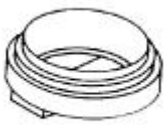
4. Position the fuel injection supply manifold. Install the four bolts.



Engine

Special Tool(s)

 ST2565-A	Alignment Set, Camshaft 303-S568 (T96T-6256-AR)
 ST1337-A	Installer, Connecting Rod 303-442 (T93P-6136-A)
 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)
 ST2197-A	Installer, Crankshaft Front Oil Seal 303-635
 ST1328-A	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A)
 ST1330-A	Compressor, Valve Spring 303-567 (T97P-6565-AH)
 ST1331-A	Compressor Spacer, Valve Spring 303-382 (T91P-6565-AH)
	Compressor, Piston Ring 303-D032 (D81L-6002-C) or equivalent

	
 ST1335-A	Holding Tool, Crankshaft 303-448 (T93P-6303-A)
 ST1480-A	Installer, Crankshaft Rear Oil Seal 303-518 (T95P-6701-DH)
 ST1479-A	Installer, Crankshaft Rear Oil Seal 303-516 (T95P-6701-BH)
 ST1482-A	Installer, Crankshaft Rear Oil Slinger 303-517 (T95P-6701-CH)
 ST2443-A	Lifting Bracket Set, Engine 303-DS086 (D93P-6001-A)
 ST1377-A	Modular Engine Lift Bracket 303-F047 (014-00073) or equivalent

Material

Item	Specification
Motorcraft Silicone Gasket Remover ZC-30	—
Motorcraft Metal Surface Prep ZC-31	—
Silicone Gasket and Sealant	

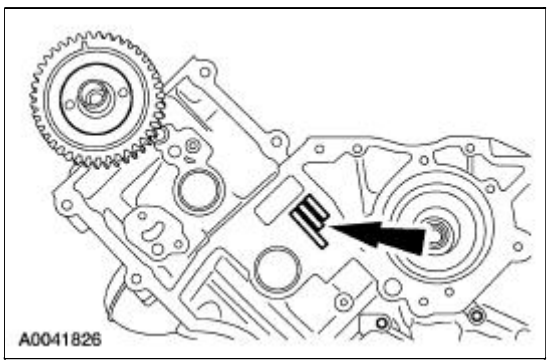
F7AZ-19554-EA or equivalent	WSE-M4G323-A4
Instant Adhesive E8AZ-19554-A	WSK-M2G402-A4
SAE 5W-20 Premium Synthetic Blend Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H
Motorcraft Premium Engine Coolant VC-4-A (in Canada CXC-10; in Oregon VC-5) or equivalent. Do not mix coolant types.	ESE-M97B44-A (Green in color)
Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) or equivalent. Do not mix coolant types.	WSS-M97B51-A1 (Yellow in color)
Hydraulic Chain Tensioner Retaining Clip	1L3Z-6P250-AA

Assembly

All engines

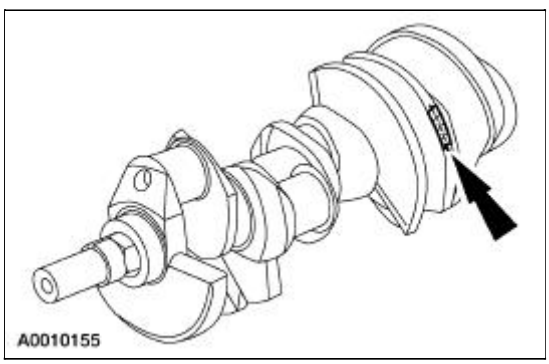
NOTE: During engine assembly it may become necessary to check bearing clearances, end play, etc. For additional information, refer to Section 303-00 .

1. Record the main bearing code found on the front of the engine block.



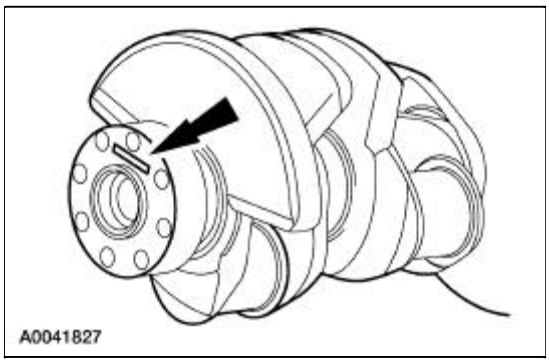
Romeo engine (4.6L)

2. Record the main bearing code found on the crankshaft counterweight.



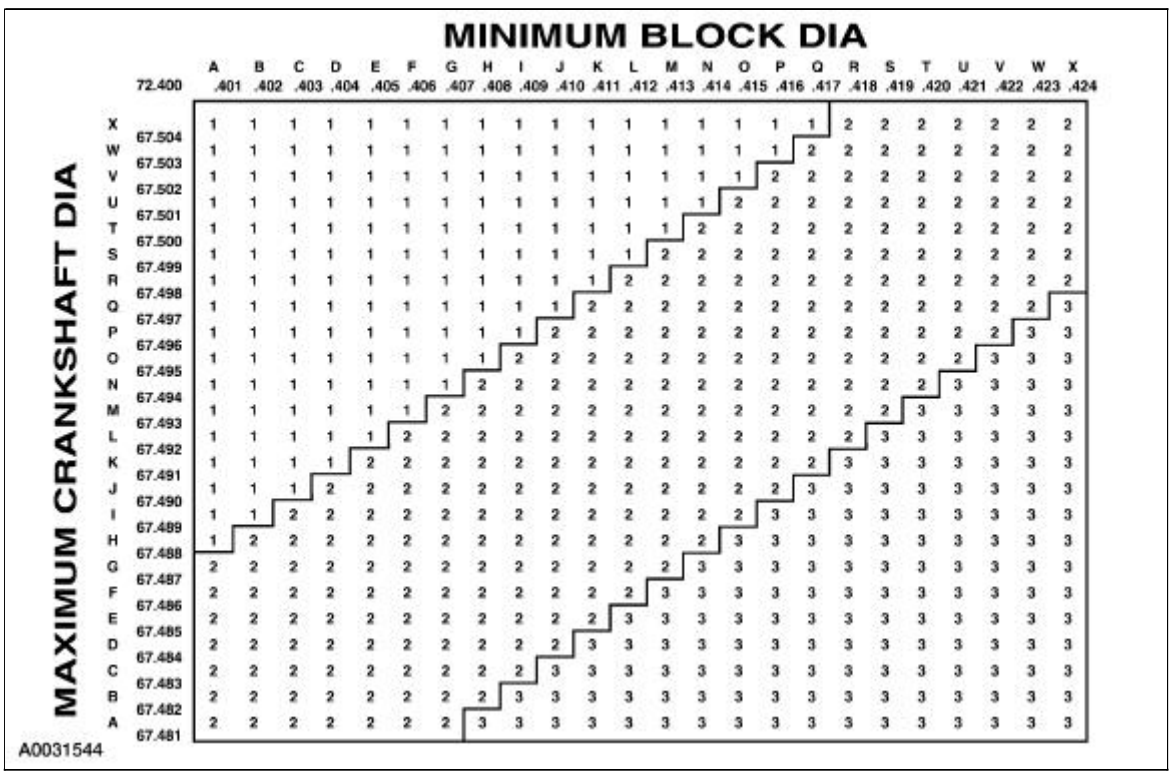
Windsor engine (5.4L)

3. Record the main bearing code found on the back of the crankshaft.



Bearing Select Fit Chart, Standard Bearings, All Engines

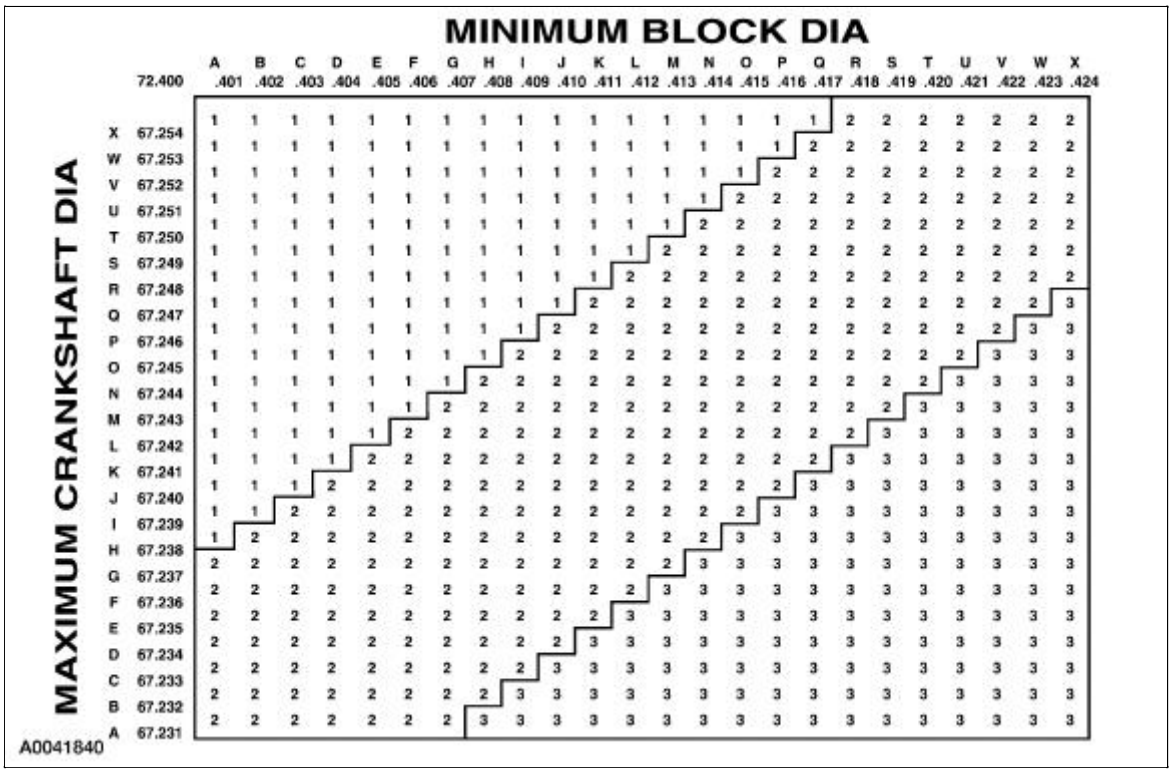
4. Using the data recorded earlier and the Bearing Select Fit Chart, Standard Bearings determine the required bearing grade for each main bearing.
    - Read the first letter of the engine block main bearing code and the first letter of the crankshaft main bearing code.
    - Read down the column below the engine block main bearing code letter, and across the row next to the crankshaft main bearing code letter, until the two intersect. This is the required bearing grade for the number one crankshaft main bearing.
    - As an example, if the engine block code letter is "F" and the crankshaft code letter is "D", the correct bearing grade for this main bearing is a "2".
    - Repeat this process for the remaining four main bearings.



Bearing Select Fit Chart, Oversize Bearings, All Engines

5. If oversize bearings are being used, use the procedure in the previous step and the Bearing

Select Fit Chart, Oversize Bearings to determine the required bearing grade for each main bearing.



All engines

6. **NOTE:** Before assembling the cylinder block, all sealing surfaces must be free of chips, dirt, paint and foreign material. Also, make sure the coolant and oil passages are clear.

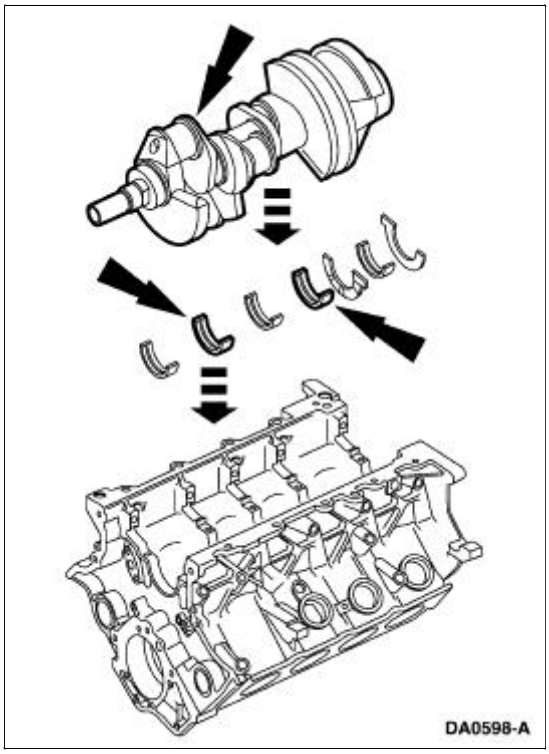
   Install the crankshaft main bearings.

   - Install the crankshaft upper main bearings into the cylinder block.
   - Install the crankshaft lower main bearings into the bearing caps.
   - Make sure all oil passages are aligned.
   - Lubricate all main bearings with clean engine oil.

Windsor engine (5.4L)

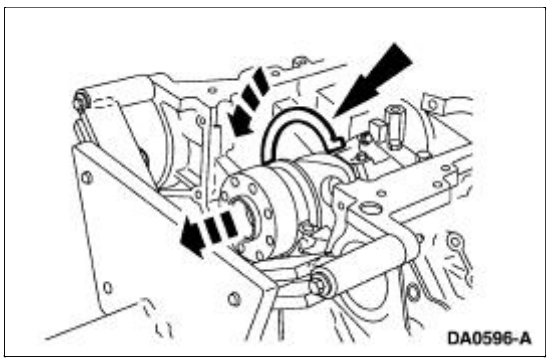
7. **NOTE:** The upper thrust washers are shown for location purposes only. Do not install the upper thrust washers until the crankshaft is installed. Refer to the following two steps.

   Lubricate the crankshaft bearing journals with clean engine oil. Install the crankshaft onto the upper crankshaft main bearings.



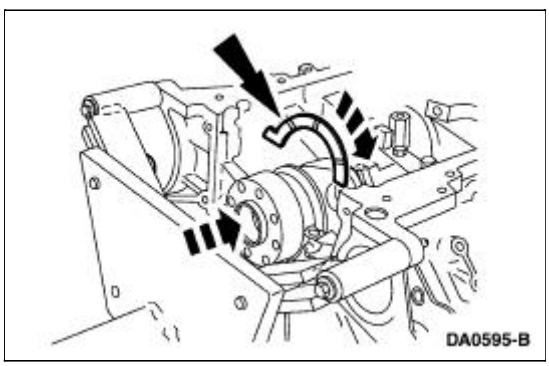
8. **NOTE:** The oil groove on the thrust washer must face toward the front of the engine (against the crankshaft thrust surface).

   Push the crankshaft rearward and install the rear crankshaft upper thrust washer at the back of the No. 5 main boss.



9. **NOTE:** The oil groove on the thrust washer must face toward the front of the engine (against the crankshaft surface).

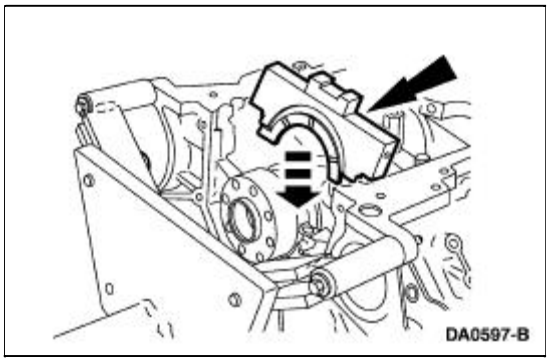
   Push the crankshaft forward and install the front crankshaft upper thrust washer at the front of the No. 5 main boss.



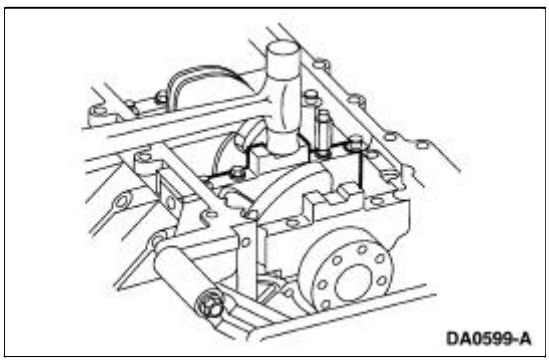
10. **NOTE:** To aid in assembly, apply petroleum jelly to the back of the crankshaft thrust washer.

    NOTE: The oil groove on the thrust washer must face toward the rear of the engine (crankshaft surface).

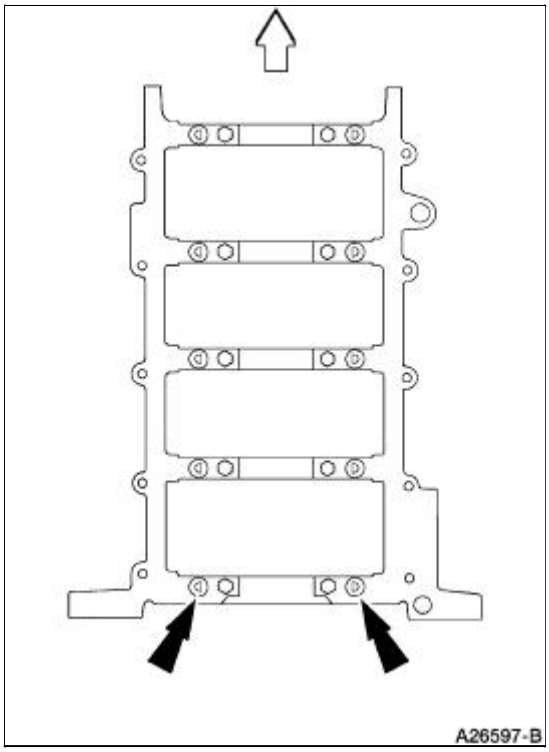
    Install the lower crankshaft thrust washer to the back side of the rear (No. 5) main bearing cap, with oil grooves facing the crankshaft surface. Install the rear (No. 5) main bearing cap.



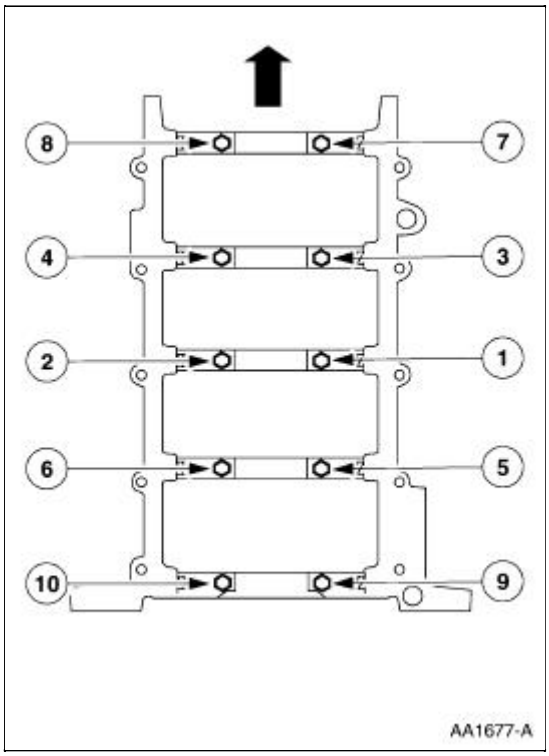
11. Locate the main bearing caps on the cylinder block and tap into place using a plastic or dead-blow hammer.



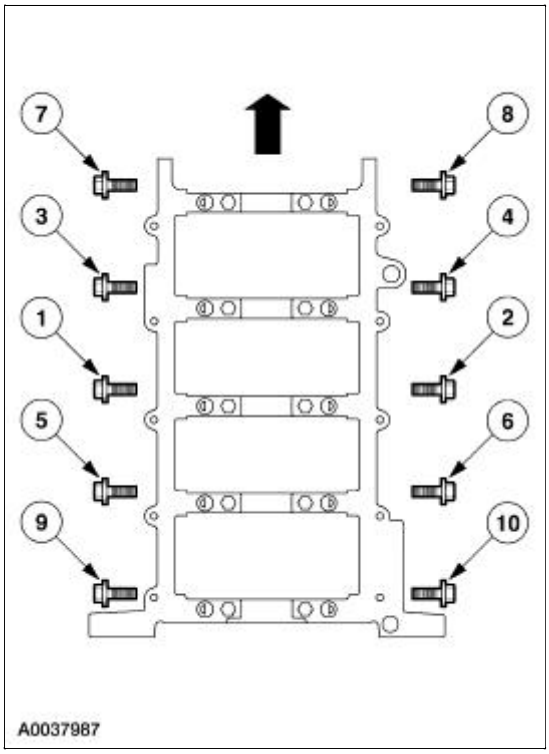
12. Install the dowel pins so the flat sides face the crankshaft, and are parallel to it.



13. Install the vertical main bearing cap fasteners and tighten in the sequence shown, in two stages.
    - Stage 1: tighten to 40 Nm (30 lb-ft).
    - Stage 2: tighten an additional 90 degrees.

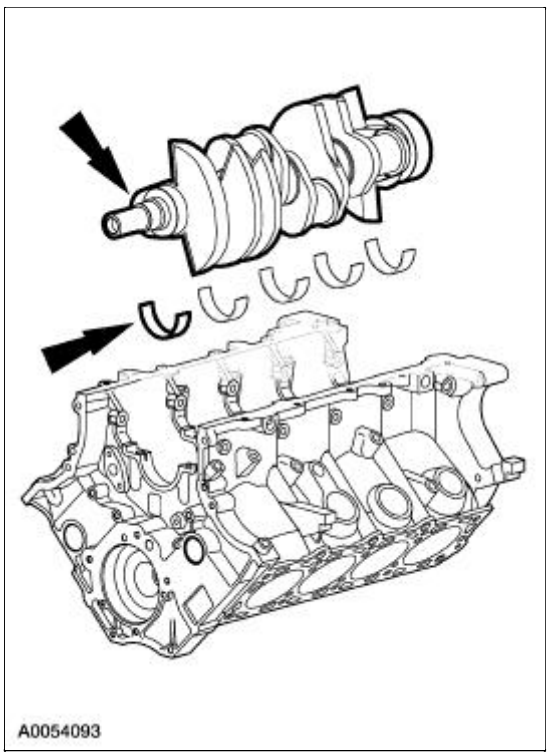


14. Install the side bolts and tighten in the sequence shown, in two stages.
    - Stage 1: tighten to 30 Nm (22 lb-ft).
    - Stage 2: tighten an additional 90 degrees.



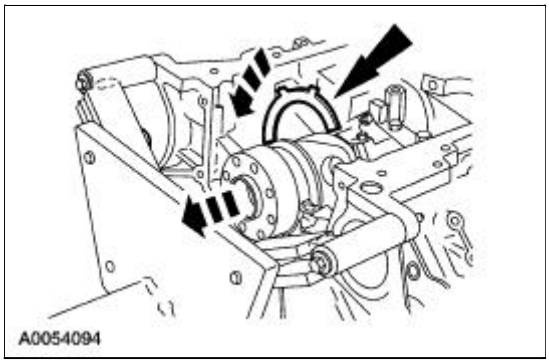
Romeo engine (4.6L)

15. Lubricate the crankshaft bearing journals with clean engine oil. Install the crankshaft onto the upper crankshaft main bearings.

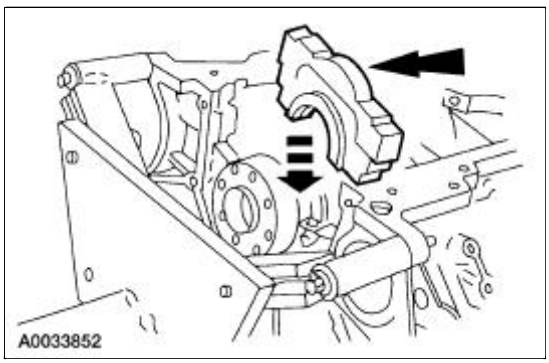


16. **NOTE:** The oil groove on the thrust washer must face toward the front of the engine (against the crankshaft thrust surface).

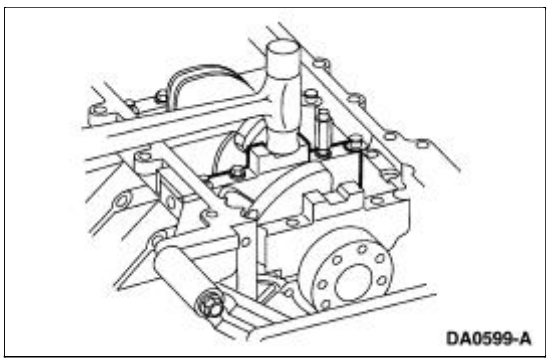
    Push the crankshaft rearward and install the crankshaft upper thrust washer at the back of the No. 5 upper main bearing.



17. Install the rear (No. 5) main bearing cap.

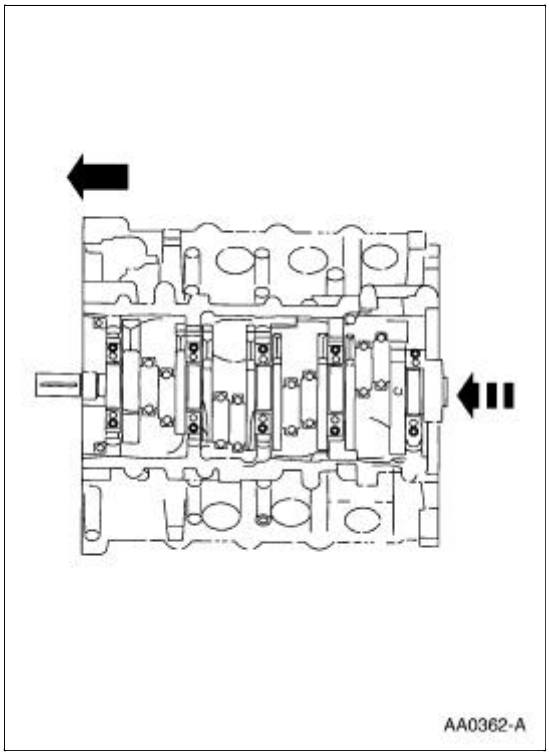


18. Locate the main bearing caps on the cylinder block and tap into place using a plastic or dead-blow hammer.

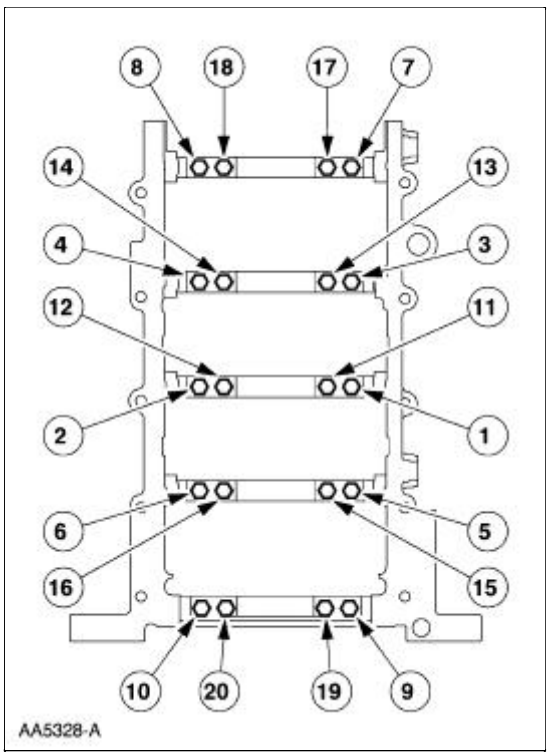


19. Loosely install all main bearing cap bolts.

20. Push the crankshaft forward to seat the crankshaft thrust washer. Hold the crankshaft in the forward position.

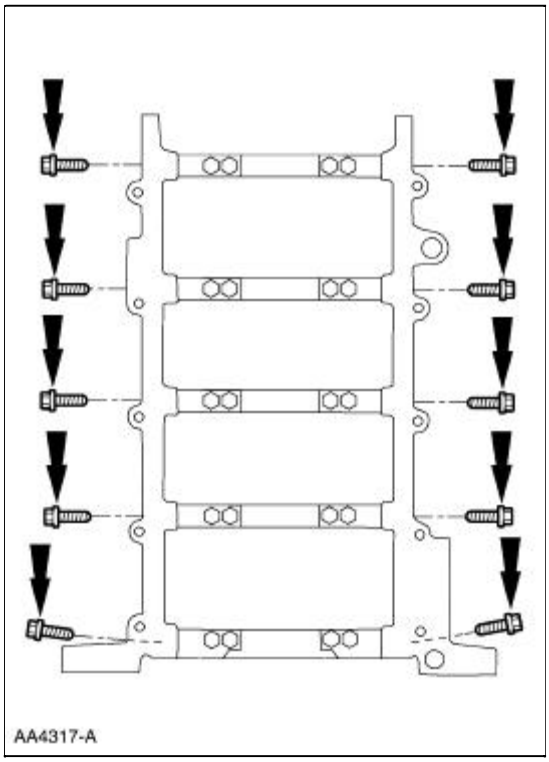


21. Tighten the vertical main bearing cap fasteners in the sequence shown, in four stages.
    - Stage 1: tighten to 10 Nm (89 lb-in).
    - Stage 2: tighten to 25 Nm (18 lb-ft).
    - Stage 3: tighten to 40 Nm (30 lb-ft).
    - Stage 4: tighten an additional 90 degrees.



22. Tighten the side bolts in the sequence shown, in two stages.
    - Stage 1: tighten to 40 Nm (30 lb-ft).

- Stage 2: tighten an additional 90 degrees.



All engines

23. Check the crankshaft end play. For additional information, refer to Section 303-00 .

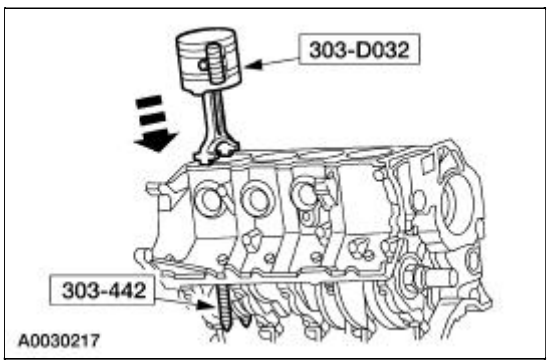
24. Check that crankshaft torque-to-turn does not exceed 6 Nm (53 lb-in).

25. **CAUTION: Do not scratch the cylinder walls or crankshaft journals with the connecting rod.**

    NOTE: The next three steps are for all eight connecting rods, rod caps and pistons. Only one connecting rod, rod cap and piston is shown.

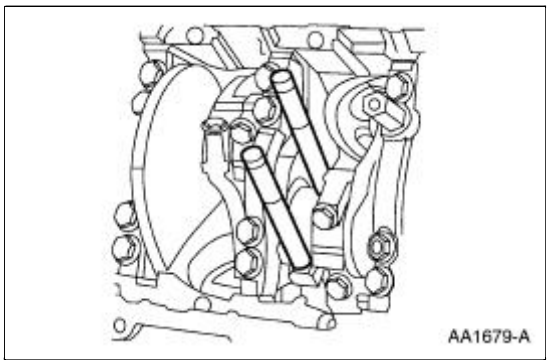
    NOTE: Make sure the identification marks on the piston and connecting rod face the front of the engine.

    Use the special tools to install the piston and connecting rod with the upper connecting rod bearing in place.



26. **CAUTION: Do not scratch the cylinder walls or crankshaft journals with the connecting rod.**

Once the connecting rod is seated on the crankshaft journal, remove the Connecting Rod Installer.



27. **CAUTION: The rod cap installation must keep the same orientation as marked during disassembly.**

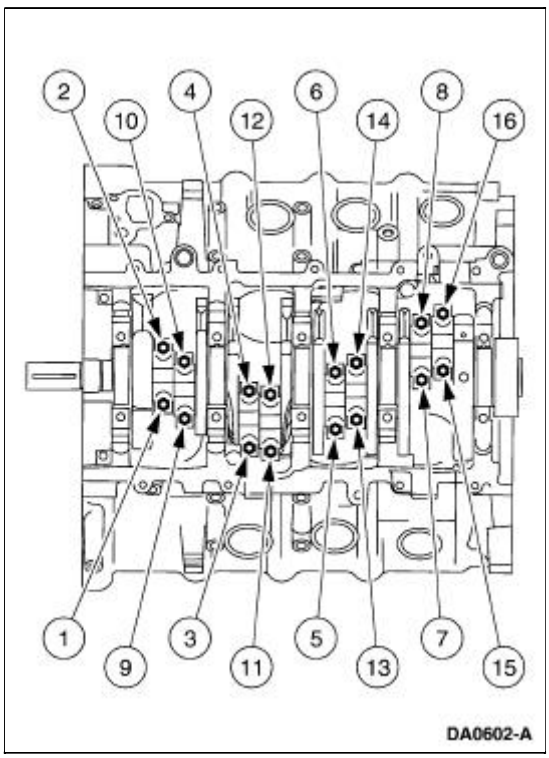
NOTE: The connecting rod caps are of the "cracked" design and must mate with the connecting rod ends. Excessive bearing clearance will result if not mated correctly.

Position the lower bearing and connecting rod, and install the new bolts loosely.

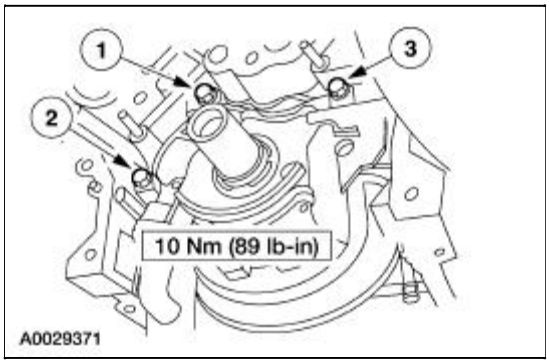
28. **NOTE:** Main bearing caps are removed for clarity.

Tighten the bolts in the sequence shown, in two stages.

- Stage 1: tighten to 43 Nm (32 lb-ft).
- Stage 2: tighten an additional 90-120 degrees.



29. Position the oil pump and install the bolts loosely. Tighten the bolts in the sequence shown.



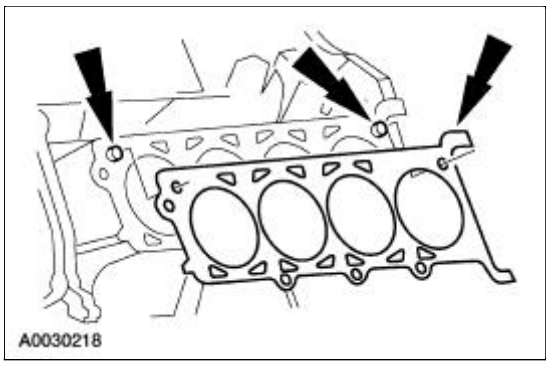
30. **CAUTION: Make sure all coolant residue and foreign material are cleaned from the block surface and cylinder bore.**

CAUTION: The use of sealing aids (aviation cement, copper spray and glue) is not permitted. The gasket must be installed dry.

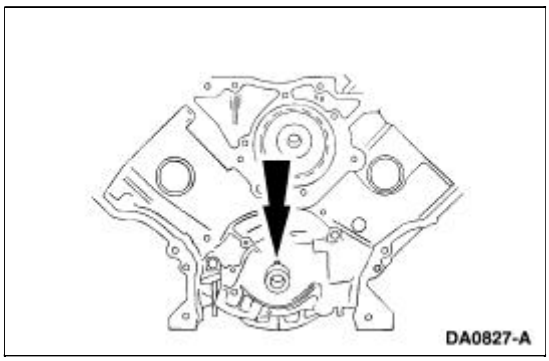
CAUTION: The new gasket has a film coating which is crucial to the gasket's ability to seal correctly. Do not scratch the gasket.

NOTE: RH is shown; LH is similar.

Position the head gasket over the dowel pins.



31. Rotate the crankshaft until the crankshaft keyway points toward the top of the engine (12 o'clock).



32. **CAUTION: The cylinder head bolts must be discarded and new bolts installed. They**

are tighten-to-yield designed and cannot be reused.

CAUTION: Cylinder head machining or milling is not authorized by the Ford Motor Company. Cylinder head flatness must be within 0.0254 mm (0.001 in) across a 38.1 mm (1.5 in) square area.

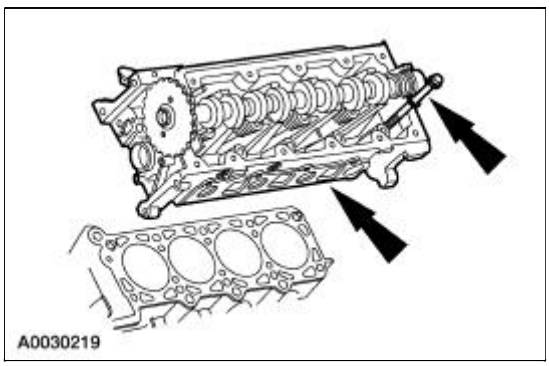
CAUTION: The use of sealing aids (aviation cement, copper spray, and glue) is not permitted. The gasket must be installed dry.

CAUTION: Do not allow the dowels to scratch the sealing surface of the cylinder head during cylinder head installation.

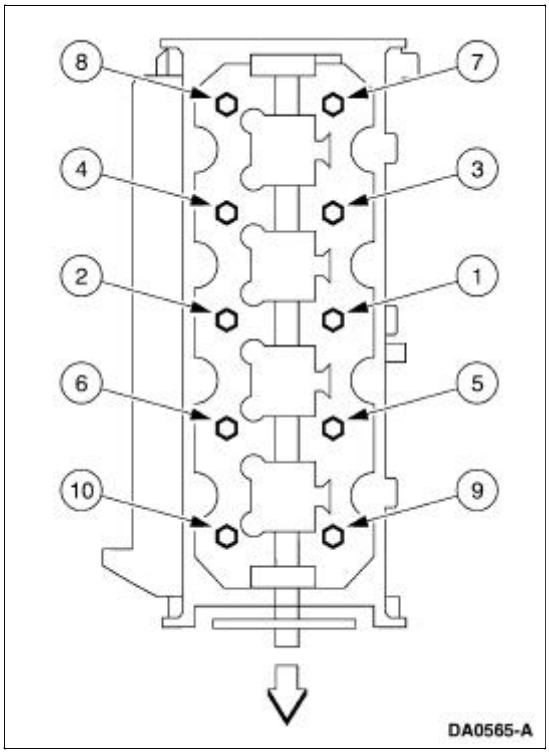
NOTE: The new cylinder head bolts must be lightly oiled with a rag, and allowed to drain for a few minutes prior to installation.

NOTE: RH is shown; LH is similar.

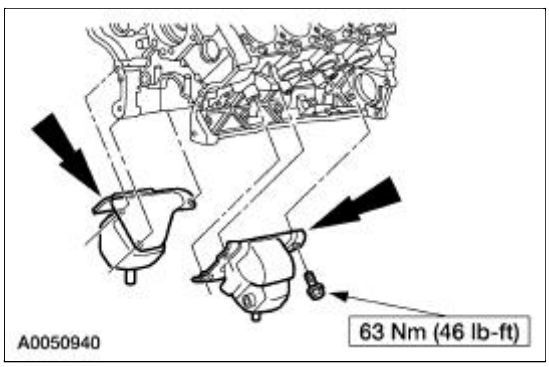
Position the cylinder head over the dowels and head gasket and install the new cylinder head bolts loosely.



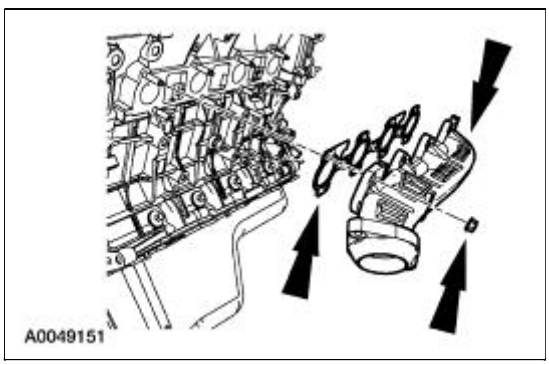
33. Tighten the bolts in the sequence shown, in three stages.
RH is shown; LH is similar.
    - Stage 1: tighten to 40 Nm (30 lb-ft).
    - Stage 2: tighten an additional 90 degrees.
    - Stage 3: tighten an additional 90 degrees.



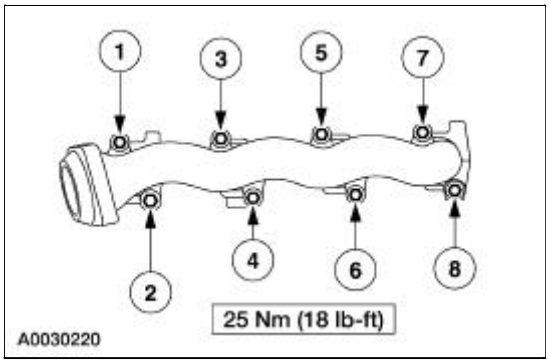
34. Position the engine mounts and install the six bolts.



35. Position the RH exhaust manifold gasket and the exhaust manifold. Loosely install the nuts.



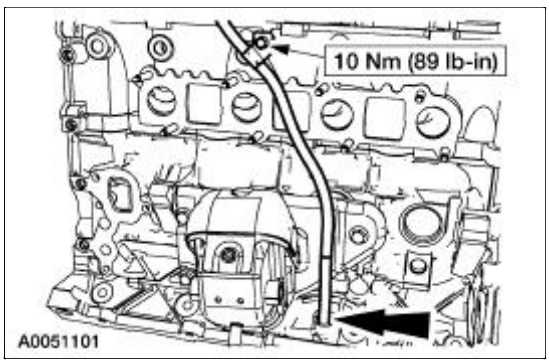
36. Tighten the RH exhaust manifold nuts in the sequence shown.



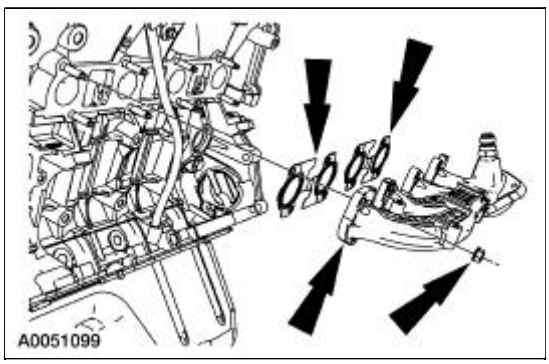
37. **NOTE:** Lubricate the O-ring seal with clean engine oil.

    Install the oil level indicator tube.

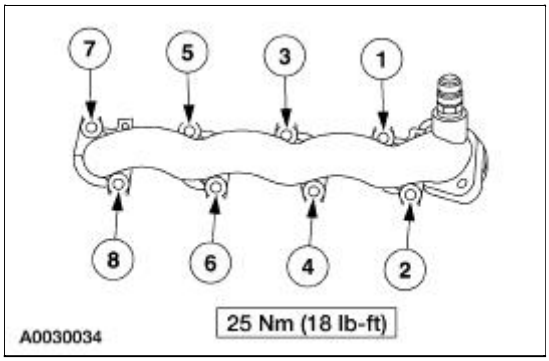
    - Install a new O-ring seal on the oil level indicator tube.
    - Install the oil level indicator tube.
    - Install the bolt.



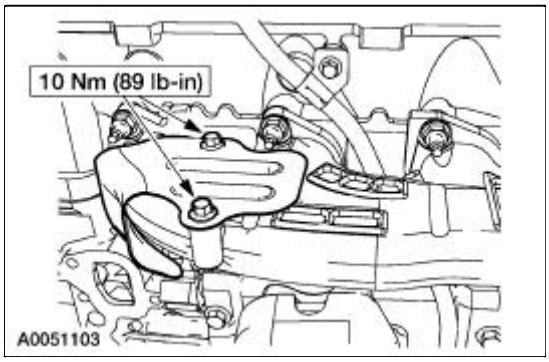
38. Position the LH exhaust manifold gaskets and the exhaust manifold. Loosely install the nuts.



39. Tighten the LH exhaust manifold nuts in the sequence shown.

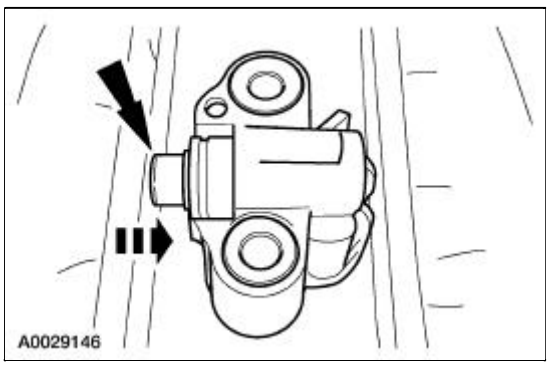


40. Install the heat shield and bolts.

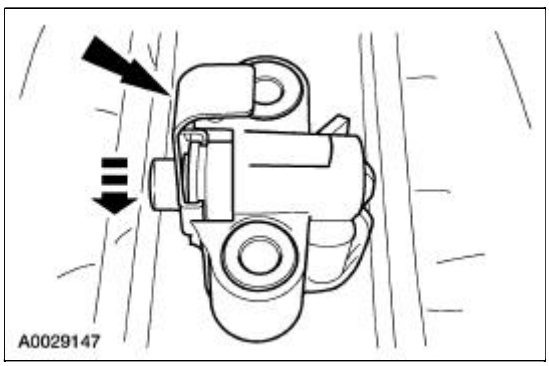


41. **CAUTION: Timing chain procedures must be followed exactly or damage to valves and pistons will result.**

    Compress the tensioner plunger, using a vise.



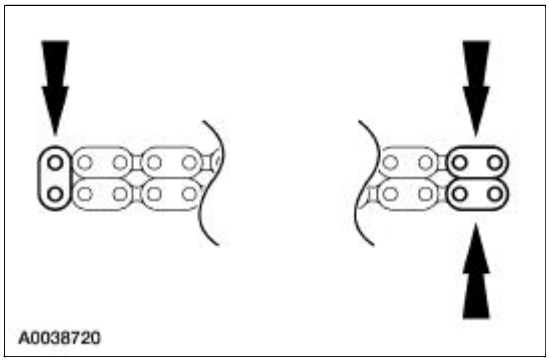
42. Install a retaining clip on the tensioner to hold the plunger in during installation.



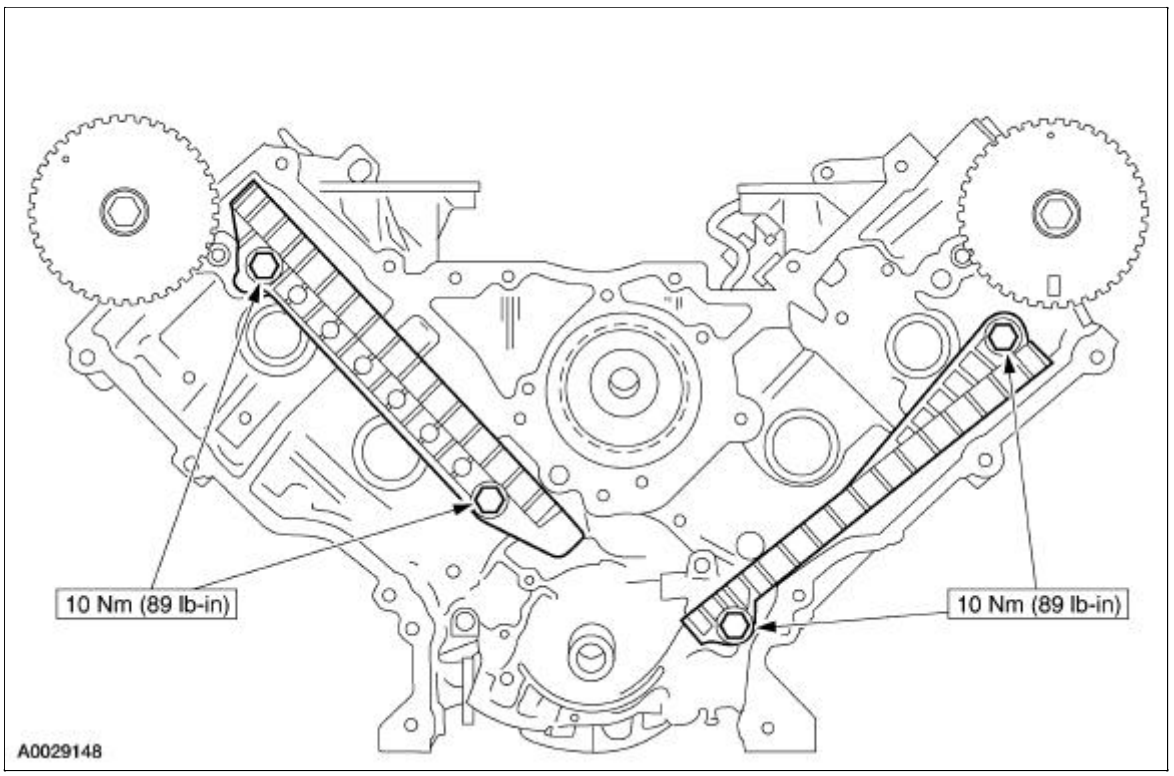
43. Remove the tensioner from the vise.

Windsor engine (5.4L)

44. If the copper links are not visible, mark two links on one end and one link on the other end, and use as timing marks.

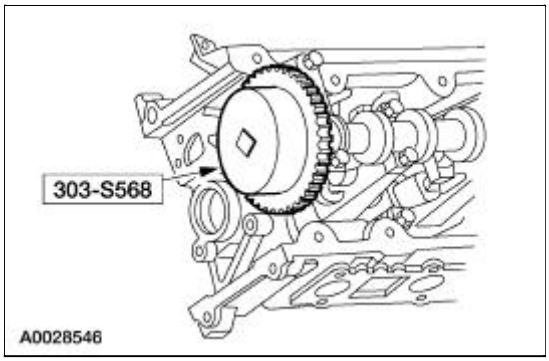


45. Install the timing chain guides.



46. **CAUTION: Do not turn the engine over with the Camshaft Positioning Tool or damage to the camshaft sprocket or the bolt can occur.**

Install the special tool.

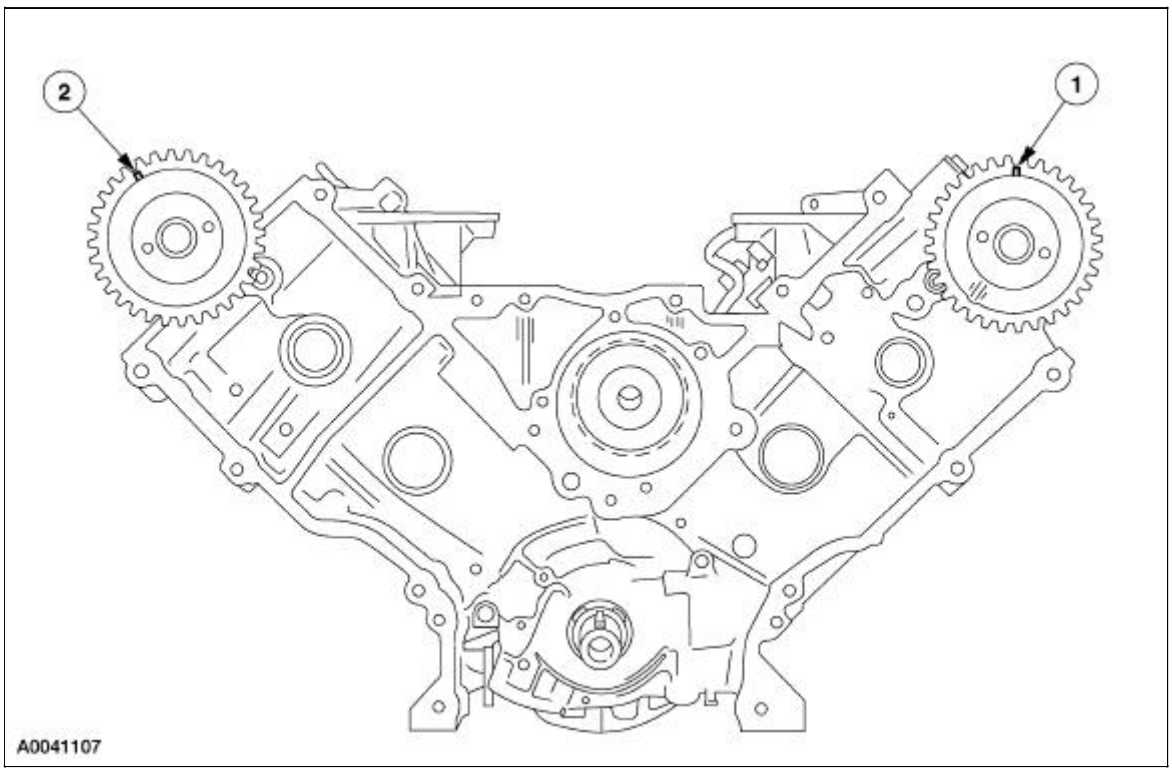


47. **NOTE:** Slightly loosen the Camshaft Holding Tool to allow slight camshaft movement.

Pre-position the camshafts.

1. Rotate the LH camshaft with the Camshaft Positioning Tool until the timing mark is approximately at 12 o'clock.
2. Rotate the RH camshaft with the Camshaft Positioning Tool until the timing mark is approximately at 11 o'clock.

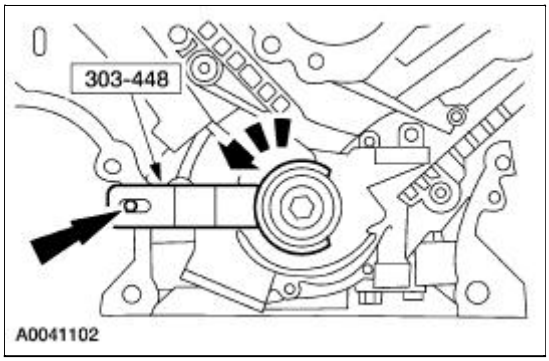
- Tighten the Camshaft Holding Tool to maintain camshaft pre-positioning.



48. **CAUTION: Rotate the crankshaft counterclockwise only. Do not rotate past position shown or severe piston and valve damage can occur.**

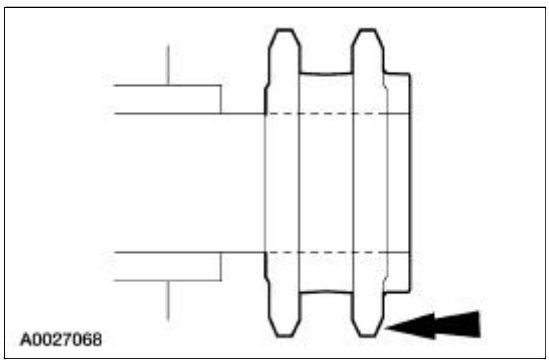
NOTE: When the stud on the engine block fits into the slot in the handle of the special tool, the number one piston is at top dead center (TDC).

Position the crankshaft so the number one cylinder is at TDC with the special tool.

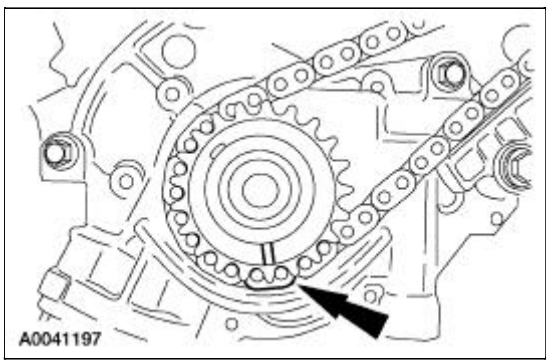


49. Remove the special tool.

50. Install the crankshaft sprocket, making sure the flange faces forward.



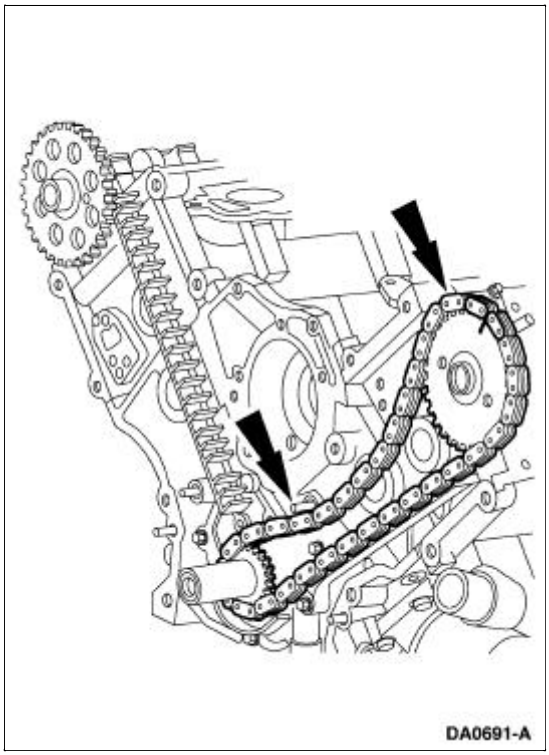
51. Position the lower end of the LH (inner) timing chain on the crankshaft sprocket, aligning the timing mark on the outer flange of the crankshaft sprocket with the single copper (marked) chain link.



52. **NOTE:** Make sure the upper half of the timing chain is below the tensioner arm dowel.

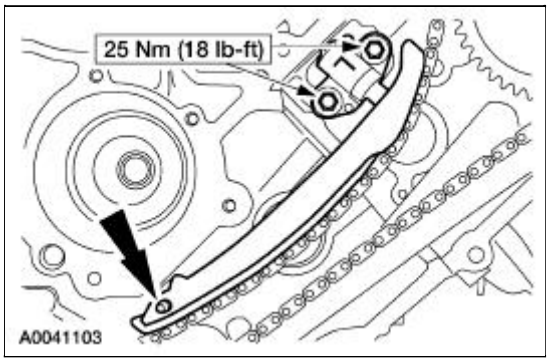
    NOTE: If necessary, use the Camshaft Positioning Tool to adjust the camshaft sprocket slightly to obtain timing mark alignment.

    Position the LH timing chain on the camshaft sprocket. Make sure the camshaft sprocket timing mark is positioned between the two copper (marked) chain links.

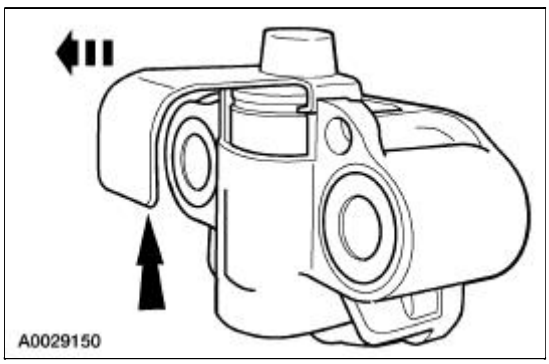


53. **NOTE:** The LH timing chain tensioner arm has a bump near the dowel hole for identification.

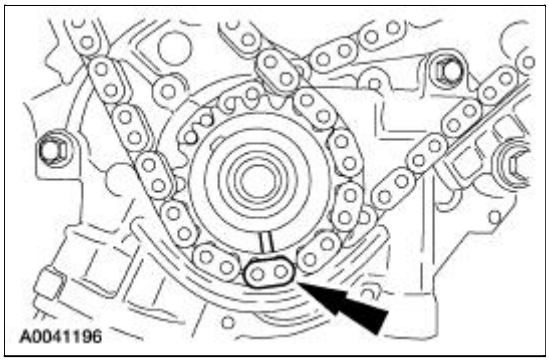
    Position the LH timing chain tensioner arm on the dowel pin and install the LH timing chain tensioner.



54. Remove the retaining clip from the LH timing chain tensioner.



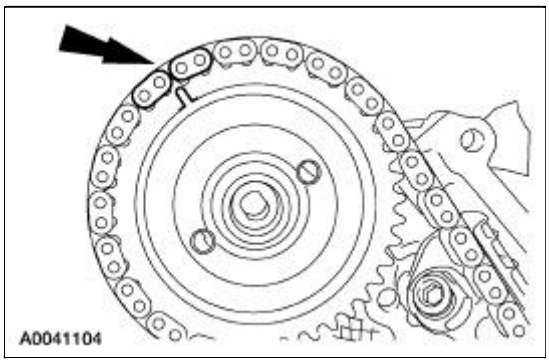
55. Position the lower end of the RH (outer) timing chain on the crankshaft sprocket, aligning the timing mark on the sprocket with the single copper (marked) chain link.



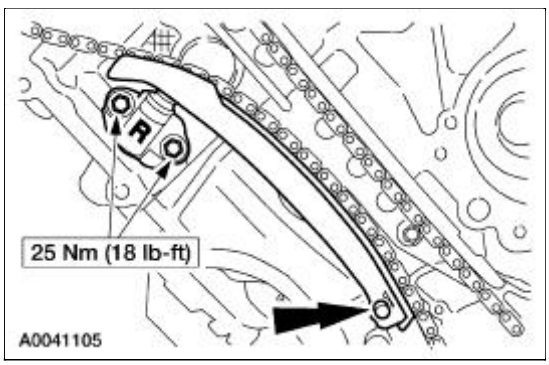
56. **NOTE:** The lower half of the timing chain must be positioned above the tensioner arm dowel.

    NOTE: If necessary, use the Camshaft Positioning Tool to adjust the camshaft sprocket slightly to obtain timing mark alignment.

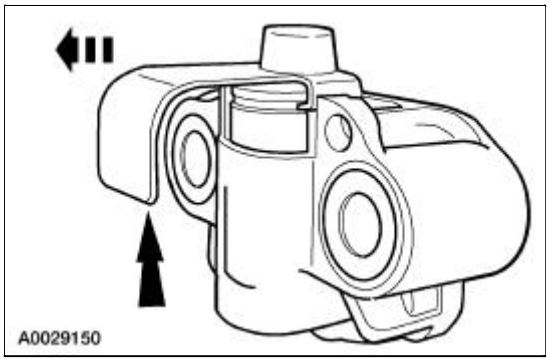
    Position the RH timing chain on the camshaft sprocket. Make sure the camshaft sprocket timing mark is positioned between the two copper (marked) chain links.



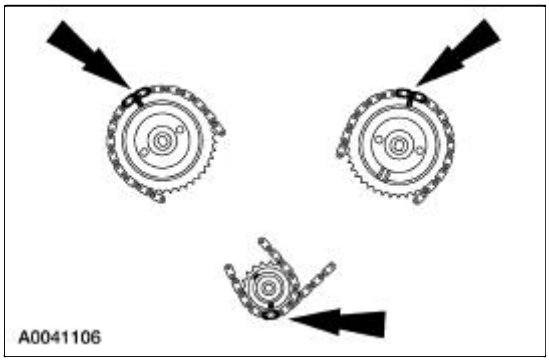
57. Position the RH timing chain tensioner arm on the dowel pin and install the RH timing chain tensioner.



58. Remove the retaining clip from the RH timing chain tensioner.

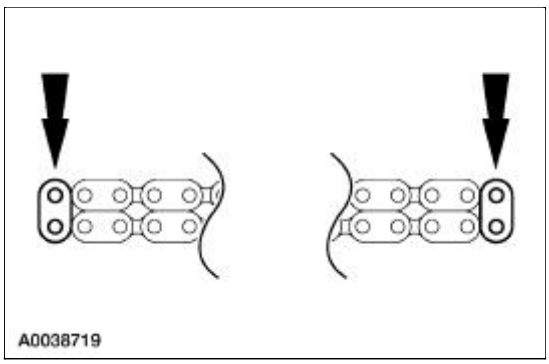


59. As a post-check, verify correct alignment of all timing marks.

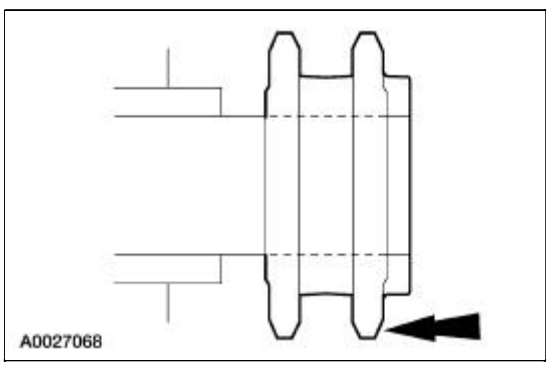


Romeo engine (4.6L)

60. If the copper links are not visible, mark one link on one end and one link on the other end, and use as timing marks.

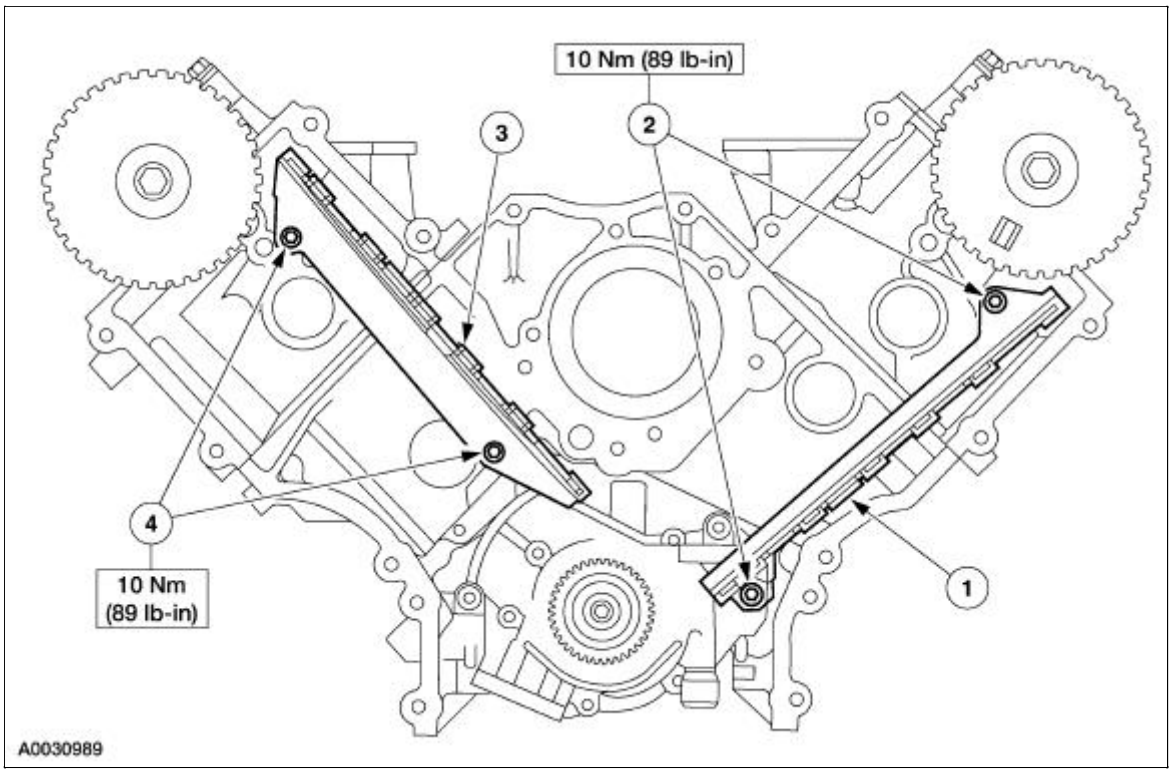


61. Install the crankshaft sprocket, making sure the flange faces forward.

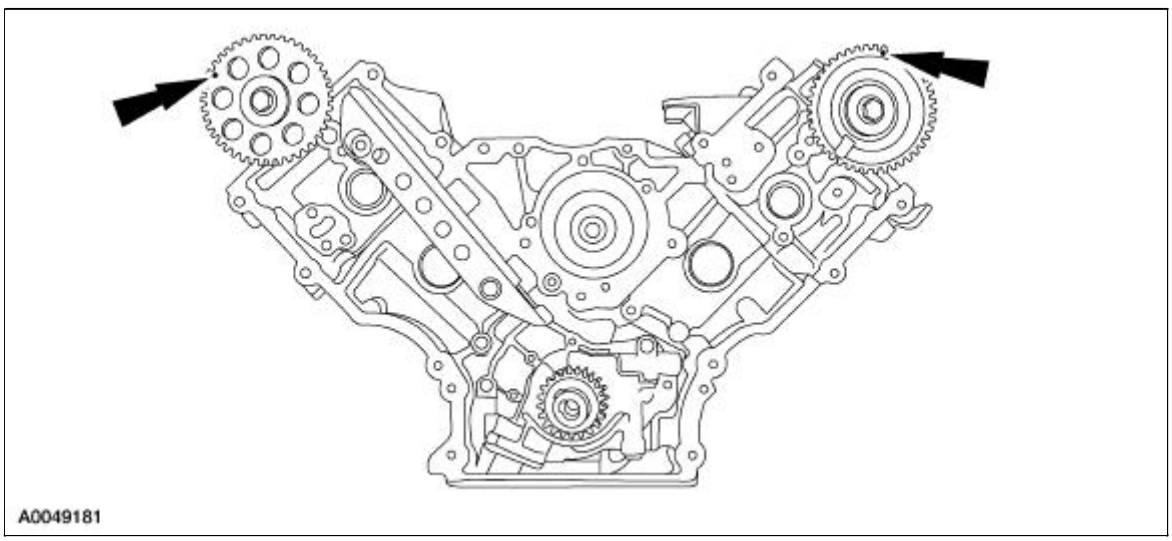


62. Install the timing chain guides.

1. Position the LH timing chain guide.
2. Install and tighten the LH bolts.
3. Position the RH timing chain guide.
4. Install and tighten the RH bolts.



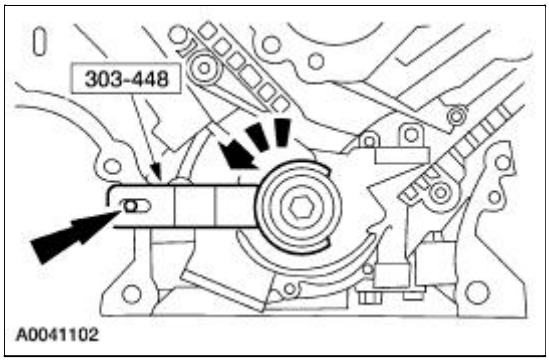
63. Rotate the RH camshaft sprocket until the timing mark is approximately at the 11 o'clock position. Rotate the LH camshaft sprocket until the timing mark is approximately at the 12 o'clock position.



64. **CAUTION: When instructed to do so, rotate the crankshaft counterclockwise only. Do not rotate past the position shown or severe piston and valve damage can occur.**

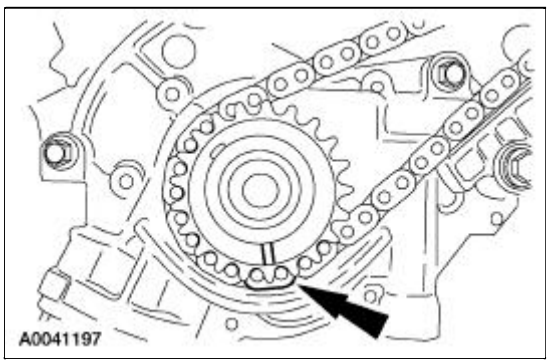
NOTE: When the stud on the engine block fits into the slot in the handle of the special tool, the number one cylinder is at top dead center (TDC).

Using the special tool, position the crankshaft so the number one cylinder is at TDC.

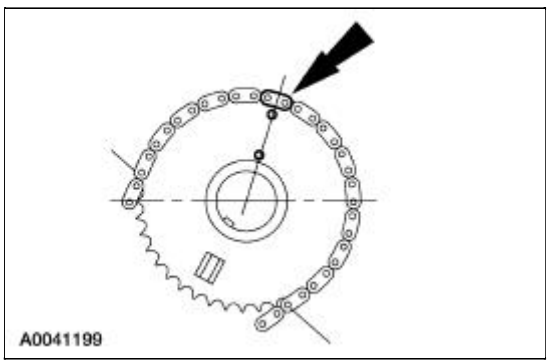


65. Remove the special tool.

66. Position the LH (inner) timing chain on the crankshaft sprocket, aligning the copper (marked) link with the timing mark on the sprocket.

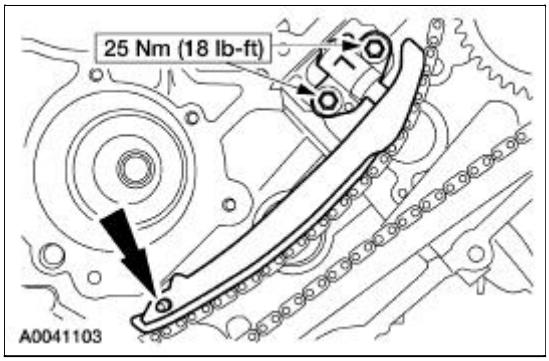


67. Install the LH timing chain on the camshaft sprocket, aligning the copper (marked) link with the timing marks on the sprocket.

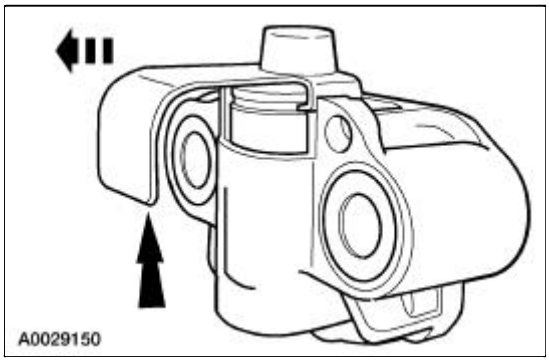


68. **NOTE:** The LH timing chain tensioner arm has a bump near the dowel hole for identification.

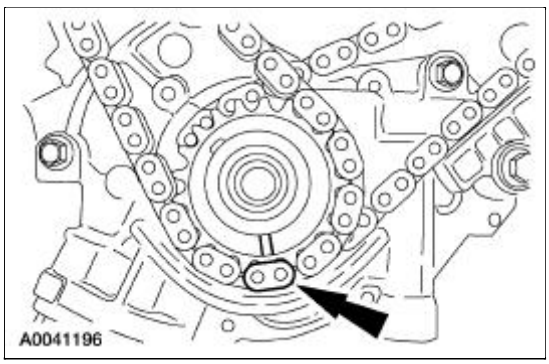
    Position the LH timing chain tensioner arm on the dowel pin and install the LH timing chain tensioner.



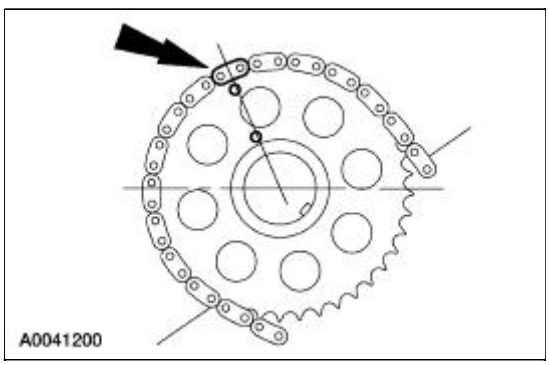
69. Remove the retaining clip from the LH timing chain tensioner.



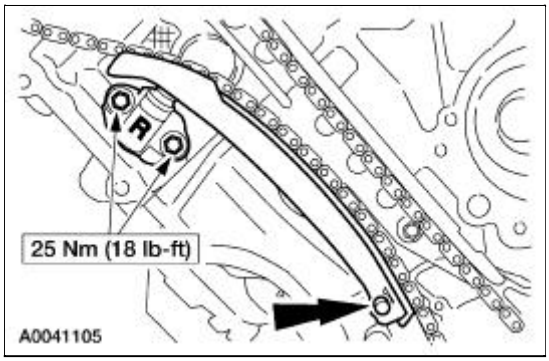
70. Position the RH (outer) timing chain on the crankshaft sprocket, aligning the copper (marked) link with the timing mark on the sprocket.



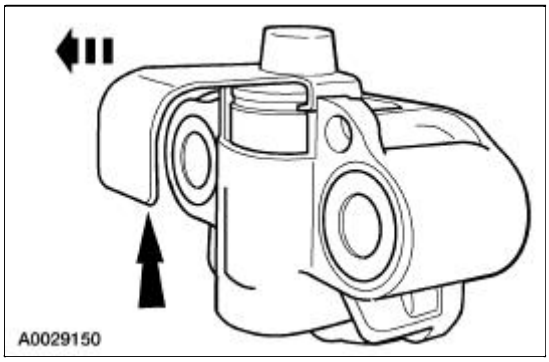
71. Install the RH timing chain on the camshaft sprocket, aligning the copper (marked) link with the timing marks on the sprocket.



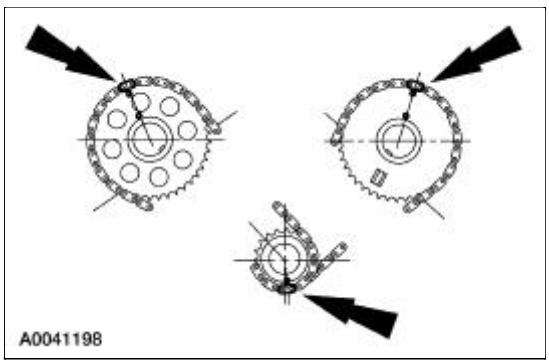
72. Position the RH timing chain tensioner arm on the dowel pin and install the RH timing chain tensioner.



73. Remove the retaining clip from the RH timing chain tensioner.

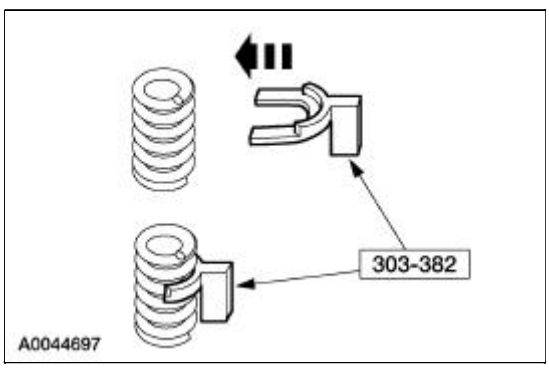


74. Make sure that the copper (marked) chain links are lined up with the dots on the crankshaft sprockets and the camshaft sprocket.



All engines

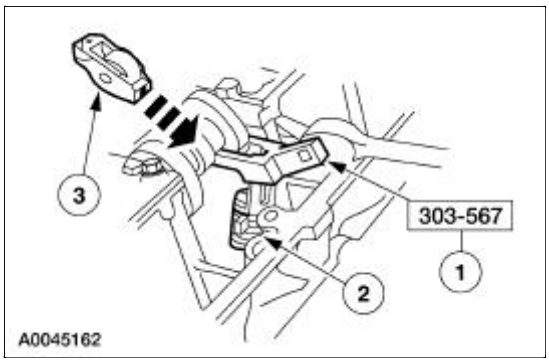
75. Install the special tool between the valve spring coils to prevent valve stem seal damage.



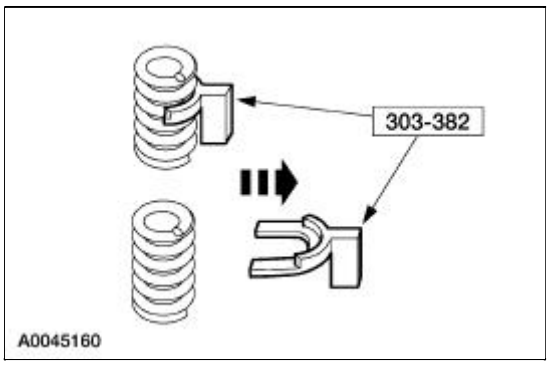
76. **NOTE:** Lubricate the camshaft roller followers using clean engine oil.

Install the camshaft roller followers.

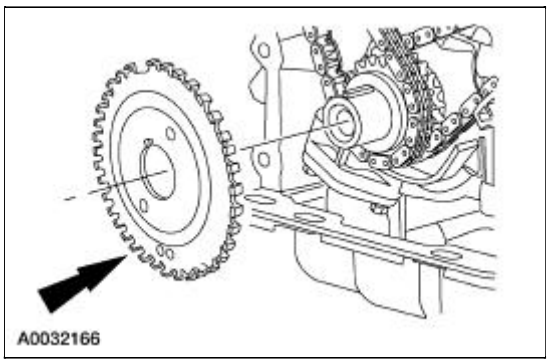
1. Install the special tool.
2. Compress the valve spring.
3. Install the camshaft roller followers in their original locations.



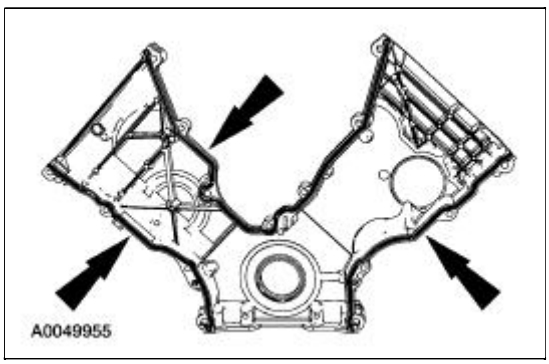
77. Remove the special tool.



78. Install the crankshaft sensor ring on the crankshaft.

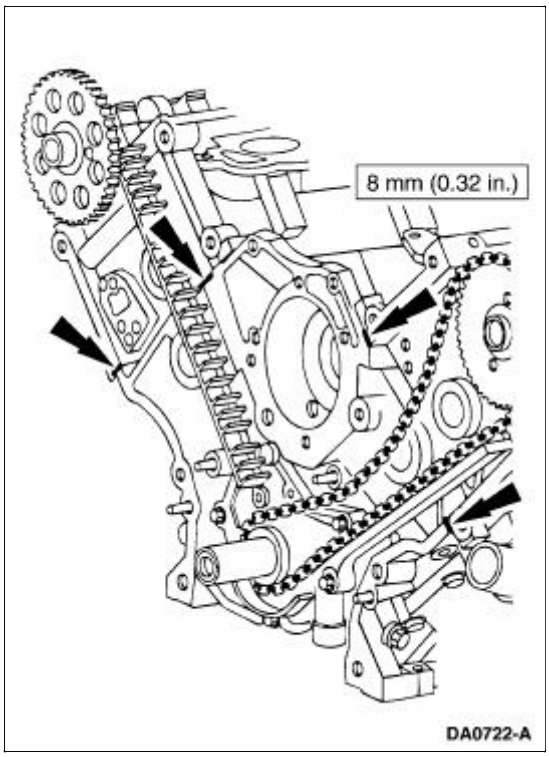


79. Install new gaskets on the engine front cover.



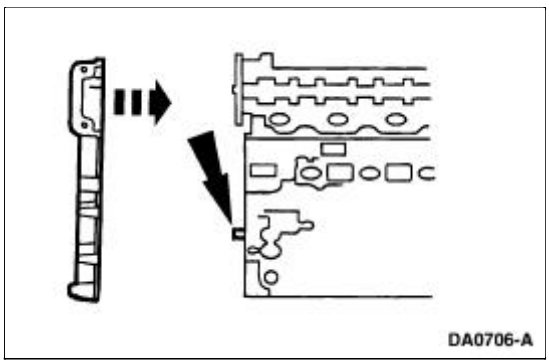
80. **NOTE:** If not secured within four minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

    Apply a bead of silicone gasket and sealant along the cylinder head-to-cylinder block surface at the locations shown.



81. **NOTE:** Make sure that the engine front cover gaskets are in place on the engine front cover before installation.

    Position the engine front cover on the front cover-to-cylinder block dowels. Install the fasteners finger-tight.

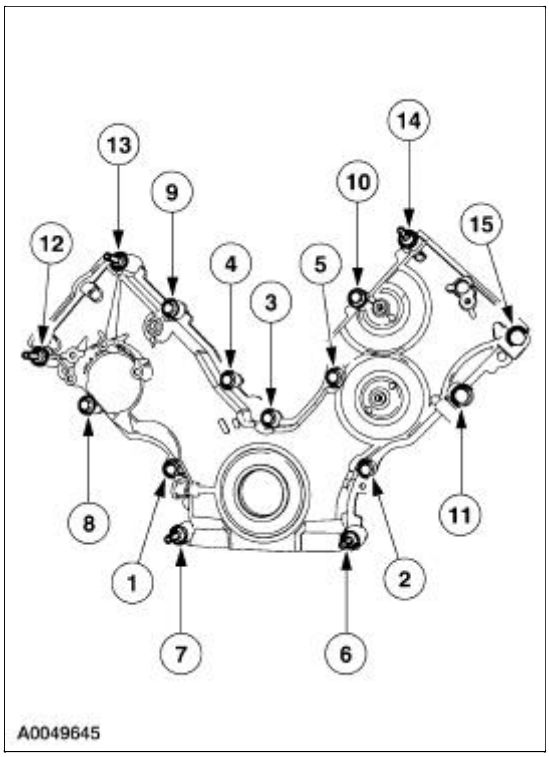


Romeo engine (4.6L)

82. Tighten the engine front cover fasteners in the sequence shown to 25 Nm (18 lb-ft).

Item	Part Number	Description
1	N806177	Bolt, Hex Flange Head Pilot, M8 x 53
2	N806177	Bolt, Hex Flange Head Pilot, M8 x 53
3	N806177	Bolt, Hex Flange Head Pilot, M8 x 53

4	N806177	Bolt, Hex Flange Head Pilot, M8 x 53
5	N806177	Bolts, Hex Flange Head Pilot, M8 x 53
6	N808586	Stud, Hex Shldr Pilot, M8 x 1.25 — M6 x 1 x 86.35
7	N808586	Stud, Hex Shldr Pilot, M8 x 1.25 — M6 x 1 x 86.35
8	N808586	Stud, Hex Shldr Pilot, M8 x 1.25 — M6 x 1 x 86.35
9	N806177	Bolt, Hex Flange Head Pilot, M8 x 53
10	N806177	Bolt, Hex Flange Head Pilot, M8 x 53
11	N806177	Bolt, Hex Flange Head Pilot, M8 x 53
12	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 1.25 x 91.1
13	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 1.25 x 91.1
14	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 1.25 x 91.1
15	N806177	Bolt, Hex Flange Head Pilot, M8 x 53

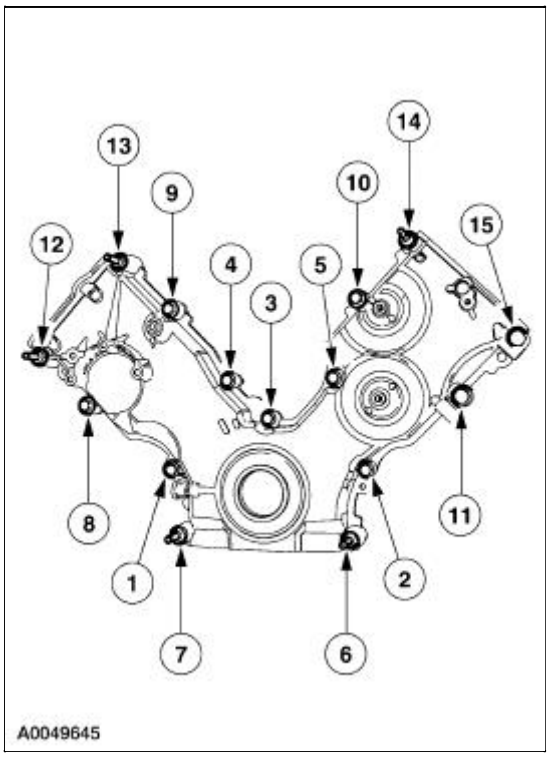


Windsor engine (5.4L)

83. Tighten the engine front cover fasteners in the sequence shown in three stages.
Stage 1: tighten fasteners 1 through 5 to 25 Nm (18 lb-ft).
Stage 2: tighten fasteners 6 and 7 to 48 Nm (35 lb-ft).
Stage 3: tighten fasteners 8 through 15 to 48 Nm (35 lb-ft).

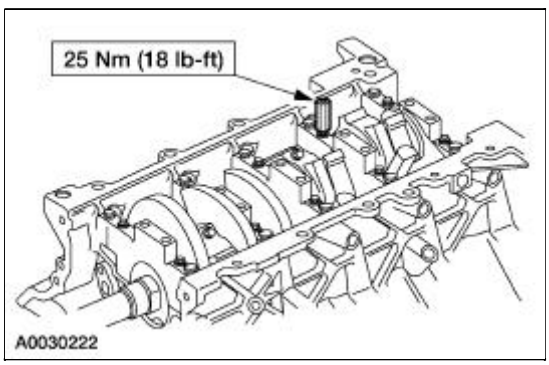
Item	Part Number	Description
1	N806177	Bolt, Hex Flange Head Pilot, M8 x 53
2	N806177	Bolt, Hex Flange Head Pilot, M8 x 53
3	N806177	Bolt, Hex Flange Head Pilot, M8 x 53
4	N806177	Bolt, Hex Flange Head Pilot, M8 x 53
5	N806177	Bolts, Hex Flange Head Pilot, M8 x 53

6	N808529	Stud, Hex Head Pilot, M10 x 103.1
7	N808529	Stud, Hex Head Pilot, M10 x 103.1
8	N808142	Screw and Washer, Hex Pilot, M10 x 1.5 x 57.5
9	N808142	Screw and Washer, Hex Pilot, M10 x 1.5 x 57.5
10	N808142	Screw and Washer, Hex Pilot, M10 x 1.5 x 57.5
11	W706604	Bolt, Hex Flange Head, M10 x 65
12	N808140	Stud and Washer, Hex Head Pilot, M10/M8 x 107
13	N808140	Stud and Washer, Hex Head Pilot, M10/M8 x 107
14	N808140	Stud and Washer, Hex Head Pilot, M10/M8 x 107
15	W706604	Bolt, Hex Flange Head, M10 x 65



All engines

84. Install the oil pump screen and pickup tube spacer.

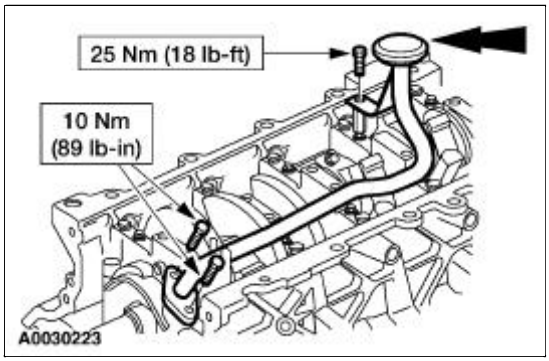


85. **CAUTION: Make sure the O-ring is in place and not damaged. A missing or damaged O-ring can cause foam in the lubrication system, low oil pressure and severe**

engine damage.

NOTE: Clean and inspect the mating surfaces and install a new O-ring. Lubricate with the O-ring with clean engine oil.

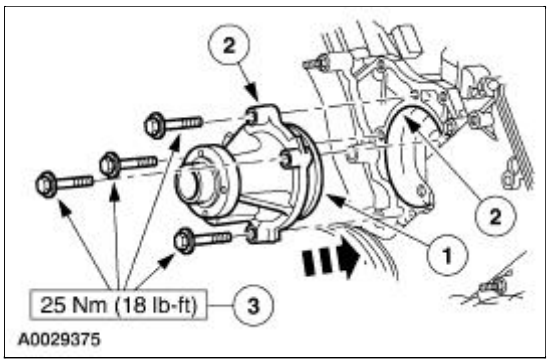
Position the oil pump screen and pickup tube and install the bolts.



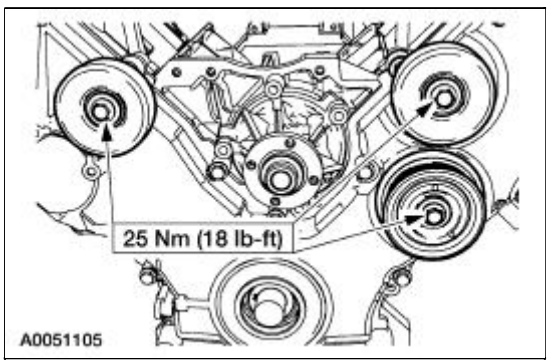
86. **CAUTION: Do not rotate the coolant pump housing once the coolant pump has been positioned in the cylinder block. Damage to the O-ring seal will occur.**

Install the coolant pump.

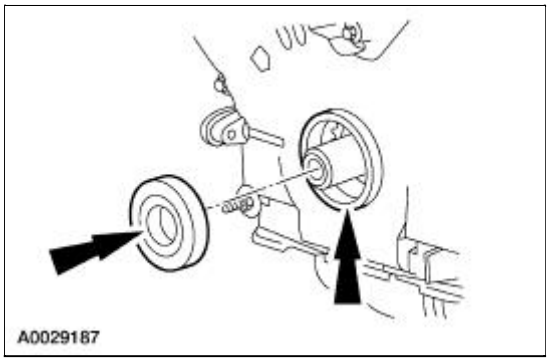
1. Lubricate the new O-ring seal using engine coolant and install the O-ring seal onto the coolant pump.
2. Position the coolant pump into the engine block.
3. Install the bolts.



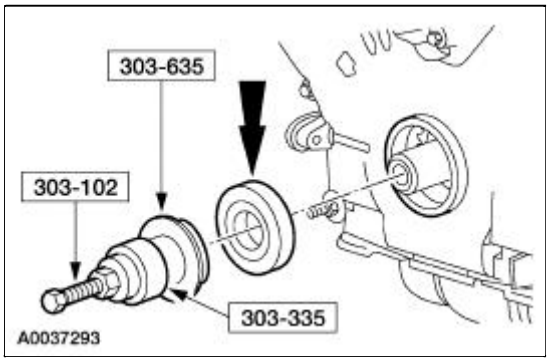
87. Position the belt idler pulleys and install the bolts.



88. Lubricate the engine front cover and the front oil seal inner lip with clean engine oil.

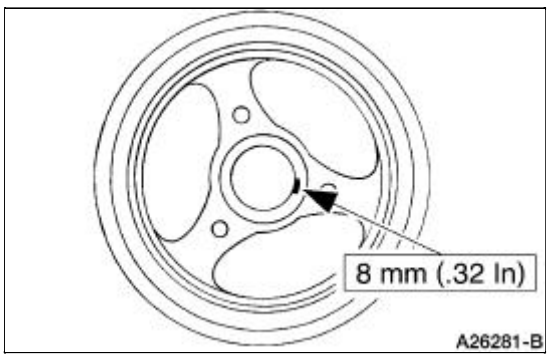


89. Use the special tools to install the crankshaft front oil seal into the engine front cover.

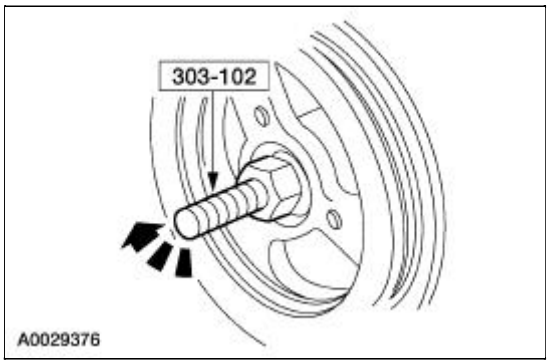


90. **NOTE:** If not secured within four minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

    Apply silicone gasket and sealant to the Woodruff key slot on the crankshaft pulley.

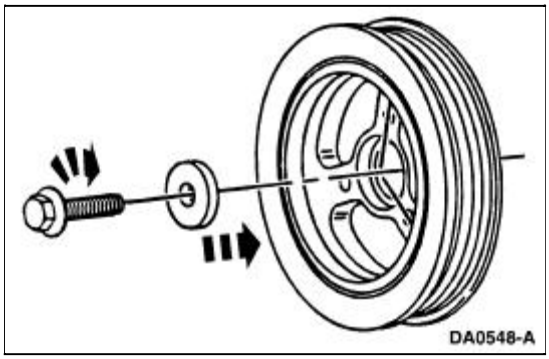


91. Use the special tool to install the crankshaft pulley.

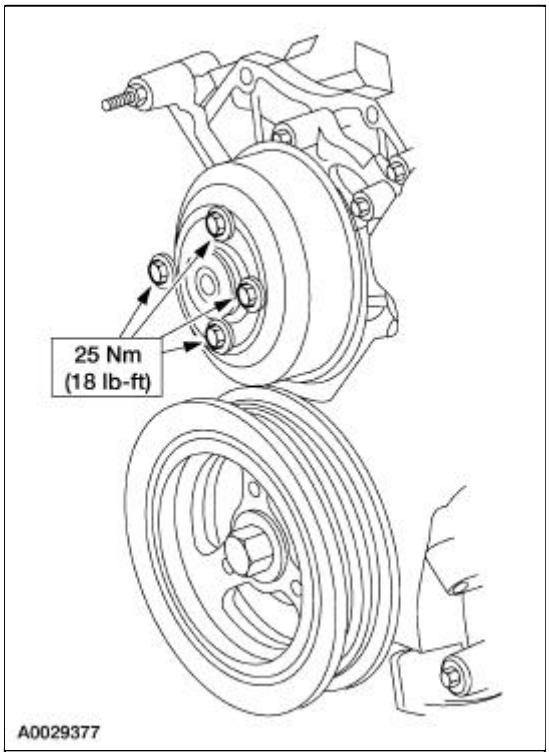


92. Tighten the new crankshaft pulley bolt in four stages.

- Stage 1: tighten to 90 Nm (66 lb-ft).
- Stage 2: loosen 360 degrees.
- Stage 3: tighten to 50 Nm (37 lb-ft).
- Stage 4: tighten an additional 90 degrees.

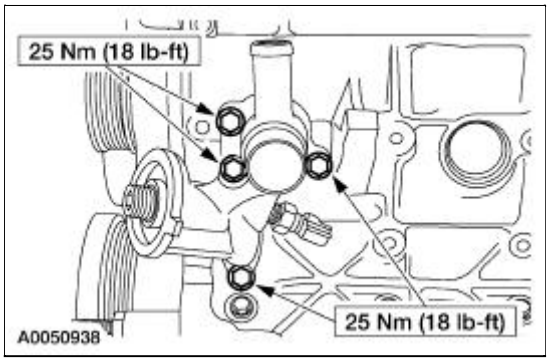


93. Position the coolant pump pulley on the coolant pump and install the bolts.

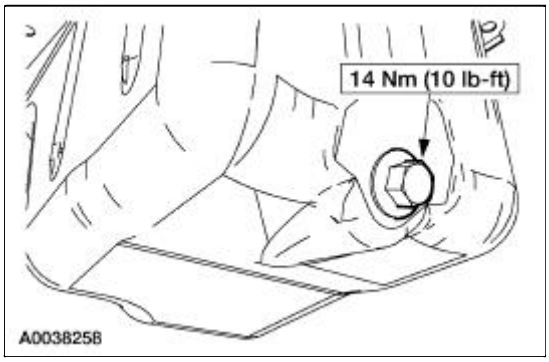


94. **NOTE:** Clean and inspect the mating surfaces, and install a new gasket.

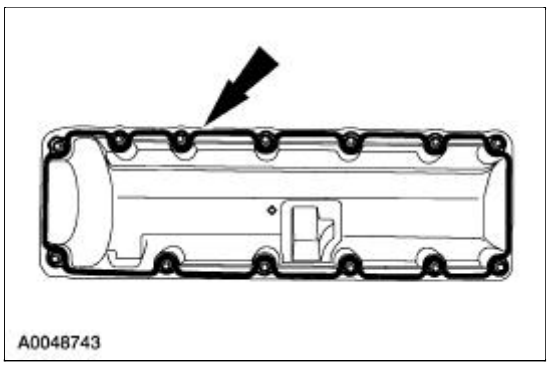
    Position the oil filter adapter gasket and the oil filter adapter. Install the four bolts.



95. Install the oil drain plug.

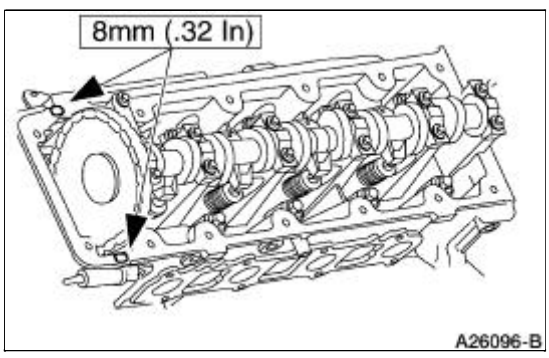


96. If a new gasket is being installed, apply instant adhesive completely around the gasket groove in the valve cover. Install the new LH valve cover gasket.

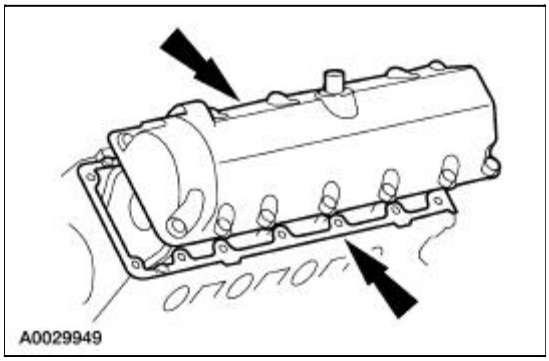


97. **NOTE:** If not secured within four minutes, sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

    Apply silicone gasket and sealant in two places where the engine front cover meets the cylinder head.

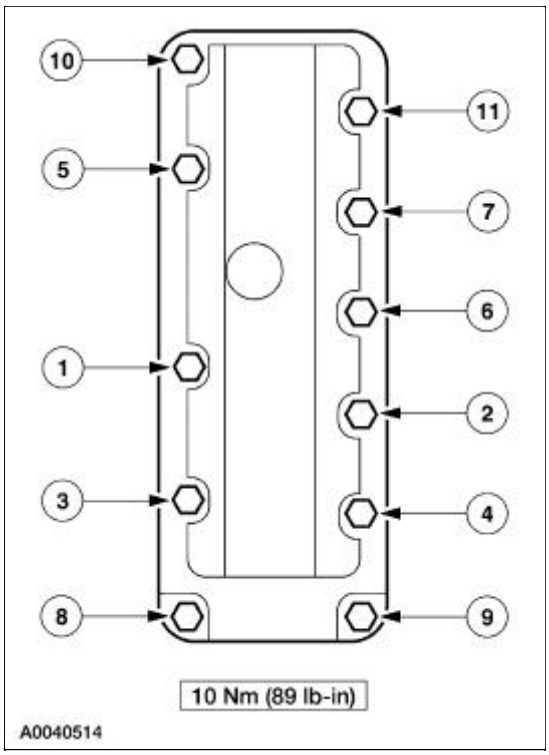


98. Position the LH valve cover and gasket on the cylinder head and install the bolts loosely.



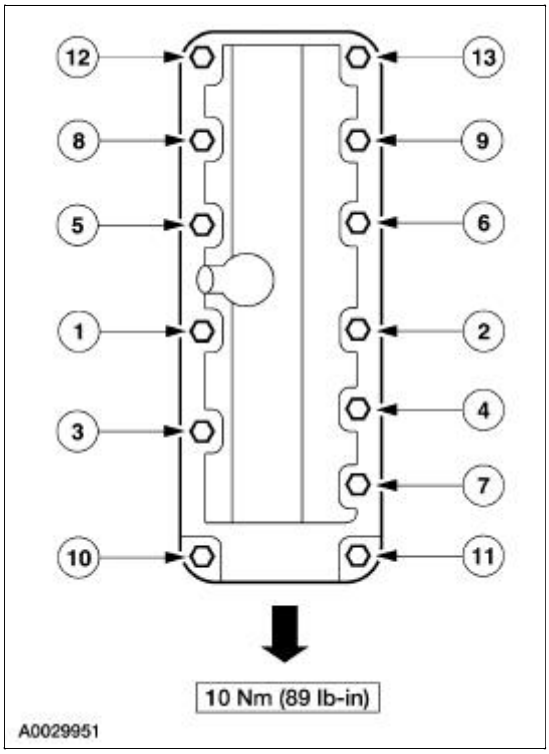
Romeo engine (4.6L)

99. Tighten the bolts in the sequence shown.



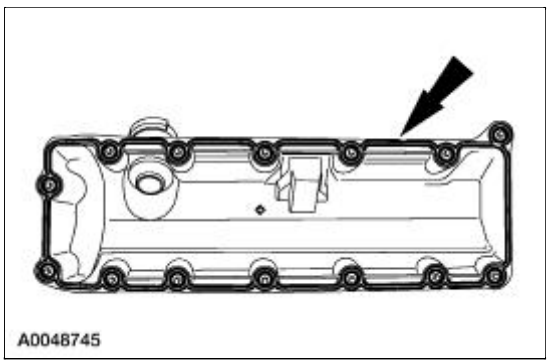
Windsor engine (5.4L)

100. Tighten the bolts in the sequence shown.



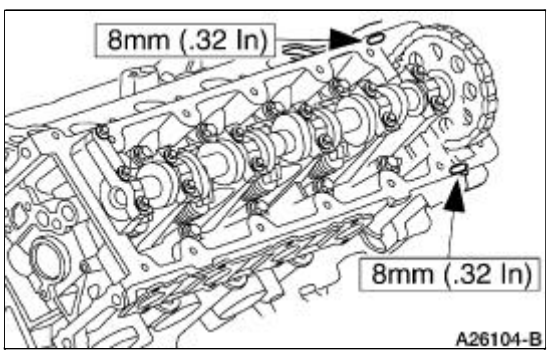
All engines

101. If a new gasket is being installed, apply instant adhesive completely around the gasket groove in the valve cover. Install the new RH valve cover gasket.

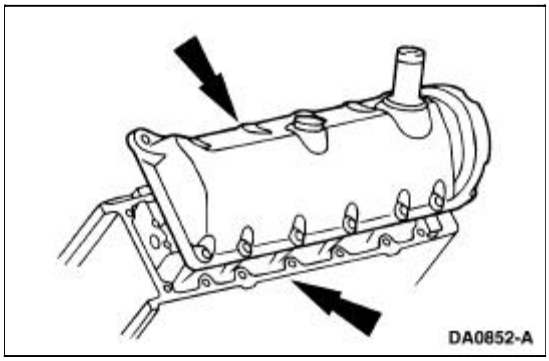


102. **NOTE:** If not secured within four minutes, sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

Apply silicone gasket and sealant in two places where the engine front cover meets the cylinder head.

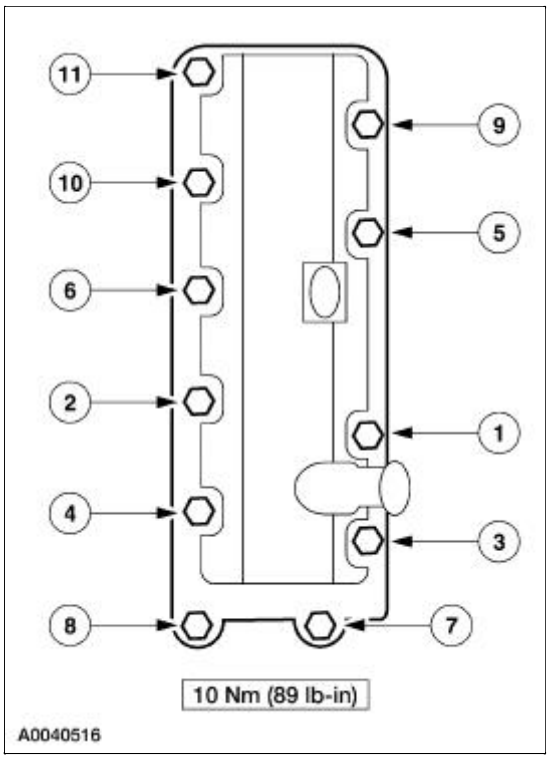


103. Position the RH valve cover and gasket on the cylinder head and install the bolts loosely.



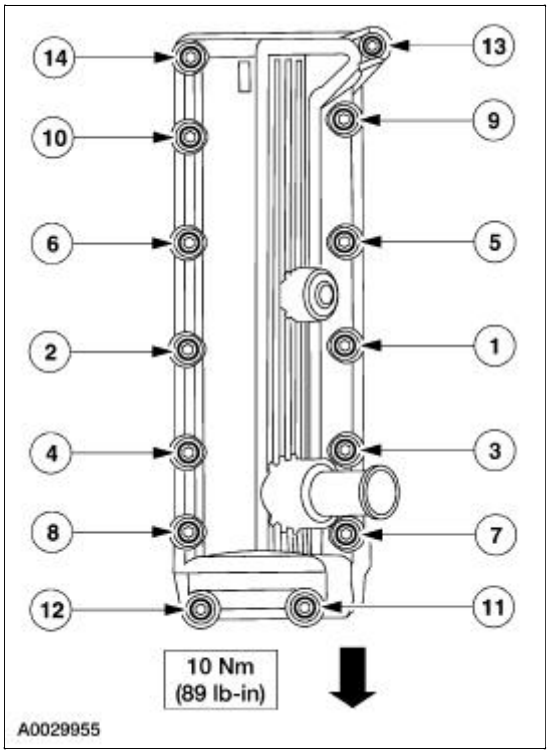
Romeo engine (4.6L)

104. Tighten the bolts in the sequence shown.



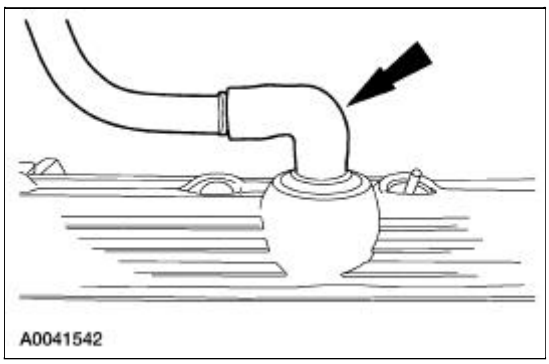
Windsor engine (5.4L)

105. Tighten the bolts in the sequence shown.

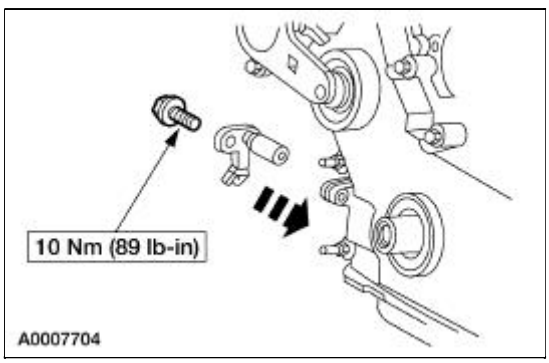


All engines

106. Install the crankcase ventilation tube on the LH valve cover.

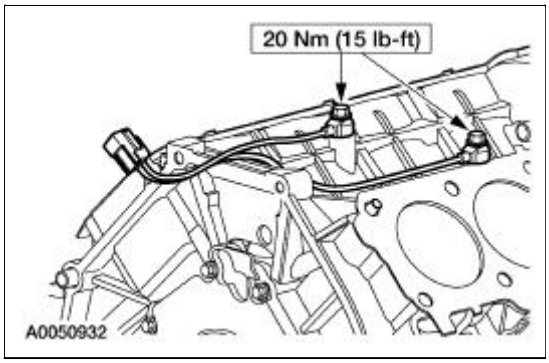


107. Insert the crankshaft position (CKP) sensor and install the bolt.



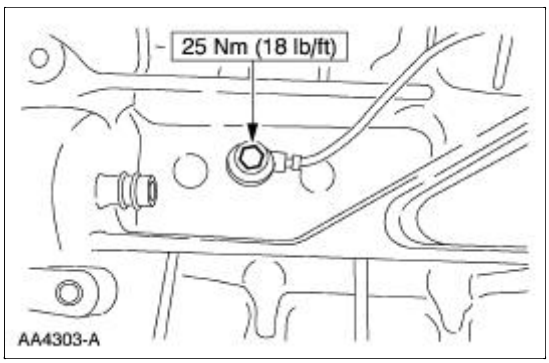
4.6L engines

108. Position the knock sensors and install the bolts.



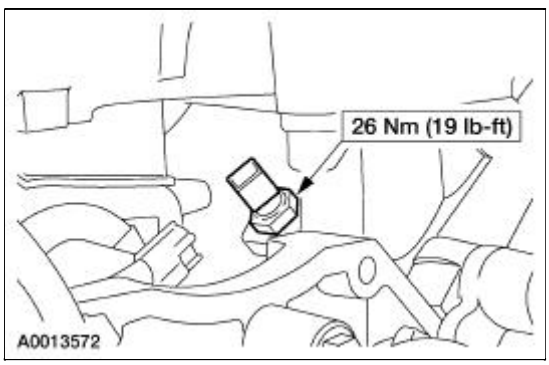
5.4L engines

109. Position the knock sensor and install the bolt.

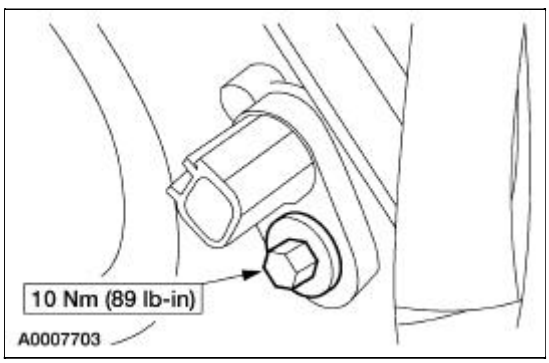


All engines

110. Install the cylinder head temperature (CHT) sensor.

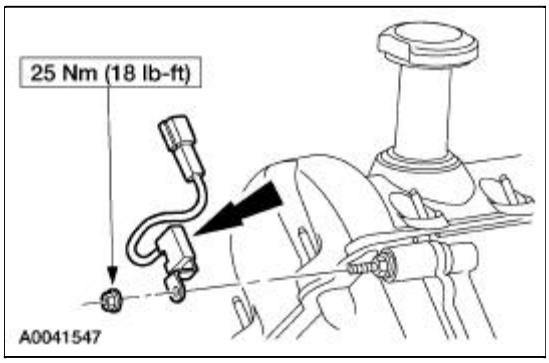


111. Install the camshaft position (CMP) sensor and bolt.



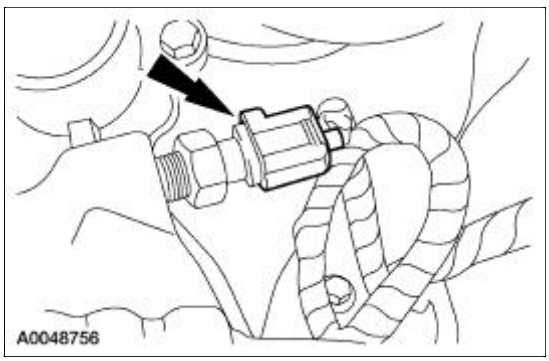
112. **NOTE:** RH shown; LH similar.

Install the radio frequency interference capacitors.



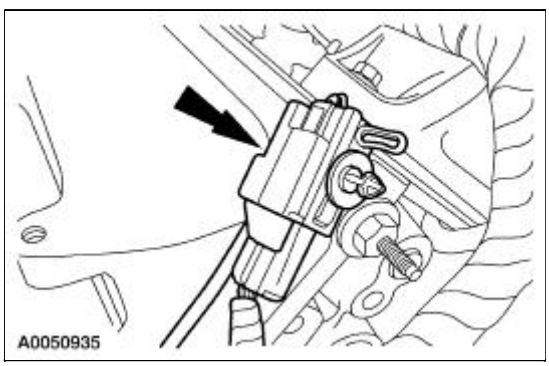
113. Roughly position the engine control sensor wiring harness. Attach the harness routing clips and connector retainers.

114. Connect the oil pressure switch electrical connector.



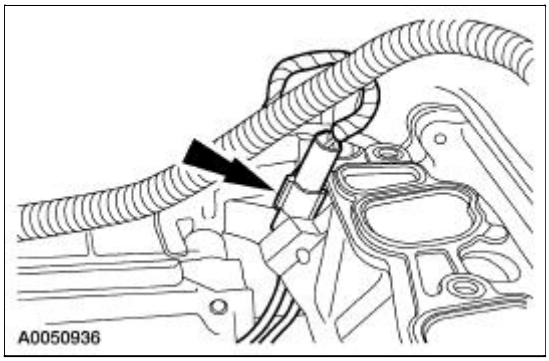
5.4L engines

115. Connect the knock sensor electrical connector.



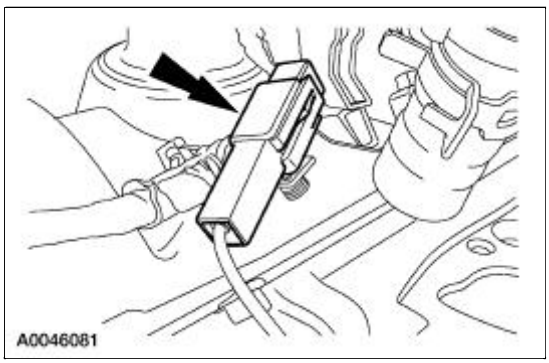
4.6L engines

116. Connect the knock sensor electrical connector.

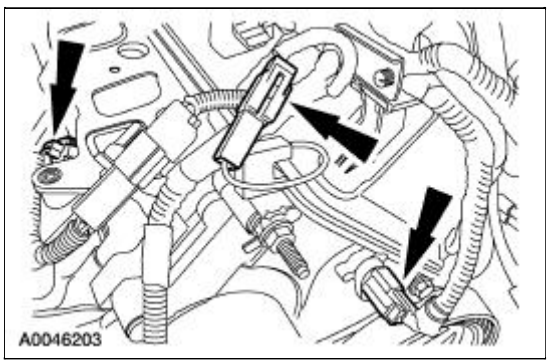


All engines

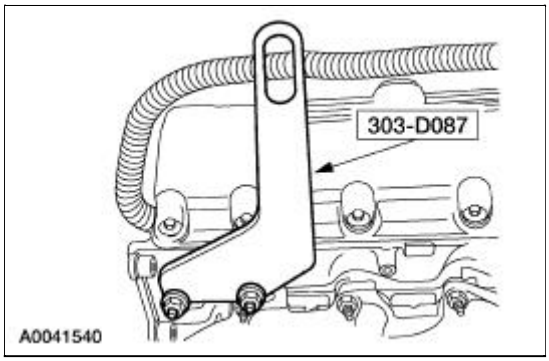
117. Connect the RH radio interference capacitor electrical connector.



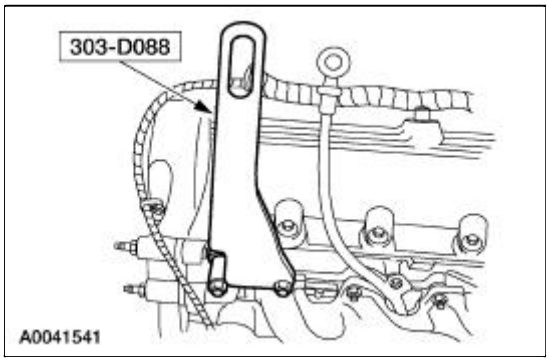
118. Connect the following electrical connectors.
    - The CHT sensor.
    - The LH radio interference capacitor.
    - The CMP sensor.



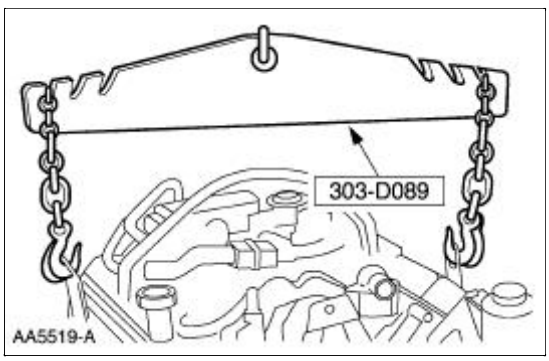
119. Install the special tool.



120. Install the special tool.



121. Install the special tool and remove the engine from the work stand.

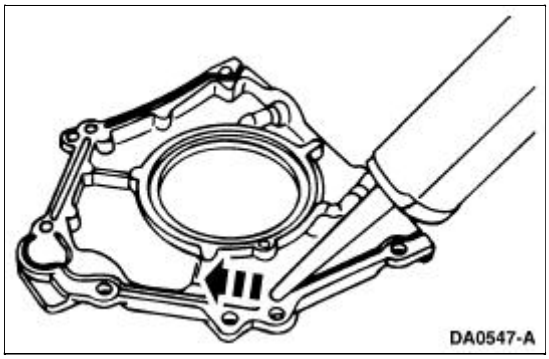


122. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the aluminum retainer plate. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

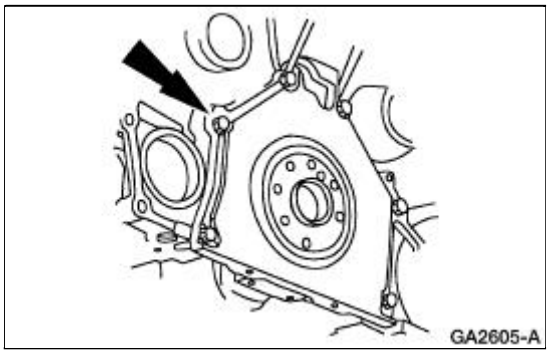
Inspect the rear seal retainer plate. Clean the mating surface for the rear seal retainer plate with silicone gasket remover and metal surface prep. Follow the directions on the packaging.

123. **NOTE:** If not secured within four minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

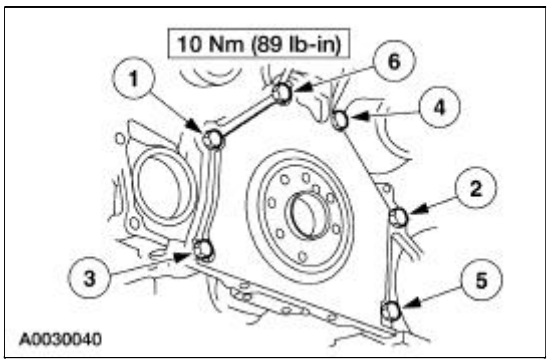
Apply a 4 mm (0.16 in) bead of silicone gasket and sealant around the rear oil seal retainer sealing surface.



124. Install the rear oil seal retainer plate and loosely install the six bolts.



125. Tighten the bolts in the sequence shown.

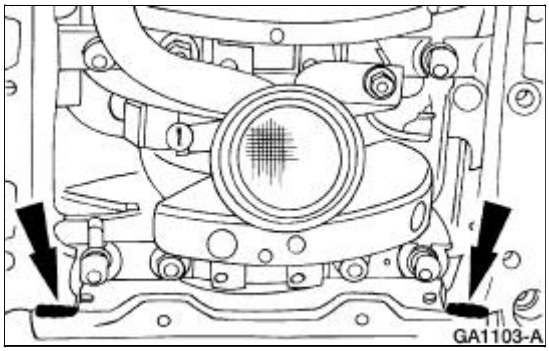


126. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

Inspect the oil pan. Clean the mating surface for the oil pan with silicone gasket remover and metal surface prep. Follow the directions on the packaging.

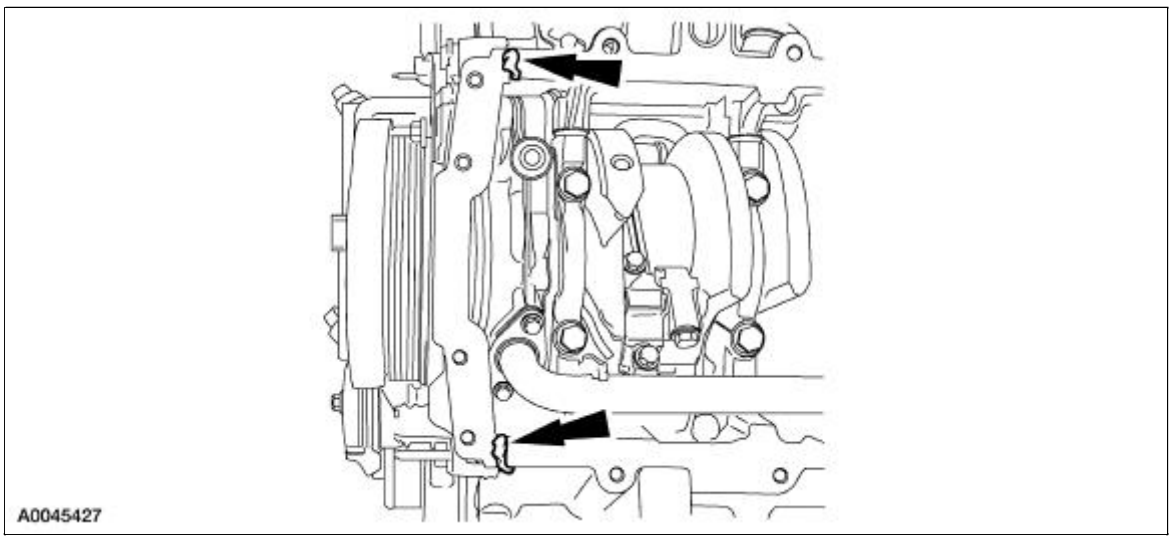
127. **NOTE:** If not secured within four minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

Apply silicone gasket and sealant at the rear oil seal retainer-to-cylinder block sealing surface.

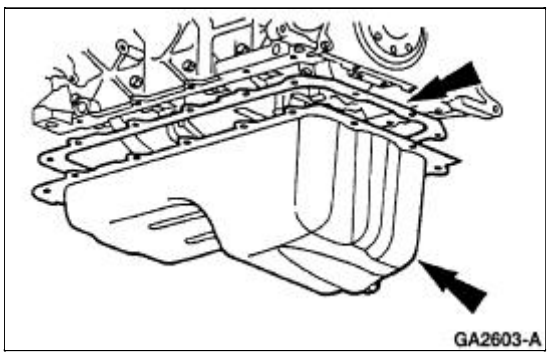


128. **NOTE:** If the oil pan is not secured within four minutes, the sealant must be removed and the sealing areas cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

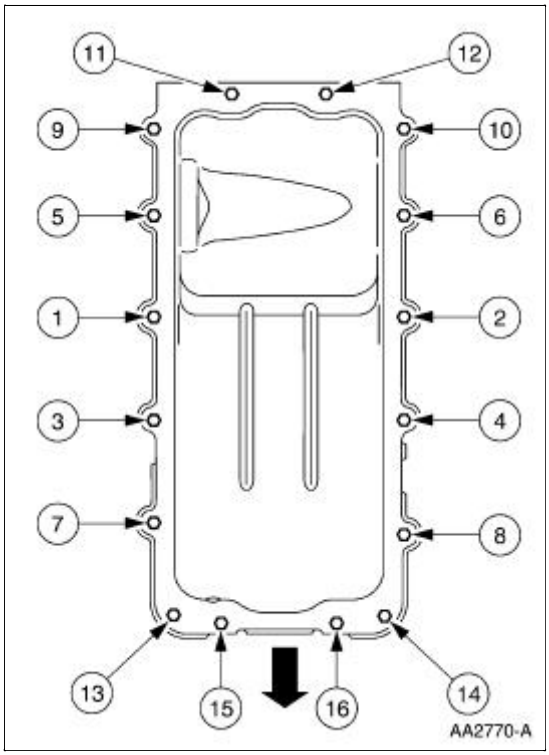
    Apply silicone gasket and sealant at the engine front cover-to-cylinder block sealing surface.



129. Install the oil pan gasket and the oil pan, and loosely install the bolts.

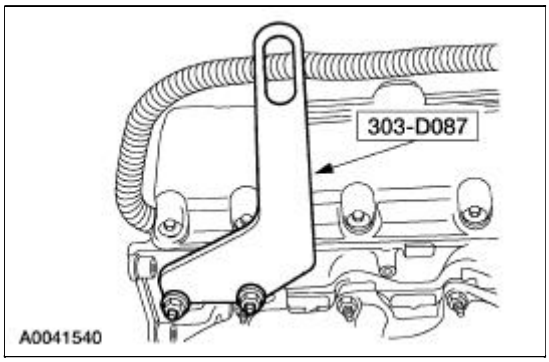


130. Tighten the bolts in the sequence shown, in three stages.
    - Stage 1: tighten to 2 Nm (18 lb-in).
    - Stage 2: tighten to 20 Nm (15 lb-ft).
    - Stage 3: tighten an additional 90 degrees.

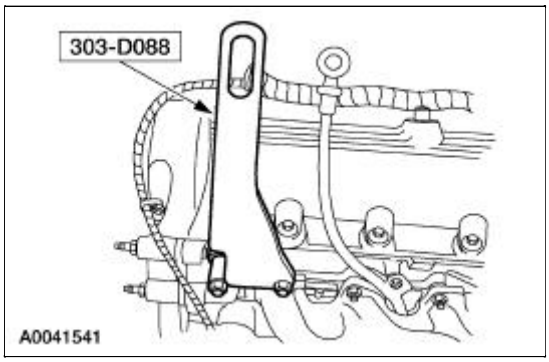


131. Lower the engine onto wooden blocks.

132. Remove the special tool.

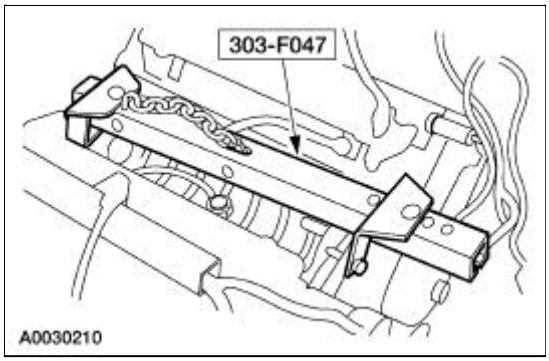


133. Remove the special tool.

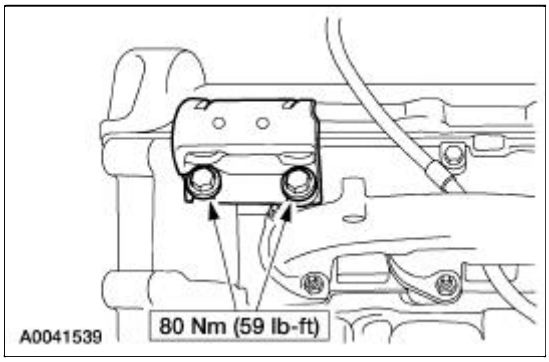


134. **NOTE:** On some engines it will be necessary to shim between the tool mounting brackets and the cylinder block.

    Install the special tool and raise the engine.

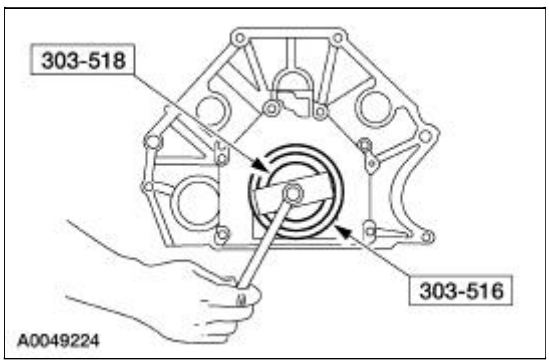


135. Install the power steering reservoir lower mounting bracket.

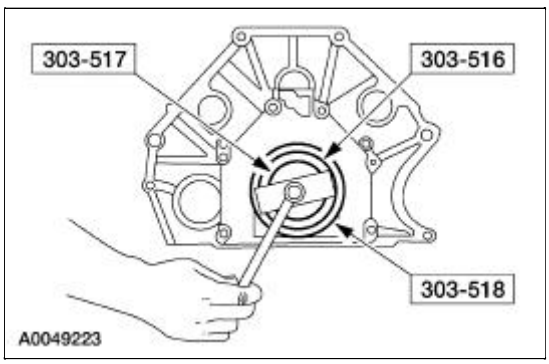


136. **NOTE:** Lubricate the inner lip of the crankshaft rear oil seal with clean engine oil.

Using the special tools, install a new crankshaft rear oil seal.

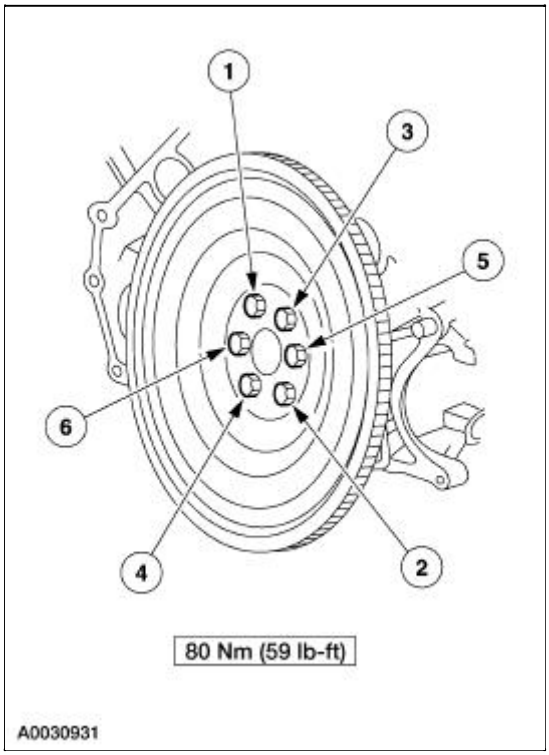


137. Using the special tools, install the crankshaft rear oil slinger.



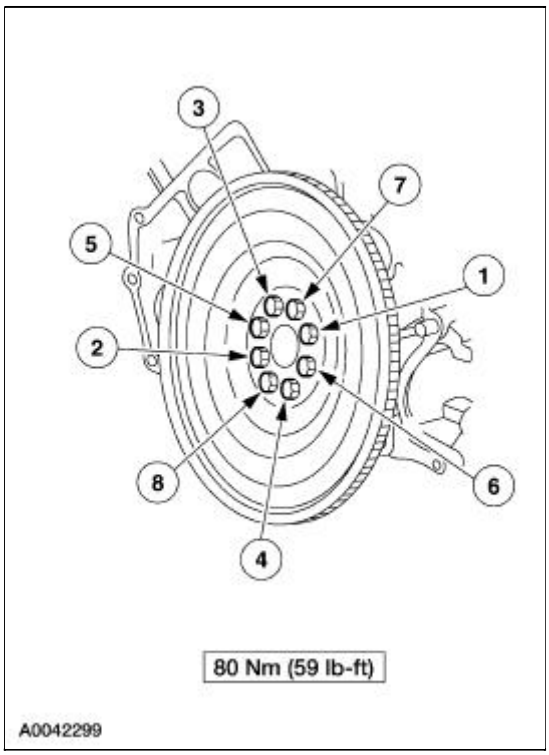
Romeo engine (4.6L)

138. Install the flexplate and bolts. Tighten the bolts in the sequence shown.



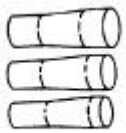
Windsor engine (5.4L)

139. Install the flexplate and bolts. Tighten the bolts in the sequence shown.



Engine

Special Tool(s)

 ST1377-A	Modular Engine Lift Bracket 303-F047 (014-00073) or equivalent
 ST1586-A	Installer, Power Steering Pump Pulley 211-185 (T91P-3A733-A)
 ST1444-A	Installer Set, Teflon Seal 211-D027 (D90P-3517-A) or equivalent

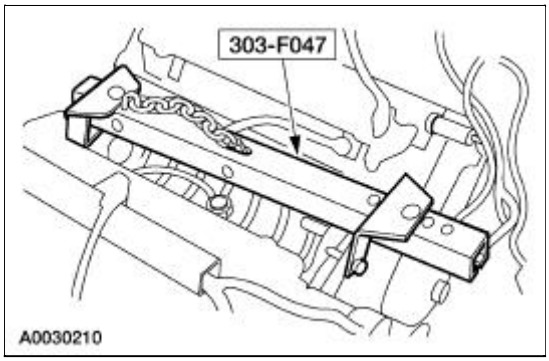
Material

Item	Specification
SAE 5W-20 Premium Synthetic Blend Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H
Motorcraft Premium Engine Coolant VC-4-A (in Canada CXC-10; in Oregon VC-5) or equivalent. Do not mix coolant types.	ESE-M97B44-A (Green in color)
Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) or equivalent. Do not mix coolant types.	WSS-M97B51-A1 (Yellow in color)

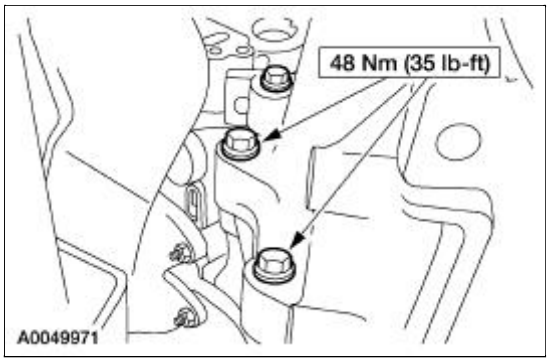
Installation

All engines

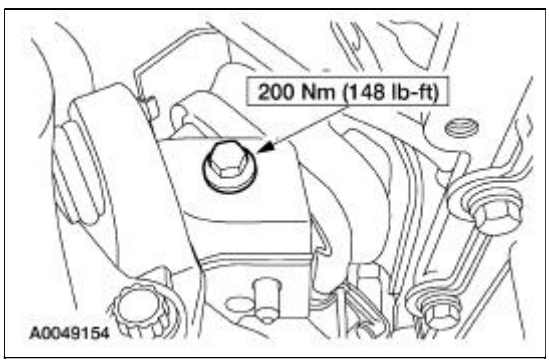
1. Position the engine in the vehicle.
2. Remove the special tool.



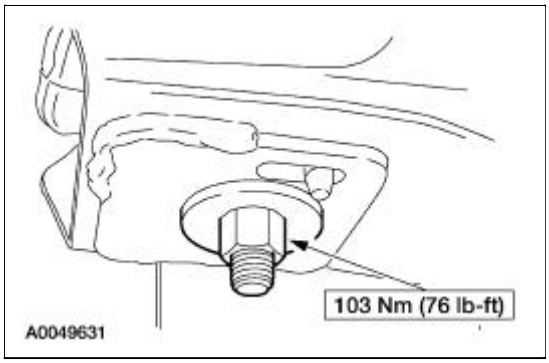
3. Remove the floor jack supporting the transmission.
4. Raise and support the vehicle. For additional information, refer to Section 100-02 .
5. Align the engine to the transmission.
6. Install the lower five transmission-to-engine bolts.



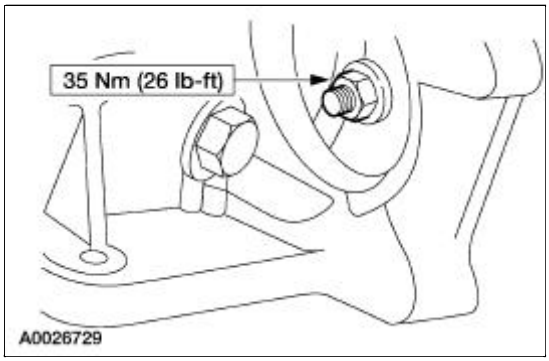
7. Install the LH engine mount bolt.



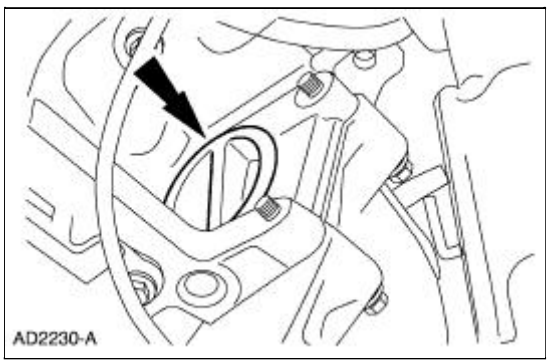
8. Install the RH engine mount nut.



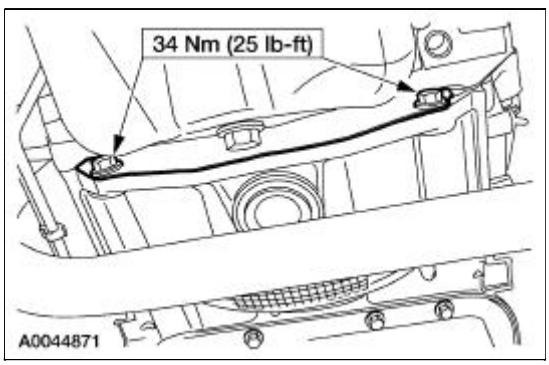
9. Install new torque converter-to-flexplate nuts.



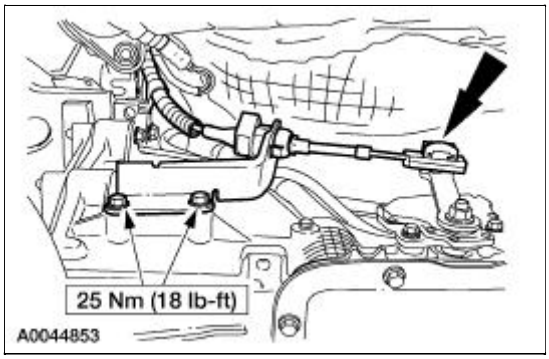
10. Install the cylinder block opening cover.



11. Install the flexplate inspection cover.

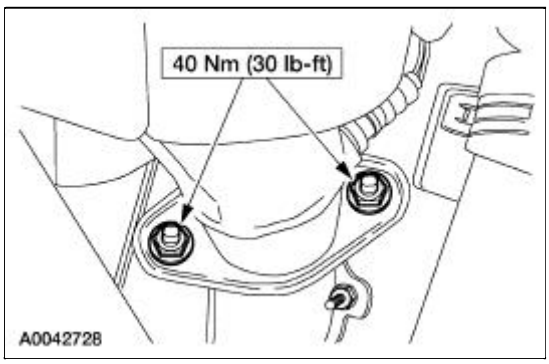


12. Install the shift cable end and the bracket.



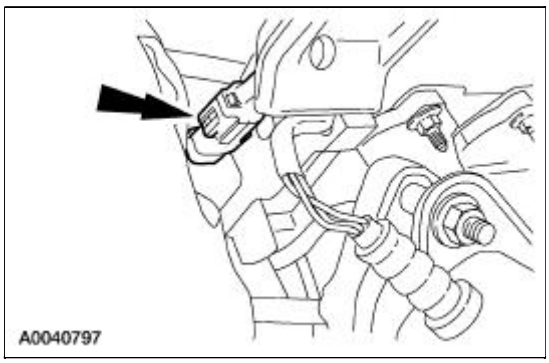
13. Install the RH exhaust manifold-to-dual converter Y-pipe studs.

14. Position the dual converter Y-pipe and install the four nuts.



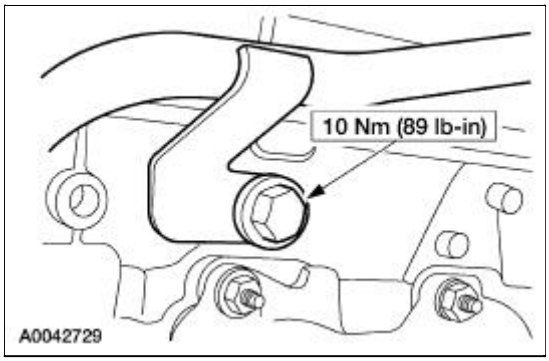
15. **NOTE:** RH is shown; LH is similar.

    Connect the two heated oxygen sensor (HO2S) electrical connectors.



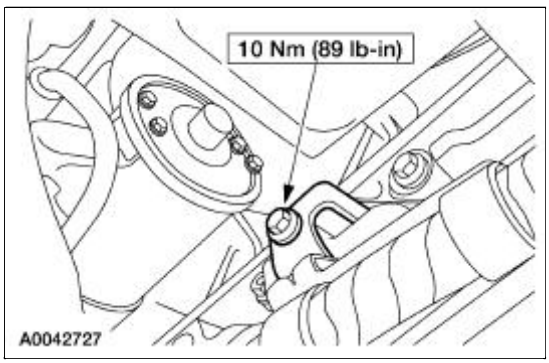
16. **NOTE:** The bolt is accessed through the RH fender well.

    Position the transmission fluid filler tube and install the bolt.

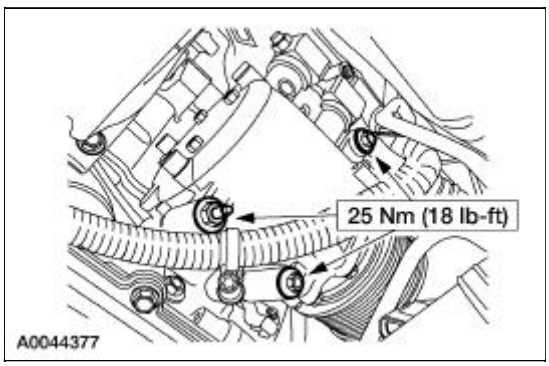


17. Install the starter motor. For additional information, refer to Section 303-06 .

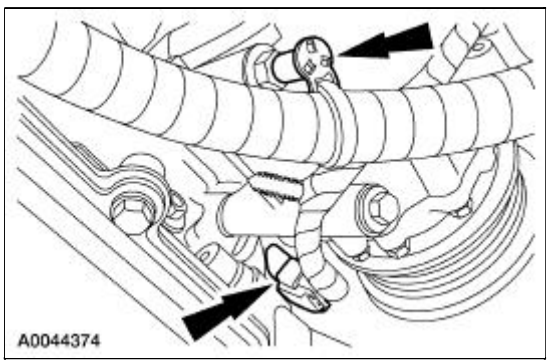
18. Position the wiring harness bracket and install the bolt.



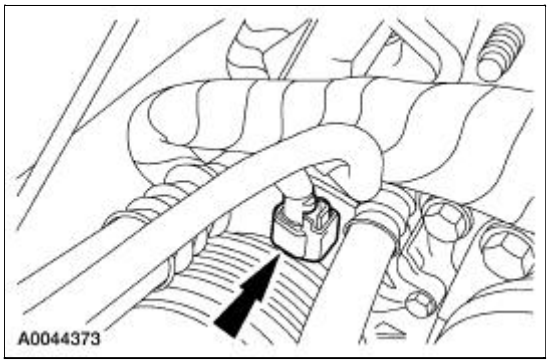
19. Position the A/C compressor and install the fasteners.



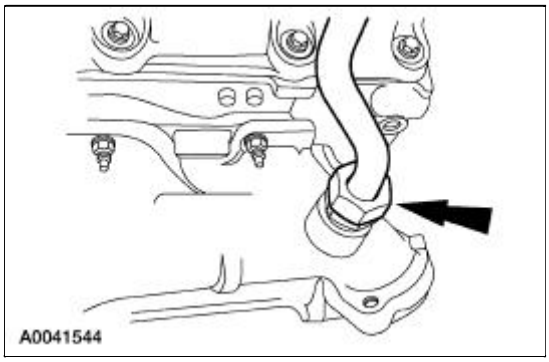
20. Attach the wiring harness retainer and connect the crankshaft position (CKP) sensor electrical connector.



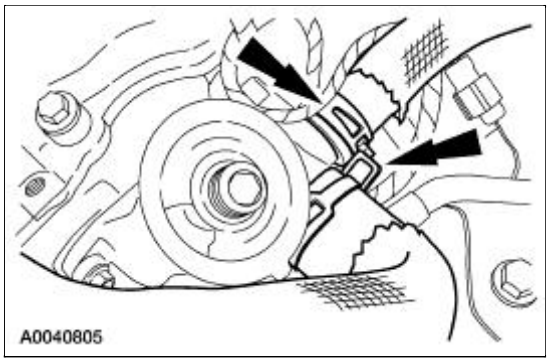
21. Connect the A/C compressor electrical connector.



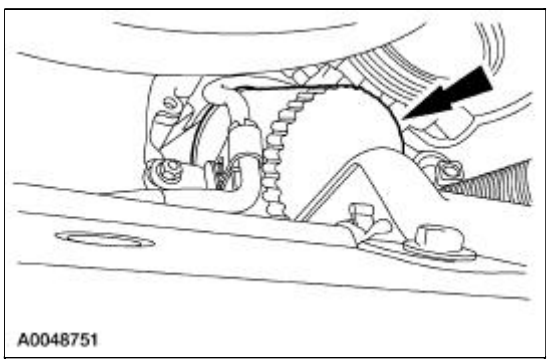
22. Position the exhaust manifold-to-exhaust gas recirculation (EGR) valve tube and loosely install the lower fitting.



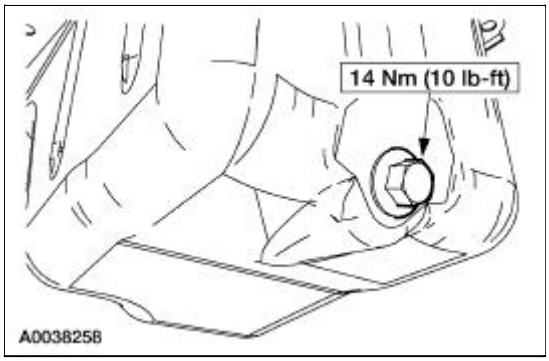
23. Connect the lower radiator hose and the degas bottle hose to the oil filter adapter.



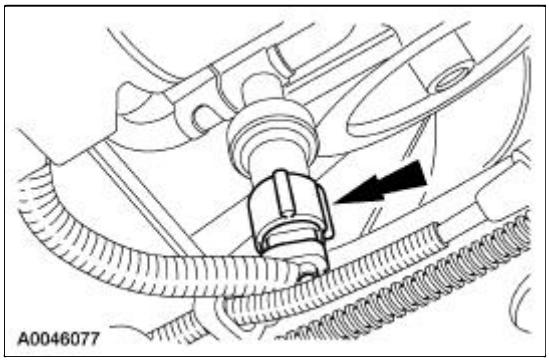
24. Install a new oil filter.



25. Install the drain plug.

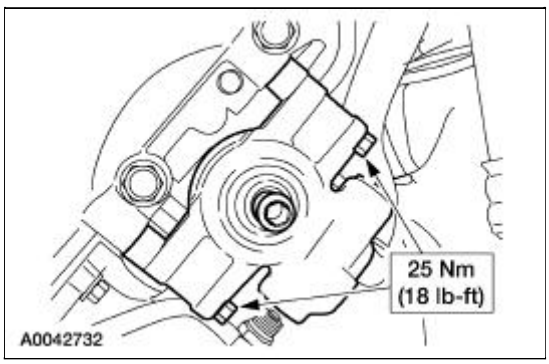


26. Connect the power steering pressure switch electrical connector.

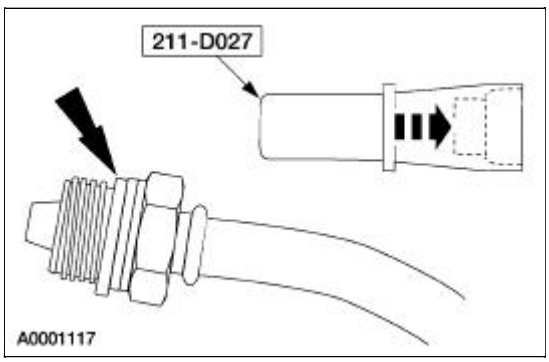


27. Lower the vehicle.

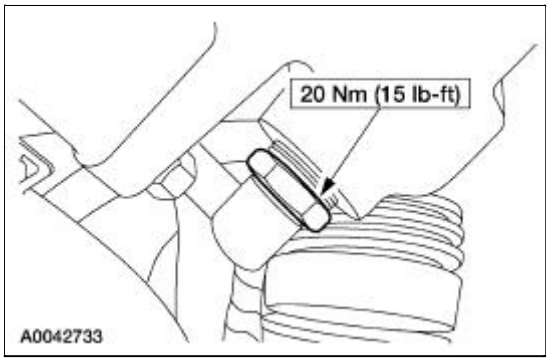
28. Position the power steering pump and install the three bolts.



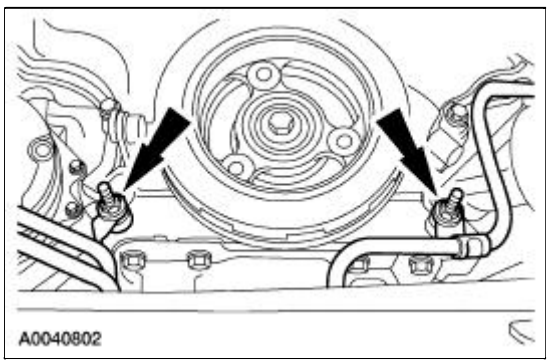
29. Using the special tool, install a new seal on the power steering pump pressure hose fitting.



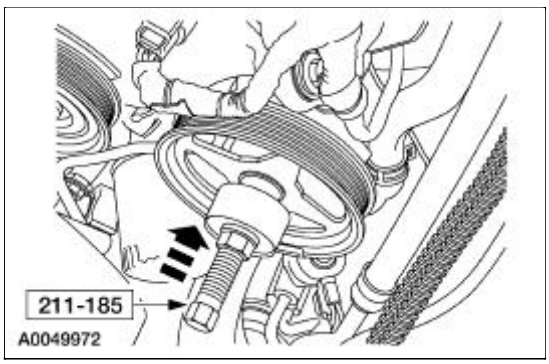
30. Connect the power steering pump pressure hose.



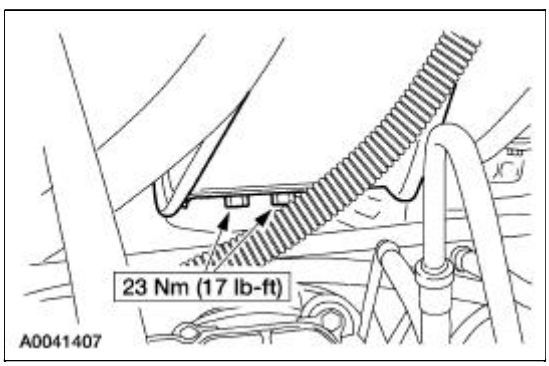
31. Position the transmission cooler tube and the power steering hose brackets. Install the nuts.
    - On 4.6L engine, tighten the nuts to 11 Nm (8 lb-ft).
    - On 5.4L engine, tighten the nuts to 40 Nm (30 lb-ft).



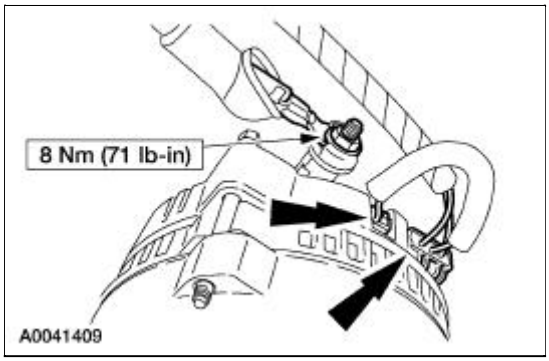
32. Using the special tool, install the power steering pump pulley.



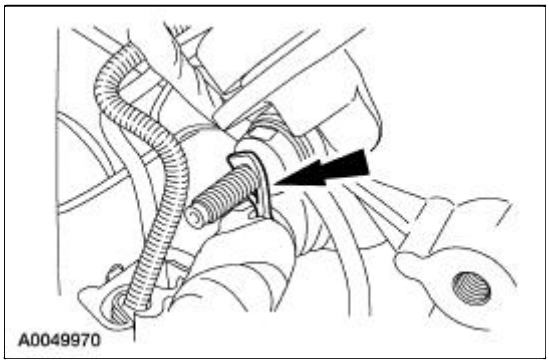
33. Position the power steering reservoir and install the two lower bolts.



34. Connect the generator electrical connections and position the generator aside.

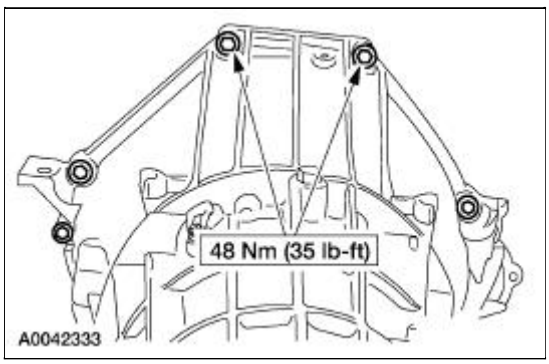


35. Install the wiring harness retainer on the front cover stud.



36. **NOTE:** On 4x4 vehicles, it may be necessary to reposition and secure the transfer case vent hose, after the transmission-to-engine bolts are installed.

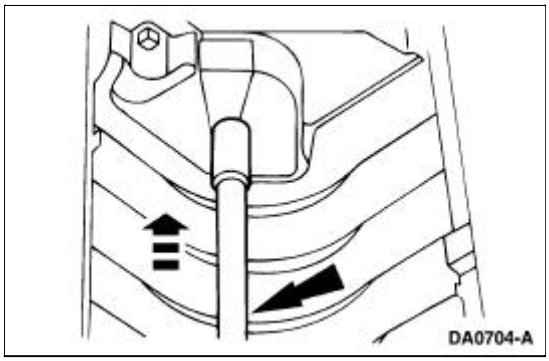
    Install the wiring harness bracket and the upper two transmission-to-engine bolts.



37. **NOTE:** Do not reuse the O-ring seal.

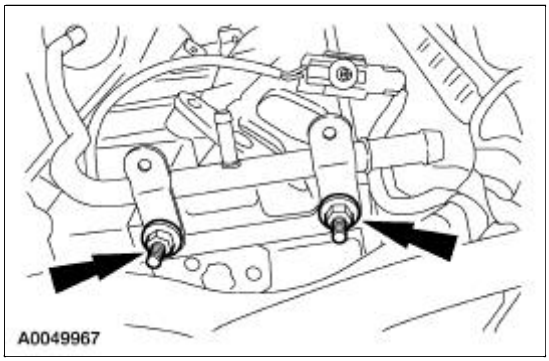
    Install the new O-ring seal and the heater outlet tube.

    - Lubricate the O-ring seal with engine coolant.



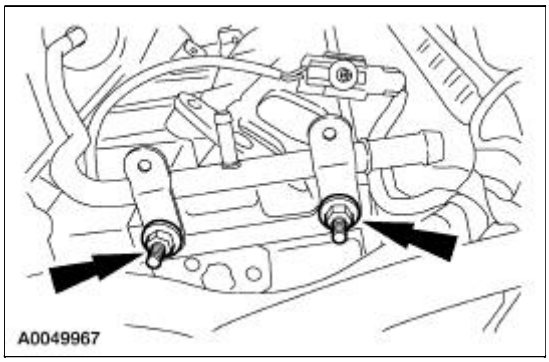
4.6L engines

38. Install the heater outlet tube upper and lower studs.
    - Tighten the studs to 25 Nm (18 lb-ft).



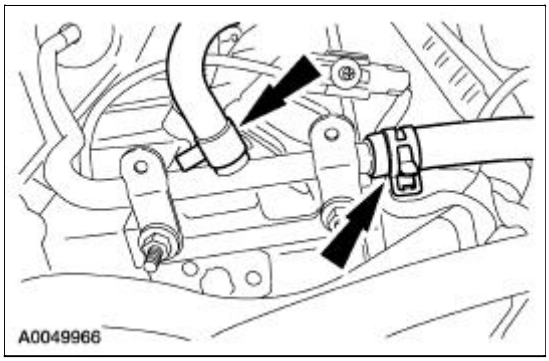
5.4L engines

39. Hand-tighten the heater outlet tube upper stud and install the lower stud.
    - Tighten the studs to 40 Nm (30 lb-ft).

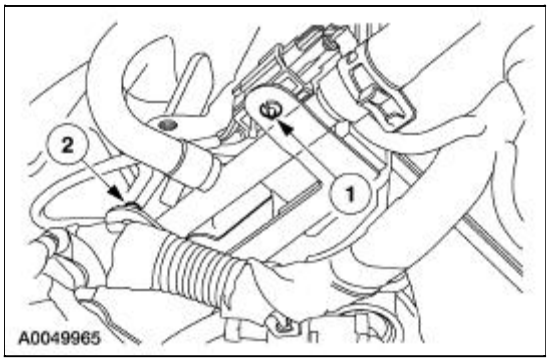


All engines

40. Connect the hoses to the heater outlet tube.

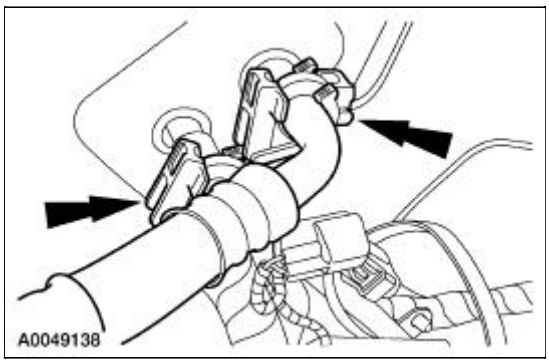


41. Install the wiring retainers on the heater outlet tube bracket.
    1. Install the knock sensor electrical connector retainer, 5.4L only.
    2. Install the engine harness routing clip.

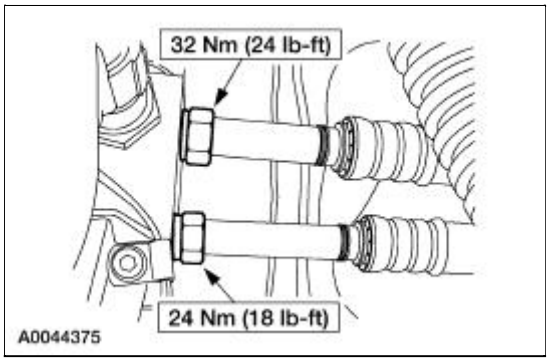


42. Install the cable routing bracket on the heater outlet tube mounting studs.
    - On 4.6L engine, tighten the nuts to 10 Nm (89 lb-in).
    - On 5.4L engine, tighten the nuts to 28 Nm (21 lb-ft).

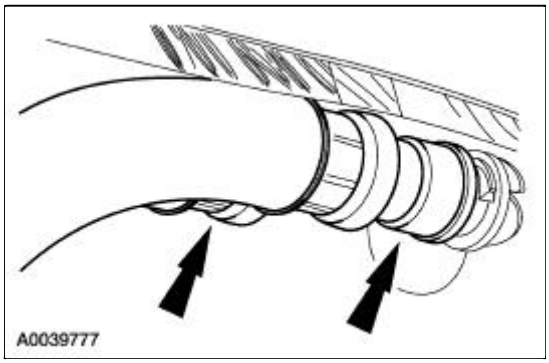
43. Connect the evaporator tubes to the evaporator.



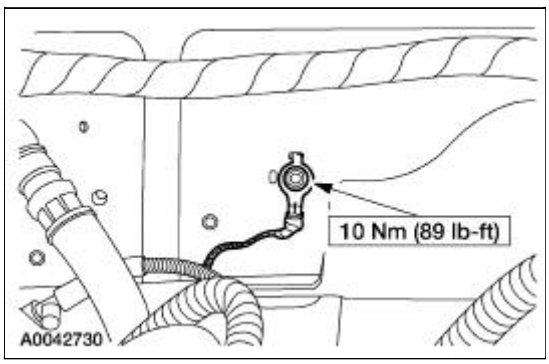
44. Connect the evaporator tubes to the manifold.



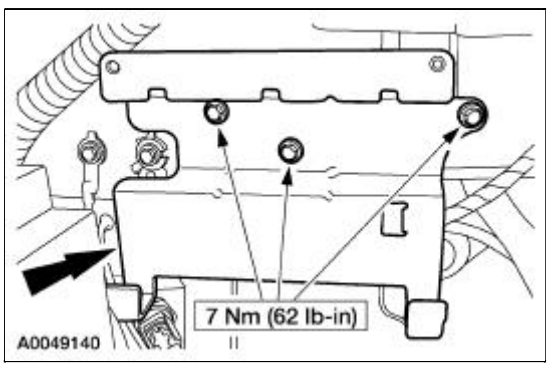
45. Connect the two heater hoses at the heater core.



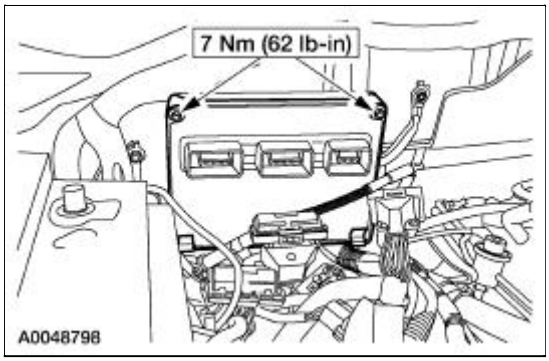
46. Position the ground wire and install the bolt.



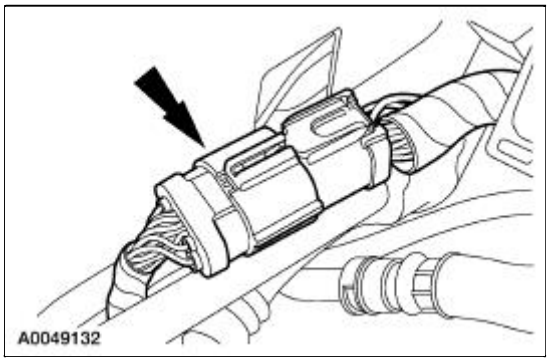
47. Position the powertrain control module (PCM) mounting bracket and install the bolts.



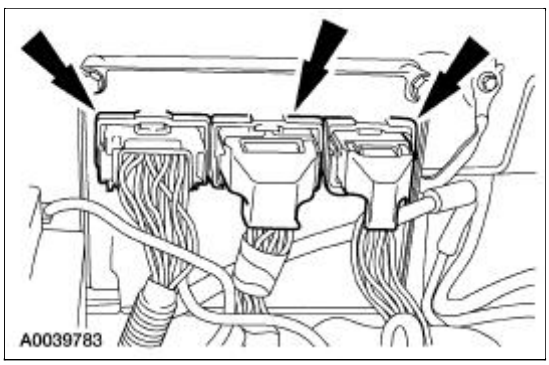
48. Position the PCM and install the bolts.



49. Connect the engine wiring harness electrical connector.



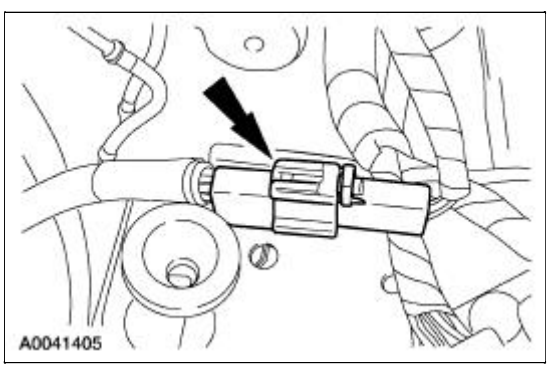
50. Connect the PCM electrical connectors.



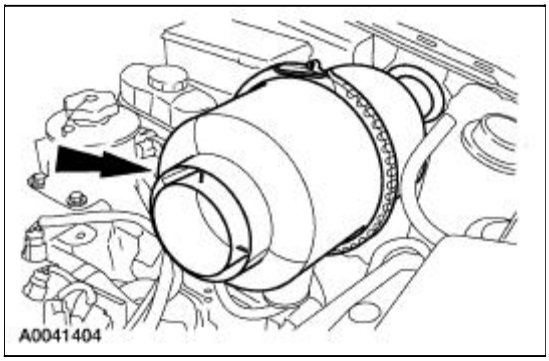
51. Install the A/C condenser core. For additional information, refer to Section 412-03A .

52. Install the radiator. For additional information, refer to Section 303-03 .

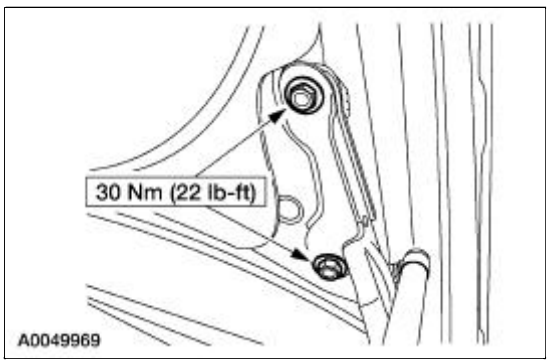
53. Position the engine air cleaner (ACL) in the vehicle and connect the mass air flow (MAF) sensor electrical connector.



54. Install the ACL.



55. Install the hood.



56. Install the intake manifold. For additional information, refer to Intake Manifold—4.6L or Intake Manifold—5.4L .

57. Fill all fluids to the correct levels.

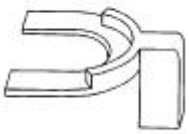
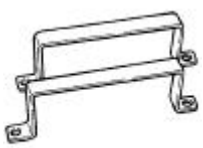
58. Start the engine and check for leaks. Stop the engine and recheck the fluid levels.

59. Recharge the A/C system. For additional information, refer to Section 412-00 .

60. If equipped, turn on the air suspension switch.

Cylinder Heads —4.6L

Special Tool(s)

 ST1330-A	Compressor, Valve Spring 303-567 (T97P-6565-AH)
 ST1331-A	Compressor Spacer, Valve Spring 303-382 (T91P-6565-AH)
 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)
 ST2197-A	Installer, Crankshaft Front Oil Seal 303-635
 ST1328-A	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A)
 ST1335-A	Holding Tool, Crankshaft 303-448 (T93P-6303-A)
 ST1668-A	Remover/Installer, Cylinder Head 303-572 (T97T-6000-A)
	Lifting Bracket Set, Engine 303-DS086 (D93P-6001-A)

 ST2443-A	
 ST1377-A	Modular Engine Lift Bracket 303-F047 (014-00073) or equivalent
 ST1438-A	Strap Wrench 303-D055 (D85L-6000-A)

Material

Item	Specification
Motorcraft Silicone Gasket Remover ZC-30	—
Motorcraft Metal Surface Prep ZC-31	—
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
Instant Adhesive E8AZ-19554-A	WSK-M2G402-A4
SAE 5W-20 Premium Synthetic Blend Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H
Motorcraft Premium Engine Coolant VC-4-A (in Canada CXC-10; in Oregon VC-5) or equivalent. Do not mix coolant types.	ESE-M97B44-A (green in color)
Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) or equivalent. Do not mix coolant types.	WSS-M97B51-A1 (yellow in color)
Hydraulic Chain Tensioner Retaining Clip	1L3Z-6P250-AA

Installation

All cylinder heads

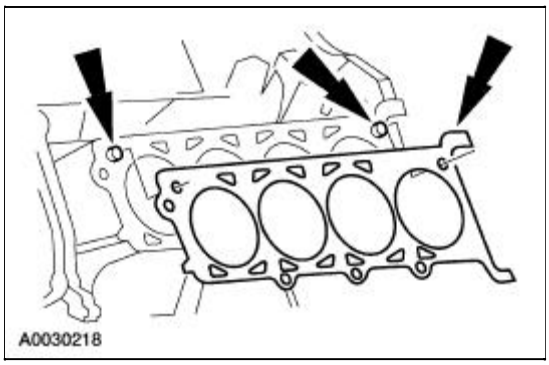
1. **CAUTION: The gasket sealing surfaces on the cylinder head and cylinder block must be clean. For additional information, refer to Cylinder Heads—4.6L in the Removal portion of this section.**

   CAUTION: The use of sealing aids (aviation cement, copper spray, and glue) is not permitted. The gasket must be installed dry.

   CAUTION: The new gasket has a film coating which is crucial to the gasket's ability to seal correctly. Do not scratch the gasket.

   NOTE: The RH head gasket is shown; the LH head gasket is similar.

   Install the head gasket over the dowel pins.



2. **CAUTION: Cylinder head machining or milling is not authorized by the Ford Motor Company. Cylinder head flatness must be within 0.0254 mm (0.001 in) across a 38.1 mm (1.5 in) square area.**

   CAUTION: The gasket sealing surfaces on the cylinder head and cylinder block must be clean. For additional information, refer to Cylinder Heads—4.6L in the Removal portion of this section.

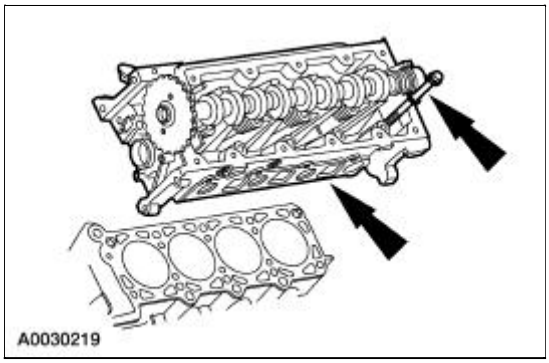
   CAUTION: The use of sealing aids (aviation cement, copper spray, and glue) is not permitted. The gasket must be installed dry.

   CAUTION: Do not allow the dowels to scratch the sealing surface of the cylinder head during cylinder head installation.

   NOTE: The new cylinder head bolts must be lightly oiled with a rag, and allowed to drain for a few minutes prior to installation.

   NOTE: The RH cylinder head is shown; the LH cylinder head is similar.

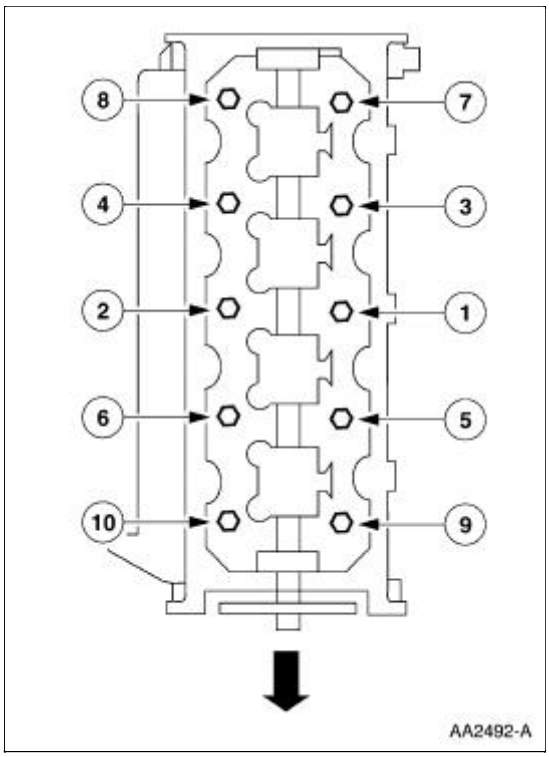
   Install the cylinder head on the dowels and the head gasket. Loosely install new bolts.



LH cylinder head

3. **NOTE:** Make sure to tighten the bolts in sequence in three stages.

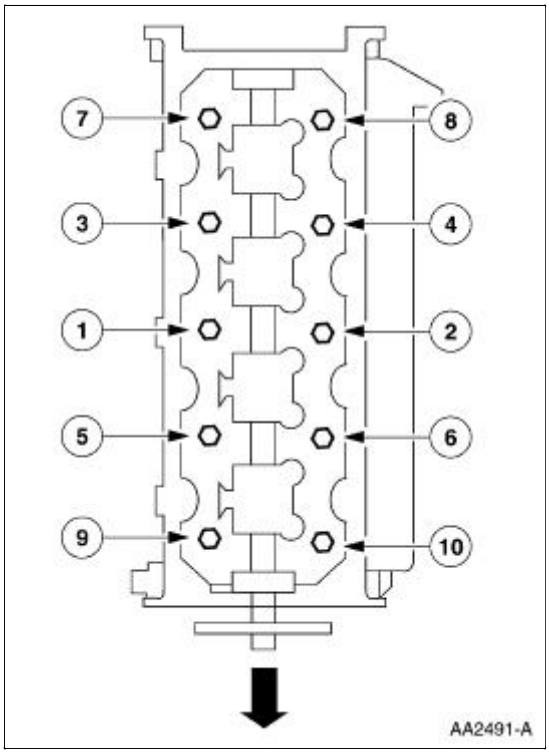
   Tighten the LH bolts in the sequence shown.
   - Stage 1: Tighten to 40 Nm (30 lb-ft).
   - Stage 2: Tighten an additional 90 degrees.
   - Stage 3: Tighten an additional 90 degrees.



RH cylinder head

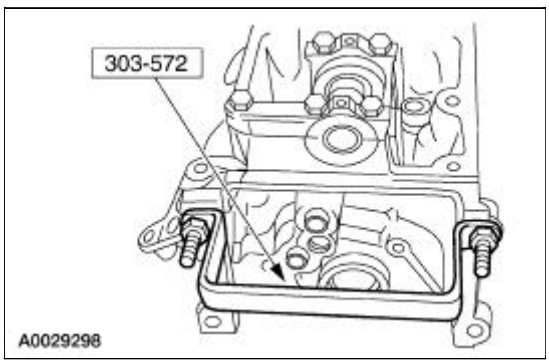
4. **NOTE:** Make sure to tighten the bolts in the following three stages.

   Tighten the RH bolts in the sequence shown.
   - Stage 1: Tighten to 40 Nm (30 lb-ft).
   - Stage 2: Tighten an additional 90 degrees.
   - Stage 3: Tighten an additional 90 degrees.



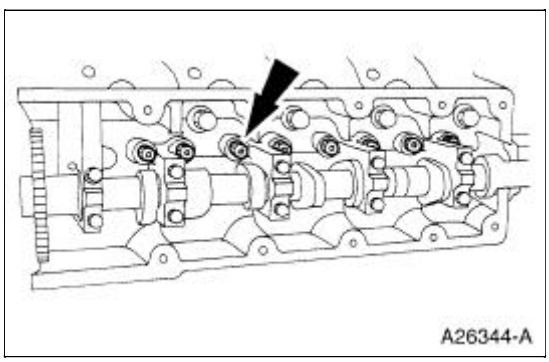
All cylinder heads

5. Remove the special tools from both ends of the cylinder head.



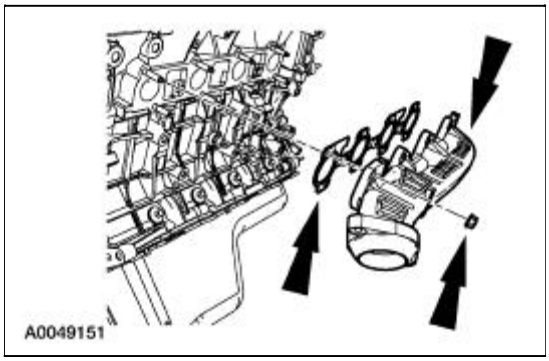
6. **NOTE:** Lubricate the hydraulic lash adjusters with clean engine oil.

   Install the hydraulic lash adjusters in their original locations.

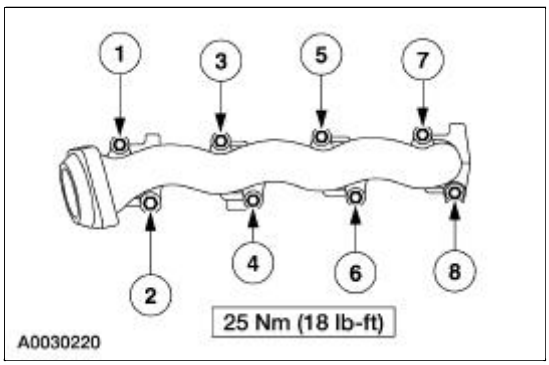


RH cylinder head

7. Position the RH exhaust manifold gasket and the exhaust manifold. Loosely install the nuts.



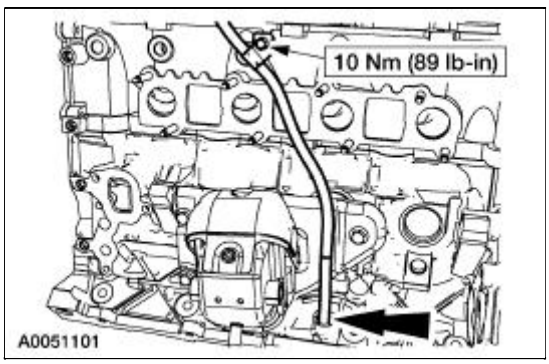
8. Tighten the RH exhaust manifold nuts in the sequence shown.



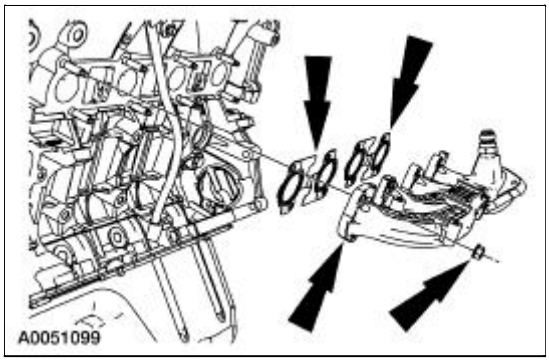
LH cylinder head

9. **NOTE:** Lubricate the O-ring seal with clean engine oil.

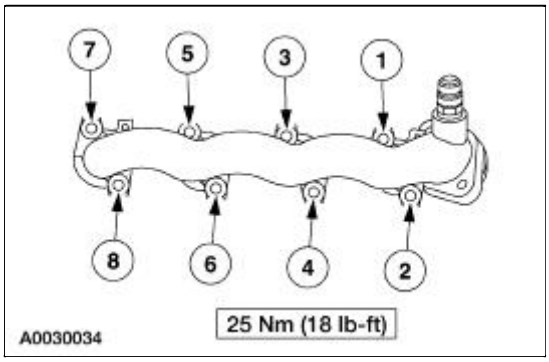
   Install the oil level indicator tube.
   - Install a new O-ring seal on the oil level indicator tube.
   - Install the oil level indicator tube.
   - Install the bolt.



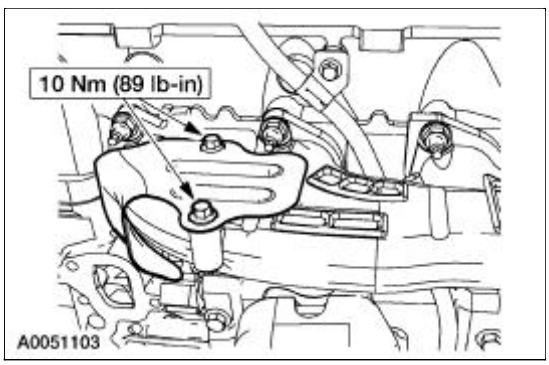
10. Position the LH exhaust manifold gaskets and the exhaust manifold. Loosely install the nuts.



11. Tighten the LH exhaust manifold nuts in the sequence shown.



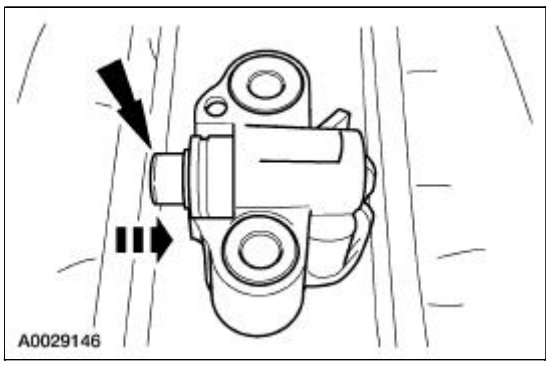
12. Install the heat shield and bolts.



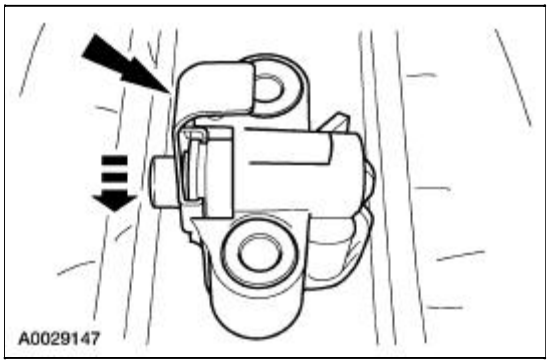
All cylinder heads

13. **CAUTION: Timing chain procedures must be followed exactly or damage to valves and pistons will result.**

    Compress the tensioner plunger, using a vise.

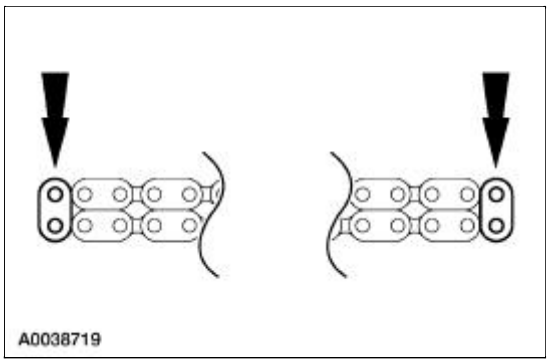


14. Install a retaining clip on the tensioner to hold the plunger in during installation.

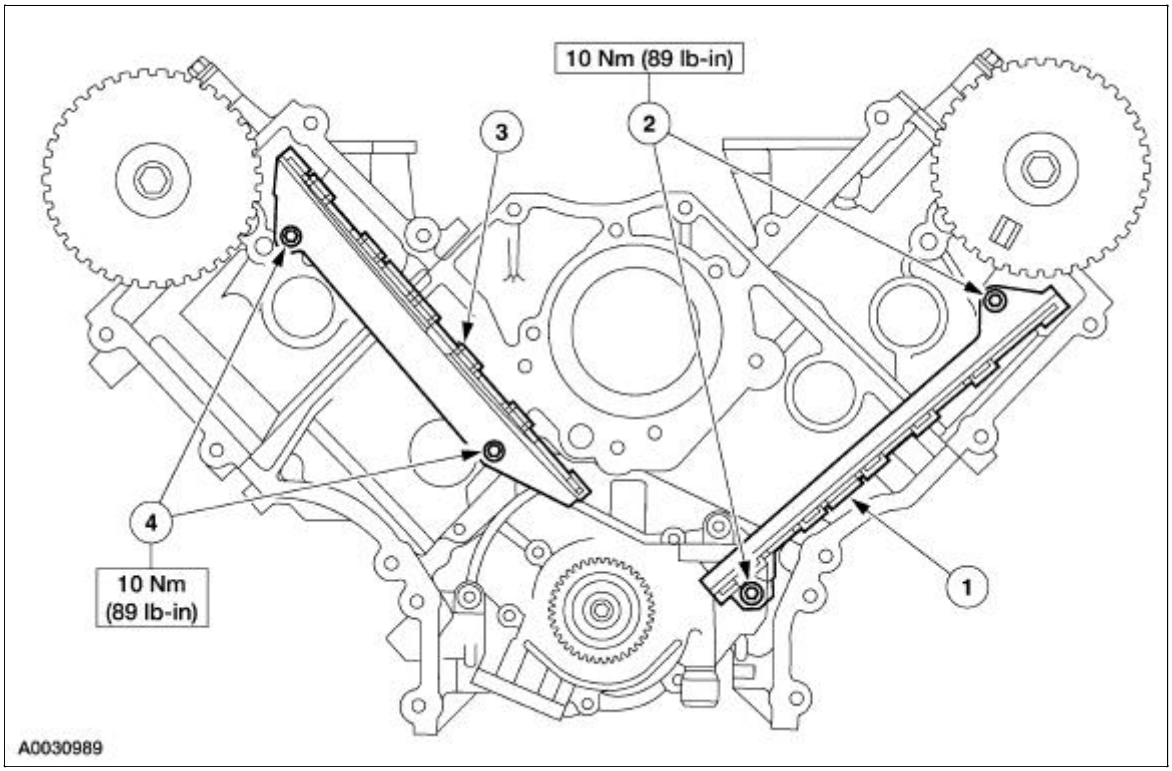


15. Remove the tensioner from the vise.

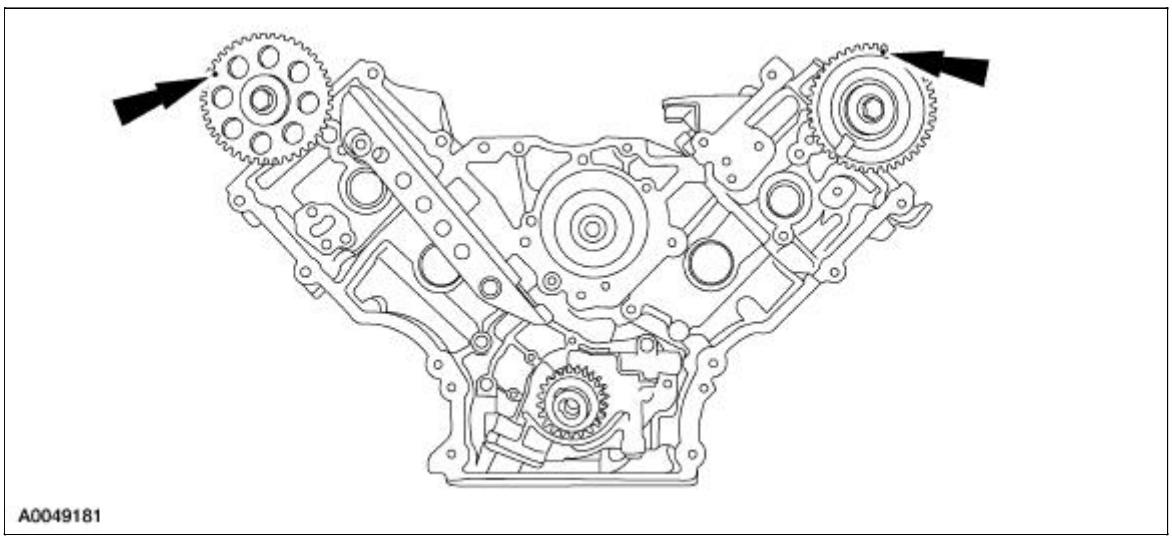
16. If the copper links are not visible, mark one link on one end and one link on the other end, and use as timing marks.



17. Install the timing chain guides.
    1. Position the LH timing chain guide.
    2. Install and tighten the LH bolts.
    3. Position the RH timing chain guide.
    4. Install and tighten the RH bolts.



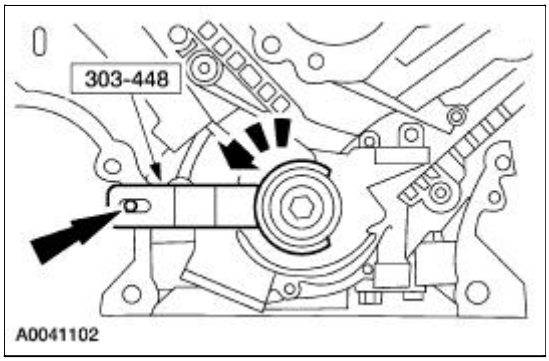
18. Rotate the RH camshaft sprocket until the timing mark is approximately at the 11 o'clock position. Rotate the LH camshaft sprocket until the timing mark is approximately at the 12 o'clock position.



19. **CAUTION: Rotate the crankshaft counterclockwise only. Do not rotate past the position shown or severe piston and valve damage can occur.**

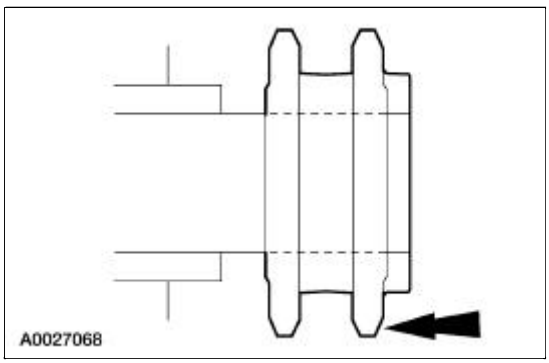
    NOTE: The number one cylinder is at top dead center (TDC) when the stud on the engine block fits into the slot in the handle of the special tool.

    Using the special tool, position the crankshaft so the number one cylinder is at TDC.

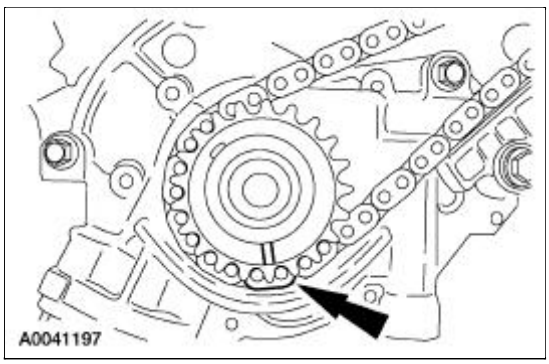


20. Remove the Crankshaft Holding Tool.

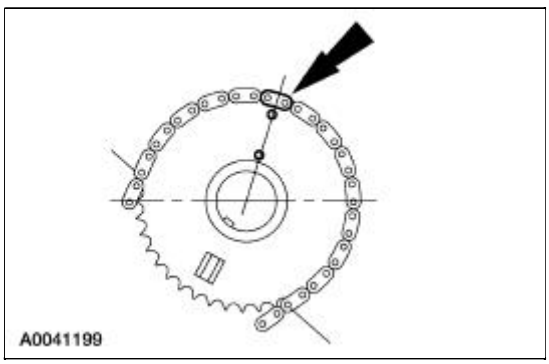
21. Install the crankshaft sprocket, making sure the flange faces forward.



22. Position the LH (inner) timing chain on the crankshaft sprocket, aligning the copper (marked) link with the timing mark on the sprocket.

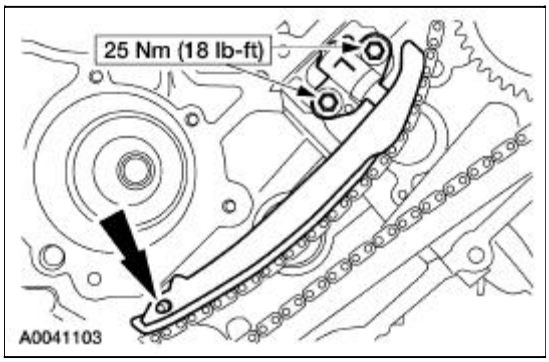


23. Install the LH timing chain on the camshaft sprocket, aligning the copper (marked) link with the timing marks on the sprocket.

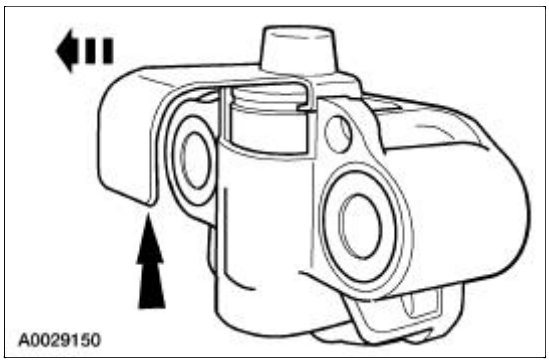


24. **NOTE:** The LH timing chain tensioner arm has a bump near the dowel hole for identification.

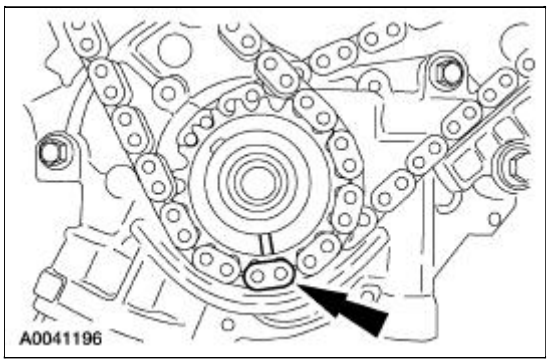
    Position the LH timing chain tensioner arm on the dowel pin and install the LH timing chain tensioner.



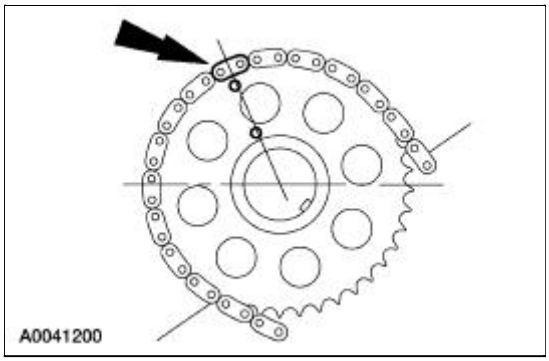
25. Remove the retaining clip from the LH timing chain tensioner.



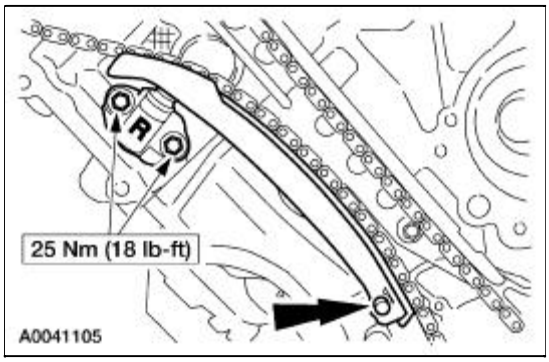
26. Position the RH (outer) timing chain on the crankshaft sprocket, aligning the copper (marked) link with the timing mark on the sprocket.



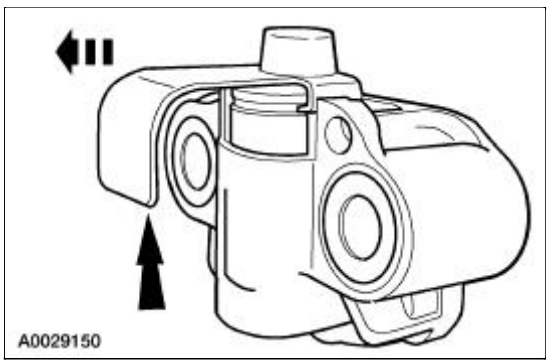
27. Install the RH timing chain on the camshaft sprocket, aligning the copper (marked) link with the timing marks on the sprocket.



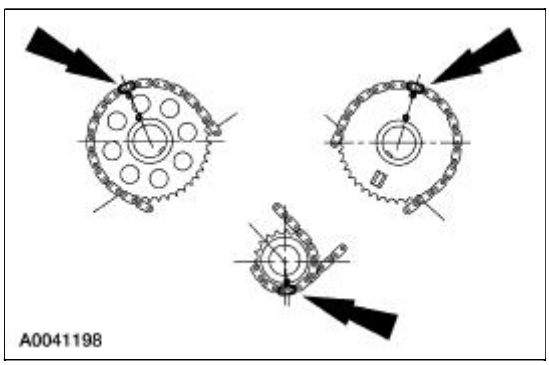
28. Position the RH timing chain tensioner arm on the dowel pin and install the RH timing chain tensioner.



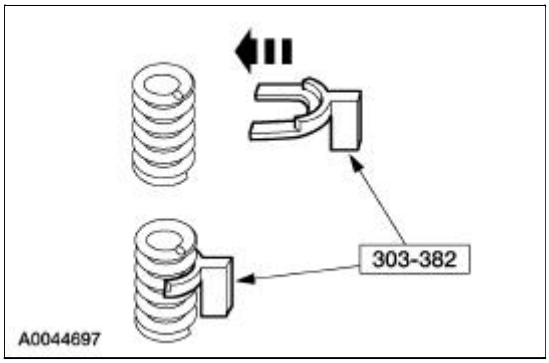
29. Remove the retaining clip from the RH timing chain tensioner.



30. Make sure that the copper (marked) chain links are lined up with the dots on the crankshaft sprockets and the camshaft sprocket.



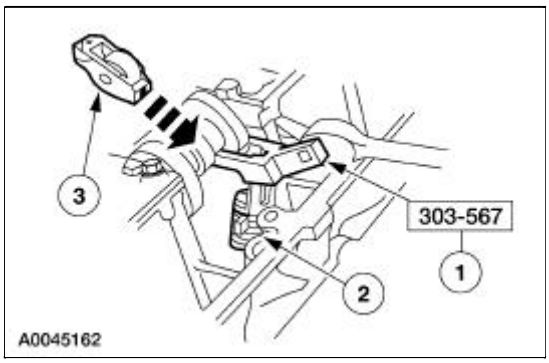
31. Install the special tool between the valve spring coils to prevent valve stem seal damage.



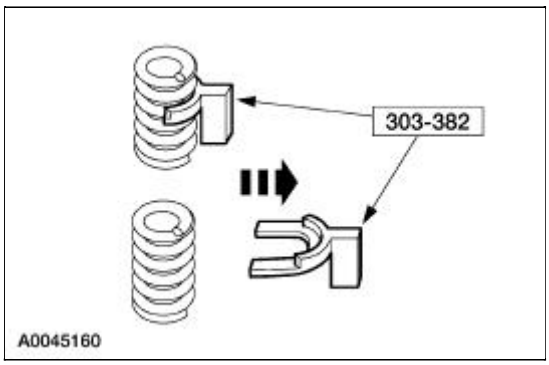
32. **NOTE:** Lubricate the camshaft roller followers using clean engine oil.

    NOTE: Position the cam lobe away from the camshaft roller follower location prior to installing each camshaft roller follower.

    Install the camshaft roller followers.
    1. Install the special tool.
    2. Compress the valve spring.
    3. Install the camshaft roller followers in their original locations.



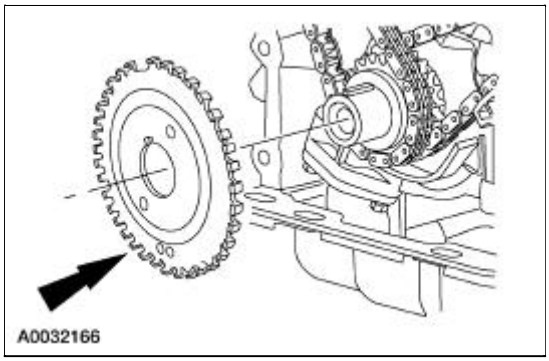
33. Remove the special tool.



34. **CAUTION: When installing the spark plugs, use care not to exceed the recommended torque.**

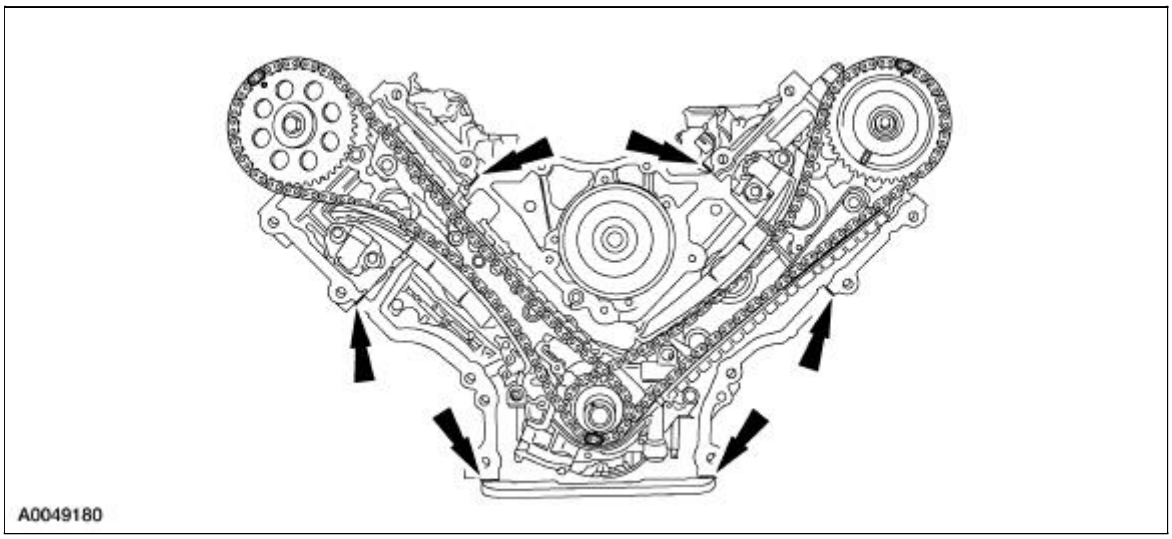
    Install the eight spark plugs.
    - Tighten the spark plugs to 18 Nm (13 lb-ft).

35. Install the crankshaft sensor ring on the crankshaft.

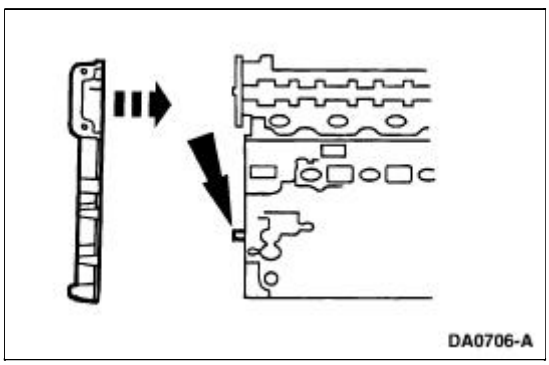


36. **NOTE:** If the front cover is not secured within four minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

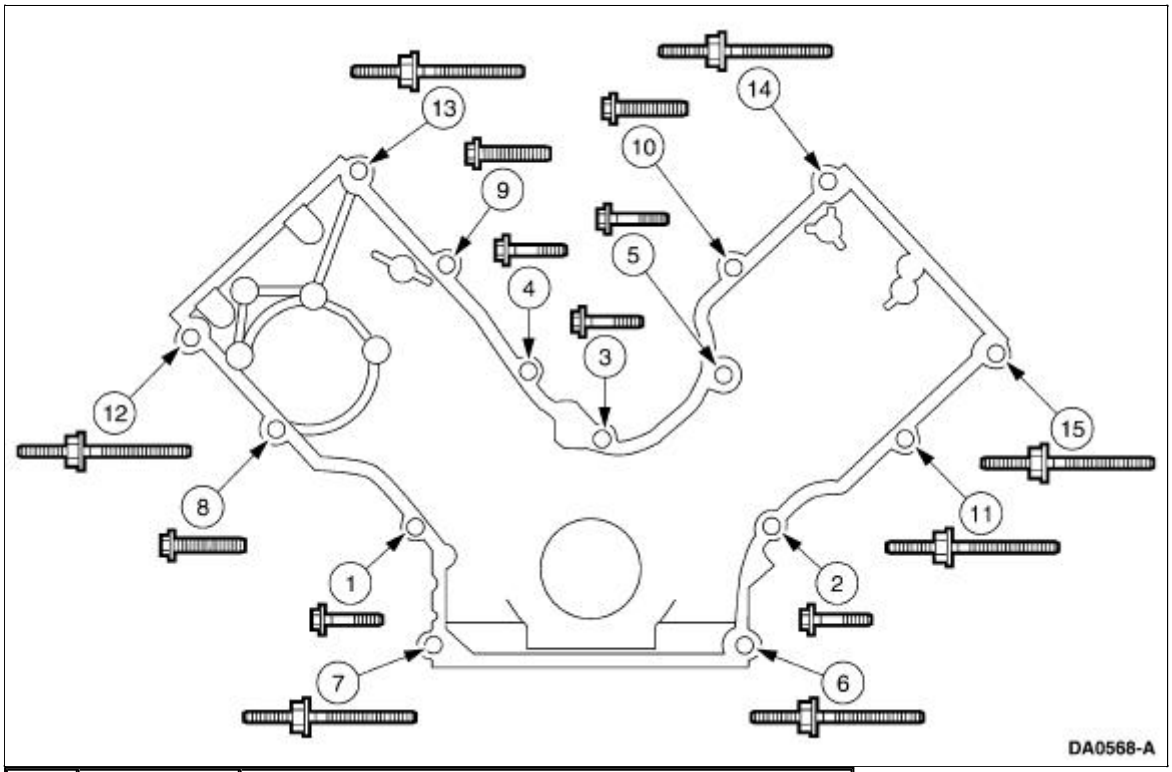
    Apply a bead of silicone gasket and sealant along the cylinder head-to-cylinder block surface and the oil pan-to-cylinder block surface, at the locations shown.



37. Install a new engine front cover gasket on the engine front cover. Position the engine front cover. Install the fasteners finger-tight.

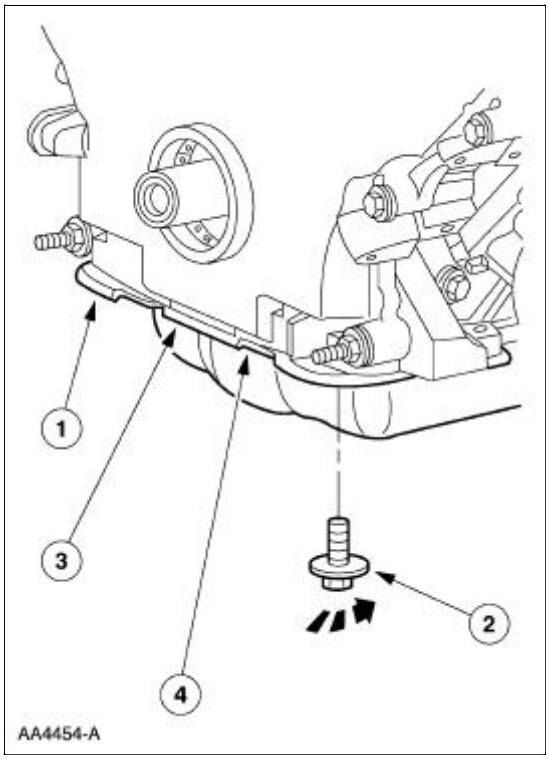


38. Tighten the front cover fasteners in the sequence shown to 25 Nm (18 lb-ft).

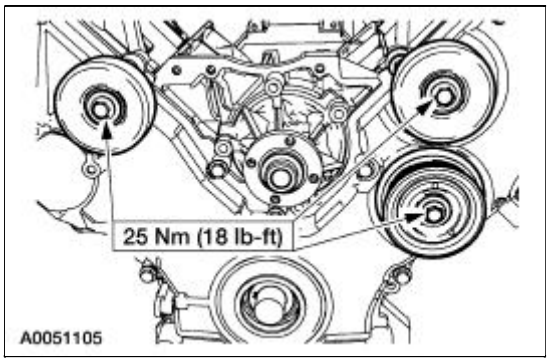


Item	Part Number	Description
1	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
2	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
3	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
4	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
5	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
6	W706508	Stud, Hex Shldr Pilot, M8 x 1.25 x 50 — M6 x 1 x 10
7	N808586	Stud and Washer, Hex Head Pilot, M8 x 1.25 x 60 — M6 x 1 x 26
8	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
9	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
10	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
11	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M6 x 1.25 x 26
12	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M6 x 1.25 x 26
13	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M6 x 1.25 x 26
14	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M6 x 1.25 x 26
15	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M6 x 1.25 x 26

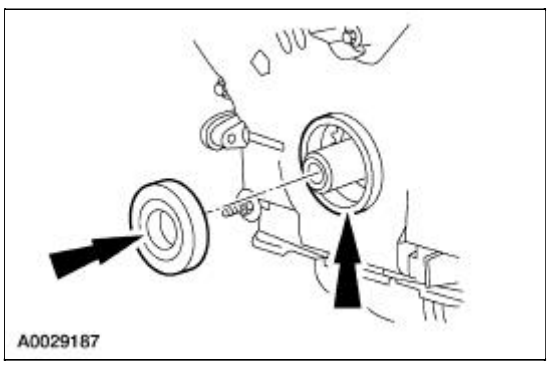
39. Loosely install the bolts, then tighten the bolts in two stages, in the sequence shown.
    - Stage 1: Tighten to 20 Nm (15 lb-ft).
    - Stage 2: Tighten an additional 90 degrees.



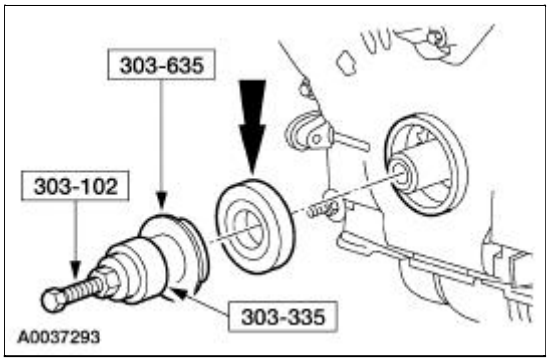
40. Position the belt idler pulleys and install the bolts.



41. Lubricate the engine front cover and the front oil seal inner lip with clean engine oil.

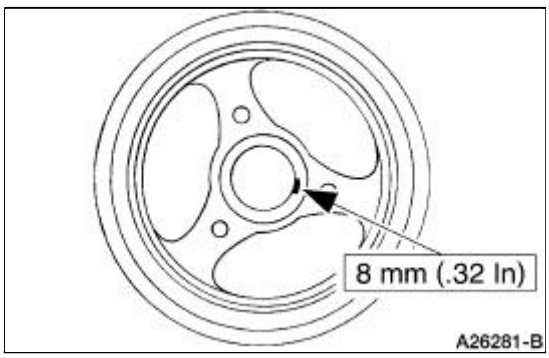


42. Use the special tools to install the crankshaft front oil seal into the engine front cover.

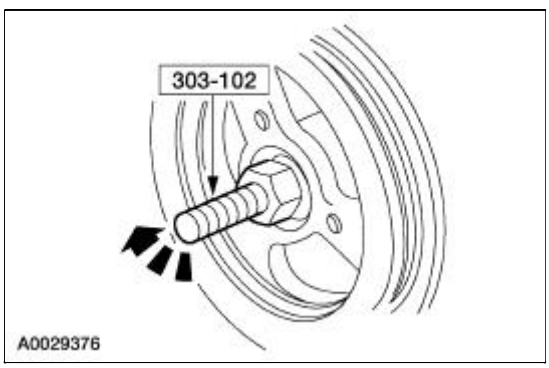


43. **NOTE:** If not secured within four minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

    Apply silicone gasket and sealant to the Woodruff key slot on the crankshaft pulley.



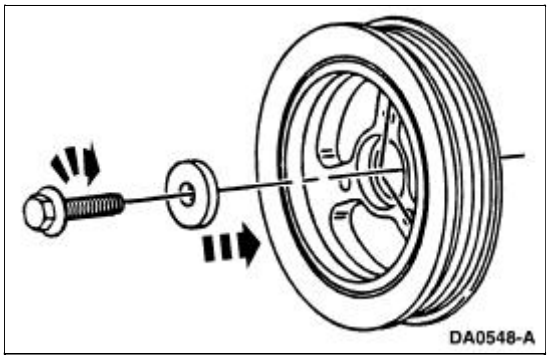
44. Use the special tool to install the crankshaft pulley.



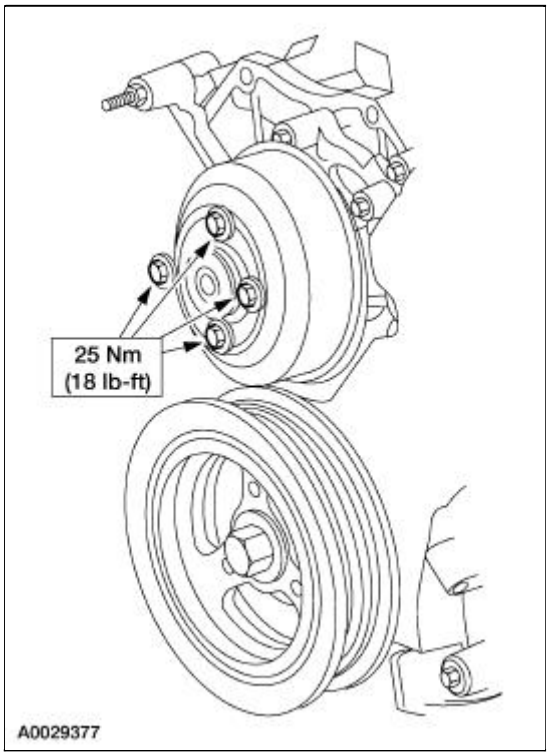
45. **NOTE:** Use a suitable strap wrench (303-D055) to hold the pulley while tightening the bolt.

    Tighten the new crankshaft pulley bolt in four stages.

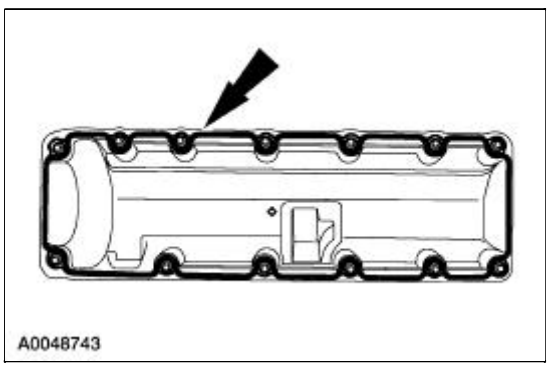
    - Stage 1: Tighten to 90 Nm (66 lb-ft).
    - Stage 2: Loosen 360 degrees.
    - Stage 3: Tighten to 50 Nm (37 lb-ft).
    - Stage 4: Tighten an additional 90 degrees.



46. Position the coolant pump pulley on the coolant pump and install the bolts.

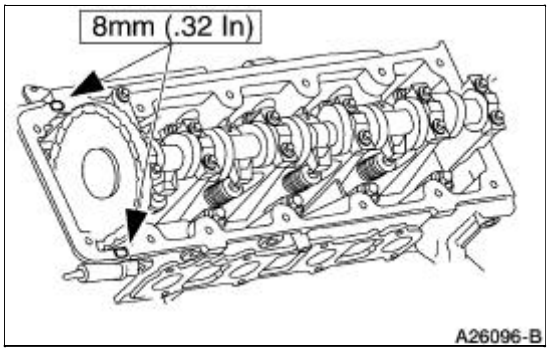


47. If a new gasket is being installed, apply instant adhesive completely around the gasket groove in the LH valve cover. Install the new valve cover gasket.

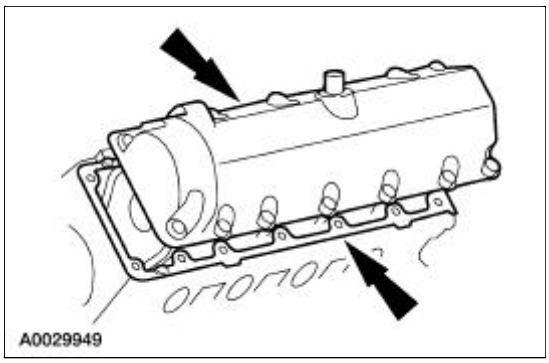


48. **NOTE:** If not secured within four minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

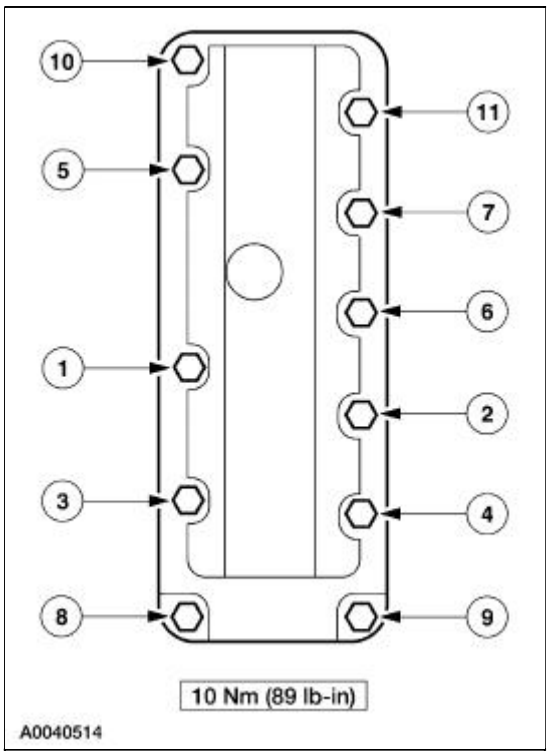
    Apply silicone gasket and sealant in two places where the engine front cover meets the cylinder head.



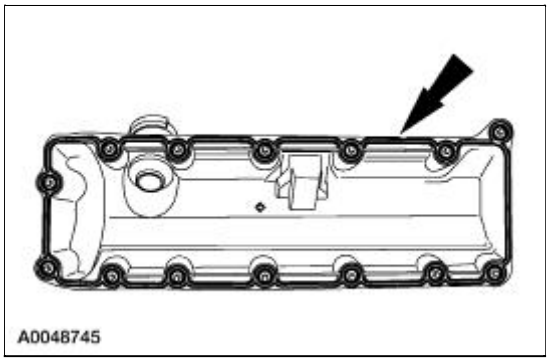
49. Position the LH valve cover and gasket on the cylinder head and install the bolts loosely.



50. Tighten the bolts in the sequence shown.

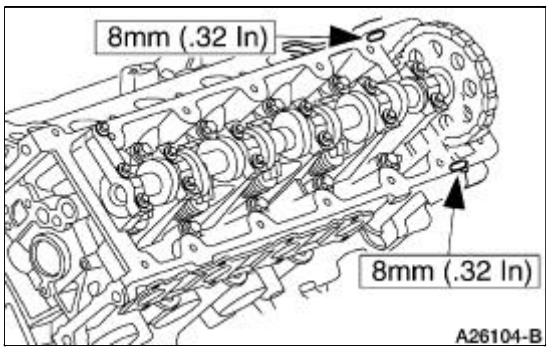


51. If a new gasket is being installed, apply instant adhesive completely around the gasket groove in the RH valve cover. Install the new valve cover gasket.

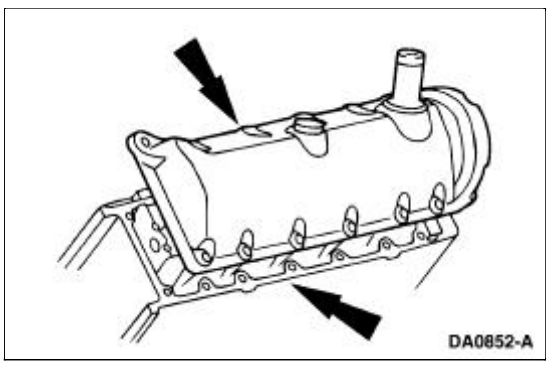


52. **NOTE:** If not secured within four minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

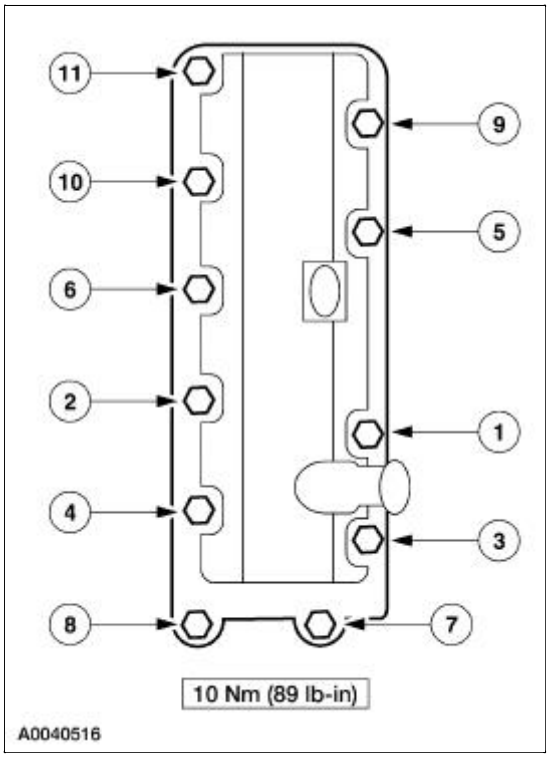
    Apply silicone gasket and sealant in two places where the engine front cover meets the cylinder head.



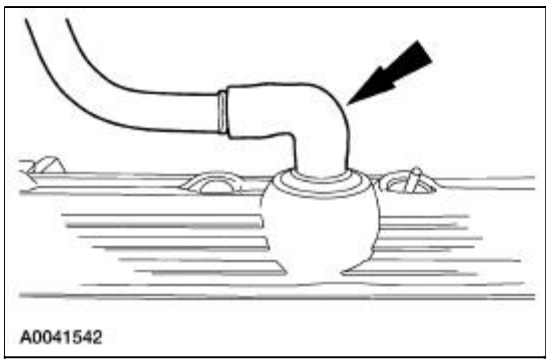
53. Position the RH valve cover and gasket on the cylinder head and install the bolts loosely.



54. Tighten the bolts in the sequence shown.

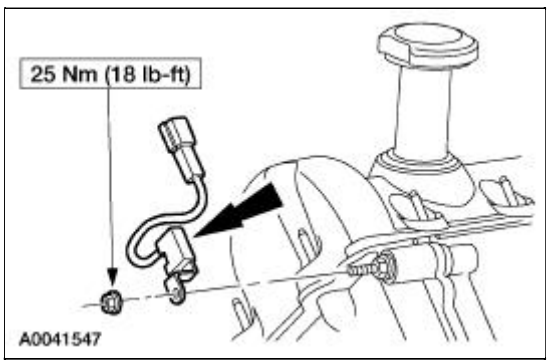


55. Install the crankcase ventilation tube on the LH valve cover.



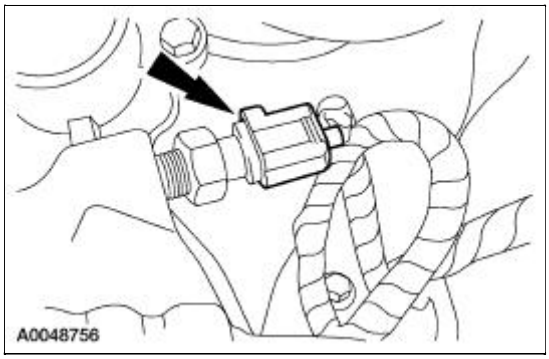
56. **NOTE:** RH shown, LH similar.

    Install the radio frequency interference capacitors and the engine appearance cover bracket.

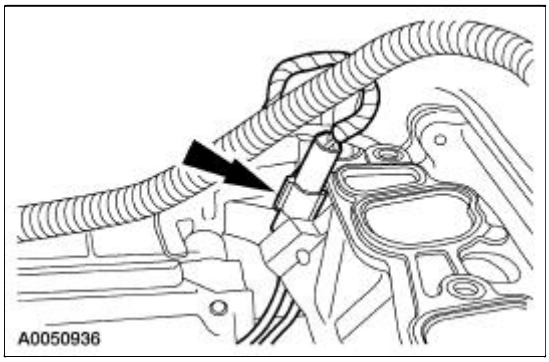


57. Roughly position the engine control sensor wiring harness and mount it on the valve cover studs.

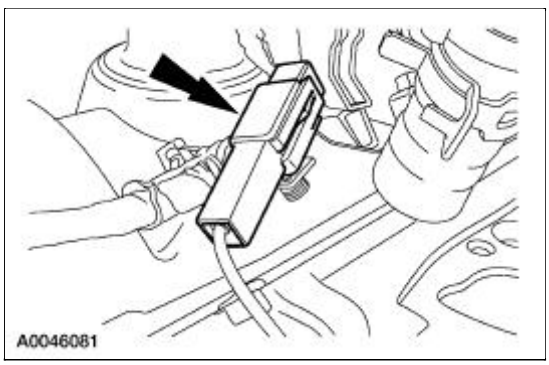
58. Connect the oil pressure switch electrical connector.



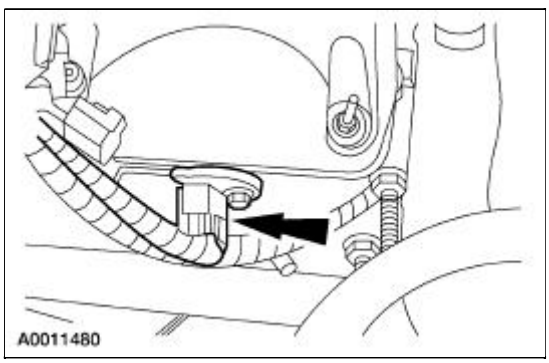
59. Connect the knock sensor electrical connector.



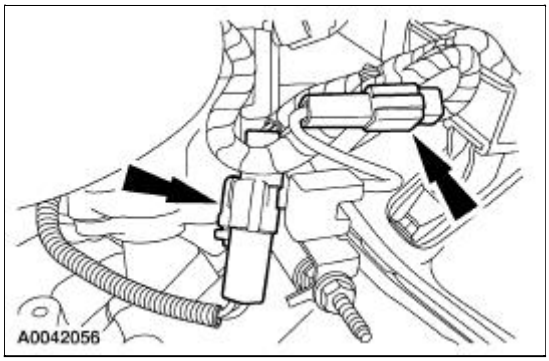
60. Connect the RH radio frequency interference capacitor electrical connector.



61. Connect the CMP sensor electrical connector.

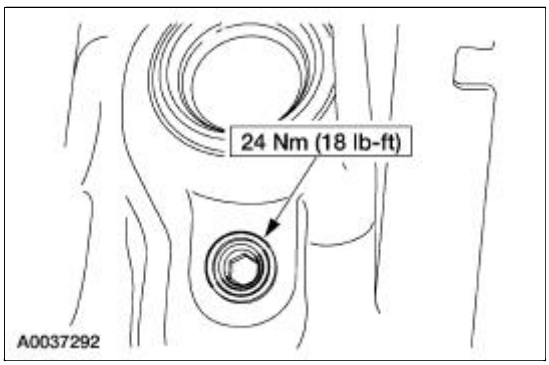


62. Connect the LH radio frequency interference capacitor and CHT sensor electrical connectors.

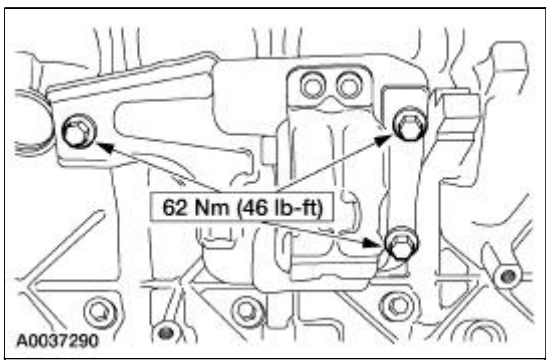


63. **NOTE:** LH shown, RH similar.

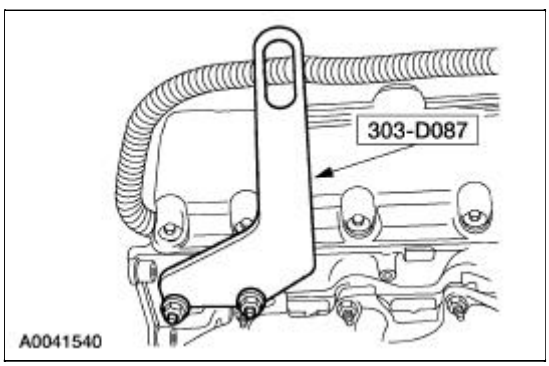
    Install the cylinder block drain plugs.



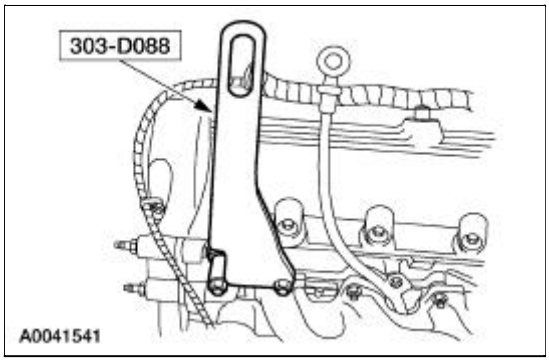
64. Install the RH engine mount.



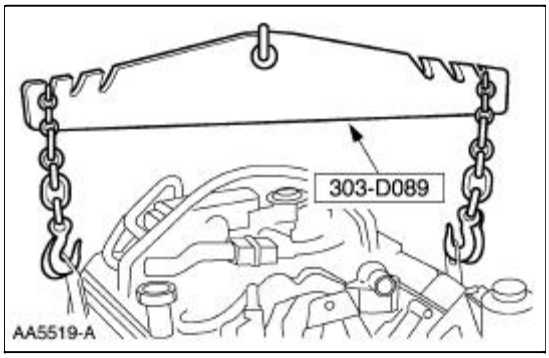
65. Install the special tool.



66. Install the special tool.

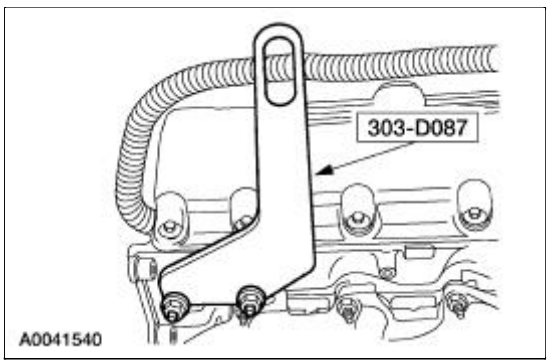


67. Install the special tool and remove the engine from the work stand.

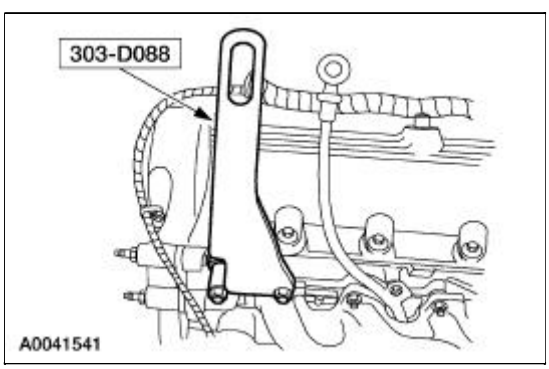


68. Lower the engine onto wooden blocks.

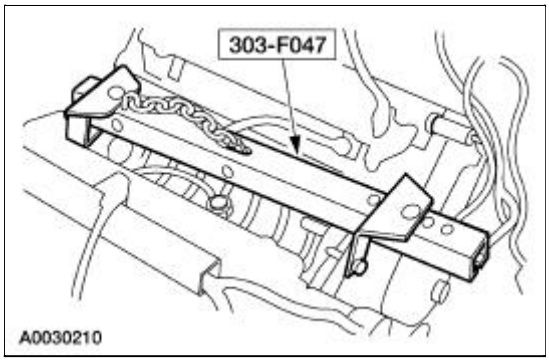
69. Remove the special tool.



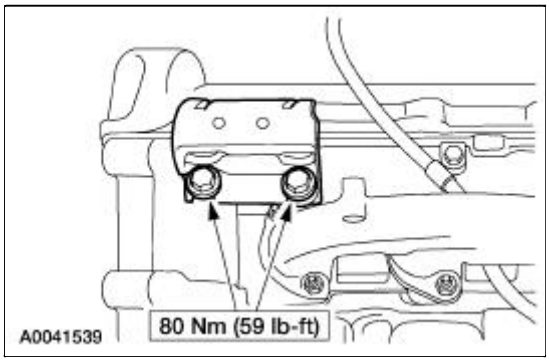
70. Remove the special tool.



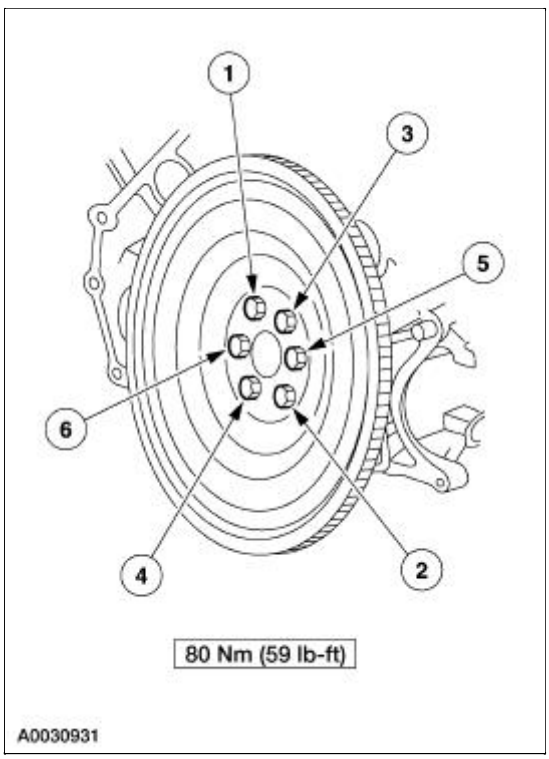
71. Install the special tool and raise the engine.



72. Install the power steering reservoir lower mounting bracket.



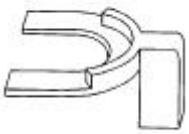
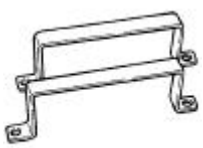
73. Install the flexplate or the flywheel and bolts. Tighten the bolts in the sequence shown.



74. Install the engine. For additional information, refer to Engine in this section.

Cylinder Heads —5.4L

Special Tool(s)

 ST1330-A	Compressor, Valve Spring 303-567 (T97P-6565-AH)
 ST1331-A	Compressor Spacer, Valve Spring 303-382 (T91P-6565-AH)
 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)
 ST2197-A	Installer, Crankshaft Front Oil Seal 303-635
 ST1328-A	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A)
 ST1335-A	Holding Tool, Crankshaft 303-448 (T93P-6303-A)
 ST1668-A	Remover/Installer, Cylinder Head 303-572 (T97T-6000-A)
	Lifting Bracket Set, Engine 303-DS086 (D93P-6001-A)

 ST2443-A	
 ST1377-A	Modular Engine Lift Bracket 303-F047 (014-00073) or equivalent
 ST1438-A	Strap Wrench 303-D055 (D85L-6000-A)

Material

Item	Specification
Motorcraft Silicone Gasket Remover ZC-30	—
Motorcraft Metal Surface Prep ZC-31	—
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
Instant Adhesive E8AZ-19554-A	WSK-M2G402-A4
SAE 5W-20 Premium Synthetic Blend Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H
Motorcraft Premium Engine Coolant VC-4-A (in Canada CXC-10; in Oregon VC-5) or equivalent. Do not mix coolant types.	ESE-M97B44-A (green in color)
Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) or equivalent. Do not mix coolant types.	WSS-M97B51-A1 (yellow in color)
Hydraulic Chain Tensioner Retaining Clip	1L3Z-6P250-AA

Installation

All cylinder heads

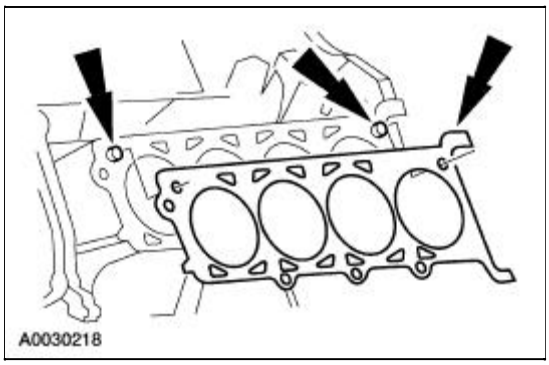
1. **CAUTION: The gasket sealing surfaces on the cylinder head and cylinder block must be clean. For additional information, refer to Cylinder Heads—5.4L in the Removal portion of this section.**

   CAUTION: The use of sealing aids (aviation cement, copper spray, and glue) is not permitted. The gasket must be installed dry.

   CAUTION: The new gasket has a film coating which is crucial to the gasket's ability to seal correctly. Do not scratch the gasket.

   NOTE: The RH head gasket is shown; the LH head gasket is similar.

   Install the head gasket over the dowel pins.



2. **CAUTION: Cylinder head machining or milling is not authorized by the Ford Motor Company. Cylinder head flatness must be within 0.0254 mm (0.001 in) across a 38.1 mm (1.5 in) square area.**

   CAUTION: The gasket sealing surfaces on the cylinder head and cylinder block must be clean. For additional information, refer to Cylinder Heads—5.4L in the Removal portion of this section.

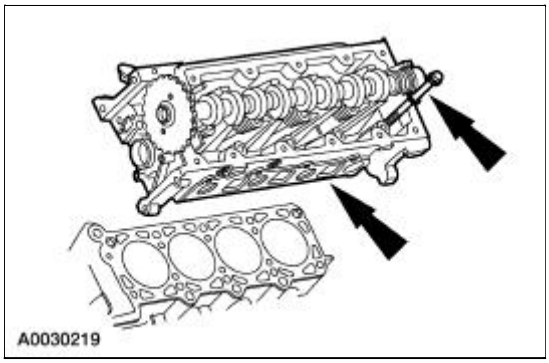
   CAUTION: The use of sealing aids (aviation cement, copper spray, and glue) is not permitted. The gasket must be installed dry.

   CAUTION: Do not allow the dowels to scratch the sealing surface of the cylinder head during cylinder head installation.

   NOTE: The new cylinder head bolts must be lightly oiled with a rag, and allowed to drain for a few minutes prior to installation.

   NOTE: The RH cylinder head is shown; the LH cylinder head is similar.

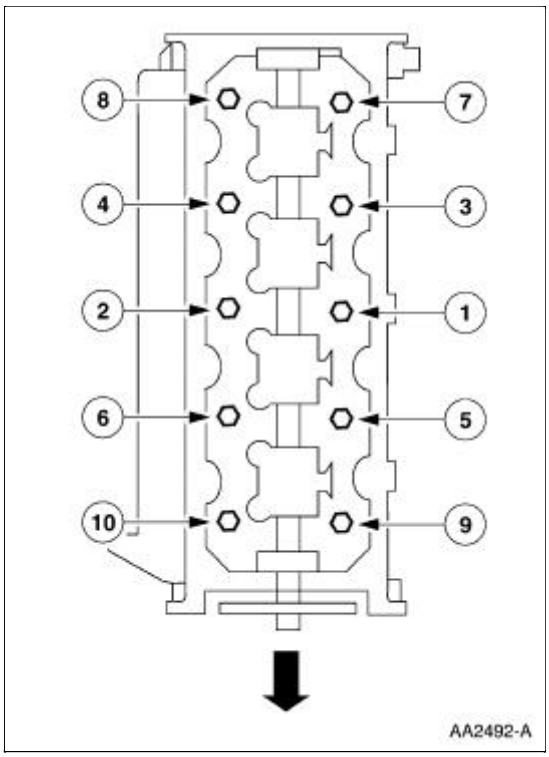
   Install the cylinder head on the dowels and the head gasket. Loosely install new bolts.



LH cylinder head

3. **NOTE:** Make sure to tighten the bolts in sequence in three stages.

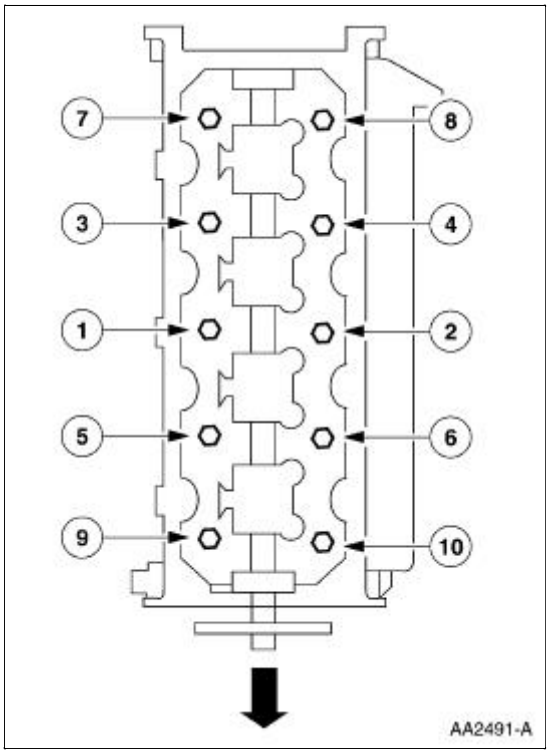
   Tighten the LH bolts in the sequence shown.
   - Stage 1: Tighten to 40 Nm (30 lb-ft).
   - Stage 2: Tighten an additional 90 degrees.
   - Stage 3: Tighten an additional 90 degrees.



RH cylinder head

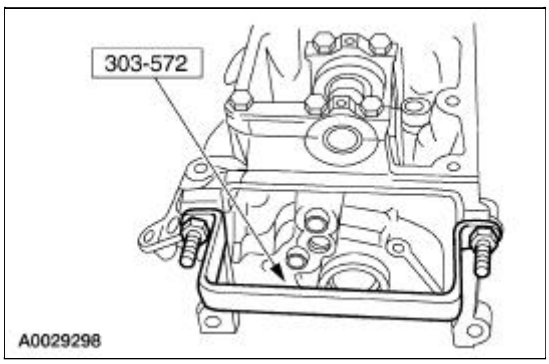
4. **NOTE:** Make sure to tighten the bolts in the following three stages.

   Tighten the RH bolts in the sequence shown.
   - Stage 1: Tighten to 40 Nm (30 lb-ft).
   - Stage 2: Tighten an additional 90 degrees.
   - Stage 3: Tighten an additional 90 degrees.



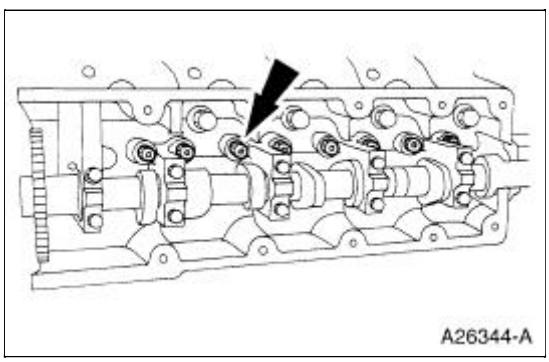
All cylinder heads

5. Remove the special tools from both ends of the cylinder head.



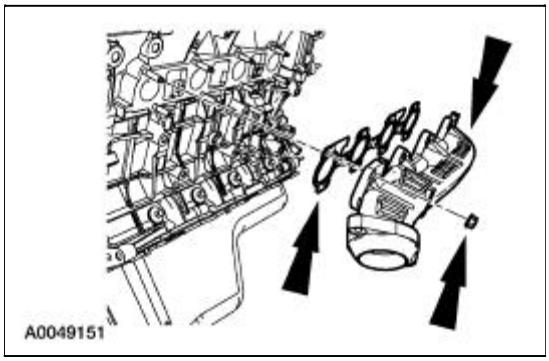
6. **NOTE:** Lubricate the hydraulic lash adjusters with clean engine oil.

   Install the hydraulic lash adjusters in their original locations.

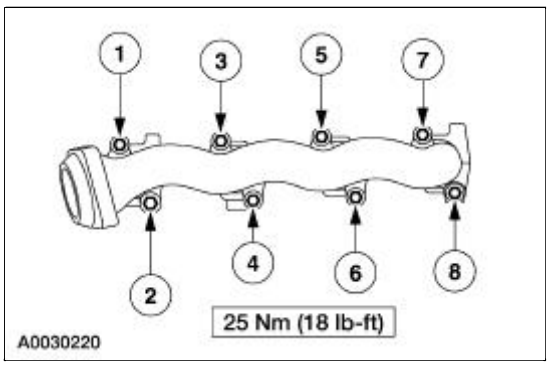


RH cylinder head

7. Position the RH exhaust manifold gasket and the exhaust manifold. Loosely install the nuts.



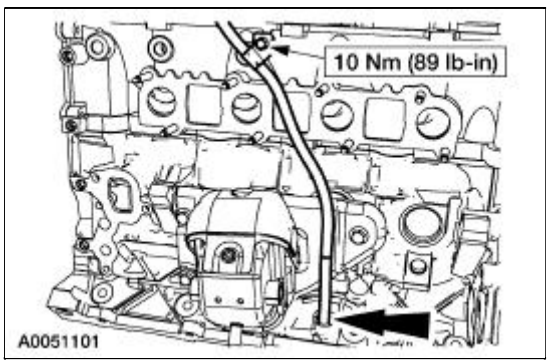
8. Tighten the RH exhaust manifold nuts in the sequence shown.



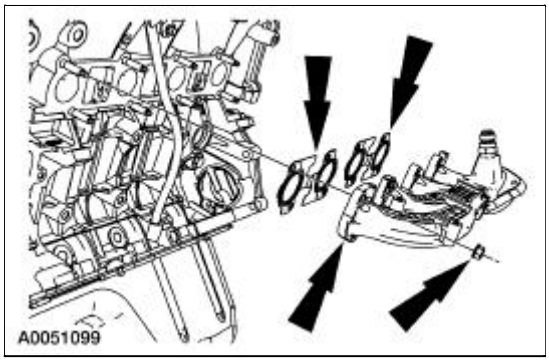
LH cylinder head

9. **NOTE:** Lubricate the O-ring seal with clean engine oil.

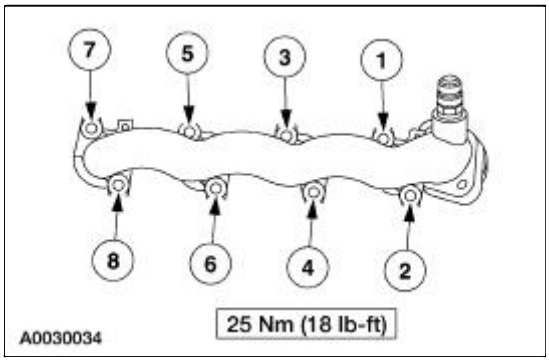
   Install the oil level indicator tube.
   - Install a new O-ring seal on the oil level indicator tube.
   - Install the oil level indicator tube.
   - Install the bolt.



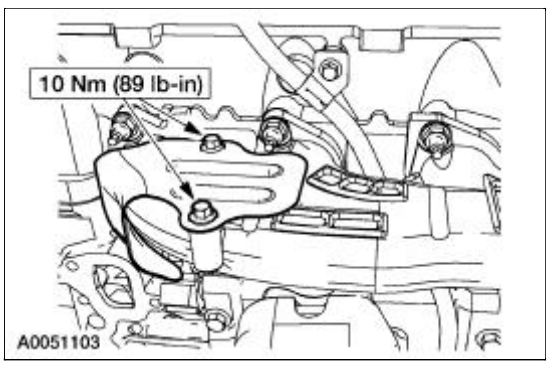
10. Position the LH exhaust manifold gaskets and the exhaust manifold. Loosely install the nuts.



11. Tighten the LH exhaust manifold nuts in the sequence shown.



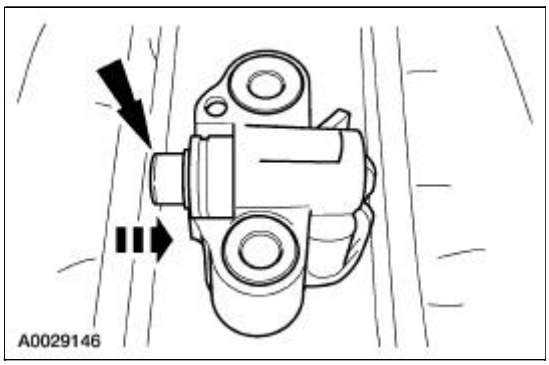
12. Install the heat shield and bolts.



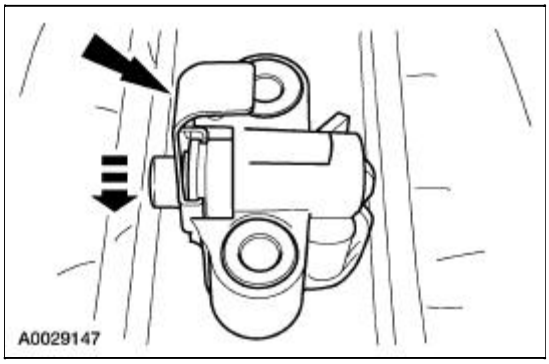
All cylinder heads

13. **CAUTION: Timing chain procedures must be followed exactly or damage to valves and pistons will result.**

    Compress the tensioner plunger, using a vise.

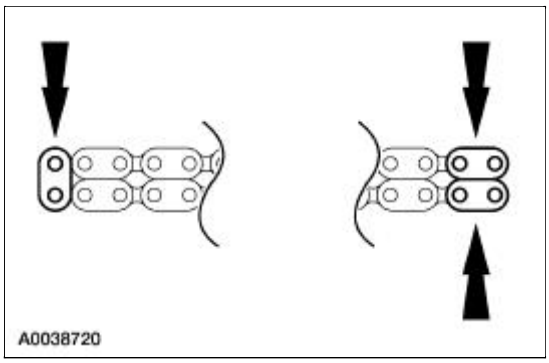


14. Install a retaining clip on the tensioner to hold the plunger in during installation.

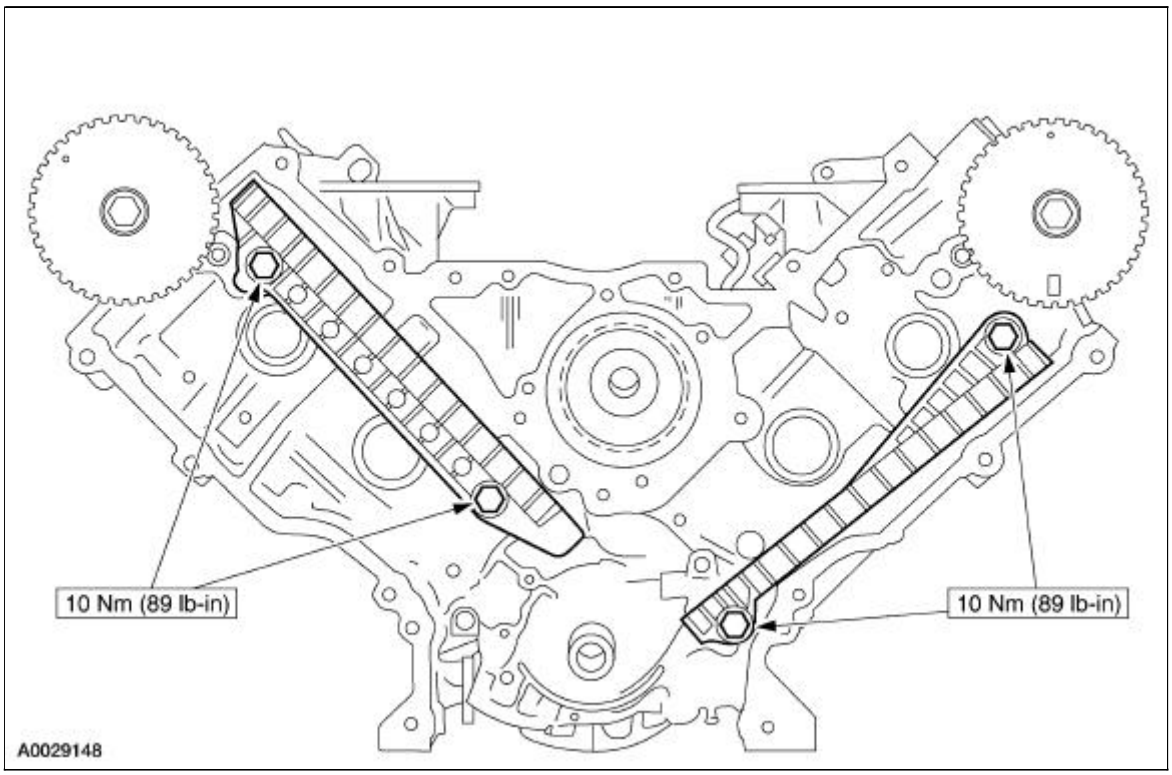


15. Remove the tensioner from the vise.

16. If the copper links are not visible, mark two links on one end and one link on the other end, and use as timing marks.

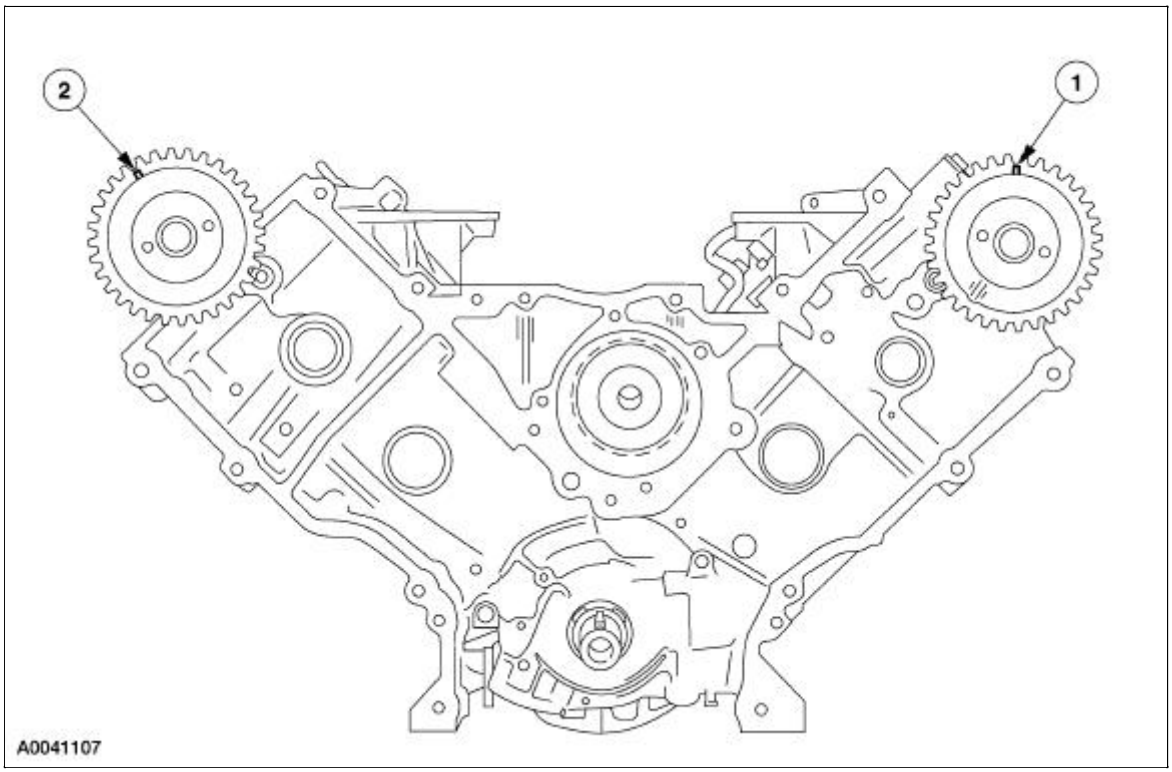


17. Install the timing chain guides.



18. Pre-position the camshafts.

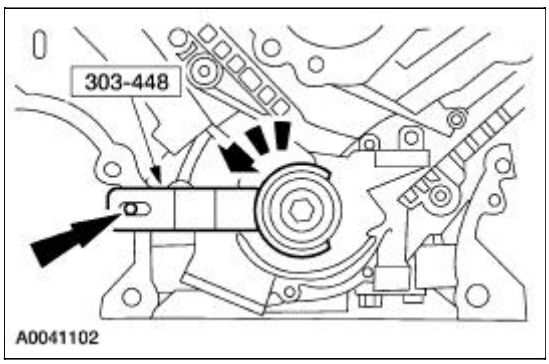
1. Rotate the LH camshaft until the timing mark is approximately at 12 o'clock.
2. Rotate the RH camshaft until the timing mark is approximately at 11 o'clock.



19. **CAUTION: Rotate the crankshaft counterclockwise only. Do not rotate past position shown or severe piston and valve damage can occur.**

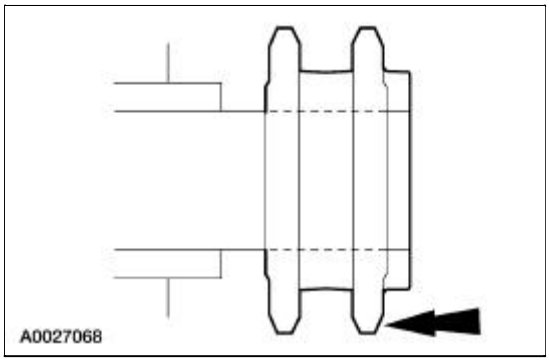
NOTE: The number one piston is at top dead center (TDC) when the stud on the engine block fits into the slot in the handle of the special tool.

Position the crankshaft so the number one cylinder is at TDC with the special tool.

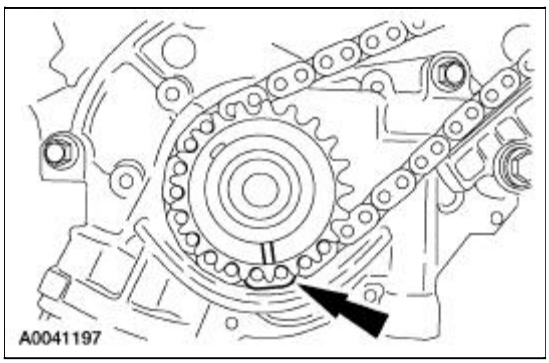


20. Remove the Crankshaft Holding Tool.

21. Install the crankshaft sprocket, making sure the flange faces forward.

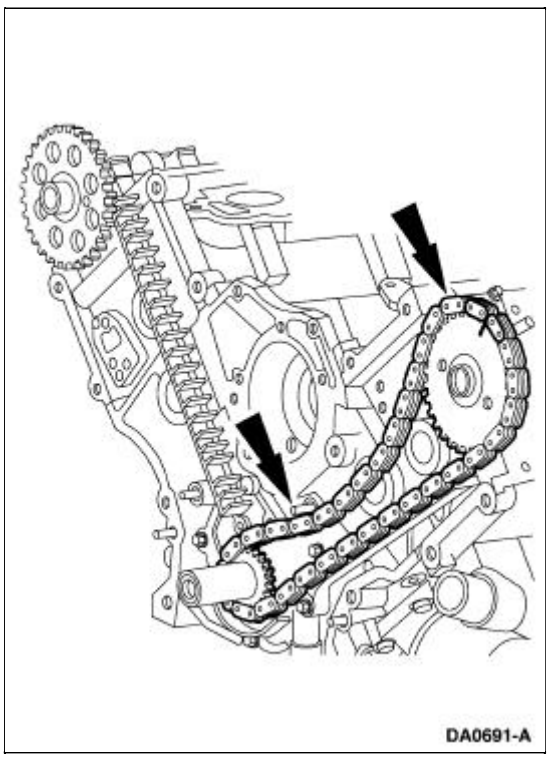


22. Position the lower end of the LH (inner) timing chain on the crankshaft sprocket, aligning the timing mark on the outer flange of the crankshaft sprocket with the single copper (marked) link on the chain.



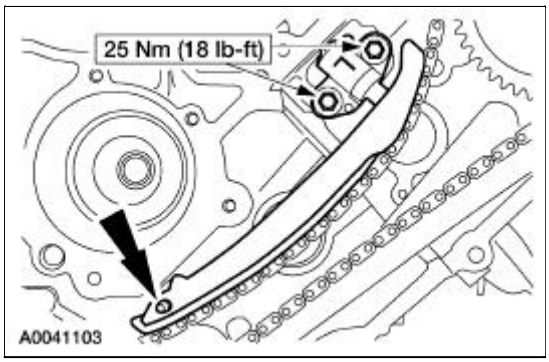
23. **NOTE:** Make sure the upper half of the timing chain is below the tensioner arm dowel.

    Position the timing chain on the camshaft sprocket with the camshaft sprocket timing mark positioned between the two copper (marked) chain links.

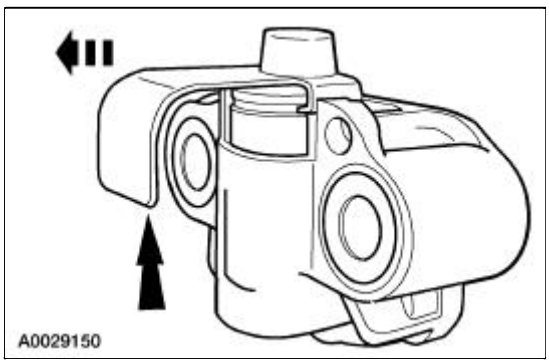


24. **NOTE:** The LH timing chain tensioner arm has a bump near the dowel hole for identification.

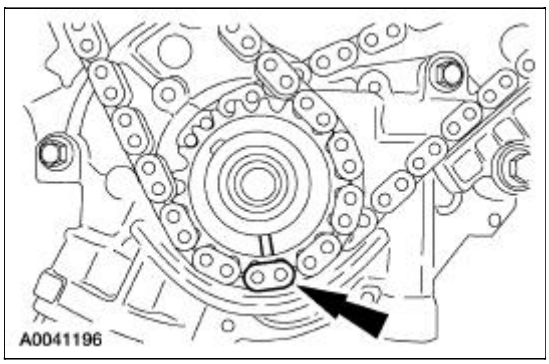
Position the LH timing chain tensioner arm on the dowel pin and install the LH timing chain tensioner.



25. Remove the retaining clip from the LH timing chain tensioner.

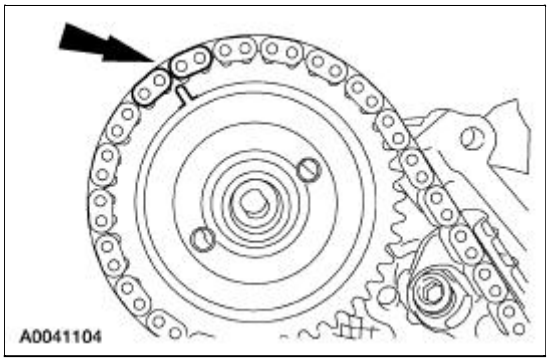


26. Position the lower end of the RH (outer) timing chain on the crankshaft sprocket, aligning the timing mark on the sprocket with the single copper (marked) chain link.

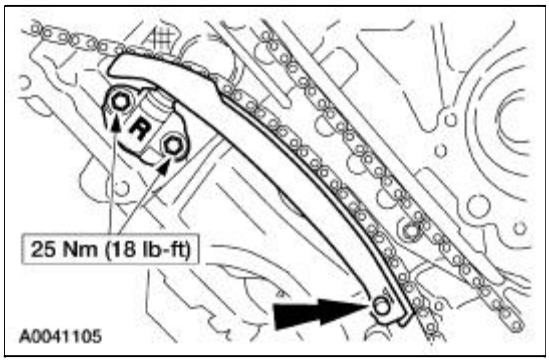


27. **NOTE:** The lower half of the timing chain must be positioned above the tensioner arm dowel.

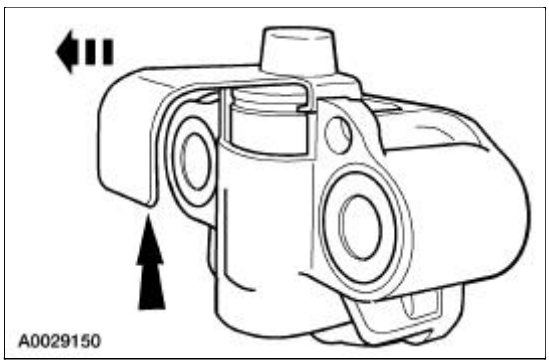
    Position the RH timing chain on the camshaft sprocket. Make sure the camshaft sprocket timing mark is positioned between the two copper (marked) chain links.



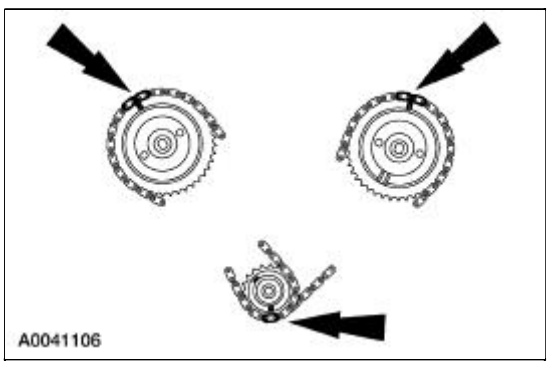
28. Position the RH timing chain tensioner arm on the dowel pin and install the RH timing chain tensioner.



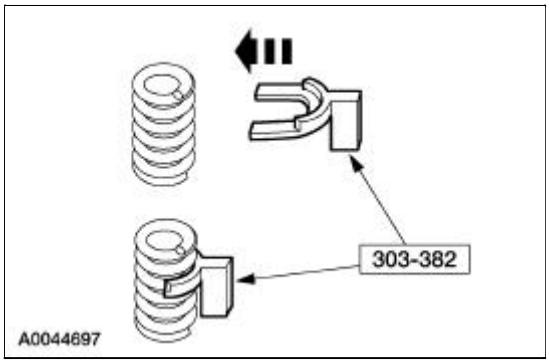
29. Remove the retaining clip from the RH timing chain tensioner.



30. As a post-check, verify correct alignment of all timing marks.



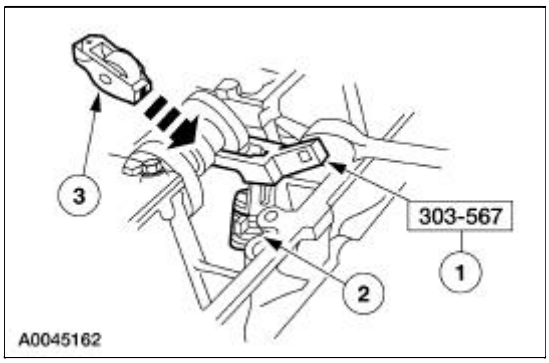
31. Install the special tool between the valve spring coils to prevent valve stem seal damage.



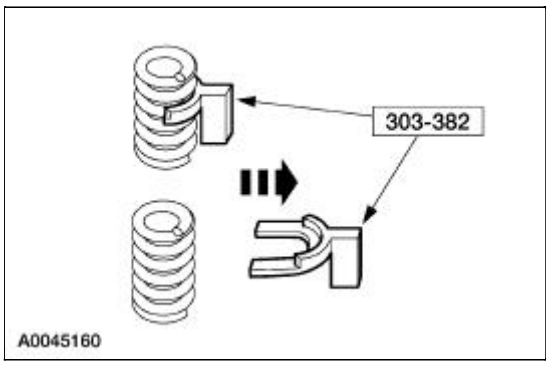
32. **NOTE:** Lubricate the camshaft roller followers using clean engine oil.

    NOTE: Position the cam lobe away from the camshaft roller follower location prior to installing each camshaft roller follower.

    Install the camshaft roller followers.
    1. Install the special tool.
    2. Compress the valve spring.
    3. Install the camshaft roller followers in their original locations.



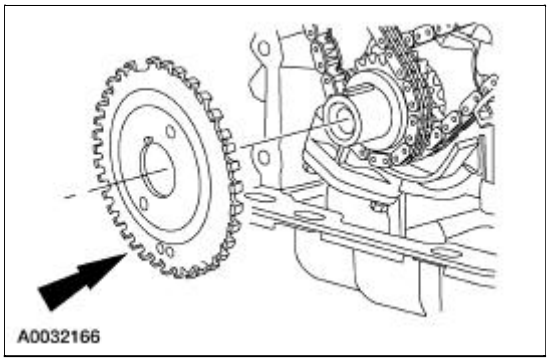
33. Remove the special tool.



34. **CAUTION: When installing the spark plugs, use care not to exceed the recommended torque.**

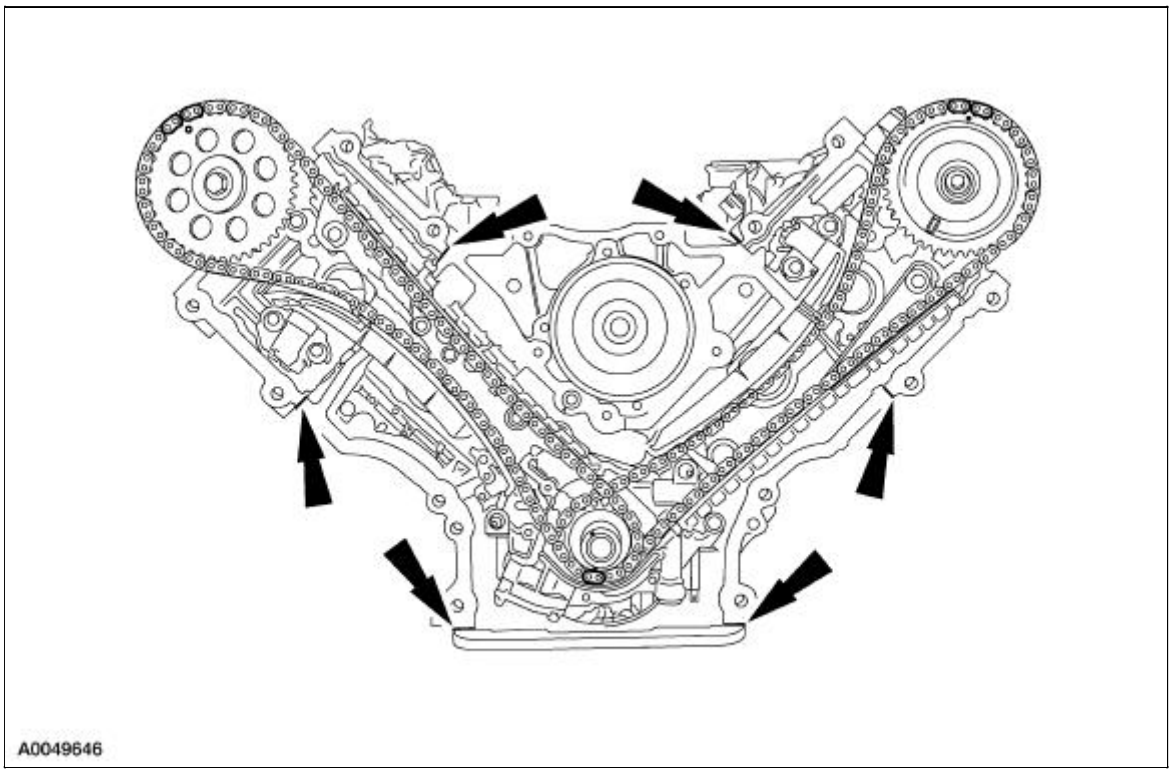
    Install the eight spark plugs.
    - Tighten the spark plugs to 18 Nm (13 lb-ft).

35. Install the crankshaft sensor ring on the crankshaft.

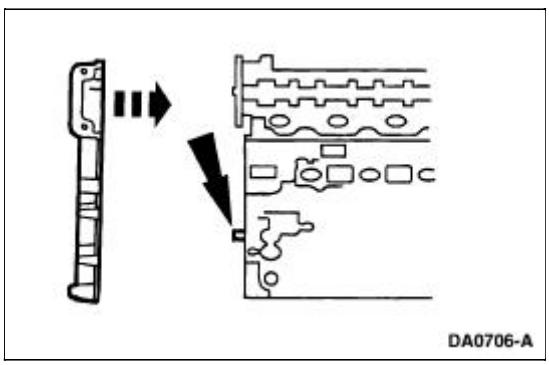


36. **NOTE:** If the front cover is not secured within four minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

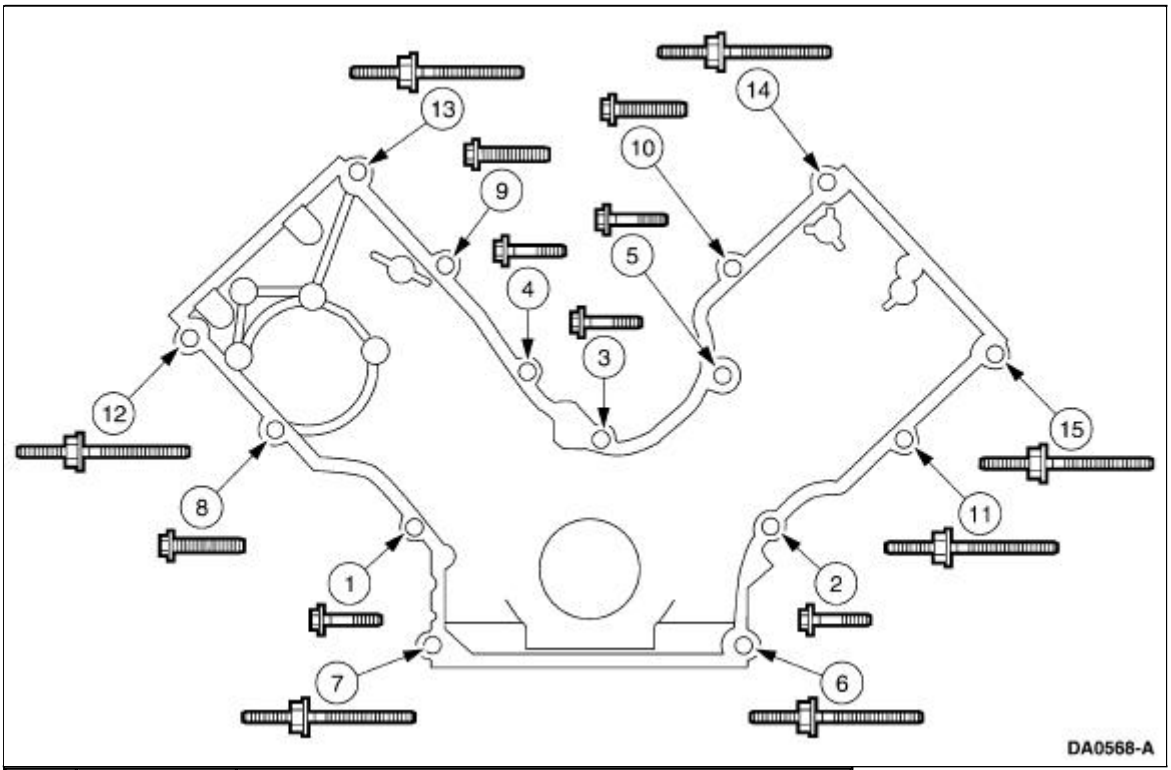
    Apply a bead of silicone gasket and sealant along the cylinder head-to-cylinder block surface and the oil pan-to-cylinder block surface, at the locations shown.



37. Install a new engine front cover gasket on the engine front cover. Position the engine front cover. Install the fasteners finger-tight.

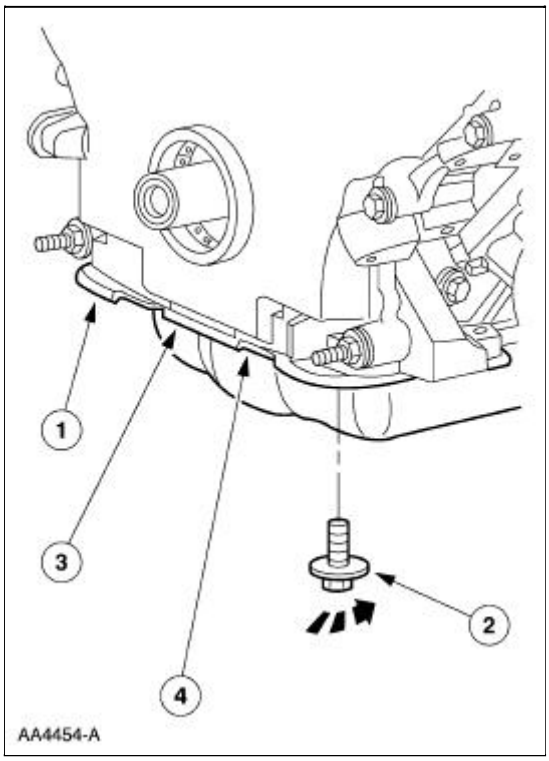


38. Tighten the engine front cover fasteners in sequence in three stages.
Stage 1: Tighten fasteners 1 through 5 to 25 Nm (18 lb-ft).
Stage 2: Tighten fasteners 6 and 7 to 48 Nm (35 lb-ft).
Stage 3: Tighten fasteners 8 through 15 to 48 Nm (35 lb-ft).

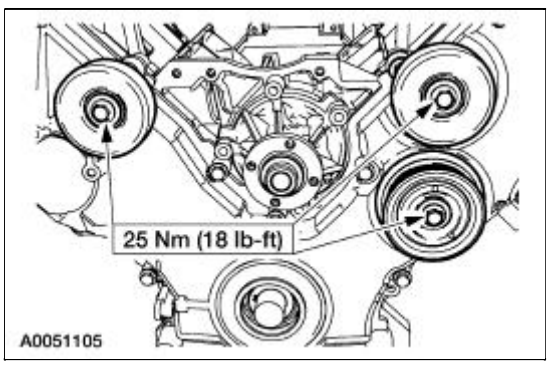


Item	Part Number	Description
1	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
2	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
3	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
4	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
5	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
6	N808529	Stud, Hex Head Pilot, M10 x 1.5 x 59 — M10 x 1.5 x 30
7	N808529	Stud, Hex Head Pilot, M10 x 1.5 x 59 — M10 x 1.5 x 30
8	N808142	Screw and Washer, Hex Pilot, M10 x 1.5 x 57.5
9	N808142	Screw and Washer, Hex Pilot, M10 x 1.5 x 57.5
10	N808142	Screw and Washer, Hex Pilot, M10 x 1.5 x 57.5
11	N808140	Stud and Washer, Hex Head Pilot, M10 x 1.5 x 68 — M8 x 1.25 x 27
12	N808140	Stud and Washer, Hex Head Pilot, M10 x 1.5 x 68 — M8 x 1.25 x 27
13	N808140	Stud and Washer, Hex Head Pilot, M10 x 1.5 x 68 — M8 x 1.25 x 27
14	N808140	Stud and Washer, Hex Head Pilot, M10 x 1.5 x 68 — M8 x 1.25 x 27
15	N808140	Stud and Washer, Hex Head Pilot, M10 x 1.5 x 68 — M8 x 1.25 x 27

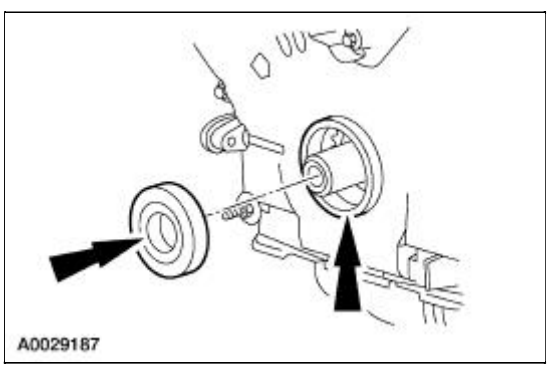
39. Loosely install the bolts, then tighten the bolts in two stages, in the sequence shown.
    - Stage 1: Tighten to 20 Nm (15 lb-ft).
    - Stage 2: Tighten an additional 90 degrees.



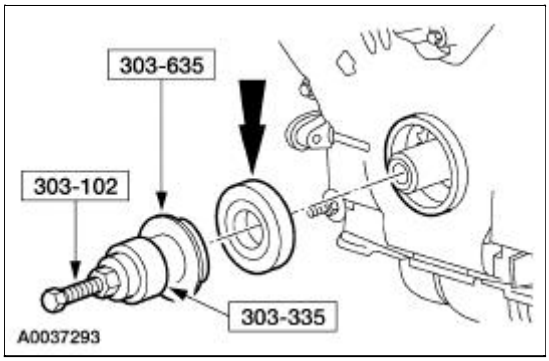
40. Position the belt idler pulleys and install the bolts.



41. Lubricate the engine front cover and the front oil seal inner lip with clean engine oil.

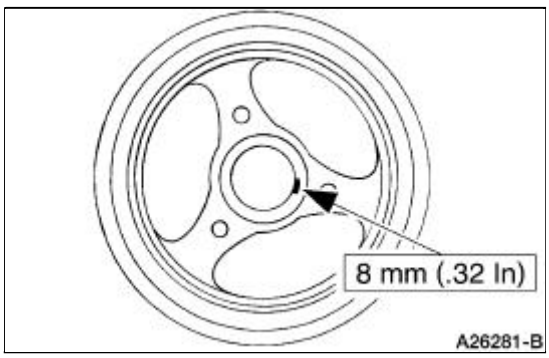


42. Use the special tools to install the crankshaft front oil seal into the engine front cover.

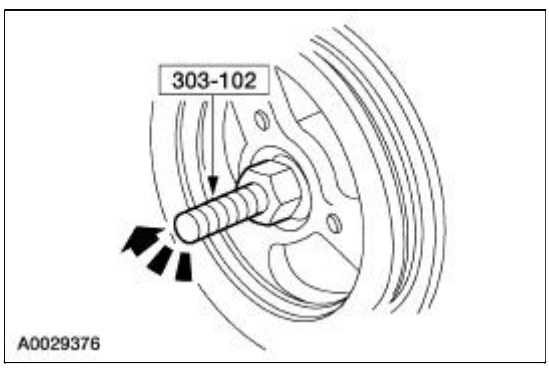


43. **NOTE:** If not secured within four minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

    Apply silicone gasket and sealant to the Woodruff key slot on the crankshaft pulley.



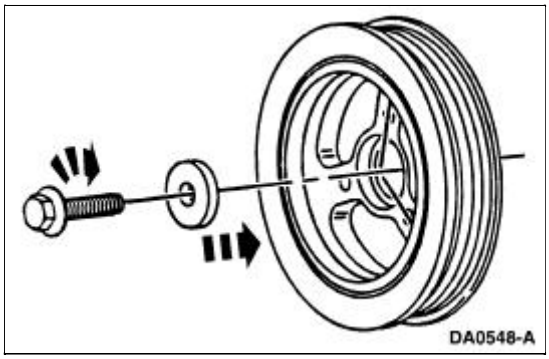
44. Use the special tool to install the crankshaft pulley.



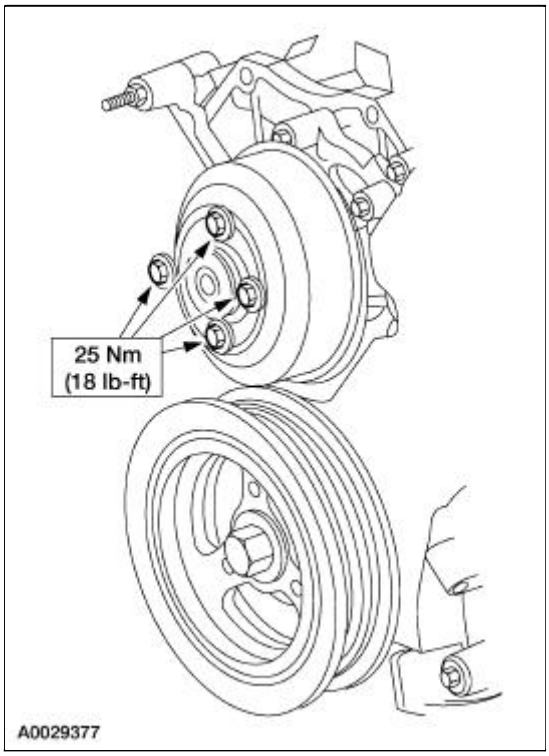
45. **NOTE:** Use a suitable strap wrench (303-D055) to hold the pulley while tightening the bolt.

    Tighten the new crankshaft pulley bolt in four stages.

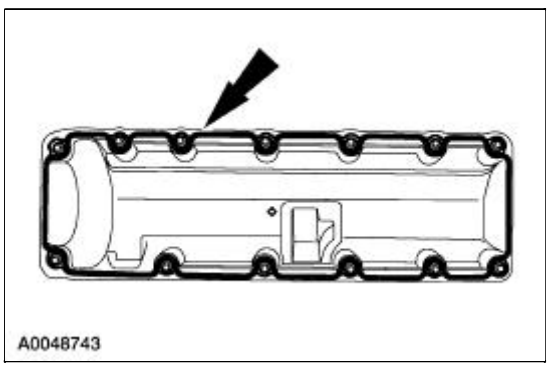
    - Stage 1: Tighten to 90 Nm (66 lb-ft).
    - Stage 2: Loosen 360 degrees.
    - Stage 3: Tighten to 50 Nm (37 lb-ft).
    - Stage 4: Tighten an additional 90 degrees.



46. Position the coolant pump pulley on the coolant pump and install the bolts.

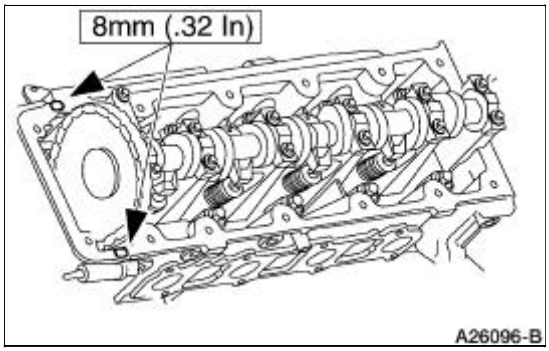


47. If a new gasket is being installed, apply instant adhesive completely around the gasket groove in the LH valve cover. Install the new valve cover gasket.

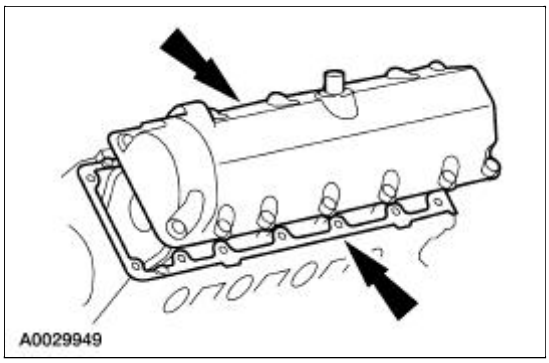


48. **NOTE:** If not secured within four minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

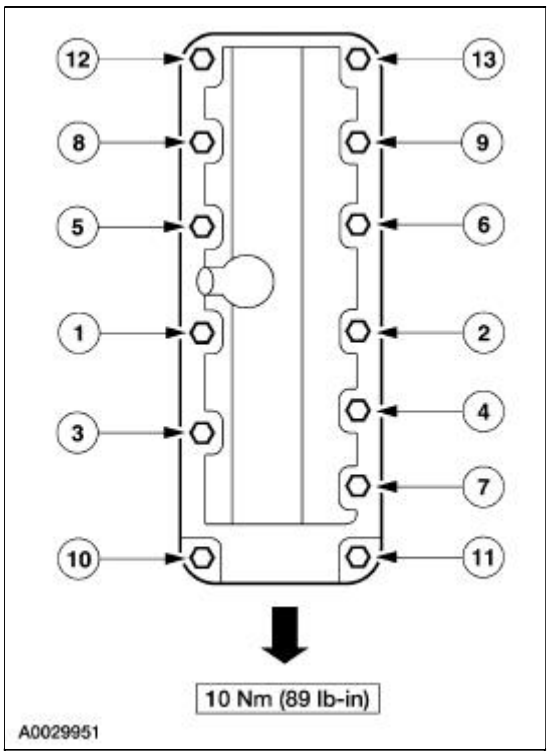
    Apply silicone gasket and sealant in two places where the engine front cover meets the cylinder head.



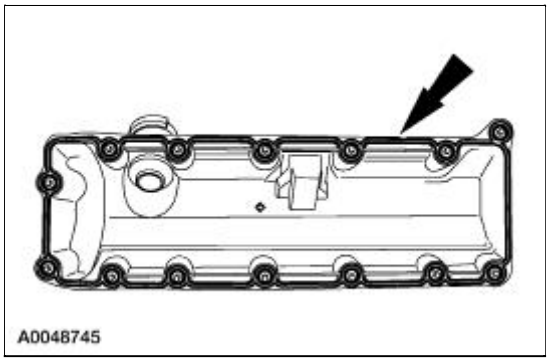
49. Position the LH valve cover and gasket on the cylinder head and install the bolts loosely.



50. Tighten the bolts in the sequence shown.

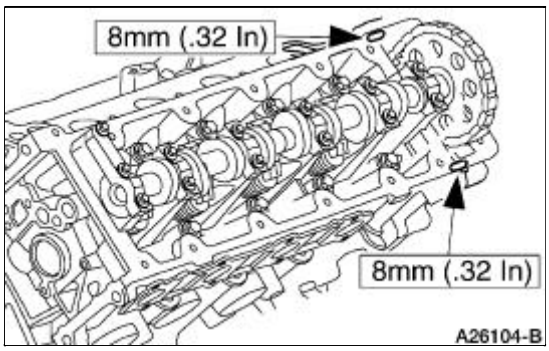


51. If a new gasket is being installed, apply instant adhesive completely around the gasket groove in the RH valve cover. Install the new valve cover gasket.

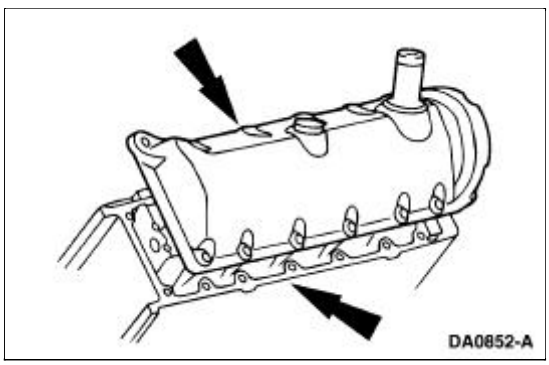


52. **NOTE:** If not secured within four minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

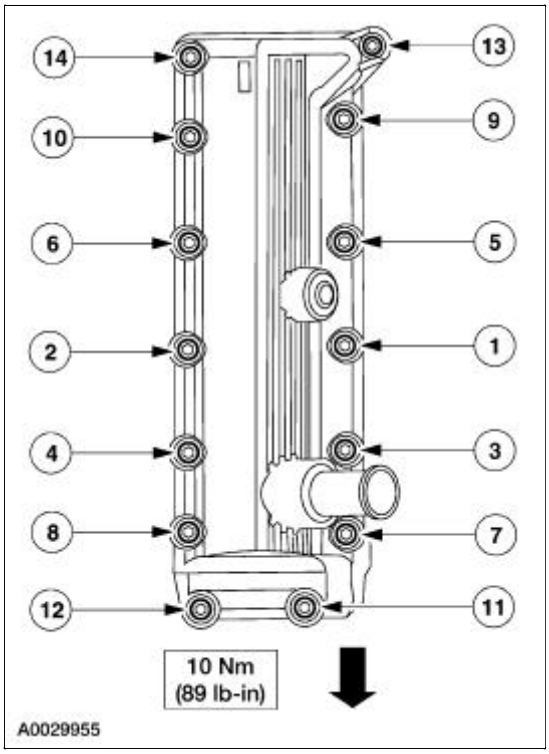
    Apply silicone gasket and sealant in two places where the engine front cover meets the cylinder head.



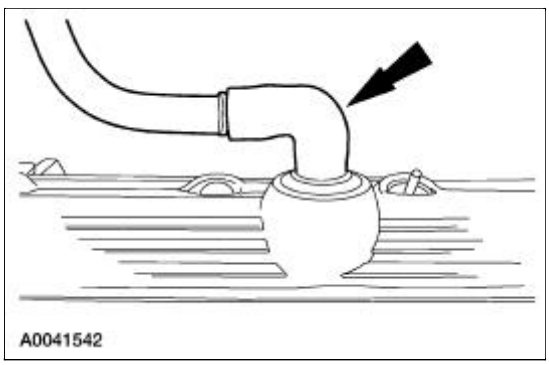
53. Position the RH valve cover and gasket on the cylinder head and install the bolts loosely.



54. Tighten the bolts in the sequence shown.

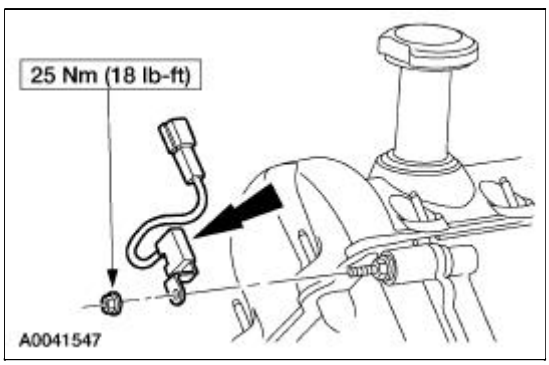


55. Install the crankcase ventilation tube on the LH valve cover.



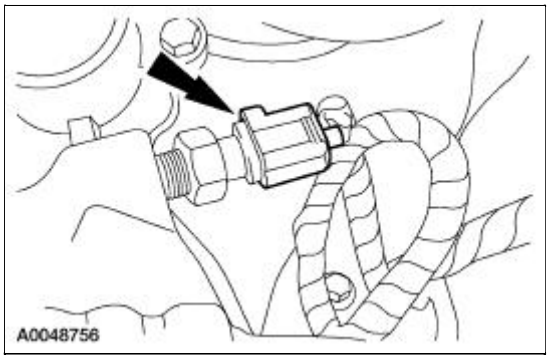
56. **NOTE:** RH shown, LH similar.

    Install the radio frequency interference capacitors.

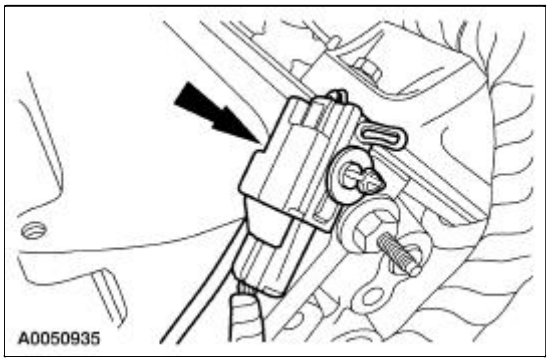


57. Roughly position the engine control sensor wiring harness and mount it on the valve cover studs.

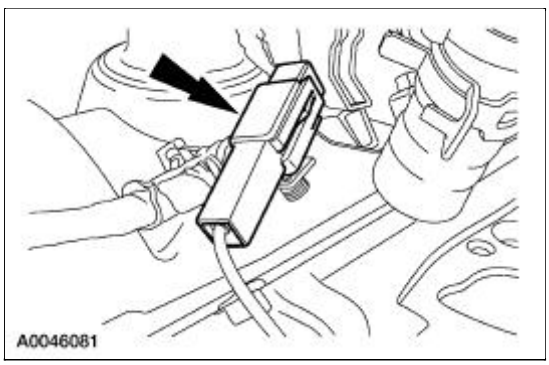
58. Connect the oil pressure switch electrical connector.



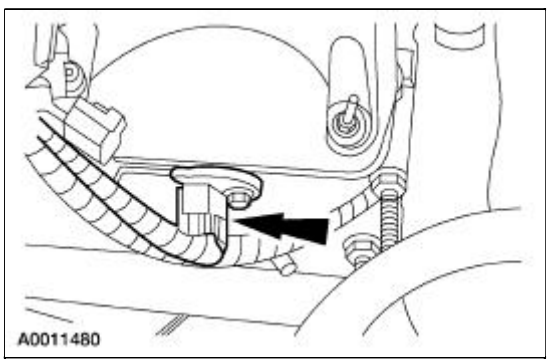
59. Connect the knock sensor electrical connector.



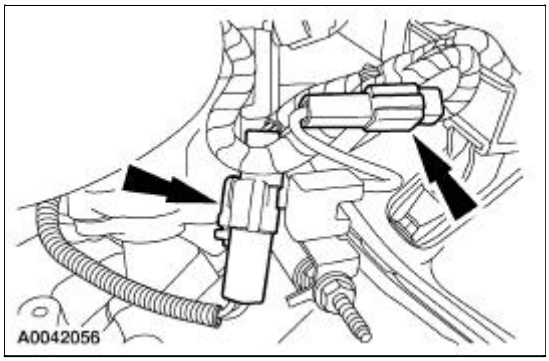
60. Connect the RH radio frequency interference capacitor electrical connector.



61. Connect the CMP sensor electrical connector.

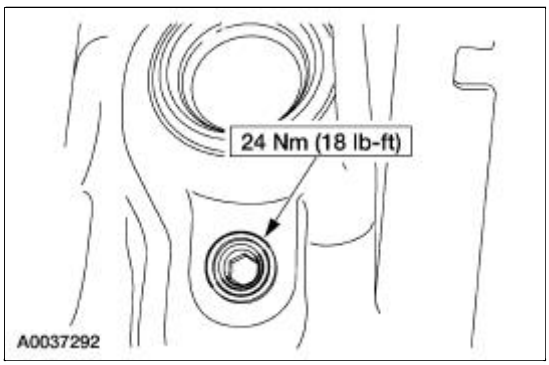


62. Connect the LH radio frequency interference capacitor and CHT sensor electrical connectors.

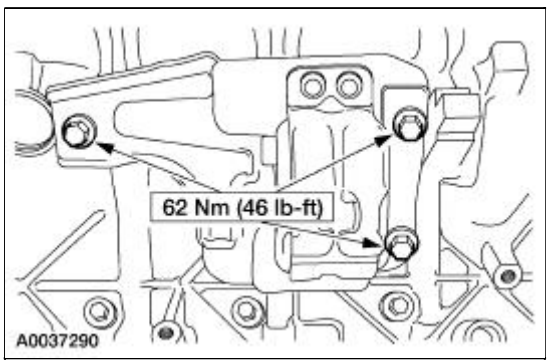


63. **NOTE:** LH shown, RH similar.

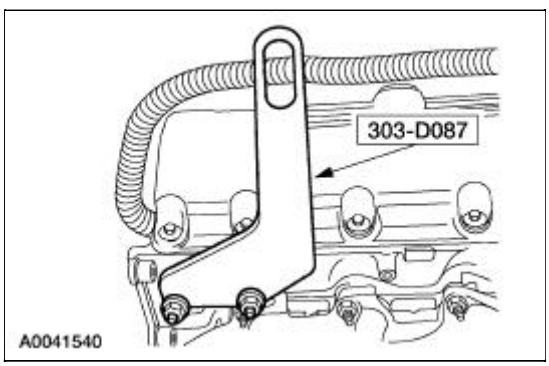
    Install the cylinder block drain plugs.



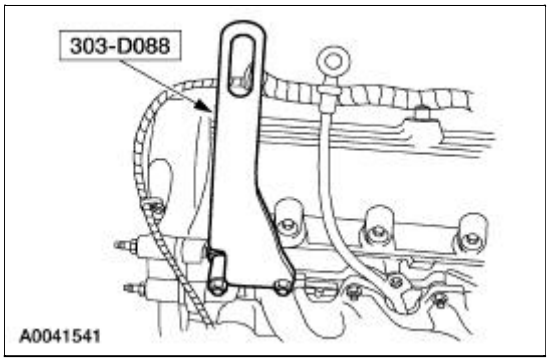
64. Install the RH engine mount.



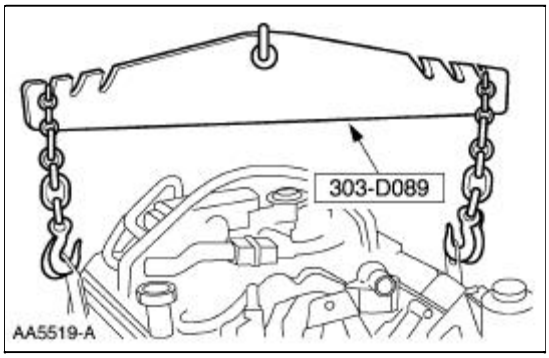
65. Install the special tool.



66. Install the special tool.

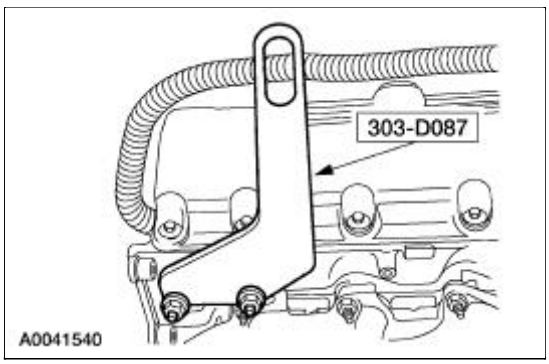


67. Install the special tool and remove the engine from the work stand.

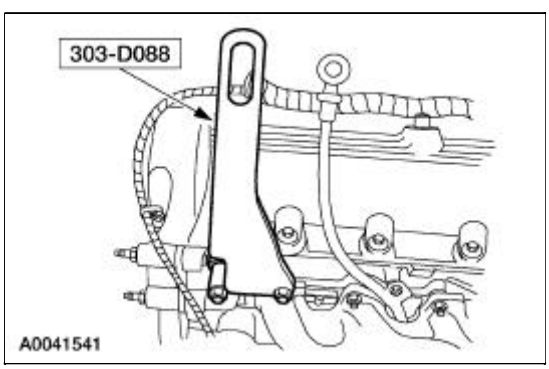


68. Lower the engine onto wooden blocks.

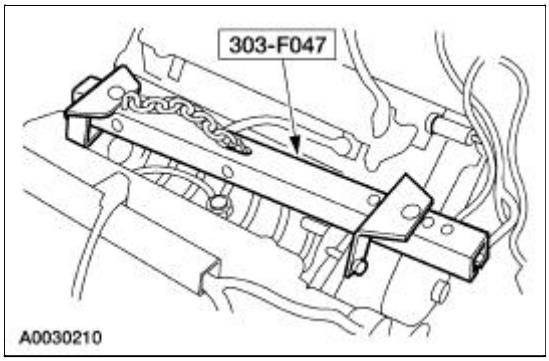
69. Remove the special tool.



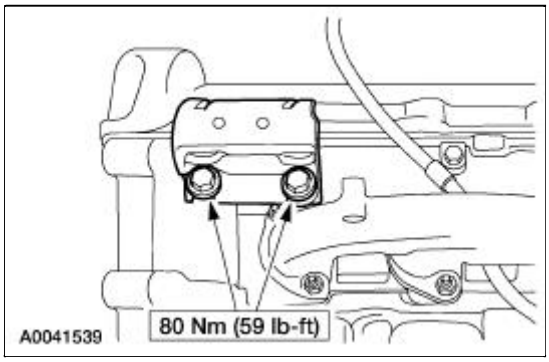
70. Remove the special tool.



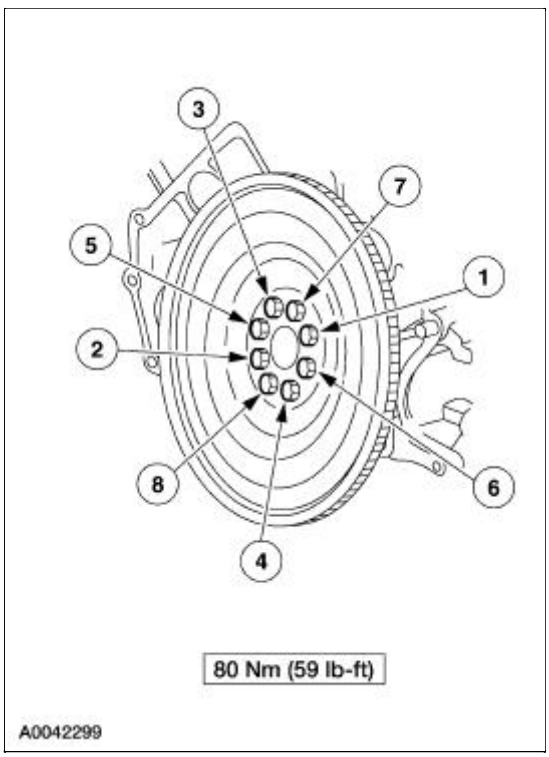
71. Install the special tool and raise the engine.



72. Install the power steering reservoir lower mounting bracket.



73. Install the flexplate or the flywheel and bolts. Tighten the bolts in the sequence shown.



74. Install the engine. For additional information, refer to Engine in this section.

General Specifications

Item	Specification
Lubricants and Sealants	
Silicone Gasket and Sealant F7AZ-19554-EA	WSE-M4G323-A4
Metal Surface Cleaner F4AZ-19A536-RA	WSE-M5B392-A
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP	WSS-M2C153-H
Motorcraft Premium Engine Coolant VC-4-A (in Oregon VC-5, in Canada CXC-10) or equivalent	ESE-M97B44-A
Motorcraft Premium Gold Engine Coolant VC-7-A or equivalent	WSS-M97B51-A1
Pipe Sealant with Teflon® XW7Z-19554-AA or equivalent	WSK-M2G350-A2 and ESR-M18P7-A
Engine	
Displacement	5.4L (4V)
Number of cylinders	8
Bore	90.215 (3.552)
Stroke	105.8 mm (4.23 in)
Firing order	1-3-7-2-6-5-4-8
Oil pressure	40-60 psi @ 2000 rpm
Oil capacity	6.62L (7 quarts)
Compression ratio	9.5:1
Cylinder Head and Valve Train	
Cylinder head gasket surface flatness	0.0254 mm (0.001 in) across any 38.1 mm (1.5 in) square area
Combustion chamber volume	53 ± 1.5cc (3.2342-0.0915 ci)
Valve arrangement (front to rear)	—
Valve guide bore diameter	7.044-7.015 mm (0.2773-0.2762 in)
Valve stem diameter — intake	6.995-6.975 mm (0.2754-0.2746 in)
Valve stem diameter — exhaust	6.970-6.949 mm (0.2744-0.2736 in)
Valve stem-to-guide clearance — intake	0.069-0.020 mm (0.0027-0.0008 in)
Valve stem-to-guide clearance — exhaust	0.095-0.045 mm (0.0037-0.0018 in)
Valve head diameter — intake	37.11-36.86 mm (1.461-1.4512 in)
Valve head diameter — exhaust	30.12-29.87 mm (1.1858-1.176 in)
Valve face runout	0.05 mm (0.0019 in)
Valve face angle	45.75-45.25 degrees
Valve seat width — intake	2.1-1.9 mm (0.0827-0.0748 in)
Valve seat width — exhaust	2.1-1.9 mm (0.0827-0.0748 in)
Valve seat runout	0.025 mm (0.001 in)

Valve seat angle	45.00-44.50 degrees
Valve spring free length — intake	50.2 mm (1.9764 in)
Valve spring free length — exhaust	50.2 mm (1.9764 in)
Valve spring squareness — intake	2.5 degrees
Valve spring squareness — exhaust	2.5 degrees
Valve spring compression pressure — intake	667.3 N @ 28.02 mm (1.1031 in)
Valve spring compression pressure — exhaust	667.3 N @ 28.02 mm (1.1031 in)
Valve spring installed height	42.56 mm (1.676 in)
Valve spring installed pressure — intake	289.1 N @ 40.01 mm (1.5752 in)
Valve spring installed pressure — exhaust	289.1 N @ 40.0 mm (1.5752 in)
Roller follower ratio	1.75:1
Hydraulic Lash Adjuster	
Diameter	16.000-15.9888 mm (0.6299-0.6295 in)
Clearance-to-bore	0.018-0.069 mm (0.0007-0.0027 in)
Service limit	0.016 mm (0.0006 in)
Hydraulic leakdown rate	5-25 seconds [a]
Collapsed lash adjuster gap	0.085-0.450 mm (0.0033-0.0177 in)
Camshaft	
Theoretical valve lift @ zero lash — intake	10.00 mm (0.3937 in)
Theoretical valve lift @ zero lash — exhaust	10.00 mm (0.3937 in)
Lobe lift — exhaust (LH)	6.5958 mm (0.2597 in)
Lobe lift — exhaust (RH)	6.5855 mm (0.2593 in)
Lobe lift — intake	6.58077 mm (0.250847 in)
Allowable lobe lift loss	0
Journal diameter	26.962-26.936 mm (1.0615-1.0605 in)
Journal bore inside diameter	27.012-26.987 mm (1.0635-1.0625 in)
Journal-to-bearing clearance	0.076-0.025 mm (0.0030-0.0010 in)
Runout	0.09 mm (0.0035 in) (4 places)
End play service limit	0.025-0.190 mm (0.0010-0.0075 in)
End play	0.027-0.190 mm (0.0011-0.0075 in)
Cylinder Block	
Cylinder bore diameter grade 1	90.200-90.210 mm (3.5511-3.5515 in)
Cylinder bore diameter grade 2	90.210-90.220 mm (3.5516-3.5521 in)
Cylinder bore diameter grade 3	90.220-90.230 mm (3.5519-3.5524 in)
Cylinder bore maximum taper	0.006 mm (0.0002 in)
Cylinder bore maximum out-of-round	0.020 mm (0.0008 in)
Main bearing bore inside diameter	72.401-72.422 mm (2.850-2.851 in)
Head gasket surface flatness	0.0254 mm (0.001 in) across any 38.1 mm (1.5 in) square area
Crankshaft	
Main bearing journal diameter	67.483-67.503 mm (2.6568-2.6576 in)
Main bearing journal maximum taper	0.004 mm (0.0002 in)

Main bearing journal maximum out-of-round	0.0075 mm (0.0003 in) between cross sections
Main bearing journal-to-cylinder block clearance	0.048-0.024 mm (0.001891-0.0009 in)
Connecting rod journal diameter	53.003-52.983 mm (2.0867-2.0859 in)
Connecting rod journal maximum taper	0.004 mm (0.0002 in)
Connecting rod journal maximum out-of-round	0.0075 mm (0.0003 in) between cross sections
Crankshaft maximum end play	0.075-0.377 mm (0.003-0.0148 in)
Piston and Connecting Rod	
Piston diameter	90.180 ± 0.005 mm (3.5504 ± 0.0002 in)
Piston to cylinder bore clearance	-0.005 to +0.025 mm (-0.0002 to 0.001 in)
Piston ring end gap — top	0.13-0.28 mm (0.0051-0.0111 in)
Piston ring end gap — intermediate	0.25-0.40 mm (0.0098-0.0157 in)
Piston ring gap — oil control	0.15-0.65 mm (0.0059-0.0256 in)
Piston ring groove width — top	1.53-1.55 mm (0.0602-0.061 in)
Piston ring groove width — intermediate	1.52-1.54 mm (0.0598-0.0606 in)
Piston ring groove width — oil control	3.030-3.050 mm (0.1193-0.1201 in)
Piston ring width	1.49-1.46 mm (0.0587-0.0575 in)
Piston ring-to-groove clearance — top	0.030-0.050 mm (0.0012-0.0020 in)
Piston ring-to-groove clearance — intermediate	0.030-0.080 mm (0.0012-0.0031 in)
Piston pin bore diameter	22.008-22.014 mm (0.8665-0.8667 in)
Piston pin diameter	22.0005-22.0030 mm (0.8662-0.8663 in)
Piston pin length	61.8 mm (2.433 in)
Piston pin-to-piston fit (clearance)	0.005-0.0135 mm (0.0002-0.0005 in)
Connecting rod-to-pin clearance	0.009-0.0235 mm (0.0004-0.0093 in)
Connecting rod pin bore diameter	22.012-22.024 mm (0.8666-0.8671 in)
Connecting rod length (centerline bore-to-bore)	169.1 mm (6.6575 in)
Connecting rod maximum allowed bend	± 0.038 mm (0.0015 in)
Connecting rod maximum allowed twist	± 0.05 mm (0.0021 in)
Connecting rod bearing bore diameter (with assembled liners)	53.049-53.027 mm (2.0885-2.0877 in)
Connecting rod bearing-to-crankshaft clearance	0.064-0.026 mm (0.0025-0.001 in)
Connecting rod side clearance (as assembled to crank) — standard play	0.300 ± 0.175 mm (0.0118 ± 0.0069 in)
Connecting rod side clearance (as assembled to crank) — max. play	0.475 mm (0.0187 in)

[a] Time required for the plunger to leak down 1.6 mm of travel with 222 N force and leak-down fluid in the lash adjuster.

Torque Specifications

Description	Nm	lb-ft	lb-in
Valve cover bolts [a]	—	—	—
A/C compressor bolts	15	11	—

Camshaft bearing cap bolts [a]	—	—	—
Camshaft sprocket bolts	120	89	—
Connecting rod bolts [a]	—	—	—
Crankshaft damper pulley bolt [a]	—	—	—
Crankshaft main bearing bolts (cross- mounted) [a]	—	—	—
Crankshaft main bearing bolts (vertical) [a]	—	—	—
Cylinder head bolts [a]	—	—	—
EGR valve-to-intake manifold bolts [a]	—	—	—
Exhaust manifold nuts	25	18	—
Driveshaft-to-pinion flange bolts	112	83	—
Drive belt idler pulley bolt	25	18	—
Flywheel bolts	80	59	—
Engine front cover bolts [a]	—	—	—
Front cross member bolts	102	75	—
Front drive axle mounting bolts	89	66	—
Heater return tube studs	25	18	—
Intake manifold tuning valve bolts	10	—	89
Ignition coil cover bolts	10	—	89
Lower intake manifold bolts [a]	—	—	—
Transmission mount-to-crossmember nuts	90	66	—
Upper intake manifold bolts [a]	—	—	—
Remote oil cooler line to cylinder block	10	—	89
Oil cooler assembly- to- oil filter adapter bolts	55	40	—
Oil filter adapter bolt	25	18	—
Oil level indicator tube bolt	10	—	89
Oil pan bolts [a]	—	—	—
Oil pan drain plug	13	10	—
Oil pressure switch	14	10	—
Oil pump bolts	10	—	89
Oil pump screen cover and tube bolts	10	—	89
Oil pump screen cover and tube spacer	25	18	—
Oil pump screen cover and tube spacer bolt	25	18	—
Power steering pump bolts	25	18	—
Radio ignition interference capacitor bolts	10	—	89
Rear main oil seal retainer bolts	10	—	89
Spark plugs	10	—	89
Timing chain guide bolts	10	—	89
Timing chain hydraulic tensioner bolts	25	18	—
Water pump bolts	28	18	—
Water pump pulley bolts	25	18	—

EGR valve-to-exhaust manifold tube fittings [a]	—	—	—
Power steering bracket lower bolts	25	18	—
42-pin bulkhead connector bolts	5	—	44
Accelerator control splash shield bolts	10	—	89
Oil cooler insert	55	40	—
Engine mount LH through bolts	200	148	—
Engine mount-to-cylinder block bolts	63	44	—
Engine mount RH nut	103	76	—

[a] Refer to the procedure in this section.

Engine

WARNING: Do not operate the engine with the hood open until the fan blade has been first examined for possible cracks and separation. Failure to follow these instructions may result in personal injury.

The 5.4L (4V) is a V-8 engine with the following features:

- dual overhead camshafts
- four valves per cylinder
- sequential multiport fuel injection (SFI)
- an aluminum intake manifold
- aluminum cylinder heads
- a cast iron, 90-degree V-cylinder block
- individually chain-driven camshafts with a hydraulic timing chain tensioner on each timing chain
- the electronic ignition system with eight ignition coils

Identification

Always refer to these labels when new parts are required or when checking engine calibrations. The engine parts often differ within a CID family. Verification of the identification codes will make sure that the correct parts are obtained. These codes contain all the pertinent information relating to the dates, optional equipment and revisions. The Ford Master Parts Catalog contains a complete listing of the codes and their application.

Code Information

The engine code information label, located on the side of the LH valve cover towards the rear, contains the following:

- engine build date
- engine plant code
- engine code

Exhaust Emission Control System

Operation and required maintenance of the exhaust emission control devices used on this engine is covered in the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Induction System

The sequential multiport fuel injection (SFI) provides the fuel/air mixture needed for combustion in the cylinders. The eight solenoid-operated fuel injectors:

- are mounted in the fuel injection supply manifold and the intake manifold above the cylinder heads.
- meter fuel into the air intake stream in accordance with engine demand.

- are positioned so that their tips direct fuel just ahead of the engine intake valves.
- are connected in series with the fuel pressure regulator.
- supply fuel from the fuel tank by a fuel pump mounted in the fuel tank.

A constant fuel pressure drop is maintained across the fuel injectors by the fuel pressure regulator. The fuel pressure regulator:

- is positioned upstream from the fuel injectors on the fuel injection supply manifold.

Valve Train

The valve train operates as follows:

- Ball tip hydraulic lash adjusters provide automatic lash adjustment.
- Roller followers ride on the camshaft lobes, transferring the up-and-down motion of the camshafts to the valves in the cylinder heads.

Positive Crankcase Ventilation System

All engines are equipped with a closed-type positive crankcase ventilation system recycling the crankcase vapors to the upper intake manifold.

Lubrication System

The engine lubrication system operates as follows:

- Oil is drawn into the oil pump through the oil pump screen cover and tube in the sump of the oil pan.
- On two-wheel and four-wheel drive vehicles, oil is pumped through the oil bypass filter on the left front side of the cylinder block.
- Oil enters the main oil gallery where it is distributed to the crankshaft main journals and to both cylinder heads.
- From the main journals, the oil is routed through cross-drilled passages in the crankshaft to lubricate the connecting rod bearings. Controlled leakage through the crankshaft main bearings and connecting rod bearings is slung radially outward to cool and lubricate the cylinder walls as well as the entire connecting rod, piston and piston rings assembly.
- The left cylinder head is fed from a drilling into the supply passage feeding the main gallery at the front of the cylinder block. The right cylinder head is fed from a drilling into the rear of the main gallery. Main gallery pressure is reduced as it enters the cylinder head galleries through fixed serviceable orifices located at the upper part of the feed passages. It is this reduced pressure in the cylinder head galleries which feeds the camshaft journals, the hydraulic lash adjusters and the primary and secondary timing chain tensioners.
- The camshaft lobe and roller followers are lubricated by splash created through valve train operation.

Oil Pump

The lubrication system of the 5.4L (4V) engine is designed to provide optimum oil flow to critical components of the engine through its entire operating range. The heart of the system is a positive displacement internal gear oil pump using top seal rotors.

Generically this design is known as a gerotor pump, which operates as follows:

- The oil pump is mounted on the front face of the cylinder block.
- The inner rotor is piloted on the crankshaft post and is driven through flats on the crankshaft.
- System pressure is limited by an integral, internally-vented relief valve which directs the bypassed oil back to the inlet side of the oil pump.
- Oil pump displacement has been selected to provide adequate volume to ensure correct oil pressure both at hot idle and maximum speed.
- The relief valve calibration protects the system from excessive pressure during high viscosity conditions.
- The relief valve is designed to provide adequate connecting rod bearing lubrication under high-temperature and high-speed conditions.

Cooling System

The engine cooling system includes the following:

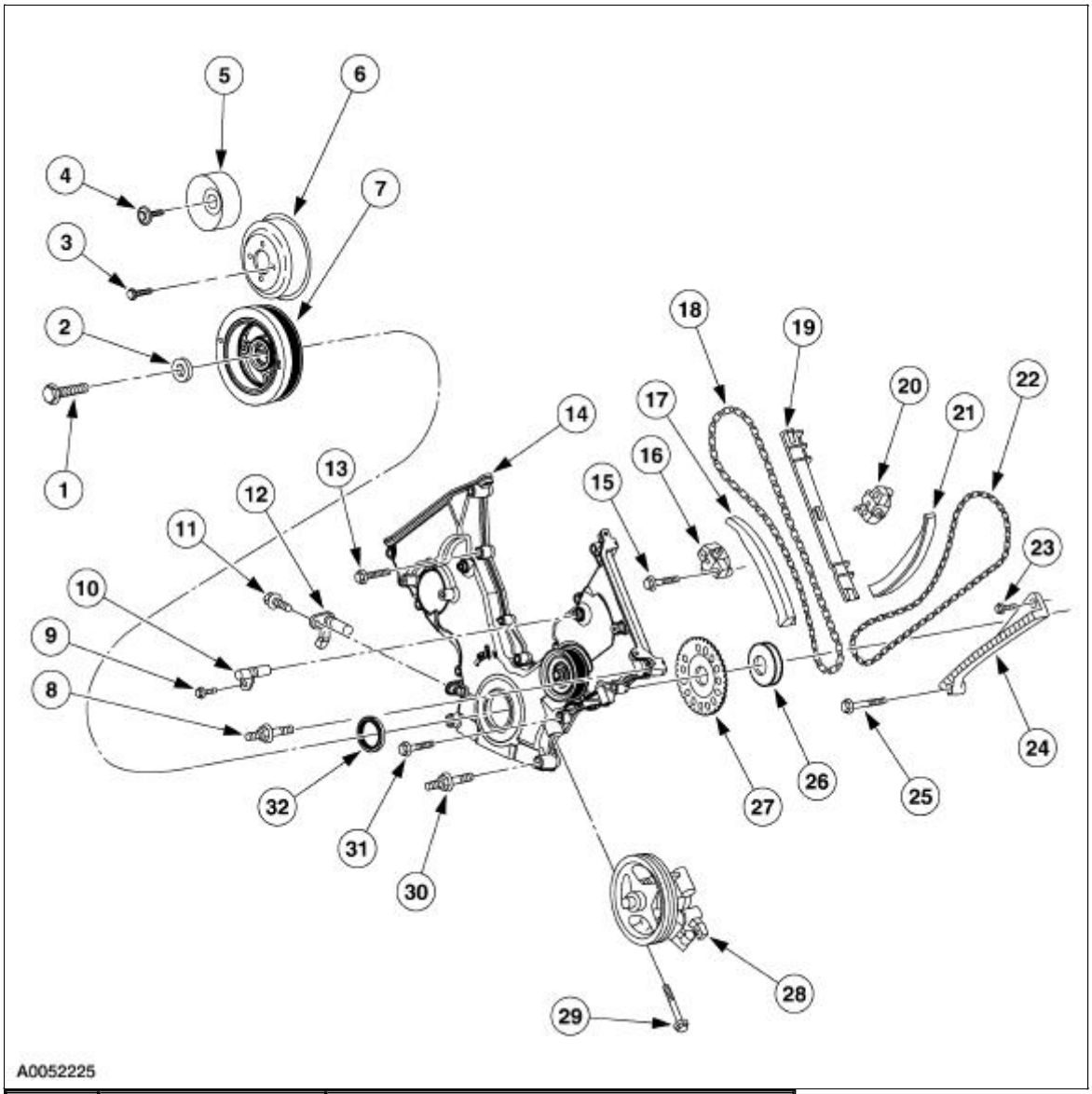
- radiator
- water pump
- viscous fan clutch
- degas bottle (aids in maintaining the correct volume of engine coolant)
- water thermostat
- upper radiator hose
- lower radiator hose
- heater water hoses
- water bypass hose

Drive Belt System

The 5.4L (4V) DOHC engine is equipped with a serpentine drive belt. To make sure of maximum life, a new drive belt should be of the same type as originally installed.

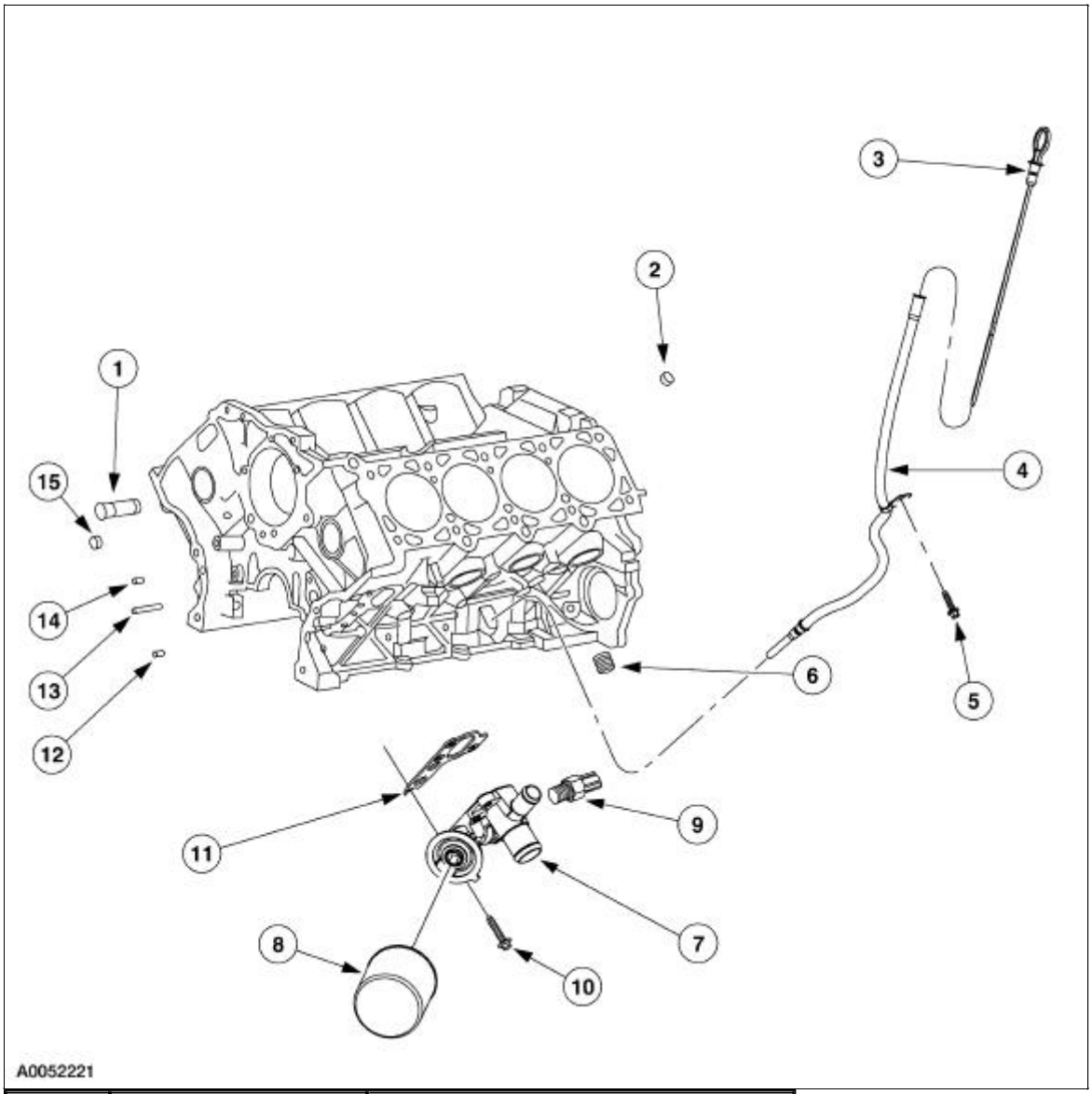
- The accessories mounted on the front of the engine are belt-driven by the crankshaft.
- The serpentine drive belt is routed over each accessory pulley, driven by the crankshaft pulley bolted to the crankshaft.

For service procedures, including tensioning, refer to Section 303-05.

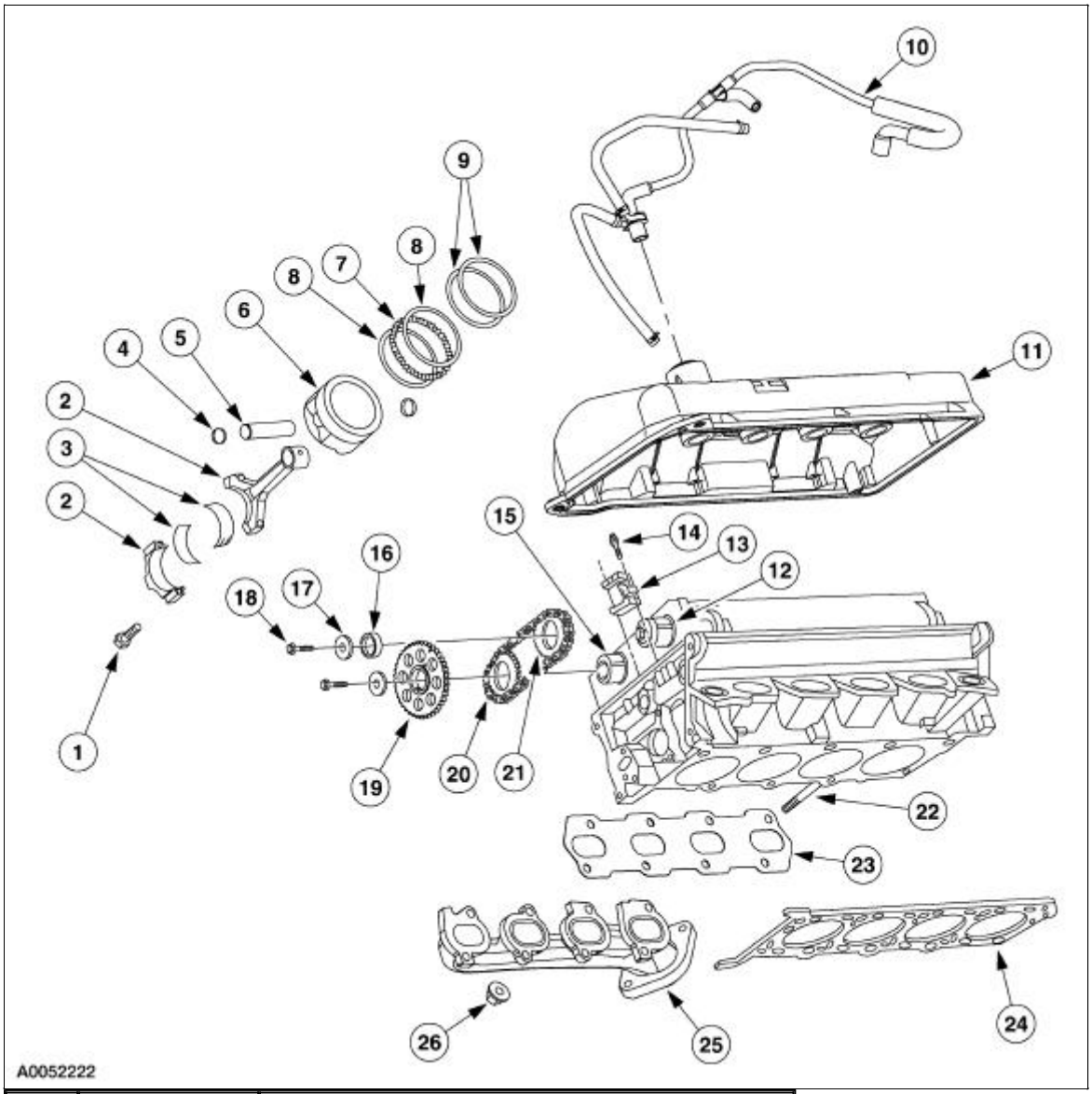


Item	Part Number	Description
1	N806139	Bolt
2	N806165	Washer
3	N806282	Bolt (4 req'd)
4	N808102	Bolt
5	19A216	Belt idler pulley
6	8A528	Water pump pulley
7	6316	Crankshaft pulley
8	N808140	Stud (5 req'd)
9	N806155	Bolt
10	6B288	Camshaft position sensor
11	N806155	Bolt
12	6C315	Crankshaft position sensor
13	N808142	Bolt (3 req'd)
14	6C086	Engine front cover
15	N606543	Bolt (4 req'd)

16	6L266	Timing chain tensioner
17	6K255	Timing chain tensioner arm
18	6268	Timing chain (2 req'd)
19	6M256	Timing chain guide
20	6M269	Timing chain tensioner
21	6M274	Timing chain tensioner arm
22	6268	Timing chain (2 req'd)
23	N605892	Bolt (3 req'd)
24	6B274	Timing chain guide
25	N606427	Bolt
26	6306	Crankshaft sprocket (2 req'd)
27	12A227	Ignition pulse ring
28	3A696	Power steering pump
29	WS00315	Bolt (3 req'd)
30	N808793	Stud (2 req'd)
31	N806177	Bolt (5 req'd)
32	6700	Crankshaft front seal

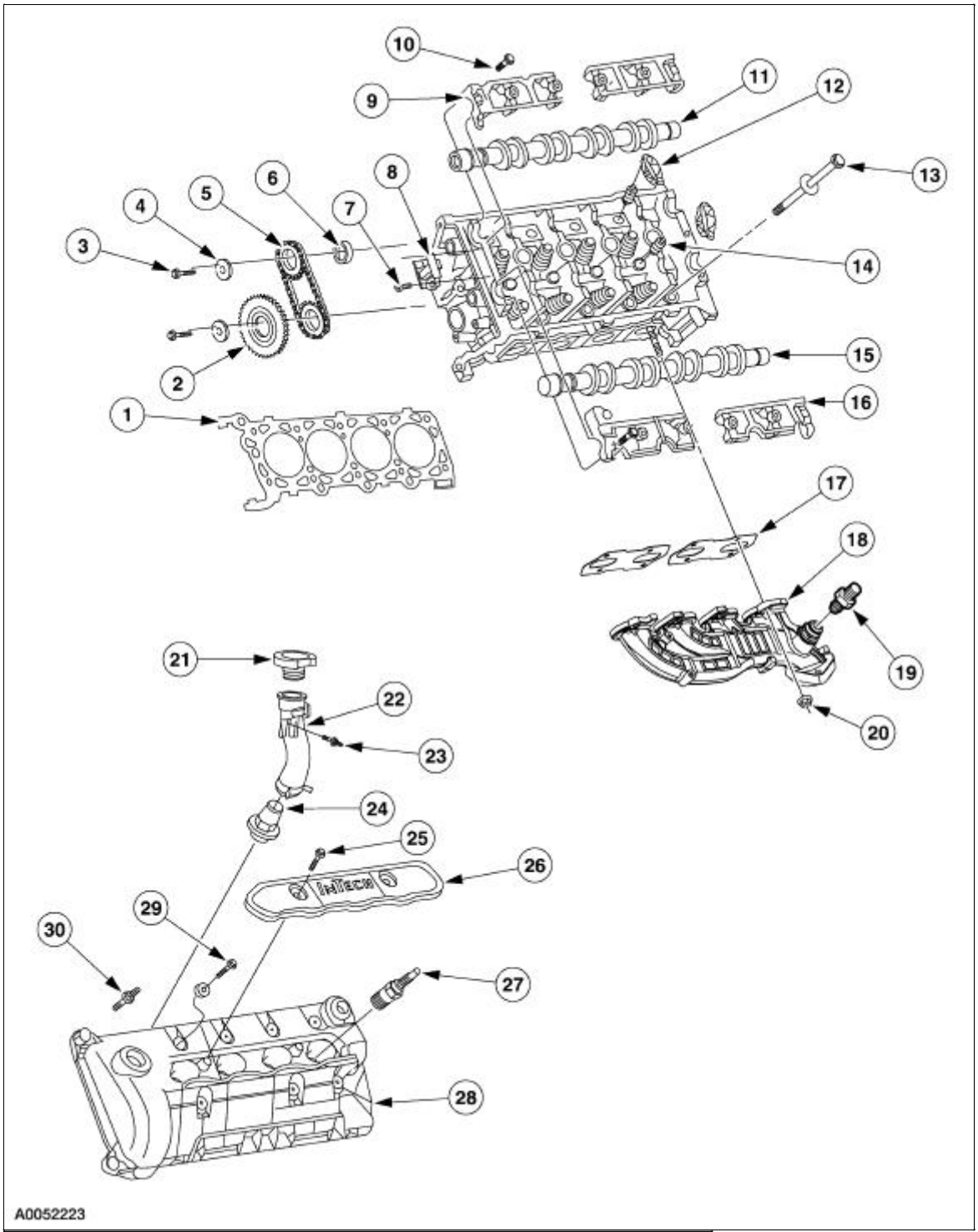


Item	Part Number	Description
1	18B402	Water bypass tube
2	N806459	Pipe plug (4 req'd)
3	6750	Oil level indicator
4	6K873	Oil level indicator tube
5	N806155	Bolt
6	87838	Pipe plug
7	6881	Oil filter adapter (4 x 2)
8	6714	Oil bypass filter
9	9278	Oil pressure sender
10	N806156	Bolt (4 req'd)
11	6A636	Oil filter adapter gasket
12	N806007	Dowel (2 req'd)
13	N806040	Dowel (2 req'd)
14	N646419	Dowel (2 req'd)
15	87836	Plug



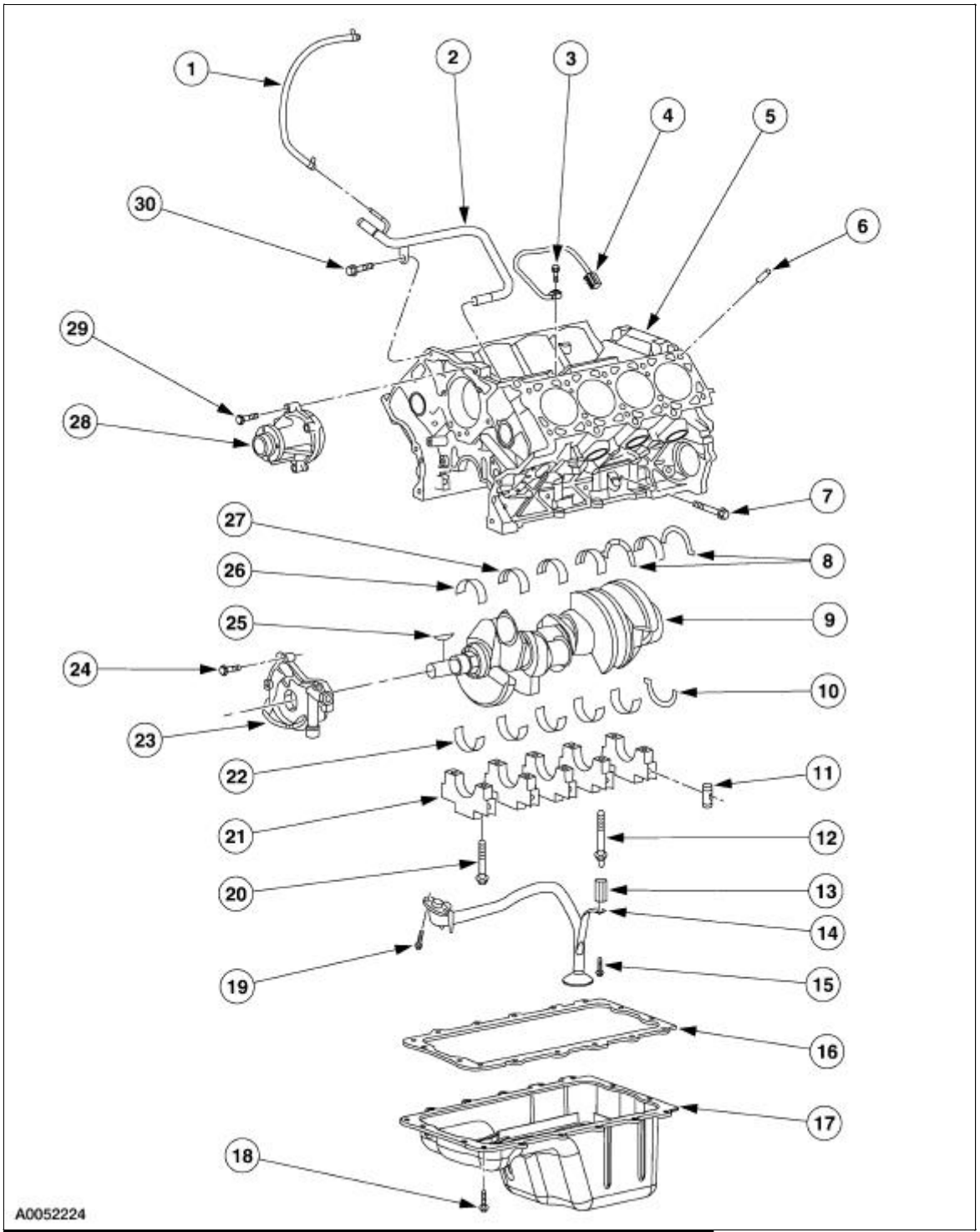
Item	Part Number	Description
1	6214	Bolt (2 req'd) (part of 6100)
2	6200	Connecting rod (8 req'd) (part of 6100)
3	6211	Connecting rod bearing (16 req'd)
4	6140	Piston pin retainer (16 req'd) (part of 6100)
5	6135	Piston pin (8 req'd) (part of 6100)
6	6110	Piston (8 req'd) (part of 6100)
7	6159	Piston ring (8 req'd) (part of 6100)
8	6161	Piston ring (8 req'd) (part of 6100)
9	6152	Piston ring (8 req'd) (part of 6100)
10	6758	Crankcase vent tube and connector
11	6582	Valve cover
12	6A270	Camshaft
13	6C271	Chain tensioner
14	6161	Bolts (2 req'd)
15	6A272	Camshaft

16	6255	Bushing
17	N806164	Washers (2 req'd)
18	N806139	Bolts (2 req'd)
19	6256	Gear
20	6268	Chain
21	6256	Gear
22	W701681	Stud (8 req'd)
23	9448	Exhaust manifold gasket
24	6051	Cylinder head gasket
25	9430	Exhaust manifold
26	W701706	Nut (8 req'd)



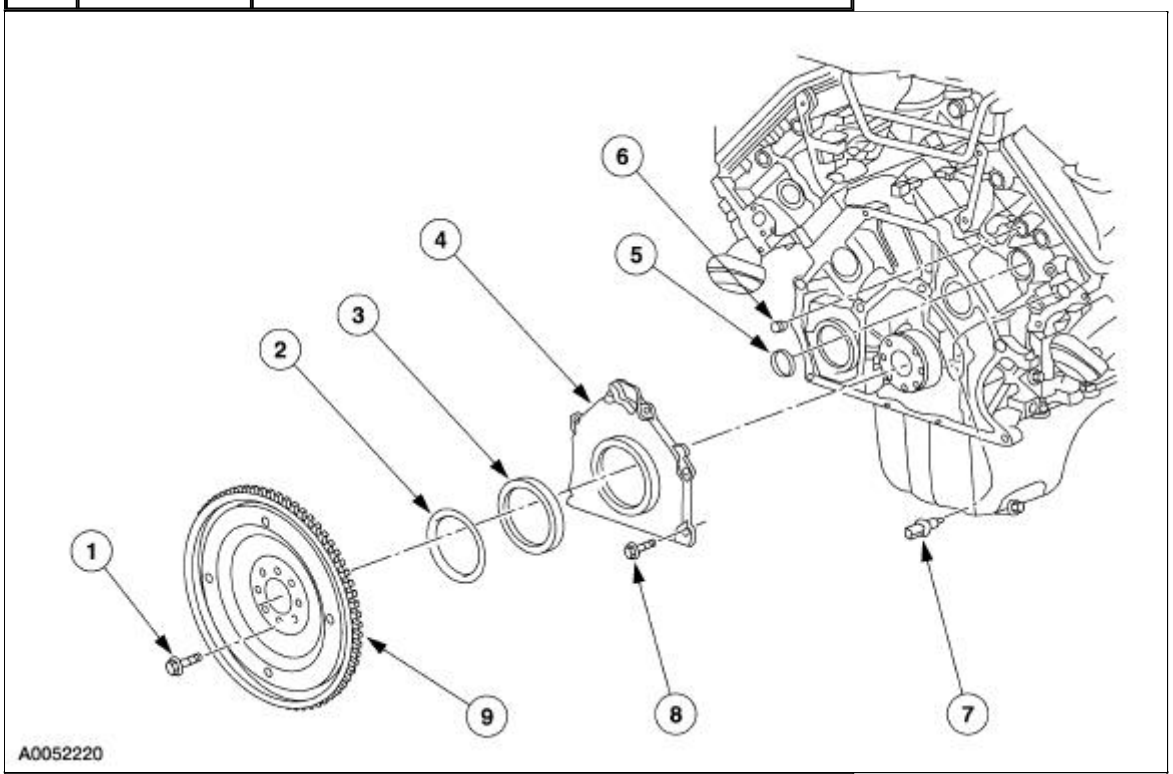
Item	Part Number	Description
1	6083	Cylinder head gasket
2	6256	Gear
3	—	Bolt (2 req'd)
4	—	Washer (2 req'd)
5	—	Secondary timing chain (2 req'd)
6	6255	Spacer
7	—	Screw and washer
8	6C271	Timing chain vibration damper

9	6B277	Camshaft bearing cap
10	—	Bolt (24 req'd)
11	6A271	Camshaft
12	6529	Roller follower (8 req'd)
13	6065	Bolt (20 req'd)
14	6C501	Hydraulic lash adjuster
15	6A273	Camshaft
16	6B278	Camshaft bearing cap (2 req'd)
17	9Y431	Exhaust manifold gasket
18	9481	Exhaust manifold
19	9F485	Tube connector
20	W701706	Nut (8 req'd)
21	6766	Oil filler cap
22	6768	Oil filler tube
23	—	Stud
24	6778	Oil filler tube adapter
25	—	Bolt (4 req'd)
26	6P067	Ignition coil cover
27	12405	Spark plug (8 req'd)
28	6A505	Valve cover
29	—	Bolt (16 req'd)
30	—	Stud (4 req'd)



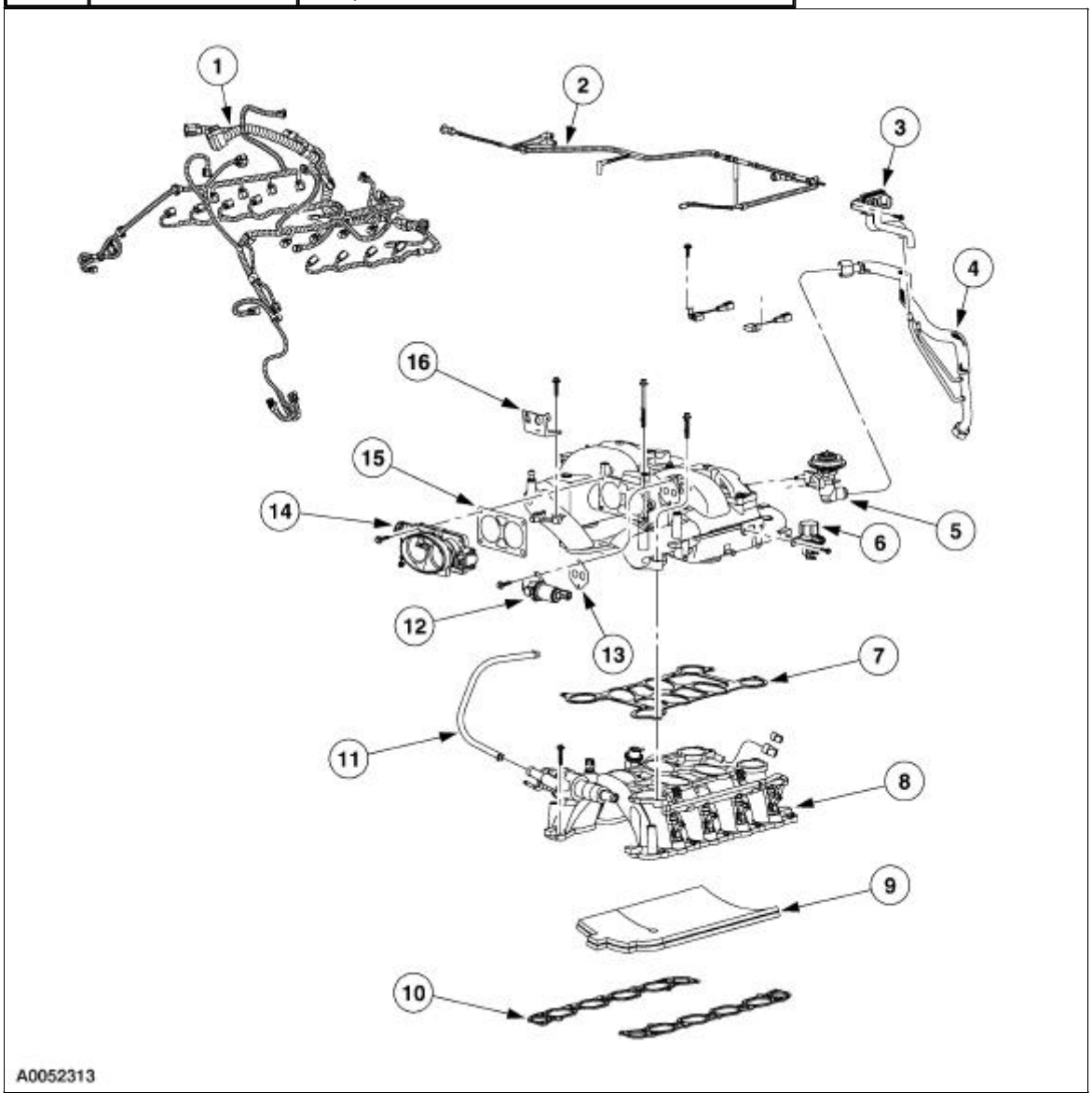
Item	Part Number	Description
1	18465	Heater water hose
2	18663	Heater water hose
3	—	Bolt
4	12A699	Knock sensor
5	6010	Engine block
6	N8064	Dowel (4 req'd)
7	6C357	Bolt (10 req'd)
8	6A341	Thrust bearing (2 req'd)

9	6303	Crankshaft
10	6K302	Thrust bearing
11	6A346	Crankshaft bearing cap adjusting screw (10 req'd)
12	6K258	Bolt
13	N806180	Spacer
14	6622	Oil pump screen cover and tube
15	N60594	Bolt
16	6710	Oil pan gasket
17	6675	Oil pan
18	W701605	Bolt (16 req'd)
19	N806155	Bolt (2 req'd)
20	6345	Bolt (9 req'd)
21	6325	Main bearing cap
22	6A338	Crankshaft main bearing (5 req'd)
23	6621	Oil pump
24	N806183	Bolt (3 req'd)
25	N806201	Woodruff key
26	6W337	Crankshaft main bearing
27	6333	Crankshaft main bearing
28	8501	Water pump
29	N808794	Bolt (4 req'd)
30	—	Bolt



Item	Part Number	Description
1	N806168	Bolt (8 req'd)

2	6310	Crankshaft oil slinger
3	6701	Crankshaft rear oil seal
4	6K318	Crankshaft rear retainer
5	N804871	Plug
6	87838	Plug
7	6G004	Cylinder head temperature sensor
8	N806155	Bolt (6 req'd)
9	6375	Flexplate



Item	Part Number	Description
1	12B637	Electrical harness
2	9E498	Vacuum harness
3	9J433	Differential pressure feedback exhaust gas recirculation (EGR) system
4	9D477	Exhaust gas recirculation valve-to-exhaust manifold tube
5	9D460	Exhaust gas recirculation valve

6	9J429	Exhaust gas recirculation vacuum regulator solenoid
7	9461	Upper intake manifold gasket
8	9J447	Lower intake manifold
9	8P013	Engine noise shield
10	9439	Lower intake manifold gasket
11	18465	PCV coolant hose
12	9F715	Idle air control valve
13	9F670	Idle air control valve gasket
14	9E926	Throttle body
15	9E936	Throttle body gasket
16	9728	Accelerator control bracket

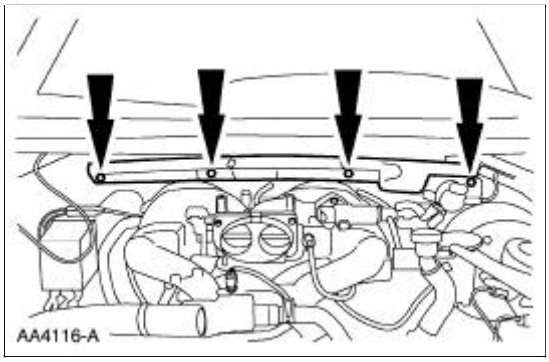
Engine

For basic engine mechanical concerns, refer to Section 303-00 . For driveability concerns, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

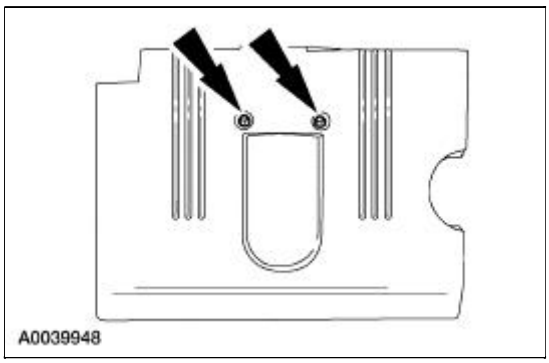
Upper Intake Manifold

Removal

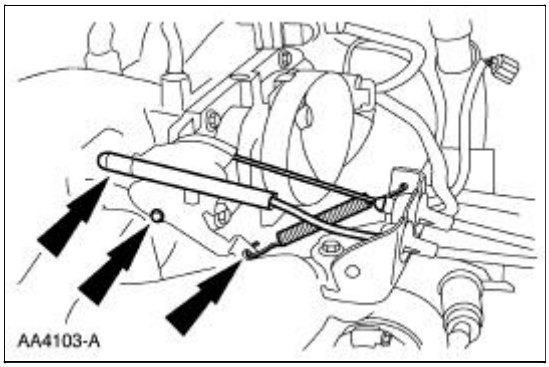
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the cowl grille. For additional information, refer to Section 501-02 .
3. Remove the bolts and five clips and the wiring harness shield.



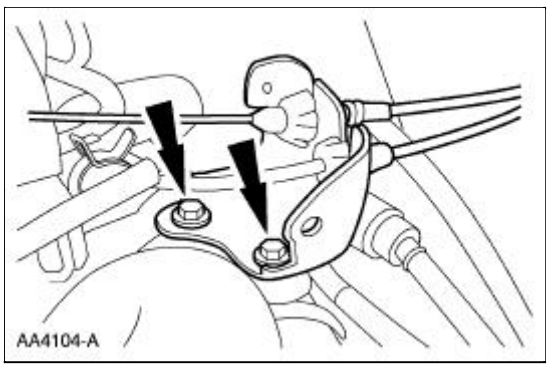
4. Remove the air cleaner outlet tube and the air cleaner assembly. For additional information, refer to Section 303-12 .
5. Partially drain the engine cooling system. For additional information, refer to Section 303-03 .
6. Remove the engine appearance cover.



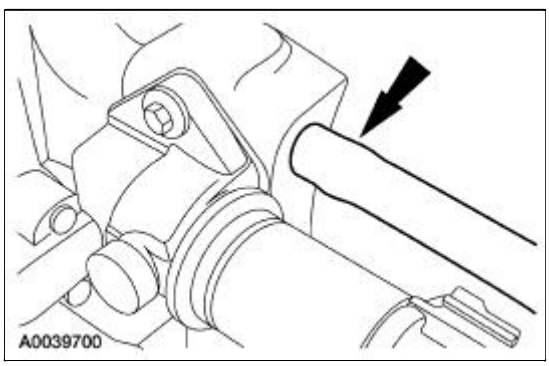
7. Disconnect the accelerator cable, speed control cable, and the return spring.



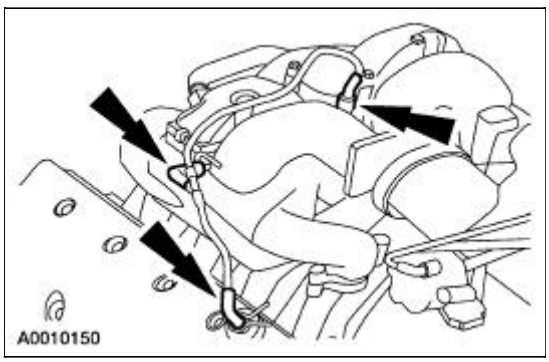
8. Remove the bolts and position the cables and bracket out of the way.



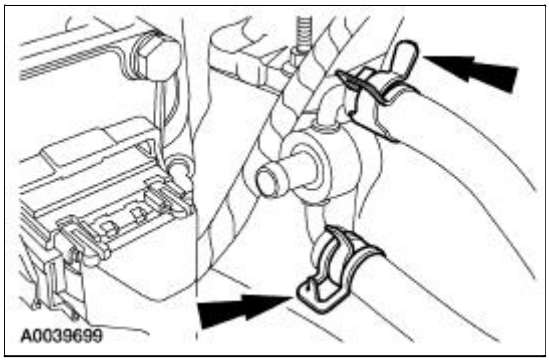
9. Disconnect the evaporative emission (EVAP) return hose.



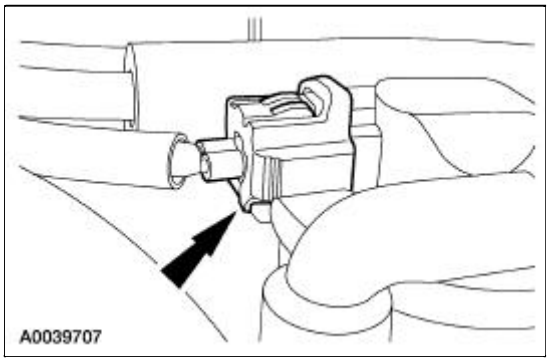
10. Disconnect and remove the positive crankcase ventilation (PCV) tube.



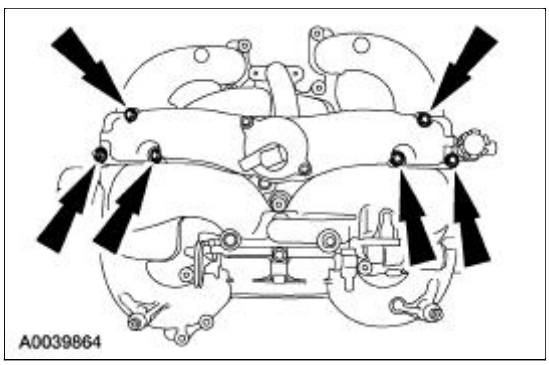
11. Disconnect the coolant hoses.



12. Disconnect the electrical connector from the intake tuning valve.

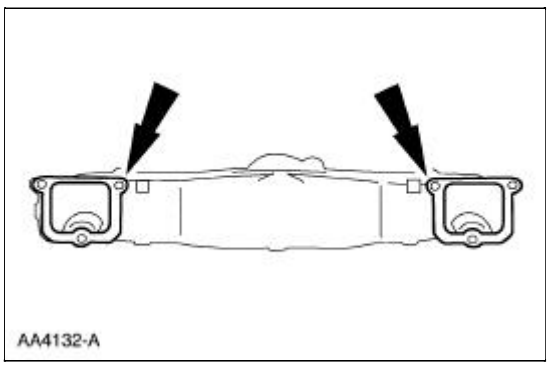


13. Remove the bolts, studs and the balance tube.

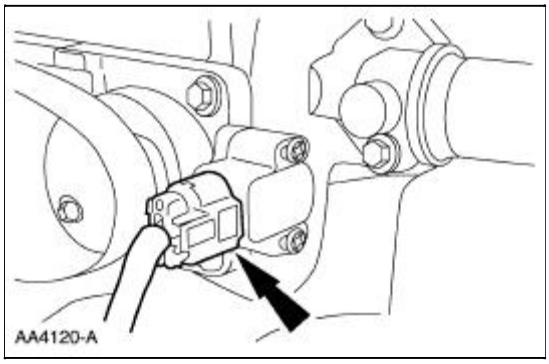


14. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

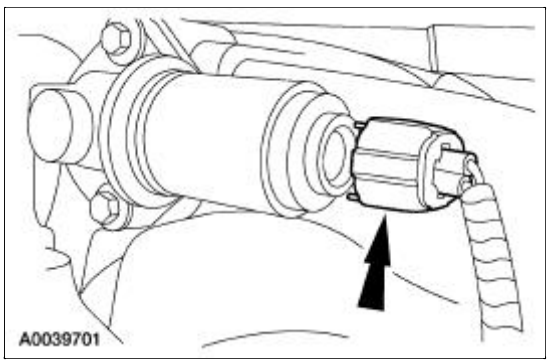
Remove and discard the gaskets and clean the sealing surfaces.



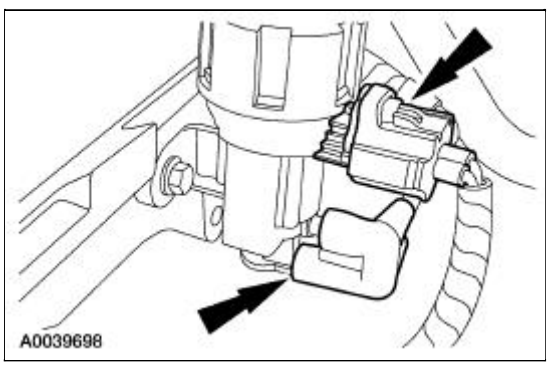
15. Disconnect the throttle position (TP) sensor electrical connector.



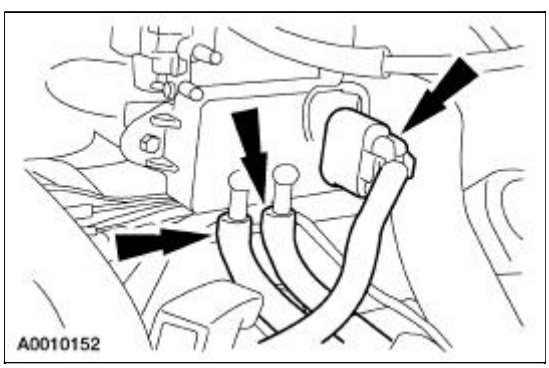
16. Disconnect the idle air control (IAC) valve electrical connector.



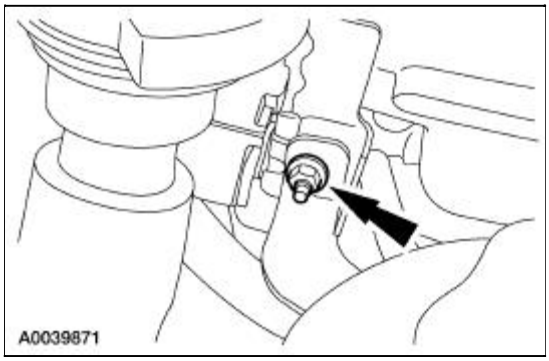
17. Disconnect the vacuum hoses and the electrical connector from the EGR vacuum regulator solenoid.



18. Disconnect the two hoses and the electrical connector from the differential pressure feedback EGR system.

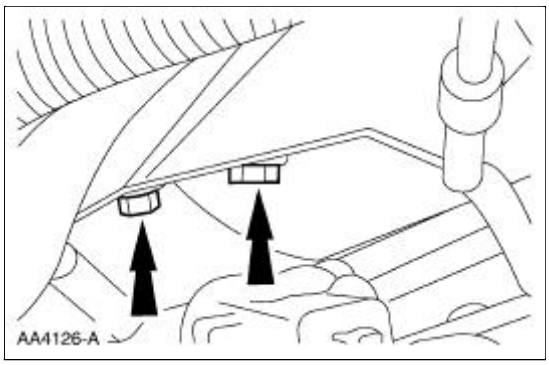


19. Remove the nut.

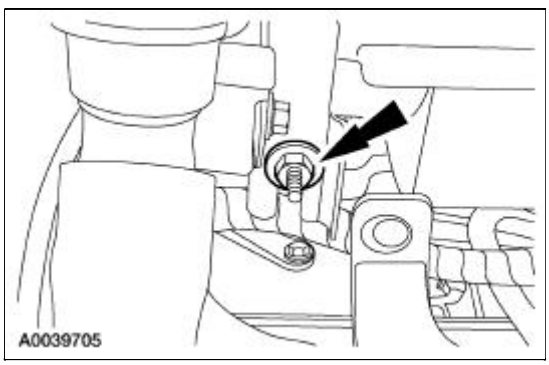


20. **NOTE:** The bolts are located at the front side of the LH cylinder head.

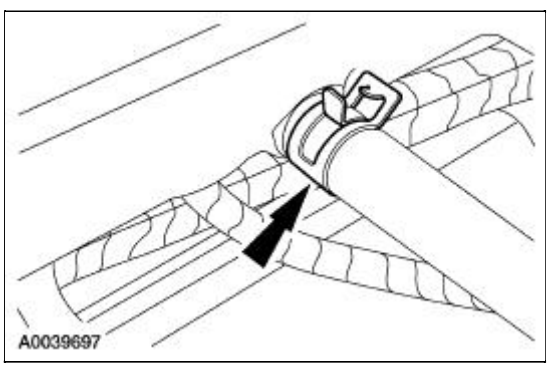
    Remove the bolts from the power steering reservoir bracket and position it aside.



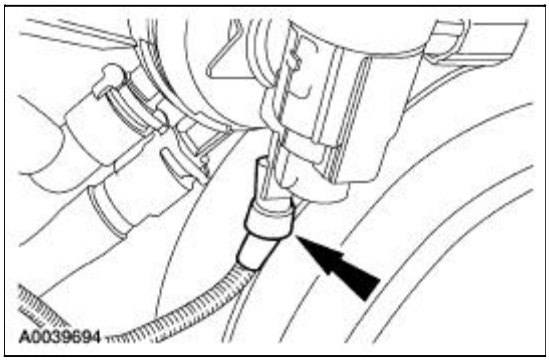
21. Remove the stud and position the oil fill tube aside.



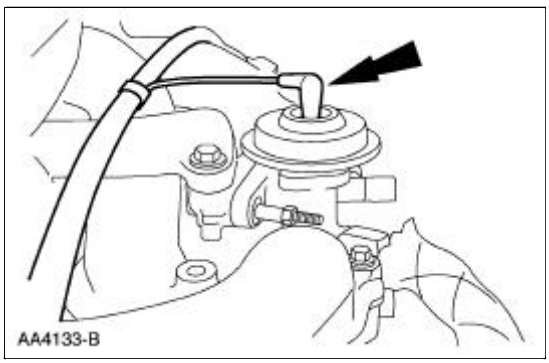
22. Disconnect the brake booster vacuum hose.



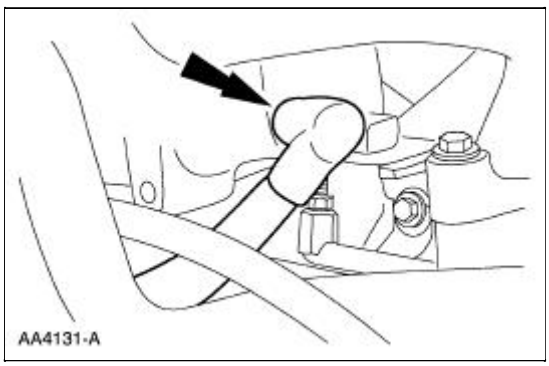
23. Disconnect the vacuum hose.



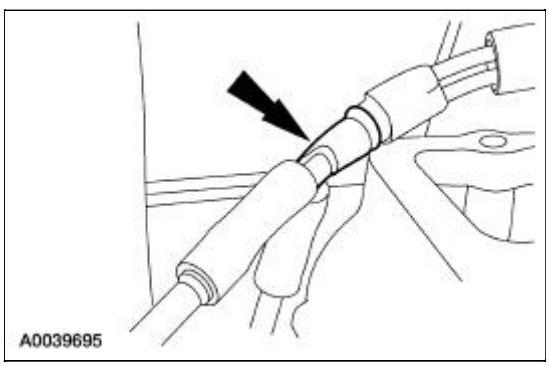
24. Disconnect the vacuum hose from the exhaust gas recirculation (EGR) valve.



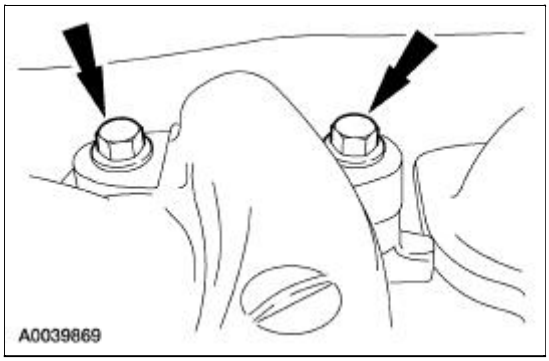
25. Disconnect the vacuum hose.



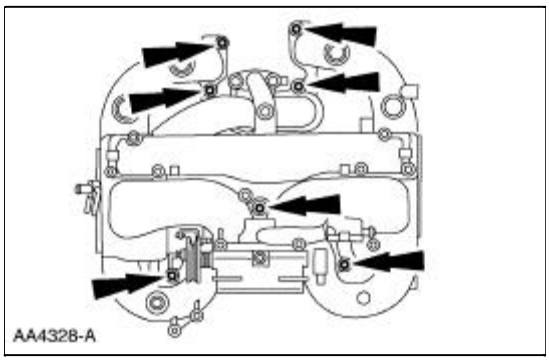
26. Disconnect the vacuum hose at the right rear of the intake manifold.



27. Remove the bolts from the EGR adapter.
    - Discard the gasket.



28. Remove the bolts and the upper intake manifold.
    - Discard the upper intake retaining bolts.

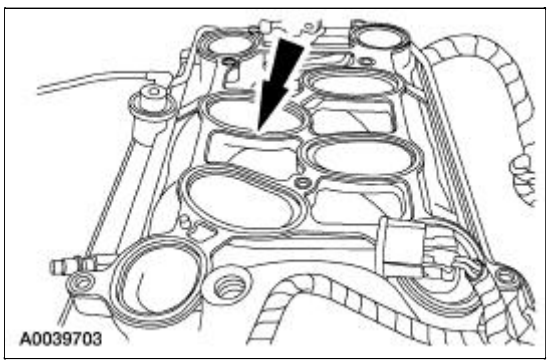


29. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

    Remove and inspect the intake gasket. Install a new gasket if necessary.
    - Clean and inspect the sealing surfaces.

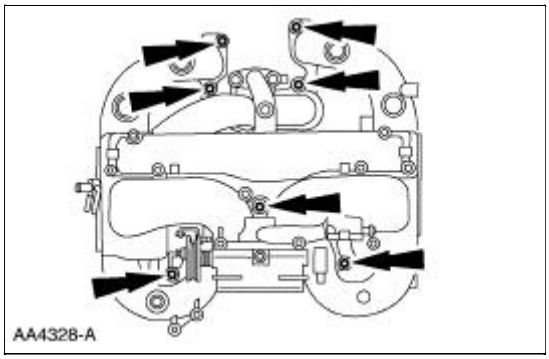
Installation

1. Install the upper intake manifold gasket.

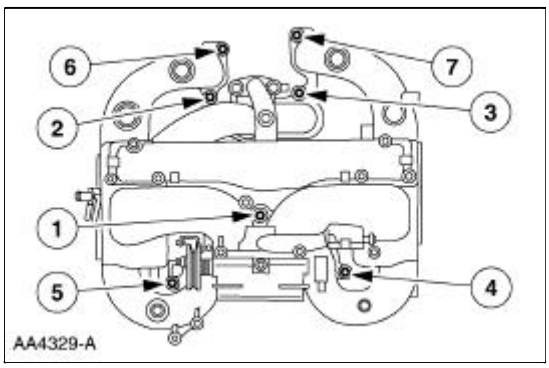


2. **NOTE:** Install new bolts.

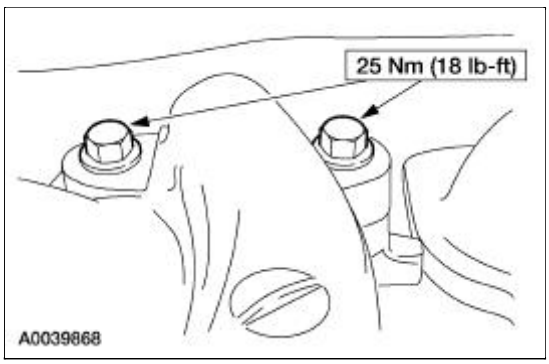
   Position the upper intake manifold and loosely install the new bolts.



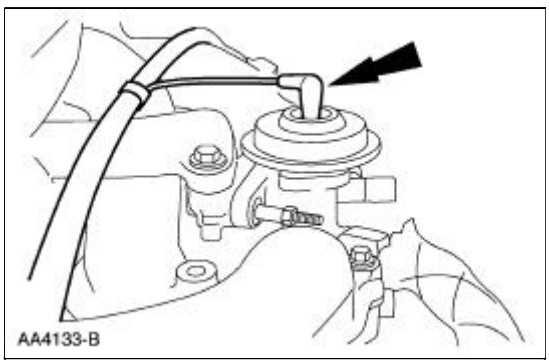
3. Tighten the bolts in the sequence shown in two stages.
    - Tighten to 10Nm (89 lb-in).
    - Tighten an additional 90 degrees.



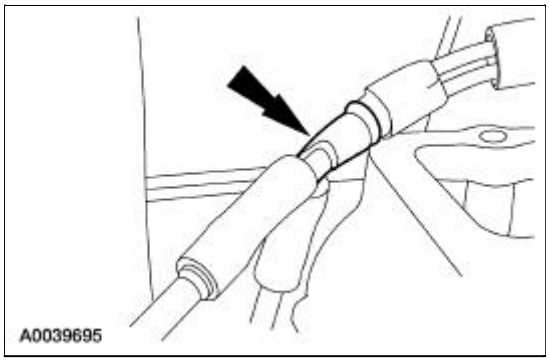
4. Install the EGR adapter using a new gasket.



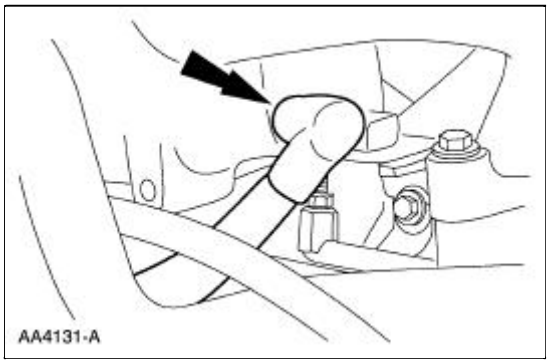
5. Connect the vacuum hose to the EGR valve.



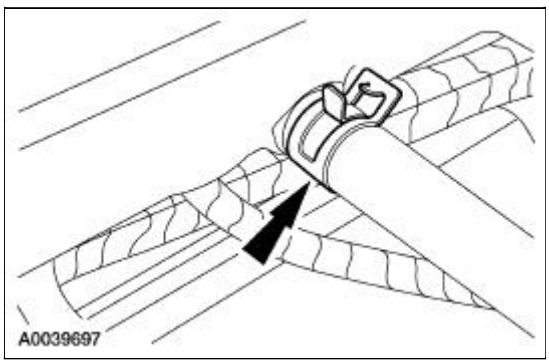
6. Connect the vacuum hose at the right rear of the intake manifold.



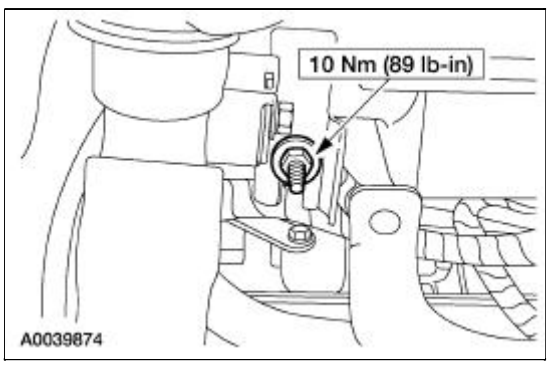
7. Connect the vacuum hose.



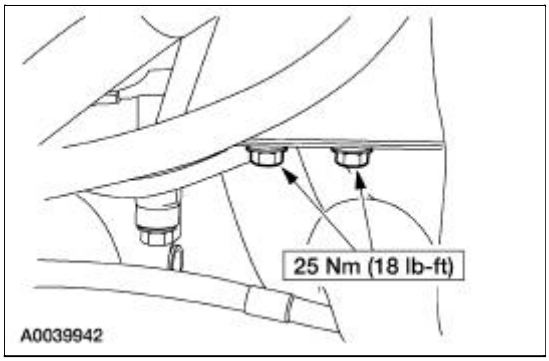
8. Connect the brake booster vacuum hose.



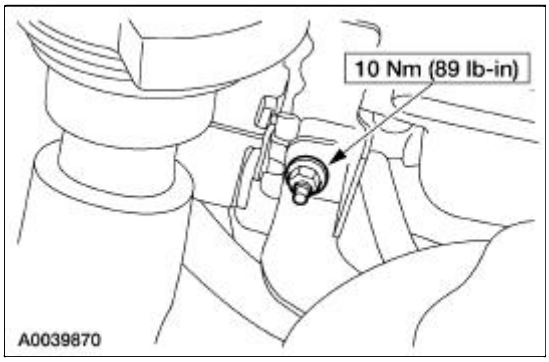
9. Position the oil fill tube and install the stud.



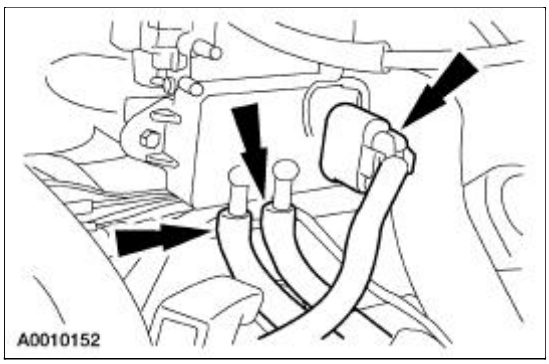
10. Position the power steering reservoir bracket and install the bolts.



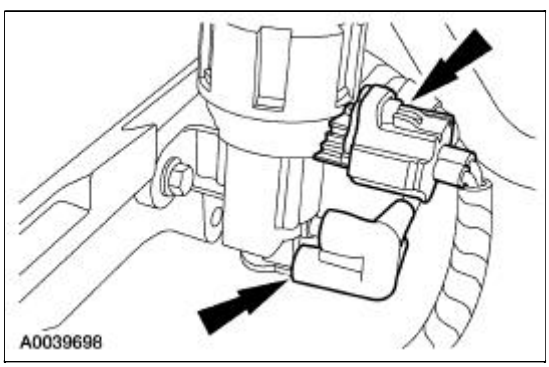
11. Install the nut.



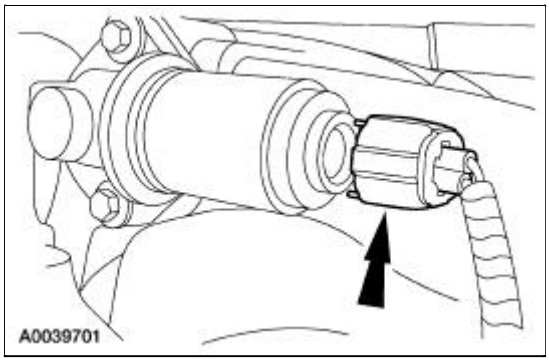
12. Connect the two vacuum hoses and the electrical connector to the differential pressure feedback EGR system.



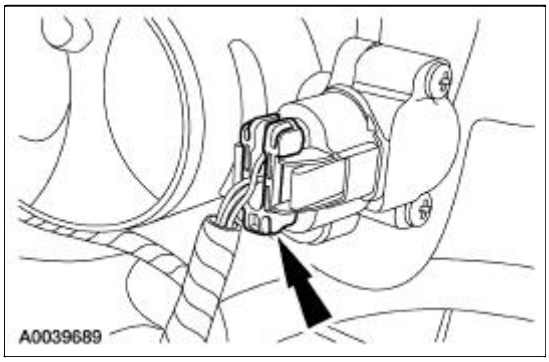
13. Connect the vacuum hoses and the electrical connector to the EGR vacuum regulator solenoid.



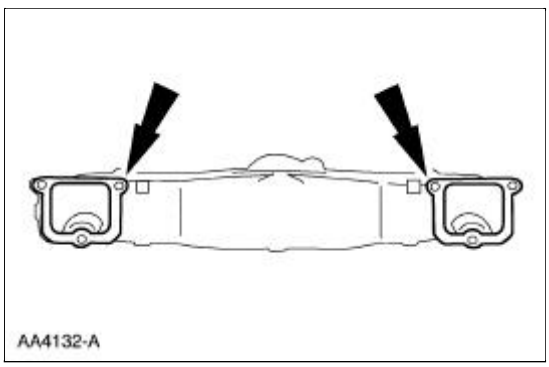
14. Connect the IAC valve electrical connector.



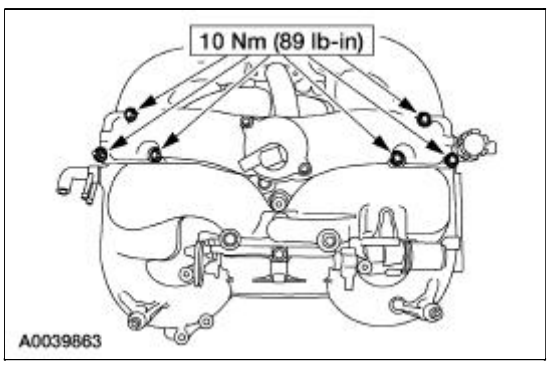
15. Connect the TP sensor electrical connector.



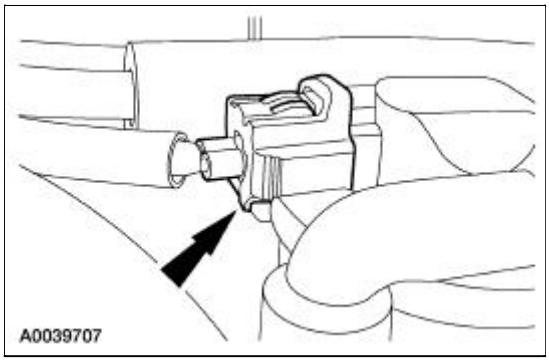
16. Install the balance tube gaskets.



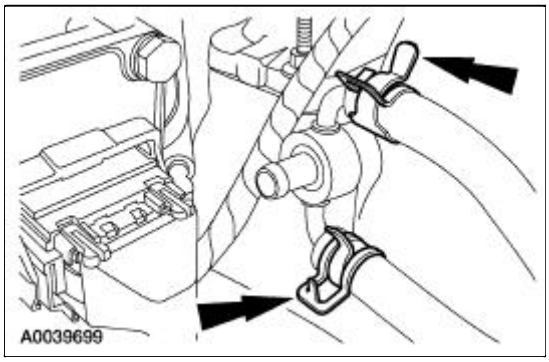
17. Install the balance tube, the bolts and the stud.



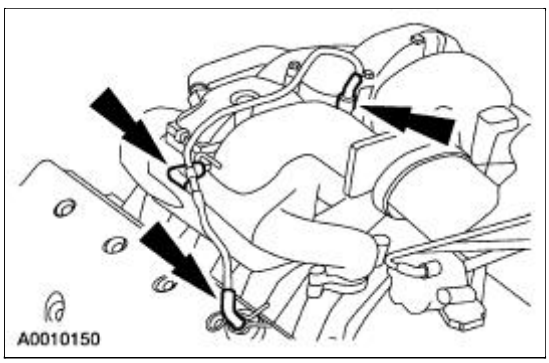
18. Connect the electrical connector to the intake manifold tuning valve.



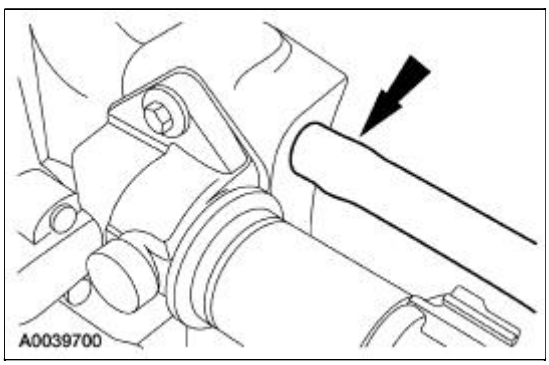
19. Connect the PCV heater coolant hoses.



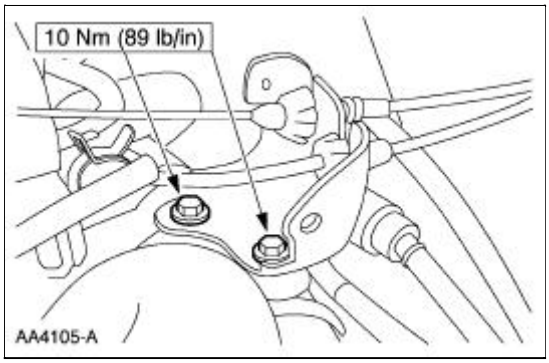
20. Install the tube assembly and connect the PCV valve tube.



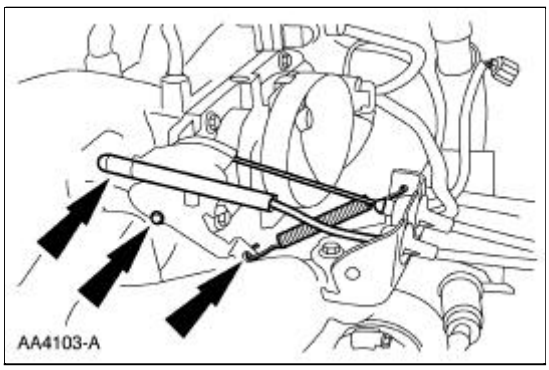
21. Connect the EVAP return hose.



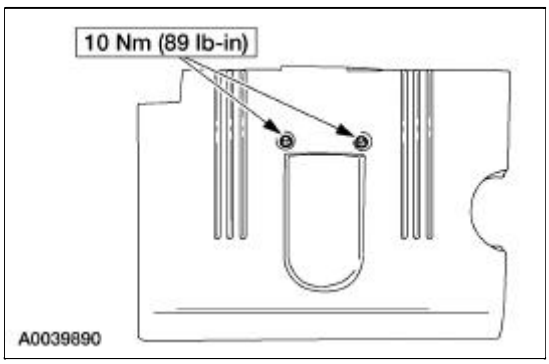
22. Position the cables and bracket, and install the bolts.



23. Connect the accelerator cable, speed control cable and the return spring.

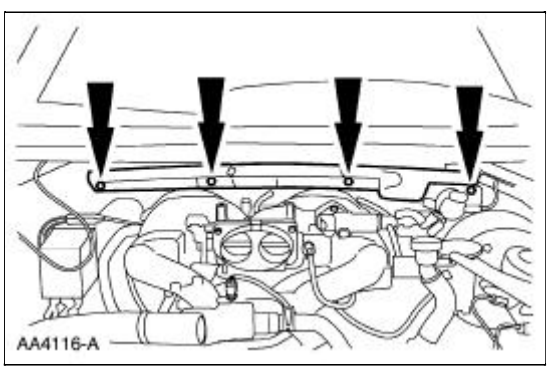


24. Install the engine appearance cover.



25. Install the engine air cleaner and outlet tube. For additional information, refer to Section 303-12 .

26. Install the wiring harness shield, the bolts and five clips.



27. Install the cowl grille. For additional information, refer to Section 501-02 .

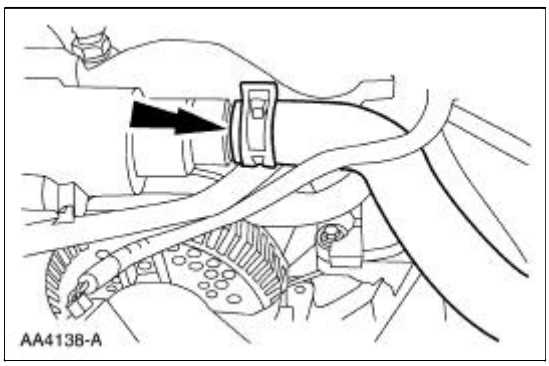
28. Connect the battery ground cable. For additional information, refer to Section 414-01 .

29. Fill the engine cooling system. For additional information, refer to Section 303-03 .

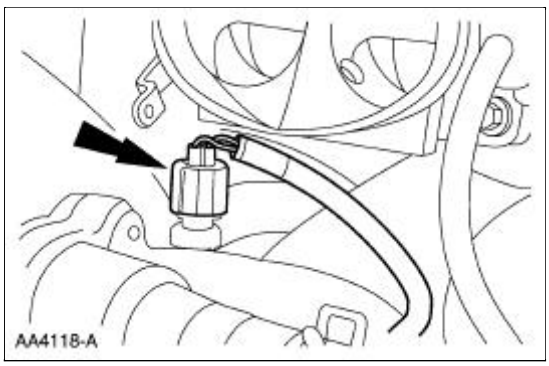
Lower Intake Manifold

Removal

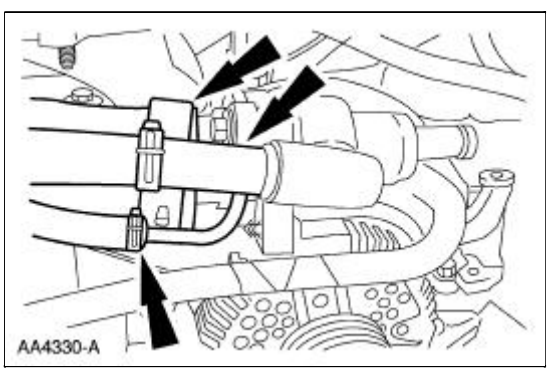
1. Remove the upper intake manifold. For additional information, refer to Upper Intake Manifold .
2. Disconnect the fuel hose spring lock couplings. For additional information, refer to Section 310-00 .
3. Disconnect the engine water bypass hose.



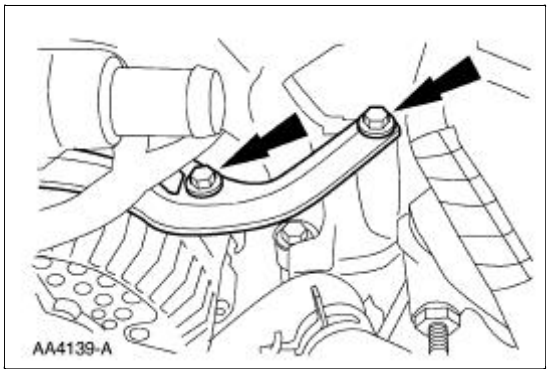
4. Disconnect the water temperature indicator sender electrical connector.



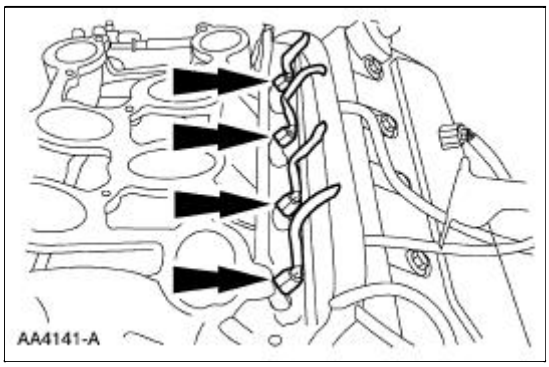
5. Disconnect the upper radiator hose, the heater water inlet hose and the heated positive crankcase ventilation (PCV) water heated fitting inlet hose.



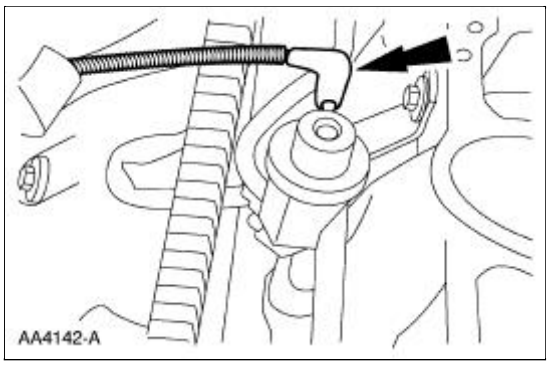
6. Remove the four bolts and the generator upper support bracket.



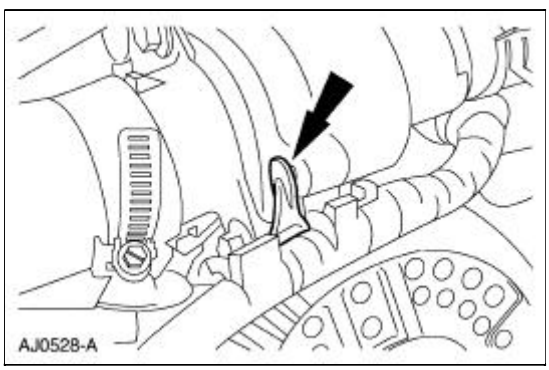
7. Disconnect the eight fuel injectors.



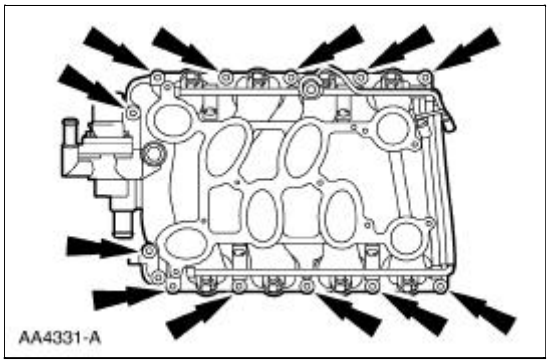
8. Disconnect the fuel injector pressure regulator vacuum hose and position out of the way.



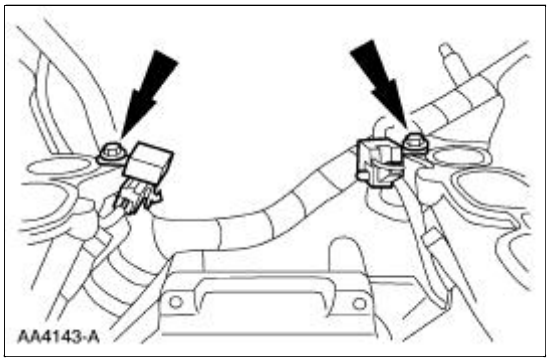
9. Disconnect the wire harness pin-type retainer.



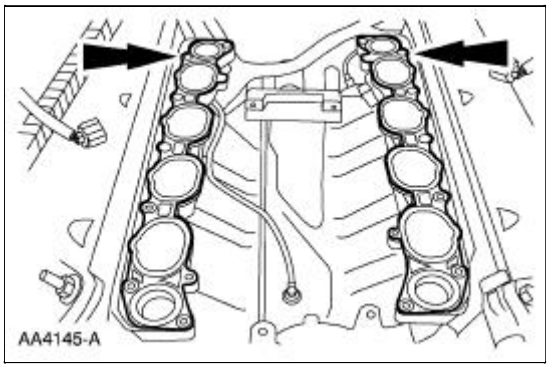
10. Remove the bolts and lower intake manifold.
    - Discard the bolts.



11. Remove the bolts and the radio ignition interference capacitors.

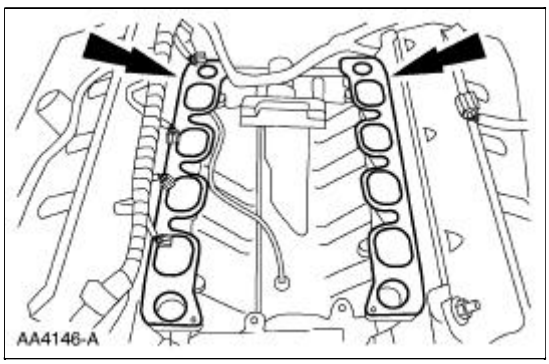


12. Remove and inspect the gaskets, and install new gaskets if necessary.



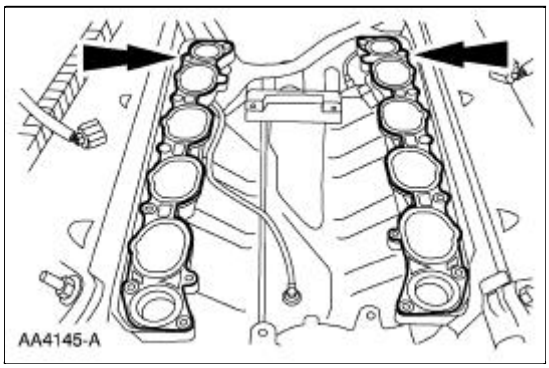
13. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

    Clean the sealing surfaces.

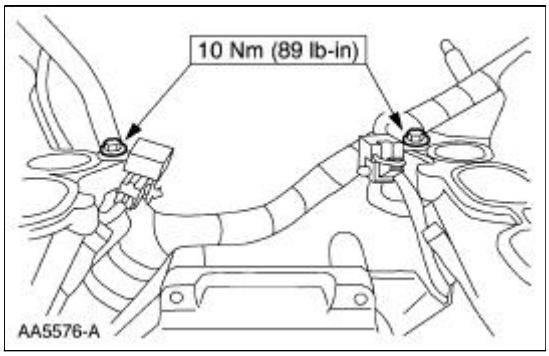


Installation

1. Install the lower intake gaskets.

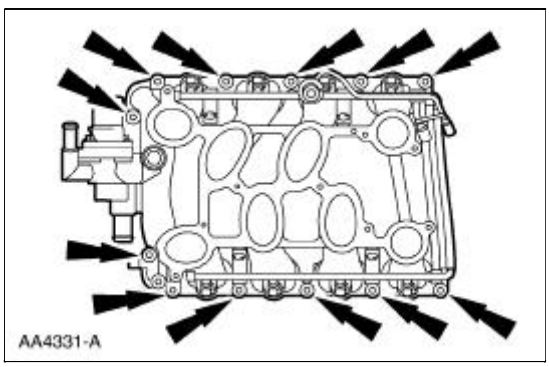


2. Install the radio ignition interference capacitors.

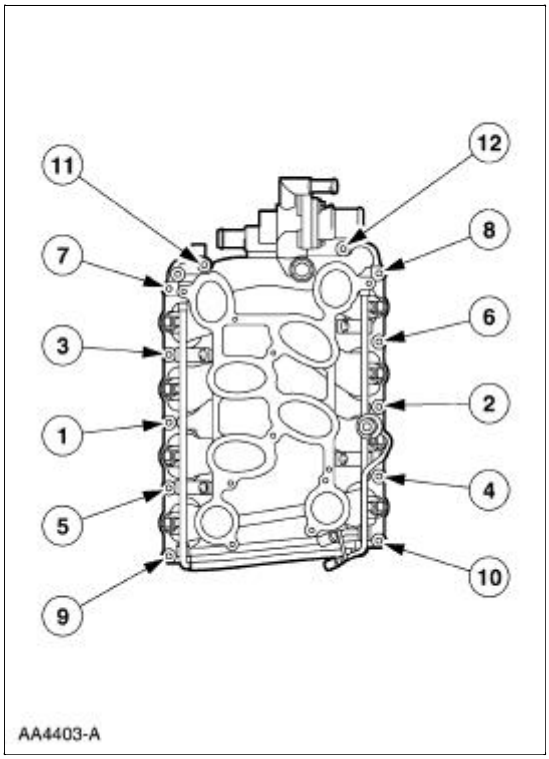


3. **NOTE:** Install new bolts.

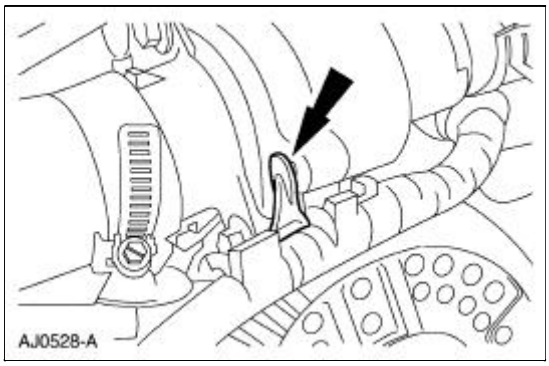
   Position the lower intake manifold. Loosely install the retaining bolts.



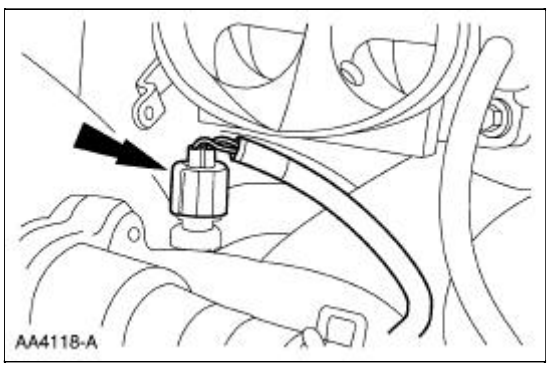
4. Tighten the retaining bolts in two stages. and then an additional 90 degrees in the sequence shown.
   - Tighten to 10 Nm (89 lb-in).
   - Tighten an additional 90 degrees.



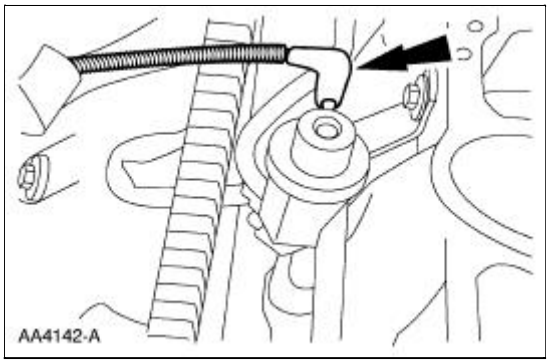
5. Connect the wire harness pin-type retainer.



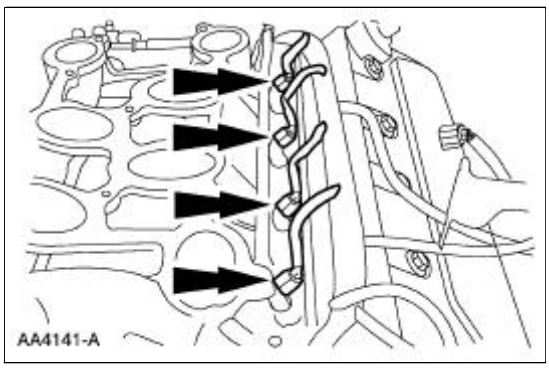
6. Connect the water temperature indicator sensor electrical connector.



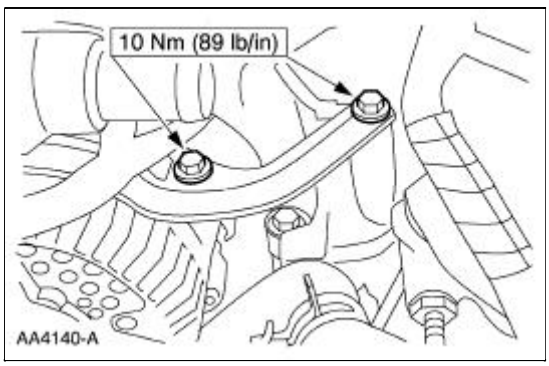
7. Position the vacuum harness and connect the vacuum line to the fuel injector pressure regulator.



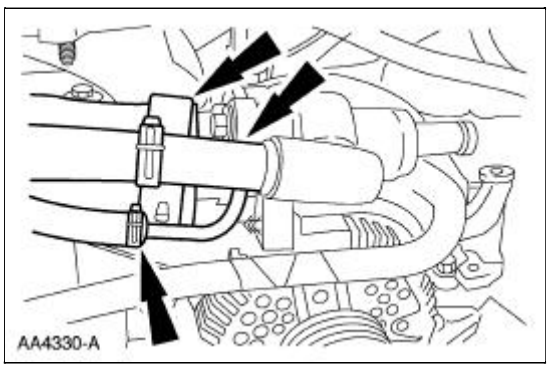
8. Connect the eight fuel injector electrical connectors.



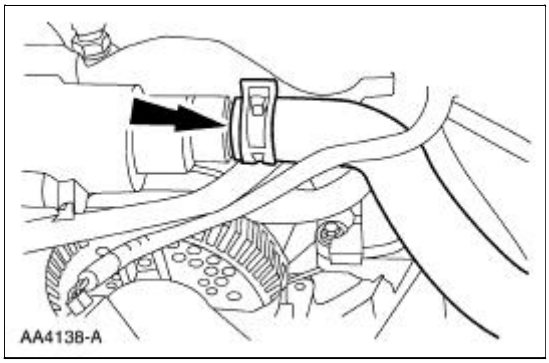
9. Install the upper generator support bracket and the four bolts.



10. Connect the heater water inlet hose, the upper radiator hose and the water heated fitting inlet hose.



11. Connect the engine water bypass return hose.



12. Connect the fuel hose spring lock couplings. For additional information, refer to Section 310-00 .

13. Install the upper intake manifold. For additional information, refer to Upper Intake Manifold in this section.

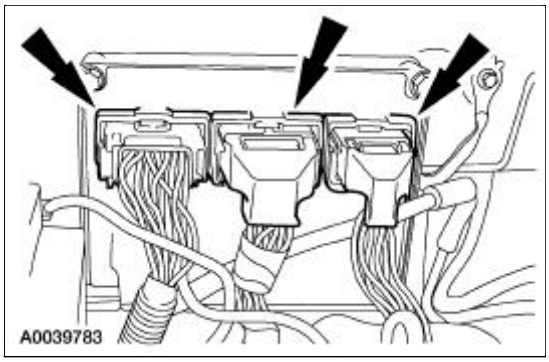
Valve Cover RH

Material

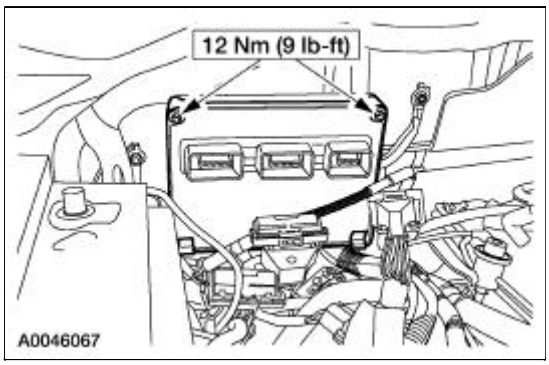
Item	Specification
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4

Removal and Installation

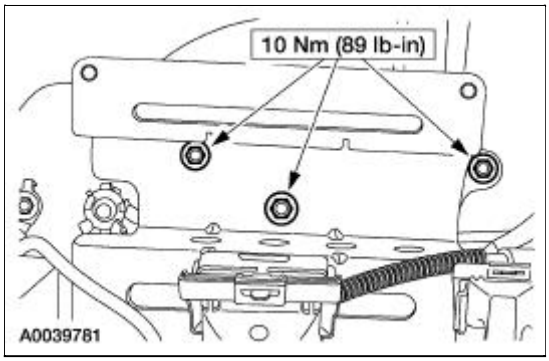
1. Remove the upper intake manifold. For additional information, refer to Upper Intake Manifold in this section.
2. Recover the A/C system refrigerant. For additional information, refer to Section 412-00 .
3. Disconnect the powertrain control module (PCM) electrical connectors.



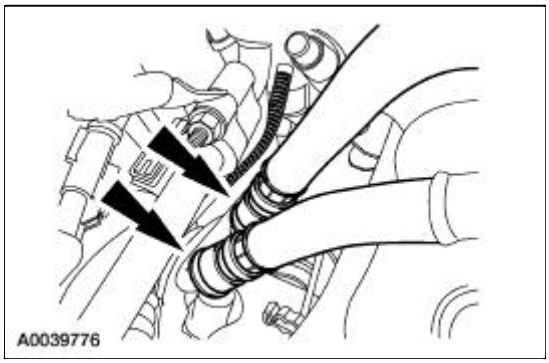
4. Remove the PCM mounting bolts and the PCM.



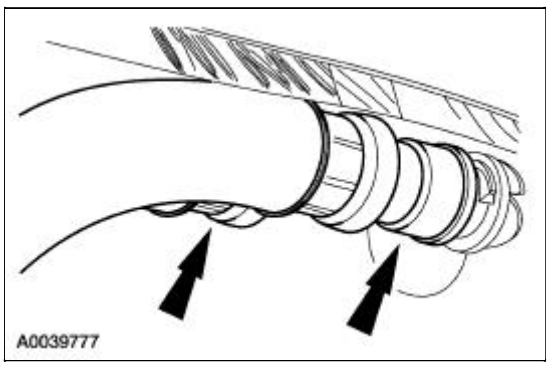
5. Remove the bolts and the PCM mounting bracket.



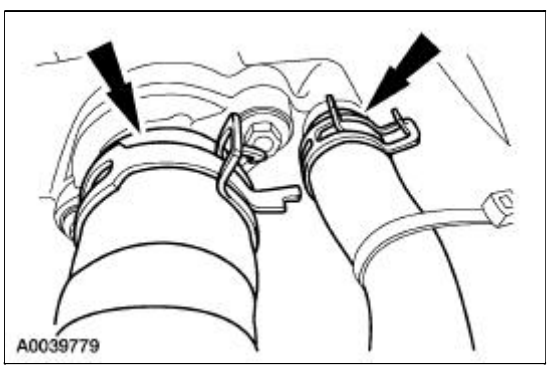
6. If equipped, disconnect the auxiliary heater hoses at the right-side valve cover.



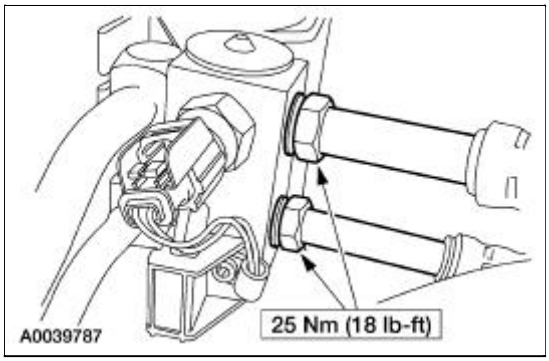
7. Disconnect the heater hoses at the heater core.



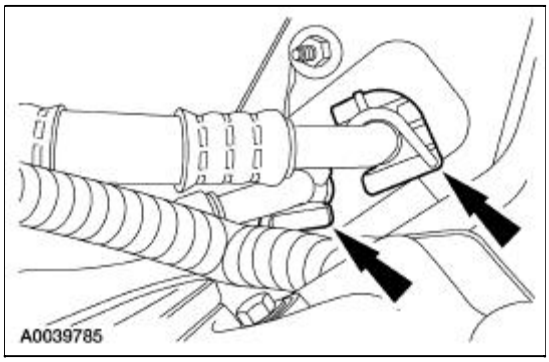
8. Disconnect the radiator upper hose and the heater hose at the lower intake manifold, and position them aside.



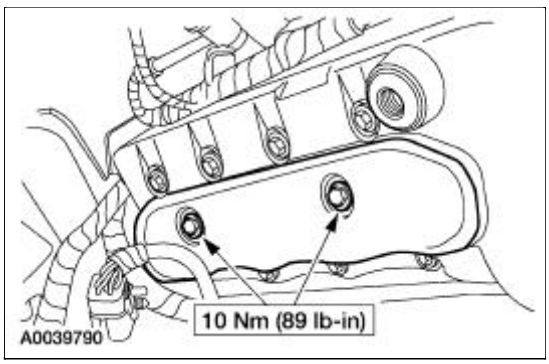
9. Disconnect the A/C hoses from the junction block.



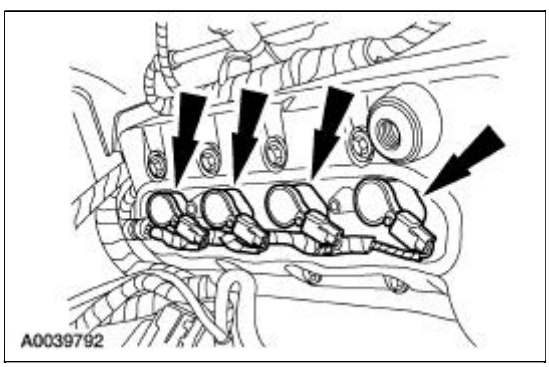
10. Remove the safety clips and disconnect the spring lock couplers at the evaporator core. For additional information, refer to Section 412-00 .



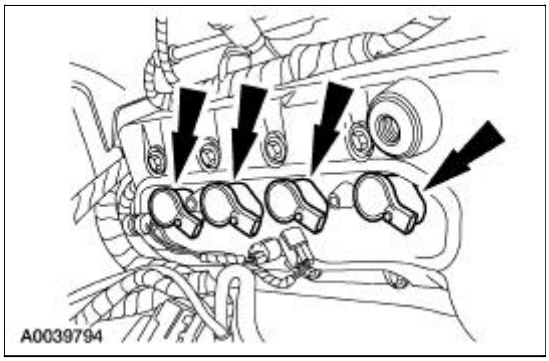
11. Remove the ignition coil cover.



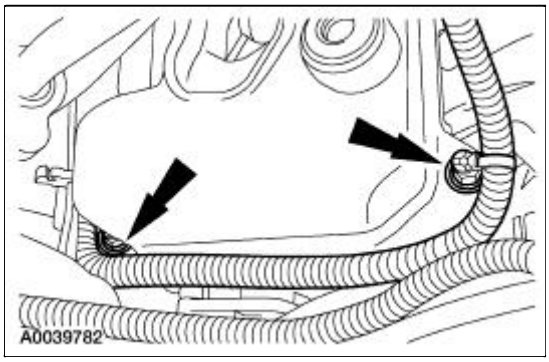
12. Disconnect the ignition coil electrical connectors.



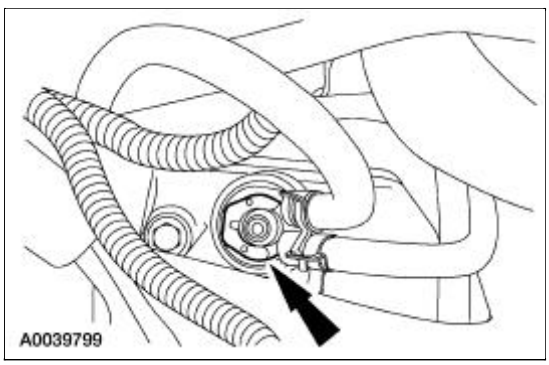
13. Remove the ignition coils.



14. Disconnect the wiring harness from the valve cover studs.

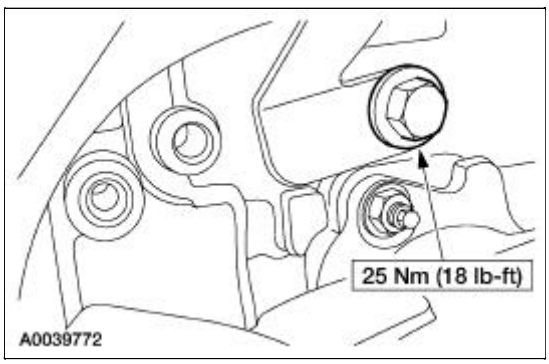


15. Remove the heated positive crankcase ventilation (PCV) valve from the valve cover.



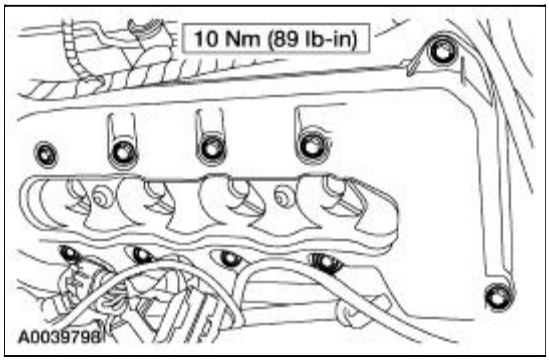
16. Raise the vehicle on a hoist. For additional information, refer to Section 100-02 .

17. Remove the transmission oil level indicator bolt and position the tube aside.



18. Lower the vehicle.

19. Remove the eight bolts, two studs, and the valve cover and gasket.

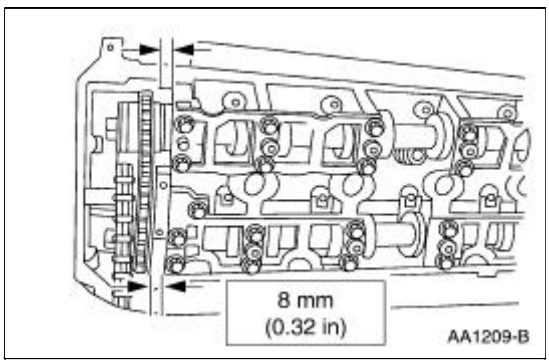


20. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

NOTE: The valve cover gasket is reusable. Inspect the gasket and install a new gasket as necessary.

NOTE: Clean the gasket sealing surfaces and apply gasket sealer in the locations shown.

To install, reverse the removal procedure.



Valve Cover LH

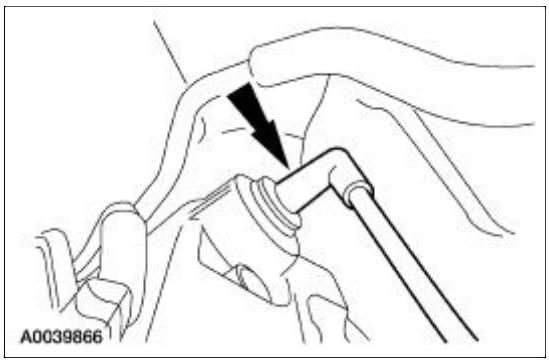
Material

Item	Specification
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4

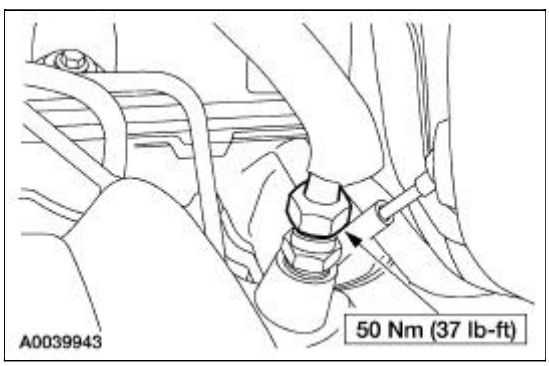
Removal and Installation

1. Remove the upper intake manifold. For additional information, refer to Upper Intake Manifold in this section.

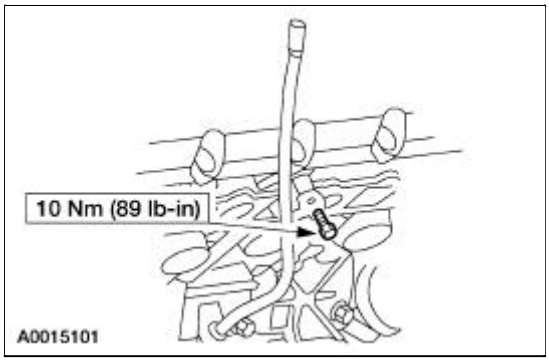
2. Remove the crankcase vent hose.



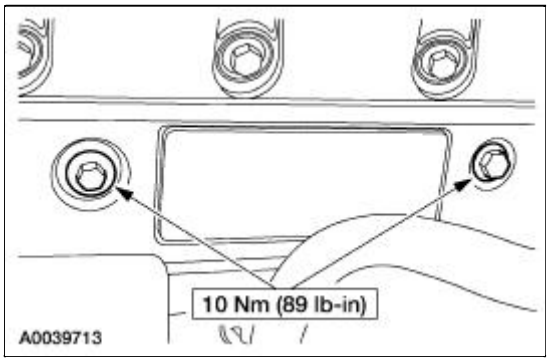
3. Disconnect the exhaust gas recirculation (EGR) tube from the exhaust manifold and remove the valve and tube as an assembly.



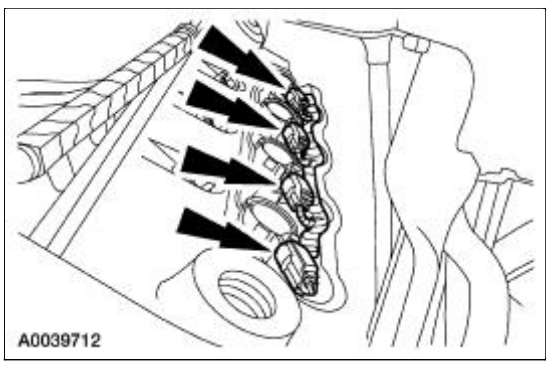
4. Remove the engine oil level indicator tube bracket bolt and position the tube aside.



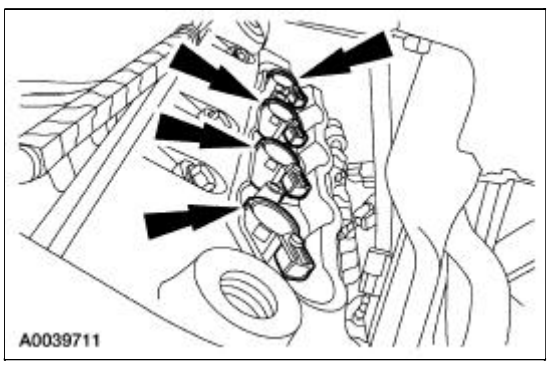
5. Remove the bolts and the ignition coil cover.



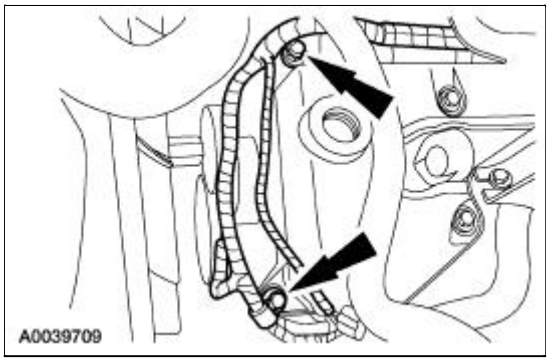
6. Disconnect the ignition coil electrical connectors.



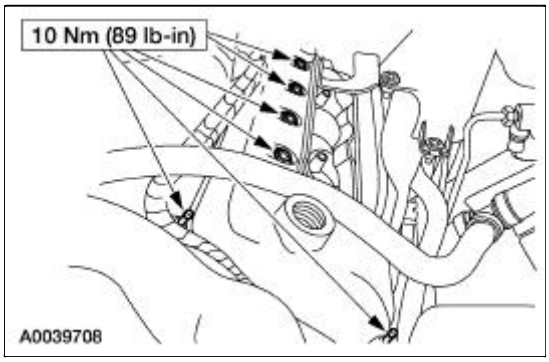
7. Remove the ignition coils.



8. Separate the engine wiring harness from the valve cover studs.



9. Remove the bolts, studs and the left valve cover and gasket.

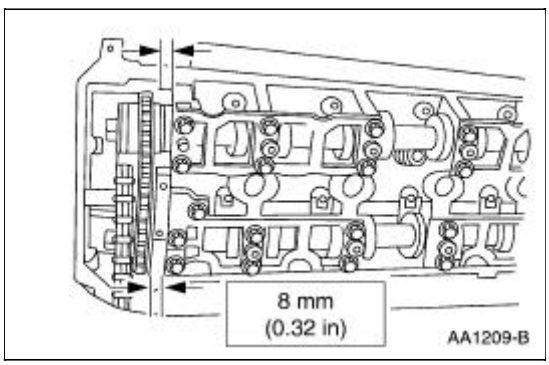


10. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

    NOTE: The valve cover gasket is reusable. Inspect the gasket and replace as necessary.

    NOTE: Clean the gasket sealing surfaces and apply gasket sealer in the locations shown.

    To install, reverse the removal procedure.



Crankshaft Pulley

Special Tool(s)

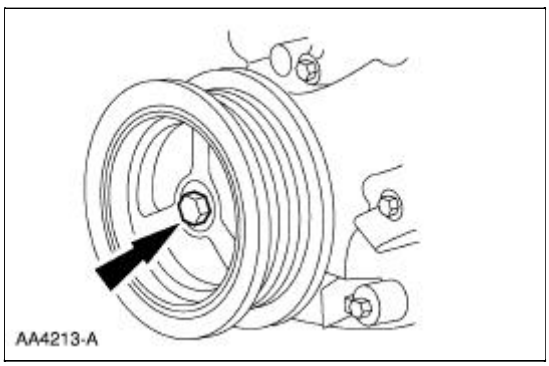
 ST1286-A	Remover, Crankshaft Vibration Damper 303-009 (T58P-6316-D)
 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)

Material

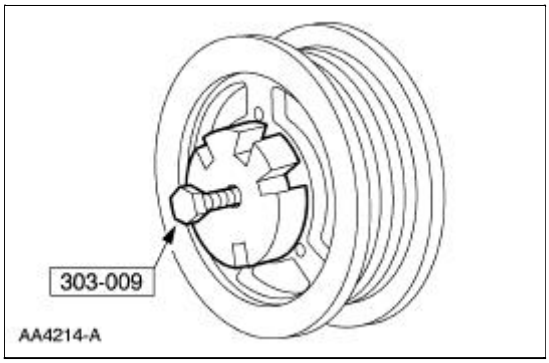
Item	Specification
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4

Removal

1. Remove the fan. For additional information, refer to Section 303-03 .
2. Remove the drive belt. For additional information, refer to Section 303-05 .
3. Raise and support the vehicle. For additional information, refer to Section 100-02 .
4. Remove the bolt.



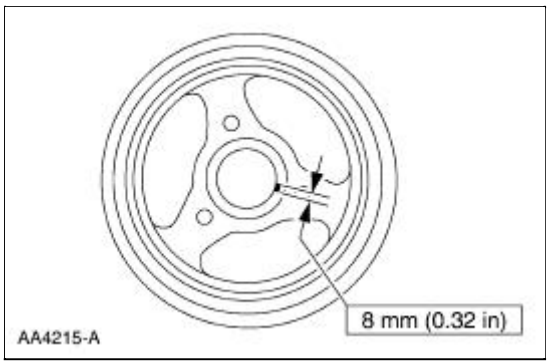
5. Using the special tool, remove the crankshaft pulley.



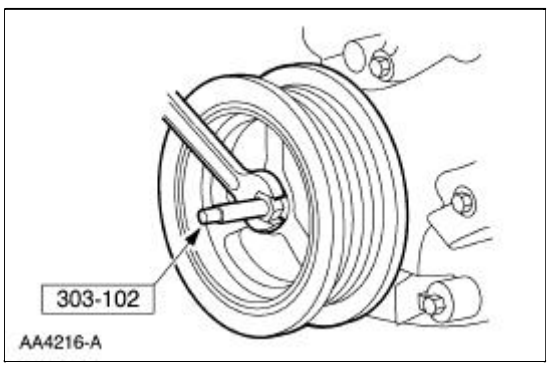
Installation

1. **NOTE:** The crankshaft pulley must be installed within four minutes after applying the silicone.

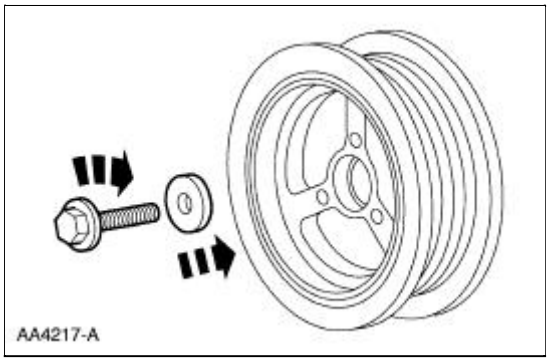
   Apply silicone gasket and sealant to the Woodruff key slot on the crankshaft pulley.



2. Using the special tool, install the crankshaft pulley.



3. Install the bolt and washer. Tighten the bolt in four stages:
   - Stage 1: Tighten to 90 Nm (66 lb-ft).
   - Stage 2: Loosen one full turn.
   - Stage 3: Tighten to 50 Nm (37 lb-ft).
   - Stage 4: Tighten an additional 85-95 degrees.



4. Lower the vehicle.
5. Install the drive belt. For additional information, refer to Section 303-05 .
6. Install the fan. For additional information, refer to Section 303-03 .

Crankshaft Front Oil Seal

Special Tool(s)

 ST2197-A	Installer, Crankshaft Front Oil Seal 303-635
 ST1328-A	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A)
 ST1288-A	Remover, Crankshaft Front Oil Seal 303-107 (T74P-6700-A)
 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)

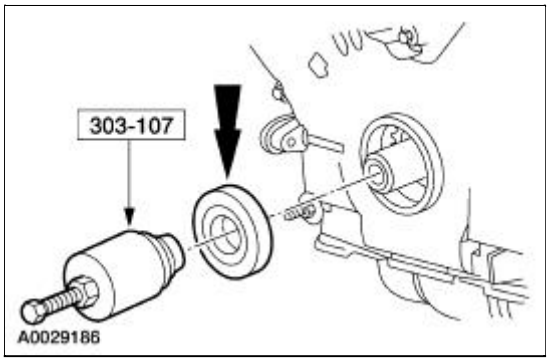
Material

Item	Specification
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

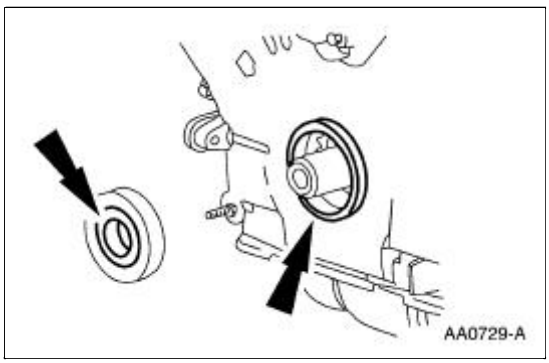
1. Remove the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.

2. Using the special tool, remove the crankshaft front oil seal.

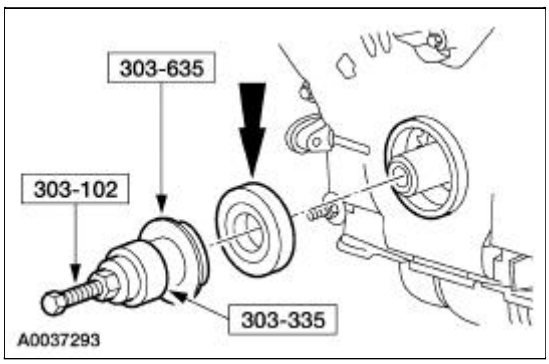


Installation

1. Lubricate the engine front cover and the crankshaft front oil seal inner lip with clean engine oil.



2. Using the special tools, install the crankshaft front oil seal into the engine front cover.



3. Install the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.

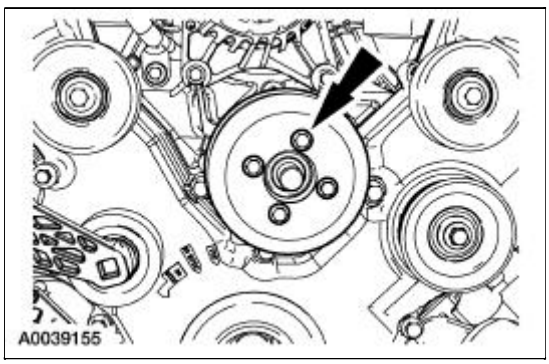
Engine Front Cover

Material

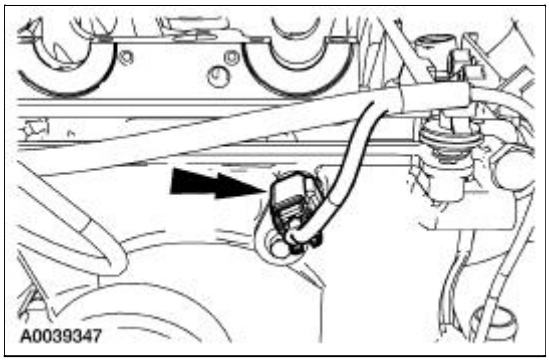
Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

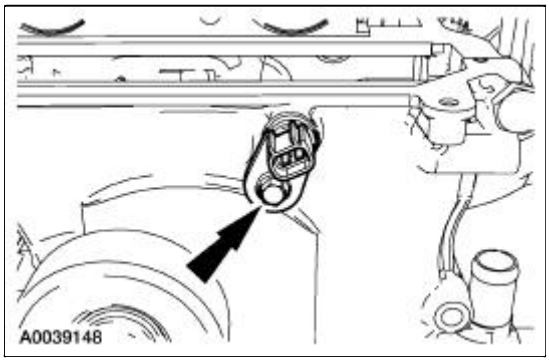
1. Remove the LH and RH valve covers. For additional information, refer to Valve Cover LH and Valve Cover RH in this section.
2. Remove the cooling fan and fan shroud. For additional information, refer to Section 303-03 .
3. Remove the bolts and the water pump pulley.



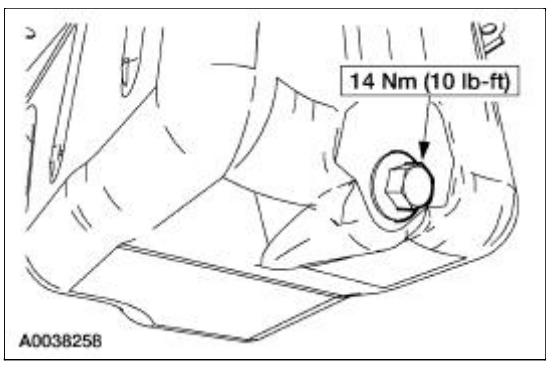
4. Remove the power steering pump. For additional information, refer to Section 211-02 .
5. Remove the crankshaft front oil seal. For additional information, refer to Crankshaft Front Oil Seal in this section.
6. Disconnect the camshaft position (CMP) sensor electrical connector.



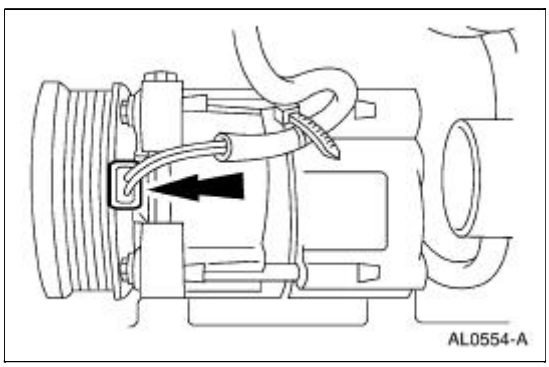
7. Remove the bolt and the CMP sensor.



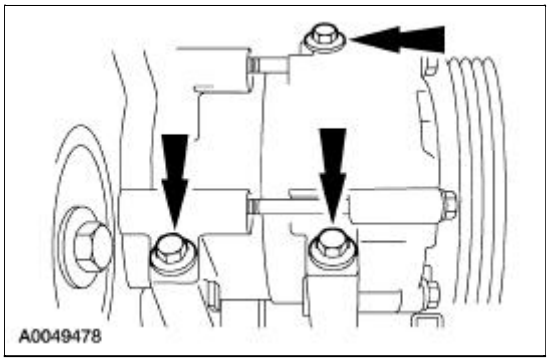
8. Remove the drain plug and drain the engine oil.
    - Install the drain plug after the oil has finished draining.



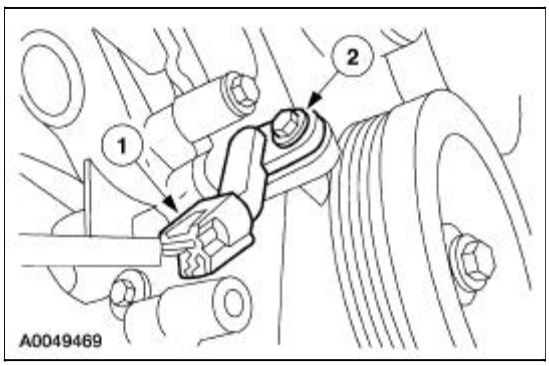
9. Disconnect the A/C compressor electrical connector.



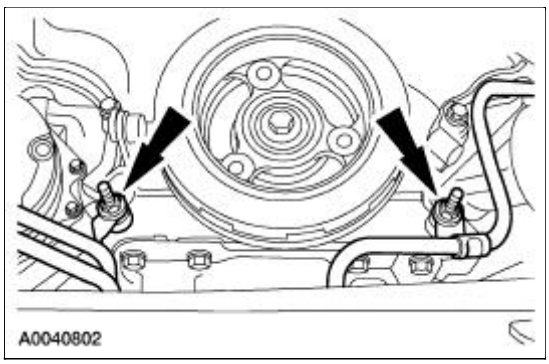
10. Remove the bolts and position the A/C compressor aside.



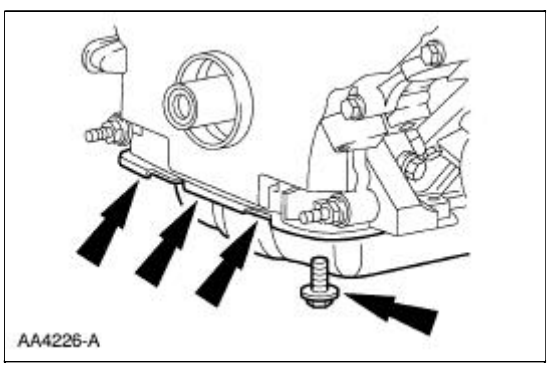
11. Remove the crankshaft position (CKP) sensor.
    1. Disconnect the electrical connector.
    2. Remove the bolt and the sensor.



12. Remove the nuts and detach the power steering and transmission cooler tube brackets.

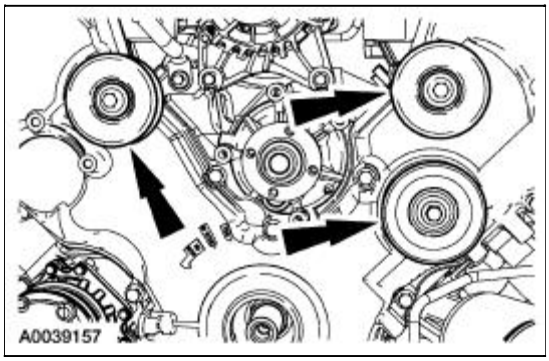


13. Remove the bolts.

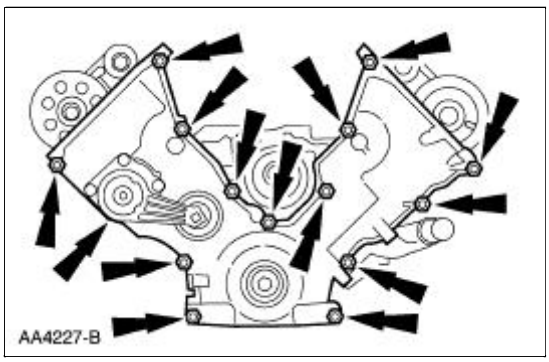


14. Lower the vehicle.

15. Remove and the drive belt idler pulleys.



16. Remove the bolts, the studbolts, the engine front cover and the gaskets.



17. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs, or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

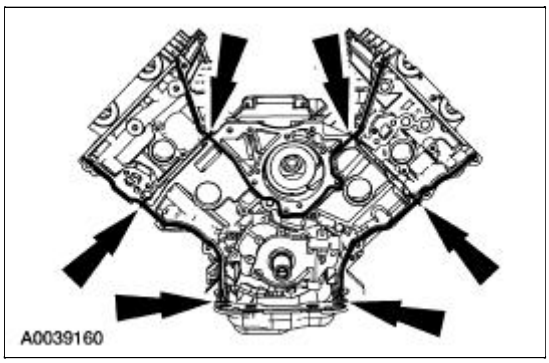
    CAUTION: Put shop towels into the oil pan opening to prevent debris from falling into the oil pan.

    Clean the gasket mating surfaces with metal surface cleaner.

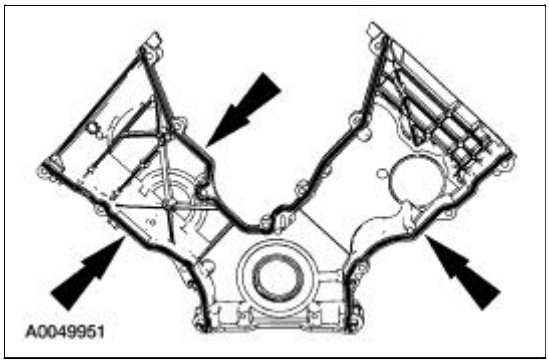
Installation

NOTE: If the front cover and gasket are not secured within four minutes, the sealant must be removed and the sealing surface cleaned with metal surface cleaner.

1. Apply an 8 mm (0.32 in) bead of sealant in the locations shown.

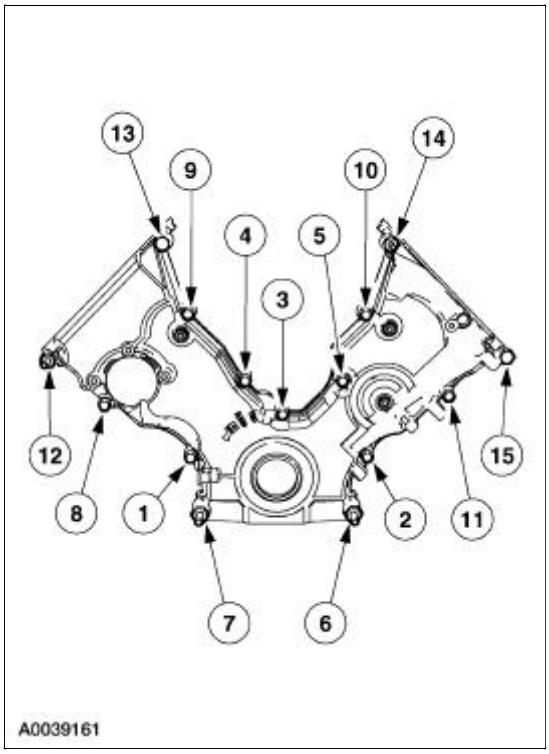


2. Position the gaskets.

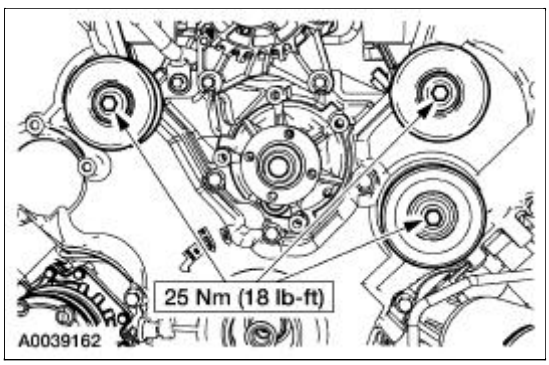


3. Position the engine front cover and install the bolts and the studs in three stages:
   Stage 1: Tighten numbers one through five to 25 Nm (18 lb-ft).
   Stage 2: Tighten numbers six and seven to 50 Nm (37 lb-ft).
   Stage 3: Tighten numbers 11 through 15 to 25 Nm (18 lb-ft).

Item	Part Number	Description
1	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
2	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
3	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
4	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
5	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
6	N808529	Stud, Hex-Head Pilot, M10 x 1.5 x 30
7	N808529	Stud, Hex-Head Pilot, M10 x 1.5 x 30
8	N806177	Bolt, Hex-Head Flange, M8 x 1.25 x 50
9	N806177	Bolt, Hex-Head Flange, M8 x 1.25 x 50
10	N806177	Bolt, Hex-Head Flange, M8 x 1.25 x 50
11	N806300	Stud Hex Shoulder Pilot, M8 x 1.25 x 65 - M8 x 1.25 x 27
12	N806300	Stud Hex Shoulder Pilot, M8 x 1.25 x 65 - M8 x 1.25 x 27
13	W705386	Bolt Hex Shoulder Pilot, M8 x 1.25 x 65
14	N806300	Stud Hex Shoulder Pilot, M8 x 1.25 x 65 - M8 x 1.25 x 27
15	W705386	Bolt Hex Shoulder Pilot, M8 x 1.25 x 65

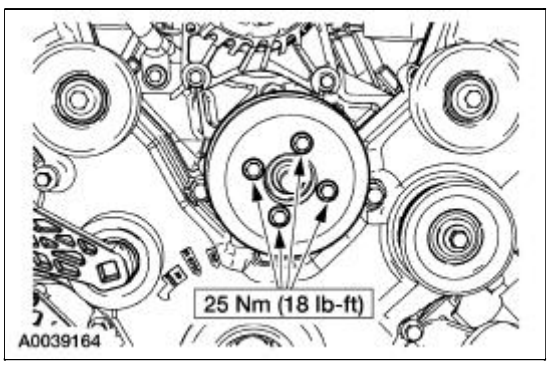


4. Install the drive belt idler pulleys and the bolts.



5. **NOTE:** Hold the water pump pulley with a suitable tool to prevent rotation.

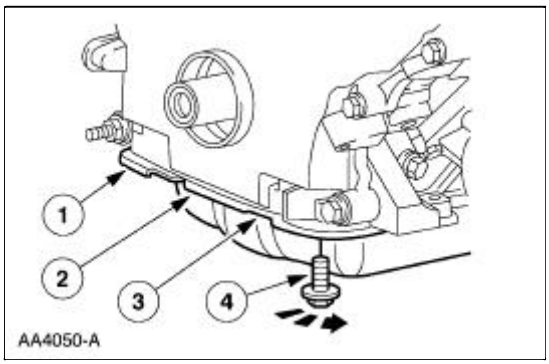
   Install the water pump pulley and install the bolts.



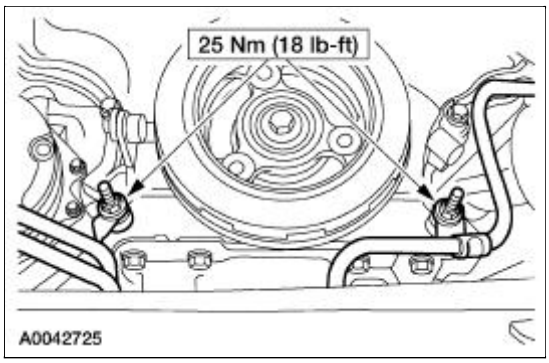
6. Raise the vehicle on a hoist.

7. Tighten the bolts in three stages in the sequence shown:
   - Stage 1: Tighten to 2 Nm (18 lb-in).

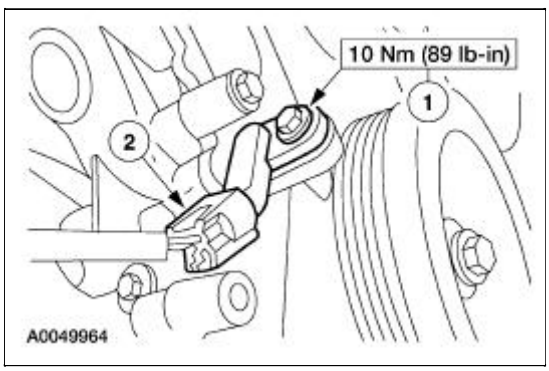
- Stage 2: Tighten to 20 Nm (15 lb-ft).
- Stage 3: Tighten an additional 90 degrees.



8. Position the transmission cooler tube and the power steering hose brackets, and install the nuts.



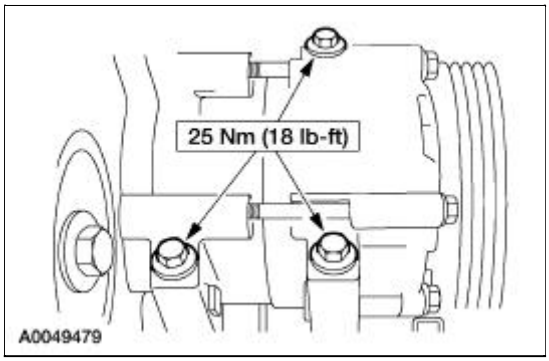
9. Install the CKP sensor.
    1. Install the sensor and the bolt.
    2. Connect the electrical connector.



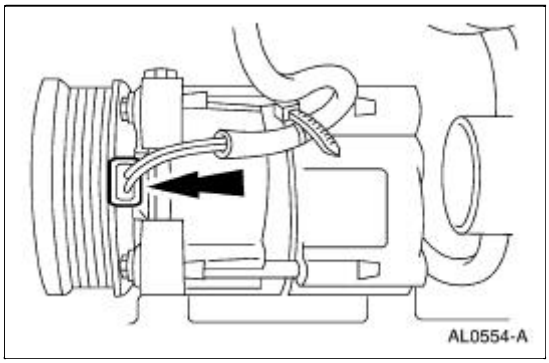
10. Install the crankshaft front oil seal. For additional information, refer to Crankshaft Front Oil Seal in this section.

11. Install the power steering pump. For additional information, refer to Section 211-02

12. Position the A/C compressor and the bolts.

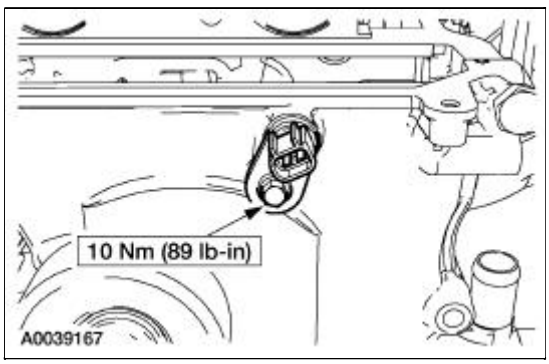


13. Connect the A/C compressor electrical connector.

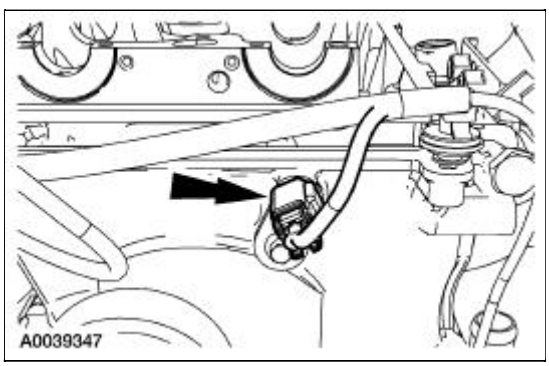


14. Install a new oil filter.

15. Install the CMP sensor and the bolt.



16. Connect the CMP sensor electrical connector.



17. Install the cooling fan and fan shroud. For additional information, refer to Section 303-03 .

18. Install the left and right valve cover. For additional information, refer to Valve Cover LH or Valve Cover RH in this section.

19. Fill the engine with clean engine oil.

Timing Drive Components

Special Tool(s)

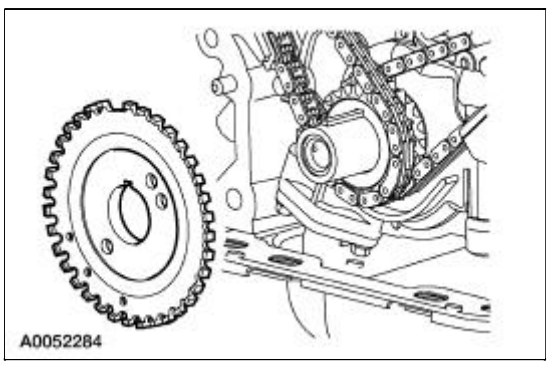
 ST1681-A	Alignment Plate, Camshaft 303-445 (T93P-6256-A)
 ST1335-A	Holding Tool, Crankshaft 303-448 (T93P-6303-A)

Removal

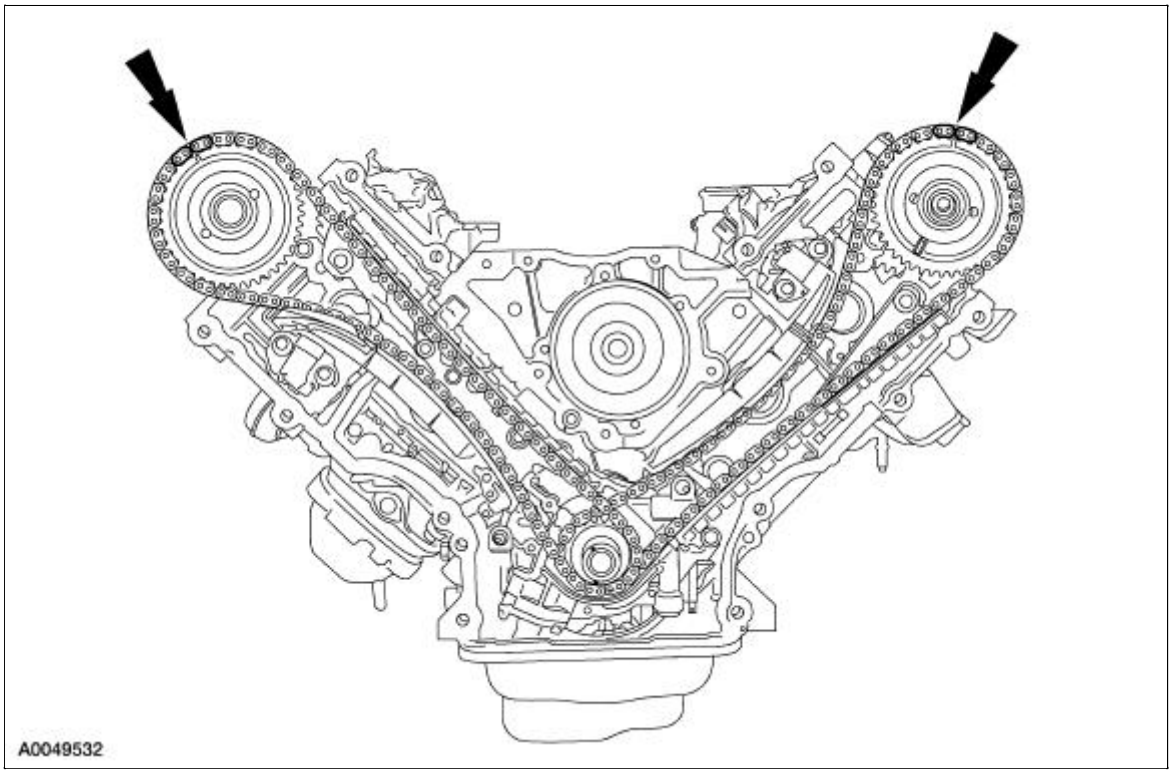
CAUTION: Since the engine is not free-wheeling, if the crankshaft or the camshafts are moved in any manner during removal and installation, the crankshaft and the camshafts must be re-synchronized.

1. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.

2. Remove the crankshaft sensor ring from the crankshaft.

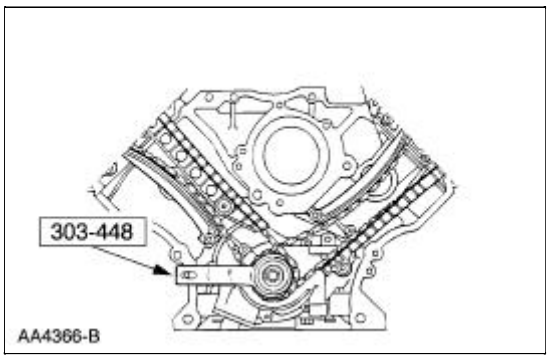


3. Rotate the crankshaft until the timing mark on the RH camshaft sprocket is approximately at the 11 o'clock position, and the timing mark on the LH camshaft sprocket is approximately at the 12 o'clock position.

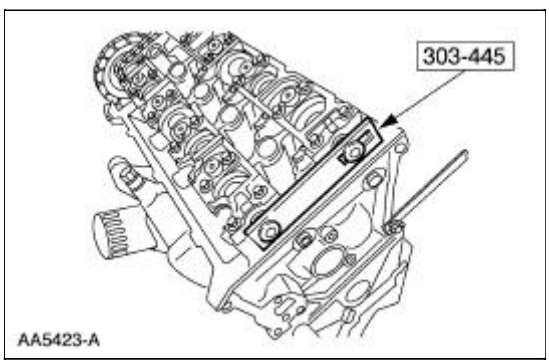


4. **CAUTION: Unless otherwise instructed, at no time when the timing chains are removed and the cylinder heads are installed is the crankshaft or the camshaft to be rotated. Severe piston and valve damage will occur.**

   Using the special tool, position the crankshaft as shown.

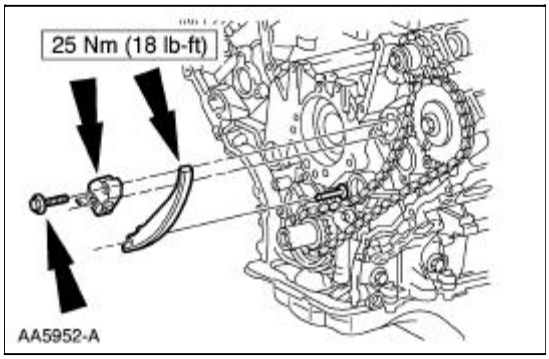


5. Install the special tool.



6. **NOTE:** LH shown; RH similar.

Remove the two bolts, the timing chain tensioner and tensioner arm.

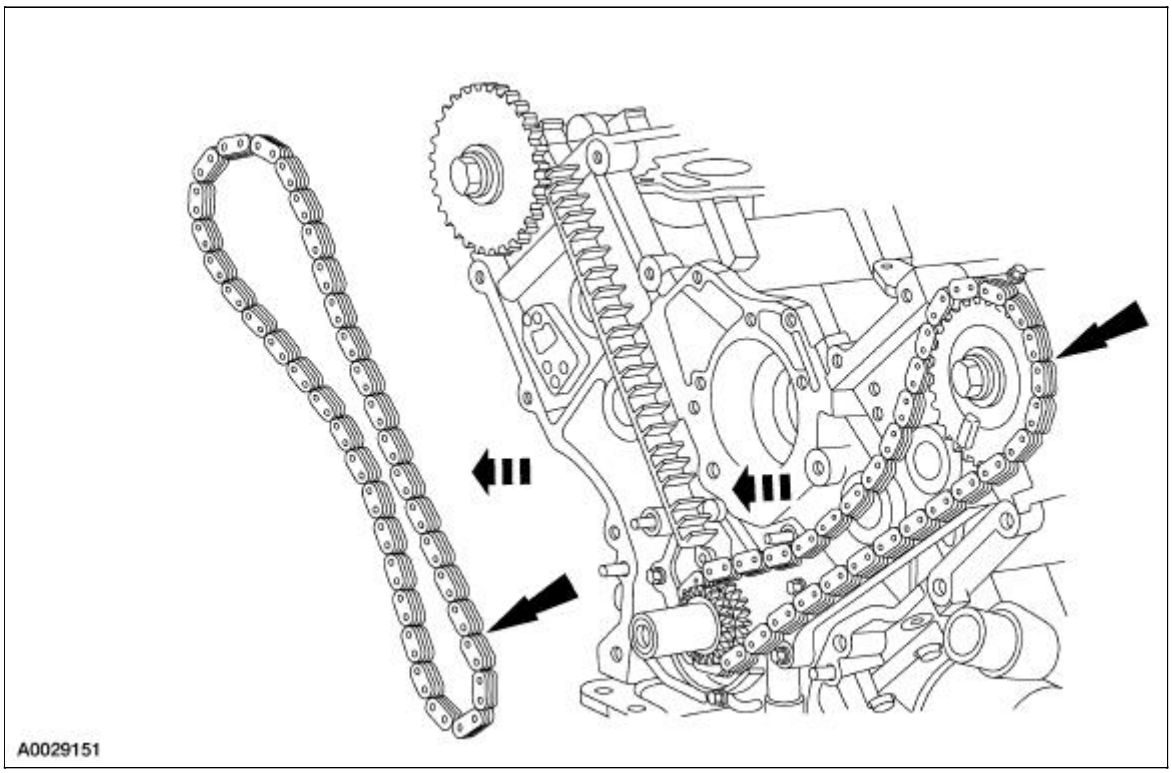


7. **CAUTION: Unless otherwise instructed, at no time when the timing chains are removed and the cylinder heads are installed is the crankshaft or the camshaft to be rotated. Severe piston and valve damage will occur.**

   CAUTION: Do not remove the special tool from the camshafts.

   Remove the LH and RH timing chains and the crankshaft sprockets.

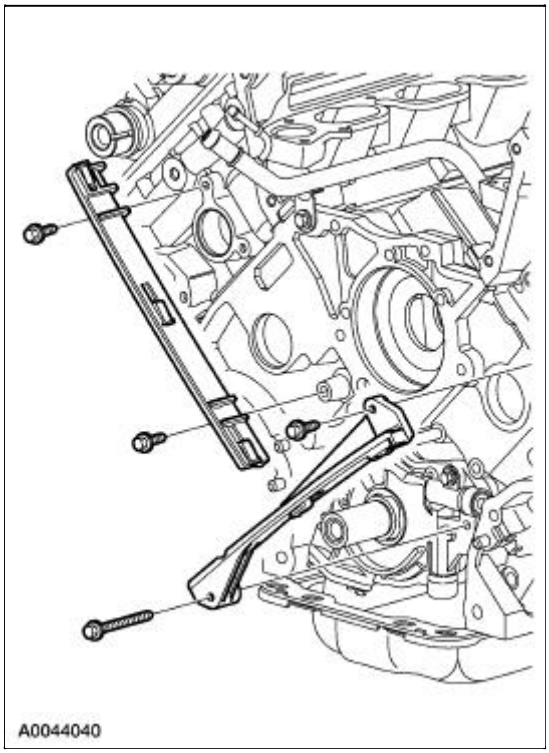
   - Remove the special tool from the crankshaft.
   - Remove the timing chains from the camshaft sprockets.
   - Remove the right and left timing chains and the crankshaft sprocket from the crankshaft.



8. **CAUTION: The bolts are different lengths and must be returned to their original location.**

   NOTE: LH shown; RH similar.

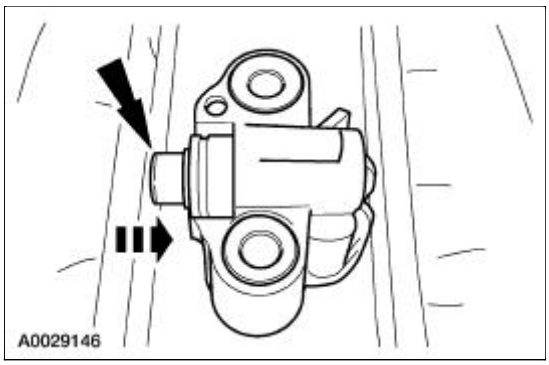
Remove the bolts and the timing chain guides.



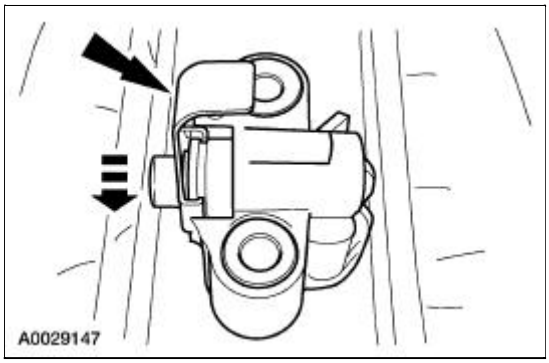
Installation

1. **CAUTION: Timing chain procedures must be followed exactly or damage to the pistons or valves will result.**

   Compress the tensioner plunger, using the edge of a soft-jawed vise.

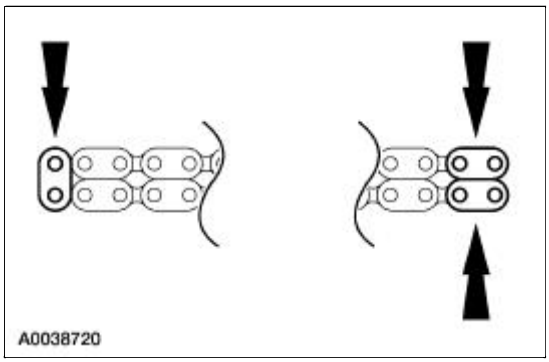


2. Install the tensioner retaining clip.
   - Remove the tensioner from the vise.

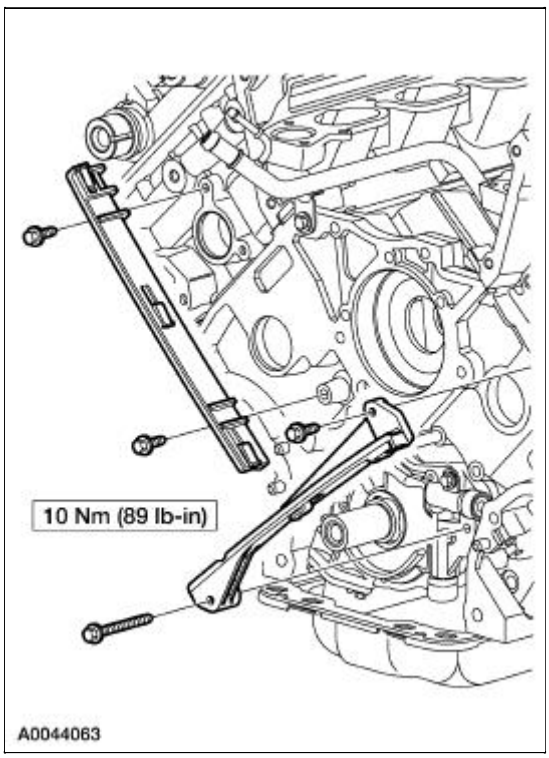


3. **NOTE:** There are 61 links in the timing chain.

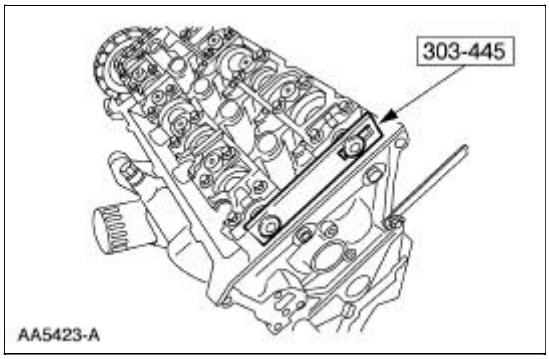
   If the copper links are not visible, mark two links on one end and one link on the other end, and use as timing marks.



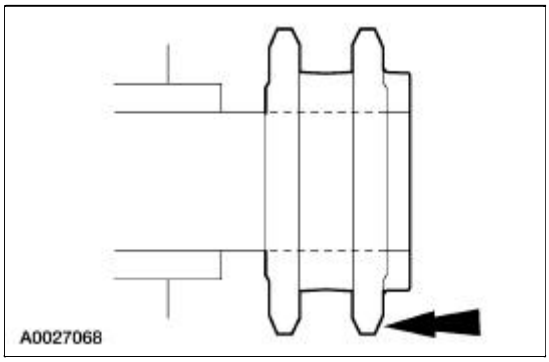
4. Install the timing chain guides.



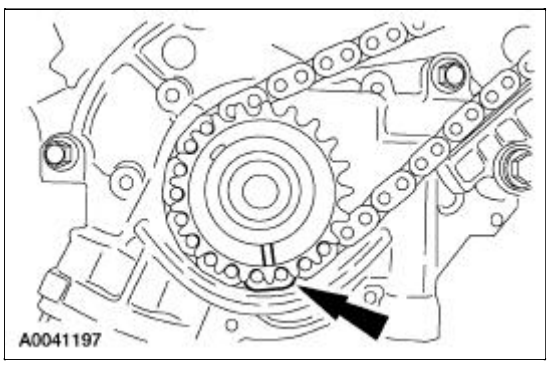
5. Remove the special tool.



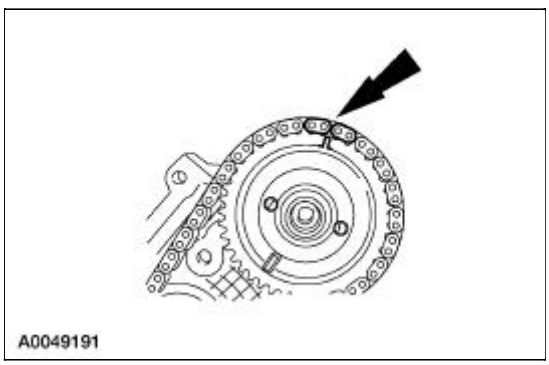
6. Position the crankshaft sprocket with the long hub facing outward.



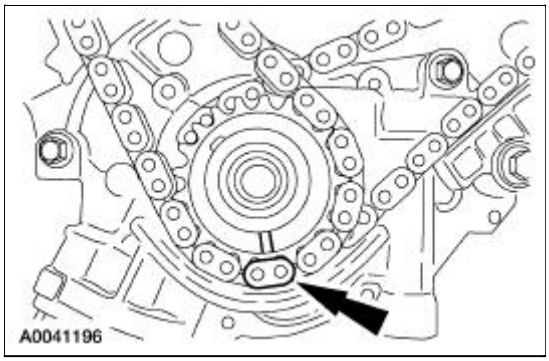
7. Install the LH timing chain onto the crankshaft sprocket, aligning the one copper (marked) link on the timing chain with the slot on the crankshaft sprocket.



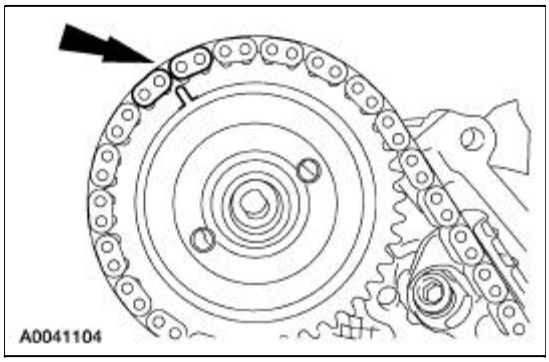
8. Position the LH timing chain on the camshaft sprocket with the two copper (marked) chain links and the camshaft sprocket timing mark aligned.



9. Position the RH (outer) timing chain on the crankshaft sprocket, aligning the copper (marked) link with the timing mark on the sprocket.

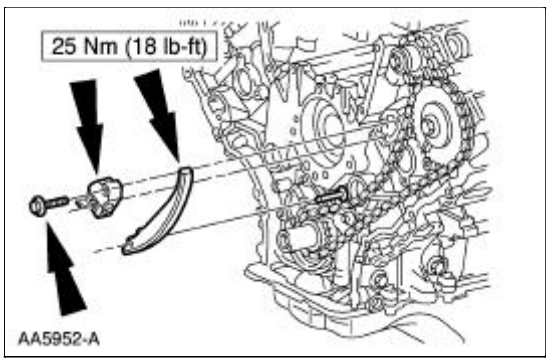


10. Position the RH timing chain on the camshaft sprocket. Make sure the two copper (marked) links align with the camshaft sprocket timing mark.

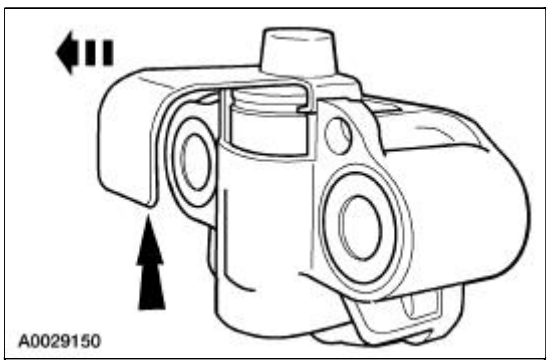


11. **NOTE:** LH shown; RH similar.

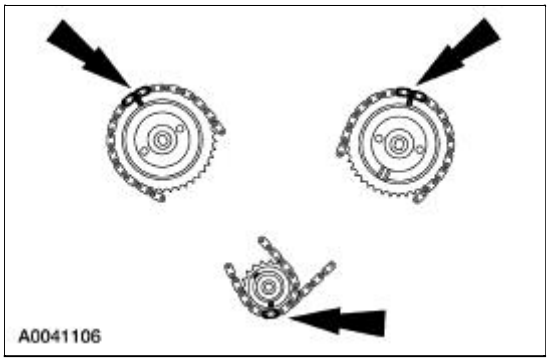
    Position the tensioner arms and tensioners, and install the bolts.



12. Remove the tensioner retaining clip.

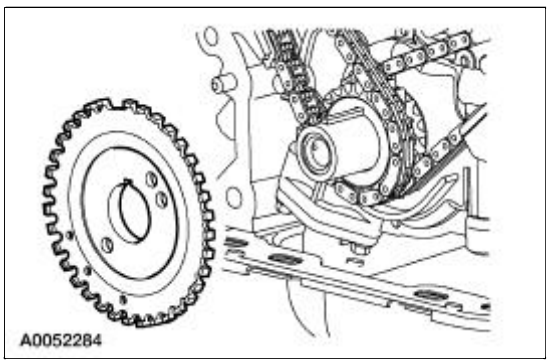


13. As a post-check, verify correct alignment of all timing marks.



14. Remove the special tool.

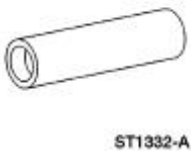
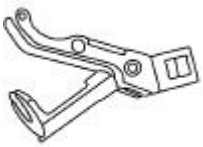
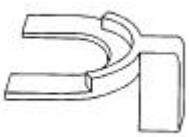
15. Position the crankshaft sensor ring on the crankshaft.



16. Install the engine front cover. For additional information, refer to Engine Front Cover in this section.

Valve Seals

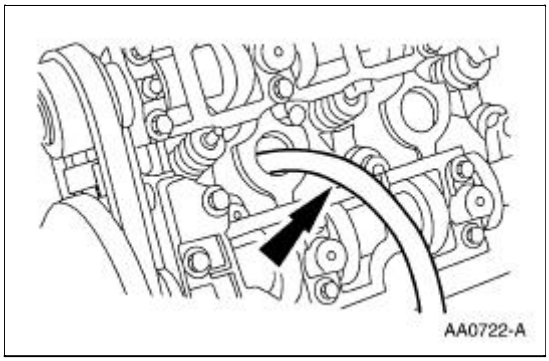
Special Tool(s)

 ST1718-A	Compressor, Valve Spring 303-452 (T93P-6565-AR)
 ST1332-A	Installer, Valve Stem Oil Seal 303-383 (T91P-6571-A)
 ST1693-A	Compressor, Valve Spring 303-567 (T97P-6565-AH)
 ST1331-A	Compressor Spacer, Valve Spring 303-382 (T91P-6565-AH)

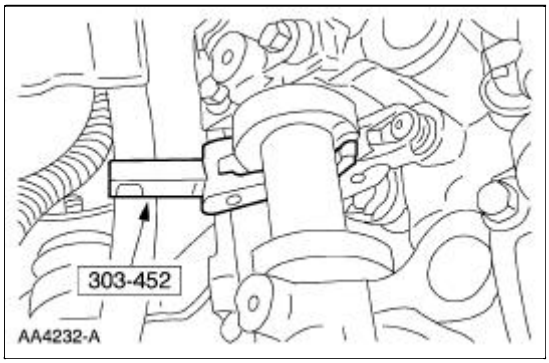
Removal

1. Remove the roller followers. For additional information, refer to Camshaft Roller Follower in this section.
2. Remove the spark plugs. For additional information, refer to Section 303-07B .
3. Position the piston of the cylinder being serviced at the bottom of the stroke.
4. **CAUTION: If air pressure has forced the piston to the bottom of the cylinder, any loss of air pressure will allow the valve to fall into the cylinder. If air pressure must be removed, support the valve prior to removal.**

   Use compressed air in the cylinder to hold both valves in position.

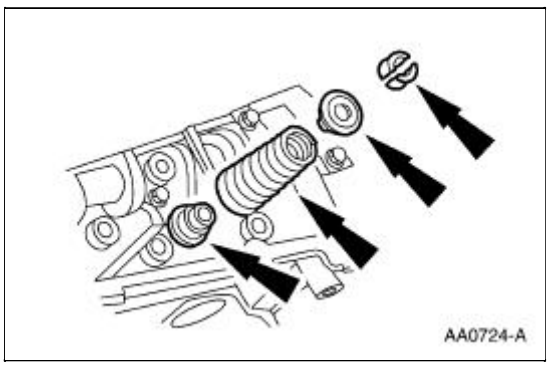


5. Using the special tool, compress the intake valve spring.

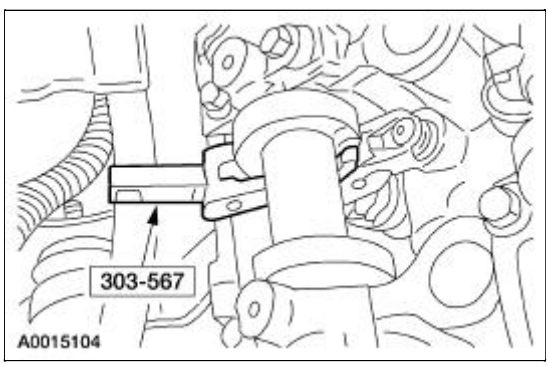


6. **NOTE:** Valve stem seals should be visually inspected if new seals are not installed.

   Remove the valve spring retainer keys, the valve spring retainer, the valve spring and the valve stem seal.

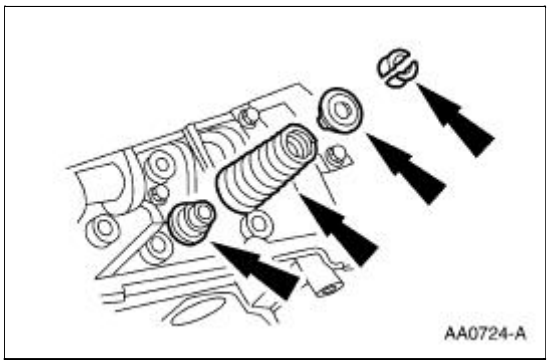


7. Using the special tool, compress the exhaust valve spring.



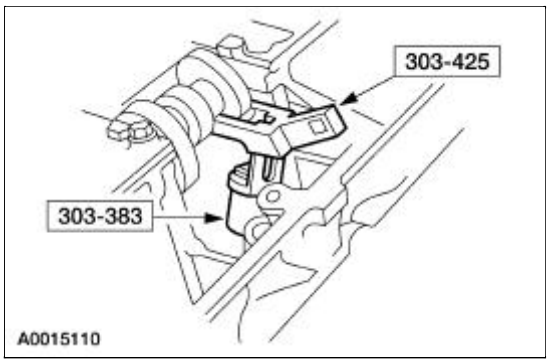
8. **NOTE:** Valve stem seals should be visually inspected if new seals are not installed.

Remove the valve spring retainer keys, the valve spring retainer, the valve spring and the valve stem seal.

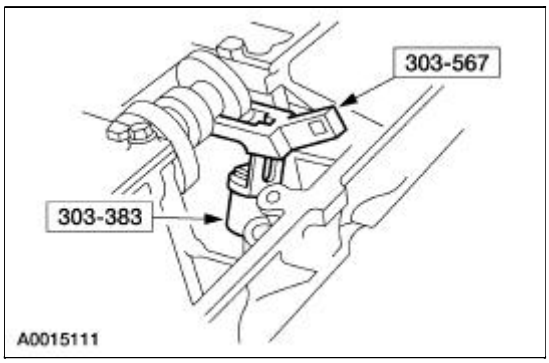


Installation

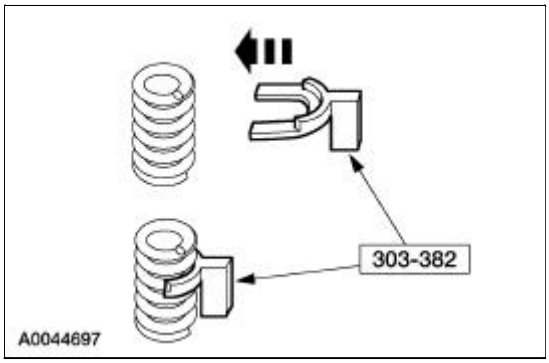
1. Using the special tools, install the new intake valve stem seals.



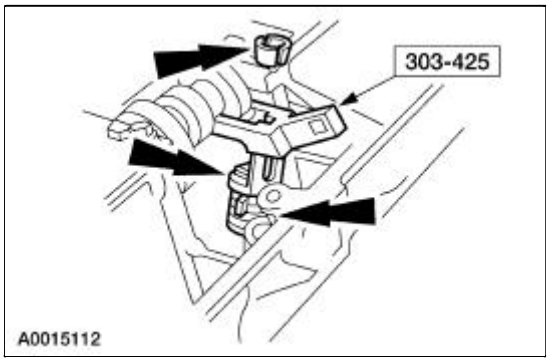
2. Using the special tools, install the new exhaust valve stem seals.



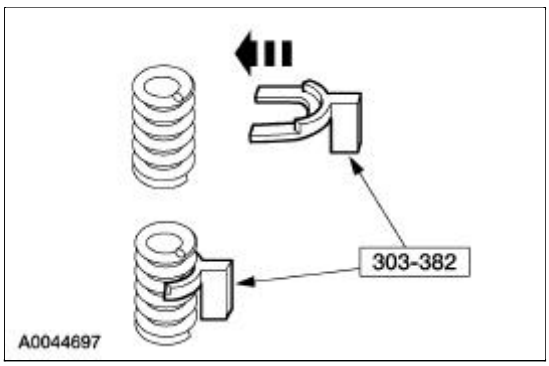
3. Install the special tool between the valve spring coils to protect the intake valve stem seal from damage.



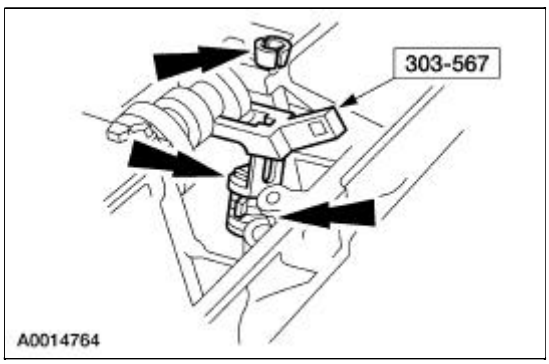
4. Using the special tool, install the intake valve spring, the spring retainer and the valve spring retainer keys.



5. Install the special tool between the valve spring coils to protect the intake valve stem seal from damage.



6. Using the special tool, install the exhaust valve spring, the spring retainer and the valve spring retainer keys.



7. Remove the compressed air hose from the cylinder.

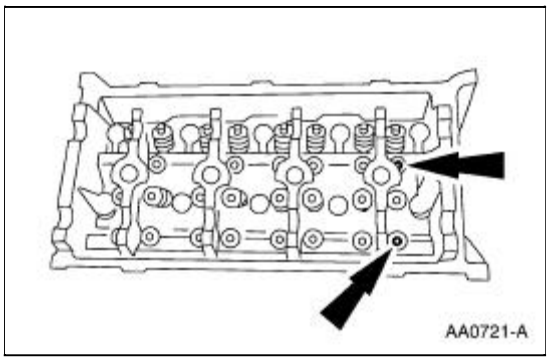
8. Install the spark plugs. For additional information, refer to Section 303-07B .

9. Install the roller followers. For additional information, refer to Camshaft Roller Follower in this section.

Hydraulic Lash Adjusters

Removal and Installation

1. Remove the roller followers. For additional information, refer to Camshaft Roller Follower in this section.
2. Remove the 16 hydraulic lash adjusters.



3. Inspect the roller followers. For additional information, refer to Section 303-00 .
4. To install, reverse the removal procedure.

Camshaft Roller Follower

Special Tool(s)

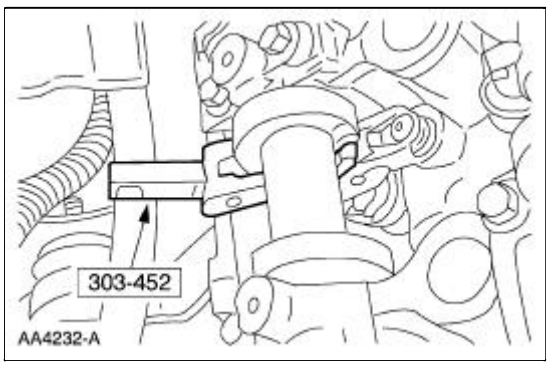
 ST1718-A	Compressor, Valve Spring 303-452 (T93P-6565-AR)

Removal and Installation

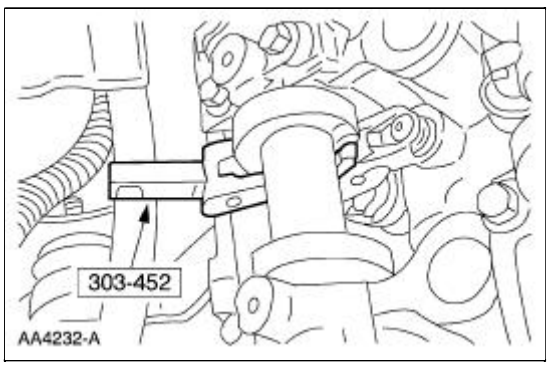
1. Remove the left and right valve cover (6582). For additional information, refer to Valve Cover RH and Valve Cover LH in this section.

2. Position the piston of the cylinder being repaired at the bottom of the stroke and camshaft lobe at base circle.

3. Using the special tool, compress the intake valve spring and remove the roller follower.



4. Using the special tool, compress the exhaust valve spring and remove the roller follower.

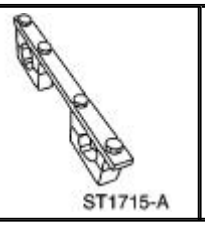


5. Repeat Steps 2, 3 and 4 to remove all the necessary roller followers. Inspect roller finger followers and camshafts. For additional information, refer to Section 303-00 .

6. To install, reverse the removal procedure.

Camshaft

Special Tool(s)

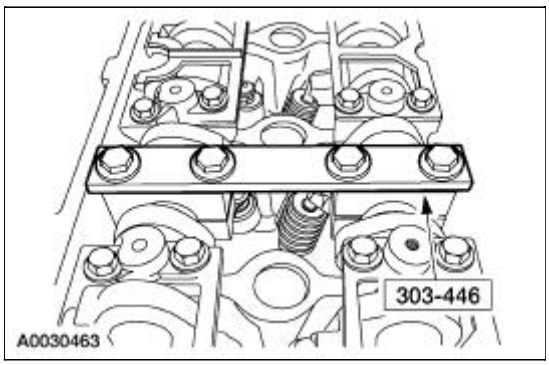
 ST1715-A	Holding Tool, Camshaft 303-446 (T93P-6256-AHR)

Material

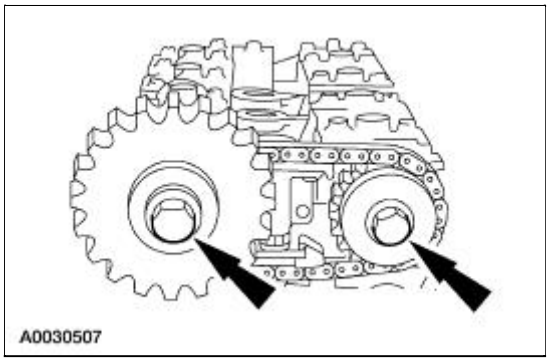
Item	Specification
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

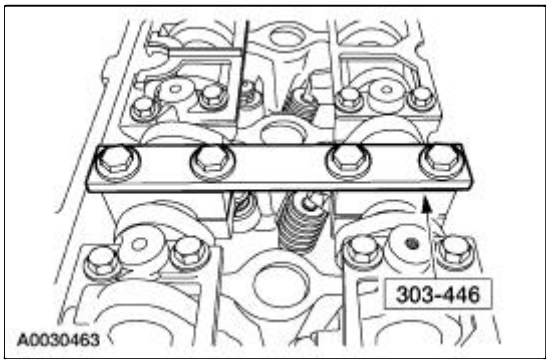
1. Remove the roller followers. For additional information, refer to Camshaft Roller Follower in this section.
2. Remove the LH timing chain for the LH side and both timing chains for the RH side. For additional information, refer to Timing Drive Components in this section.
3. Install the special tool.



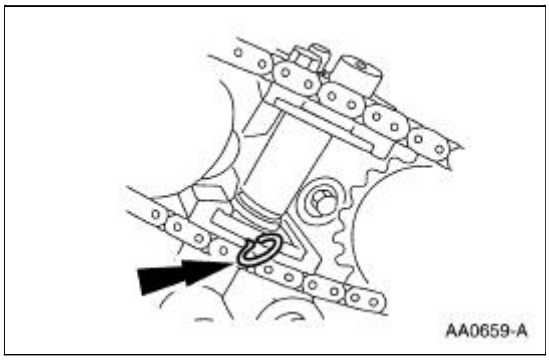
4. Remove the exhaust camshaft sprocket and the intake camshaft bolt, washer and spacer.



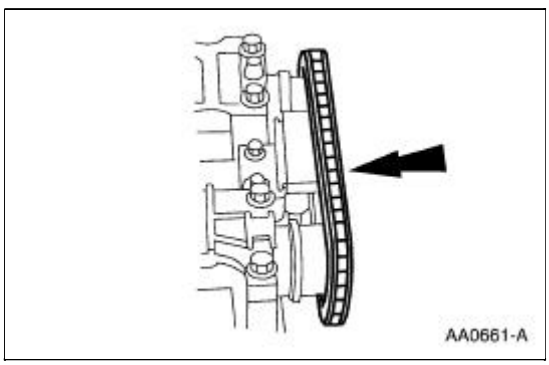
5. Remove the special tool.



6. Compress the tensioner and install a lock pin.

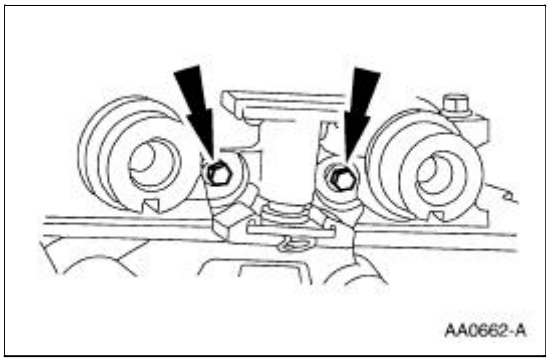


7. Remove the timing chain, the sprocket, and intake camshaft sprocket spacer.



8. **NOTE:** LH shown; RH similar.

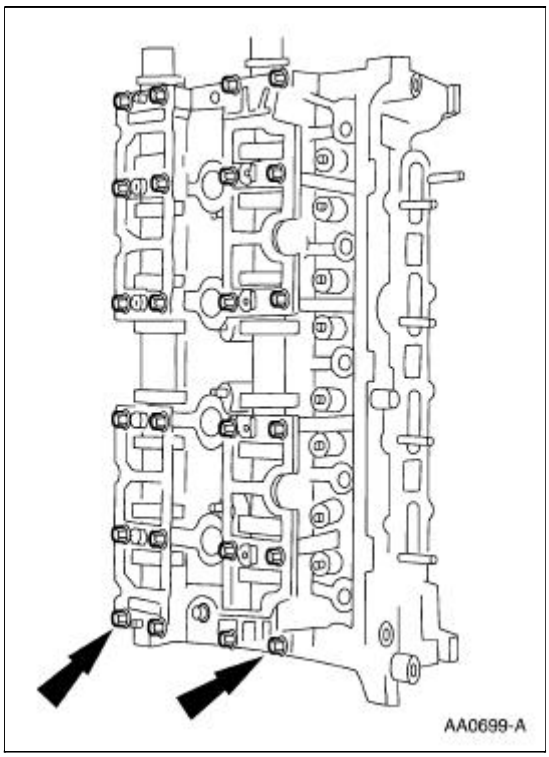
   Remove the bolts.



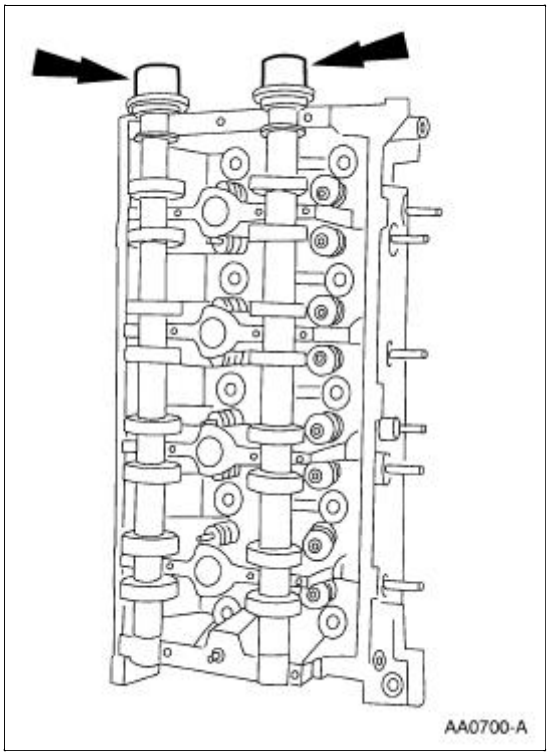
9. **CAUTION: The outer bolts on the outer cam bearing cap (exhaust) are longer and must be returned to the same location or engine damage may occur.**

   NOTE: Identify the camshaft to cylinder head location. Caps are not interchangeable.

   Remove the bolts and the camshaft bearing cap assemblies.



10. Remove the camshafts (6250).

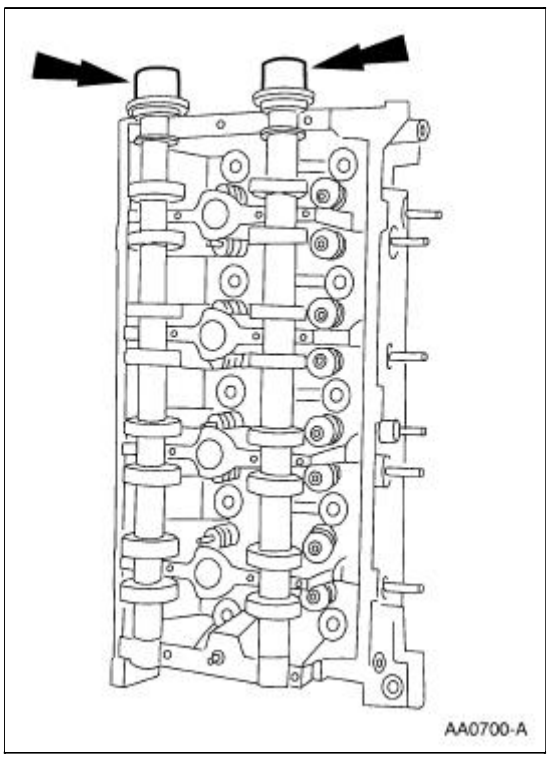


Installation

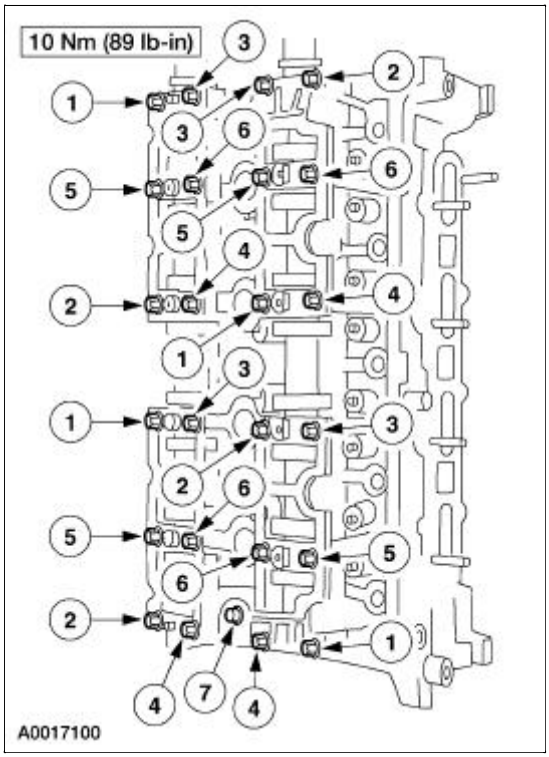
1. **NOTE:** LH shown; RH similar.

   Install the camshafts.

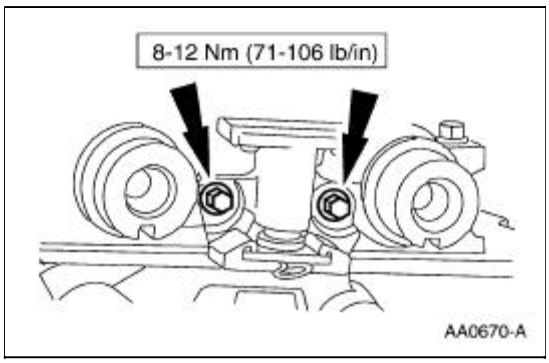
   - Lubricate the camshafts with clean engine oil.



2. Install the camshaft bearing cap assemblies.



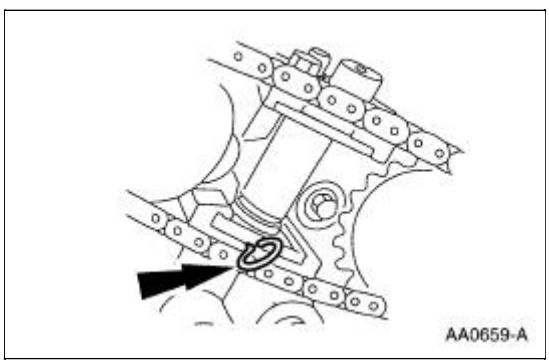
3. Install the bolts.



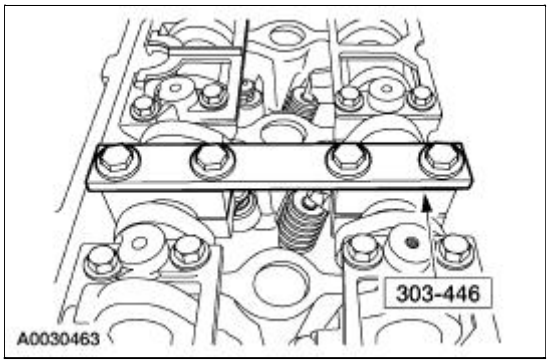
4. **CAUTION: Timing marks must be at 12 o'clock and indexed at 6 o'clock.**

   Install the camshaft sprockets and the chain as an assembly.

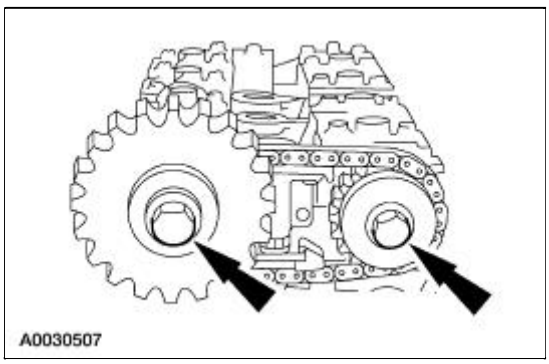
5. Remove the lockpin from the chain tensioner.



6. Install the special tool.



7. Tighten the exhaust camshaft sprocket and the intake camshaft bolt washer and spacer in two stages:
   - Stage 1: Tighten to 40 Nm (30 lb-ft).
   - Tighten an additional 90 degrees.



8. Remove the special tool.

9. Install the left timing chain for the left side or both timing chains for the right side. For additional information, refer to Timing Drive Components in this section.

10. Install the roller followers. For additional information, refer to Camshaft Roller Follower in this section.

Exhaust Manifold RH

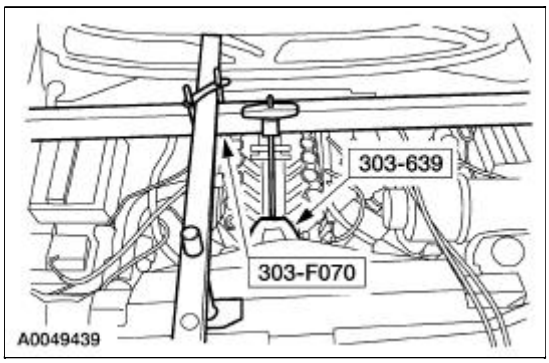
Special Tool(s)

 ST2176-A	3-Bar Engine Support 303-F070
 ST2592-A	Support Bracket, Engine 303-639

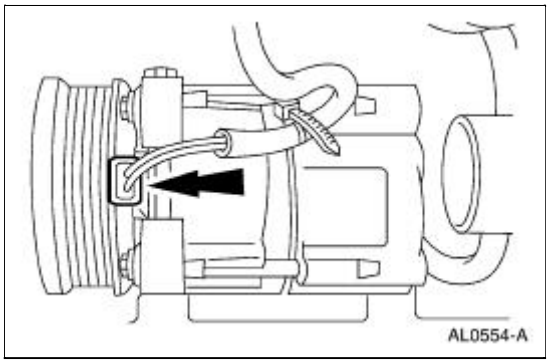
Removal and Installation

1. Remove the lower intake manifold. For additional information, refer to Section 303-01B .
2. **NOTE:** The alternator bolts may be used to attach the engine support bracket.

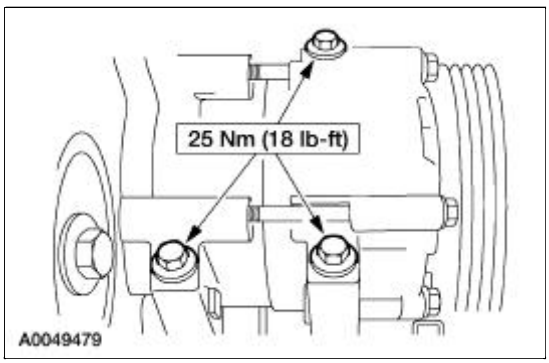
   Install the special tools and support the engine.

3. Remove the starter. For additional information, refer to Section 303-06 .
4. Remove the RH front wheel and tire assembly.
5. Remove the RH front fender splash shield.
6. Disconnect the A/C compressor electrical connector.

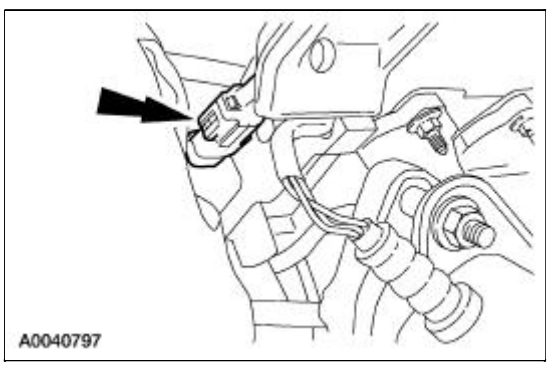


7. Remove the bolts and position the A/C compressor aside.

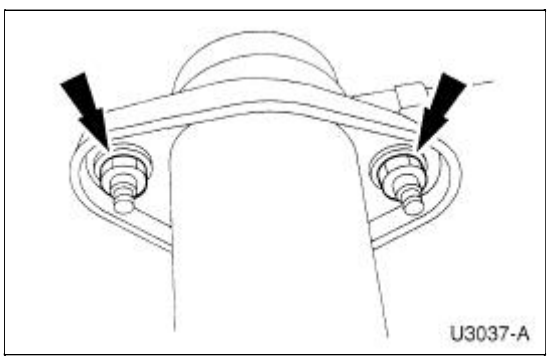


8. **NOTE:** Right side shown, left side similar.

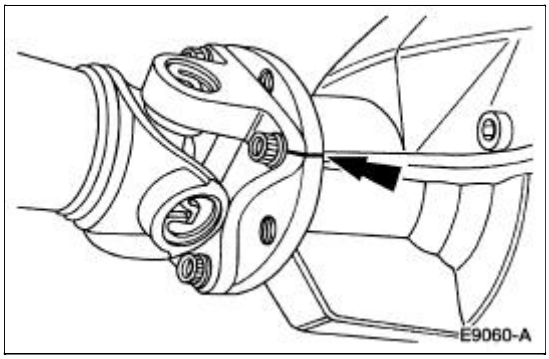
   Disconnect the heated oxygen sensor (HO2S) electrical connectors.



9. Remove the two nuts from the RH and LH Y-pipes.

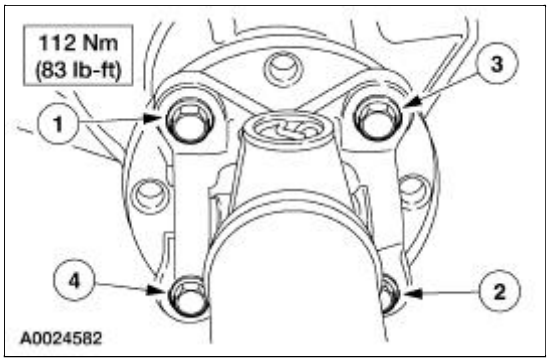


10. Index-mark the driveshaft flange yoke and the pinion flange.

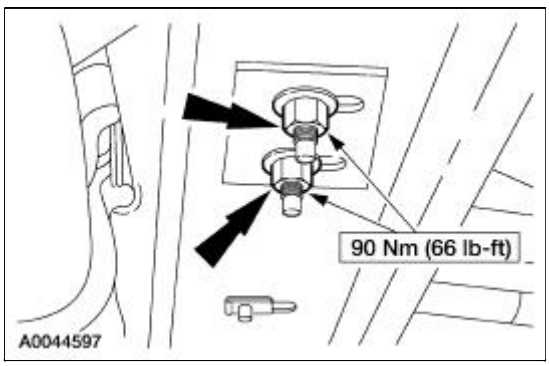


11. **CAUTION: Do not allow the driveshaft to hang unsupported. Support the driveshaft with mechanics wire.**

    Remove the four bolts.

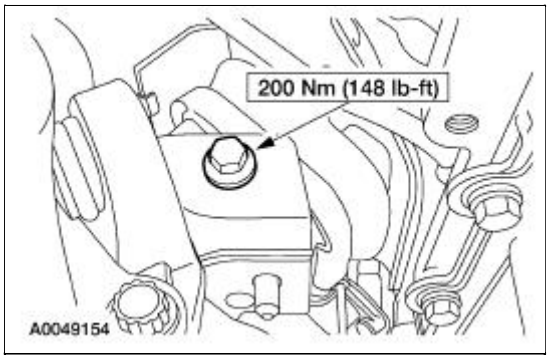


12. Remove the transmission mount-to-crossmember nuts.

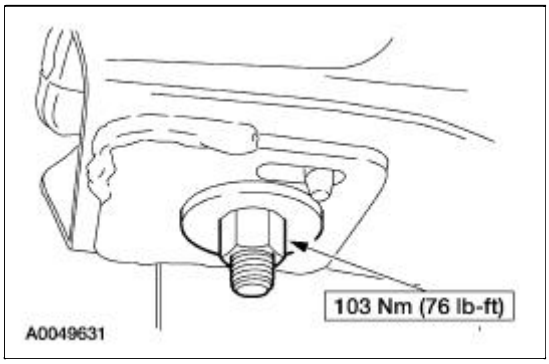


13. **NOTE:** The caged nut on the frame may break during bolt removal. If necessary, install a new nut.

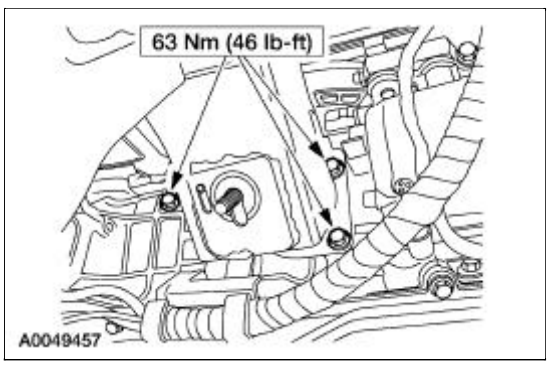
    Remove the bolt from the LH motor mount.



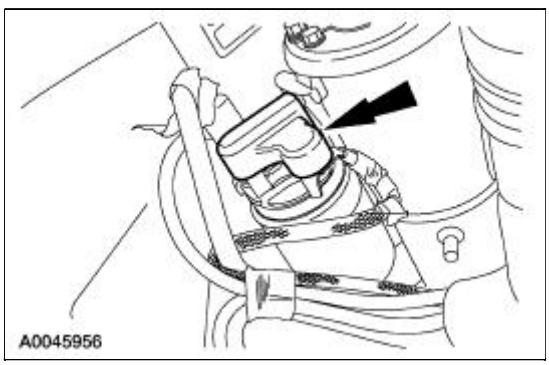
14. Remove the nut from the RH motor mount.



15. Remove the right motor mount bolts.



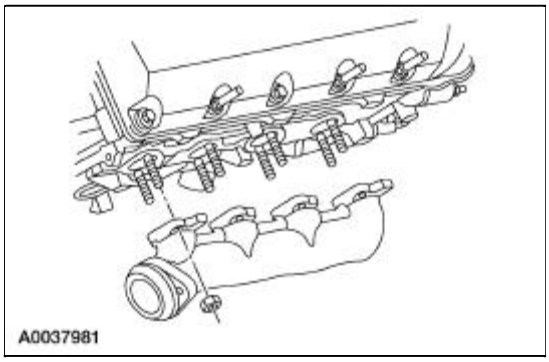
16. Remove the left motor mount bolts.



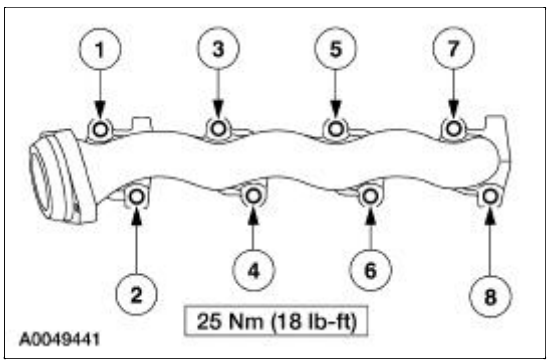
17. Lower the vehicle and raise the engine approximately 45 mm (1.8 in).

18. Remove the exhaust manifold.
    - Remove the eight nuts.

- Remove the exhaust manifold and gasket.



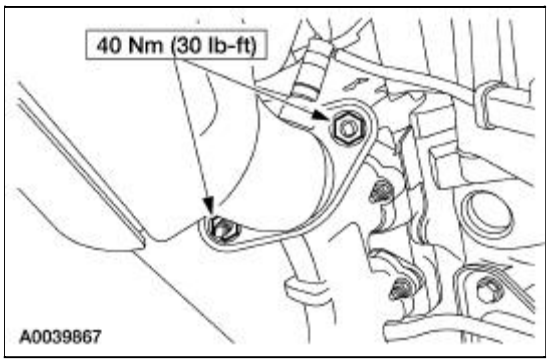
19. To install, reverse the removal procedure.
    - Install a new gasket.
    - Tighten the exhaust manifold in the sequence shown.



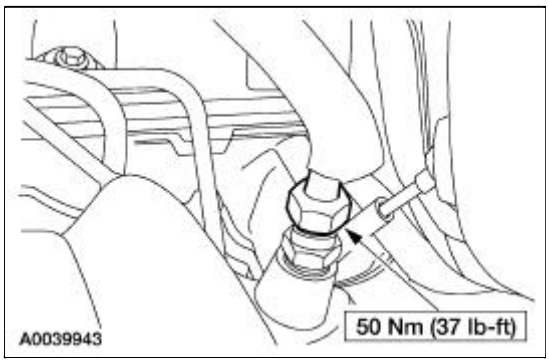
Exhaust Manifold LH

Removal and Installation

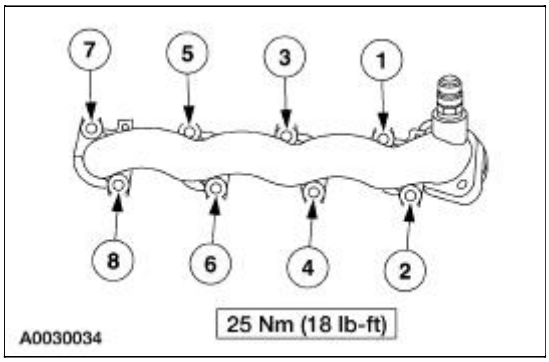
1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Remove the two nuts from the RH and LH catalytic converter assemblies and position the Y-pipe down.



3. Disconnect the EGR tube.



4. Remove the exhaust manifold.
   - Remove the eight nuts.
   - Remove the exhaust manifold and gaskets.

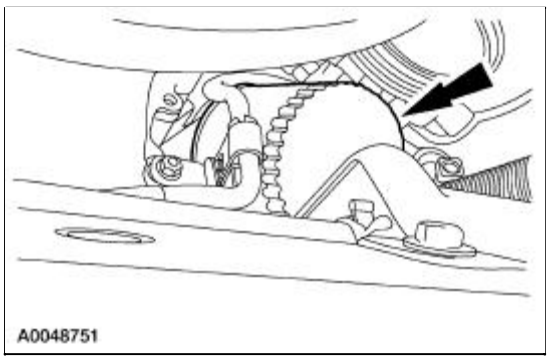


5. To install, reverse the removal procedure.

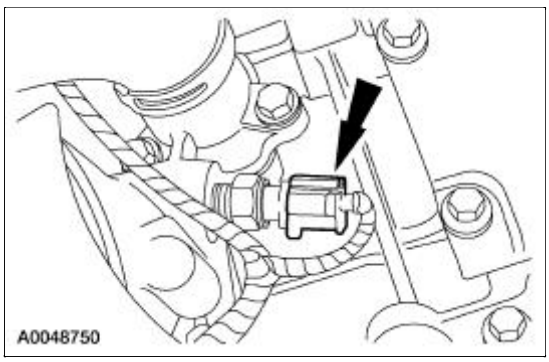
Oil Filter Adapter —4x2

Removal and Installation

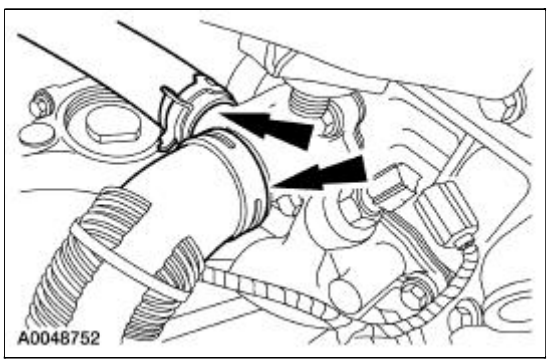
1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Drain the cooling system. For additional information, refer to Section 303-03 .
3. Remove the oil filter.



4. Disconnect the oil pressure sensor electrical connector.



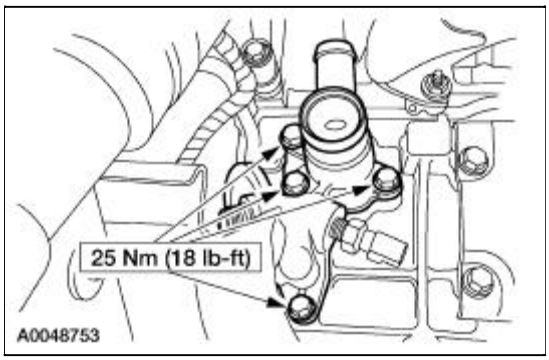
5. Slide back the clamps and disconnect the radiator lower hose and the degas hose.



6. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

Remove the four bolts and the filter adapter.

- Discard the gasket.
- Clean and inspect the mating surfaces.



7. To install, reverse the removal procedure.
    - Use a new gasket.

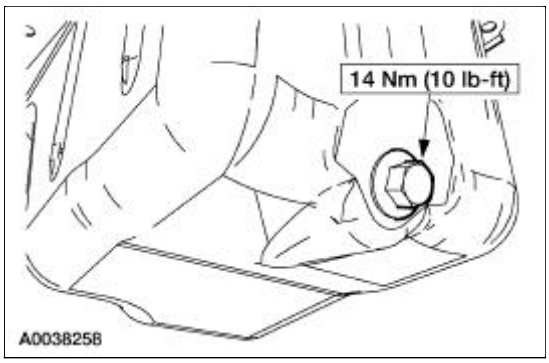
Oil Filter Adapter —4x4

Material

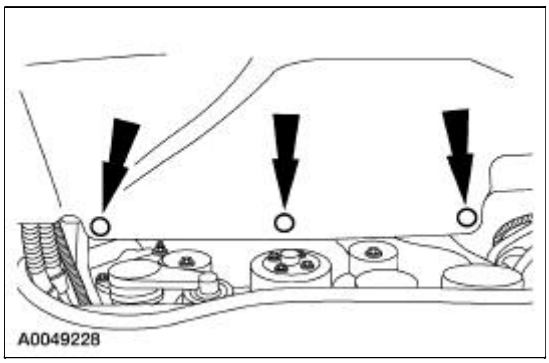
Item	Specification
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent)	WSS-M2C153-H

Removal

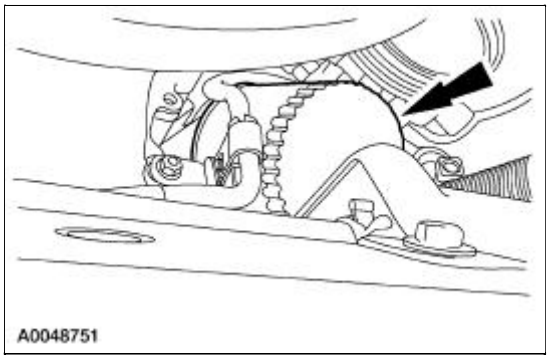
1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Drain the cooling system. For additional information, refer to Section 303-03 .
3. Remove the drain plug and drain the engine oil.
   - Install the drain plug after the oil has finished draining.



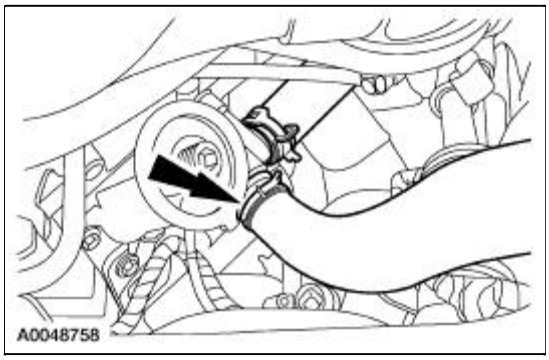
4. Remove the six pushpins and the lower radiator splash shield.



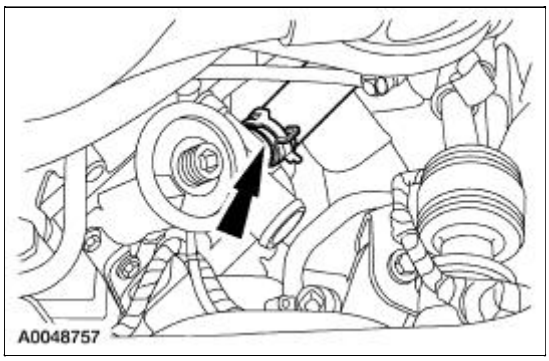
5. Remove the oil filter.



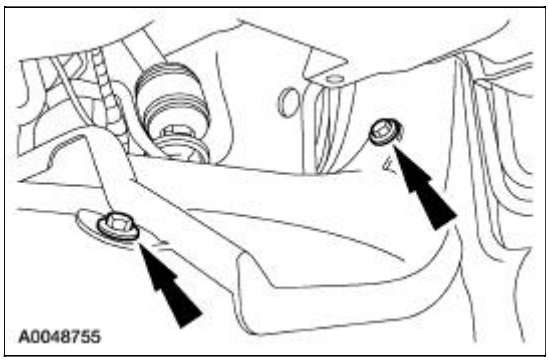
6. Slide back the hose clamp and disconnect the lower radiator hose from the oil filter adapter.



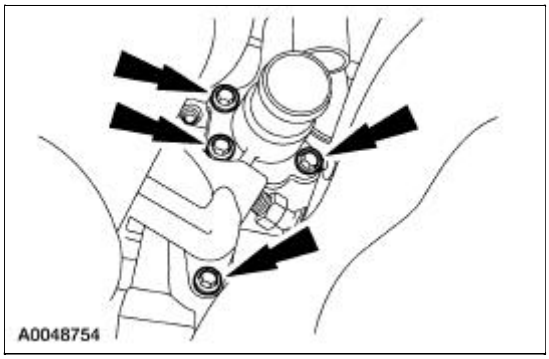
7. Slide back the hose clamp and disconnect the degas hose from the oil filter adapter.



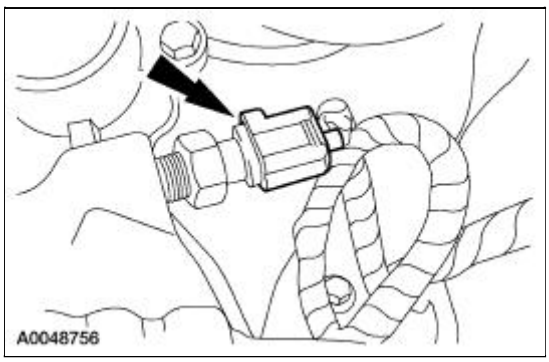
8. Remove the oil filter drip shield.



9. Remove the four bolts.



10. Remove the oil filter adapter.
    - Carefully lower the oil filter adapter and disconnect the oil pressure sender electrical connector.
    - Discard the gasket.

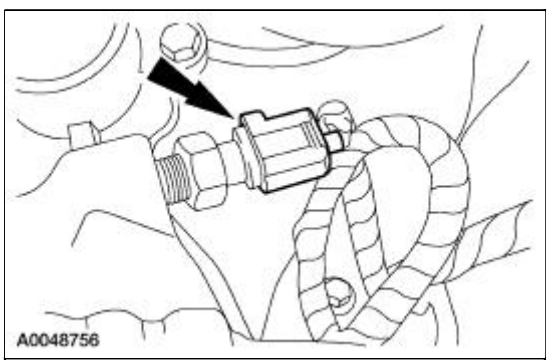


Installation

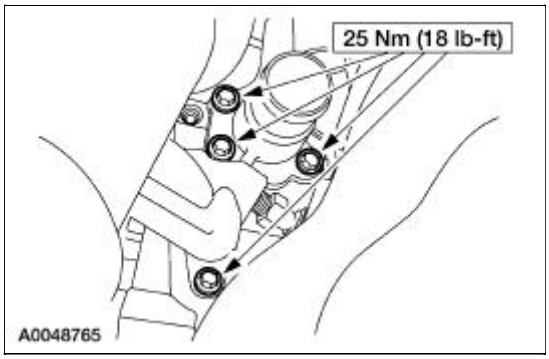
1. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

   Clean the gasket mating surfaces.

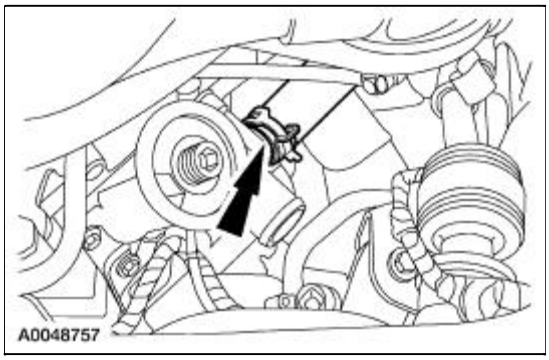
2. Position the oil filter adapter in the vehicle and connect the oil pressure switch electrical connector.



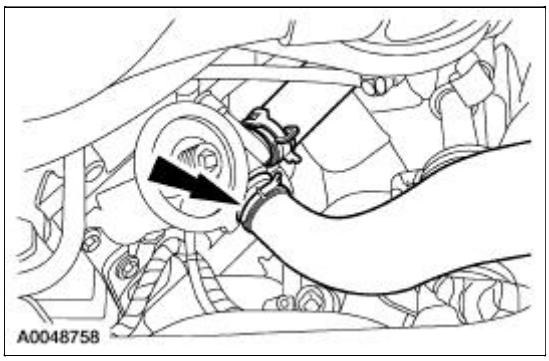
3. Install the oil filter adapter.
    - Install a new oil filter adapter gasket.
    - Position the oil filter adapter and install the four bolts.



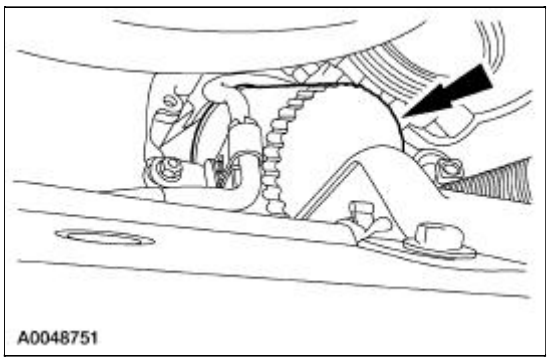
4. Position the degas hose on the oil filter adapter and secure the hose clamp.



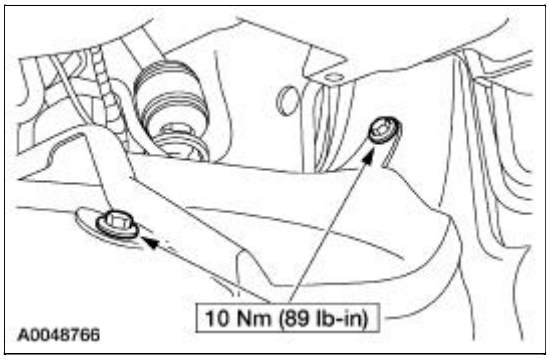
5. Position the radiator hose on the oil filter adapter and secure the hose clamp.



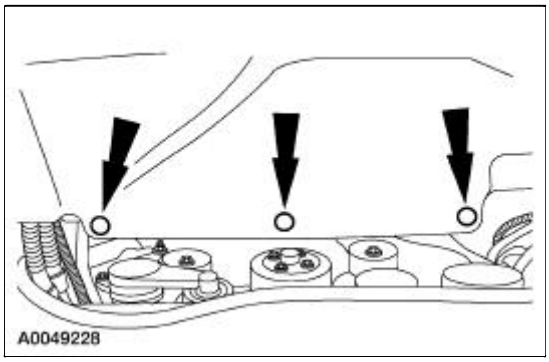
6. Install a new oil filter.



7. Install the oil filter drip shield.



8. Install the lower radiator splash shield.



9. Lower the vehicle.
10. Fill the engine with clean engine oil.
11. Fill the engine cooling system. For additional information, refer to Section 303-03 .

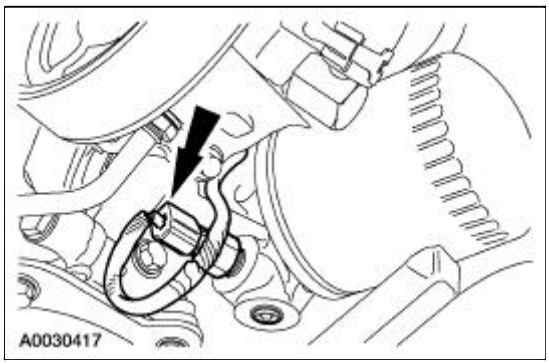
Oil Pressure Sender

Material

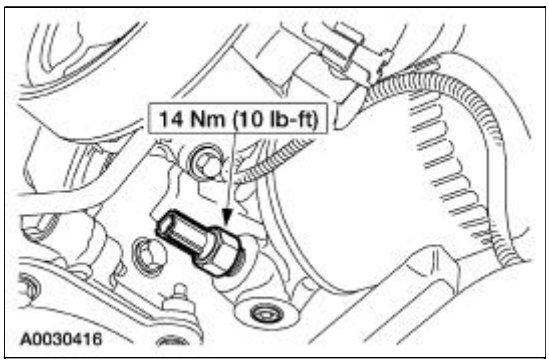
Item	Specification
Pipe Sealant with Teflon® XW7Z-19554-AA or equivalent	WSK-M2G350-A2 and ESR-M18P7-A

Removal and Installation

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Disconnect the oil pressure sender electrical connector.



3. Remove the oil pressure sender.



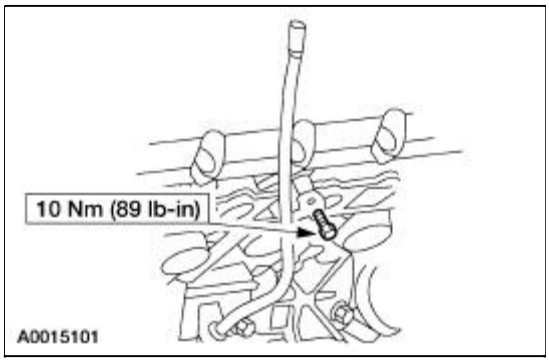
4. **NOTE:** If reusing the sender, clean the threads and coat the oil pressure sensor threads with pipe sealant.

   To install, reverse the removal procedure.

Oil Level Indicator and Tube

Removal and Installation

1. Remove LH exhaust manifold. For additional information, refer to Exhaust Manifold LH in this section.
2. Remove the oil level indicator.
3. Remove the bolt.



4. Remove the oil level indicator tube.
   - Install a new O-ring seal.



5. To install, reverse the removal procedure.

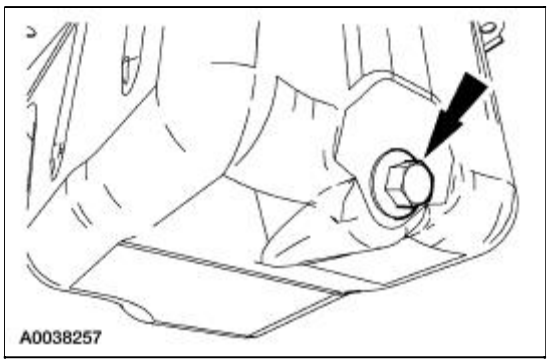
Oil Pan —4x2

Material

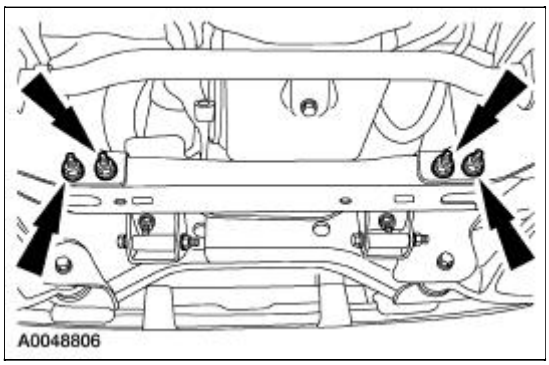
Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

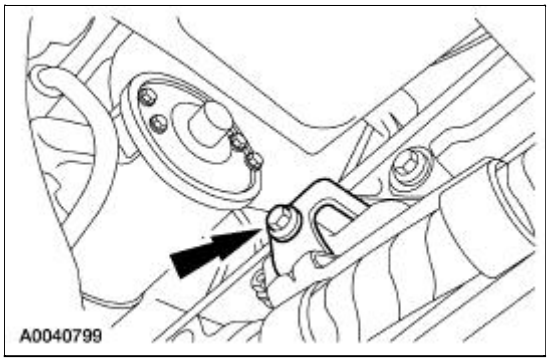
1. Raise the vehicle on the hoist. For additional information, refer to Section 100-02 .
2. Drain the engine oil.



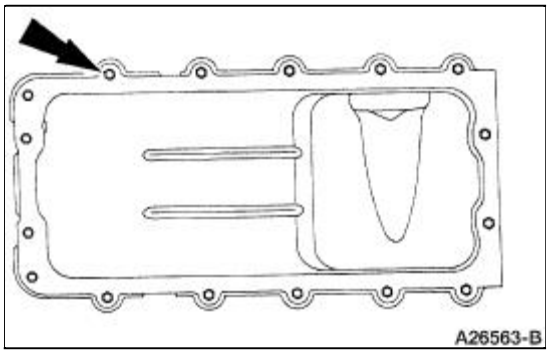
3. Remove the bolts and nuts, and the frame crossmember.



4. Remove the bolt and detach the wire harness bracket.



5. Remove the bolts and the oil pan.



6. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs, or other abrasive means to clean the sealing surfaces. These may cause scratches and gouges resulting in leak paths. Use a plastic scraper to clean the sealing surfaces.**

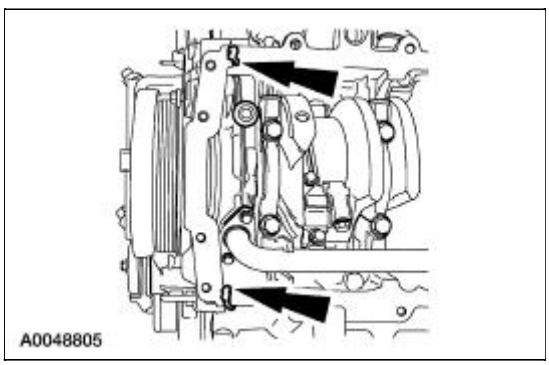
   Remove and discard the oil pan gasket. Clean the sealing surfaces.

   - Use metal surface cleaner. Allow the surfaces to dry for four minutes or until there is no sign of wetness, whichever is longest. Failure to do so can cause future oil leaks.

Installation

1. **NOTE:** If the oil pan is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure may result in future oil leakage.

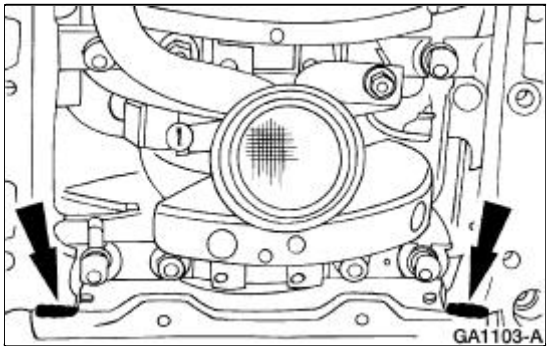
   Apply silicone gasket and sealant at the engine front cover-to-cylinder block mating surface.



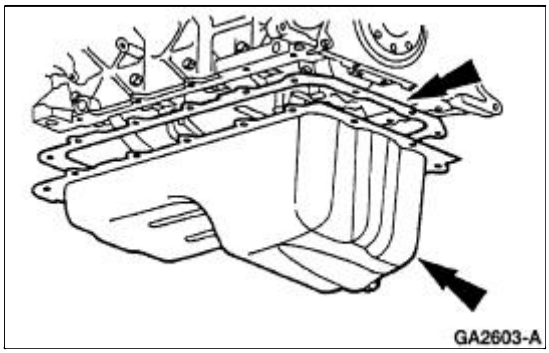
2. **NOTE:** If the oil pan is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure may result in future oil

leakage.

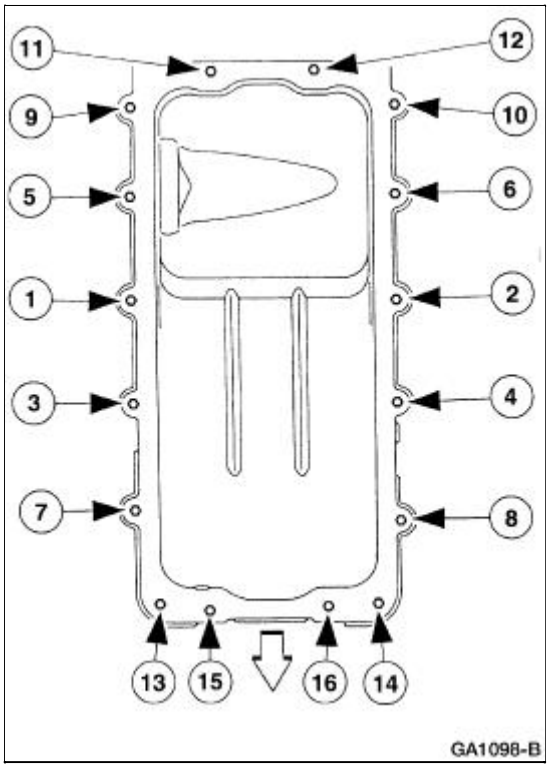
Apply silicone gasket and sealant at the rear seal retainer-to-cylinder block sealing surface.



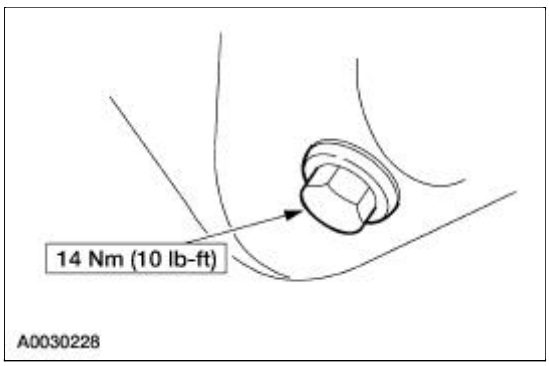
3. Position the new oil pan gasket and the oil pan and loosely install the bolts.



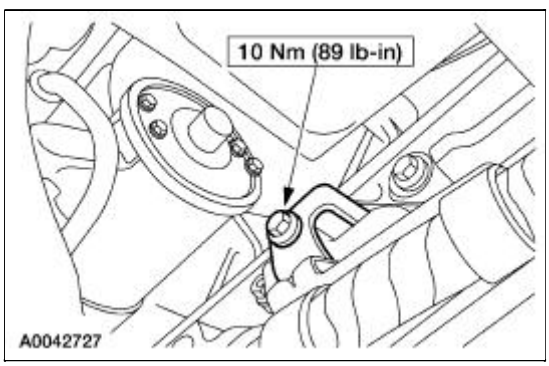
4. Tighten the bolts in three stages, in the sequence shown.
    - Stage 1: Tighten to 2 Nm (18 lb-in).
    - Stage 2: Tighten to 20 Nm (15 lb-ft).
    - Stage 3: Tighten an additional 60 degrees.



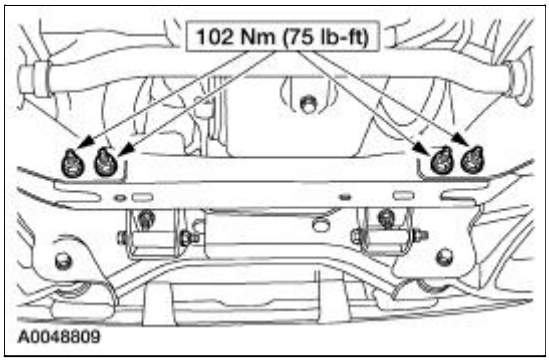
5. Install the drain plug.



6. Position the wire harness bracket and install the bolt.



7. Install the frame crossmember.



8. Lower the vehicle.
9. Fill the engine with clean engine oil.
10. Start the engine and inspect for leaks.

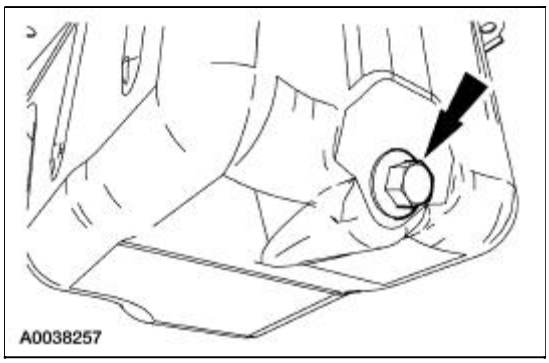
Oil Pan —4x4

Material

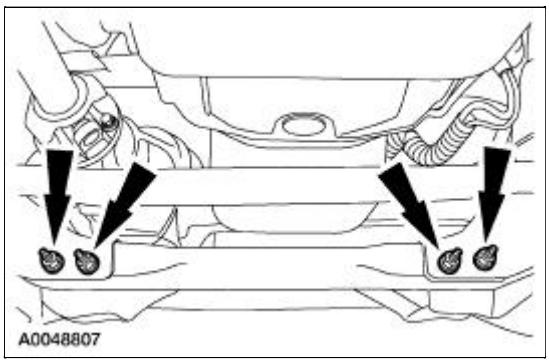
Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

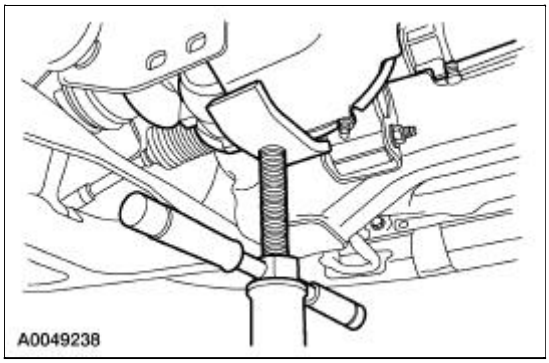
1. Raise the vehicle on the hoist. For additional information, refer to Section 100-02 .
2. Drain the engine oil.



3. Remove the frame crossmember.

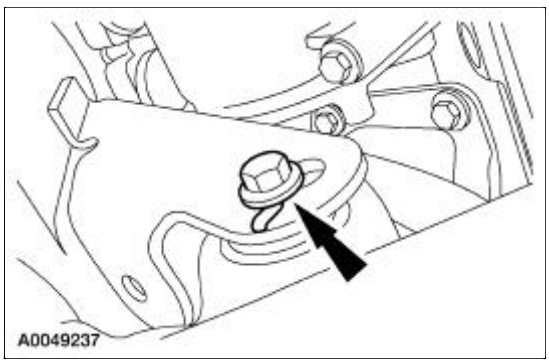


4. Support the front axle housing with a jack stand.



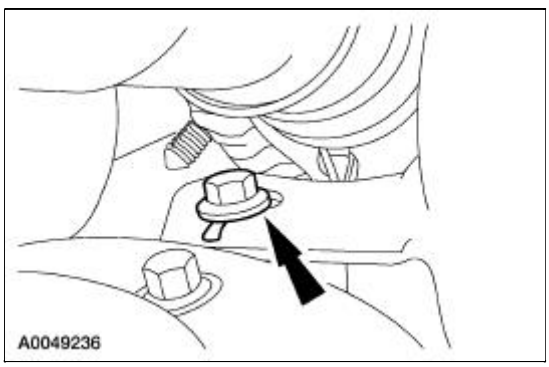
5. **NOTE:** Mark the bolt and bracket so that alignment can be maintained on installation.

   Remove front axle housing RH mounting bolt.



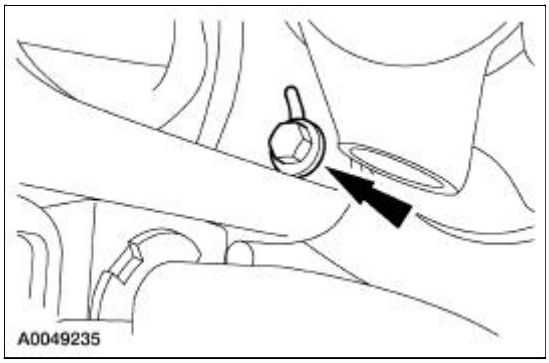
6. **NOTE:** Mark the bolt and bracket so that alignment can be maintained on installation.

   Remove front axle housing LH front mounting bolt.



7. **NOTE:** Mark the bolt and bracket so that alignment can be maintained on installation.

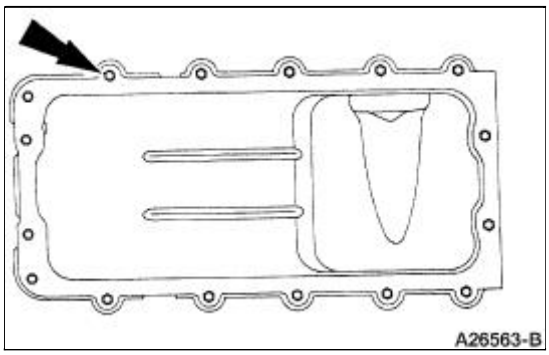
   Remove front axle housing LH rear mounting bolt.



8. **CAUTION: Use care when lowering the front axle housing, or the vacuum lines to the axle solenoid may become disconnected or damaged.**

   Lower the axle to allow clearance for the oil pan to be removed.

9. Remove the bolts and the oil pan.



10. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs, or other abrasive means to clean the sealing surfaces. These may cause scratches and gouges resulting in leak paths. Use a plastic scraper to clean the sealing surfaces.**

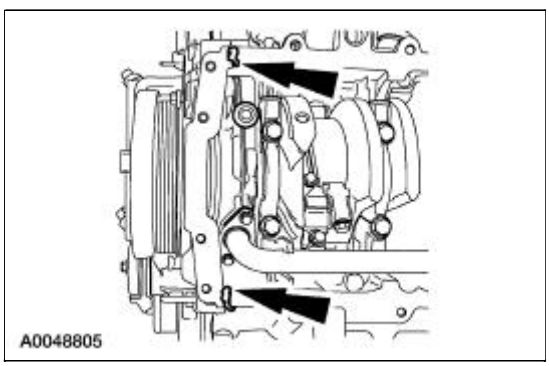
    Remove and discard the oil pan gasket. Clean the sealing surfaces.

    - Use metal surface cleaner. Allow the surfaces to dry for four minutes or until there is no sign of wetness, whichever is longest. Failure to do so can cause future oil leaks.

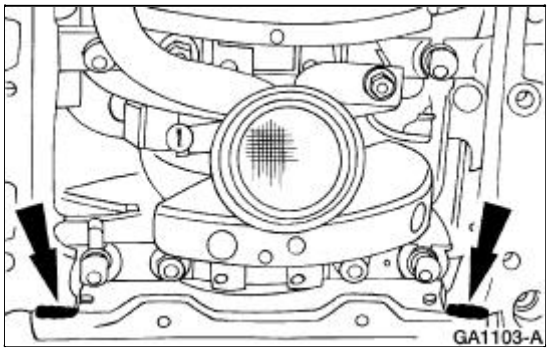
Installation

1. **NOTE:** If the oil pan and gasket are not secured within four minutes of sealer application, the sealant must be removed and the sealing surfaces cleaned with metal surface cleaner.

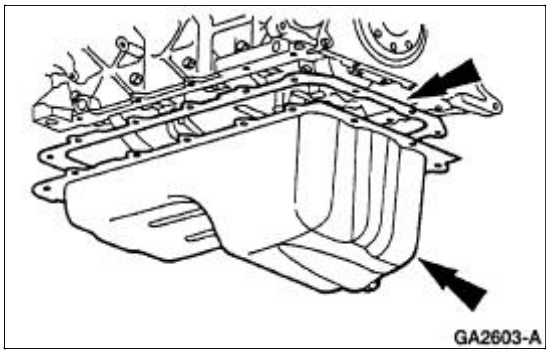
   Apply silicone gasket and sealant in at the front cover-to- cylinder block sealing surface.



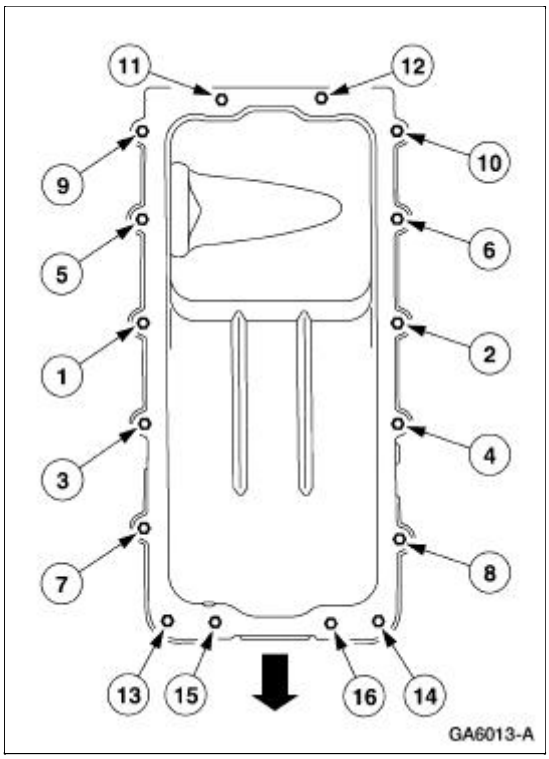
2. Apply silicone gasket and sealant in at the rear seal retainer-to-cylinder block sealing surface.



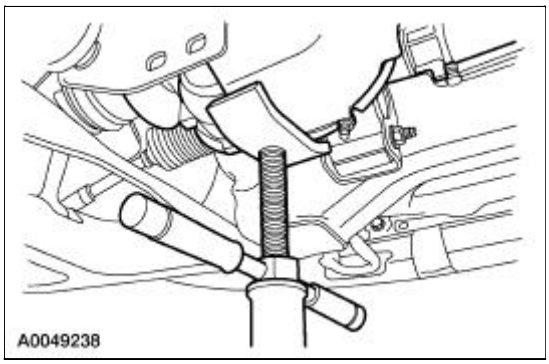
3. Position the new oil pan gasket and the oil pan and loosely install the bolts.



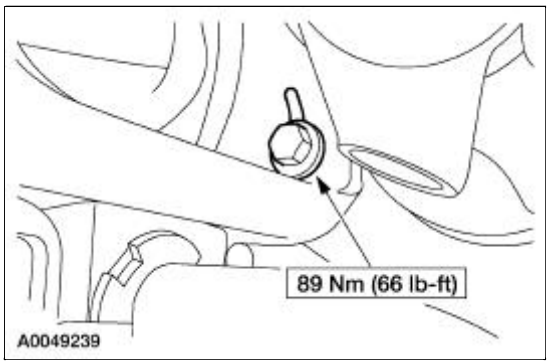
4. Tighten the bolts in three stages in the sequence shown.
    - Stage 1: Tighten to 2 Nm (18 lb-in).
    - Stage 2: Tighten to 20 Nm (15 lb-ft).
    - Stage 3: Tighten an additional 60 degrees.



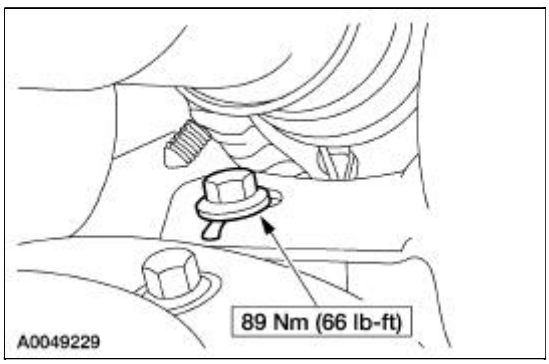
5. Position the front axle housing and loosely install the three bolts, aligning the bolt location marks made during removal.



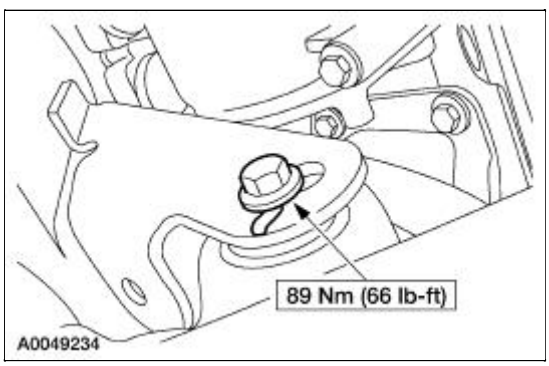
6. Tighten the front axle housing LH rear mounting bolt.



7. Tighten the front axle housing LH front mounting bolt.

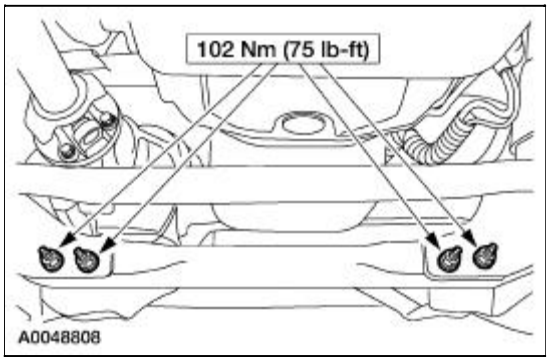


8. Tighten the front axle housing RH mounting bolt.



9. Remove the jack stand.

10. Install the frame crossmember.



11. Lower the vehicle.
12. Fill the engine with clean engine oil.
13. Start the engine and inspect for leaks.

Oil Pump Screen and Pickup Tube

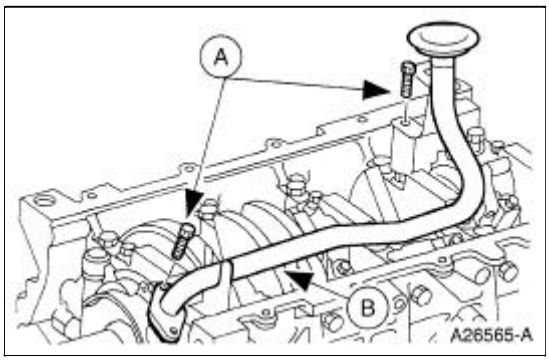
Material

Item	Specification
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

1. Remove the oil pan. For additional information, refer to Oil Pan—4x4 and Oil Pan—4x2 in this section.

2. Remove the three (A) bolts and the (B) oil pump screen cover and tube.



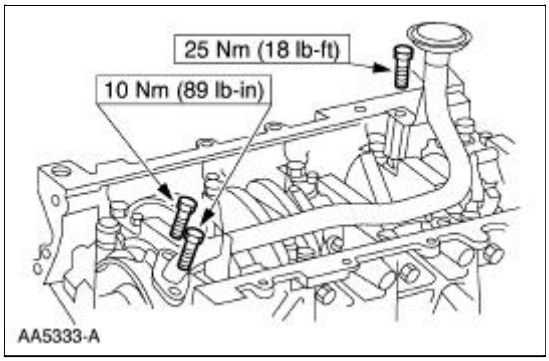
Installation

1. Clean and inspect the mating surfaces.
   - Inspect the O-ring seal.

2. **CAUTION: Make sure the O-ring is in place and not damaged. A missing or damaged O-ring can cause foam in the lubrication system, low oil pressure and severe engine damage.**

   NOTE: Clean and inspect the mating surfaces and install a new O-ring. Lubricate with clean engine oil.

   Install the oil pump screen cover and tube and install the bolts.

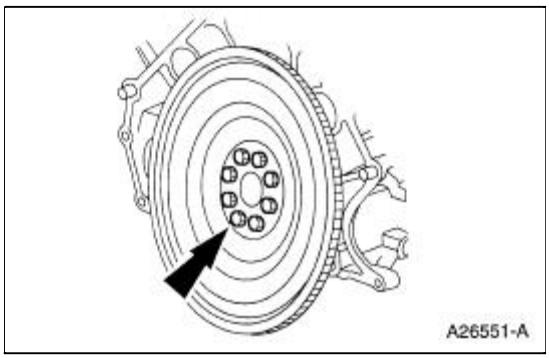


3. Install the oil pan. For additional information, refer to Oil Pan—4x4 and Oil Pan—4x2 in this section.

Flywheel

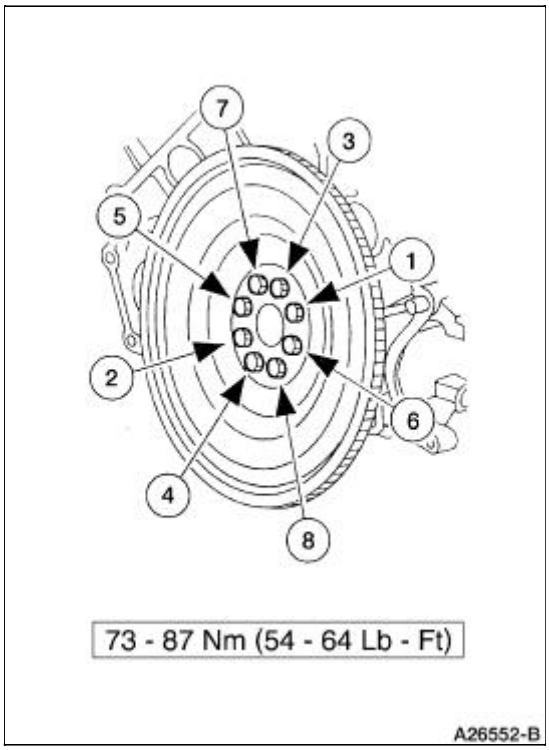
Removal

1. Remove the transmission. For additional information, refer to Section 307-01A .
2. Remove the bolts and the flywheel (6375).



Installation

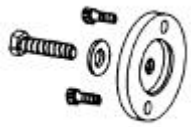
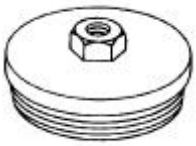
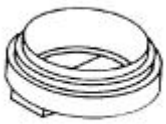
1. Position the flywheel and install the bolts in the sequence shown.



2. Install the transmission. For additional information, refer to Section 307-01A .

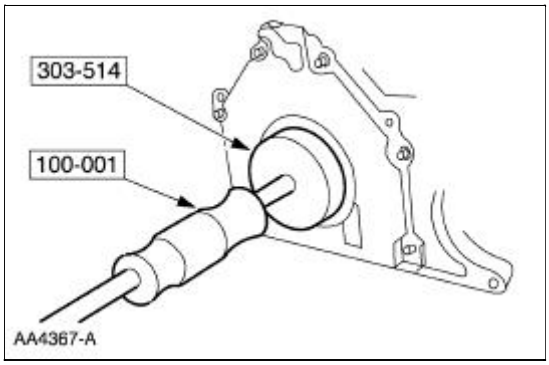
Crankshaft Rear Seal with Retainer Plate

Special Tool(s)

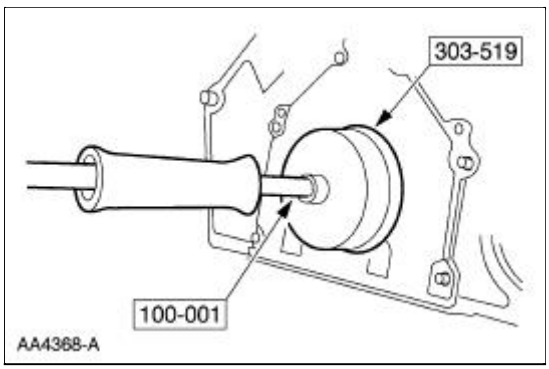
 ST1480-A	Installer, Crankshaft Rear Oil Seal 303-518 (T95P-6701-DH)
 ST1382-A	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)
 ST1479-A	Installer, Crankshaft Rear Oil Seal 303-516 (T95P-6701-BH)
 ST1481-A	Remover, Crankshaft Rear Oil Slinger 303-514 (T95P-6701-AH)
 ST1482-A	Installer, Crankshaft Rear Oil Slinger 303-517 (T95P-6701-CH)
 ST1185-A	Impact Slide Hammer 100-001 (T50T-100-A)

Removal

1. Remove the flexplate. For additional information, refer to Flywheel in this section.
2. Using the special tools, remove the crankshaft oil slinger.

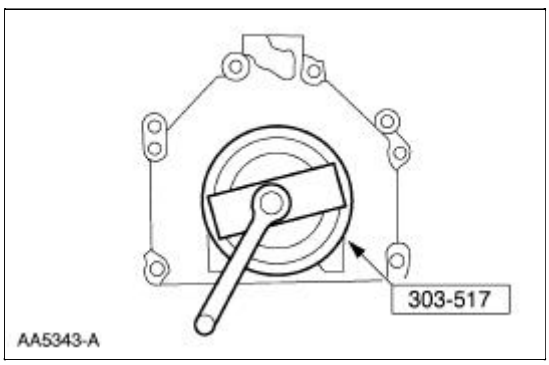


3. Using the special tools, remove the crankshaft rear oil seal.

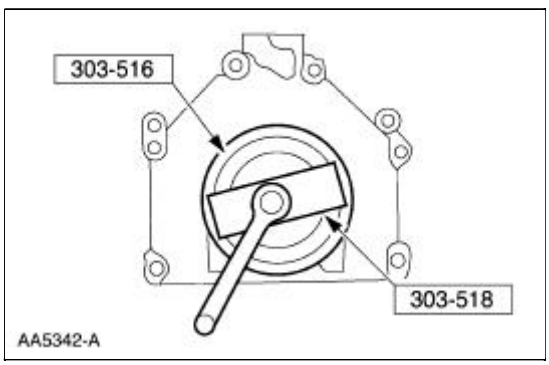


Installation

1. Using the special tool, install the crankshaft rear oil seal.



2. Using the special tools, install the crankshaft oil slinger.



3. Install the flexplate. For additional information, refer to Flywheel in this section.

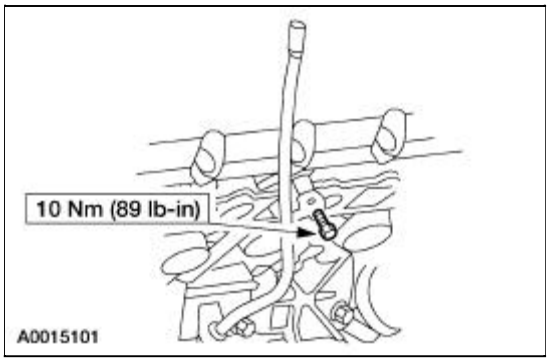
Engine Mount

Removal and Installation

1. Remove the RH exhaust manifold. For additional information, refer to Exhaust Manifold RH in this section.

2. Remove the left exhaust manifold. For additional information, refer to Exhaust Manifold LH in this section.

3. Remove the bolt.

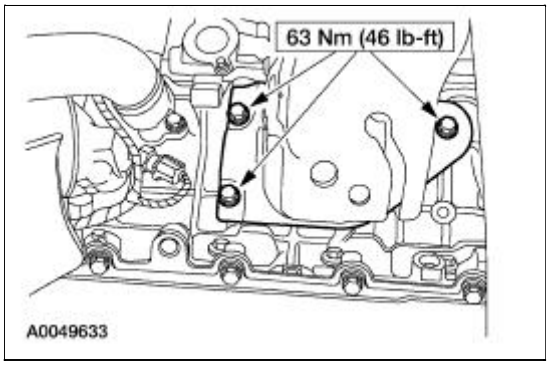


4. Remove the oil level indicator tube.
   - Install a new O-ring seal.



5. **NOTE:** LH shown, RH similar.

   Remove the RH or LH motor mount as needed.



6. To install, reverse the removal procedure.

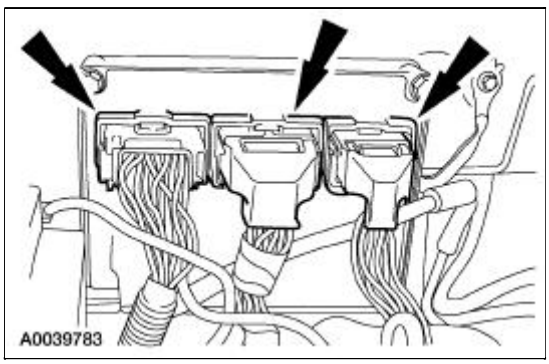
Engine

Special Tool(s)

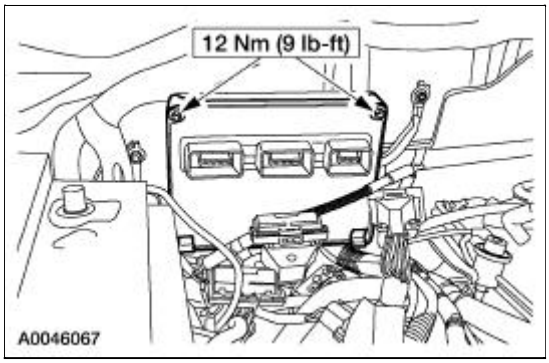
 ST1377-A	Modular Engine Lifting Bar 303-F047 (014-00073)
 ST1290-B	Remover, Power Steering Pump Pulley 211-016 (T69L-10300-B)

Removal

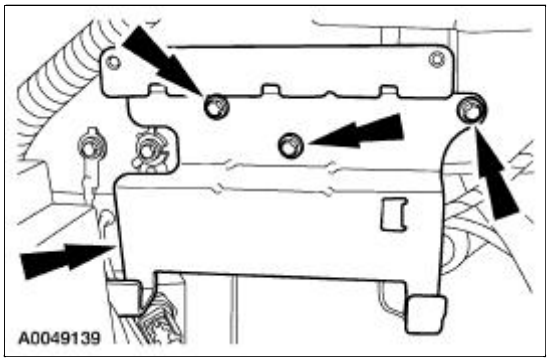
1. Remove the hood.
2. Remove the radiator. For additional information, refer to Section 303-03 .
3. Recover the A/C system refrigerant. For additional information, refer to Section 412-00 .
4. Remove the lower intake manifold. For additional information, refer to Lower Intake Manifold in this section.
5. Disconnect the powertrain control module (PCM) electrical connectors.



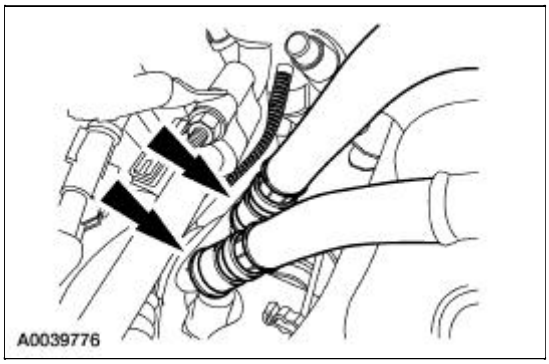
6. Remove the PCM mounting bolts and the PCM.



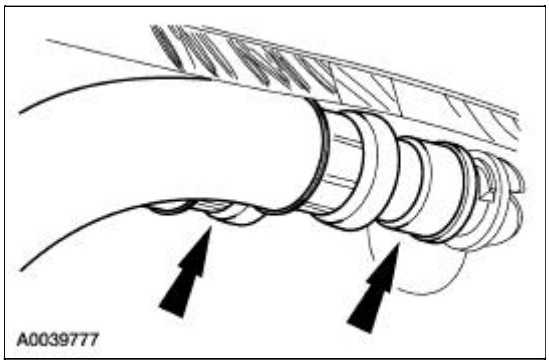
7. Remove the bolts and the PCM mounting bracket.



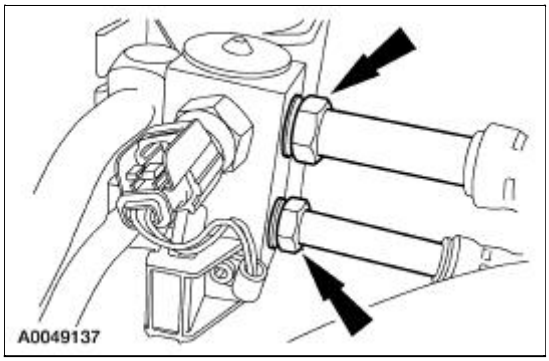
8. Disconnect the auxiliary heater hoses at the right side valve cover.



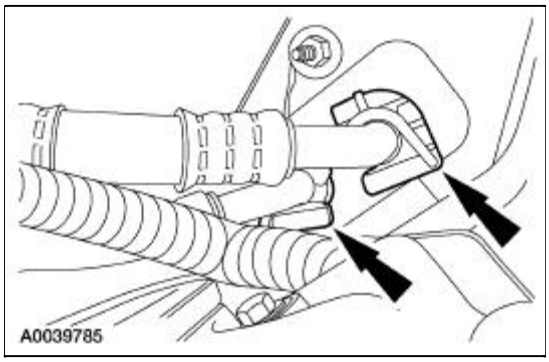
9. Disconnect the heater hoses at the heater core.



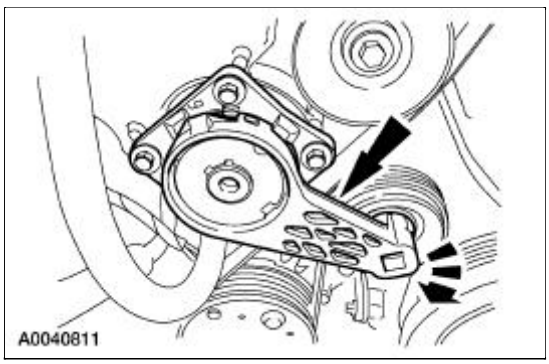
10. Disconnect the A/C hoses from the junction block.



11. Remove the safety clips and disconnect the spring lock couplers at the evaporator core. For additional information, refer to Section 412-00 .

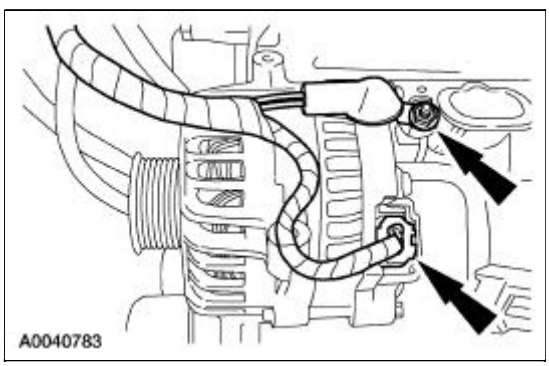


12. Rotate the belt tensioner counterclockwise and remove the drive belt.

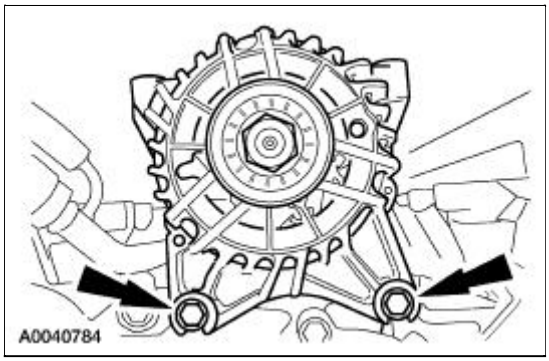


13. **NOTE:** Position the rubber boot aside to access the B+ cable.

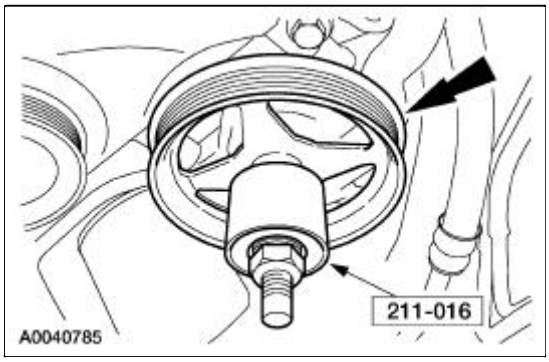
    Disconnect the generator electrical connectors.



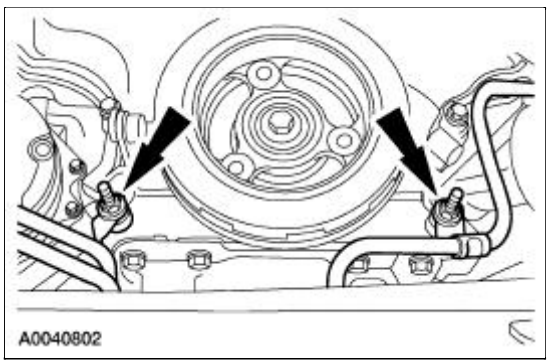
14. Remove the bolts and the generator.



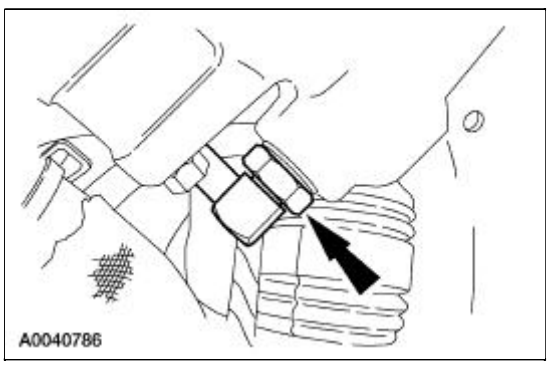
15. Using the special tool, remove the power steering pump pulley.



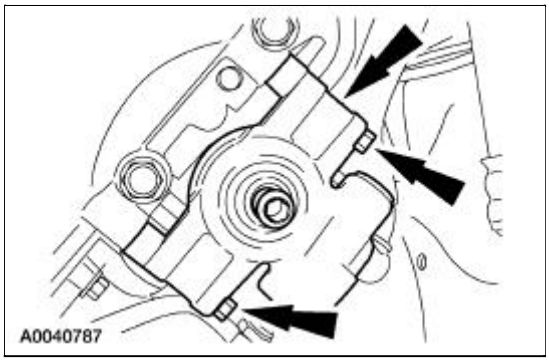
16. Remove the nuts and disconnect the transmission cooler tube and the power steering hose brackets.



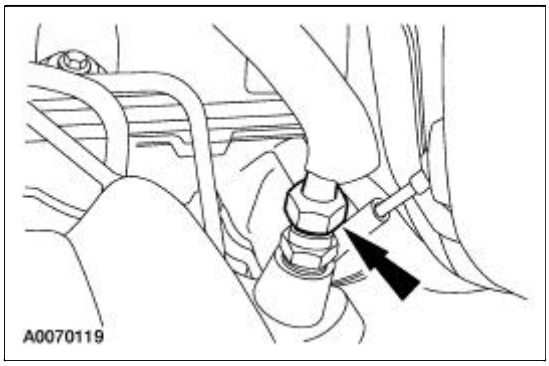
17. Disconnect the power steering pressure hose.
    - Drain the power steering fluid into a suitable container.



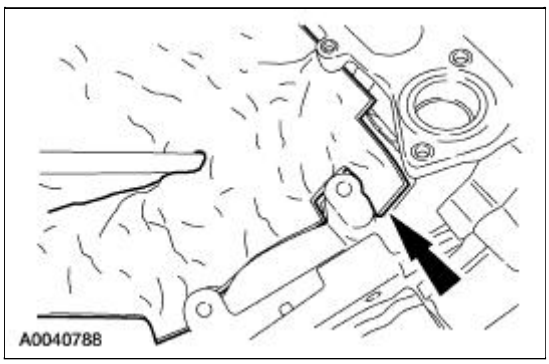
18. Remove the three bolts and position the power steering pump out of the way.



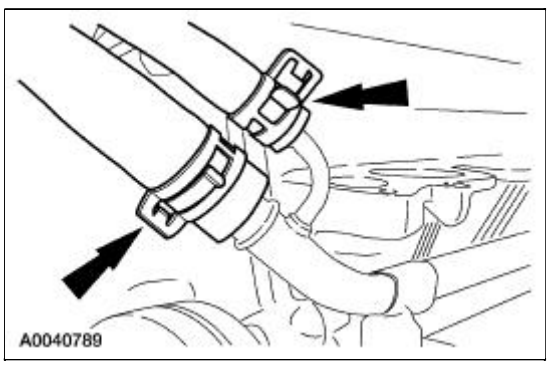
19. Disconnect the exhaust gas recirculation (EGR) valve tube nut from the LH exhaust manifold and remove the tube.



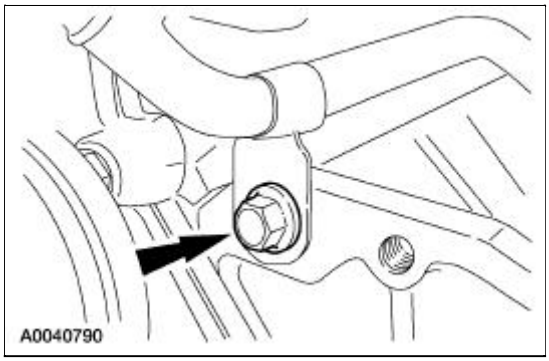
20. Remove the engine noise shield.



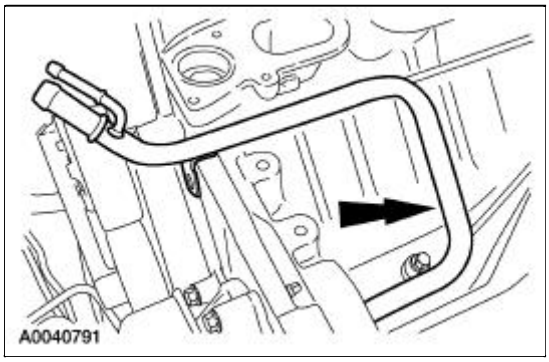
21. Squeeze the clamps and disconnect the hoses.
    - Remove the positive crankcase ventilation (PCV) valve and hose assembly from the vehicle.



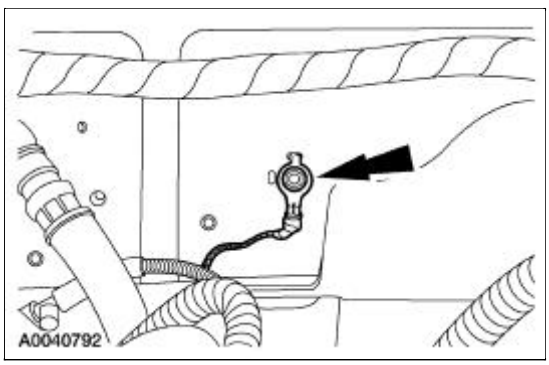
22. Remove the bolt.



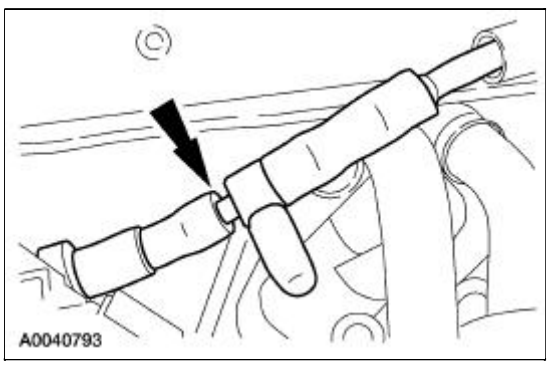
23. Remove the tube.



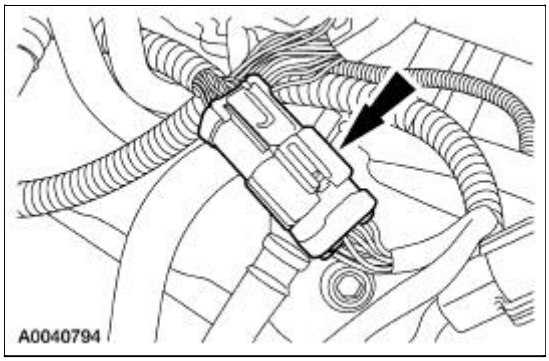
24. Remove the bolt and disconnect the ground wire.



25. Disconnect the vacuum hose and remove the vacuum harness.



26. Disconnect the main engine harness electrical connector.

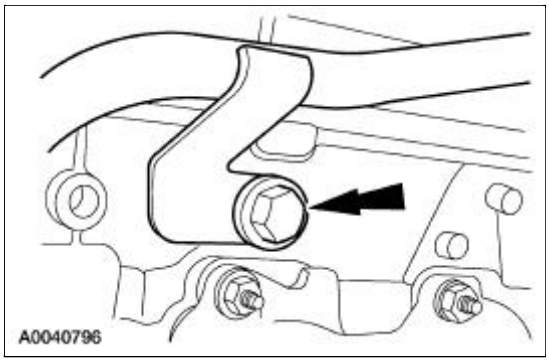


27. Raise the vehicle. For additional information, refer to Section 100-02 .

28. Remove the bolts and the skid plate, if equipped.

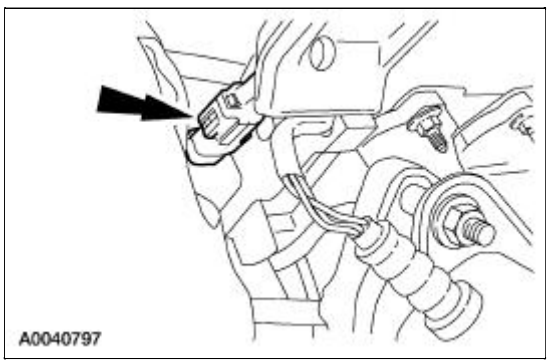
29. **NOTE:** The bolt is accessed through the RH fender well.

    Remove the transmission filler tube-to-engine block bolt.



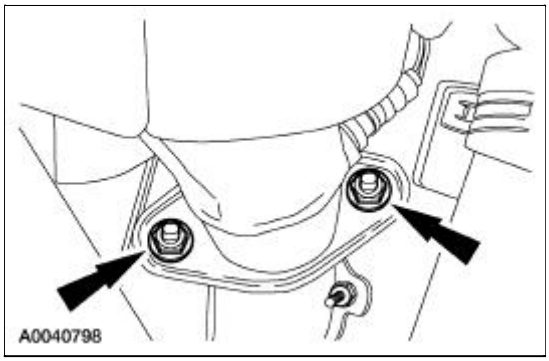
30. **NOTE:** Right side shown, left side similar.

    Disconnect the heated oxygen sensor (HO2S) electrical connectors.

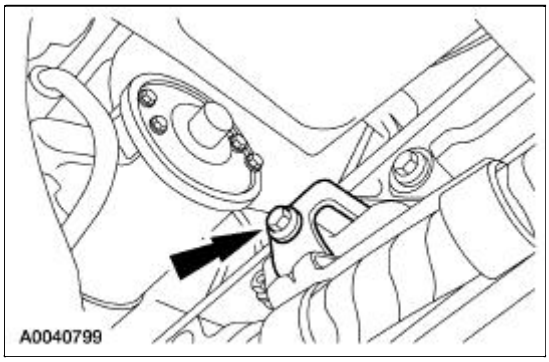


31. **NOTE:** Left side shown, right side similar.

    Remove the nuts and detach the dual converter Y-pipe.



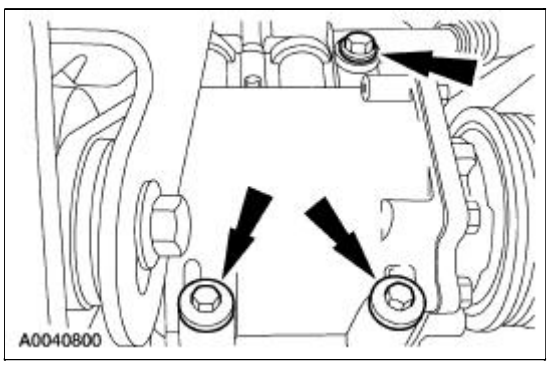
32. Remove the bolt and detach the wire harness bracket.



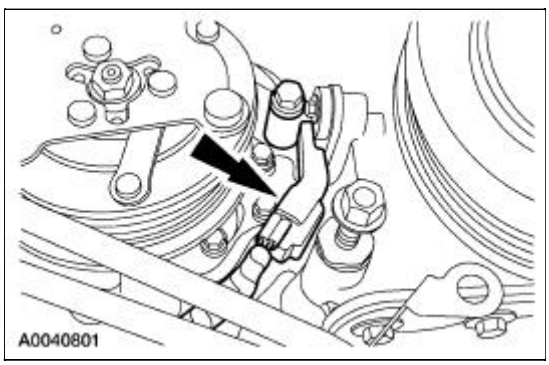
33. Remove the starter. For additional information, refer to Section 303-06 .

34. Disconnect the A/C clutch electrical connector.

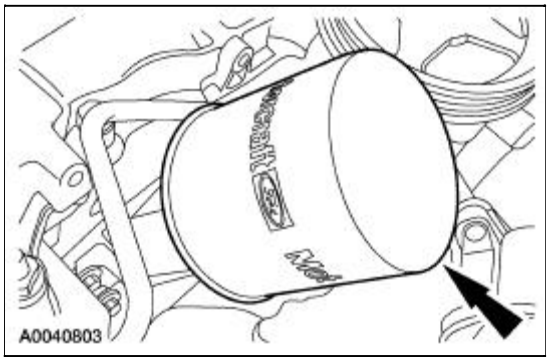
35. Remove the bolts and position the A/C compressor aside.



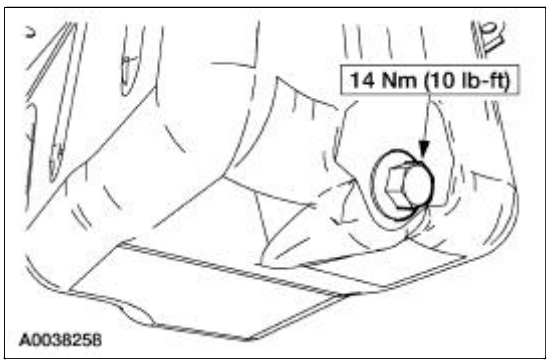
36. Disconnect the crankshaft position (CKP) sensor electrical connector.



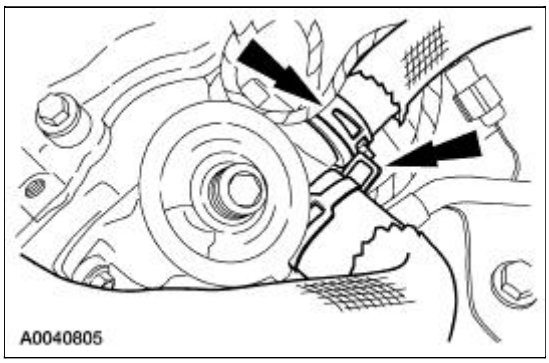
37. Remove the oil filter.



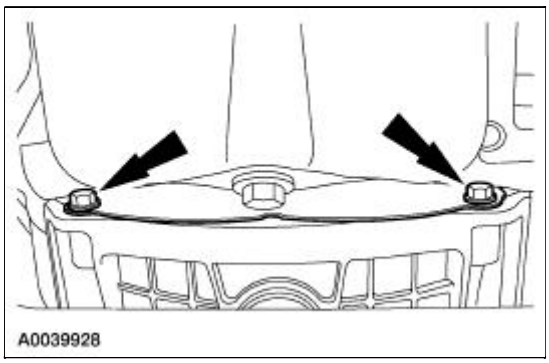
38. Remove the drain plug and drain the engine oil.
    - Install the drain plug when finished.



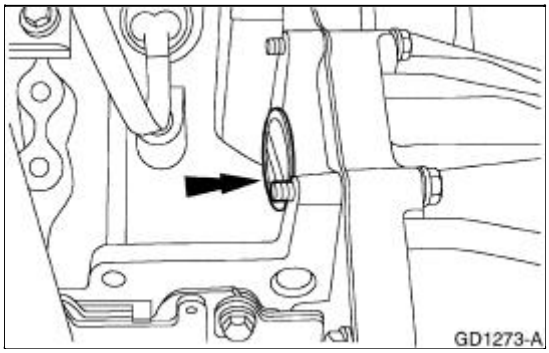
39. Squeeze the clamps and disconnect the hoses.
    - Remove the lower radiator hose.



40. Remove the inspection plate bolts and the inspection plate.



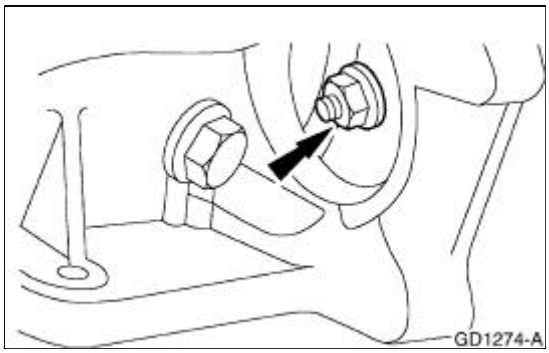
41. Remove the flexplate-to-torque converter nut access plug.



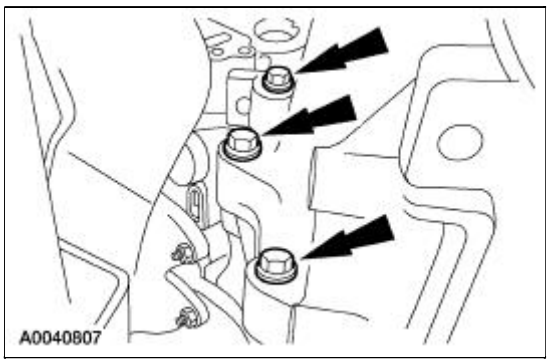
42. **NOTE:** Mark one stud and the flexplate for assembly reference.

    Remove the four torque converter nuts.

    - Rotate the crankshaft, using the crankshaft pulley bolt.

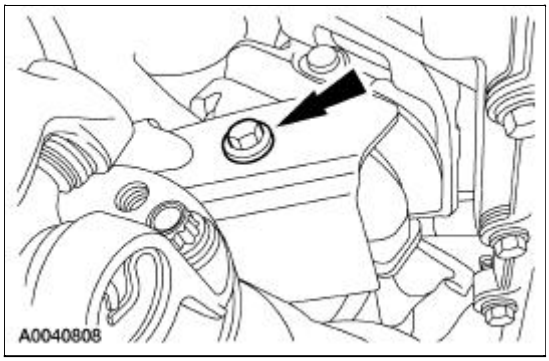


43. Remove the six lower transmission-to-engine bolts.

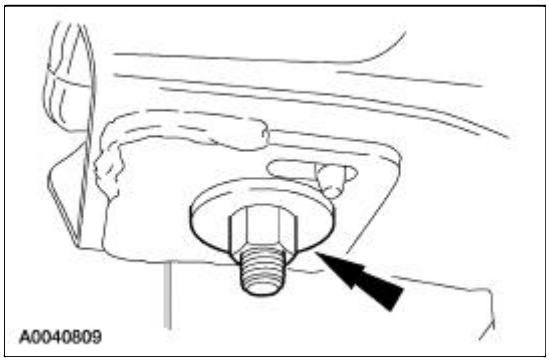


44. **NOTE:** The caged nut on the frame may break during bolt removal. If necessary, install a new nut.

    Remove the bolt from the LH motor mount.



45. Remove the nut from the RH motor mount.



46. Lower the vehicle.

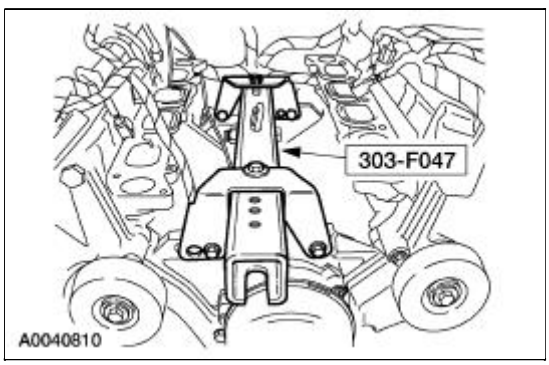
47. Support the transmission, using a block of wood and a floor jack.

48. **NOTE:** On 4x4 vehicles, disconnect the transfer case vent hose from the bracket and position aside to gain access to the upper transmission-to-engine bolts.

    Remove the two upper transmission-to-engine bolts.

49. **NOTE:** The alternator bolts may be used to attach the special tool to the front of the engine. The two bolts used to attach the special tool to the rear of the engine must be shorter than the transmission-to-engine mounting bolts.

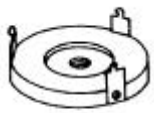
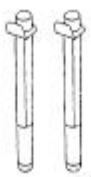
    Install the special tool.



50. Using a floor crane, remove the engine from the vehicle.

Engine

Special Tool(s)

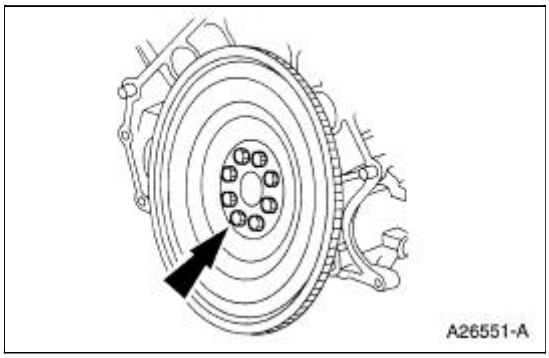
 ST1382-A	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)
 ST1481-A	Remover, Crankshaft Rear Oil Slinger 303-514 (T95P-6701-AH)
 ST1185-A	Impact Slide Hammer 100-001 (T50T-100-A)
 ST2443-A	Lift Bracket Set, Engine 303-DS086 (D93P-6001-A)
 ST1286-A	Remover, Crankshaft Vibration Damper 303-009 (T58P-6316-D)
 ST1337-A	Installer, Connecting Rod 303-442 (T93P-6136-A)
 ST1730-A	Remover, Crankshaft Front Oil Seal 303-107 (T74P-6700-A)
	Compressor, Valve Spring (Exhaust Side)

 ST2373-A	303-567 (T97P-6565-AH)
 ST1718-A	Compressor, Valve Spring (Intake Side) 303-452 (T93P-6565-AR)
 ST1276-A	Cylinder Ridge Reamer 303-016 (T64L-6011-EA)

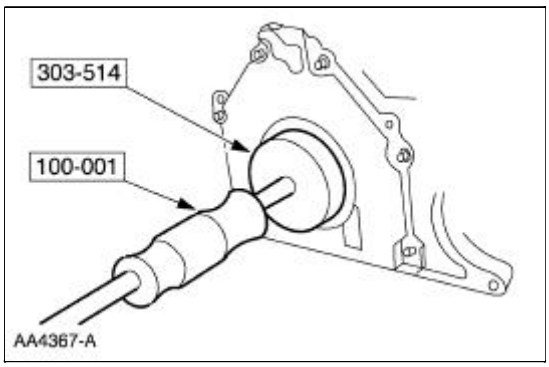
Disassembly

NOTE: The crankshaft rear oil seal slinger and the oil seal retainer plate must be removed before mounting the engine on the engine stand.

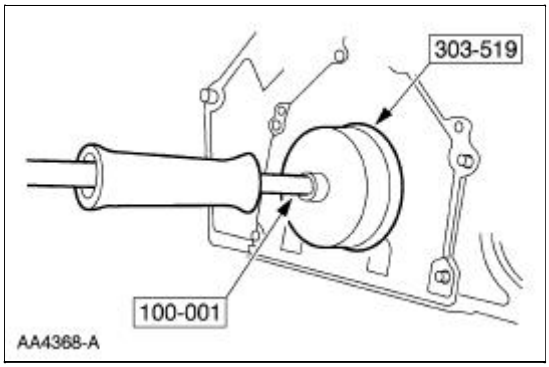
1. Remove the bolts and the flywheel.



2. Using the special tools, remove the rear oil slinger.

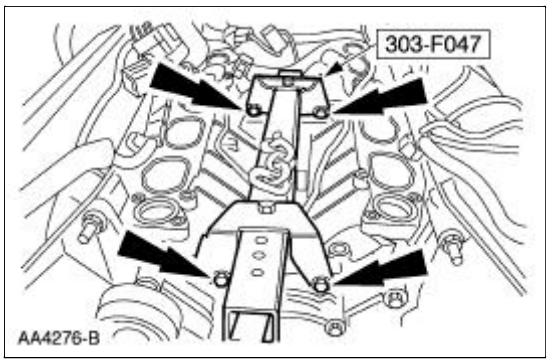


3. Using the special tools, remove the rear main seal.

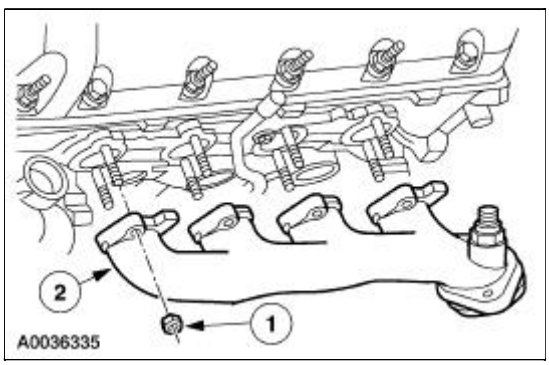


4. Lower the engine onto the wooden blocks.

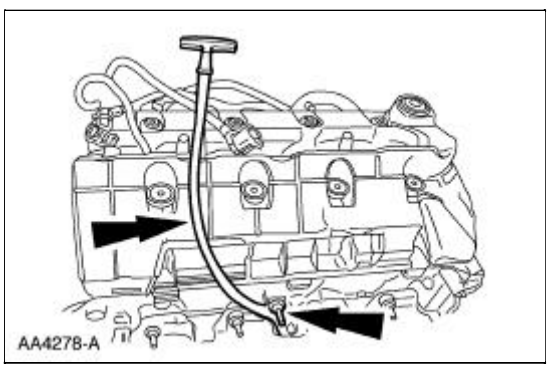
5. Remove the special tool.



6. Remove the LH exhaust manifold.
    1. Remove the eight nuts.
    2. Remove the manifold and discard the gasket.

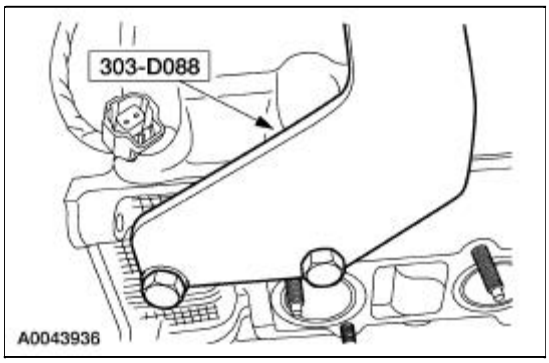


7. Remove the stud and the oil level indicator and tube.

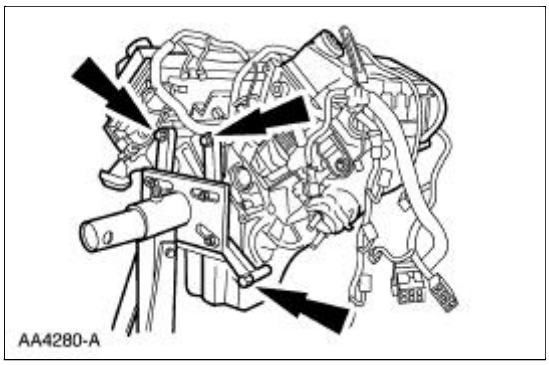


8. **NOTE:** LH shown, RH similar.

   Install the special tools on the LH and RH sides of the engine.



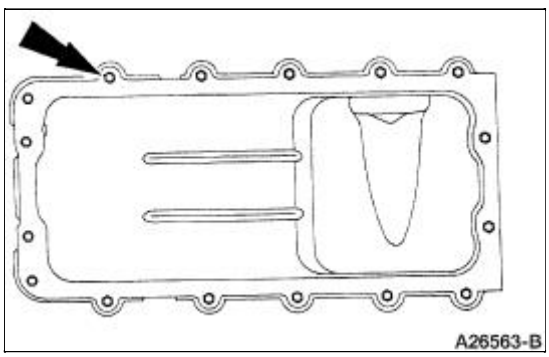
9. Mount the engine on a work stand.



10. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

    Remove the bolts and the oil pan.

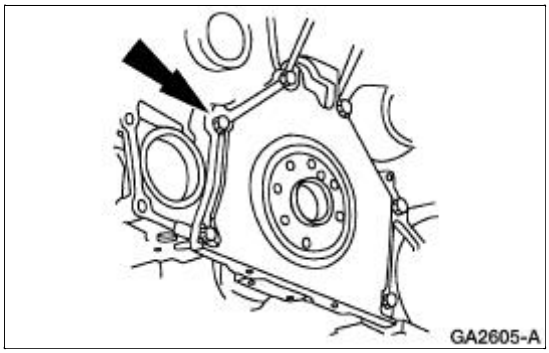
    - Clean and inspect the sealing surfaces.



11. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

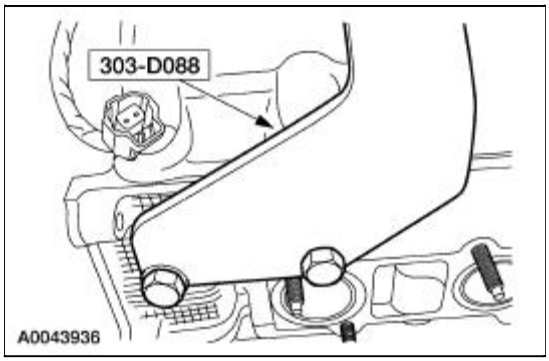
    Remove the bolts and the rear seal retainer plate.

    - Clean and inspect the sealing surfaces.



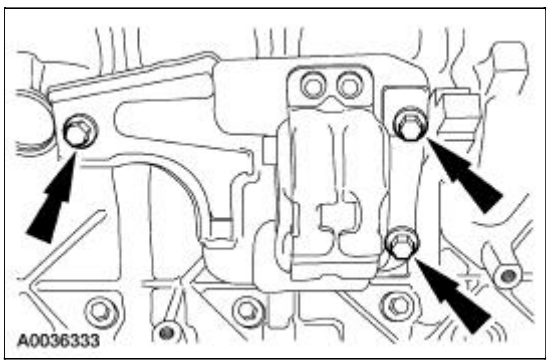
12. **NOTE:** LH shown, RH similar.

    Remove the special tools from the LH and RH sides of the engine.



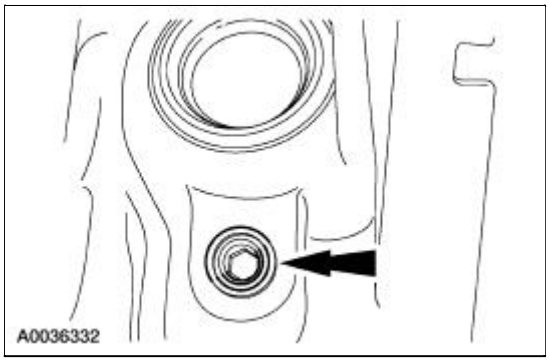
13. **NOTE:** LH shown, RH similar.

    Remove the RH and LH engine mounts.

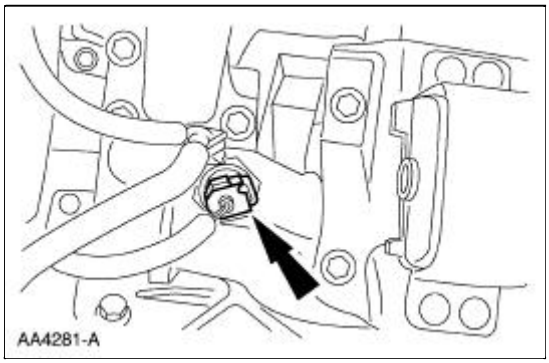


14. **NOTE:** LH shown, RH similar.

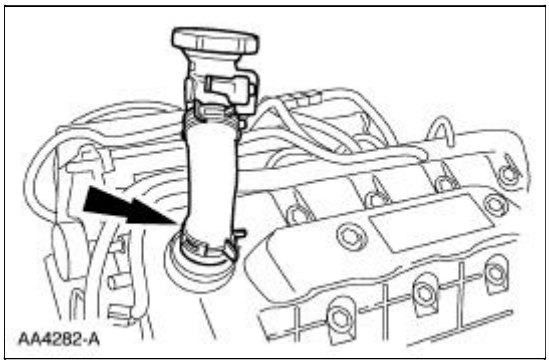
    Remove the cylinder block drain plugs, and drain the coolant in a suitable container.



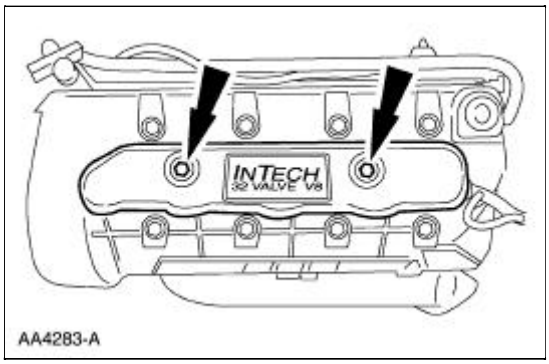
15. Disconnect the oil pressure sender.



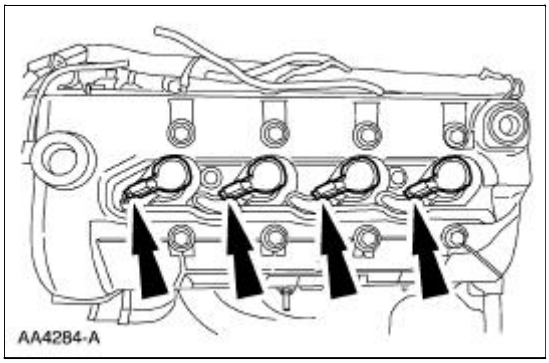
16. Remove the oil fill tube.



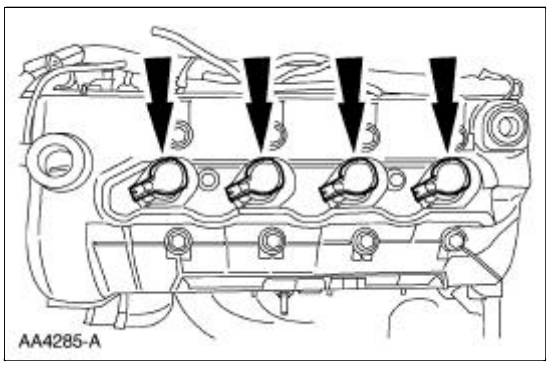
17. Remove the bolts and the LH ignition coil cover.



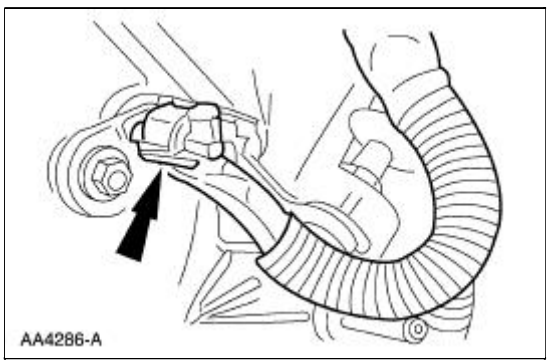
18. Disconnect the ignition coils.



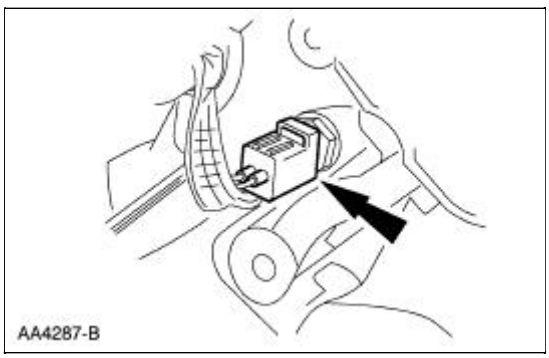
19. Remove the ignition coils.



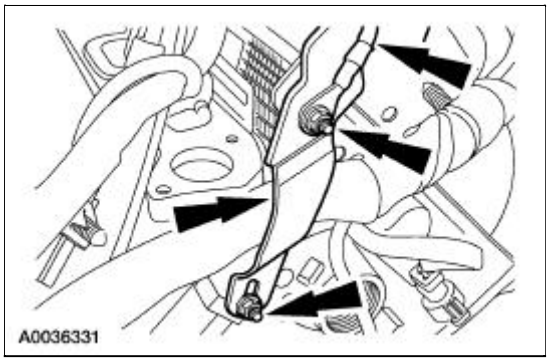
20. Disconnect the camshaft position (CMP) sensor.



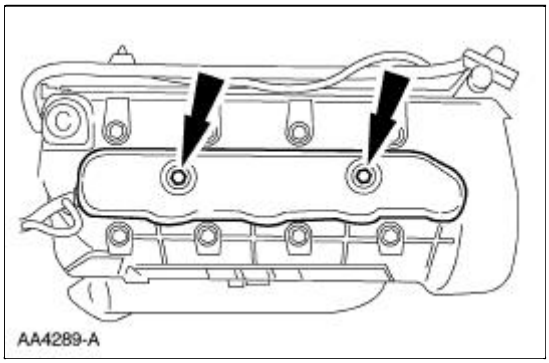
21. Disconnect the cylinder head temperature (CHT) sensor.



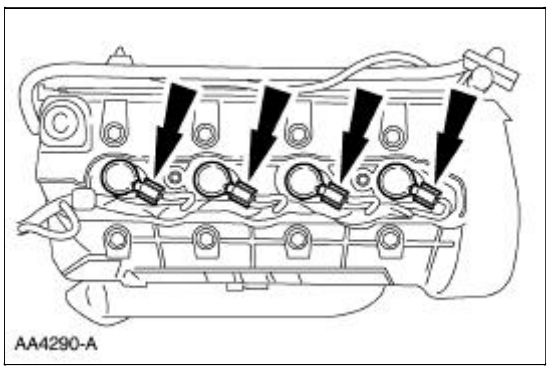
22. Remove the nuts, bracket and ground strap.



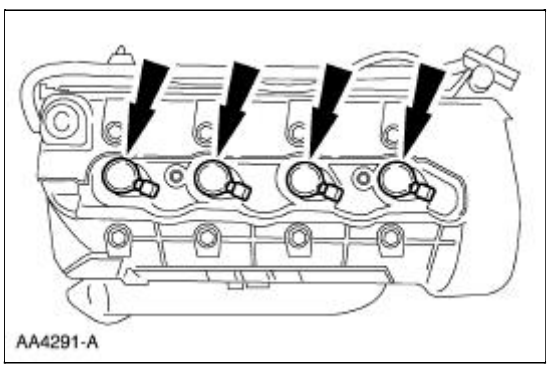
23. Remove the bolts and the RH ignition coil cover.



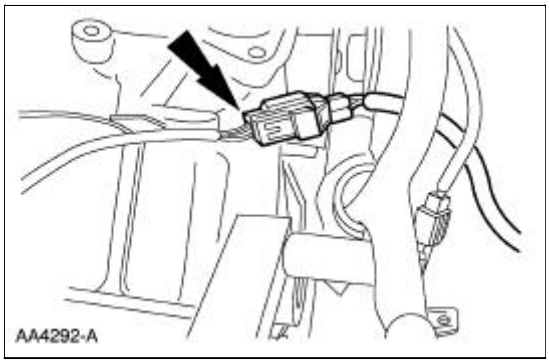
24. Disconnect the ignition coils.



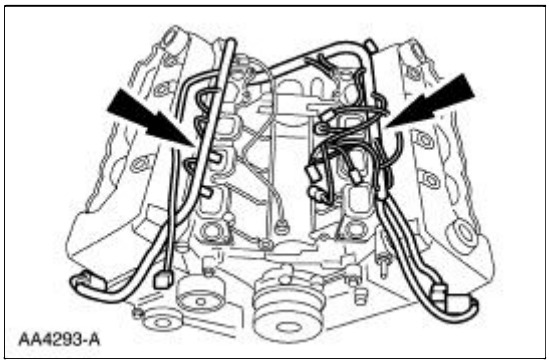
25. Remove the ignition coils.



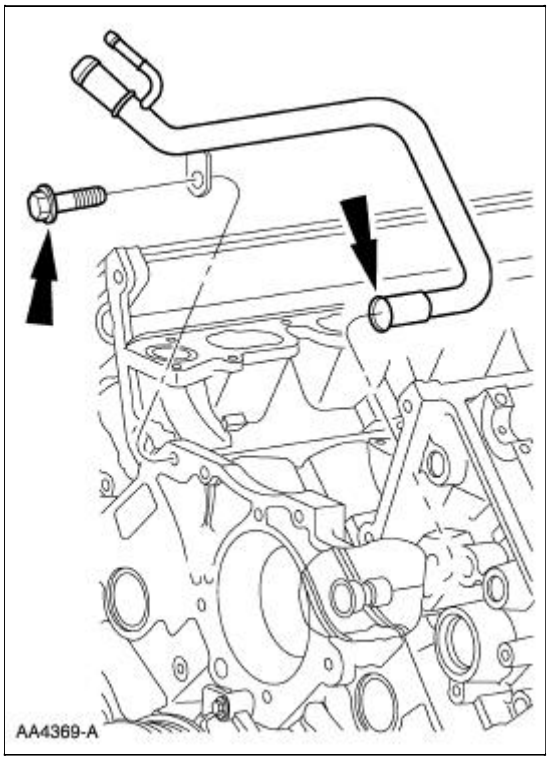
26. Disconnect the knock sensor (KS).



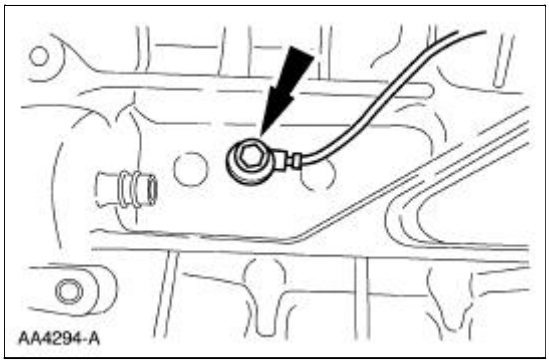
27. Separate the engine control sensor wiring from the engine at six locations and remove the wiring.



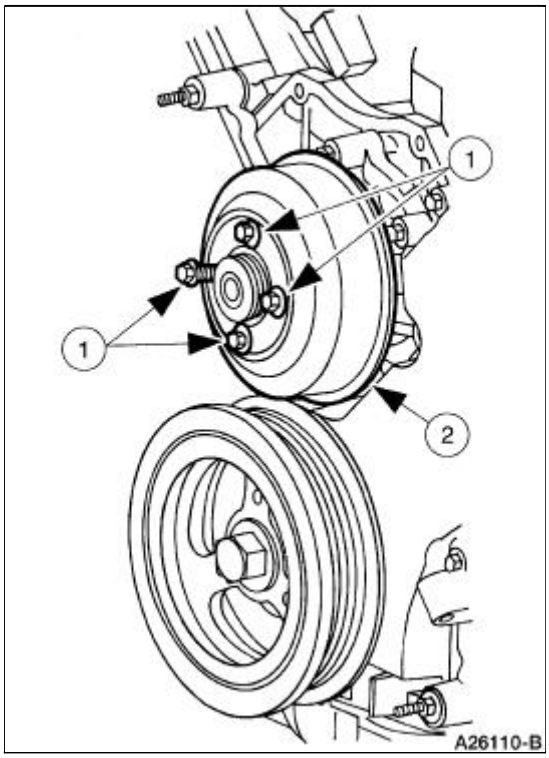
28. Remove the bolt and the heater return tube.



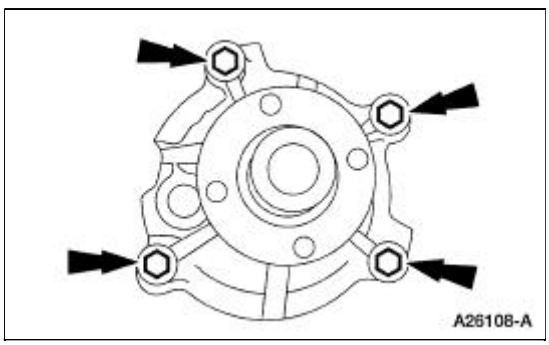
29. Remove the bolt and the knock sensor (KS).



30. Remove the water pump pulley.
    1. Remove the bolts.
    2. Remove the pulley.



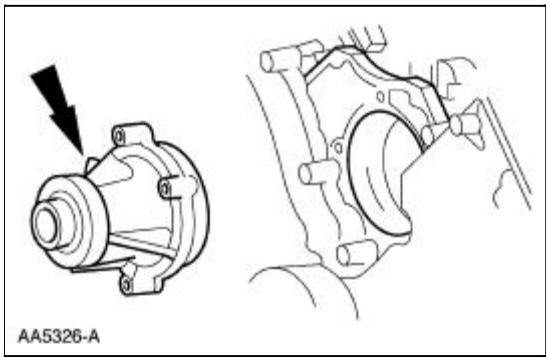
31. Remove the bolts.



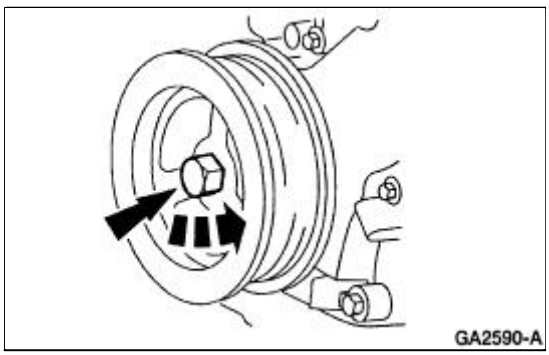
32. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

Remove the water pump.

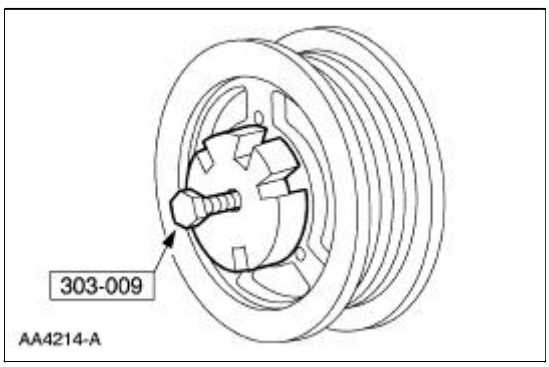
- Clean and inspect the sealing surfaces.



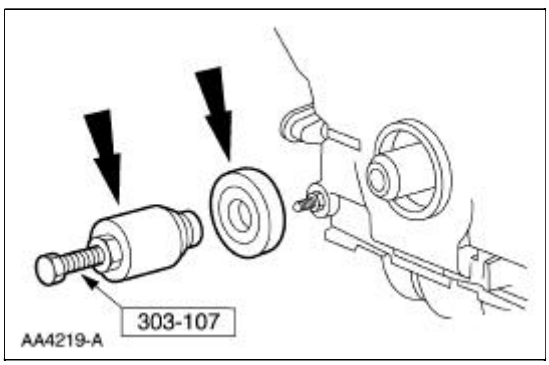
33. Remove the bolt.



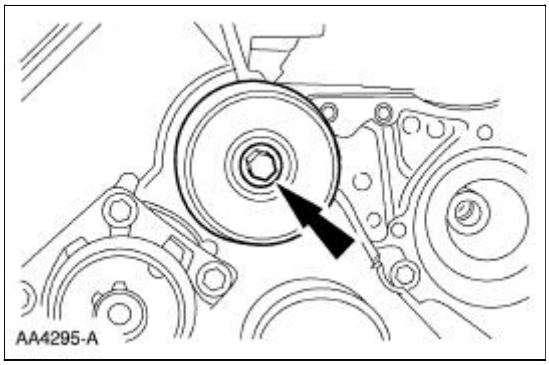
34. Using the special tool, remove the crankshaft damper.



35. Using the special tool, remove the front crank seal.

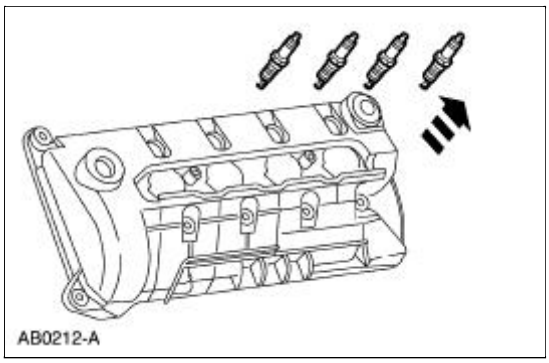


36. Remove the bolt and the belt idler pulley.



37. **NOTE:** LH shown, RH similar.

    Remove the eight spark plugs.

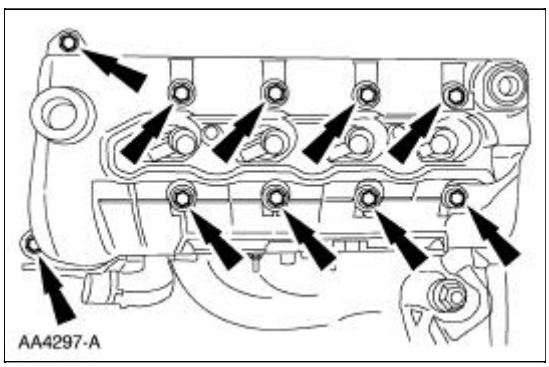


38. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

    NOTE: LH shown, RH similar.

    Remove the bolts, studs and the valve covers.

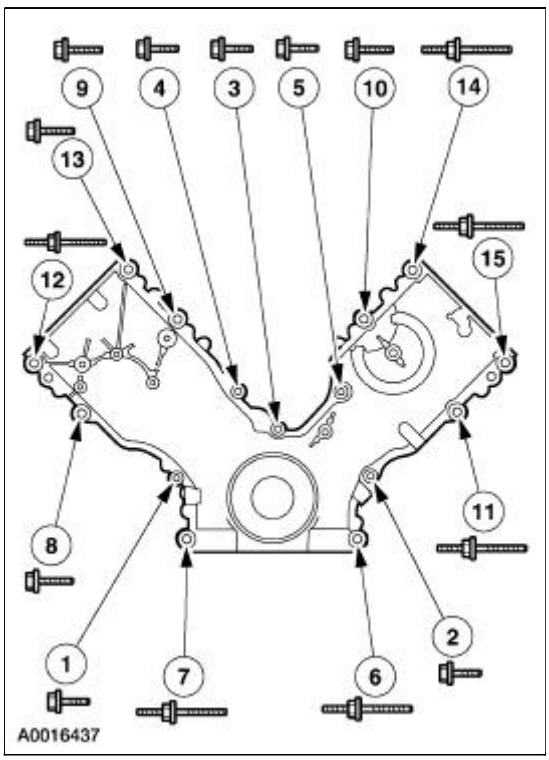
    - Remove the gaskets. Clean and inspect the sealing surfaces.



39. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

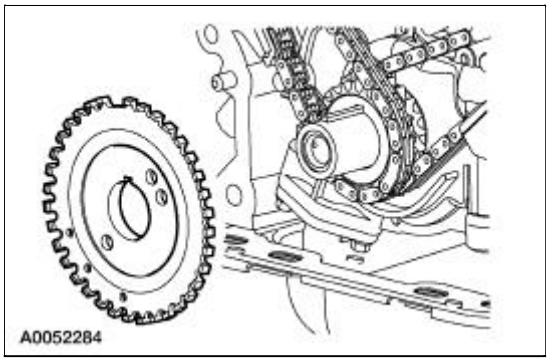
    Remove the studs, bolts, and the engine front cover.
    Remove the gaskets, clean and inspect the sealing surfaces.

Item	Part Number	Description
1	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
2	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
3	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
4	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
5	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
6	N808529	Stud, Hex-Head Pilot, M10 x 1.5 x 30
7	N808529	Stud, Hex-Head Pilot, M10 x 1.5 x 30
8	N806177	Bolt, Hex-Head Flange, M8 x 1.25 x 50
9	N806177	Bolt, Hex-Head Flange, M8 x 1.25 x 50
10	N806177	Bolt, Hex-Head Flange, M8 x 1.25 x 50
11	N806300	Stud Hex Shoulder Pilot, M8 x 1.25 x 65 - M8 x 1.25 x 27
12	N806300	Stud Hex Shoulder Pilot, M8 x 1.25 x 65 - M8 x 1.25 x 27
13	W705386	Bolt Hex Shoulder Pilot, M8 x 1.25 x 65
14	N806300	Stud Hex Shoulder Pilot, M8 x 1.25 x 65 - M8 x 1.25 x 27
15	W705386	Bolt Hex Shoulder Pilot, M8 x 1.25 x 65

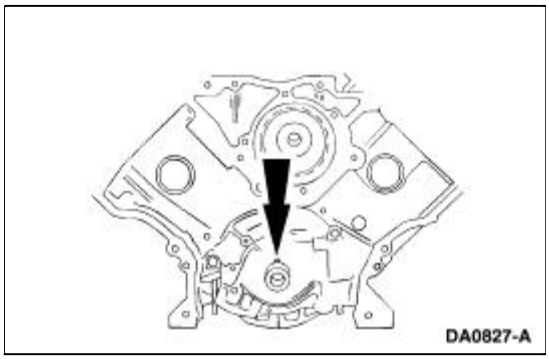


40. **CAUTION: Since the engine is not free-wheeling, if the crankshaft (6303) or the camshafts (6250) are moved in any manner during removal and installation, the crankshaft and the camshafts must be re-synchronized.**

Remove the crankshaft sensor ring from the crankshaft.

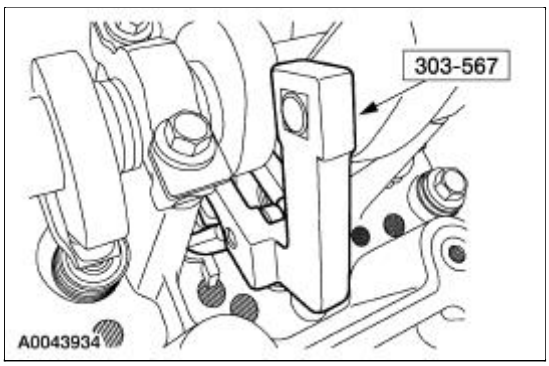


41. Rotate the crankshaft until the crankshaft keyway points towards the top of the engine (12 o'clock).

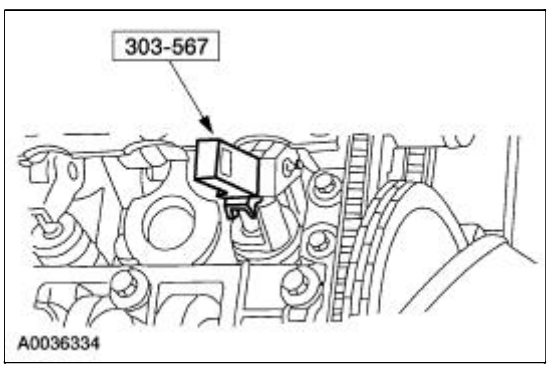


42. Position the camshaft lobes at the base circle.

43. Using the special tool, compress the intake valve springs and remove the roller followers.



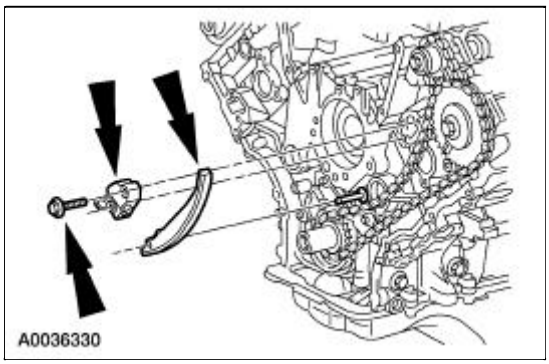
44. Using the special tool, compress the exhaust valve springs and remove the roller followers.



45. Repeat the previous steps to remove all roller followers.

46. **NOTE:** LH shown, RH similar.

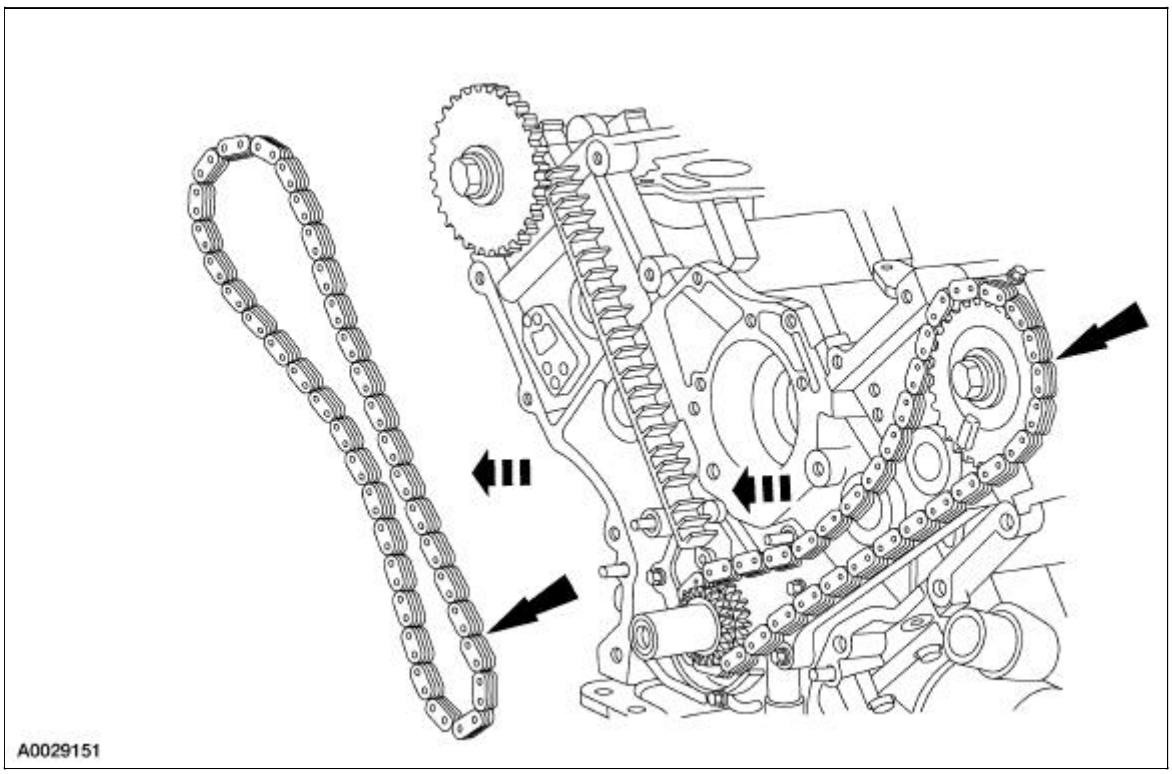
Remove the two bolts, the timing chain tensioner (6L266) and tensioner arm (6L253).



47. **NOTE:** LH shown, RH similar.

Remove the LH and RH timing chains and the crankshaft sprocket.

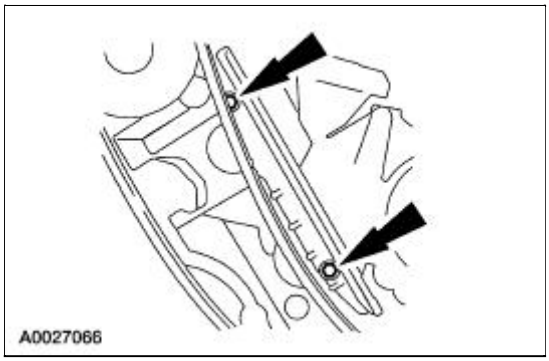
- Remove the timing chains from the camshaft sprockets.
- Remove the right and left timing chains and the crankshaft sprocket from the crankshaft.



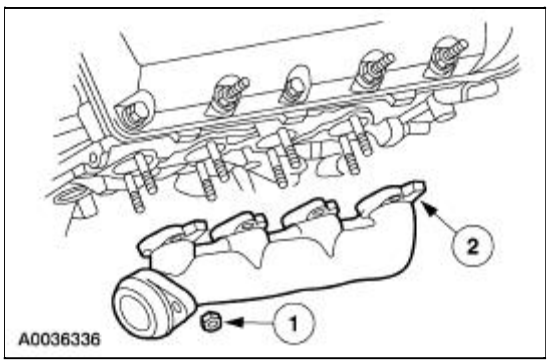
48. **CAUTION: The bolts are different lengths and must be returned to their original location.**

NOTE: RH shown, LH similar.

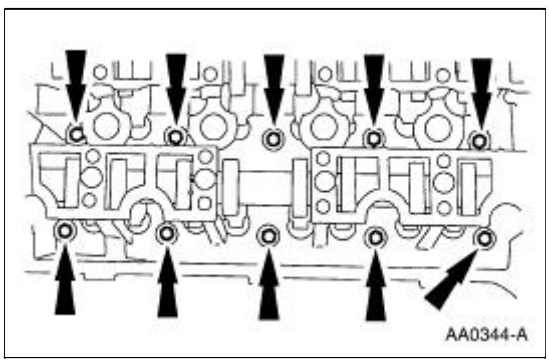
Remove the bolts and the timing chain guides.



49. Remove the RH exhaust manifold.
    1. Remove the eight nuts.
    2. Remove the exhaust manifold and gasket.

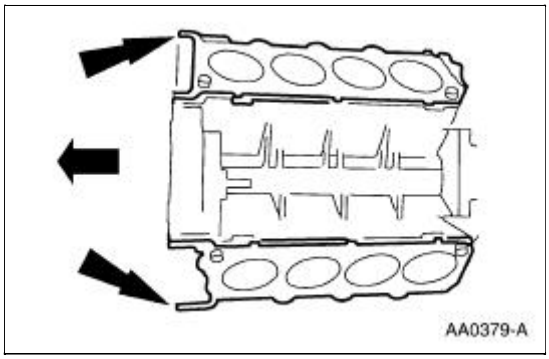


50. Remove the bolts from the RH and LH cylinder head and remove the cylinder heads.
    - Discard the bolts.

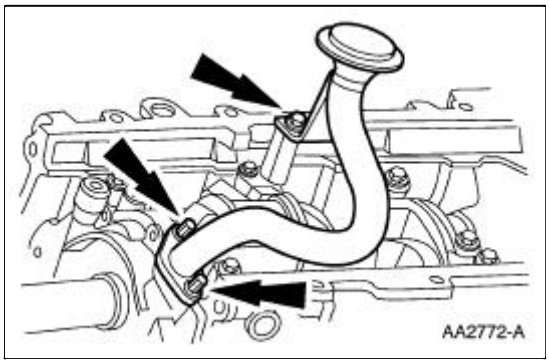


51. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

    Remove and discard head gaskets.
    - Clean and inspect the cylinder block and the head sealing surfaces.



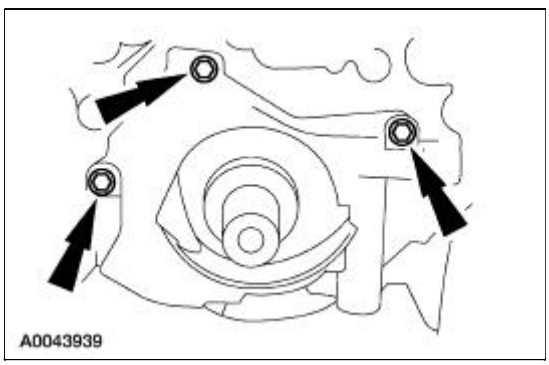
52. Remove the bolts and remove the oil pump screen cover and tube and the spacer.



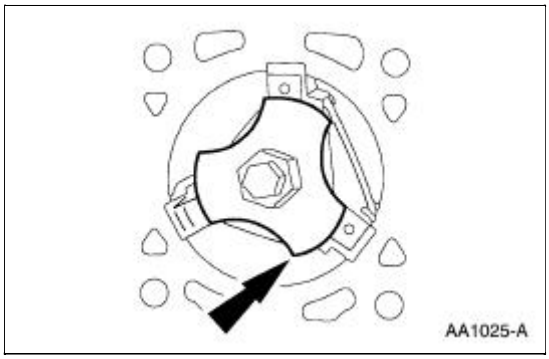
53. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

    Remove the bolts and remove the oil pump.

    - Remove the gasket. Clean and inspect the sealing surfaces.



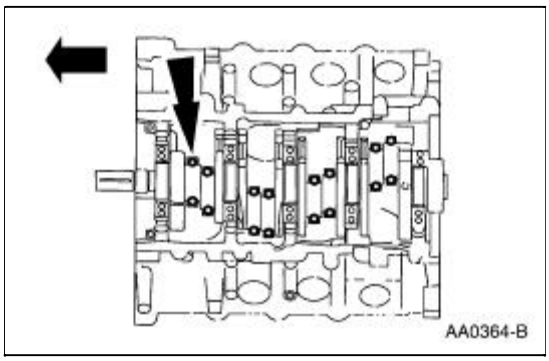
54. Before removing pistons, inspect the top of the cylinder bores. If necessary, remove the ridge or carbon deposits from each cylinder using a Cylinder Ridge Reamer, following manufacturer's instructions.



55. **CAUTION: Do not stamp the top of pistons. This may cause ring land damage.**

NOTE: Connecting rods and rod caps should be numbered to keep the correct orientation.

Remove the bolts and the connecting rod caps for pistons number 1 and 6.



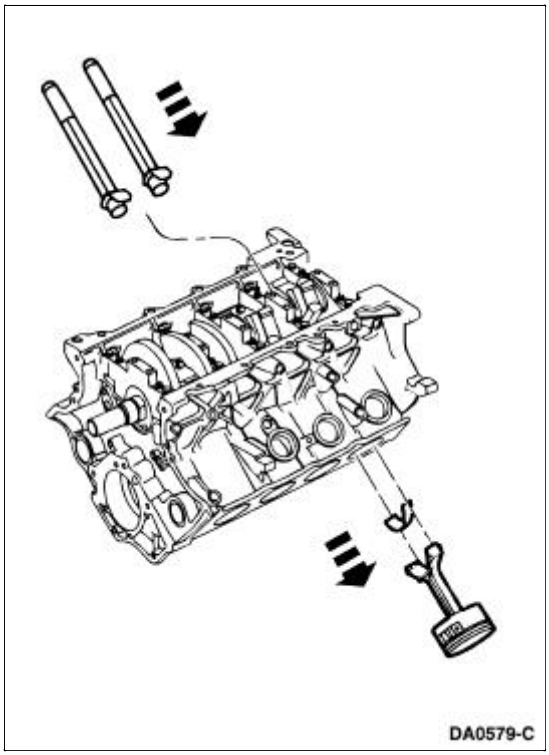
56. **NOTE:** Carefully tap connecting rod bolts out. Avoid damaging the rod cap.

Discard the bolts.

57. **CAUTION: Do not scratch the cylinder walls or crankshaft journals with the connecting rod.**

NOTE: Connecting rod guides shown uninstalled for clarity.

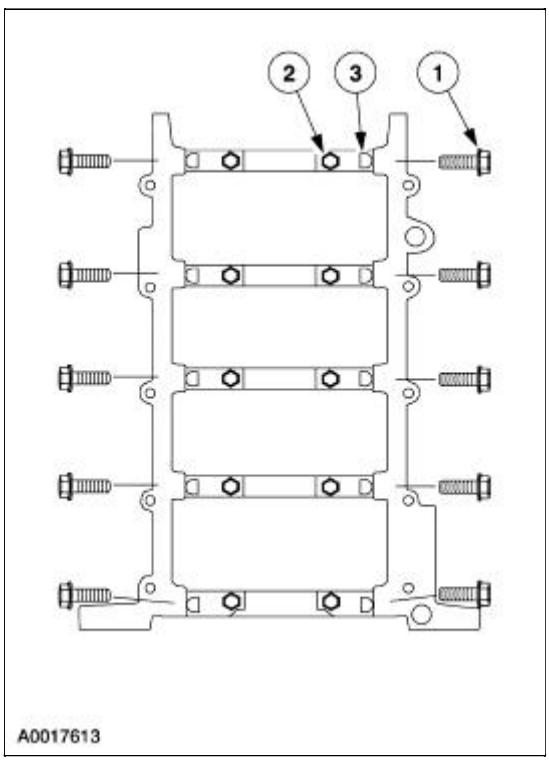
Install the Connecting Rod Guides and push the pistons number 1 and 6 through the top of the cylinder block (6010).



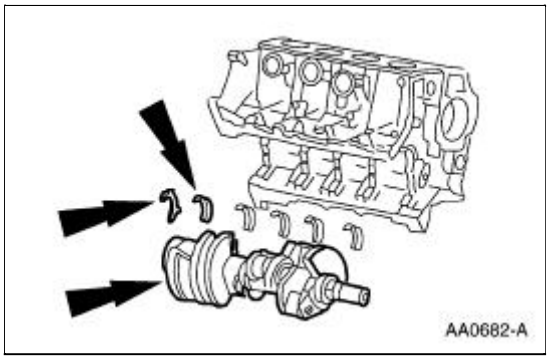
58. To remove pistons 3 and 5, 4 and 7, 2 and 8, turn crankshaft 90 degrees and repeat the previous steps.

59. **NOTE:** Crankshaft not shown for clarity.

    Remove the crankshaft main bearing caps.
    1. Remove and discard the side bolts.
    2. Remove and discard the main bearing cap bolts.
    3. Remove the dowel pins.

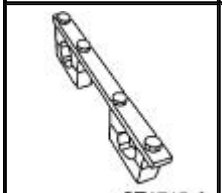


60. Remove the crankshaft (6303), the crankshaft thrust washer (6334), and the crankshaft upper main bearings from the cylinder block.



Cylinder Head

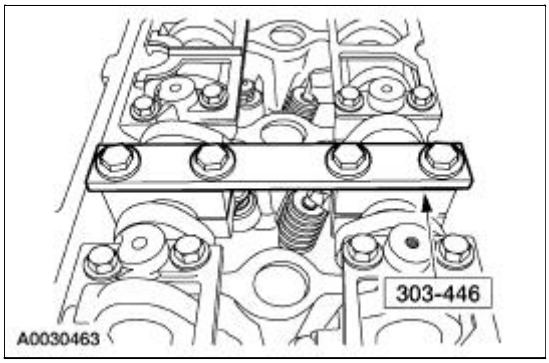
Special Tool(s)

 ST2648-A	Compressor, Valve Spring 303-567 (T97P-6565-AH)
 ST1718-A	Compressor, Valve Spring 303-452 (T93P-6565-AR)
 ST1715-A	Holding Tool, Camshaft 303-446 (T93P-6256-AHR)
 ST1332-A	Installer, Valve Stem Oil Seal 303-383 (T91P-6571-A)
 ST1331-A	Compressor Spacer, Valve Spring 303-382 (T91P-6565-AH)

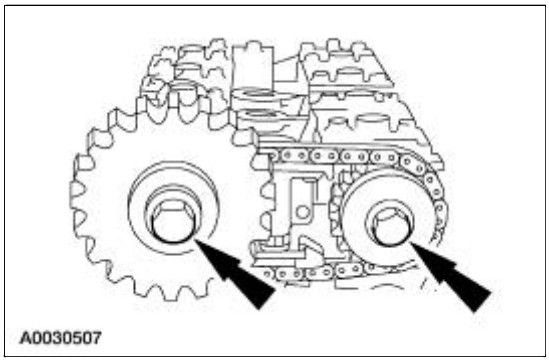
Disassembly

1. **CAUTION: Before disassembly begins, mark the valve position on the face of each valve being removed. The valves must be installed in their original positions.**

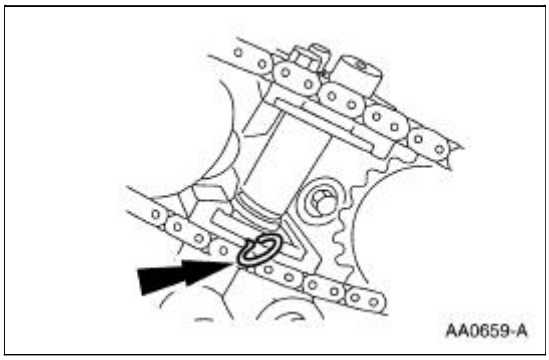
   Install the special tool.



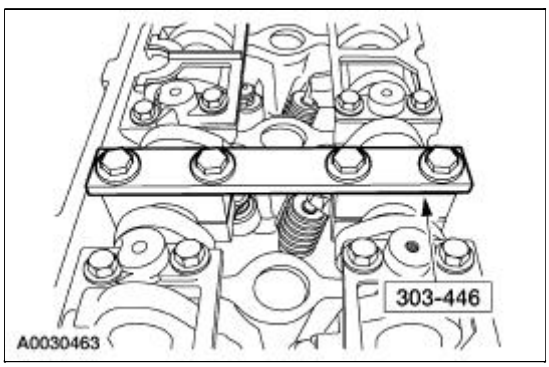
2. Remove the exhaust camshaft sprocket and the intake camshaft bolt, washer and spacer.



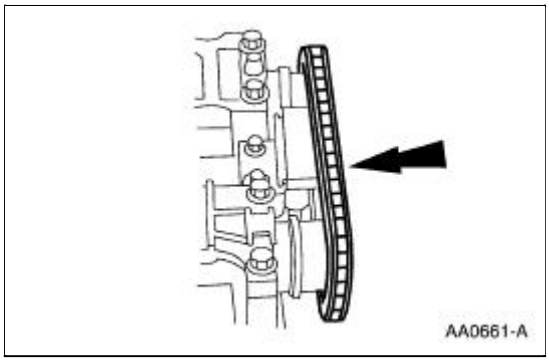
3. Compress the tensioner and install a lock pin.



4. Remove the special tool.

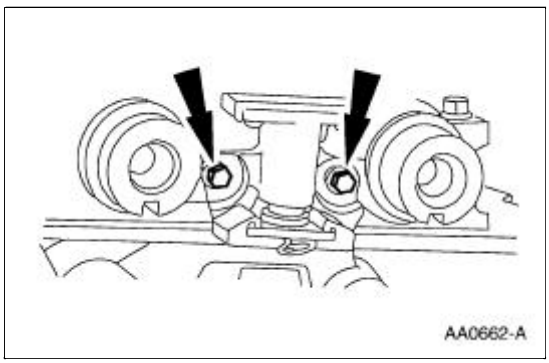


5. Remove the timing chain and the camshaft sprocket.

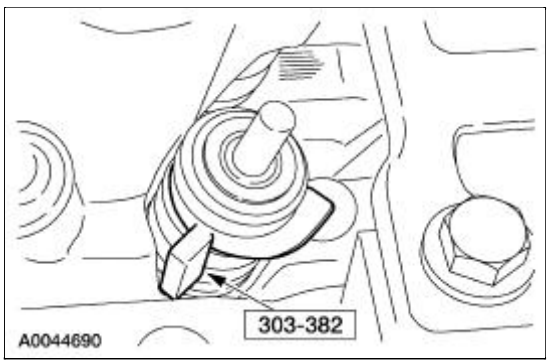


6. **NOTE:** LH tensioner shown, RH tensioner similar.

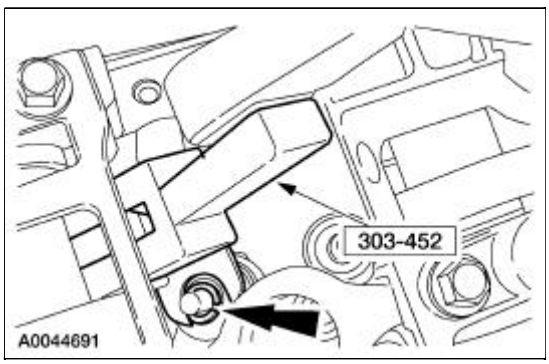
   Remove the tensioner.



7. Install the special tool between the valve spring coils to protect the intake valve stem seal from damage.

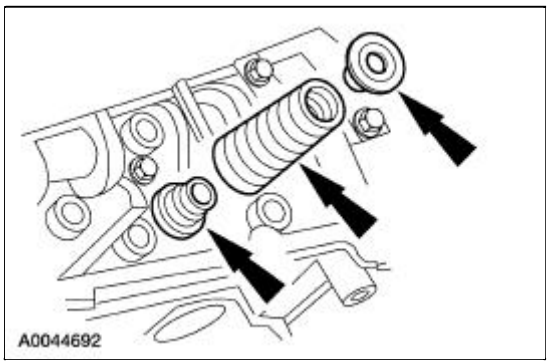


8. Using the special tool, compress the intake valve spring. Remove the intake valve spring retainer keys.



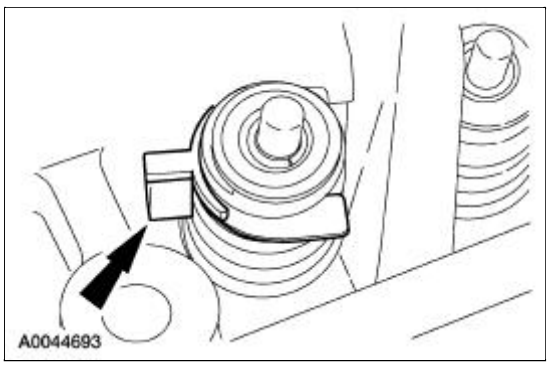
9. **NOTE:** Valve stem seals should be visually inspected if new seals are not installed.

   Remove the special tool, the valve spring retainer, the valve spring and the valve stem seal.

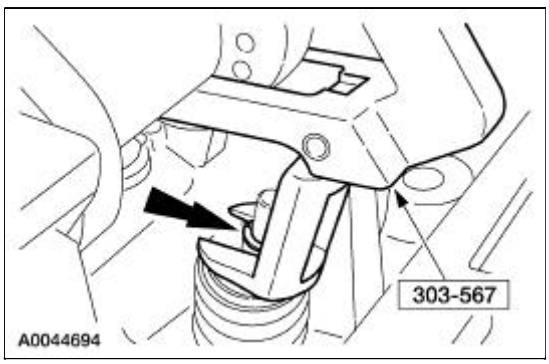


10. Repeat above three steps to remove all necessary intake valve spring assemblies.

11. Install the special tool between the valve spring coils to protect the exhaust valve stem seal from damage.

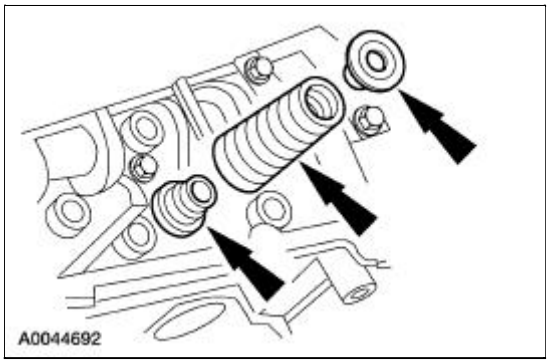


12. Using the special tool, compress the exhaust valve spring. Remove the exhaust valve spring retainer keys.



13. **NOTE:** Valve stem seals should be visually inspected if new seals are not installed.

    Remove the special tool, the valve spring retainer, the valve spring and the valve stem seal.

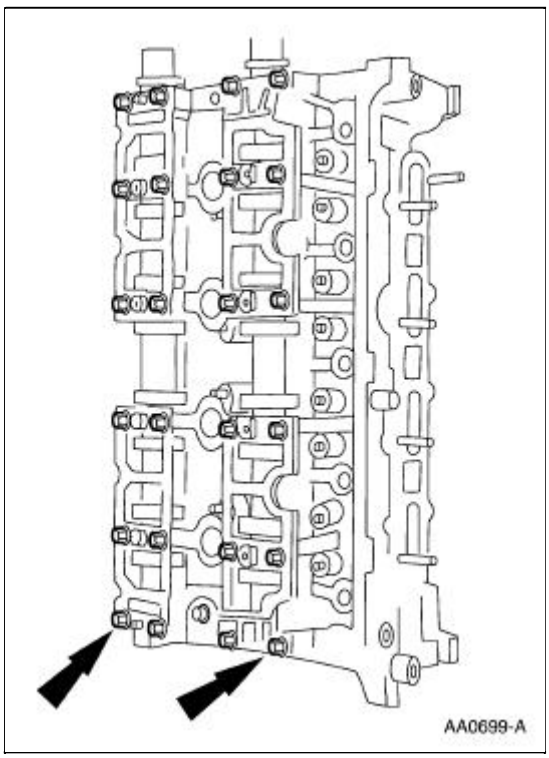


14. Repeat above three steps to remove all necessary exhaust valve spring assemblies.

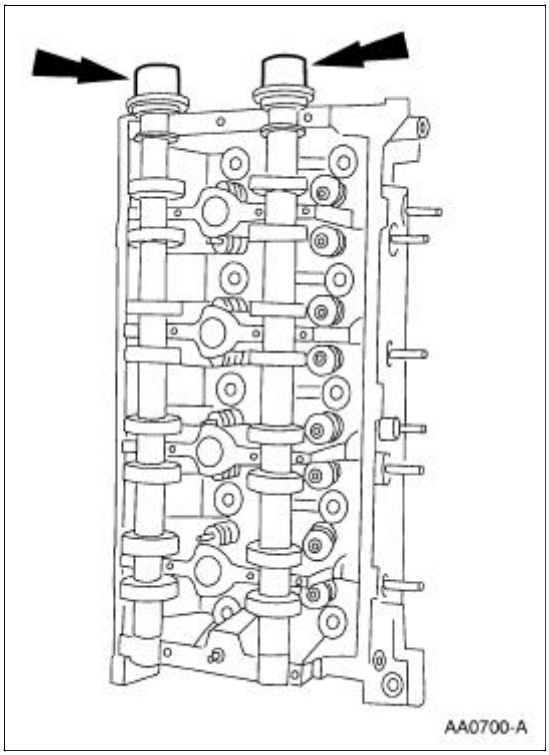
15. **CAUTION: The outer bolts on the outer cam bearing cap (exhaust) are longer and must be returned to the same location or engine damage can occur.**

    NOTE: Identify the camshaft-to-cylinder head location. Caps are not interchangeable.

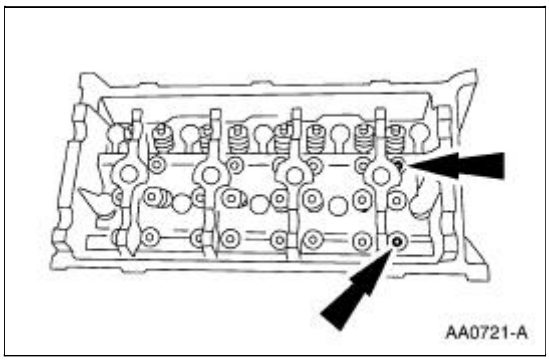
    Remove the bolts and the camshaft bearing cap assemblies.



16. Remove the camshafts.

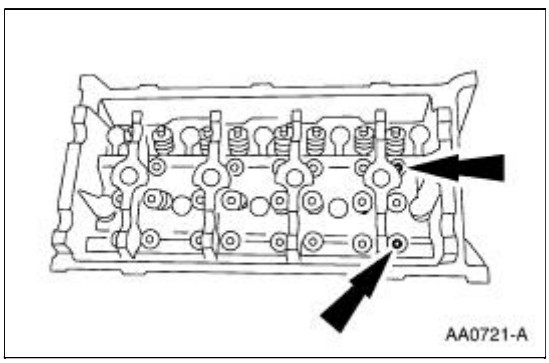


17. Remove the hydraulic lash adjusters.



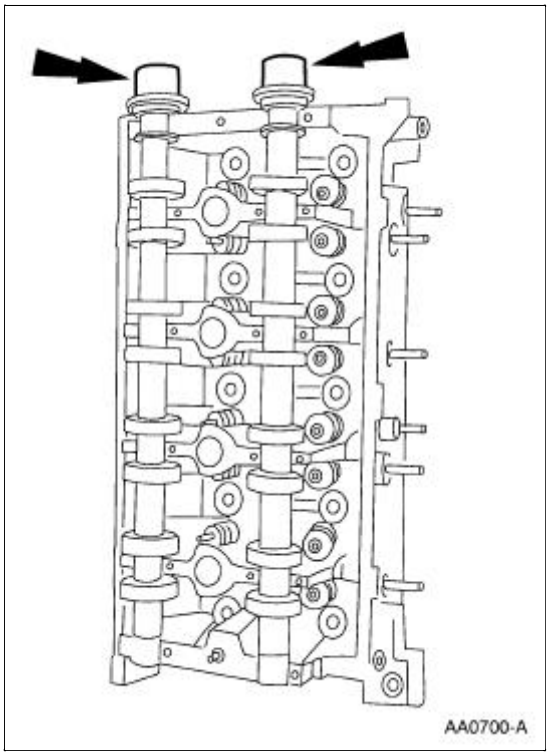
Assembly

1. Install the hydraulic lash adjusters.

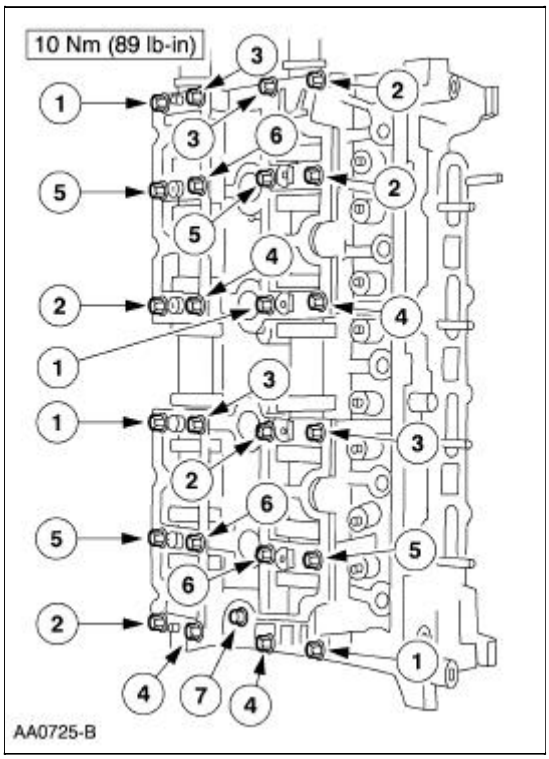


2. **NOTE:** LH shown, RH similar.

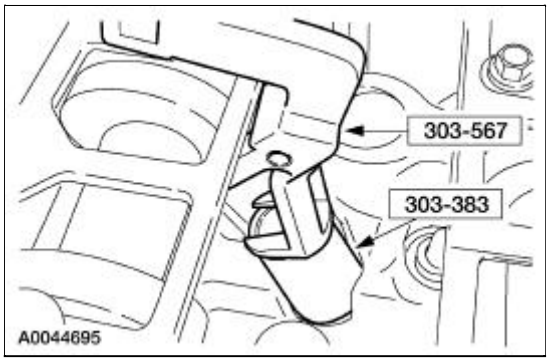
   Install the camshafts.



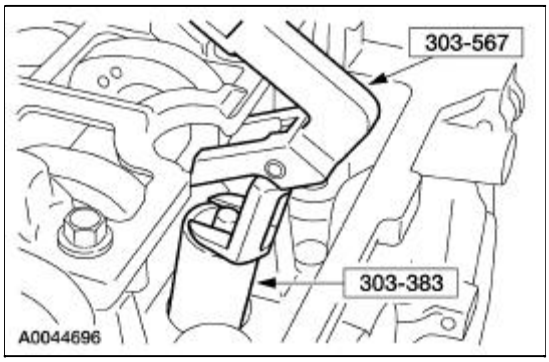
3. Install the camshaft bearing cap assemblies.



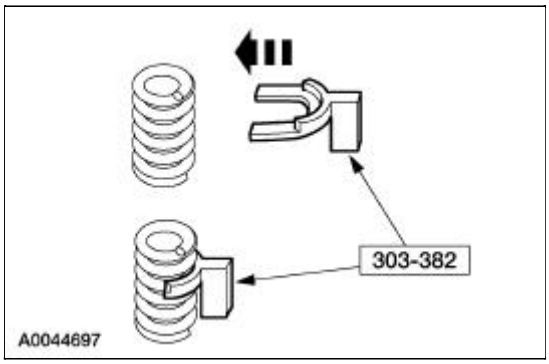
4. Using the special tools, install the new intake valve stem seals. Repeat this step to install all necessary intake valve stem seals.



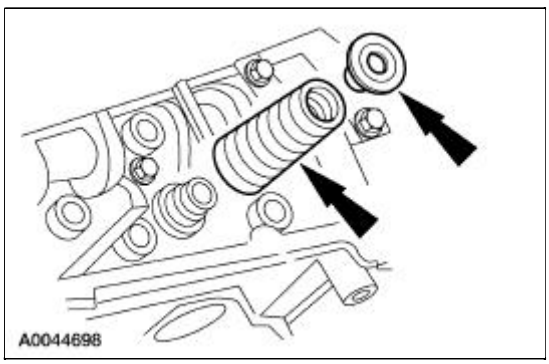
5. Using the special tools, install the new exhaust valve stem seals. Repeat this step to install all necessary exhaust valve stem seals.



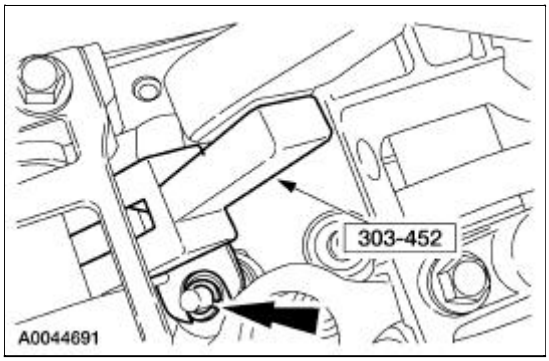
6. Install the special tool between the valve spring coils to protect the intake valve stem seal from damage.



7. Position the intake valve spring and the spring retainer over the intake valve stem and the valve seal.

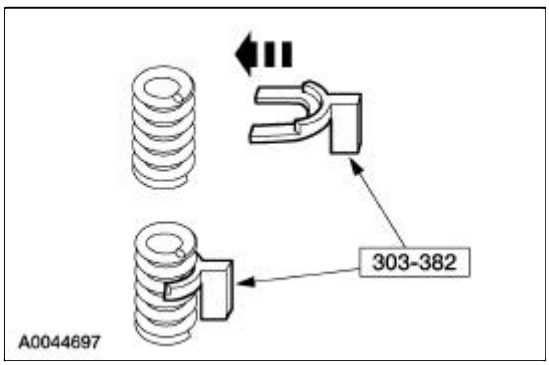


8. Using the special tool, compress the intake valve spring. Install the intake valve spring retainer keys.

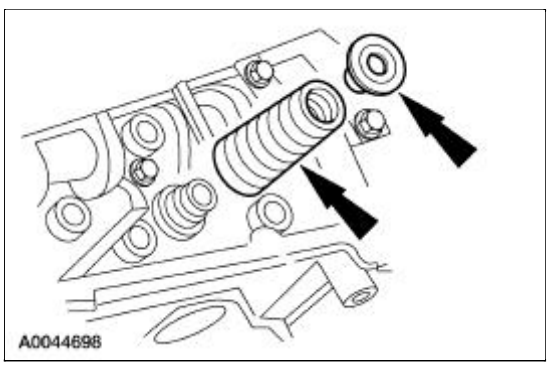


9. Repeat above three steps to install all necessary intake valve spring assemblies.

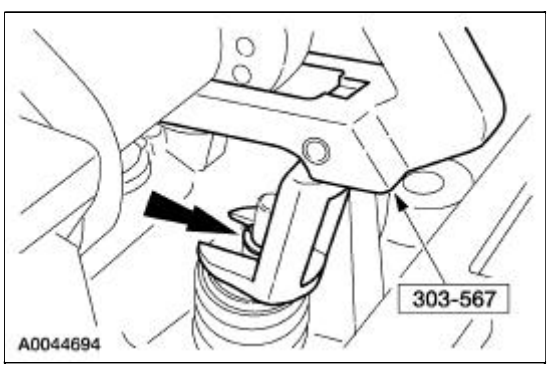
10. Install the special tool between the valve spring coil to protect the exhaust valve stem seal from damage.



11. Position the exhaust valve spring and the spring retainer over the exhaust valve stem and the valve seal.



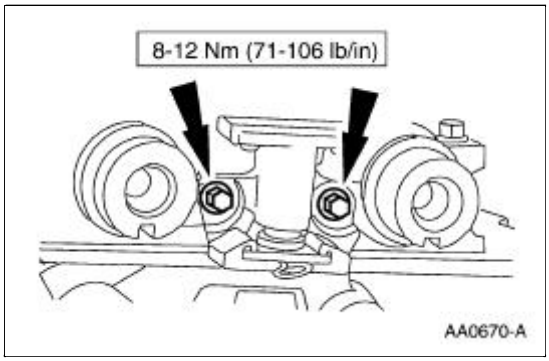
12. Using the special tool, compress the exhaust valve spring. Install the exhaust valve spring retainer keys.



13. Repeat above three steps to install all necessary exhaust valve spring assemblies.

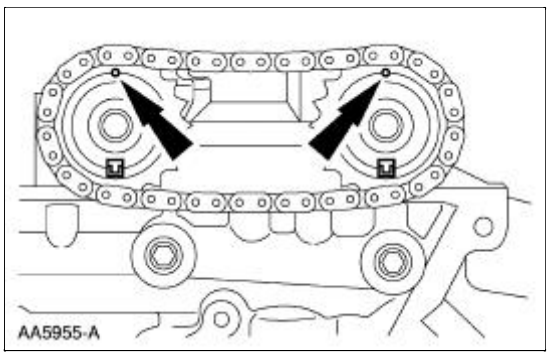
14. **NOTE:** LH tensioner shown, RH tensioner similar.

    Install the tensioner.

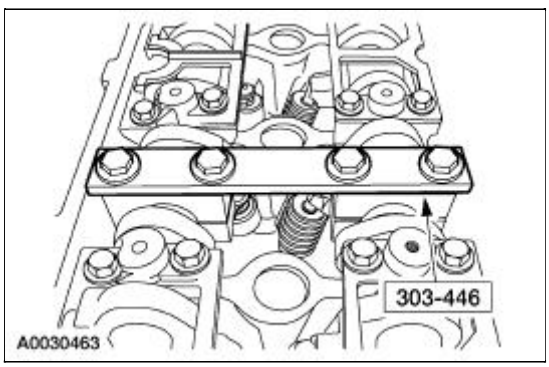


15. **CAUTION: Timing marks must be at 12 o'clock and indexed at 6 o'clock.**

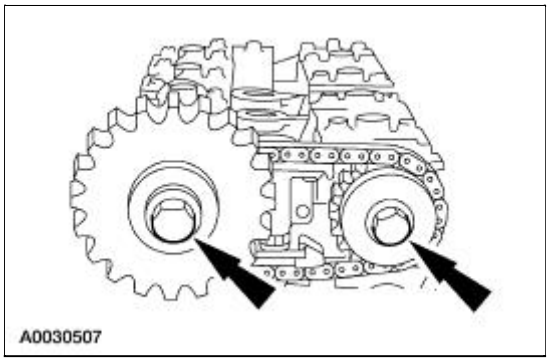
    Install the camshaft sprockets and the chain as an assembly.



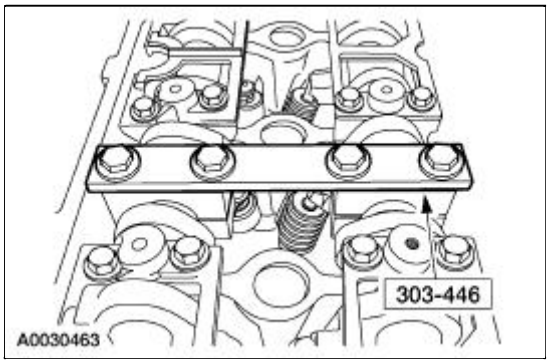
16. Install the special tool.



17. Tighten the exhaust camshaft sprocket and the intake camshaft bolt washer and spacer in two stages:
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Tighten an additional 90 degrees.



18. Remove the special tool.



Piston

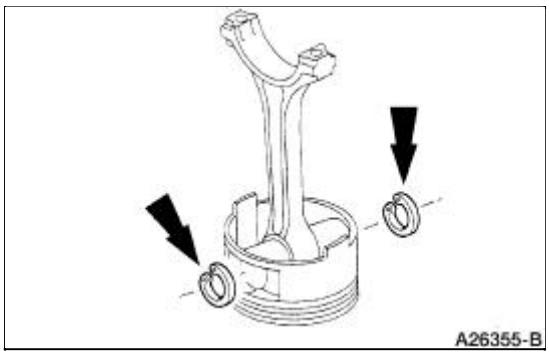
Material

Item	Specification
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

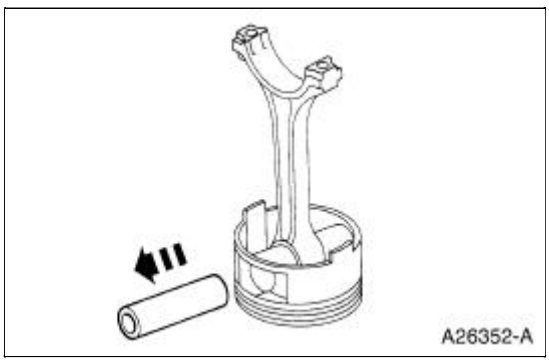
Disassembly

1. **NOTE:** Connecting rods and rod caps are a matched set and cannot be interchanged.

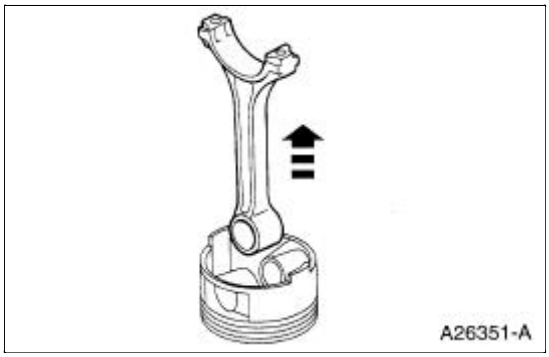
   Remove the clips.



2. Remove the piston pin (6135) from the piston (6108) and connecting rod assembly.



3. Remove the connecting rod (6200) from the piston.

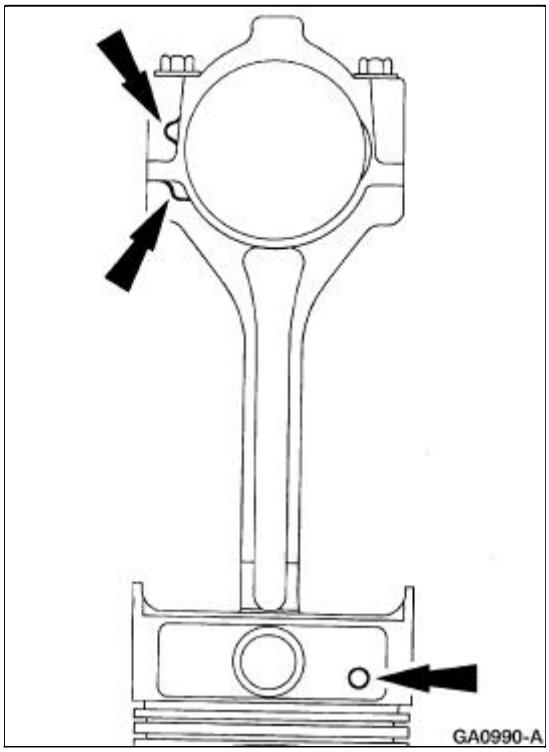


4. Clean and inspect the piston and connecting rod. For additional information, refer to Section 303-00 .

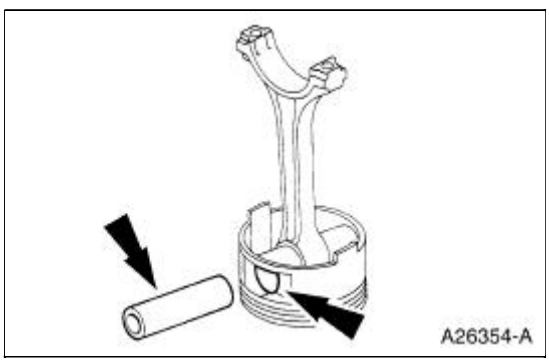
Assembly

1. **NOTE:** Connecting rod must be installed into piston with identification markings toward front.

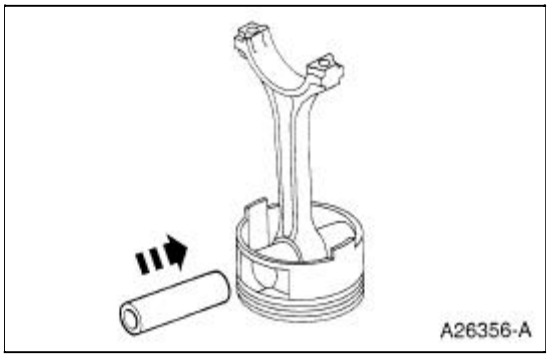
   Position the connecting rod in the piston.



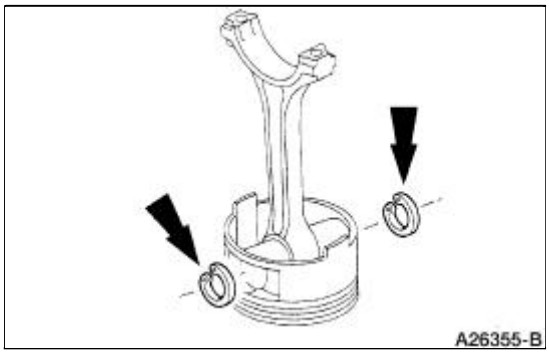
2. Lubricate the piston pin and pin bore with clean engine oil.



3. Install the piston pin in the piston and connecting rod assembly.

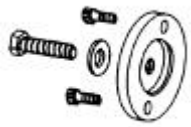
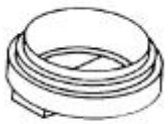
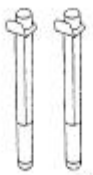


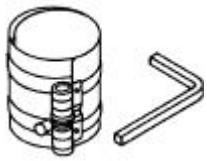
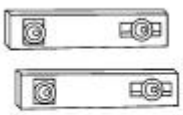
4. Install the piston pin retaining clips in the piston.



Engine

Special Tool(s)

 ST1480-A	Installer, Crankshaft Rear Oil Seal 303-518 (T95P-6701-DH)
 ST1479-A	Installer, Crankshaft Rear Oil Seal 303-516 (T95P-6701-BH)
 ST1482-A	Installer, Crankshaft Rear Oil Seal 303-517 (T95P-6701-CH)
 ST2443-A	Lifting Bracket Set, Engine 303-DS086 (D93P-6001-A)
 ST1337-A	Installer, Connecting Rod 303-442 (T93P-6136-A)
 ST2197-A	Installer, Crankshaft Front Oil Seal 303-635
 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)
	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A)

 ST1328-A	
	Compressor, Piston Ring 303-D032 (D81L-6002-C) or equivalent
 ST1377-A	Modular Engine Lift Bracket 303-F047 (014-00073) or equivalent
 ST2361-A	Alignment Plate, Camshaft 303-445 (T93P-6256-A)
 ST2373-A	Compressor, Valve Spring (Exhaust Side) 303-567 (T97P-6565-AH)
 ST1718-A	Compressor, Valve Spring (Intake Side) 303-452 (T93P-6565-AR)
 ST1335-A	Holding Tool, Crankshaft 303-448 (T93P-6303-A)

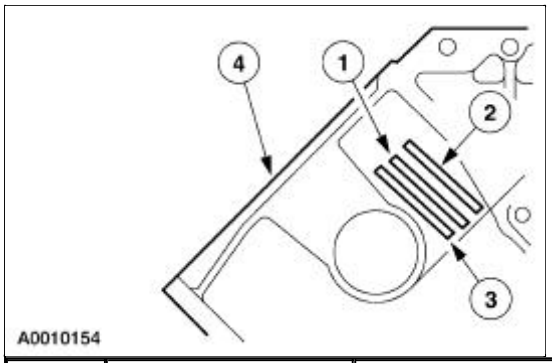
Material

Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Assembly

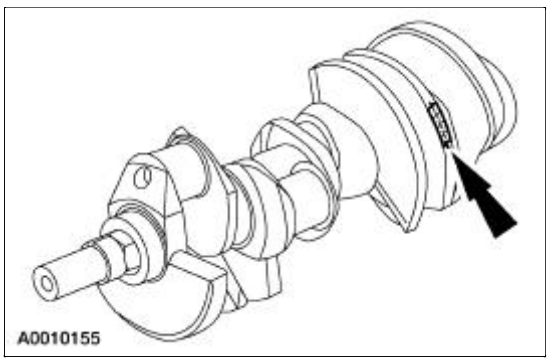
NOTE: During engine assembly it may become necessary to check bearing clearances, end play etc. For additional information, refer to Section 303-00 .

1. Read the first character code information on the cylinder block face (1) and record the information.

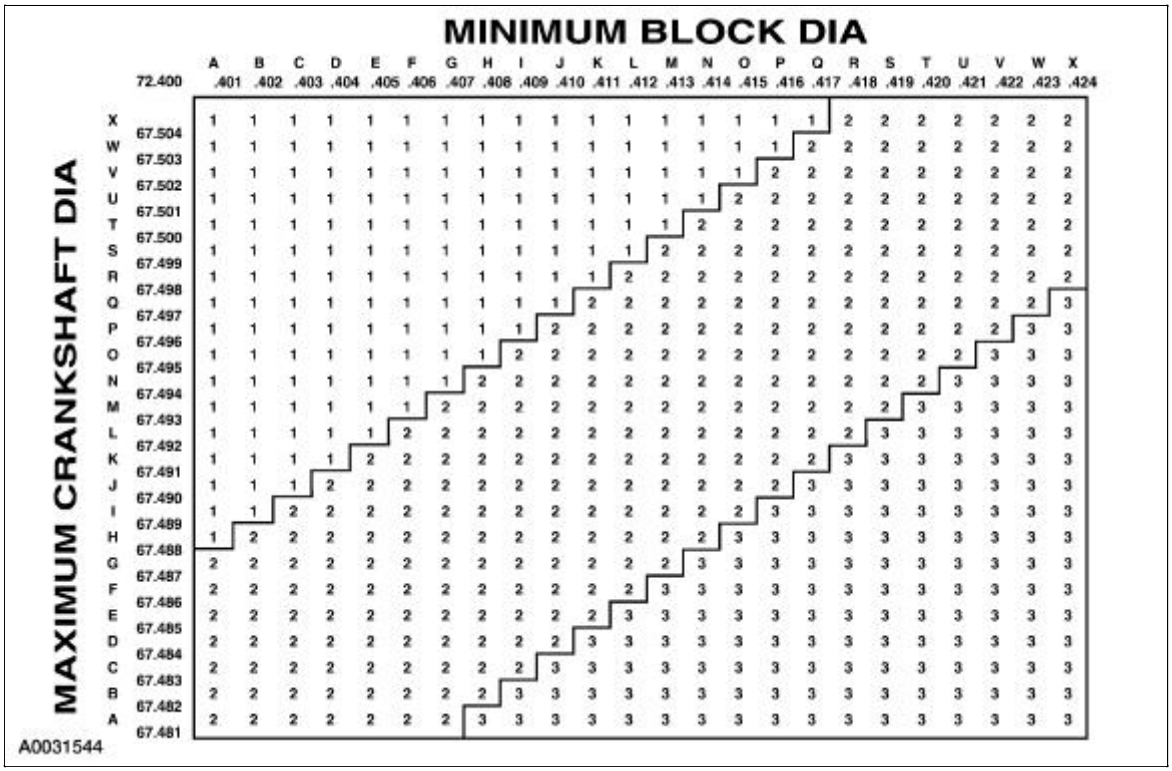


Item	Part Number	Description
1	—	Cylinder block identification
2	—	Cylinder bore grade
3	—	Cylinder block serial number
4	6010	Cylinder block front face

2. Read the first character on the No. 7 crankshaft counterweight and note it.

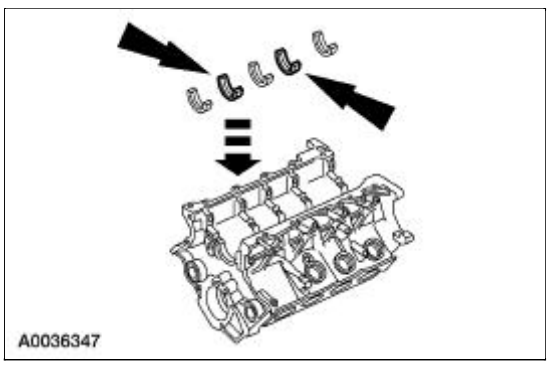


3. Using the data recorded in the previous two steps, cross-reference using the chart to obtain bearing grade.



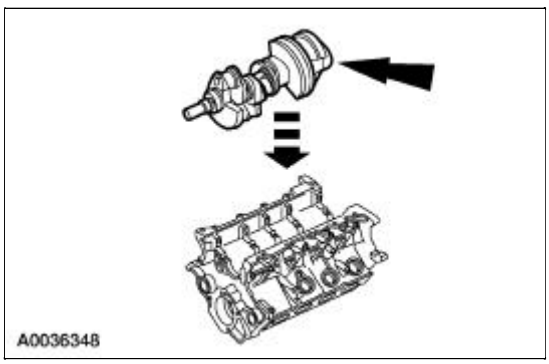
4. **NOTE:** Before assembling the cylinder block, all sealing surfaces must be free from chips, dirt, paint and foreign material. Also, make sure the coolant and oil passages are clear.

   Lubricate the crankshaft main bearings with clean engine oil and install into the cylinder block. Install the crankshaft main bearings into the main bearing caps.



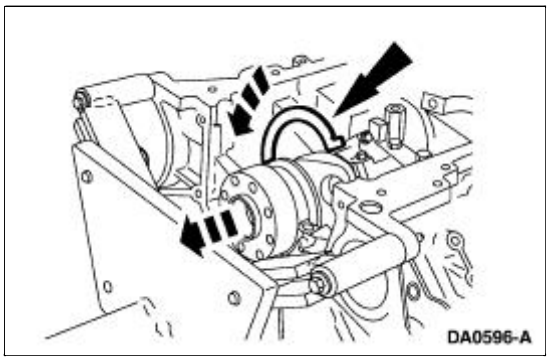
5. **NOTE:** Do not install the upper thrust bearings until the crankshaft is installed.

   Install the crankshaft onto the upper main bearings.



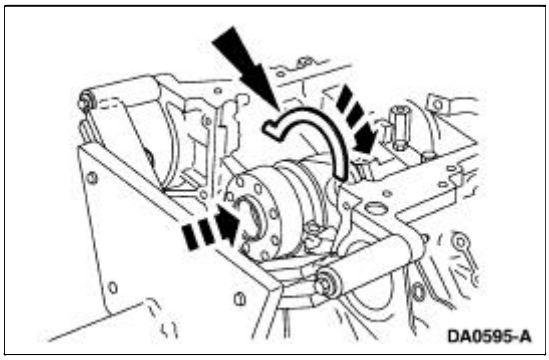
6. **CAUTION: Make sure the side of the thrust washer with three 5-mm wide oil grooves faces the crankshaft thrust surface.**

   Push the crankshaft rearward and install the crankshaft thrust washer at the back of the No. 5 main boss.



7. **CAUTION: Make sure the side of the thrust washer with three 5-mm wide oil grooves faces the crankshaft thrust surface.**

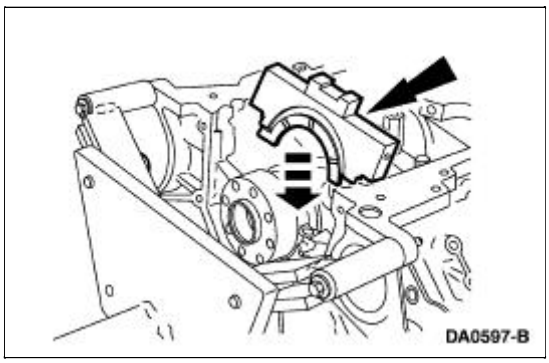
   Push the crankshaft forward and install the front crankshaft upper thrust washer at the front of the No. 5 main boss.



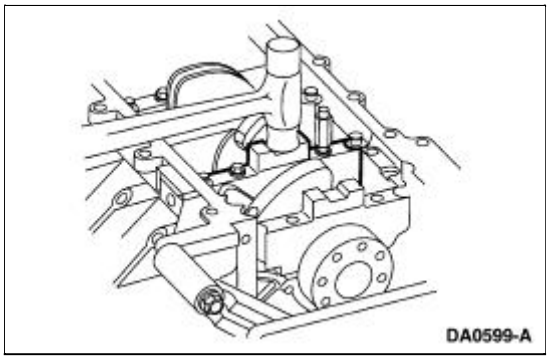
8. **CAUTION: Make sure the side of the thrust washer with three 5-mm wide oil grooves faces the rear of the engine.**

   NOTE: To aid in assembly apply petroleum jelly to the back of the crankshaft thrust washer.

   Install the lower crankshaft thrust washer to the back side of the No. 5 main bearing cap, with the oil grooves facing the crankshaft surface.

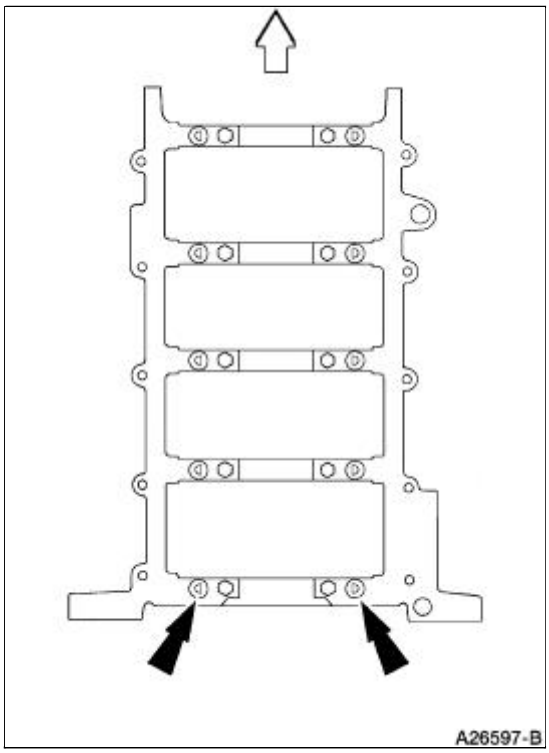


9. Install the crankshaft lower main bearings into the main bearing caps. Locate the main bearing cap on the cylinder block and tap into place using a plastic or deadblow hammer.



10. **NOTE:** Crankshaft not shown for clarity.

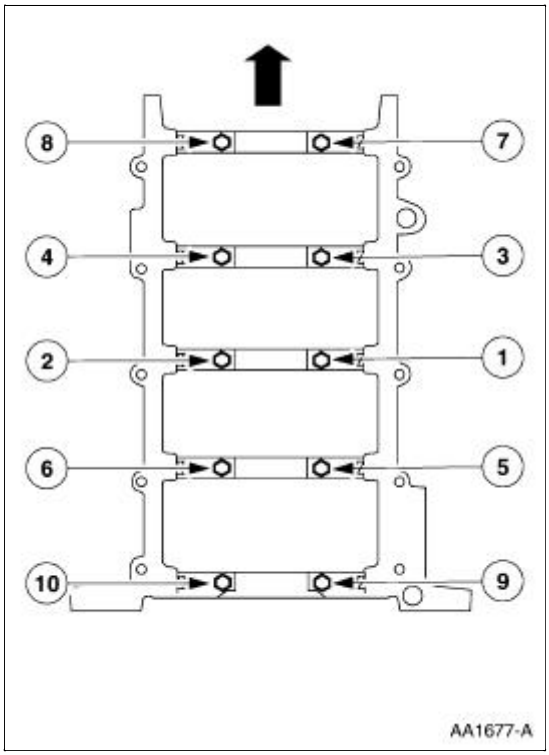
    Install the main bearing cap dowel pins so the flat sides face the crankshaft.



11. **NOTE:** Crankshaft not shown for clarity.

    Install and tighten the new bolts in two stages:

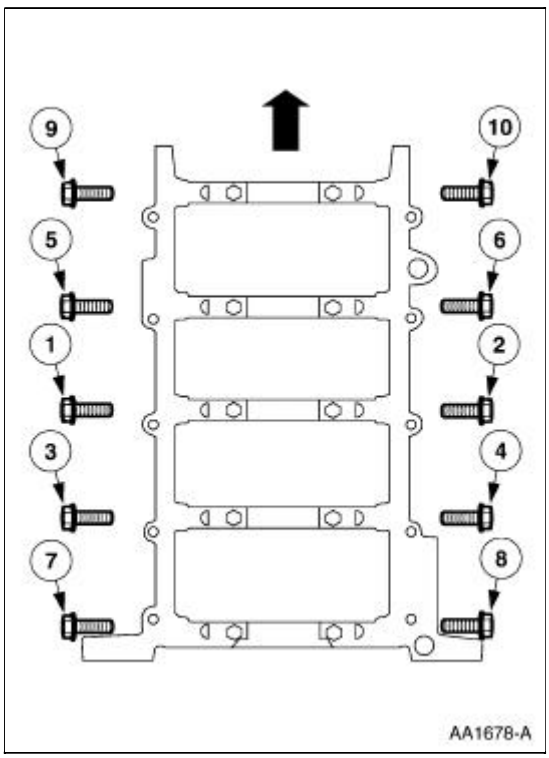
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Tighten an additional 90 degrees.



12. **NOTE:** Crankshaft not shown for clarity.

    Install and tighten the new cross-mounted bolts in two stages:

    - Stage 1: Tighten to 30 Nm (22 lb-ft).
    - Stage 2: Tighten an additional 90 degrees.

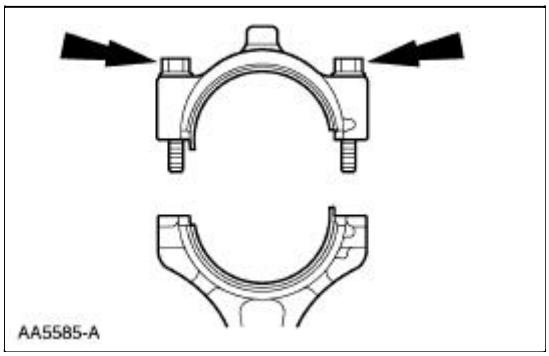


13. **NOTE:** Verify the connecting rods and rod caps for correct orientation.

    NOTE: Carefully tap the connecting rod bolts in. Avoid damaging the connecting rod.

Prepare the connecting rod and caps.

- Insert the bolts in the rod cap.
- Insert the upper and lower rod bearings into the rod and cap.

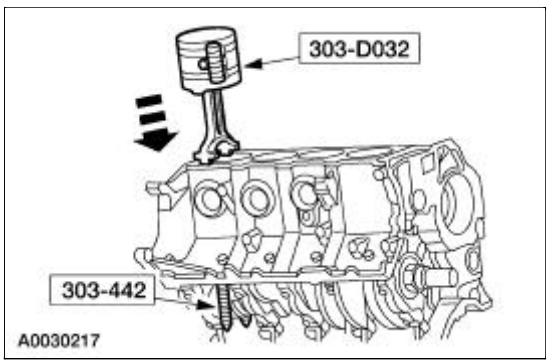


14. **CAUTION: Do not scratch the cylinder walls or crankshaft journals with the connecting rod.**

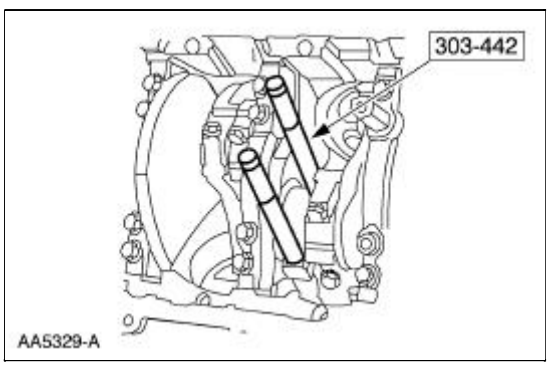
NOTE: Make sure the piston arrow is facing forward.

Using the special tools, install the No. 1 and No. 6 piston and connecting rod assemblies.

- Lubricate the piston and ring with clean engine oil.
- Lubricate the rod bearings with clean engine oil.



15. Seat the connecting rods on the crankshaft journals and remove the special tools.

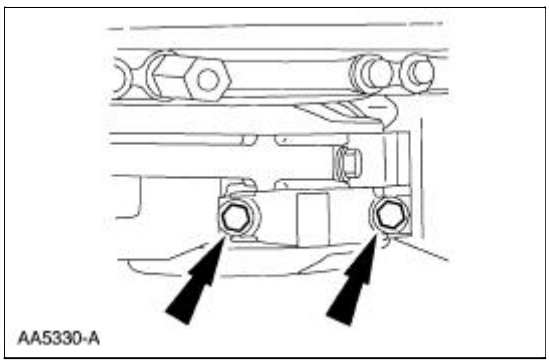


16. **CAUTION: The rod bearing caps must keep the same orientation as marked during disassembly.**

NOTE: The rod bearing cap bolts are torque-to-yield. Install new bolts each time repaired.

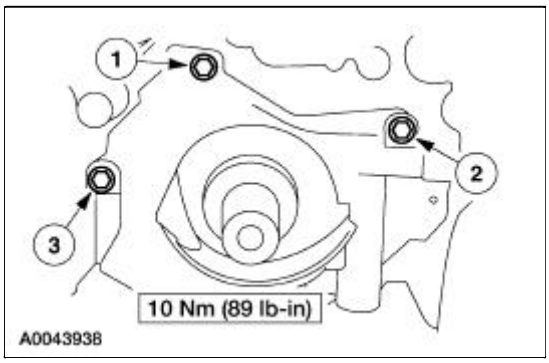
Install the rod bearing caps and tighten the bolts in three stages:

- Stage 1: Tighten to 25 Nm (18 lb-ft).
- Stage 2: Tighten to 45 Nm (30 lb-ft).
- Stage 3: Tighten an additional 90 degrees.

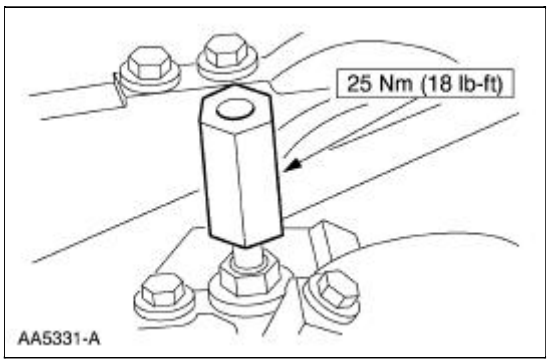


17. Install the piston connecting rod assemblies 3 and 5, 4 and 7, 2 and 8, by turning the crankshaft 90 degrees and repeating the previous steps.

18. Position the oil pump and gasket and install the bolts in the sequence shown.



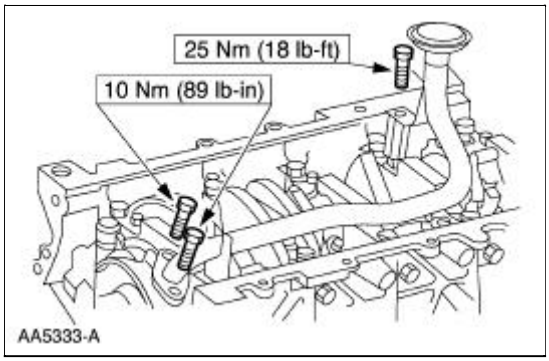
19. Install and tighten the oil pump screen and cover spacer.



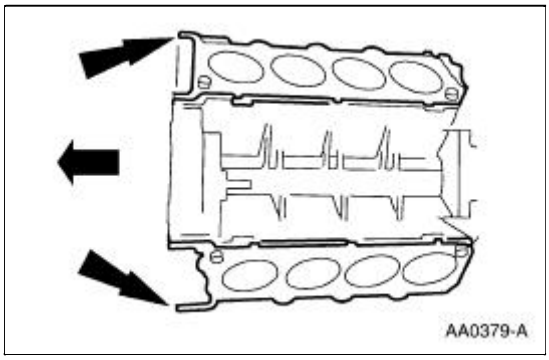
20. **CAUTION: Make sure the O-ring is in place and not damaged. A missing or damaged O-ring can cause foam in the lubrication system, low oil pressure and severe engine damage.**

NOTE: Clean and inspect the mating surfaces and install a new O-ring. Lubricate with clean engine oil.

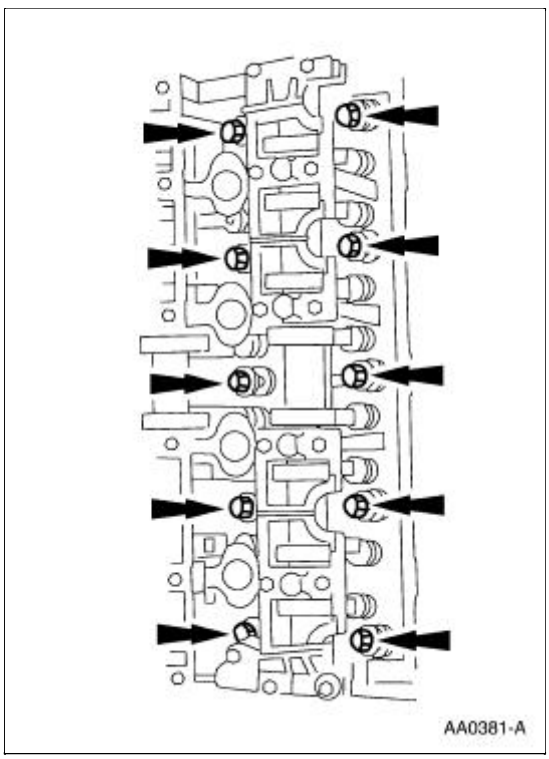
Install the oil pump screen cover and tube, and the bolts.



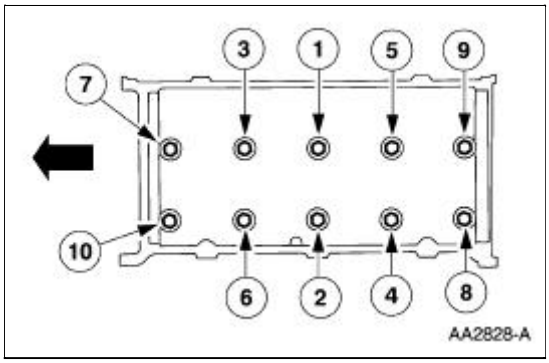
21. Install the cylinder head gaskets.



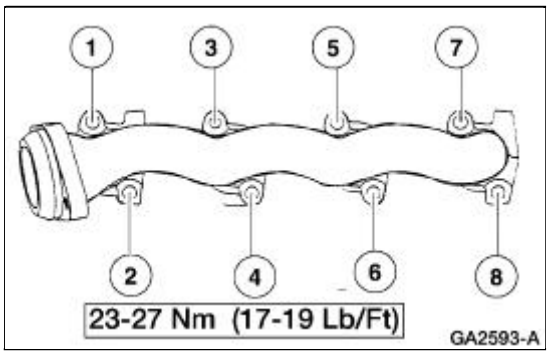
22. Install the LH and the RH cylinder heads. Loosely install the new bolts.



23. Tighten the LH and RH bolts in three stages, in the sequence shown.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Tighten an additional 90 degrees.
    - Stage 3: Tighten an additional 90 degrees.

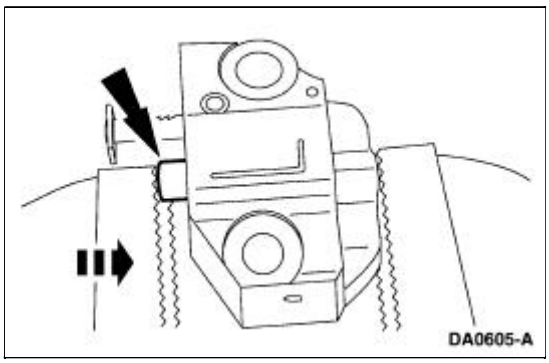


24. Install RH exhaust manifold gaskets and the exhaust manifold.
    - Tighten the nuts in the sequence shown.

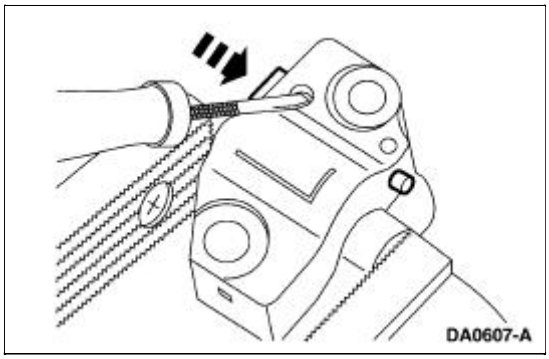


25. **CAUTION: Timing chain procedures must be followed exactly or damage to the pistons or valves can result.**

    Compress the tensioner plunger, using the edge of a soft-jawed vise.

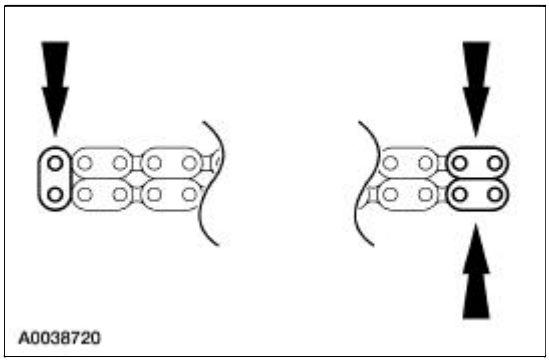


26. Install a paper clip into the hose in the tensioner housing to hold the ratchet assembly.
    - Remove the tensioner from the vise.

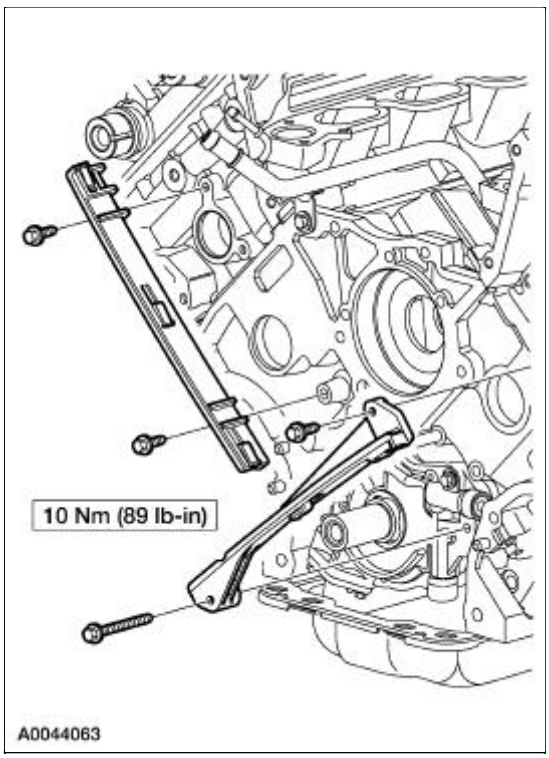


27. **NOTE:** There are 61 links in the timing chain.

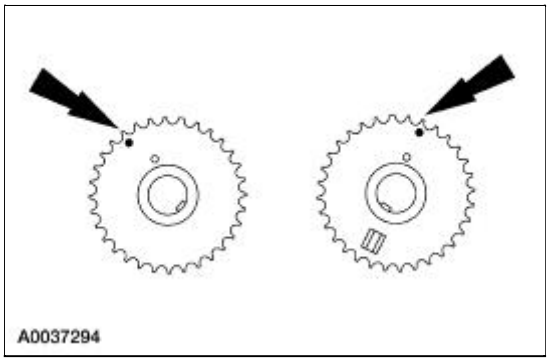
    If the copper links are not visible, mark two links on one end and one link on the other end, and use as timing marks.



28. Install the timing chain guides.

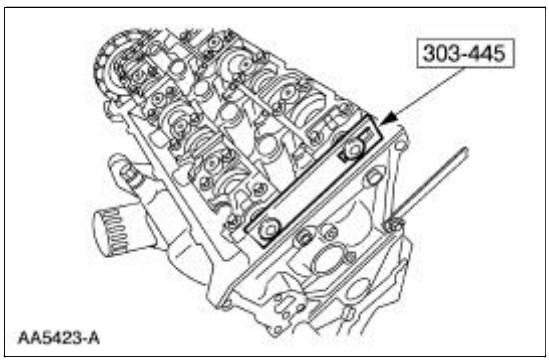


29. Rotate the LH camshaft sprocket until the timing mark is approximately at the 12 o'clock position. Rotate the RH camshaft timing sprocket until the timing mark is approximately in the 11 o'clock position.

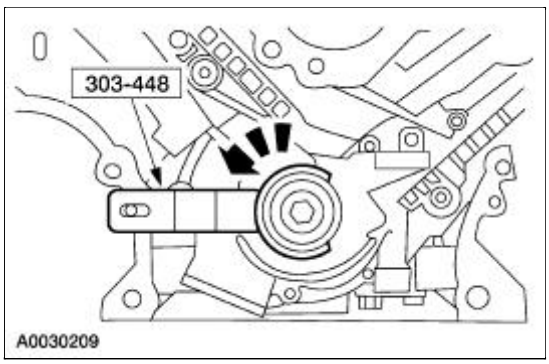


30. **NOTE:** LH shown, RH similar.

    Install the special tools on the LH and RH cylinder heads.

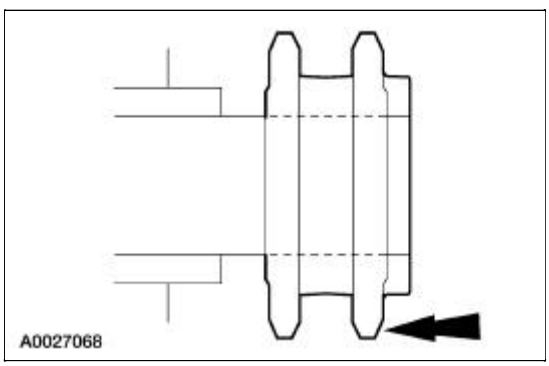


31. Using the special tool, position the crankshaft.

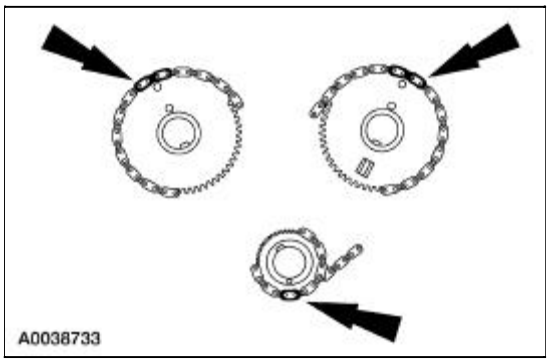


32. Remove the special tool.

33. Install the crankshaft sprocket with the timing mark facing outward.

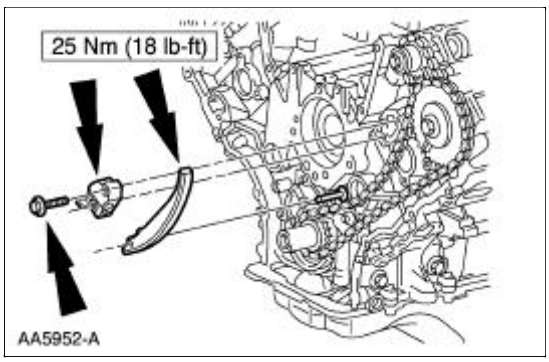


34. Install the LH and RH timing chain onto the crankshaft and camshaft sprockets.
    - Align the two copper (marked) links with the timing mark on the camshaft sprocket.
    - Align the one copper-colored link with the timing mark on the crankshaft sprocket.

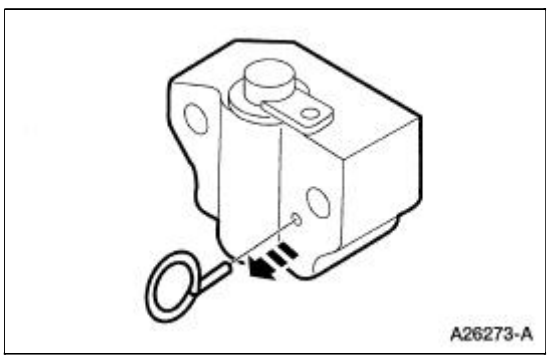


35. **NOTE:** LH shown, RH similar.

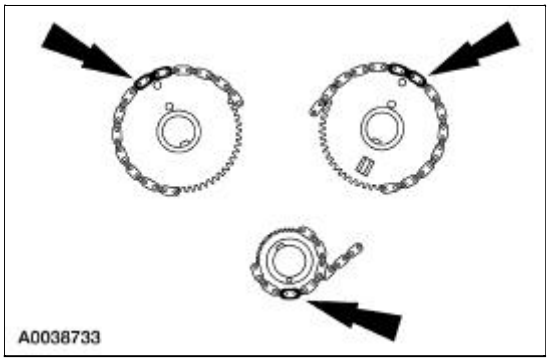
    Position the tensioner arms and tensioners, and install the bolts.



36. Remove the paper clip.

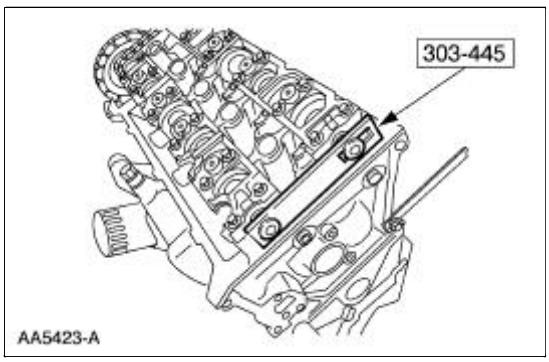


37. Verify the camshaft and crankshaft sprocket to copper link alignment.



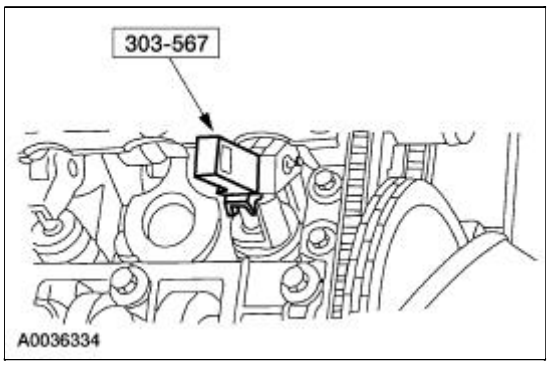
38. **NOTE:** LH shown, RH similar.

    Remove the special tools from the LH and RH cylinder heads.

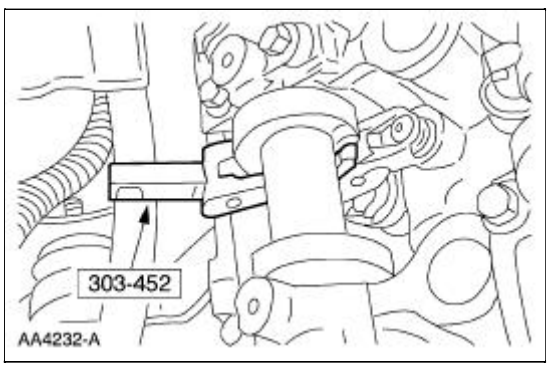


39. Position the camshaft lobes at the base circle.

40. Using the special tool, compress the exhaust valve springs and install the roller followers.

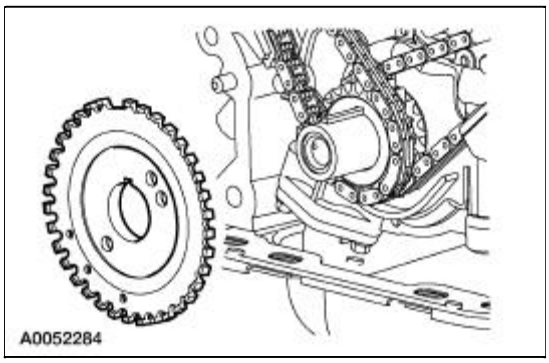


41. Using the special tool, compress the intake valve springs and install the roller followers.

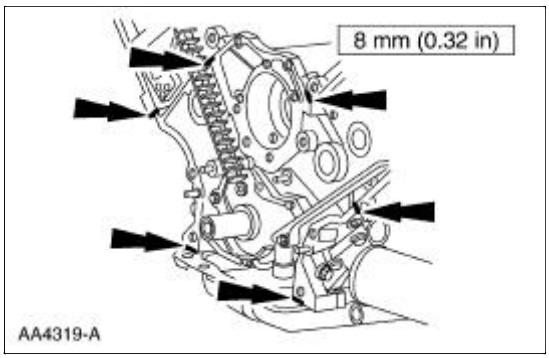


42. Repeat the previous steps to install all roller followers.

43. Position the crankshaft sensor ring on the crankshaft.

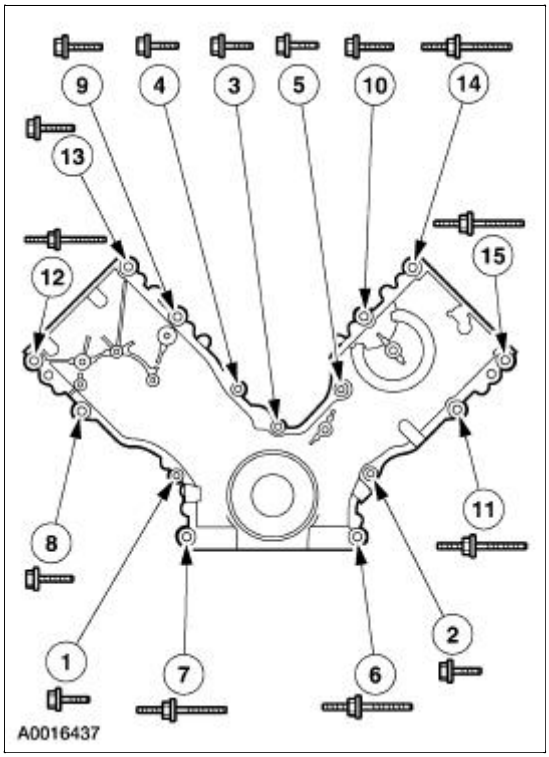


44. Apply silicone gasket sealant in the locations shown.

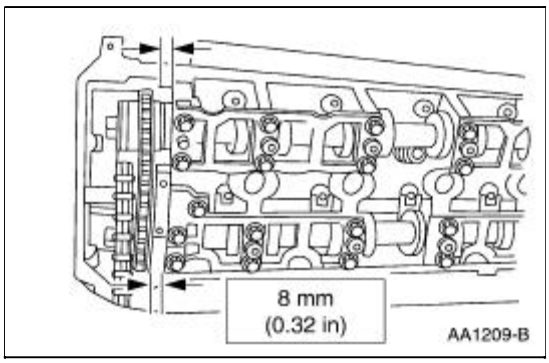


45. Position the engine front cover and install the bolts and the studs in three stages:
Stage 1: Tighten numbers one through five to 25 Nm (18 lb-ft).
Stage 2: Tighten numbers six and seven to 50 Nm (37 lb-ft).
Stage 3: Tighten numbers 11 through 15 to 25 Nm (18 lb-ft).

Item	Part Number	Description
1	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
2	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
3	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
4	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
5	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
6	N808529	Stud, Hex-Head Pilot, M10 x 1.5 x 30
7	N808529	Stud, Hex-Head Pilot, M10 x 1.5 x 30
8	N806177	Bolt, Hex-Head Flange, M8 x 1.25 x 50
9	N806177	Bolt, Hex-Head Flange, M8 x 1.25 x 50
10	N806177	Bolt, Hex-Head Flange, M8 x 1.25 x 50
11	N806300	Stud, Hex Shoulder Pilot, M8 x 1.25 x 65 - M8 x 1.25 x 27
12	N806300	Stud, Hex Shoulder Pilot, M8 x 1.25 x 65 - M8 x 1.25 x 27
13	W705386	Bolt, Hex Shoulder Pilot, M8 x 1.25 x 65
14	N806300	Stud, Hex Shoulder Pilot, M8 x 1.25 x 65 - M8 x 1.25 x 27
15	W705386	Bolt, Hex Shoulder Pilot, M8 x 1.25 x 65



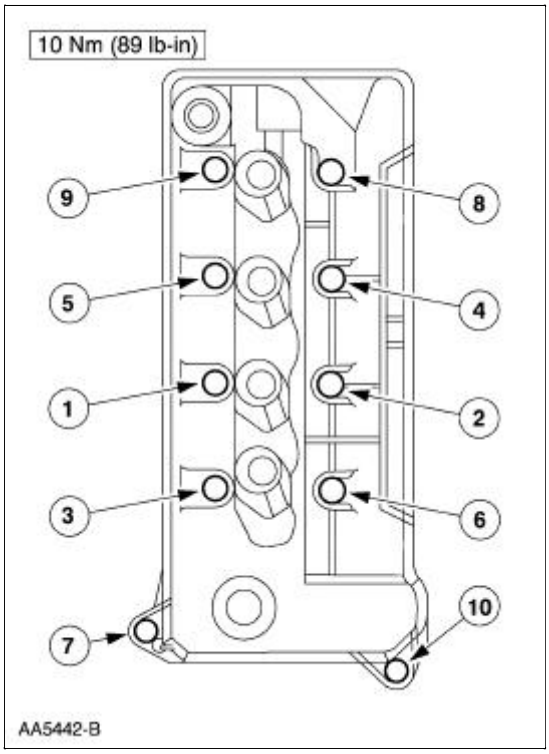
46. Apply silicone gasket sealant in the locations shown.



47. **NOTE:** LH shown, RH similar.

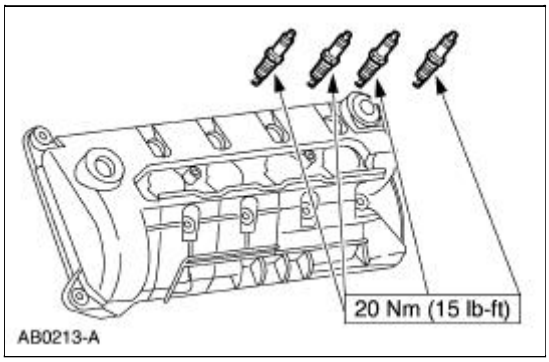
Install the valve covers, the bolts, and the studs.

1. Install the gaskets.
2. Install the valve covers.

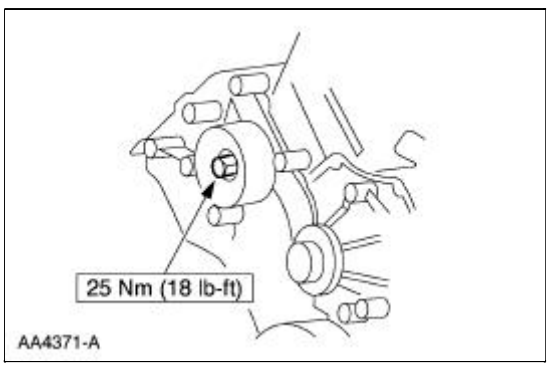


48. **NOTE:** LH shown, RH similar.

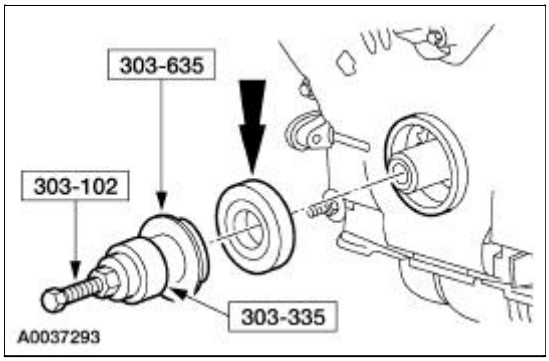
    Install the eight spark plugs.



49. Install the bolt and the belt idler pulley.

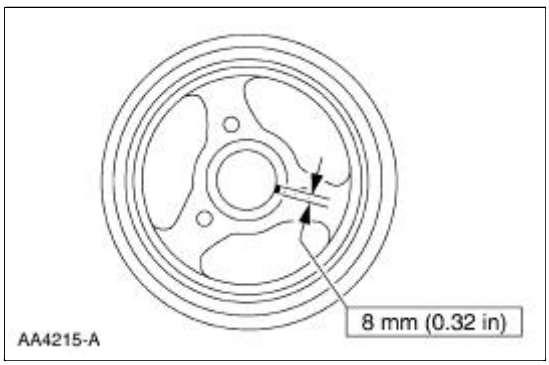


50. Using the special tools, install the front crank seal.

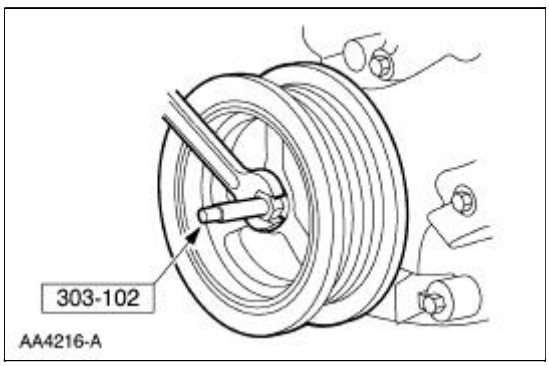


51. **NOTE:** The crankshaft pulley must be installed within four minutes after applying the silicone.

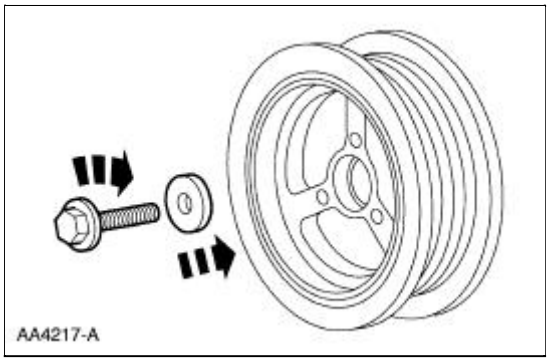
    Apply silicone gasket and sealant to the Woodruff key slot on the crankshaft pulley.



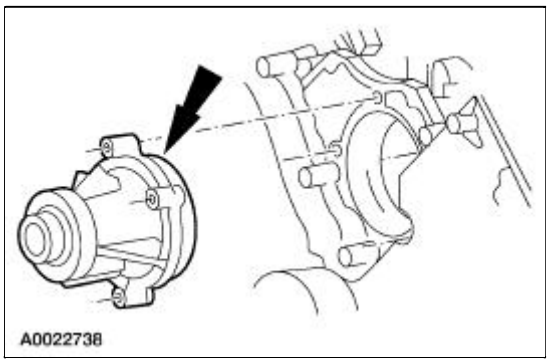
52. Using the special tool, install the crankshaft pulley.



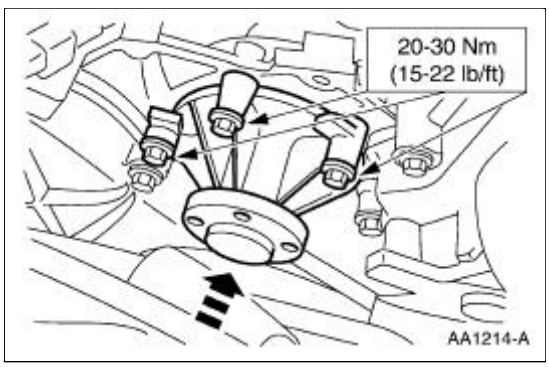
53. Install the bolt and washer. Tighten the bolt in four stages:
    - Stage 1: Tighten to 90 Nm (66 lb-ft).
    - Stage 2: Loosen one full turn.
    - Stage 3: Tighten to 50 Nm (37 lb-ft).
    - Stage 4: Tighten an additional 90 degrees.



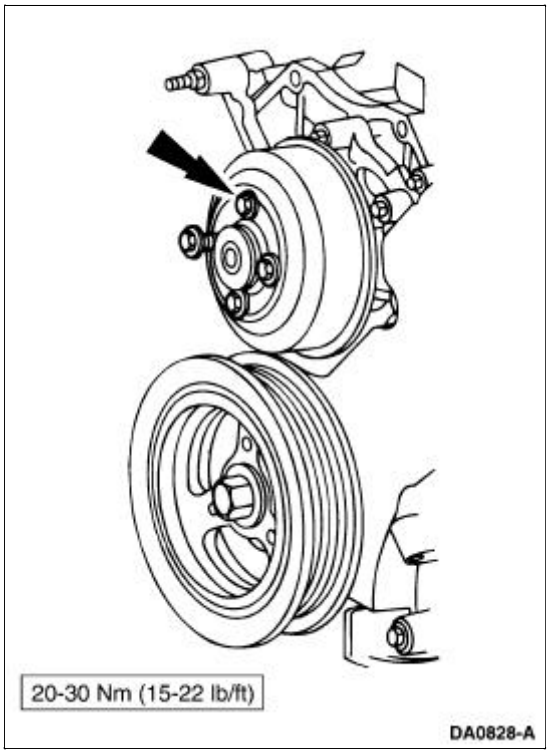
54. Install the water pump.
    - Inspect and lube the water pump O-ring seal before installation.



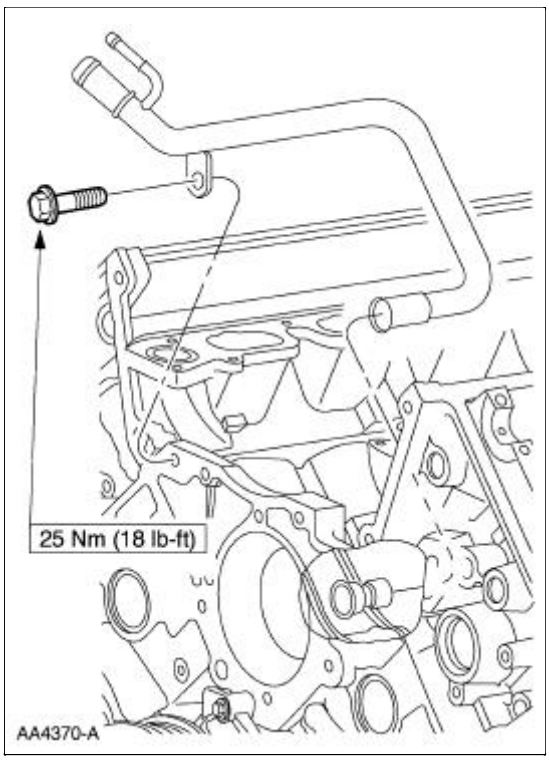
55. Install the four bolts.



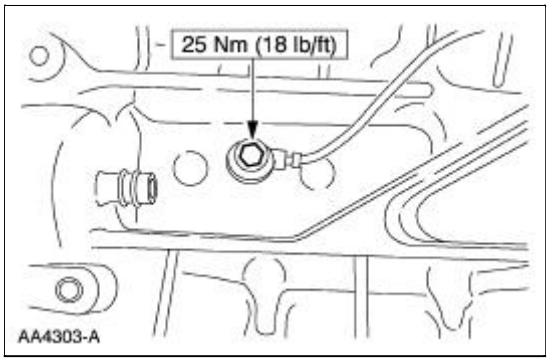
56. Install the water pump pulley and the bolts.



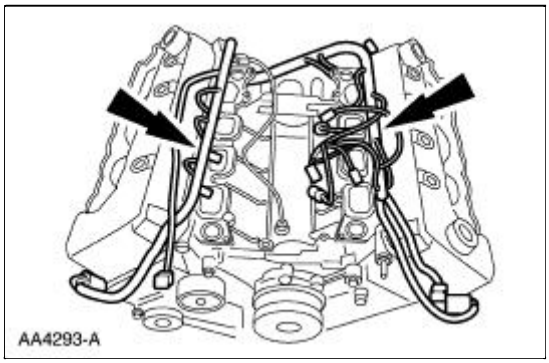
57. Install the heater return tube and the bolt.
    - Inspect and lube the O-ring seals.



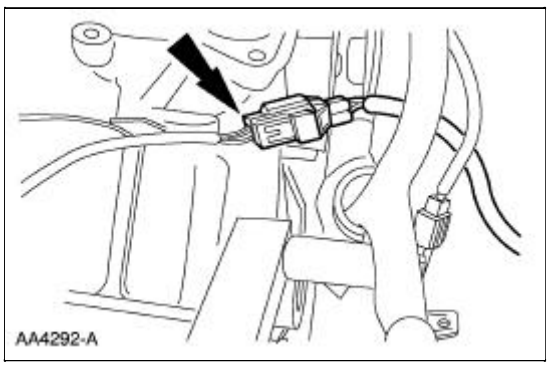
58. Install the knock sensor (KS).



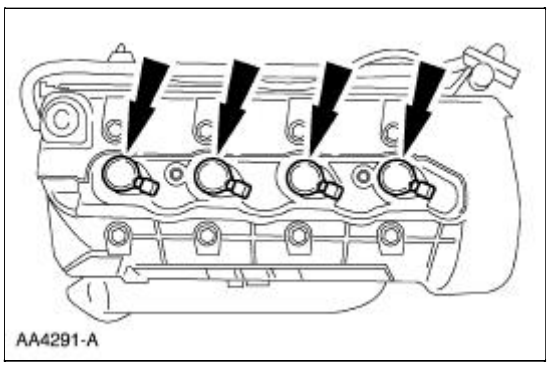
59. Install the wiring and connect to the engine at six locations.



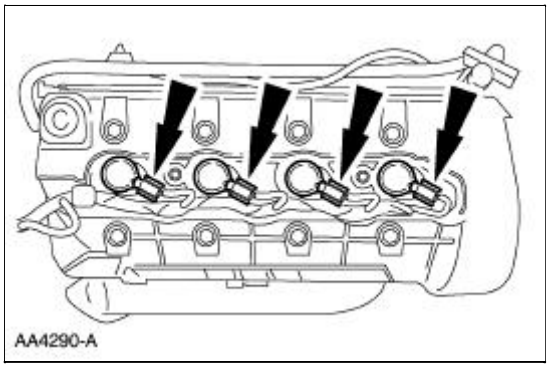
60. Connect the KS.



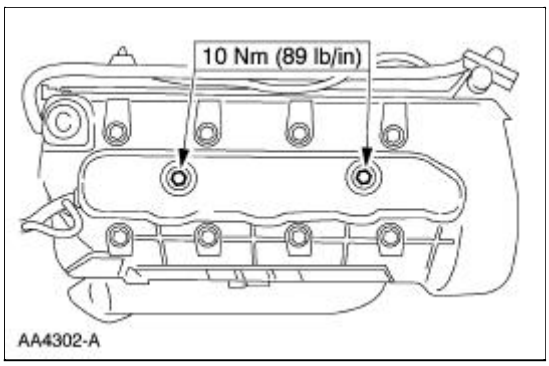
61. Install the RH ignition coils.



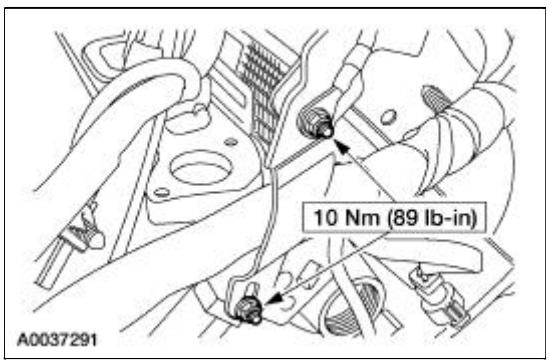
62. Connect the RH ignition coils.



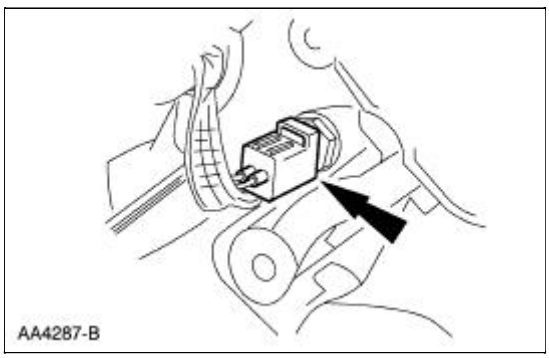
63. Install the RH ignition coil cover.



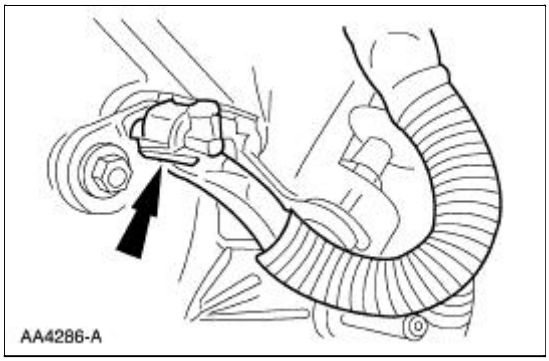
64. Position the bracket and the ground strap and install the nuts.



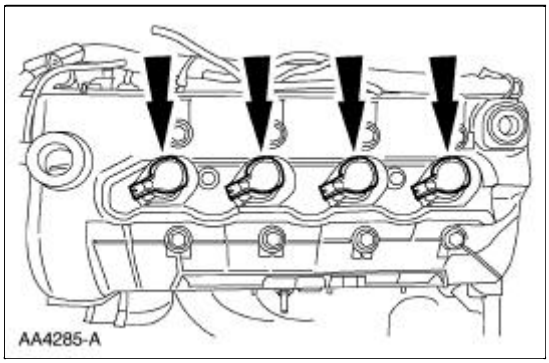
65. Connect the cylinder head temperature (CHT) sensor.



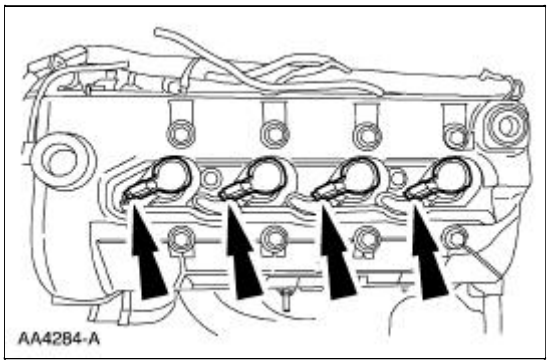
66. Connect the camshaft position (CMP) sensor.



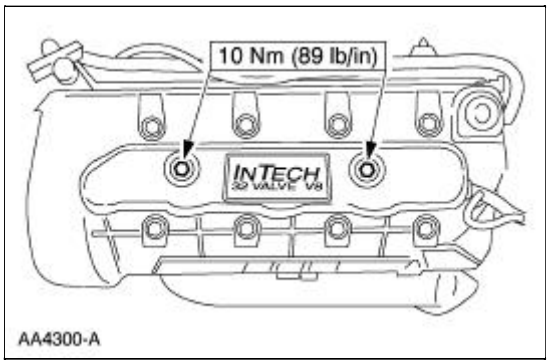
67. Install the LH ignition coils.



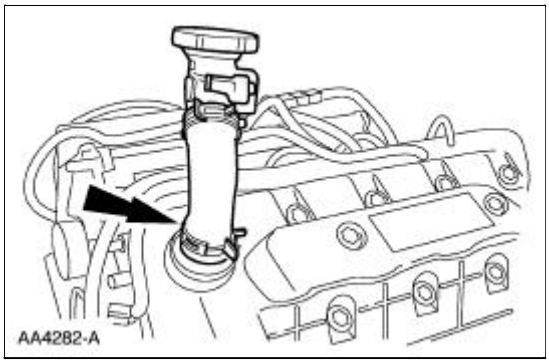
68. Connect the LH ignition coils.



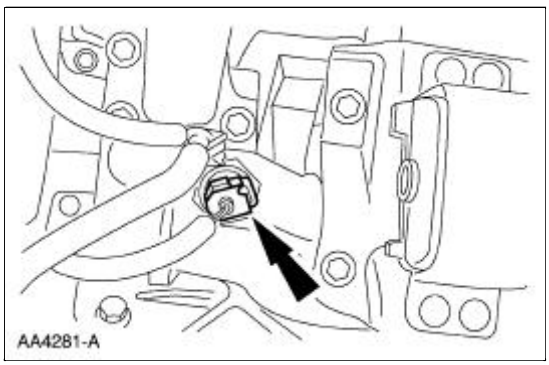
69. Install the bolts and the LH ignition coil cover.



70. Install the oil fill tube.

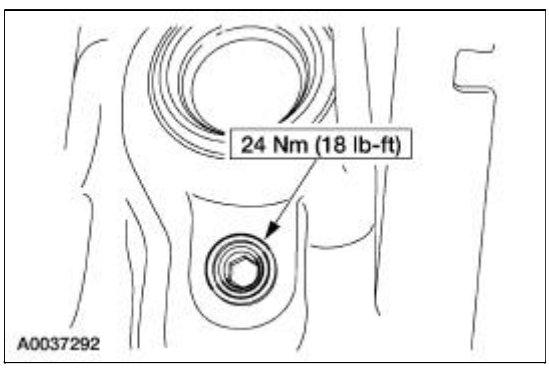


71. Connect the oil pressure sender.



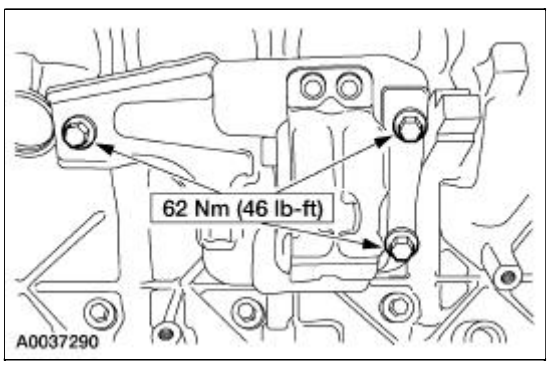
72. **NOTE:** LH shown, RH similar.

    Install the cylinder block drain plugs.



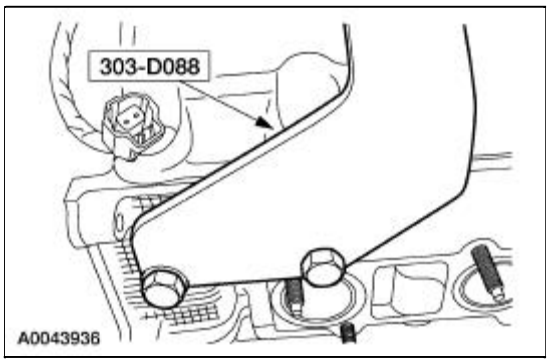
73. **NOTE:** RH shown, LH similar.

    Install the left and right engine mounts.

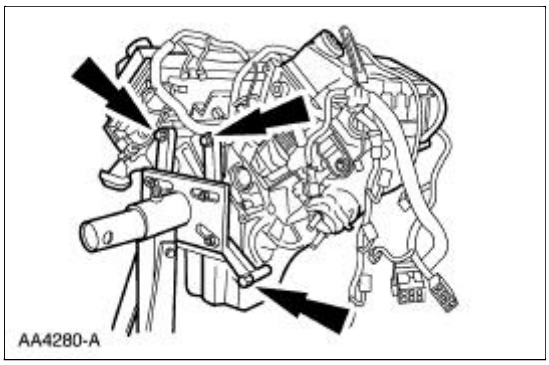


74. **NOTE:** LH shown, RH similar.

    Install the special tool.



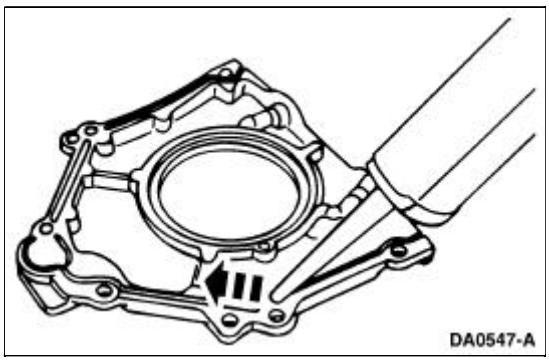
75. Remove the engine from the work stand.



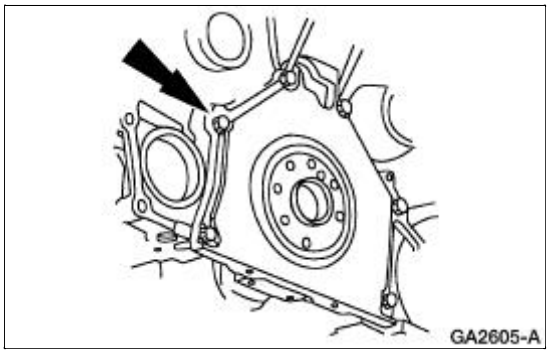
76. **NOTE:** If the rear crankshaft seal retaining plate is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

    NOTE: The silicone must be applied on the groove along the retainer plate.

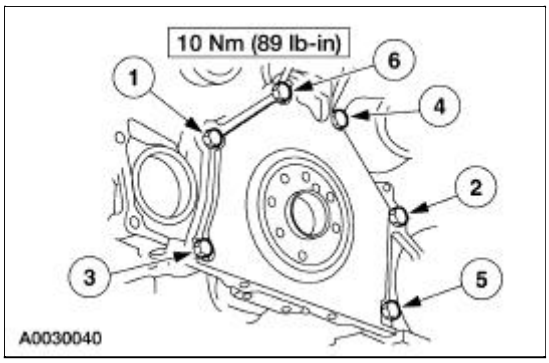
    Apply a 4 mm (0.16 in) bead of silicone gasket and sealant around the rear oil seal retainer sealing surface.



77. Install the rear oil seal retainer and loosely install the six bolts.

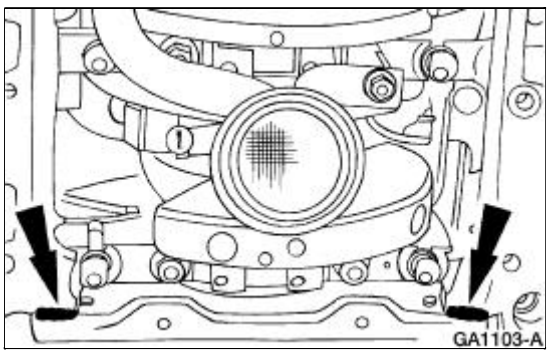


78. Tighten the bolts in the sequence shown.



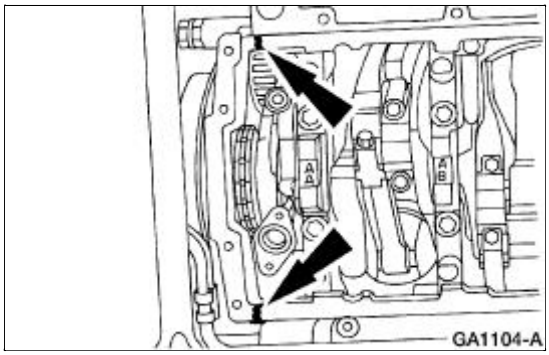
79. **NOTE:** If the oil pan and the oil pan gasket are not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

    Apply silicone gasket and sealant at the engine front cover-to-cylinder block sealing surface.

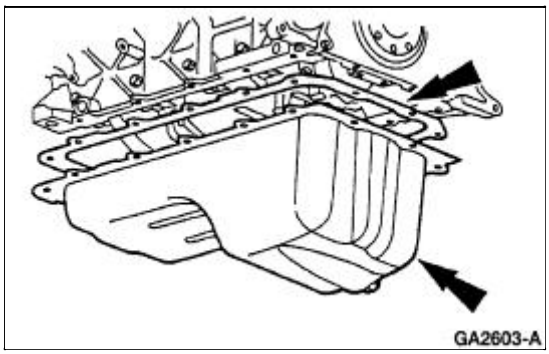


80. **NOTE:** If the oil pan and the oil pan gasket are not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

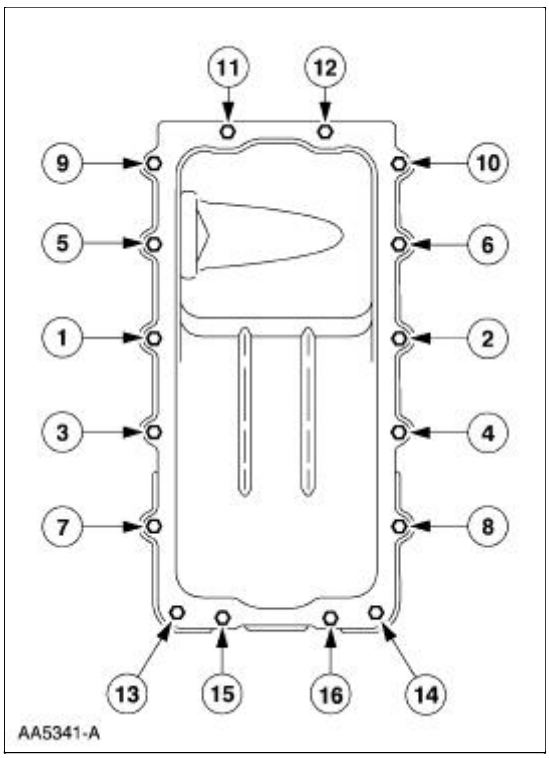
    Apply silicone gasket and sealant at the engine front cover-to-cylinder block sealing surface.



81. Install the oil pan gasket and the oil pan and loosely install the 16 bolts.

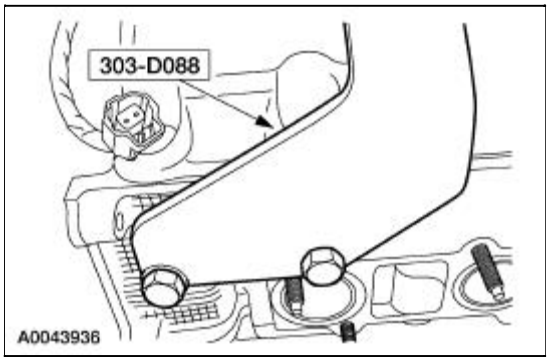


82. Tighten the bolts in three stages, in the sequence shown.
    - Stage 1: Tighten to 2 Nm (18 lb-in).
    - Stage 2: Tighten to 20 Nm (15 lb-ft).
    - Stage 3: Tighten an additional 60 degrees.

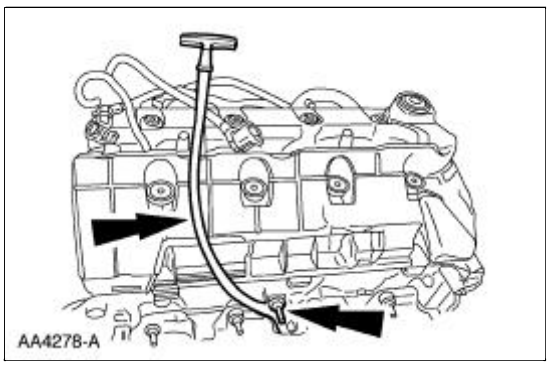


83. Lower the engine onto wooden blocks.

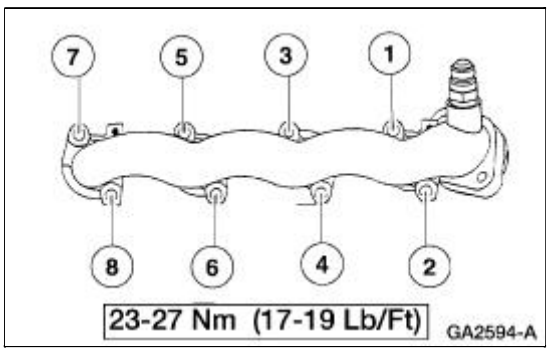
84. Remove the special tool.



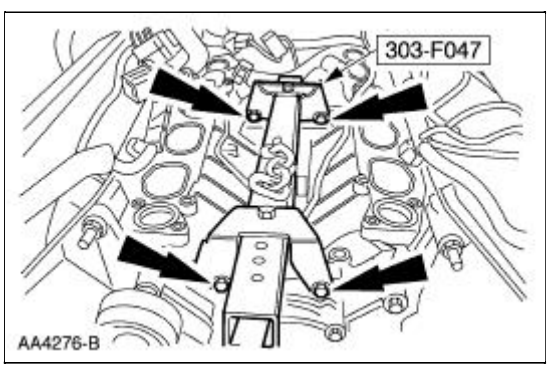
85. Install the oil level indicator and tube, and the stud.



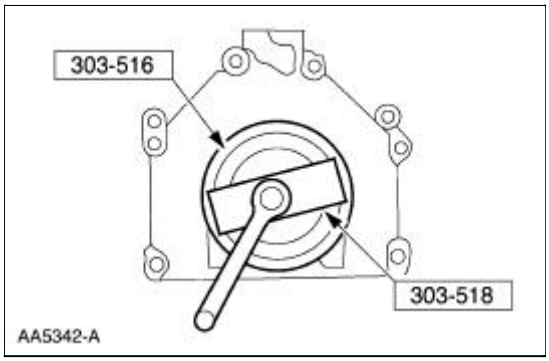
86. Install the LH exhaust manifold and gaskets.
    - Tighten the nuts in the sequence shown.



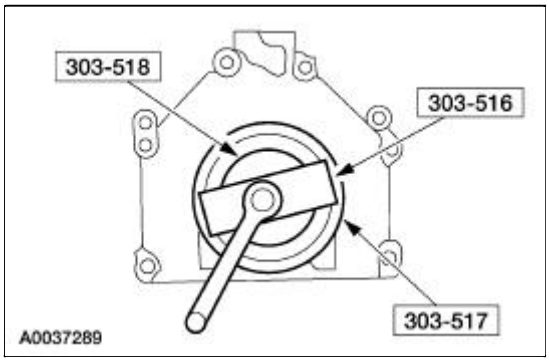
87. Install the special tool and raise the engine.



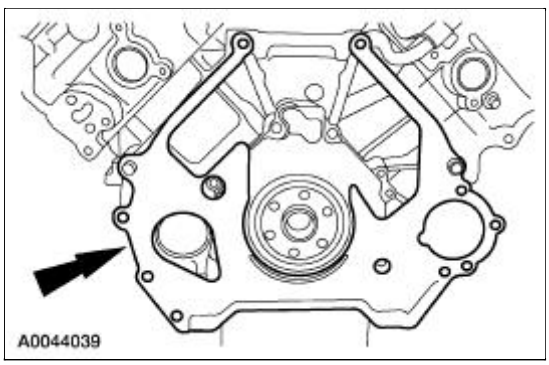
88. Using the special tool, install the crankshaft rear oil seal.



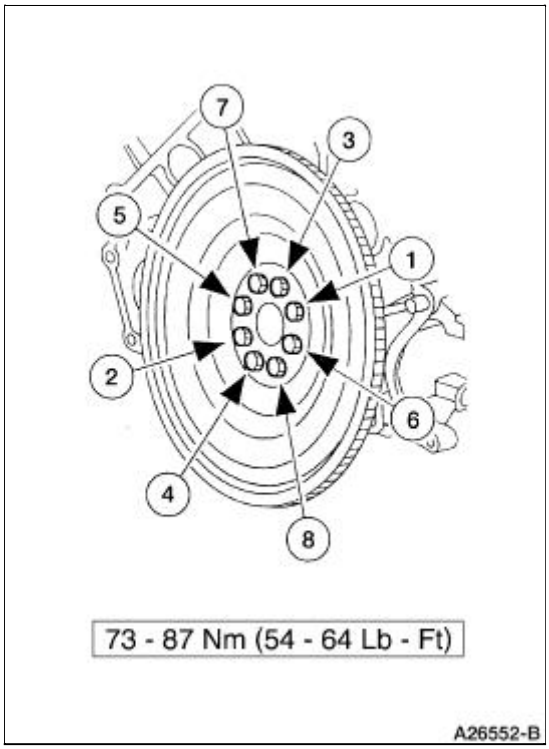
89. Using the special tool, install the crankshaft oil slinger.



90. Install the spacer plate.

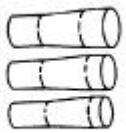


91. Install the bolts and the flywheel.


7
3
5
1
2
6
4
8
73 - 87 Nm (54 - 64 Lb - Ft)
A26552-B

Engine

Special Tool(s)

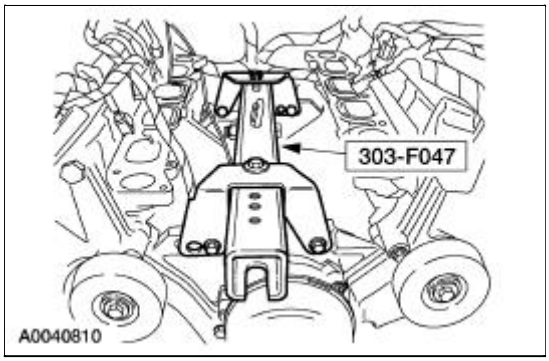
 ST1377-A	Modular Engine Lift Bracket 303-F047 (014-00073) or equivalent
 ST1586-A	Installer, Power Steering Pump Pulley 211-185 (T91P-3A733-A)
 ST1444-A	Installer Set, Teflon Seal 211-D027 (D90P-3517-A) or equivalent

Material

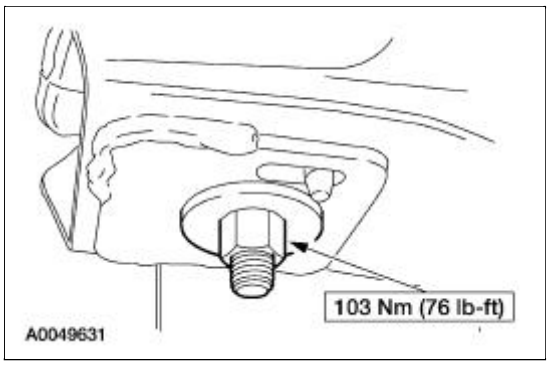
Item	Specification
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H
Motorcraft Premium Engine Coolant VC-4-A (in Oregon VC-5, in Canada CXC-10) or equivalent	ESE-M97B44-A
Motorcraft Premium Gold Engine Coolant VC-7-A or equivalent	WSS-M97B51-A1

Installation

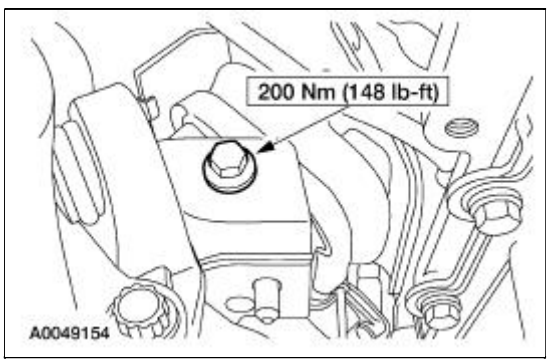
1. Using a floor crane, install the engine in the vehicle.
   - Make sure the marks on the flexplate and the torque converter stud made during removal are lined up.
2. Remove the special tool.



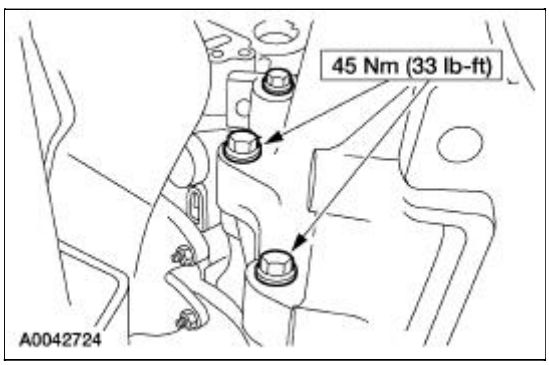
3. Remove the floor jack and wood block supporting the transmission.
4. Raise the vehicle. For additional information, refer to Section 100-02 .
5. Install the RH motor mount nut.



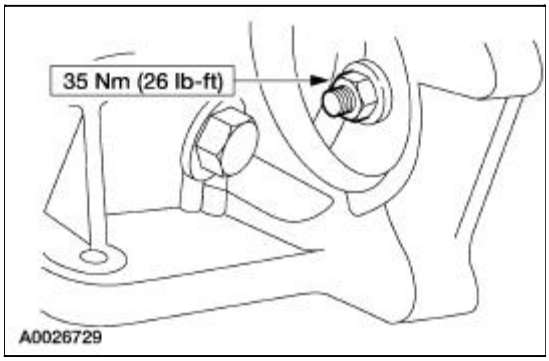
6. Install the LH motor mount bolt.



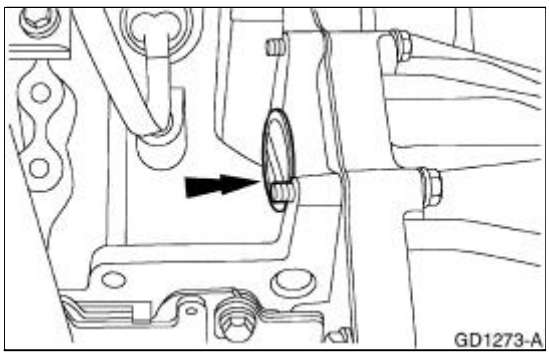
7. Align the transmission to the engine and install the six lower transmission-to-engine bolts.



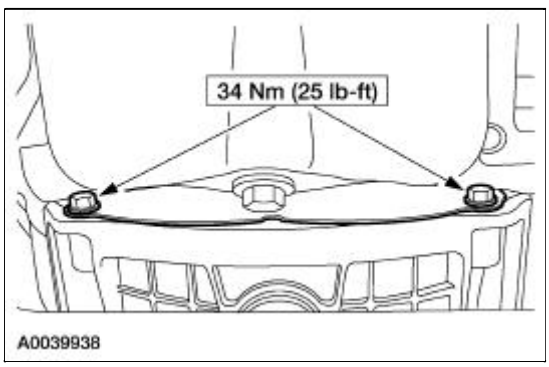
8. Install the four torque converter nuts.
    - Rotate the crankshaft, using the crankshaft pulley bolt.



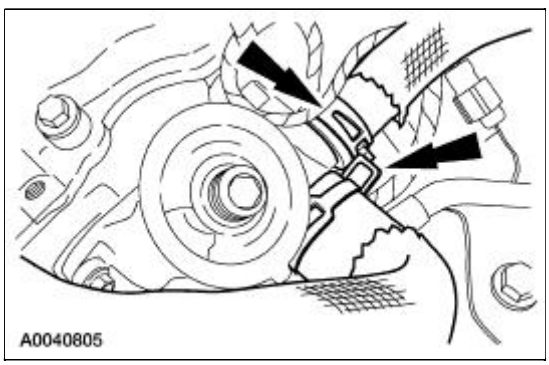
9. Install the flexplate-to-torque converter nut access plug.



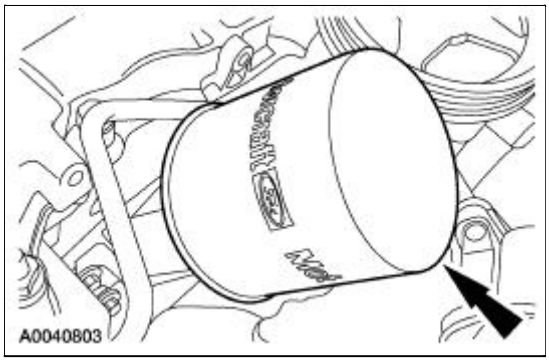
10. Install the inspection plate.



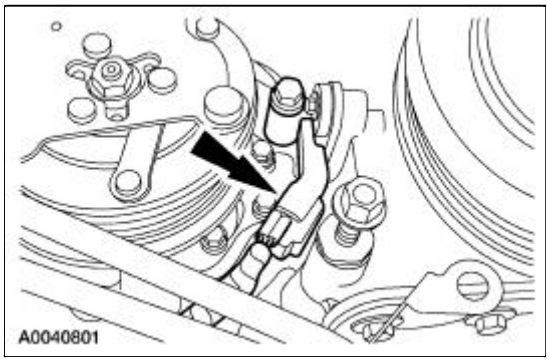
11. Position the hoses and install the clamps.



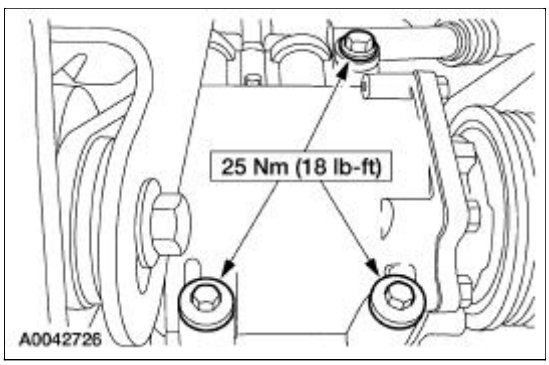
12. Install a new oil filter.



13. Connect the crankshaft position (CKP) sensor electrical connector.



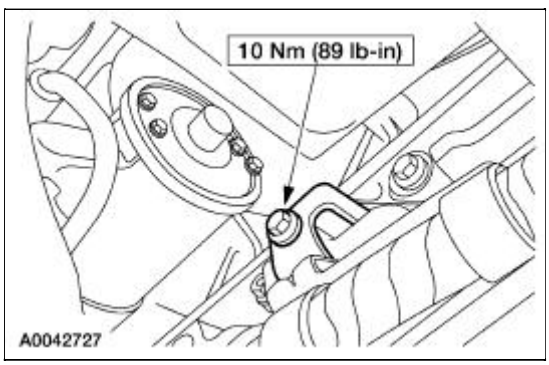
14. Position the A/C compressor and install the bolts.



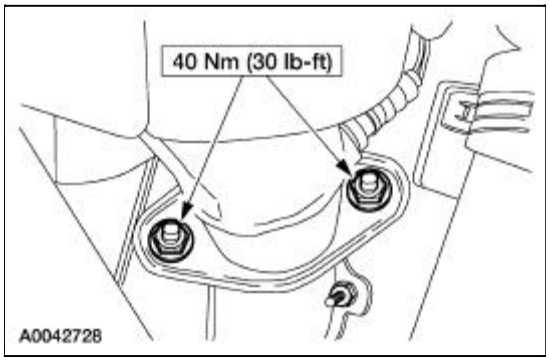
15. Connect the A/C clutch electrical connector.

16. Install the starter. For additional information, refer to Section 303-06 .

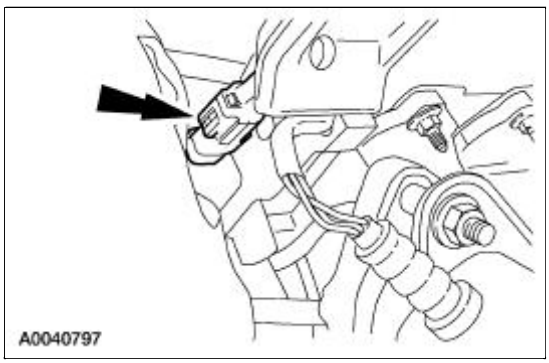
17. Position the wire harness bracket and install the nut.



18. Position the dual converter Y-pipe and install the four nuts.

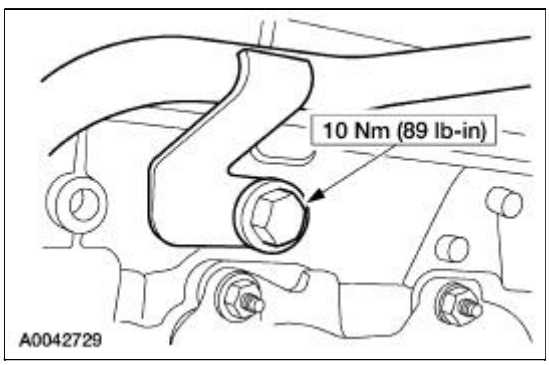


19. Connect the heated oxygen sensor (HO2S) electrical connectors.



20. **NOTE:** The bolt is accessed through the RH fender well.

    Position the transmission filler tube and install the bolt.



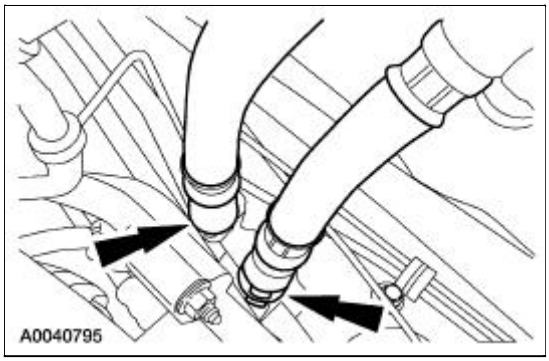
21. Install the skid plate and the bolts, if equipped.

22. **NOTE:** On 4x4 vehicles, connect the transfer case vent hose to the bracket after installing the upper transmission-to-engine bolts.

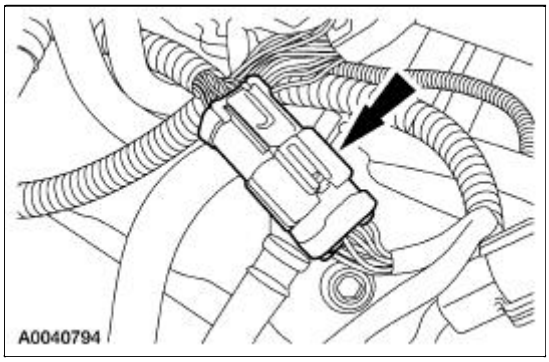
    Install the two upper transmission-to-engine bolts.

23. Lower the vehicle.

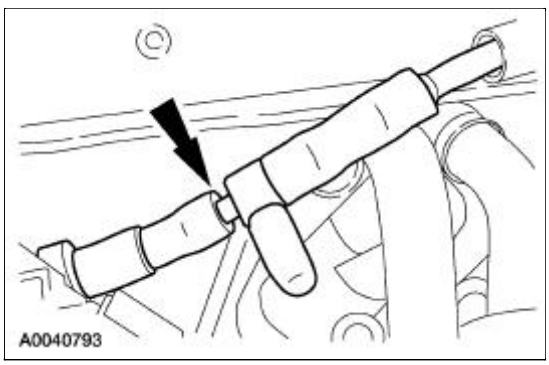
24. Connect the auxiliary heater hoses.



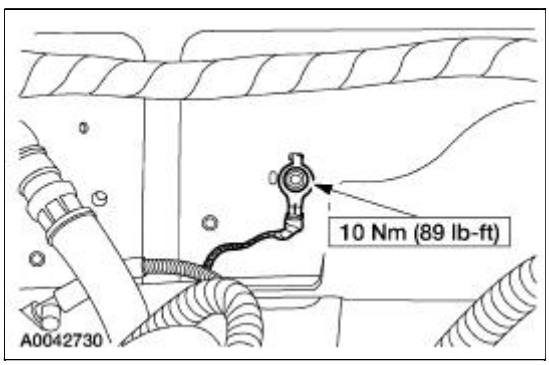
25. Connect the main engine harness electrical connector.



26. Position the vacuum harness and connect the hose.

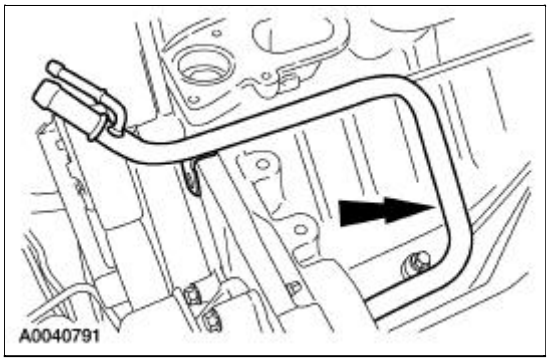


27. Position the ground cable and install the bolt.

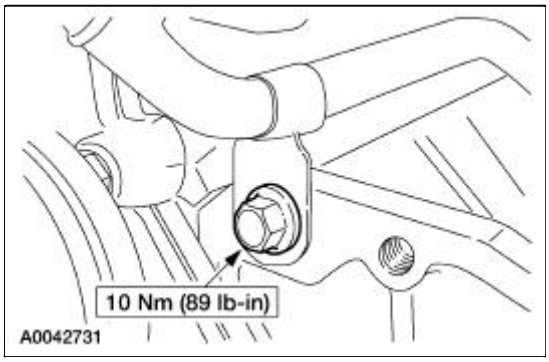


28. **NOTE:** Install a new O-ring. Lubricate the O-ring with clean engine coolant. Use the same coolant type that was drained from the engine.

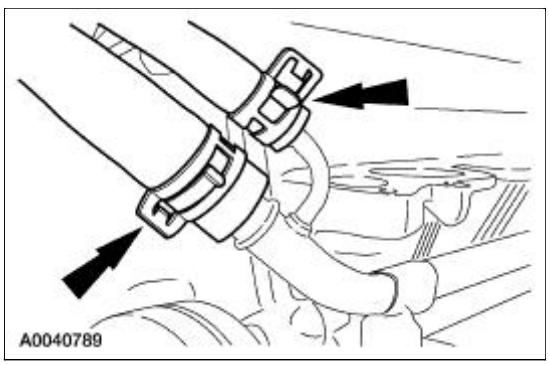
    Position the tube.



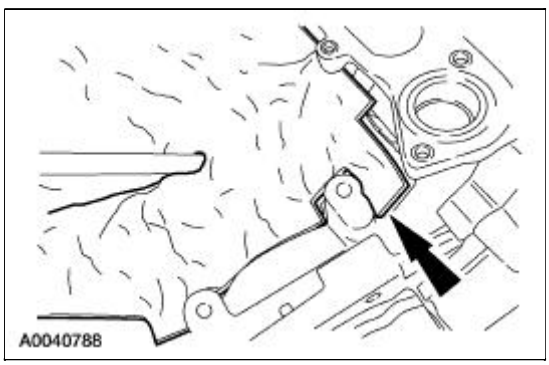
29. Install the bolt.



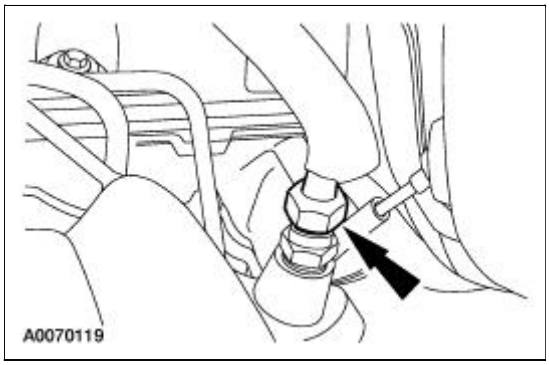
30. Position the hoses and install the clamps.



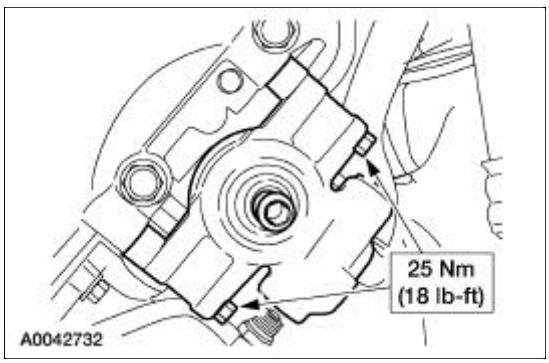
31. Install the engine noise shield.



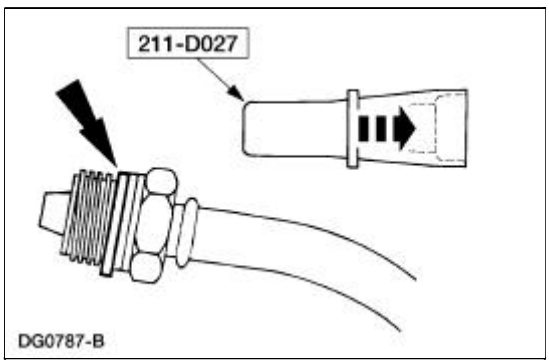
32. Connect the exhaust gas recirculation (EGR) valve tube nut to the LH exhaust manifold and hand-tighten.



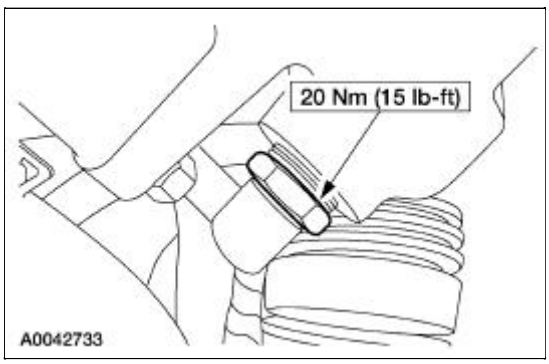
33. Position the power steering pump and install the three bolts.



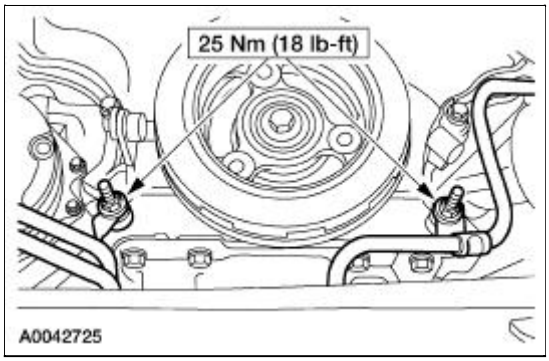
34. Using the special tool, install a new O-ring seal on the power steering pressure hose fitting.



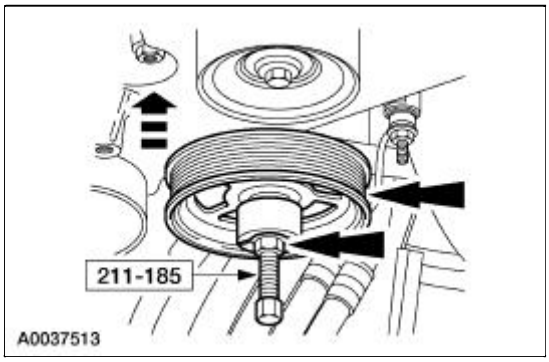
35. Connect the power steering pressure hose.



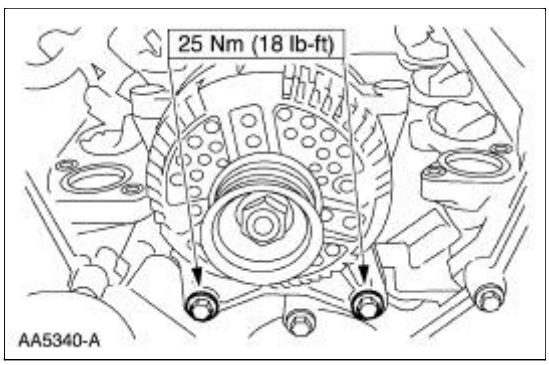
36. Position the transmission cooler tube and the power steering hose brackets and install the nuts.



37. Using the special tool, install the power steering pump pulley.

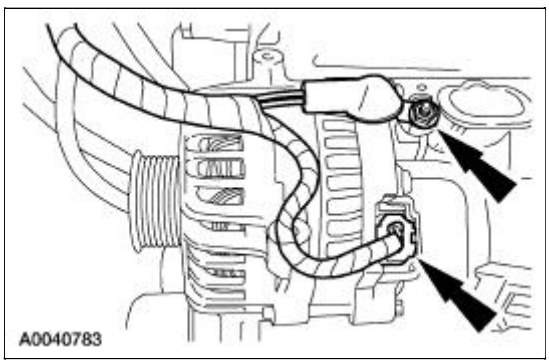


38. Position the generator and install the bolts.



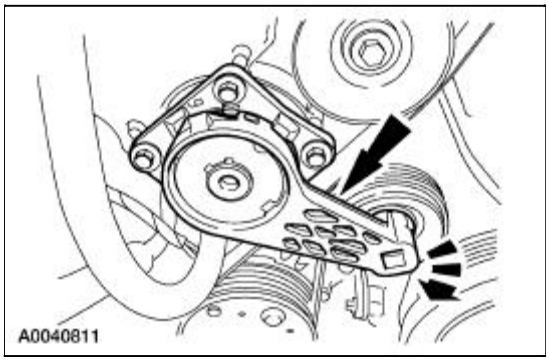
39. **NOTE:** Position the rubber boot on the B+ connector after tightening the nut.

    Connect the generator electrical connectors.

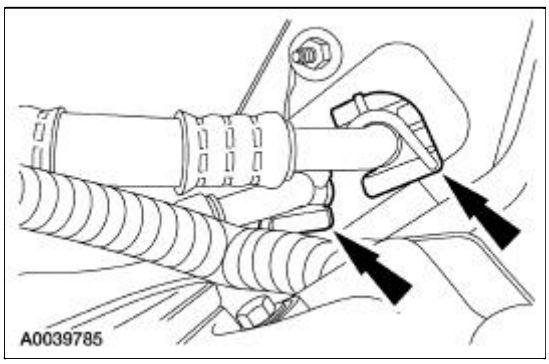


40. **NOTE:** For correct drive belt routing, refer to Section 303-05 .

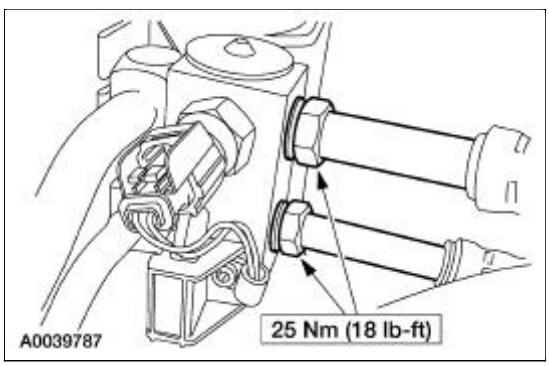
Rotate the belt tensioner counterclockwise and install the drive belt.



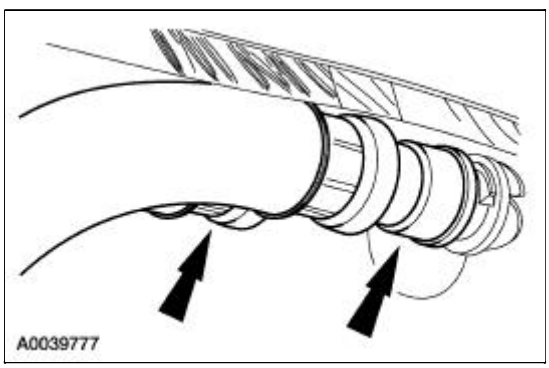
41. Connect the spring lock couplers and install the safety clips. For additional information, refer to Section 412-00 .



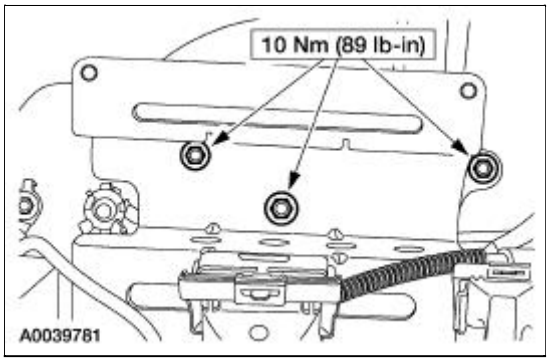
42. Connect the A/C hoses at the junction block.



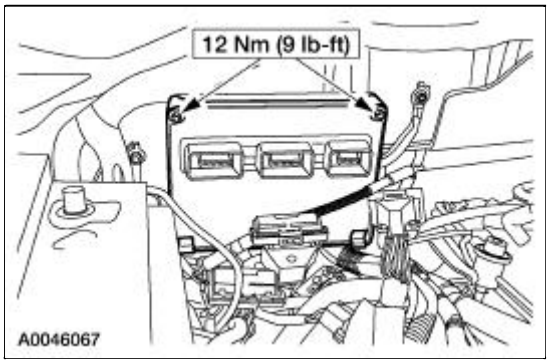
43. Connect the heater hoses to the heater core.



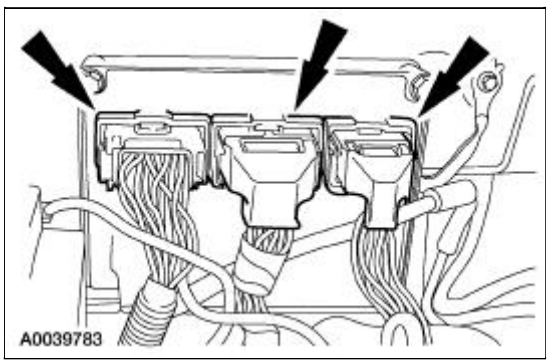
44. Install the power train control module (PCM) mounting bracket.



45. Install the PCM and the bolts.

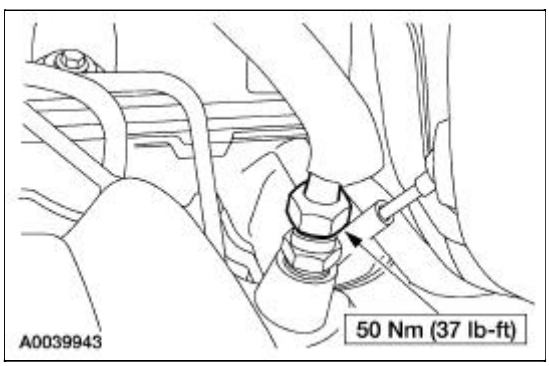


46. Connect the PCM electrical connectors.



47. Install the lower intake manifold. For additional information, refer to Lower Intake Manifold .

48. Tighten the EGR valve tube nut.



49. Fill the engine with clean engine oil.

50. Connect the battery ground cable. For additional information, refer to Section 414-01 .
51. Install the radiator. For additional information, refer to Section 303-03 .
52. Recharge the A/C system. For additional information, refer to Section 412-00 .
53. Fill and bleed the power steering system. For additional information, refer to Section 211-02 .
54. Install the hood.

General Specifications

Item	Specification
Cooling System Capacity	
4.6L	19.0 L (20.1 quarts)
4.6L — with aux. rear heat	21.0 L (22.2 quarts)
5.4L	21.0 L (22.2 quarts)
5.4L — with aux. rear heat	23.0 L (24.3 quarts)
Coolant Type	
Motorcraft Premium Engine Coolant VC-4-A (in Oregon VC-5, in Canada CXC-10 or equivalent [a]	ESE-M97B44-A (Green color)
Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) or equivalent [a b]	WSS-M97B51-A1 (Yellow color)
Other Chemicals	
Motorcraft Cooling System Flush VC-1	ESR-M14P7-A
Premium Long Life Grease XG-1-C	ESA-M1C75-B
Cooling System Stop Leak Pellets VC-6	ESE-M99B37-B5 except as noted in ES-F6SE-19A511-AA
Cooling System Pressure Test Specifications	
Radiator test pressure	152 kPa (22 psi)
Radiator Cap Pressure Test Specifications	
Pressure relief opening pressure	110 kPa (16 psi)
Thermostat Opening Temperatures	
Starts to open °C (°F)	87-91 (188-195)
Fully open °C (°F)	100 (212)

[a] Use the same type coolant that was drained from the cooling system. Do not mix coolant types.
[b] The addition of Motorcraft Cooling System Stop Leak Pellets, VC-6, darkens Motorcraft Premium Gold Engine Coolant from yellow to golden tan.

Torque Specifications

Description	Nm	lb-ft	lb-in
Cylinder block drain plug	20	15	—
Fan blade to fan clutch bolts	17	13	—
Fan blade and fan clutch to water pump pulley	55	41	—
Fan shroud screws	9	—	80
Degas bottle bolts	9	—	80
Radiator support bracket bolts	30	22	—
Water outlet connection bolts	25	18	—
Water temperature indicator sender unit	20	15	—
Water pump bolts	25	18	—

Water pump pulley bolts	25	18	—

Engine Cooling

CAUTION: Some vehicle cooling systems are filled with Motorcraft Premium Engine Coolant VC-4-A (in Oregon VC-5, in Canada CXC-10) or equivalent meeting Ford specification ESE-M97B44-A (green color). Others are filled with Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) or equivalent meeting Ford specification WSS-M97B51-A1 (yellow color). Always fill the cooling system with the same coolant that is present in the system. Do not mix coolant types.

NOTE: The addition of Motorcraft Cooling System Stop Leak Pellets, VC-6, darkens Motorcraft Premium Gold Engine Coolant from yellow to golden tan.

The cooling system components are:

- block heater
- engine coolant temperature ECT sensor (5.4L [4V] only).
- fan blade
- fan clutch
- fan shroud
- radiator
- radiator cap
- degas bottle
- radiator draincock
- water temperature indicator sender unit
- water thermostat
- upper radiator hose
- lower radiator hose

The water pump circulates the coolant.

The water thermostat:

- controls coolant temperature.
- allows quicker engine warm-up.

The degas bottle:

- holds surplus coolant when hot.
- deaerates the system reducing engine hot spots.
- is the location for service fill.
- allows coolant expansion and system pressurization.
- provides a location for air separation during operation.
- replenishes coolant to the system.

The fan blade draws air through the radiator to help cool the system coolant.

The fan clutch is either a thermostatically-controlled or a electronically-controlled clutch that controls the fan drive.

The radiator allows excess heat to be transferred to the air.

- The radiator cannot be serviced. Install a new radiator.

The engine coolant flows:

- from the lower radiator hose to the water pump.
- from the water pump to the engine block and the cylinder heads.
    - Thermostat closed, the coolant returns to the water pump.
    - Thermostat open, the coolant flows back to the radiator.
- to the radiator for heat rejection then back to the lower radiator hose.

Engine coolant provides freeze protection, boil protection, cooling efficiency, and corrosion protection to the engine and cooling components. In order to obtain these protections, the engine coolant must be maintained at the correct concentration and fluid level in the degas bottle.

When adding engine coolant, use a 50/50 mixture of engine coolant and clean, drinkable water.

To maintain the integrity of the coolant and the cooling system:

- Add Motorcraft Premium Engine Coolant VC-4-A (in Oregon VC-5, in Canada CXC-10) or equivalent meeting Ford specification ESE-M97B44-A (green color) or Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) or equivalent meeting Ford specification WSS-M97B51-A1 (yellow color). Always fill the cooling system with the same coolant that is present in the system. Do not mix coolant types.
    - The addition of Motorcraft Cooling System Stop Leak Pellets, VC-6, darkens Motorcraft Premium Gold Engine Coolant from yellow to golden tan.
- Do not add/mix orange colored Motorcraft Specialty Orange Engine Coolant VC-2 or equivalent meeting Ford specification WSS-M97B44-D. Mixing coolants can degrade the coolants corrosion protection.
- Do not add alcohol, methanol, or brine, or any engine coolants mixed with alcohol or methanol antifreeze. These can cause engine damage from overheating or freezing.
- Do not mix with recycled coolant unless it meets the requirements of Ford specification ESE-M97B44-A or WSS- M97B51-A1. Not all coolant recycling processes meet these Ford specifications. Use of such coolants can harm the engine and cooling system components.

The block heater:

- is an optional electrical heating element installed in core plug opening.
- uses a standard 110 V electrical supply.
- keeps the engine coolant warm during cold weather.

Engine Cooling

Special Tool(s)

 ST1474-A	Radiator Pressure Tester 014-R1072 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool
 ST1720-A	Battery/Antifreeze Tester 014-R1060 or equivalent

Inspection and Verification

WARNING: To avoid personal injury, do not unscrew the coolant pressure relief cap while the engine is operating or hot. The coolant system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly.

CAUTION: Check the coolant level, engine oil and transmission fluid, top off the coolant if needed. If there is engine coolant in the engine oil or transmission fluid, the cause must be corrected and oil/fluid changed or major component damage can occur.

CAUTION: Some vehicle cooling systems are filled with Motorcraft Premium Engine Coolant VC-4-A (in Oregon VC-5, in Canada CXC-10) or equivalent meeting Ford specification ESE-M97B44-A (green color). Others are filled with Motorcraft Premium Gold Coolant VC-7-A (in Oregon VC-7-B) or equivalent meeting Ford specification WSS-M97B51-A1 (yellow color). Always fill the cooling system with the same coolant that is present in the system. Do not mix coolant types.

1. Verify the customer concern by operating the engine to duplicate the condition.

2. Inspect to determine if any of the following mechanical or electrical concerns apply.

Visual Inspection Chart

Mechanical	Electrical
● Leaks ● Damaged hoses ● Loose/damaged hose clamps ● Damaged water thermostat gasket ● Damaged head gaskets ● Damaged intake manifold gasket ● Damaged water pump ● Damaged radiator ● Damaged degas bottle ● Damaged heater core ● Damaged fan/fan clutch	● Damaged engine coolant temperature sensor ● Damaged wiring

3. If the inspection reveals an obvious concern that can be readily identified, repair as necessary.

4. Inspect the coolant condition.
    1. Inspect the coolant color.
        - If Motorcraft Premium Engine Coolant VC-4-A (in Oregon VC-5, in Canada CXC-10) or equivalent meeting Ford specification ESE-M97B44-A (green color) has a clear, light green or blue color, this indicates higher water content than required.
        - If Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) or equivalent meeting Ford specification WSS-M97B51-A1 (yellow color) has a clear or pale yellow color, this indicates higher water content than required.
        - Dark brown could indicate unauthorized stop leak may have been used. Use Motorcraft Cooling System Stop Leak Pellets VC-6 or equivalent meeting Ford specification ESE-M99B37-B5 except as noted in ES-F6SE-19A511-AA only.
            - The addition of Motorcraft Cooling System Stop Leak Pellets, VC-6, darkens Motorcraft Premium Gold Engine Coolant from yellow to golden brown.
        - A light or reddish brown color indicates that rust may be present in the cooling system. Flush the system and refill with the correct mixture of water and Premium Engine Coolant or Premium Gold Engine Coolant. For additional information, refer to Engine and Radiator Flushing in this section.
        - An iridescent sheen on top of the coolant could indicate a trace of oil is entering the system. For additional information on engine diagnosis, refer to Section 303-00 .
        - A milky brown color may indicate that either engine oil or transmission fluid is entering the cooling system. If transmission fluid is suspected, the cause may be a leaky radiator. Pressure test the cooling system. For additional information, refer to component tests in this section. If engine oil is suspected, the cause of the leak may be internal to the engine. For additional information, refer to Section 303-00 .
        - If transmission fluid is contaminated with engine coolant, the cause may be a leaky radiator. Pressure test the system. For additional information, refer to the component tests in this section.
    2. If the engine coolant appearance is acceptable, test the engine coolant freezing point range with the Battery/Anti-Freeze Tester. The freezing point should be in the range -23° C to -46°C (-10°F to -50°F). If the vehicle is driven in cold climates less than -37°C (-34° F), it may be necessary to increase the coolant concentration to get adequate freeze protection.
        - Maximum coolant concentration is 60/40.
        - Minimum coolant concentration is 40/60.
    3. Adjust coolant range and level if necessary:
        - If the coolant is low, add specified coolant mixture only.

- If the engine coolant tests weak, add straight engine coolant until the readings are within acceptable levels.
- If the engine coolant tests strong, remove some of the engine coolant and add water until the readings are within acceptable levels.

5. If the concern remains after the inspection, determine the symptom(s) and go to the Symptom Chart.

Symptom Chart

SYMPTOM CHART

Condition	Possible Sources	Action
• Loss of coolant	• Radiator. • Water pump seal. • Radiator hoses. • Heater hoses/tubes. • Heater core. • Engine gaskets. • Degas bottle.	• Go To Pinpoint Test A .
• The engine overheats	• Water thermostat. • Water pump. • Internal engine coolant leak. • Radiator. • Heater core. • Cooling fan or visctronic fan clutch. • Pressure relief cap.	• Go To Pinpoint Test B .
• The engine does not reach normal operating temperature	• Water thermostat.	• Go To Pinpoint Test C .
• The block heater does not operate correctly	• Block heater power cable. • Block heater.	• CHECK for continuity in all three power cord circuits. INSTALL a new power cord, if necessary. • INSTALL a new block heater.

Pinpoint Tests

PINPOINT TEST A: LOSS OF COOLANT

Test Step	Result / Action to Take
A1 CHECK THE ENGINE COOLANT LEVEL	

WARNING: To avoid personal injury, do not unscrew the coolant pressure relief cap while the engine is operating or hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. NOTE: Allow the engine to cool before checking the engine coolant level. • Key in OFF position. • Visually check the engine coolant level at the degas bottle. • **Is the engine coolant level within specification?**	**Yes** GO to A2 . **No** REFILL the engine coolant as necessary. GO to A6 .
A2 CHECK THE PRESSURE RELIEF CAP	
WARNING: To avoid personal injury, do not unscrew the coolant pressure relief cap while the engine is operating or hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. • Carry out the pressure relief cap test. Refer to Component Tests, Cap—Pressure Relief in this section. • **Is pressure relief cap OK?**	**Yes** GO to A3 . **No** INSTALL a new pressure relief cap. TEST the system for normal operation.
A3 CHECK THE ENGINE COOLANT FOR INTERNAL LEAK	
WARNING: To avoid personal injury, do not unscrew the coolant pressure relief cap while the engine is operating or hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. • Key in OFF position. • Inspect the engine coolant in the degas bottle for signs of transmission fluid or engine oil. • **Is oil or transmission fluid evident in coolant?**	**Yes** If engine oil is evident, GO to Section 303-00 . If transmission fluid is evident, REPAIR or INSTALL a new radiator as necessary. **No** GO to A4 .
A4 CHECK THE ENGINE AND THE TRANSMISSION FOR COOLANT	
• Remove the oil level dipsticks from the engine and the transmission. • **Is coolant evident in oil or transmission fluid?**	**Yes** If coolant is in engine, GO to Section 303-00 . If coolant is in transmission, INSTALL a new radiator as necessary. GO to Section 307-01A (4R100) or Section 307-01B (4R70W) to repair the automatic transmission. **No** GO to A5 .
A5 PRESSURE TEST THE ENGINE COOLING SYSTEM	
• Pressure test the engine cooling system. Refer to Component Tests, Pressure Test in this section. • **Does the engine cooling system leak?**	**Yes** REPAIR or INSTALL new components as necessary. TEST the system for normal operation. **No** The cooling system is operational. RETURN to the Symptom Chart.
A6 CHECK THE COOLANT RECOVERY SYSTEM	

WARNING: Never remove the pressure relief cap while the engine is operating or when the cooling system is hot. Failure to follow these instructions can result in damage to the cooling system or engine or personal injury. To avoid having scalding hot coolant or steam blow out of the degas bottle when removing the pressure relief cap, wait until the engine has cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly. Step back while the pressure is released from the cooling system. When certain all pressure has been released, (still with a cloth) turn and remove the pressure relief cap. ● Remove the pressure relief cap. ● Inspect the pressure relief cap for foreign material between the sealing gasket and the diaphragm. ● **Is the pressure relief cap OK?**	**Yes** GO to A7 . **No** CLEAN or INSTALL a new pressure relief cap. TEST the system for normal operation. GO to A1 .
A7 CHECK THE DEGAS BOTTLE	
WARNING: To avoid personal injury, do not unscrew the coolant pressure relief cap while the engine is operating or hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. ● **NOTE:** The engine must be cool when coolant is added to the degas bottle. ● Add coolant to the degas bottle until fluid is between the coolant fill level marks. ● **Does the degas bottle leak?**	**Yes** INSTALL a new degas bottle. TEST the system for normal operation. **No** CARRY OUT the cooling system pressure test. REFER to Component Tests, Pressure Test in this section. REPAIR as necessary. TEST the system for normal operation.

PINPOINT TEST B: THE ENGINE OVERHEATS

Test Step	Result / Action to Take
B1 CHECK THE ENGINE COOLANT LEVEL	
WARNING: Never remove the pressure relief cap under any conditions while the engine is operating. Failure to follow these instructions could result in damage to the cooling system or engine, or result in personal injury. To avoid having scalding hot coolant or steam blow out of the cooling system, use extreme care when removing the pressure relief cap from a hot degas bottle. Wait until the engine has cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly one turn (counterclockwise). Step back while the pressure is released from the cooling system. When certain all the pressure has been released, remove the pressure relief cap (still with a cloth). **NOTE:** If the engine is hot, allow the engine to cool before proceeding. ● Key in OFF position. ● Check the engine coolant level at the degas bottle. ● **Is the engine coolant OK?**	**Yes** GO to B2 . **No** REFILL the engine coolant at the degas bottle. GO to Pinpoint Test A .
B2 CHECK THE COOLANT CONDITION	
● Check the coolant for dirt, rust or contamination. ● **Is the coolant condition OK?**	**Yes** GO to B3 .

	No FLUSH the engine cooling system. REFER to Engine and Radiator Flushing in this section. TEST the system for normal operation.
B3 CHECK FOR AN AIRFLOW OBSTRUCTION ● Inspect the A/C condenser core and radiator for obstructions such as leaves or dirt. ● **Is there an obstruction?**	**Yes** REMOVE the obstruction. CLEAN the A/C condenser core and radiator. TEST the system for normal operation. **No** GO to B4.
B4 CHECK THE HEATER CORE OPERATION ● Install the pressure relief cap. ● Key in START position. ● As the engine starts to heat up, feel the inlet and outlet heater water hoses. They should feel approximately the same after three or four minutes. ● **Is the outlet heater water hose approximately the same temperature as the inlet heater water hose?**	**Yes** GO to B5. **No** TURN the engine off. REPAIR or INSTALL a new heater core. REFER to Section 412-02. TEST the system for normal operation.
B5 CHECK THE WATER THERMOSTAT OPERATION ● Key in START position. ● Start the engine and allow the engine to run for 10 minutes. ● Feel the inlet and outlet heater water hoses and the underside of the upper radiator hose. ● **Are the upper radiator hose and the heater water hoses cold?**	**Yes** INSTALL a new water thermostat. TEST the system for normal operation. **No** GO to B6.
B6 CHECK THE COOLING FAN OPERATION ● Key in OFF position. ● Carry out the cooling fan clutch or visctronic fan clutch component tests. Refer to the Component Tests in this section. ● **Is the cooling operation OK?**	**Yes** GO to Section 303-00 for diagnosis and testing of the engine. **No** INSTALL a new cooling fan clutch. REFER to Cooling Fan in this section.

	TEST the system for normal operation.

PINPOINT TEST C: THE ENGINE DOES NOT REACH NORMAL OPERATING TEMPERATURE

Test Step	Result / Action to Take
C1 CHECK THE ENGINE TEMPERATURE • Key in START position. • Start the engine and allow the engine to idle for 10 minutes. • Key in OFF position. • Feel the inlet and heater water hoses and the underside of the upper radiator hose. • **Are the upper radiator hose and the heater water hoses cold?**	**Yes** INSTALL a new water thermostat. REFER to Thermostat—4.6L and 5.4L (2V) and Thermostat—5.4L (4V) in this section. TEST the system for normal operation. **No** GO to Section 413-01 for diagnosis and testing of the engine coolant temperature gauge.

Component Tests

Pressure Test

1. Turn the engine OFF.

2. **WARNING: Never remove the pressure relief cap under any conditions while the engine is operating. Failure to follow these instructions could result in damage to the cooling system or engine, or result in personal injury. To avoid having scalding hot coolant or steam blow out of the cooling system, never remove the pressure relief cap from a hot degas bottle. Wait until the engine has cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly one turn (counterclockwise). Step back while the pressure is released from the cooling system. When certain all the pressure has been released, remove the pressure relief cap (still with a cloth).**

   Check the engine coolant level. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

3. Connect Radiator Heater Core Pressure Tester to the degas bottle nipple and overflow hose. Install a pressure test pump to the quick-connect fitting of the test adapter.

4. **NOTE:** If the plunger of the pump is depressed too fast, an erroneous pressure reading will result.

   Slowly depress the plunger of the pressure test pump until the pressure gauge reading stops increasing and note the highest pressure reading obtained.

5. If the pressure relief cap does not hold pressure, remove and wash the pressure relief cap in clean water to dislodge all foreign particles from the gaskets. Check the sealing surface in the filler neck.

6. If 89 kPa (13 psi) cannot be reached, install a new pressure relief cap. If more than 124 kPa (18 psi) shows on the gauge, install a new pressure relief cap.

7. **CAUTION: If the pressure drops, check for leaks at the engine to heater core hoses, engine-to-radiator hoses, water valve hose (if applicable), oil cooler return tube gasket, radiator and heater core or other system components and connections. Any leaks which are found must be corrected and the system rechecked.**

   Pressurize the engine cooling system as described in Step 4 (using a pressure relief cap that operates within the specified upper and lower pressure limits). Observe the gauge reading for approximately two minutes. For additional information, refer to Specifications in this section. Pressure should not drop during this time.

8. Release the system pressure by loosening the pressure relief cap. Check the engine coolant level and replenish, if necessary, with the correct engine coolant mixture. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

Cap—Pressure Relief

1. **WARNING: Never remove the pressure relief cap under any conditions while the engine is operating. Failure to follow these instructions could result in damage to the cooling system or engine or personal injury. To avoid having scalding hot coolant or steam blow out of the cooling system, never remove the pressure relief cap from a hot degas bottle. Wait until the engine has cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly one turn (counterclockwise). Step back while the pressure is released from the cooling system. When certain all the pressure has been released, remove the pressure relief cap (still with a cloth).**

   Inspect the pressure relief cap and seals for damage or deterioration. Install a new pressure relief cap if necessary.

2. Fit the pressure relief cap to Radiator/Heater Core Pressure Tester Kit using the aftermarket adapter.

3. **NOTE:** If the plunger of the pressure tester is depressed too fast, an incorrect pressure reading will result.

   Slowly pump the pressure tester until the pressure gauge stops increasing and note the highest pressure reading. Release pressure and repeat the test. Install a new pressure relief cap if the pressure is not 99.3-121.4 kPa (14.4-17.6 psi).

Thermostat

A new water thermostat should be installed only after the following electrical and mechanical tests have been carried out.

Thermostat—Electrical Test — 5.4L (4V) Only

CAUTION: Always vent the exhaust to the outside when carrying out this test.

NOTE: The electrical thermostat test is most accurate if carried out indoors at less than 37.8°C (100°F) ambient air. This test may be carried out with or without the hood open and with the engine warm or cold.

1. Check the engine coolant level. Fill as needed.

2. With the key OFF, remove the engine coolant temperature (ECT) sensor harness connector and attach ECT Sensor "T" Cable as a jumper between the powertrain control module (PCM) and the ECT Sensor. Attach 73 Digital Multimeter to the ECT Sensor "T" Cable. Voltage values (0 to 5 V) can now be monitored while the sensor retains its connection to the wiring harness.

Use a scan tool to monitor the ECT sensor voltage.

3. **NOTE:** Running this test with the vehicle in gear or with the A/C compressor clutch engaged (running) will cause incorrect diagnosis.

   Place transmission in PARK (P) or NEUTRAL (N).

4. Start the engine and allow to idle throughout this test. Allow the engine to run for two minutes, then record the ECT voltage. Record the ECT voltage every 60 seconds. When the ECT voltage trend changes direction or only changes slightly (0.03 volt or less) from the previous reading, record this as the thermostat opening voltage. Use the voltage and corresponding coolant temperature chart listed below.

Coolant Temperature °C (°F)	ECT (Volts)
22 (71)	3.00
43 (109)	2.01
71 (159)	1.01
82 (180)	0.75
91 (195)	0.059
97 (206)	0.050
105 (221)	0.040

5. If the thermostat opening voltage is greater than 0.75 volt and less than 82°C (180°F), install a new water thermostat.

6. If the thermostat opening voltage is less than 0.75 volt and greater than 82°C (180°F), the water thermostat is good and a new thermostat should not be installed. For additional information, refer to the Symptom Chart.

Thermostat— Mechanical Test

1. Remove the water thermostat.

2. Check the water thermostat for seating. Hold the water thermostat up to a lighted background. Leakage of light around the thermostat valve at room temperature indicates that a new water thermostat should be installed. Some water thermostats have a small leakage notch at one location on the perimeter of the thermostat valve, which is considered normal.

3. Immerse it in a boiling antifreeze and water mixture.

4. For additional information, refer to Specifications for water thermostat opening temperature.

Radiator Leak Test, Removed From Vehicle

CAUTION: Never leak test an aluminum radiator in the same water that copper/brass radiators are tested in. Flux and caustic cleaners may be present in the cleaning tank and they will damage aluminum radiators.

NOTE: Always install plugs in the oil cooler fittings before leak-testing or cleaning any radiator.

NOTE: Clean the radiator before leak-testing to avoid contamination of the tank.

Leak-test the radiator in clean water with 138 kPa (20 psi) air pressure.

Mechanical Fan Clutch Test

Spin the fan blade by hand. A light resistance should be felt. If there is no resistance or very high resistance, the minimum and maximum fan speeds must be checked as follows:

Minimum Speed Fan Clutch Requirement Test

1. Use a suitable marker to mark the water pump pulley, one of the fan blade bolts, and the crankshaft pulley.

2. Connect a tachometer to the engine.

3. Install a throttle adjusting tool.

4. Connect a digital photoelectric tachometer.

5.  **WARNING: To avoid the possibility of personal injury or damage to the vehicle, do not operate the engine until the fan blade has been first examined for possible cracks and separation. Failure to follow these instructions can result in personal injury.**

   Start the engine and run it at approximately 1,500 rpm until the normal operating temperature has been achieved.

6. Adjust the engine speed to 2,300 rpm.

7. Adjust the strobe light to 3,000 rpm and aim it at the water pump pulley. Adjust the engine speed until the light flash and the water pump pulley mark are synchronized.

8. Aim the strobe light at the fan blade retaining bolts. Adjust the strobe light until the light flash is synchronized with the marked fan blade retaining bolt (fan blade appears to stand still).

9. The fan blade speed must not be greater than 1,500 rpm at 3,000 water pump rpm.

10. Turn the engine off.

11. If the fan blade speed was greater than 1,500 rpm, install a new fan clutch.

Maximum Speed Fan Clutch Requirement Test

1. Carry out Steps 1 through 5 of the Minimum Speed Fan Clutch Requirement Test.

2. **NOTE:** The engine temperature should be above 96°C (205°F) for maximum fan speed.

   Block off areas on each side of the radiator in the engine compartment and the front of the radiator grille. This will raise the temperature of the air striking the fan clutch and should cause the fan to operate at maximum speed.

3. Place the climate control function selector switch in the MAX A/C position and the blower motor switch in the HI position.

4. Adjust the strobe light to 3,000 rpm.

5.  **WARNING: To avoid the possibility of personal injury or damage to the vehicle, do not operate the engine until the fan blade has been first examined for possible cracks and separation. Failure to follow these instructions can result in personal injury.**

Start the engine and adjust the engine speed until the strobe light flash and the water pump pulley mark are synchronized.

6. Aim the strobe light at the fan blade retaining bolts. Adjust the strobe light until the light flash is synchronized with the marked fan blade retaining bolt (fan blade appears to stand still).

7. If the fan blade speed is less than 2,300 rpm, install a new fan clutch.

Visctronic Fan Clutch Test

1. **WARNING: To avoid the possibility of personal injury or damage to the vehicle, do not operate the engine until the fan blade has been first examined for possible cracks and separation. Failure to follow these instructions can result in personal injury.**

   Start the engine.

2. Using the diagnostic tool, set the visctronic drive fan duty cycle PID to 100 percent.

3. If after several minutes the fan speed increases, the minimum and maximum fan speeds must be checked. Refer to minimum and maximum speed visctronic drive fan clutch requirement tests.

4. If sent here from the Powertrain Control/Emissions Diagnosis (PC/ED) manual, install a new visctronic drive fan clutch.

5. If after several minutes the fan speed does not increase, refer to Powertrain Control/Emissions Diagnosis (PC/ED) manual for further diagnosis.

Minimum Speed Visctronic Fan Clutch Requirement Test

1. **WARNING: To avoid the possibility of personal injury or damage to the vehicle, do not operate the engine until the fan blade has been first examined for possible cracks and separation. Failure to follow these instructions can result in personal injury.**

   Start the engine.

2. Using the diagnostic tool, set the visctronic drive fan duty cycle PID to 0 percent.

3. Adjust the engine speed to 1,500 rpm until normal operating temperature is reached.

4. Increase the engine speed to 3,000 rpm for two minutes while reading the fan speed PID on the diagnostic tool.

5. If the fan speed is above 1,500 rpm, install a new visctronic drive fan clutch.

Maximum Speed Visctronic Fan Clutch Requirement Test

1. **WARNING: To avoid the possibility of personal injury or damage to the vehicle, do not operate the engine until the fan blade has been first examined for possible cracks and separation. Failure to follow these instructions can result in personal injury.**

   Start the engine.

2. Using the diagnostic tool, set the visctronic drive fan duty cycle PID to 100 percent.

3. Adjust the engine speed to 1,500 rpm until normal operating temperature is reached.

4. Increase the engine speed to 3,000 rpm for two minutes while reading the fan speed PID on the diagnostic tool.

5. If the fan speed is less than 2,300 rpm, install a new visctronic fan clutch.

6. If DTC P0480 or DTC P0528 are present, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Cooling System Draining, Filling and Bleeding

Material

Item	Specification
Motorcraft Premium Engine Coolant VC-4-A (in Oregon VC-5, in Canada CXC-10) or equivalent (green color)	ESE-M97B44-A
Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) or equivalent (yellow color)	WSS-M97B51-A1

Draining

WARNING: Never remove the pressure relief cap under any conditions while the engine is operating. Failure to follow these instructions can result in damage to the cooling system or engine, or result in personal injury. To avoid having scalding hot coolant or steam blow out of the cooling system, never remove the pressure relief valve from a hot degas bottle. Wait until the engine has cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly one turn (counterclockwise). Step back while the pressure is released from the cooling system. When certain all the pressure has been released, remove the pressure relief cap (still with a cloth).

CAUTION: The coolant must be recovered in a suitable, clean container for reuse. If the coolant is contaminated, it must be recycled or disposed of correctly and replaced.

CAUTION: Some vehicle cooling system are filled with Motorcraft Premium Engine Coolant VC-4-A (in Oregon VC-5, in Canada CXC-10) or equivalent meeting Ford specification ESE-M97B44-A (green color). Others are filled with Motorcraft Premium Gold Coolant VC-7-A (in Oregon VC-7-B) or equivalent meeting Ford specification WSS-M97B51-A1 (yellow color). Always fill the cooling system with the same coolant that is present in the system. Do not mix coolant types.

NOTE: The addition of Motorcraft Cooling System Stop Leak Pellets, VC-6, darkens Motorcraft Premium Gold Engine Coolant from yellow to golden tan.

NOTE: Less than 80% of coolant capacity can be recovered with the engine in the vehicle. Dirty, rusty or contaminated coolant requires replacement.

1. Release the pressure in the cooling system by slowly turning the pressure relief cap one half turn counterclockwise. When the pressure is released, remove the pressure relief cap.
2. Place a suitable container below the radiator draincock (8115). If equipped, disconnect the coolant return hose at the oil cooler.
3. Open the radiator draincock.
4. Close the radiator draincock when finished.

Filling

CAUTION: Engine coolant provides freeze protection, boil protection, cooling efficiency, and corrosion protection to the engine and cooling components. In order to obtain these protections, the engine coolant must be maintained at the correct concentration and fluid level in the degas bottle.

When adding engine coolant, use a 50/50 mixture of engine coolant and clean, drinkable water.

To maintain the integrity of the coolant and the cooling system:

- **Add Motorcraft Premium Engine Coolant VC-4-A (in Oregon VC-5, in Canada CXC-10) or equivalent meeting Ford specification ESE-M97B44-A (green color), or Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) or equivalent meeting Ford specification WSS-M97B51-A1 (yellow color). Use the same coolant that was drained from the cooling system. Do not mix coolant types.**
  - **The addition of Motorcraft Cooling System Stop Leak Pellets, VC-6, darkens Motorcraft Premium Gold Engine Coolant from yellow to golden tan.**
- **Do not add orange colored Motorcraft Specialty Orange Engine Coolant VC-2 or equivalent meeting Ford specification WSS-M97B44-D. Mixing coolants can degrade the coolants corrosion protection.**
- **Do not add alcohol, methanol, or brine, or any engine coolants mixed with alcohol or methanol antifreeze. These can cause engine damage from overheating or freezing.**
- **Do not mix with recycled coolant unless it meets the requirements of Ford specification ESE-M97B44-A or WSS-M97B51-A1. Not all coolant recycling processes meet these Ford specifications. Use of such coolants can harm the engine and cooling system components.**

1. Add the correct engine coolant mixture to the degas bottle.
2. Move the temperature blend selector to the full warm position.
3. Run the engine until it reaches operating temperature.
4. Add the correct engine coolant mixture to the degas bottle until the coolant level is between the "COOLANT FILL LEVEL" marks.
5. Turn off the engine and allow the cooling system to cool.
6. Repeat Steps 1 through 5 until the degas bottle level is OK.

Bleeding

1. Select maximum heater temperature and blower motor speed settings. Position control to discharge air at A/C vents in the instrument panel (04320).
2. Start the engine and allow to idle. While the engine is idling, feel for hot air at A/C vents.
3. **CAUTION: If the air discharge remains cool and the engine coolant temperature gauge does not move, the engine coolant level is low in the engine and must be filled. Stop the engine, allow to cool and fill the cooling system as described.**

   Start the engine and allow to idle until normal operating temperature is reached. Hot air should discharge from the A/C vents. The engine coolant temperature gauge should maintain a stabilized reading in the middle of the NORMAL range and the upper radiator hose (8260) should feel hot to the touch.

4. Shut the engine off and allow it to cool.
5. Check the engine for coolant leaks.
6. Check the engine coolant level in the degas bottle and fill as necessary.

Engine and Radiator Flushing

Material

Item	Specification
Motorcraft Cooling System Flush VC-1 or equivalent	ESR-M14P7-A

1. **WARNING: Do not open the cooling system while it is hot or while the engine is running. Failure to follow these instructions can result in personal injury.**

   Drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

2. Remove the water thermostat.

3. Install the water hose connection without the water thermostat.

4. **NOTE:** For additional information, refer to the cooling system flusher operating instructions for specific vehicle hook-up.

   Use an appropriate cooling system flusher to flush the engine and radiator.
   Use Motorcraft Cooling System Flush VC-1 or equivalent meeting Ford specification ESR-M14P7-A.

5. Install the water thermostat.

6. Backflush the heater core (18476). For additional information, refer to Heater Core Backflushing in this section.

7. Fill the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

Heater Core Backflushing

Material

Item	Specification
Motorcraft Cooling System Flush VC-1 or equivalent	ESR-M14P7-A

1. **WARNING: Do not open the cooling system while it is hot or while the engine is running. Failure to follow these instructions can result in personal injury.**

   Partially drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

2. **NOTE:** For additional information, refer to the cooling system flusher operating instructions for specific vehicle hook-up.

   Use an appropriate cooling system flusher to backflush the heater core. Use Motorcraft Cooling System Flush VC-1 or equivalent meeting Ford specification ESR-M14P7-A.

3. Fill the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

Block Heater

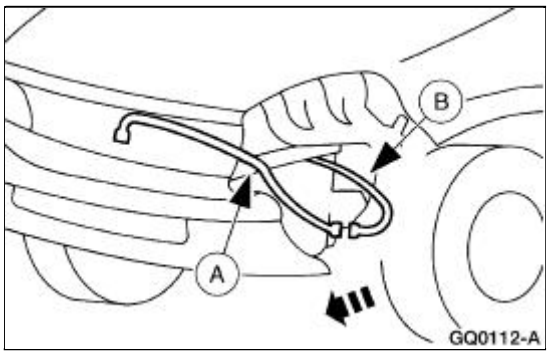
Material

Item	Specification
Premium Long Life Grease XG-1-C	ESA-M1C75-B

Removal and Installation

1. Drain the engine cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

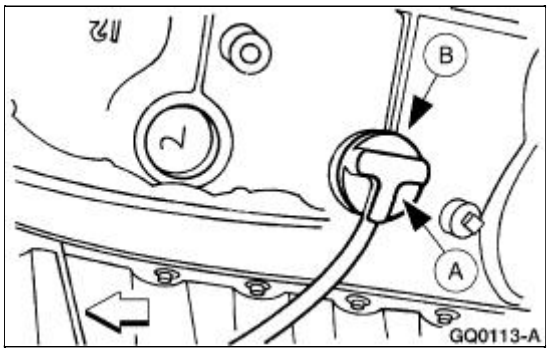
2. Disconnect the (A) block heater wire extension (6B019) from the (B) block heater wiring (6B018) and remove.



3. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the RH kick panel area. Failure to do so may result in unexpected inflation or deflation of the air springs which may result in shifting of the vehicle during these operations. Failure to follow these instructions may result in personal injury.**

   Raise and support the vehicle. For additional information, refer to Section 100-02 .

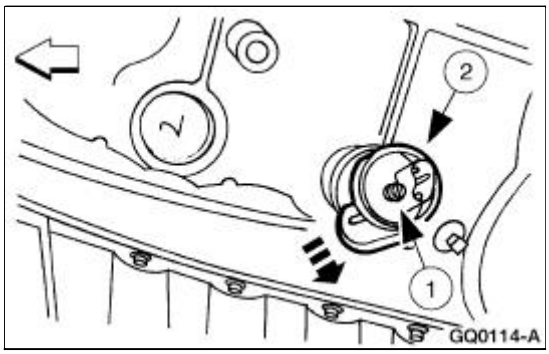
4. Disconnect the (A) block heater wiring from the (B) block heater (6A051).



5. Remove the block heater.

1. **CAUTION: Do not loosen the screw more than necessary for removal.**

   Loosen the screw.
2. Twist and slide the block heater to release the retainer clip and remove. Discard the retainer clip.



6. **NOTE:** To ease installation, coat the block heater seal and the cylinder block hole with grease.

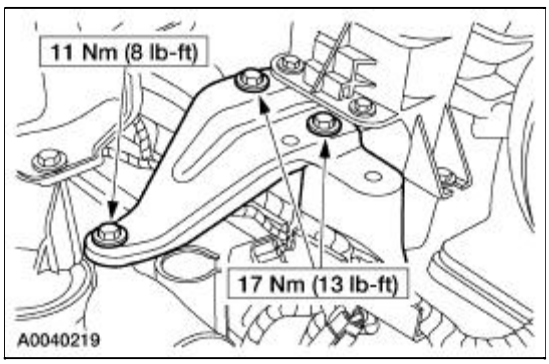
   NOTE: If equipped with air suspension, reactivate the system by turning on the air suspension switch.

   To install, reverse the removal procedure.

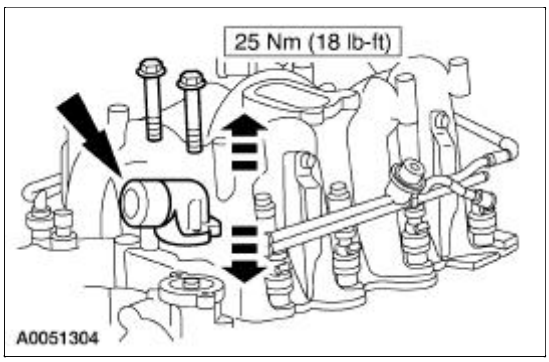
Thermostat —4.6L and 5.4L (2V)

Removal and Installation

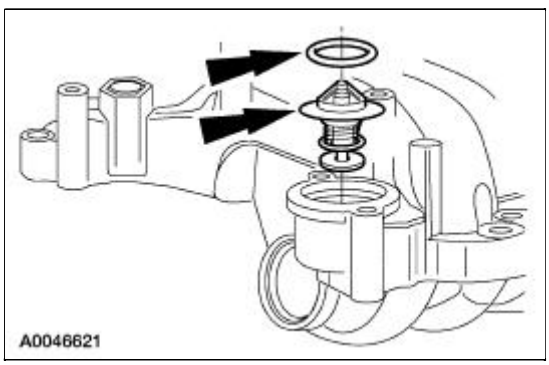
1. Partially drain the engine cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.
2. Disconnect the upper radiator hose from the water outlet adapter.
3. Remove the power steering reservoir upper mounting bracket.



4. Remove the bolts and remove the water outlet adapter.



5. Remove the water thermostat and the O-ring seal.
   - Discard the O-ring seal.



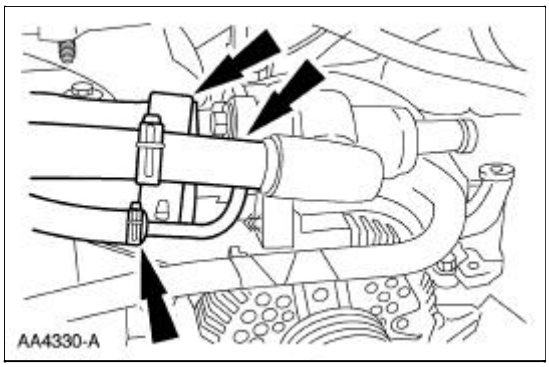
6. To install, reverse the removal procedure.

Thermostat —5.4L (4V)

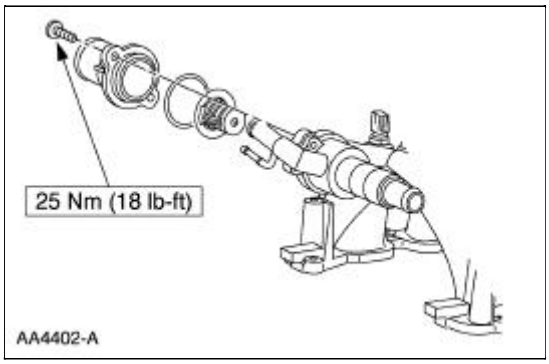
Removal and Installation

1. Partially drain the engine cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

2. Disconnect the upper radiator hose, the heater water inlet hose and the heated PCV inlet hose from the water outlet adapter.



3. Remove the water hose connection (8592).



4. To install, reverse the removal procedure.

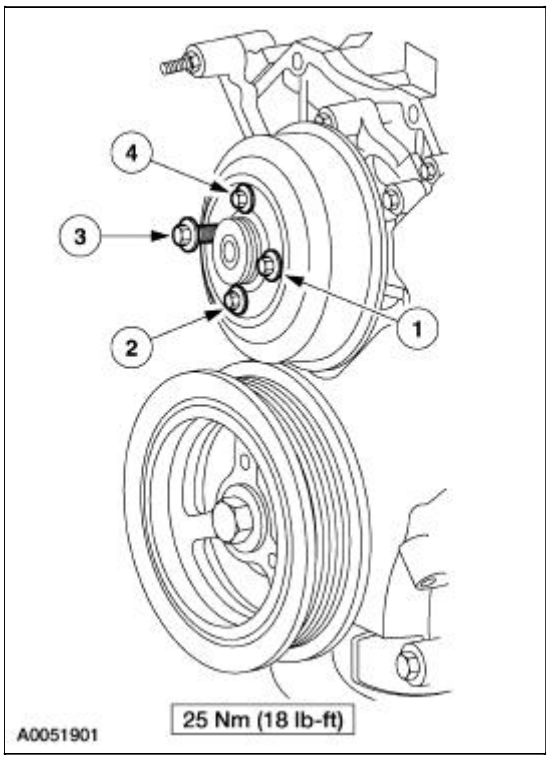
Water Pump

Material

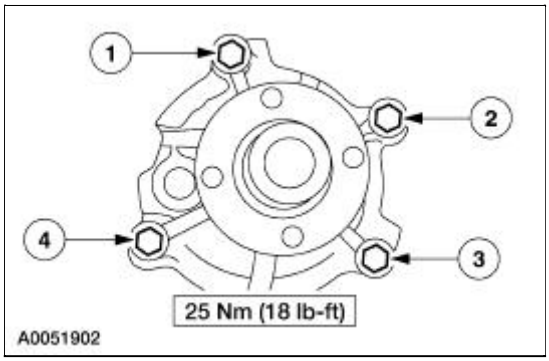
Item	Specification
Motorcraft Premium Engine Coolant VC-4-A (in Oregon VC-5, in Canada CXC-10) (green color)	ESE-M97B44-A
Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) (yellow color)	WSS-M97B51-A1

Removal and Installation

1. Remove the engine cooling fan (8K620) and fan shroud (8146). For additional information, refer to Cooling Fan in this section.
2. Remove the drive belt (8620). For additional information, refer to Section 303-05 .
3. Remove the bolts in the sequence shown, and the water pump pulley.



4. Remove the bolts in the sequence shown, and the water pump.



5. Wipe the water pump mounting surface with a soft cloth if necessary.

6. **CAUTION: Do not rotate the water pump housing once installed in the engine. Damage to the O-ring seal can occur, causing the water pump to leak.**

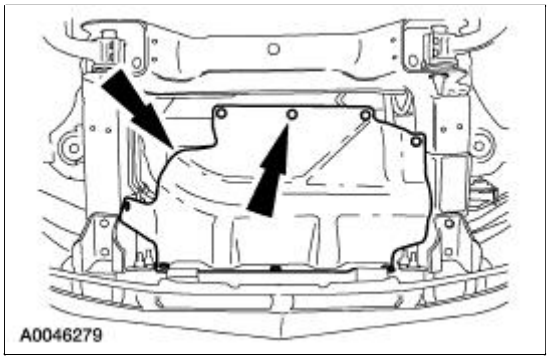
   NOTE: Install a new O-ring seal and lubricate with Motorcraft Premium Engine Coolant E2FZ-19549-AA, F5FZ-19549-CC in Oregon, CXC-10 in Canada or equivalent meeting Ford specification ESE-M97B44-A (green color) or Motorcraft Premium Gold Engine Coolant VC-7-A meeting Ford specification WSS-M97B51-A1 (yellow color). Use the same coolant that was drained from the engine.

   To install, reverse the removal procedure.

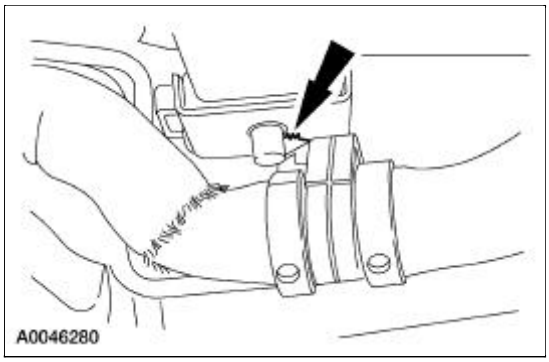
Radiator

Removal and Installation

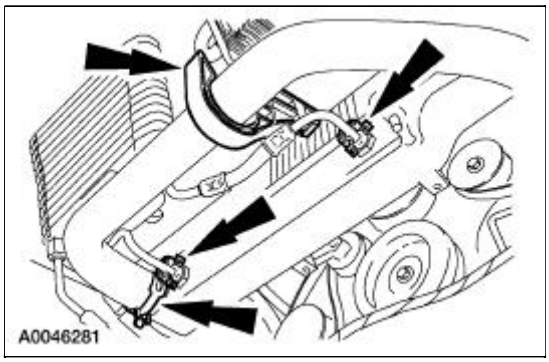
1. Remove the fan blade. For additional information, refer to Cooling Fan in this section.
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. Remove the splash shield.



4. Remove the pushpin securing the lower radiator hose to the radiator routing hook.

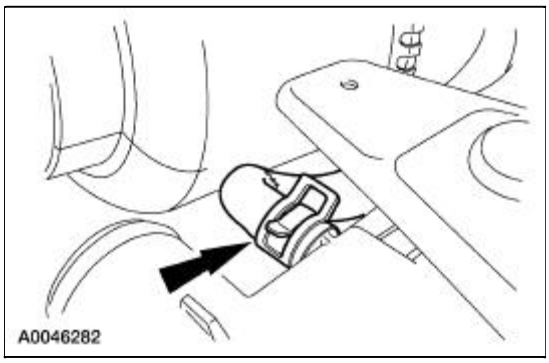


5. Disconnect the following:
   - Lower radiator hose from the radiator.
   - Lower radiator hose from the routing hook.
   - Transmission tubes from the radiator.

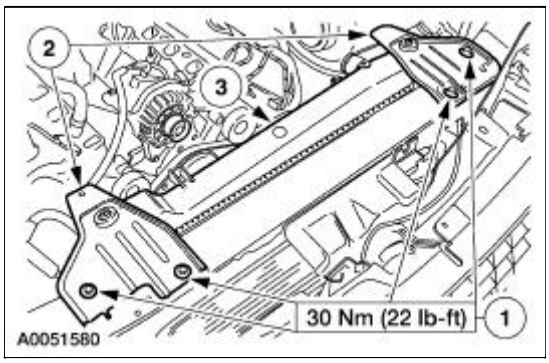


6. Lower the vehicle.

7. Disconnect the degas bottle hose from the radiator.



8. Remove the radiator.
    1. Remove the bolts.
    2. Remove the radiator upper support brackets.
    3. Remove the radiator.



9. To install, reverse removal procedure.

Cooling Fan

Special Tool(s)

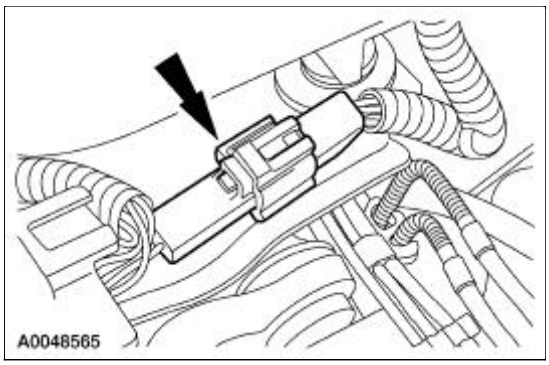
 ST1499-A	Holding Wrench, Fan Pulley 303-239 (T84T-6312-C)
 ST1828-A	Wrench, Fan Clutch Nut 303-240 (T84T-6312-D)

Removal

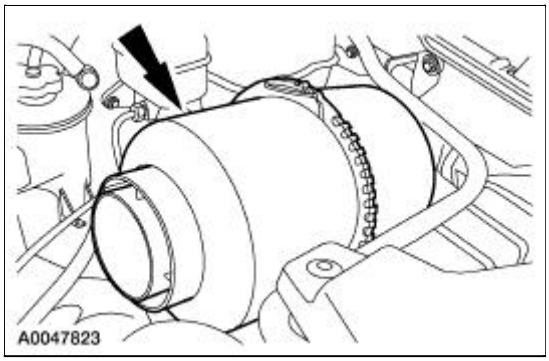
WARNING: Do not run the engine while the protective components are removed. Failure to follow these instructions can result in personal injury.

All vehicles

1. Remove the air cleaner outlet pipe. For additional information, refer to Section 303-12 .
2. Disconnect the mass air flow (MAF) sensor electrical connector.

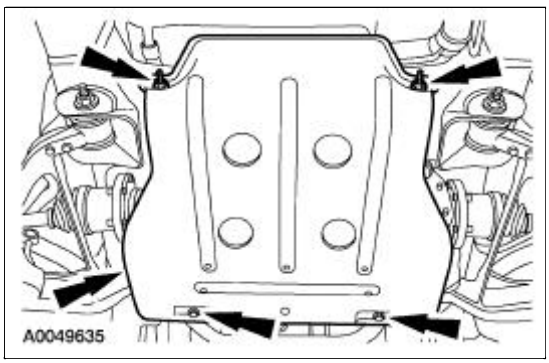


3. Remove the outlet side of the air cleaner.

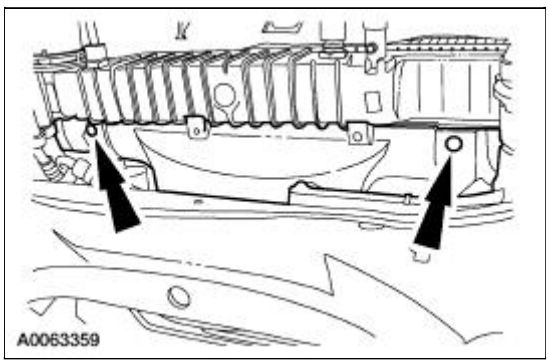


4. Raise and support the vehicle. For additional information, refer to Section 100-02 .

5. If equipped, remove the skidplate.



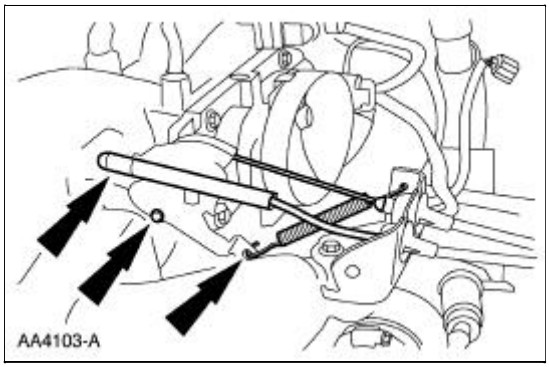
6. Remove the screws and the lower section of the cooling fan shroud.



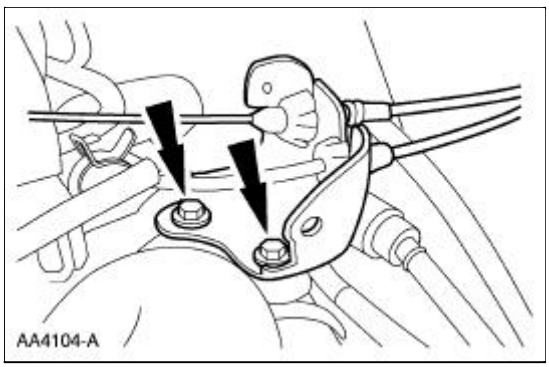
7. Lower the vehicle.

Vehicles equipped with 5.4L 4V engines

8. Disconnect the accelerator cable, speed control cable, and the return spring.

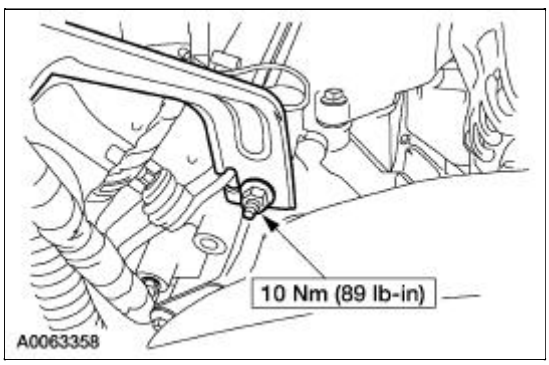


9. Remove the bolts and position the cable and brackets out of the way.



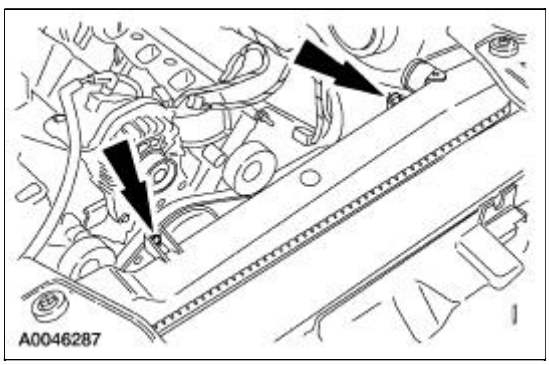
Vehicles equipped with 4.6L engines

10. Remove the nut and the engine appearance cover bracket.

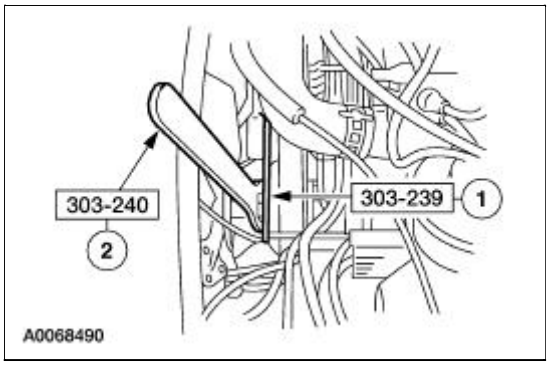


All vehicles

11. Remove the mounting bolts and the upper section of the cooling fan shroud.

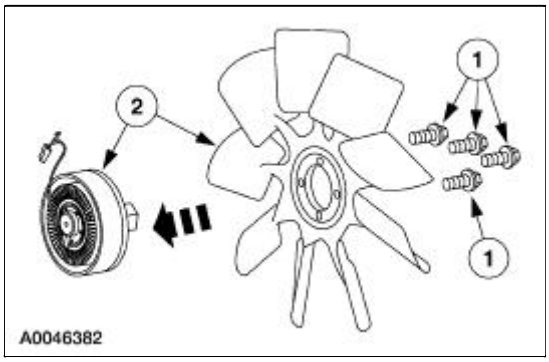


12. Remove the fan blade and the fan clutch.
    1. Using the special tool, hold the coolant pump pulley steady.
    2. Using the special tool, remove the cooling fan assembly locknut.



13. **NOTE:** Electronically-controlled fan clutch shown, thermostatically-controlled fan clutch similar.

    Separate the fan clutch from the fan blade.
    1. Remove the bolts.
    2. Separate the fan blade from the fan clutch.

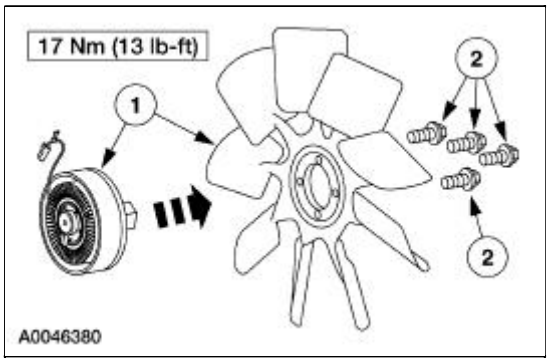


Installation

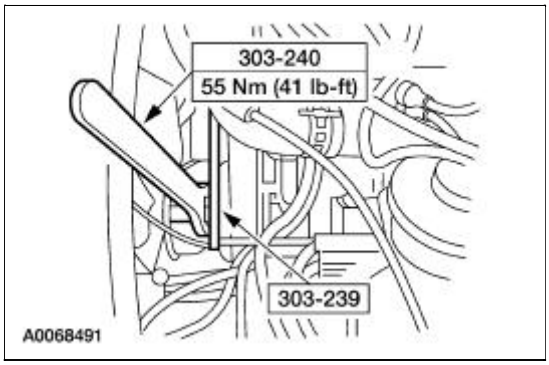
All vehicles

1. **NOTE:** Electronically-controlled fan clutch shown, thermostatically-controlled fan clutch similar.

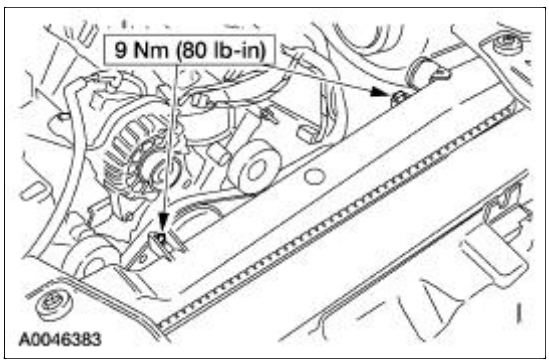
   Assemble the fan clutch to the fan blade.
   1. Position the fan clutch on the fan blade.
   2. Install the bolts.



2. Using the special tools, install the cooling fan assembly.

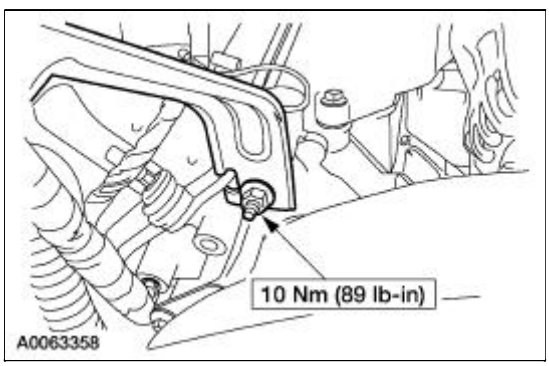


3. Install the upper section of the fan shroud and mounting bolts.



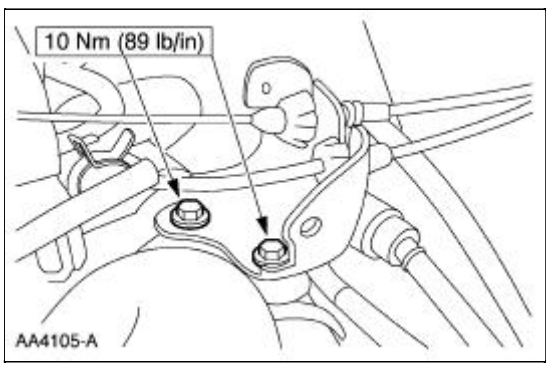
Vehicles equipped with 4.6L engines

4. Install the engine appearance cover bracket and nut.

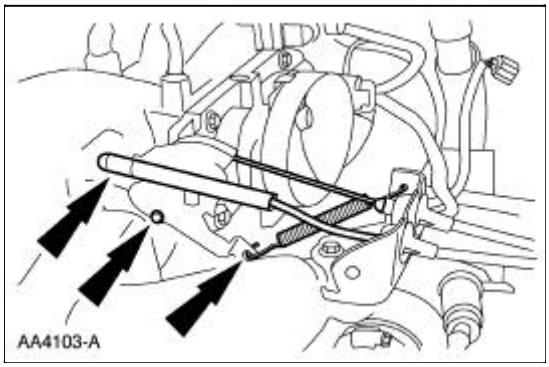


Vehicles equipped with 5.4L 4V engines

5. Position the cables and bracket, and install the bolts.

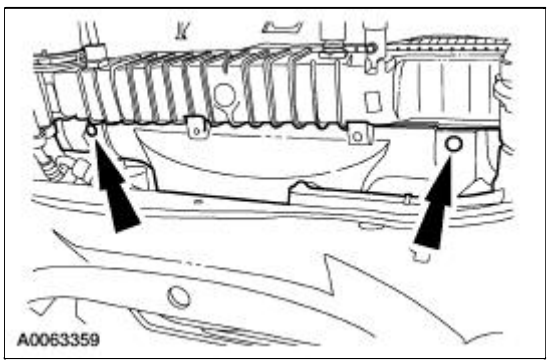


6. Connect the accelerator cable, speed control cable and the return spring.

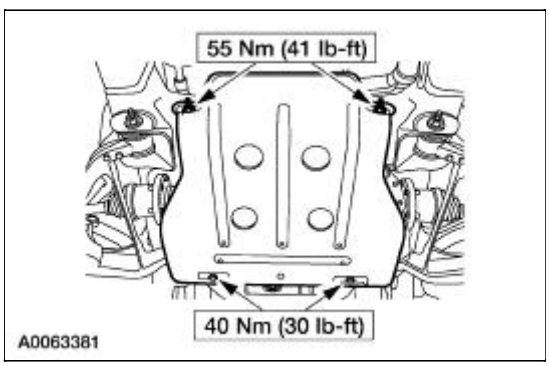


All vehicles

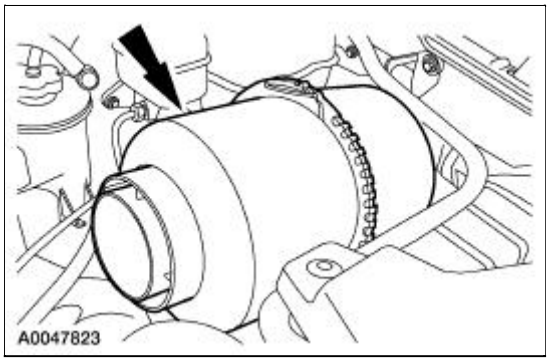
7. Raise the vehicle.
8. Install the screws and the lower section of the cooling fan shroud.



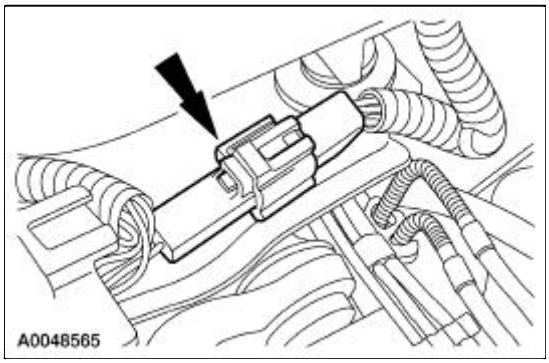
9. If equipped, install the skidplate.



10. Lower the vehicle.
11. Install the outlet side of the air cleaner.



12. Connect the mass air flow (MAF) sensor electrical connector.



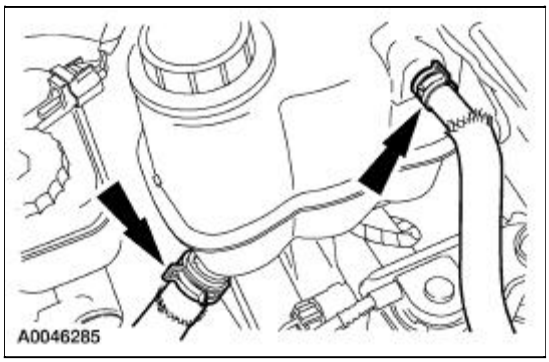
13. Install the air cleaner outlet pipe. For additional information, refer to Section 303-12 .

Degas Bottle

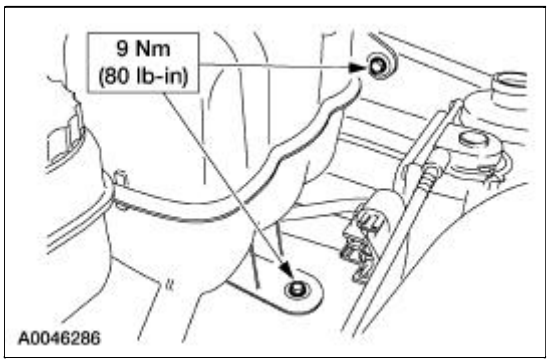
Removal and Installation

1. Partially drain the cooling system. For additional information, refer to Cooling System Draining, Filling and Bleeding in this section.

2. Disconnect the coolant hoses.



3. Remove the mounting bolts.



4. Remove the degas bottle.

5. To install, reverse the removal procedure.

General Specifications

Item	Specification
Lubricants and Chemicals	
SAE 5W-20 Premium Synthetic Blend Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Torque Specifications

Description	Nm	lb-ft	lb-in
EGR vacuum regulator solenoid bracket bolt	10		89
Brake booster vacuum tube bolt	10	—	89
EGR tube fittings	40	30	—
Fuel injection supply manifold bolts	10	—	89
Throttle body bolts	9	—	80
Throttle body adapter bolts	10		89

Fuel Charging and Controls

The fuel injection supply manifold (9F792):

- delivers fuel to the individual fuel injectors (9F593).
- receives fuel from the fuel supply line.

The throttle body (9E926):

- controls air supply to the upper intake manifold (9424) by positioning the throttle plate.
- connects the accelerator cable (9A758) and, if equipped, the speed control actuator cable (9A825) to the throttle lever.
- is not adjustable.
- cannot be cleaned.

The fuel injectors:

- are electrically operated by the powertrain control module (PCM) (12A650).
- atomize the fuel as the fuel is delivered.
- are deposit-resistant.
- each have an internal solenoid that opens a needle valve to inject fuel into the lower intake manifold.

The fuel pressure relief valve (9H321) is used to inspect and relieve fuel pressure.

The fuel pressure regulator (9C968):

- maintains constant fuel pressure throughout the fuel system and to the fuel injectors.
- is spring-loaded and operated by intake manifold vacuum.

The A/C compressor clutch control relay (if A/C equipped):

- is controlled by the PCM.
- interrupts A/C clutch operation during engine start or manual transmission clutch engagement to reduce engine load.

The fuel pump relay engages the fuel pump when energized by the PCM.

Fuel Charging and Controls

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

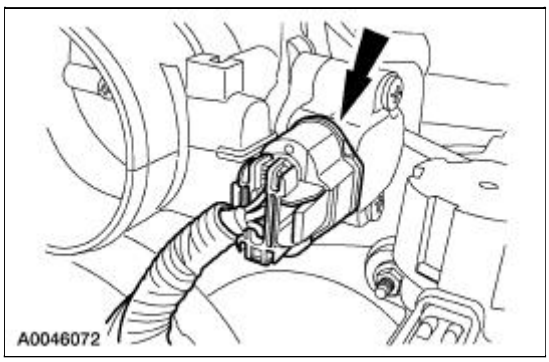
Throttle Body

Removal and Installation

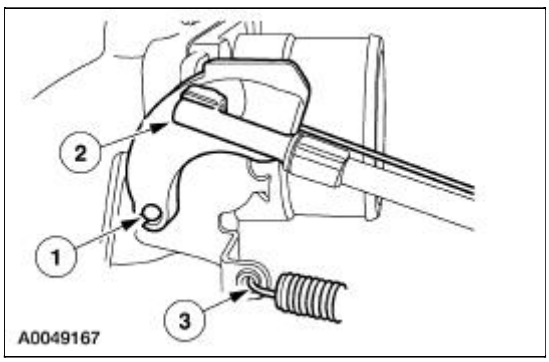
WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and can be ignited. Failure to follow these instructions can result in personal injury.

CAUTION: Throttle body bore and plate area have a special coating and cannot be cleaned.

1. Remove the air cleaner outlet pipe. For additional information, refer to Section 303-12 .
2. Disconnect the throttle position (TP) sensor electrical connector.

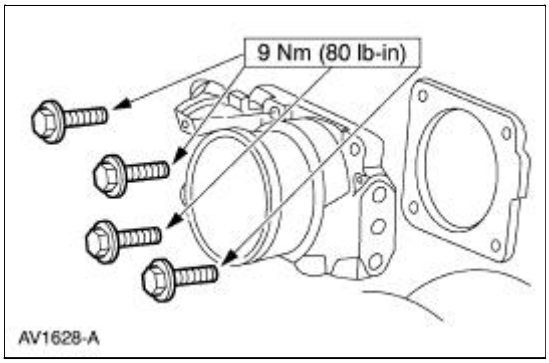


3. Disconnect the accelerator controls.
    1. Disconnect the accelerator cable.
    2. Disconnect the speed control cable.
    3. Disconnect the return spring.



4. **NOTE:** Discard the throttle body gasket.

    Remove the bolts, the throttle body and the throttle body gasket.



5. To install, reverse the removal procedure.

Fuel Injectors

Removal and Installation

WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and can be ignited. Failure to follow these instructions can result in personal injury.

WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before working on or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved. Failure to follow these instructions can result in personal injury.

NOTE: In order to remove the fuel injectors, the fuel injection supply manifold must be removed.

1. Remove the fuel injection supply manifold. For additional information, refer to Fuel Injection Supply Manifold—4.6L or Fuel Injection Supply Manifold—5.4L in this section.

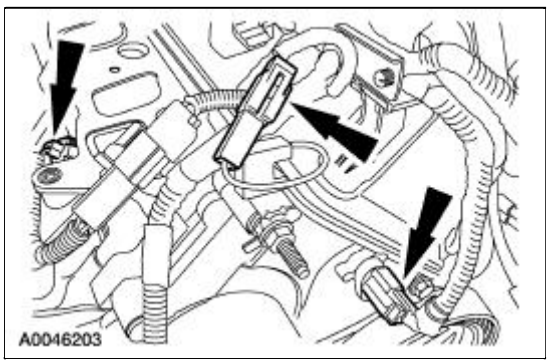
Fuel Charging Wiring Harness

Removal and Installation

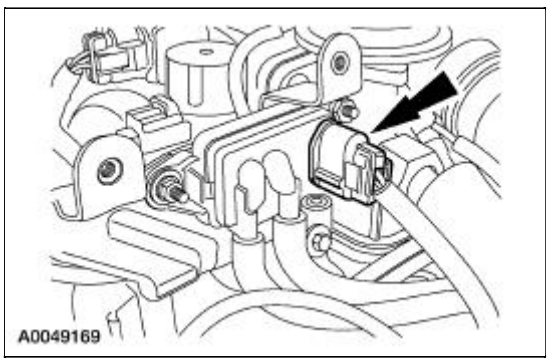
WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and can be ignited. Failure to follow these instructions can result in personal injury.

All vehicles

1. Remove the intake manifold. For additional information, refer to Section 303-01A .
2. Disconnect the following electrical connectors:
   - Camshaft position (CMP) sensor.
   - Left radio interference capacitor.
   - Cylinder head temperature sensor.



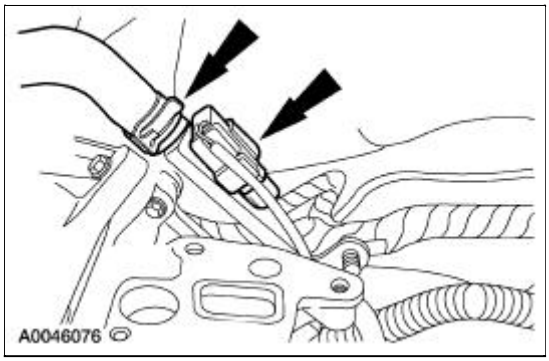
3. Disconnect the differential pressure feedback exhaust gas recirculation (EGR) system electrical connector.



4. Release the fuel charging wiring harness from the left valve cover.

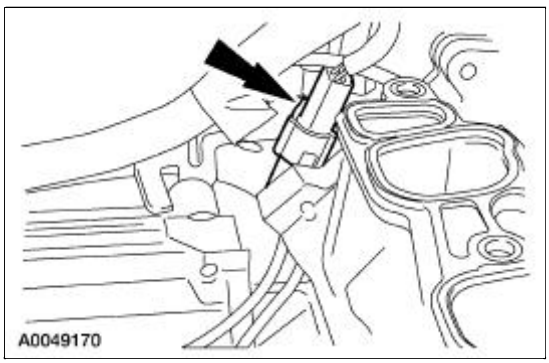
Vehicles with 5.4L engine

5. Remove the coolant hose from the water outlet tube and disconnect the knock sensor electrical connector.

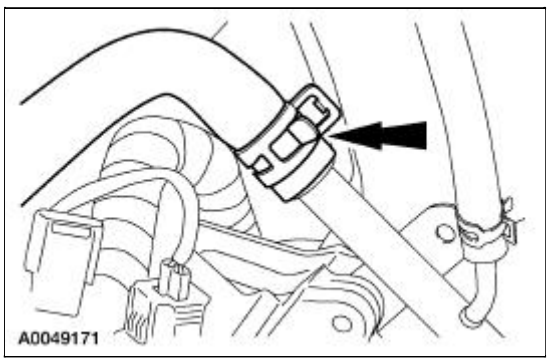


Vehicles with 4.6L engine

6. Disconnect the knock sensor electrical connector.

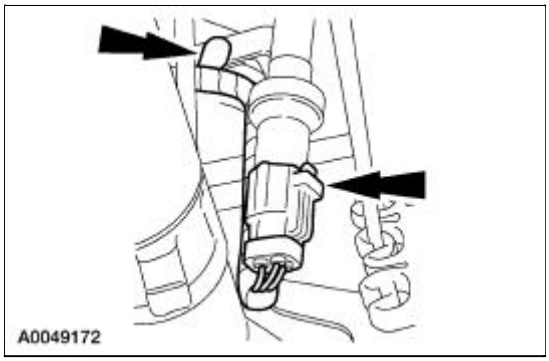


7. Remove the coolant hose from the water outlet tube.

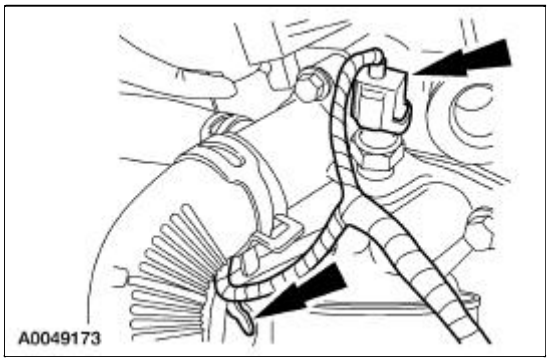


All vehicles

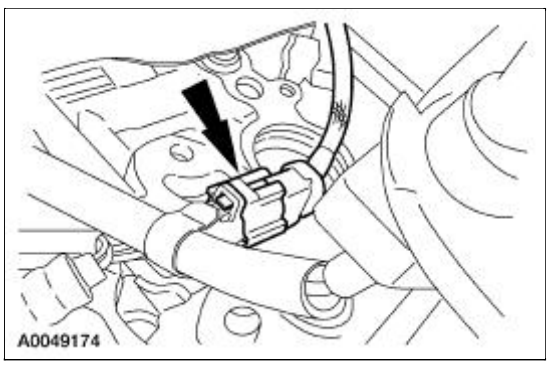
8. Raise and support the vehicle. For additional information, refer to Section 100-02 .
9. Disconnect the power steering pressure sensor electrical connector and wiring anchor.



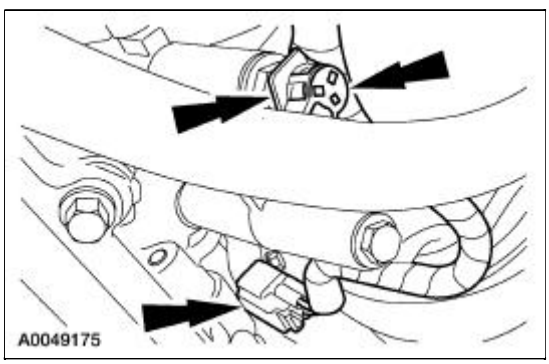
10. Disconnect the oil pressure sensor electrical connector and wiring anchor.



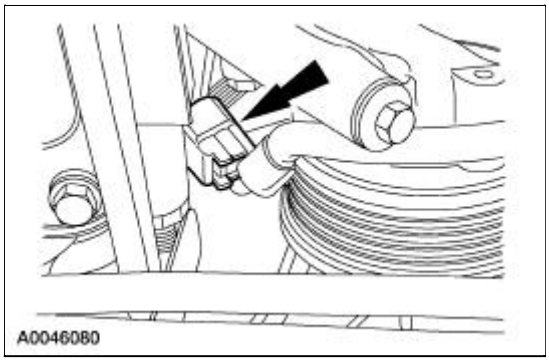
11. Disconnect the LH and RH oxygen sensor electrical connectors.



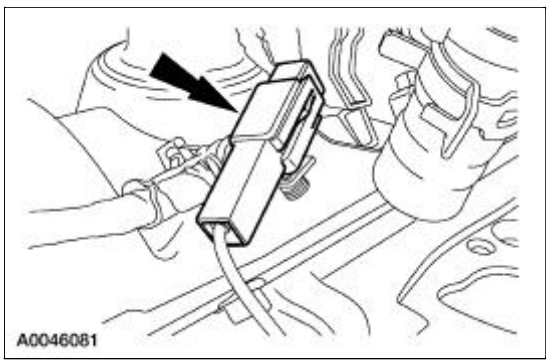
12. Disconnect the following:
    - Crankshaft position (CKP) sensor electrical connector.
    - Wiring harness anchors from the A/C compressor stud.



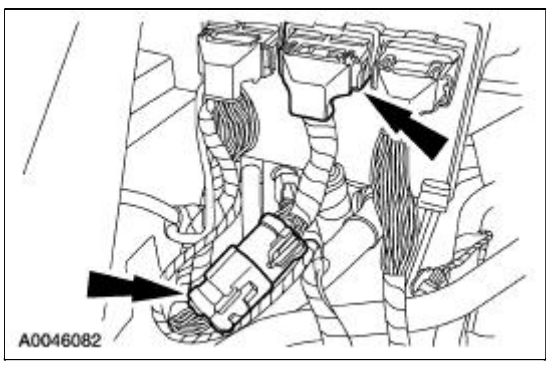
13. Disconnect the A/C compressor clutch electrical connector.



14. Lower the vehicle.
15. Remove the fuel charging wiring harness bracket from the water outlet tube brace.
16. Route all bottom-of-engine wiring into the engine compartment.
17. Disconnect the right radio interference capacitor electrical connector.



18. Disconnect the powertrain control module (PCM) electrical connectors.



19. Release the fuel charging wiring harness from the right valve cover.
20. Remove the fuel charging wiring harness.
21. To install, reverse the removal procedure.

Fuel Injection Supply Manifold —4.6L

Material

Item	Specification
Super Premium SAE 5W-20 Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

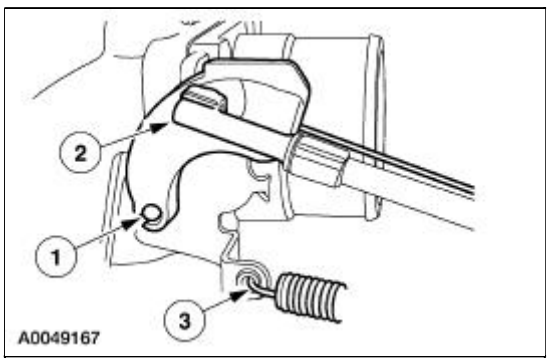
Removal

WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and can be ignited. Failure to follow these instructions can result in personal injury.

WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before working on or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved. Failure to follow these instructions can result in personal injury.

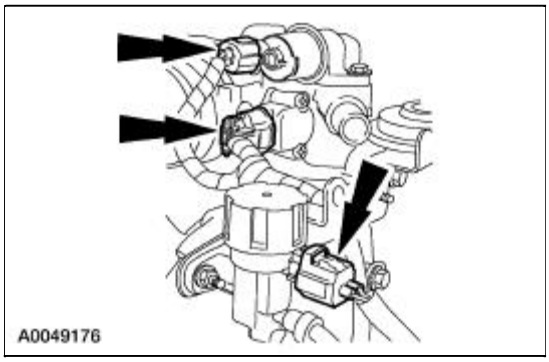
All vehicles

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Partially drain the cooling system. For additional information, refer to Section 303-03 .
3. Remove the air cleaner outlet pipe. For additional information, refer to Section 303-12 .
4. Disconnect the accelerator controls.
    1. Disconnect the accelerator cable.
    2. Disconnect the speed control cable.
    3. Disconnect the return spring.

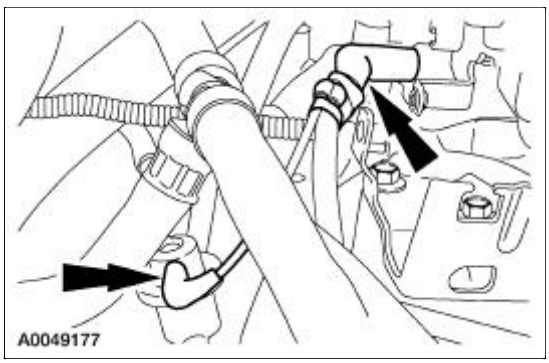


5. Disconnect the following electrical connectors:
    - Idle air control (IAC).
    - Throttle position (TP) sensor.

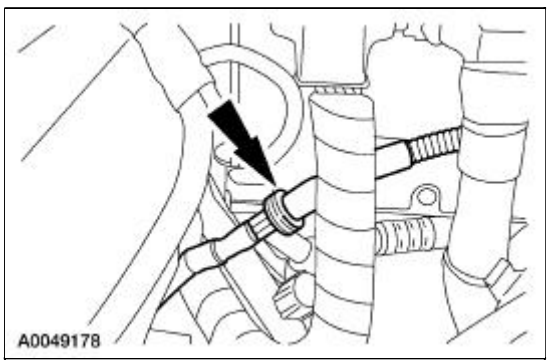
- Exhaust gas recirculation (EGR) vacuum regulator solenoid.



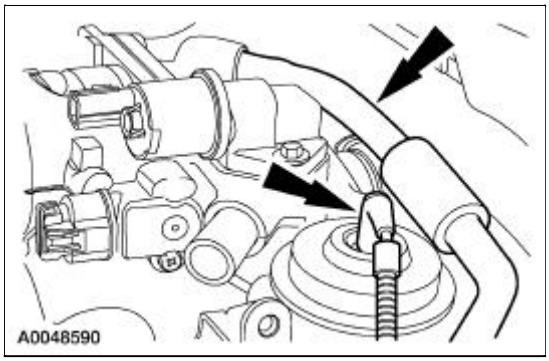
6. Disconnect the following vacuum connections:
   - Connection on the right side of the throttle body.
   - Fuel pressure regulator.



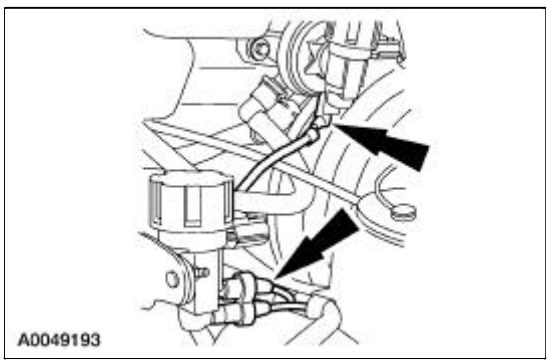
7. Disconnect the vacuum hose connection.



8. Disconnect the EGR valve vacuum hose and the evaporative emission (EVAP) hose at the throttle body.

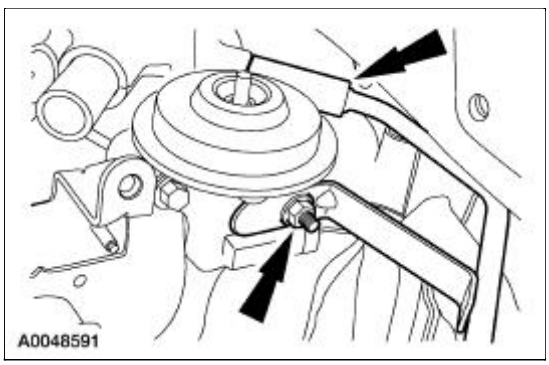


9. Disconnect the following vacuum connections:
    - EGR vacuum regulator solenoid.
    - EVAP canister purge solenoid.

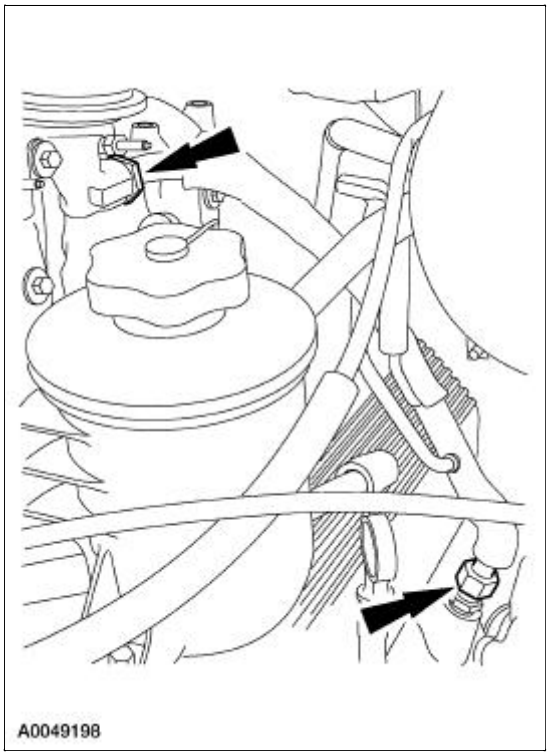


10. Position the vacuum harness aside.

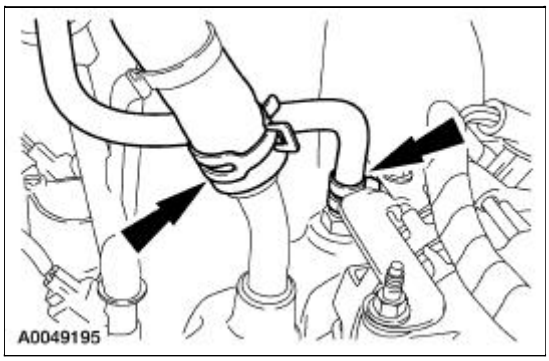
11. Remove the brake booster vacuum tube bracket nut. Disconnect and position the vacuum tube aside.



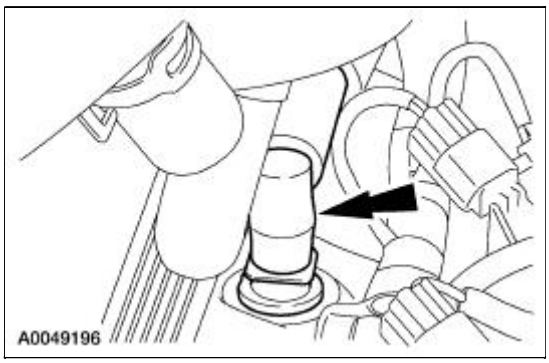
12. Disconnect the EGR tube upper fitting. Loosen the EGR tube lower fitting. Position the EGR tube aside.



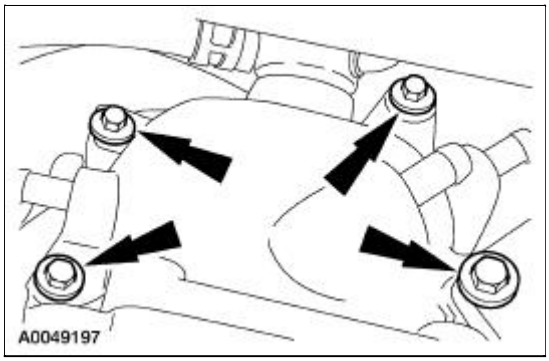
13. Remove the coolant hoses from the intake manifold.



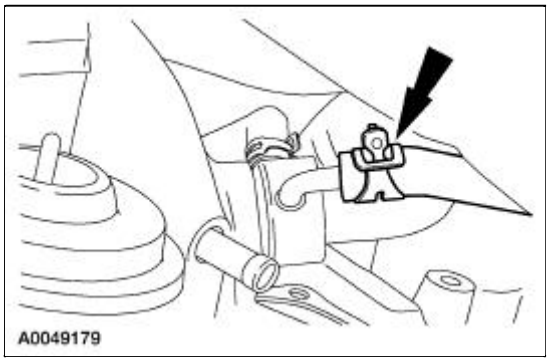
14. Remove the positive crankcase ventilation (PCV) valve from the valve cover.



15. Remove the throttle body adapter retaining bolts.



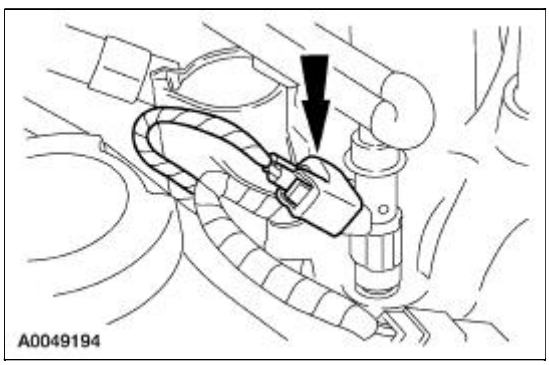
16. Position the throttle body adapter slightly forward and disconnect the PCV coolant hose.



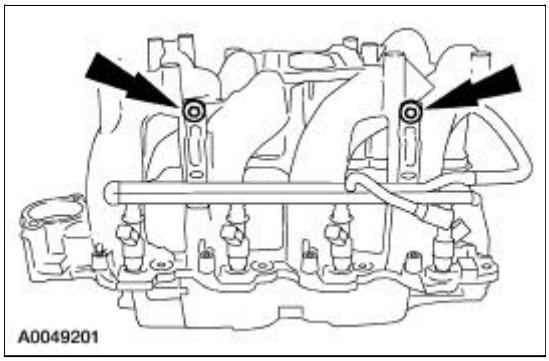
17. Remove the throttle body adapter assembly.

18. Disconnect the fuel tube spring lock coupling. For additional information, refer to Section 310-00 .

19. Disconnect the eight fuel injector electrical connectors.

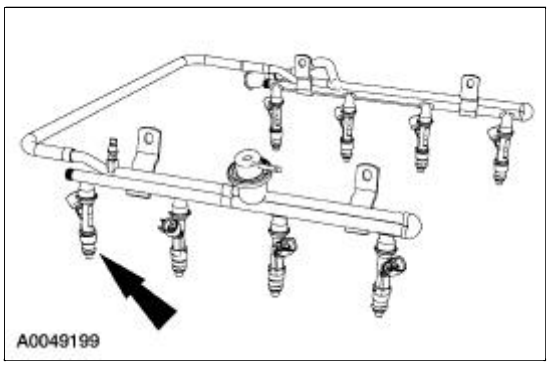


20. Remove the four bolts and lift the fuel injection supply manifold and the injectors upward out of the intake manifold.

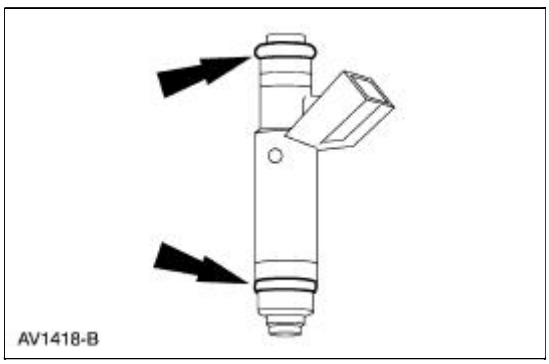


Vehicles requiring fuel injector service

21. Remove fuel injectors from the fuel injection supply manifold.



22. Inspect the O-ring seals from each fuel injector. Install new O-ring seals as needed.



Installation

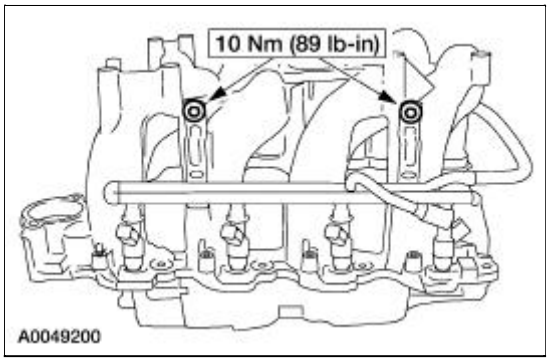
Vehicles requiring fuel injector service

1. **NOTE:** Lubricate the new O-ring seals with clean engine oil to aid installation.

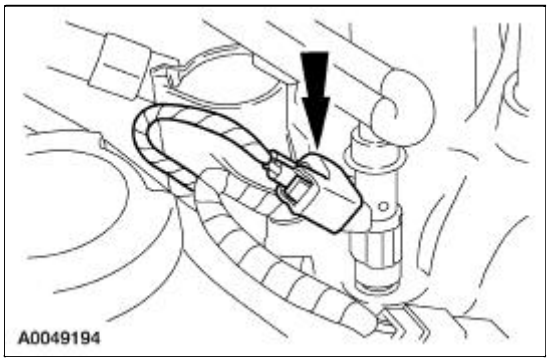
   Install the fuel injectors into the fuel injection supply manifold.

All vehicles

2. Install the fuel injection supply manifold.

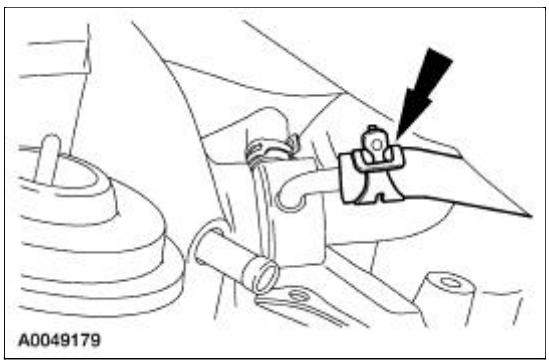


3. Connect the eight fuel injector electrical connectors.

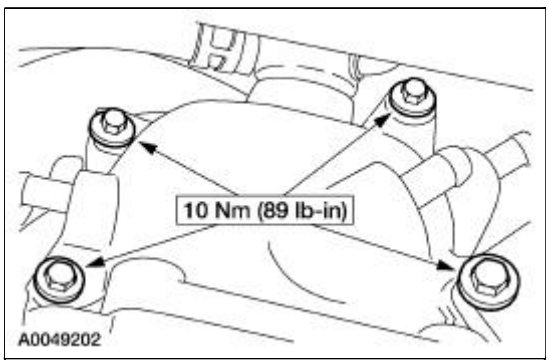


4. Connect the fuel tube spring lock coupling. For additional information, refer to Section 310-00 .

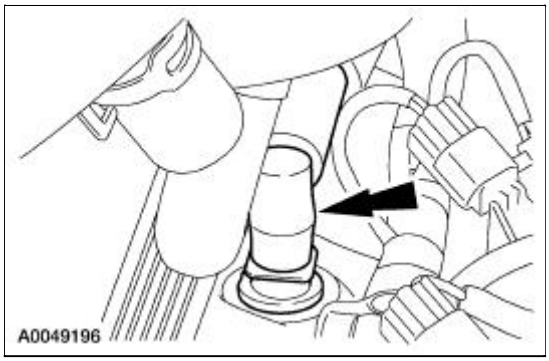
5. Position the throttle body adapter close to the installed position and connect the positive crankcase ventilation (PCV) coolant hose.



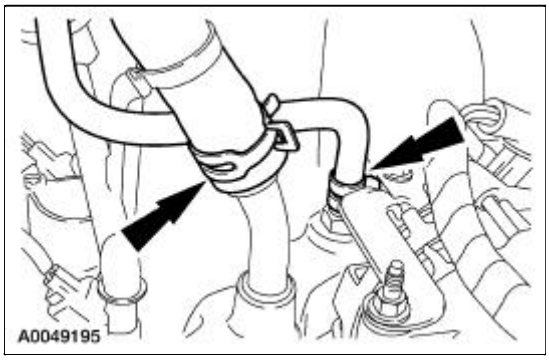
6. Install the throttle body adapter retaining bolts.



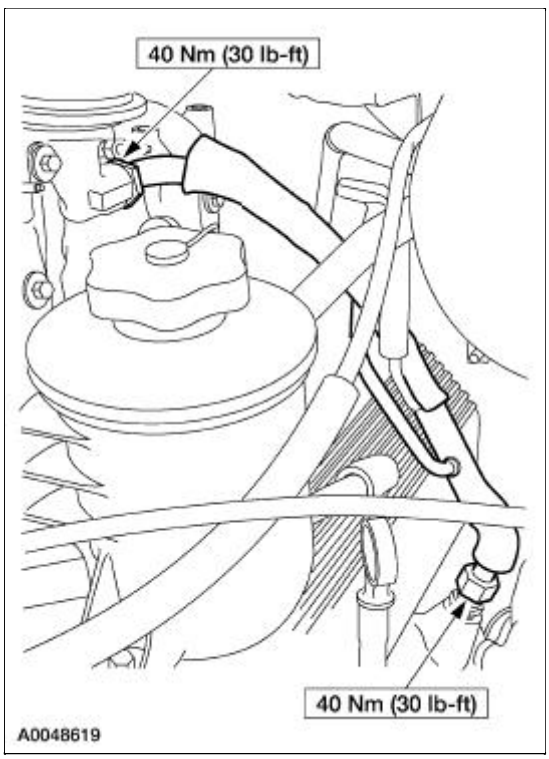
7. Install the PCV valve.



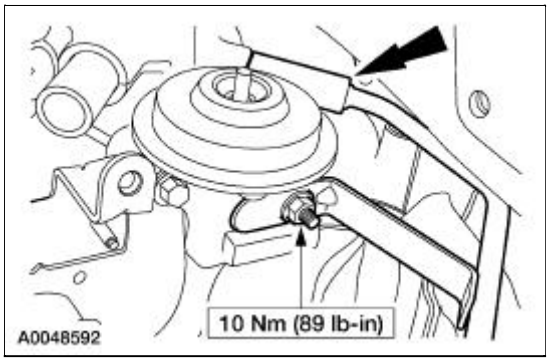
8. Connect the coolant hose to the intake manifold.



9. Install the exhaust gas recirculation (EGR) tube.

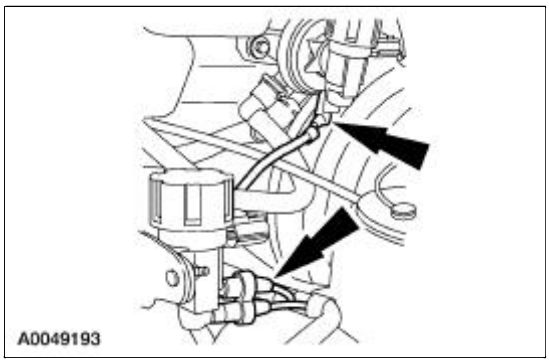


10. Connect the brake booster vacuum tube and install the bolt.

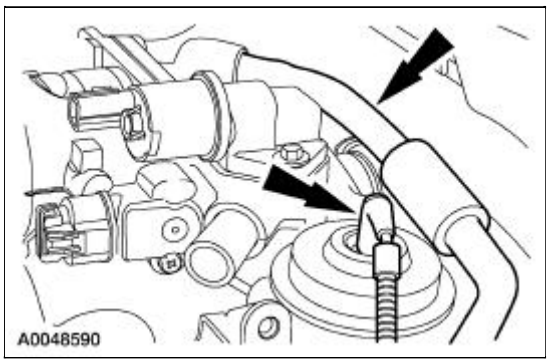


11. Position the vacuum harness across the engine.

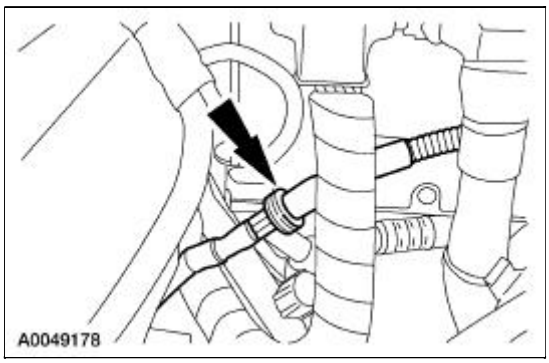
12. Connect the following vacuum connections:
    - EGR vacuum regulator solenoid.
    - Evaporative emission (EVAP) canister purge solenoid.



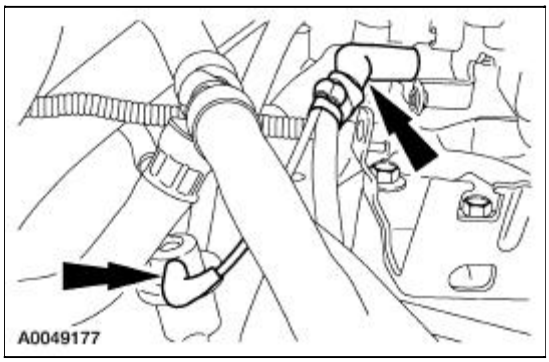
13. Connect the EGR vacuum hose and the EVAP hose to the throttle body.



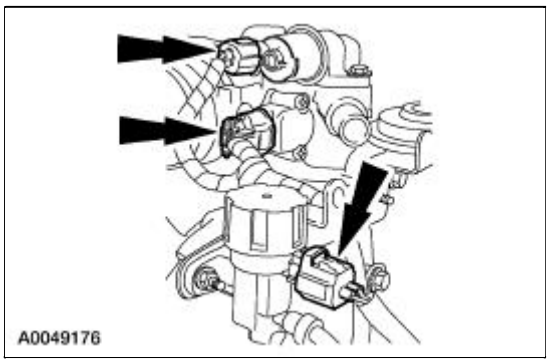
14. Connect the vacuum hose connection.



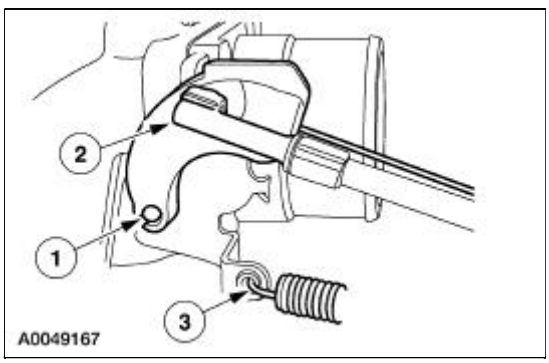
15. Connect the following vacuum connections:
    - Connection on the right side of the throttle body.
    - Fuel pressure regulator.



16. Connect the following electrical connectors:
    - EGR vacuum regulator solenoid.
    - Throttle position (TP) sensor.
    - Idle air control (IAC).



17. Connect the accelerator controls.
    1. Connect the accelerator cable.
    2. Connect the speed control cable.
    3. Connect the return spring.



18. Install the air cleaner outlet pipe. For additional information, refer to Section 303-12 .
19. Fill and bleed the cooling system. For additional information, refer to Section 303-03 .
20. Connect the battery ground cable. For additional information, refer to Section 414-01 .

Fuel Injection Supply Manifold —5.4L

Material

Item	Specification
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

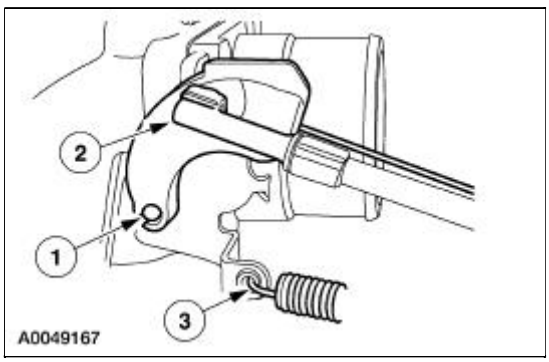
Removal

WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and can be ignited. Failure to follow these instructions can result in personal injury.

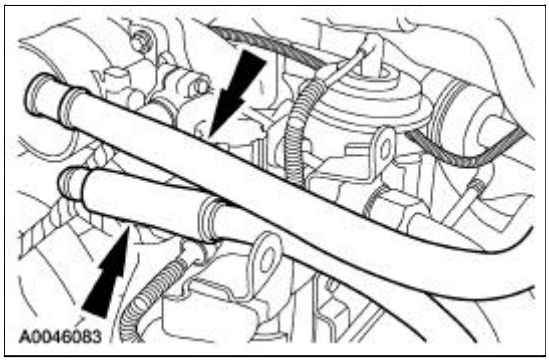
WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before working on or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved. Failure to follow these instructions can result in personal injury.

All vehicles

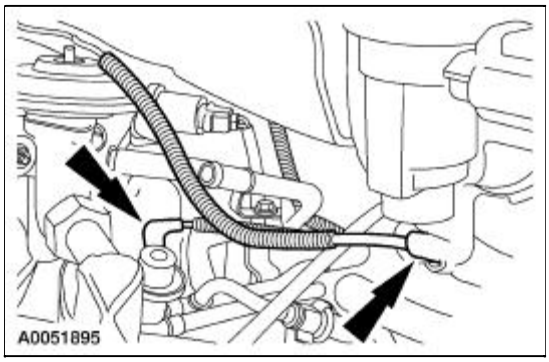
1. Partially drain the cooling system.
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
3. Remove air cleaner outlet pipe. For additional information, refer to Section 303-12 .
4. Disconnect the accelerator controls.
    1. Disconnect the accelerator cable.
    2. Disconnect the speed control cable.
    3. Disconnect the return spring.



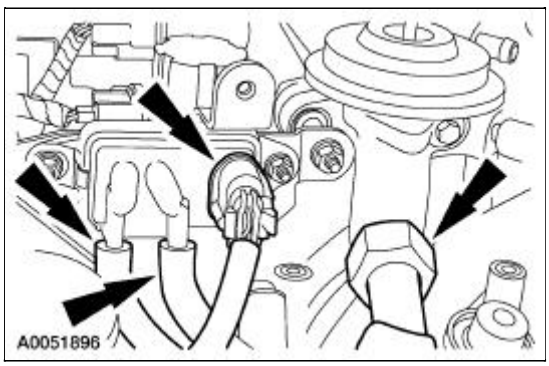
5. Remove the air tubes from the throttle body adapter and the valve cover.



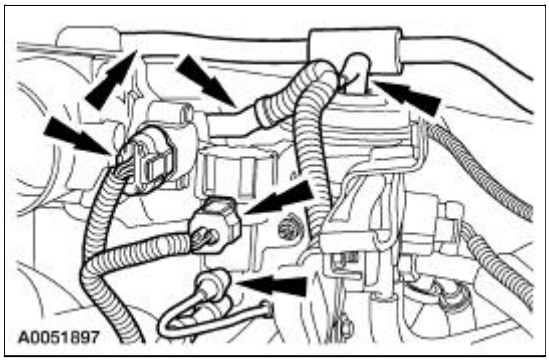
6. Disconnect the vacuum hoses from the evaporative emission (EVAP) canister purge solenoid and the fuel pressure regulator.



7. Disconnect the following:
    - Exhaust gas recirculation (EGR) tube from the EGR valve.
    - Differential pressure feedback EGR (DPFE) vacuum and electrical connections.

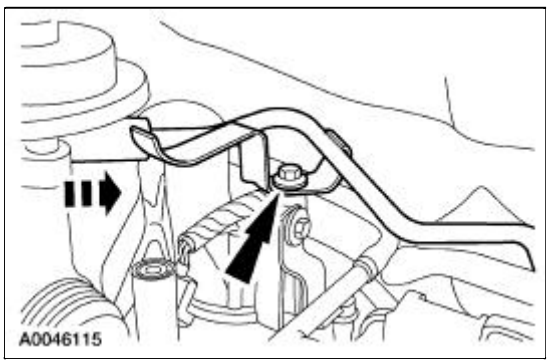


8. Disconnect the following:
    - Throttle position (TP) sensor electrical connector.
    - Exhaust gas recirculation (EGR) vacuum hose.
    - Evaporative emission (EVAP) canister purge solenoid vapor hose at the throttle body adapter.
    - EGR vacuum regulator solenoid electrical and vacuum connections.
    - Vacuum tap at throttle body adapter.

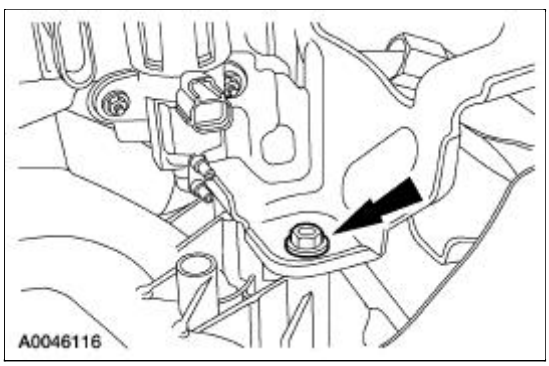


9. Position the vacuum harness aside.

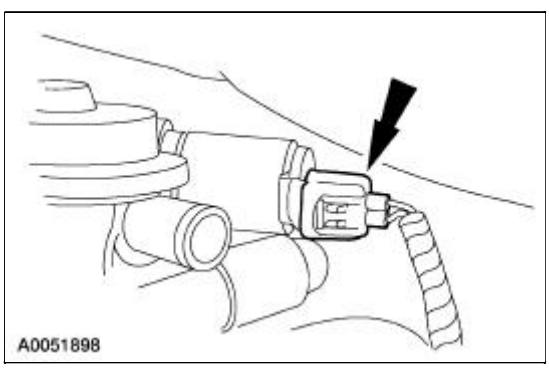
10. Remove the brake booster vacuum tube bracket nut. Disconnect and position the vacuum tube aside.



11. Remove the EGR vacuum regulator solenoid bracket bolt.

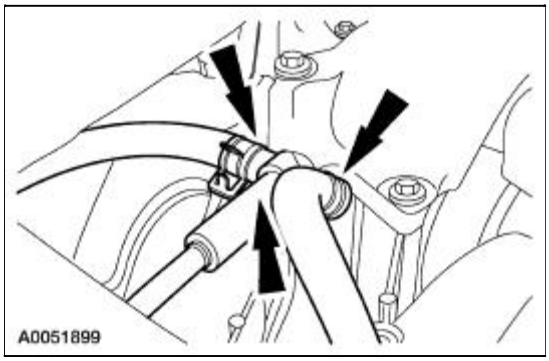


12. Disconnect the idle air control (IAC) electrical connector.

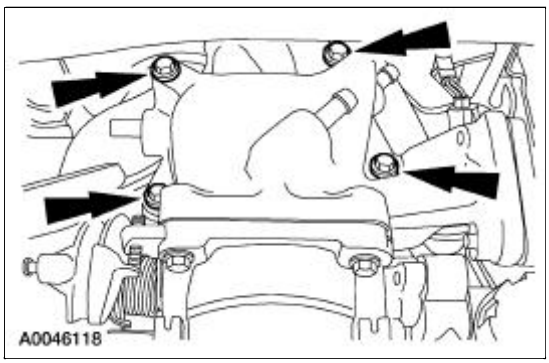


13. Disconnect the coolant hoses and the vacuum hose from the positive crankcase ventilation

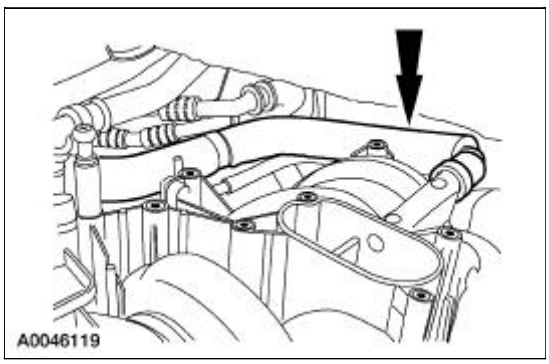
(PCV) heater fitting.



14. Remove the throttle body adapter assembly.

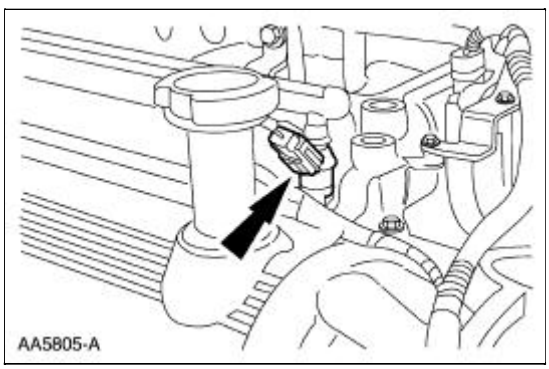


15. Remove the positive crankcase ventilation (PCV) valve and hose.

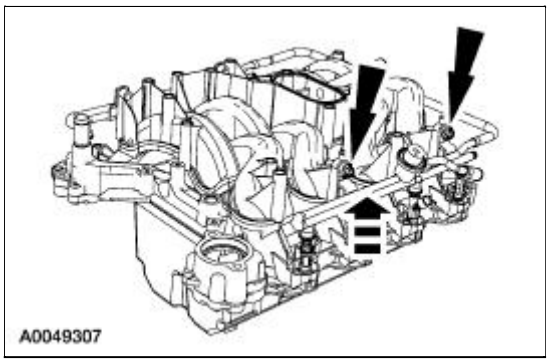


16. Disconnect the fuel tube spring lock coupling. For additional information, refer to Section 310-00 .

17. Disconnect the eight fuel injector electrical connectors.

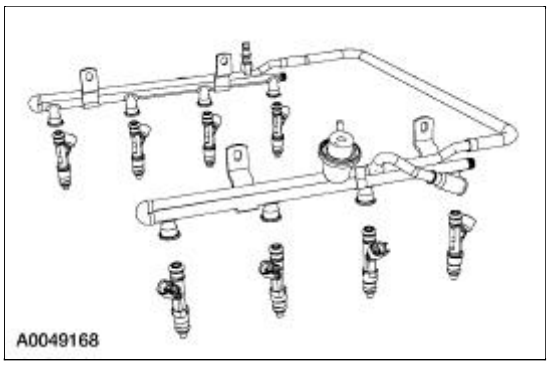


18. Remove the four bolts and lift the fuel injection supply manifold and the injectors upward out of the intake manifold.

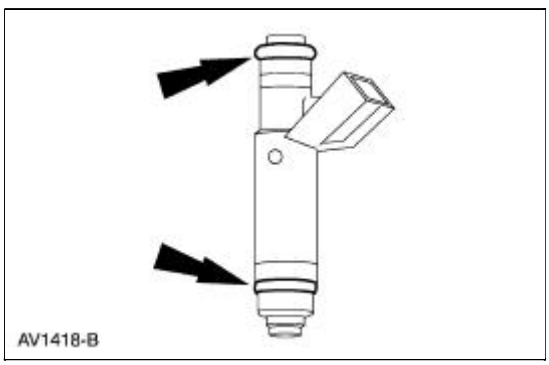


Vehicles requiring fuel injector service

19. Remove the fuel injectors from the fuel injection supply manifold.



20. Inspect the O-ring seals from each fuel injector. Install new O-ring seals as needed.

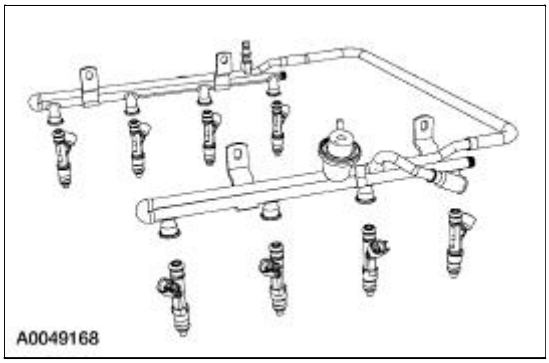


Installation

Vehicles requiring fuel injector service

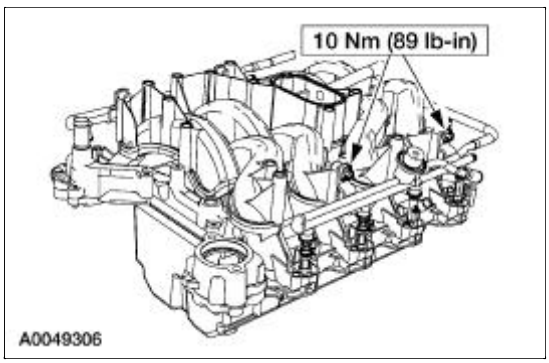
1. **NOTE:** Lubricate the new O-ring seals with clean engine oil to aid installation.

   Install the fuel injectors in the fuel injection supply manifold.

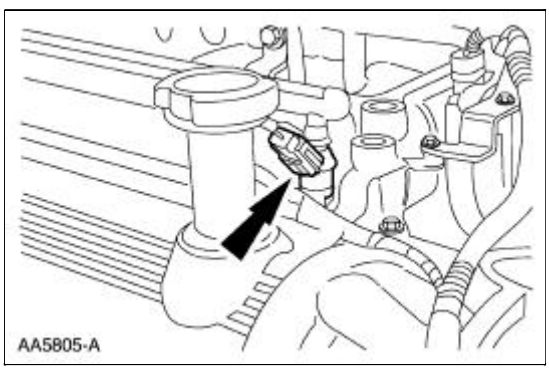


All vehicles

2. Install the fuel injection supply manifold.

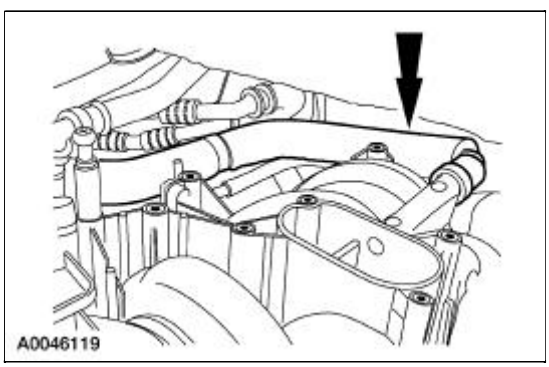


3. Connect the eight fuel injector electrical connectors.

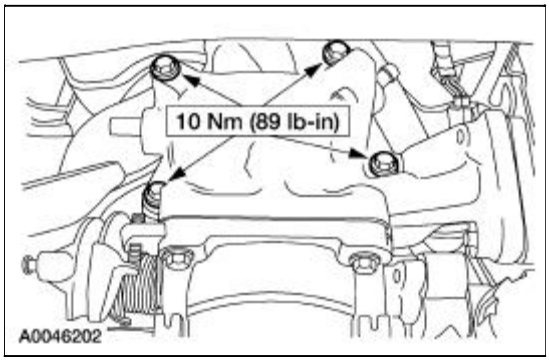


4. Connect the fuel tube spring lock coupling. For additional information, refer to Section 310-00 .

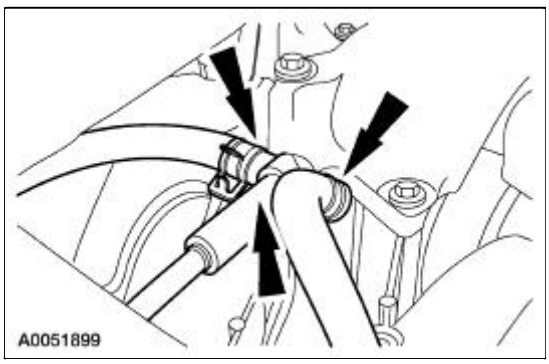
5. Install the positive crankcase ventilation (PCV) hose and valve.



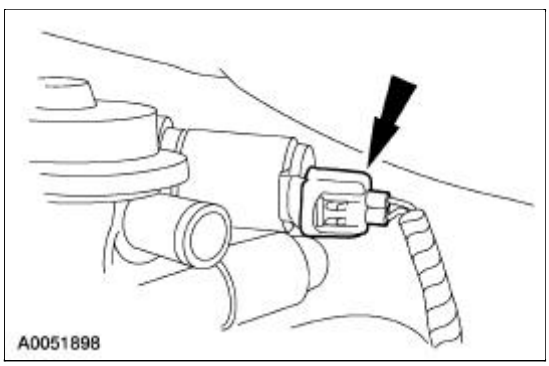
6. Install the throttle body adapter assembly.



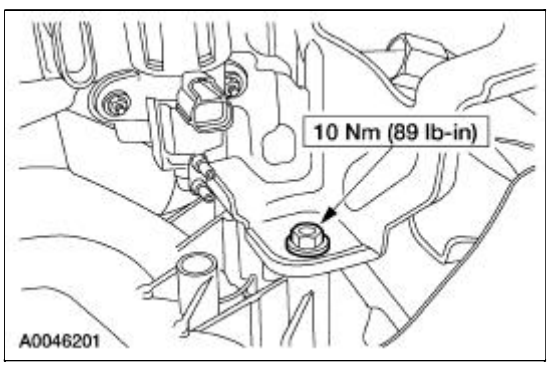
7. Connect the coolant hoses and the vacuum hose to the positive crankcase ventilation (PCV) heater fitting.



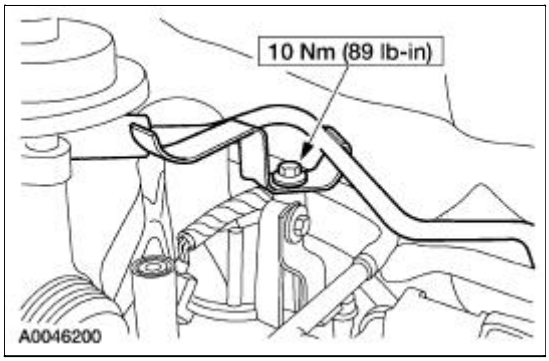
8. Connect the idle air control (IAC) electrical connector.



9. Install the exhaust gas recirculation (EGR) vacuum regulator solenoid bracket bolt.

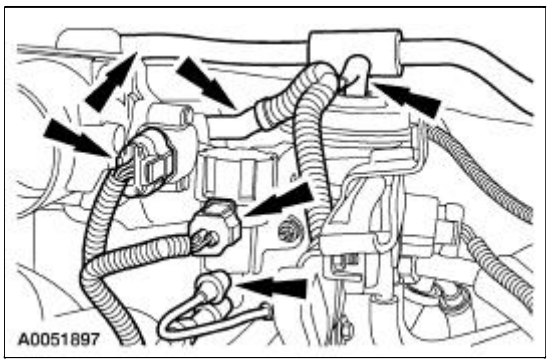


10. Connect the brake booster vacuum tube and install the bolt.

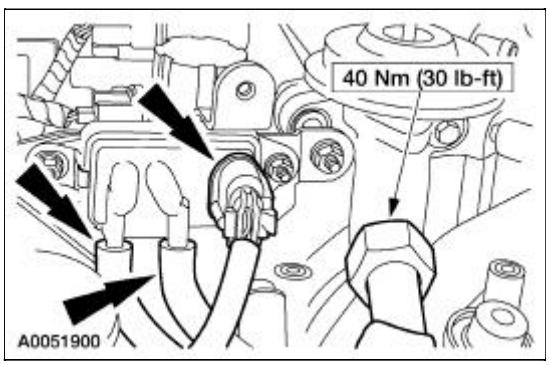


11. Position the vacuum harness across the engine.

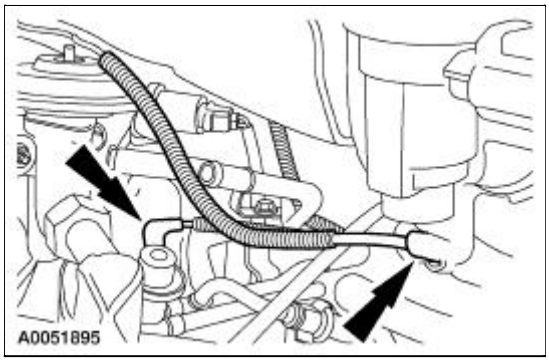
12. Connect the following:
    - Vacuum tap at the throttle body adapter.
    - EGR vacuum regulator solenoid electrical and vacuum connections.
    - Evaporative emission (EVAP) canister purge solenoid vapor hose at the throttle body adapter.
    - EGR vacuum hose.
    - Throttle position (TP) sensor electrical connector.



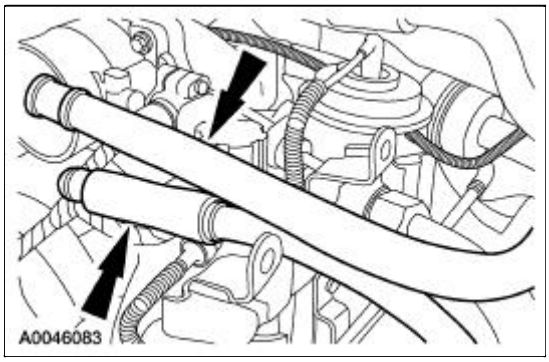
13. Connect the following:
    - Differential pressure feedback EGR (DPFE) vacuum and electrical connections.
    - EGR tube to the EGR valve.



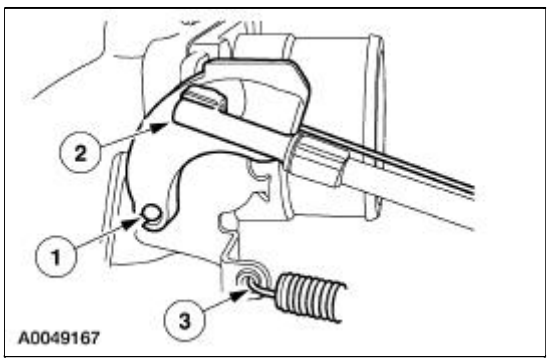
14. Connect the vacuum hoses to the evaporative emission (EVAP) canister purge solenoid and the fuel pressure regulator.



15. Install the air tubes to the throttle body adapter and the valve cover.



16. Connect the accelerator controls:
    1. Connect the accelerator cable.
    2. Connect the speed control cable.
    3. Connect the return spring.



17. Install the air cleaner outlet pipe. For additional information, refer to Section 303-12 .

18. Connect the battery ground cable. For additional information, refer to Section 414-01 .

19. Fill and bleed the cooling system. For additional information, refer to Section 303-03 .

Fuel Pressure Regulator

Material

Item	Specification
Super Premium SAE 5W-20 Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

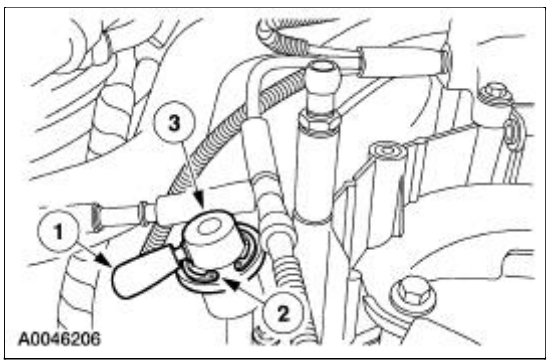
Removal and Installation

WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and can be ignited. Failure to follow these instructions can result in personal injury.

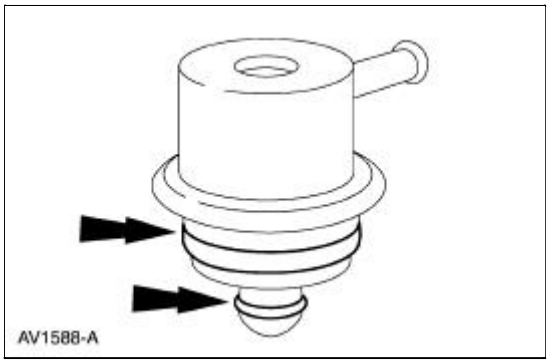
WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before working on or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved. Failure to follow these instructions can result in personal injury.

1. Relieve the fuel pressure. For additional information, refer to Section 310-00 .

2. Remove the fuel pressure regulator.
   1. Disconnect the vacuum hose.
   2. Remove the snap ring.
   3. Remove the fuel pressure regulator.



3. Remove and discard the fuel pressure regulator O-ring seals.



4. **CAUTION: Use O-ring seals that are made of special fuel resistant material. Use of ordinary O-ring seals can cause the fuel system to leak. Do not reuse the O-ring seals.**

   NOTE: Lubricate the new O-ring seals with clean engine oil to aid installation.

   To install, reverse the removal procedure.

General Specifications

Item	Specification
Lubricants and Chemicals	
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Torque Specifications

Description	Nm	lb-in
Fuel injection supply manifold bolts	10	89
Throttle body bolts	9	80
Pressure relief valve	8	71

Fuel Charging And Controls

The fuel charging and controls system consists of the:

- throttle body (9E926)
- fuel injectors (9F593)
- fuel charging wiring
- fuel injection supply manifold (9F792)
- fuel pressure regulator (9C968)
- fuel pressure relief valve (9H321)
- A/C compressor clutch relay
- fuel pump relay

The fuel charging and controls system is:

- a sequential multiport fuel injection (SFI) system.
- pulse width modulated.
- mass air flow controlled.

The fuel injection supply manifold:

- delivers fuel to the individual fuel injectors.
- receives fuel from the fuel supply line.
- returns unused fuel to the fuel tank (9002) through the fuel return line.

The throttle body:

- controls air supply to the upper intake manifold (9424) by positioning the throttle plate.
- connects the accelerator cable (9A758), and if equipped, speed control actuator cable (9A825) to the throttle lever.
- is not adjustable.
- cannot be cleaned.

The fuel injectors:

- are electrically operated by the powertrain control module (PCM) (12A650).
- each have an internal solenoid which opens a needle valve to inject fuel into the lower intake manifold.
- atomize the fuel as the fuel is delivered.
- are deposit-resistant.

The fuel pressure relief valve:

- is used to inspect and relieve fuel pressure.

The fuel pressure regulator:

- maintains a constant fuel pressure throughout the fuel system and to the fuel injectors.
- is spring loaded and operated by the intake manifold vacuum.

The A/C compressor clutch control relay (if A/C equipped):

- is controlled by the powertrain control module (PCM).
- interrupts A/C clutch operation during engine start or manual transmission clutch engagement to reduce engine load.

The fuel pump relay engages the fuel pump when energized by the PCM.

Fuel Charging And Controls

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

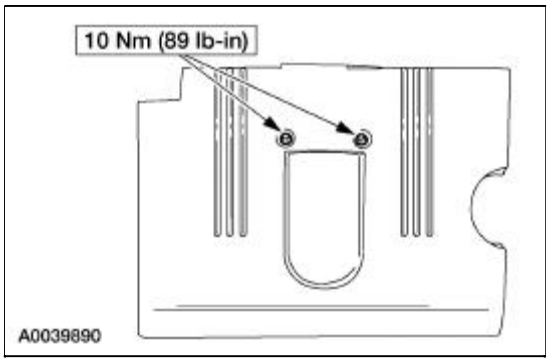
Throttle Body

Removal and Installation

WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.

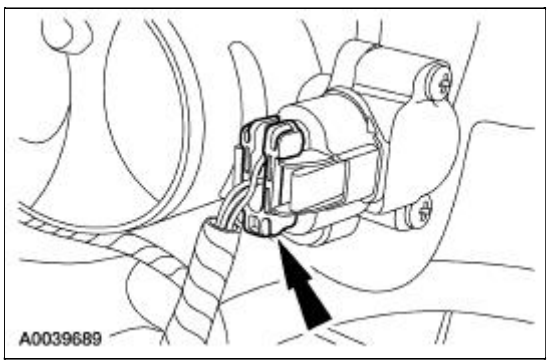
CAUTION: Throttle body bore and plate area have a special coating and cannot be cleaned.

1. Remove the engine appearance cover.

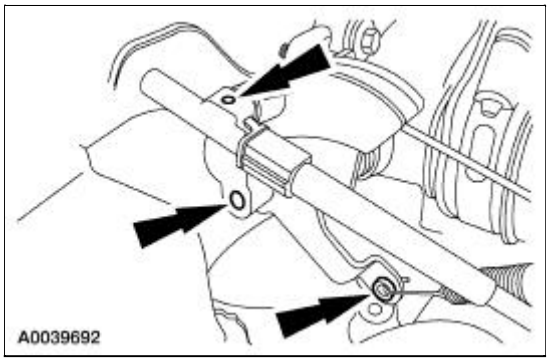


2. Remove the air cleaner resonator and outlet tube assembly. For additional information, refer to Section 303-12 .

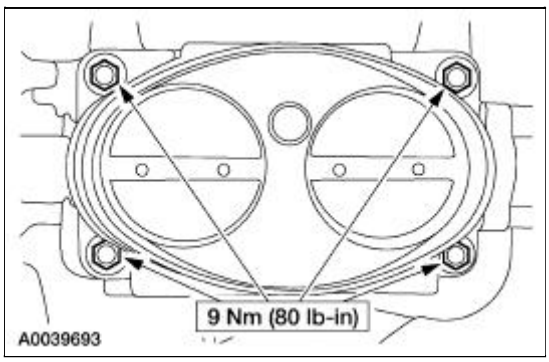
3. Disconnect the throttle position (TP) sensor electrical connector.



4. Disconnect the accelerator cable, speed control cable and the return spring.



5. Remove the throttle body.
    1. Remove the bolts.
    2. Remove and discard the throttle body gasket.



6. To install, reverse the removal procedure.

Fuel Injectors

Material

Item	Specification
Super Premium SAE 5W-20 Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

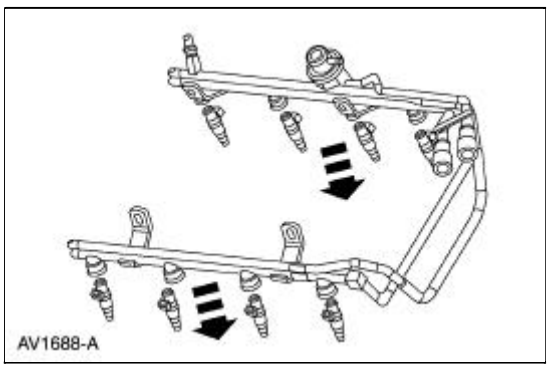
Removal and Installation

WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.

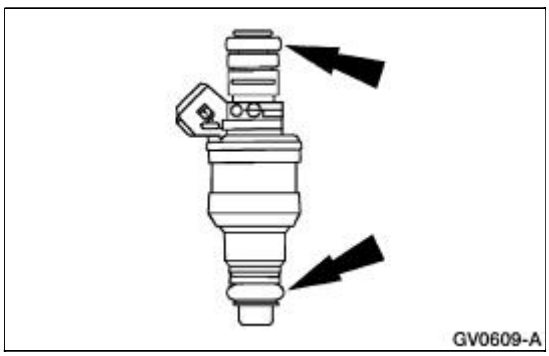
WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before working on or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved. Failure to follow these instructions may result in personal injury.

1. Remove the fuel injection supply manifold (9F927). For additional information, refer to Fuel Injection Supply Manifold in this section.

2. Remove the fuel injectors (9F593) from the fuel injection supply manifold.



3. Inspect the two O-ring seals from each fuel injector. Install new O-ring seals as needed.



4. **NOTE:** Lubricate new O-ring seals with clean engine oil to aid installation.

   To install, reverse the removal procedure.

Fuel Injection Supply Manifold

Material

Item	Specification
Super Premium SAE 5W-20 Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal and Installation

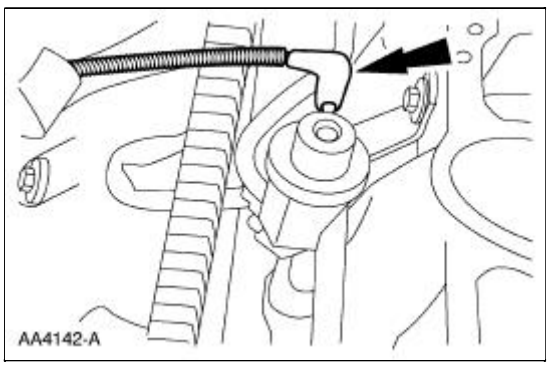
WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.

WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before working on or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved. Failure to follow these instructions may result in personal injury.

1. Relieve the fuel pressure. For additional information, refer to Section 310-00 .
2. Remove the upper intake manifold. For additional information, refer to Section 303-01B .

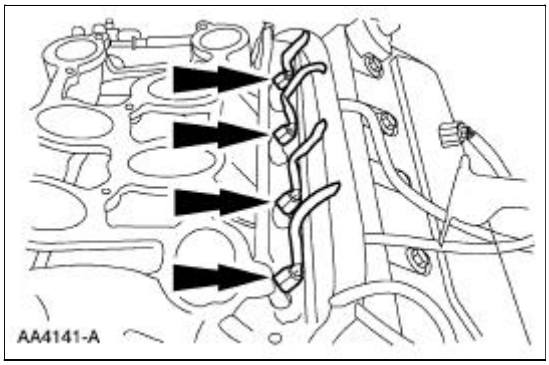
NOTE: After disconnecting, plug the fuel lines to prevent leakage.

3. Disconnect the fuel lines. For additional information, refer to Section 310-00 .
4. Disconnect the fuel pressure regulator (9C968) vacuum hose.

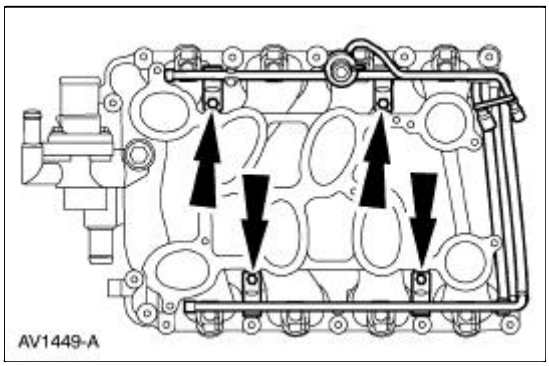


5. **NOTE:** The left side is shown, the right side is similar.

   Disconnect the eight fuel injector (9H321) electrical connectors.

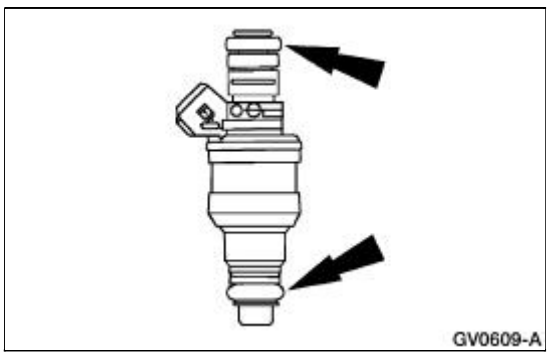


6. Remove the fuel injection supply manifold (9F792).
    - Remove the bolts, then remove the fuel injection supply manifold with the fuel injectors attached.



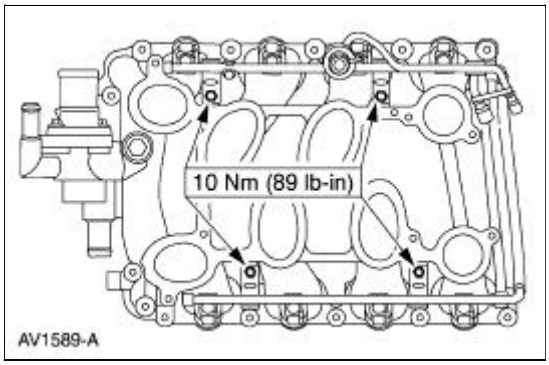
7. Remove the fuel injectors from the fuel injection supply manifold (9F792).

8. Inspect the two O-ring seals from each fuel injector. Install new O-ring seals as needed.



9. **NOTE:** Lubricate the new O-rings with clean engine oil to aid installation.

    To install, reverse the removal procedure.


10 Nm (89 lb-in)
AV1589-A

Fuel Pressure Regulator

Material

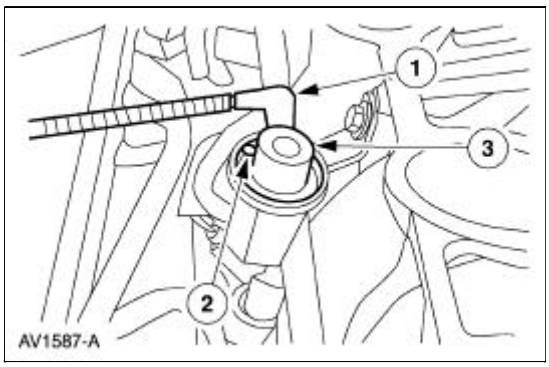
Item	Specification
Super Premium SAE 5W-20 Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal and Installation

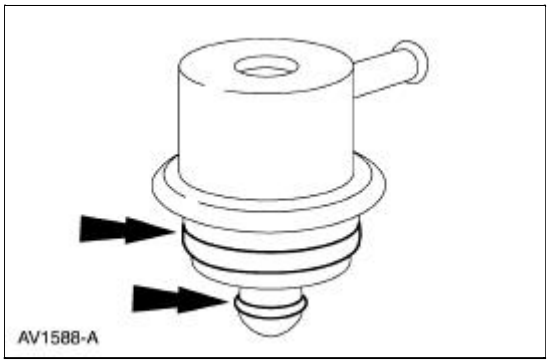
WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.

WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before working on or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved. Failure to follow these instructions may result in personal injury.

1. Relieve the fuel pressure. For additional information, refer to Section 310-00 .
2. Remove the upper intake manifold. For additional information, refer to Section 303-01B .
3. Remove the fuel pressure regulator (9C968).
    1. Disconnect the fuel pressure regulator vacuum hose.
    2. Remove the snap ring.
    3. Remove the fuel pressure regulator.



4. Remove and discard the fuel pressure regulator O-ring seals.



5. **CAUTION: Use O-ring seals that are made of special fuel resistant material. Use of ordinary O-ring seals can cause the fuel system to leak. Do not reuse O-ring seals.**

   NOTE: Lubricate the new O-ring seals with clean engine oil to aid installation.

   To install, reverse the removal procedure.

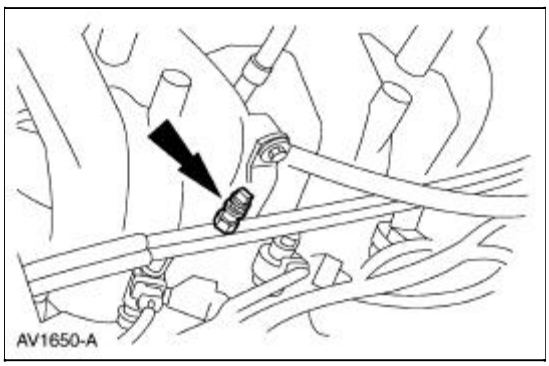
Fuel Pressure Relief Valve

Removal

WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.

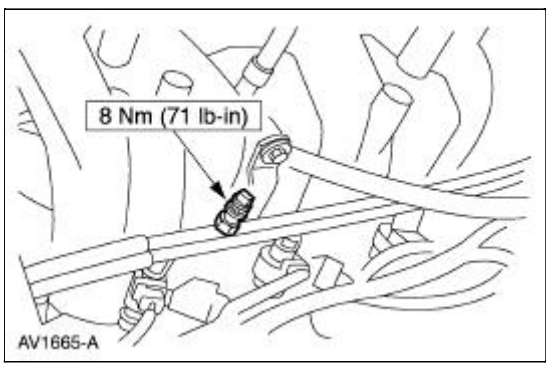
WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before working on or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved. Failure to follow these instructions may result in personal injury.

1. Relieve the fuel pressure. For additional information, refer to Section 310-00 .
2. Remove the fuel pressure relief valve (9H321).



Installation

1. To install, reverse the removal procedure.



General Specifications

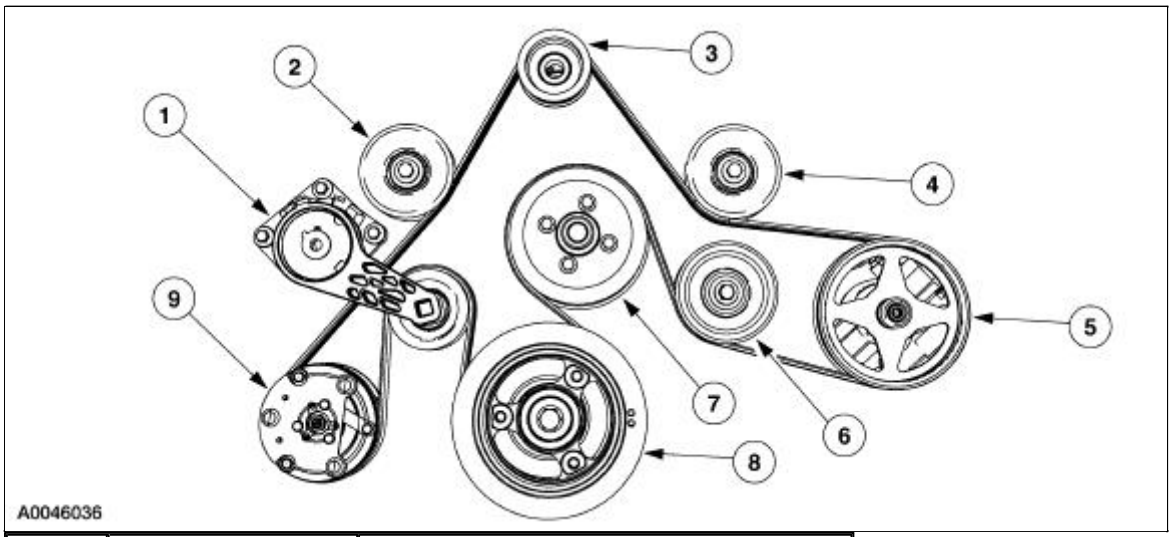
Item	Specification
Drive belt specification	6 rib

Torque Specifications

Description	Nm	lb-ft
Belt idler pulley bolt	25	18
Drive belt tensioner bolts	25	18

Accessory Drive

Component Locations — 4.6L, 5.4L(2V), 5.4L(4V)



Item	Part Number	Description
1	6B209	Drive belt tensioner
2	8678	Belt idler pulley
3	10A352	Generator pulley
4	8678	Belt idler pulley
5	3A733	Power steering pump pulley
6	6C348	Belt idler pulley
7	8509	Water pump pulley
8	6312	Crankshaft pulley
9	2E884	A/C clutch pulley

The accessory drive consists of the:

- drive belt (8620)
- generator pulley
- power steering pump pulley
- crankshaft pulley
- A/C clutch pulley
- belt idler pulley
- drive belt tensioner
- water pump pulley

The accessory drive:

- has a single serpentine drive belt.
- has an automatic drive belt tensioner.
- does not require adjustment.

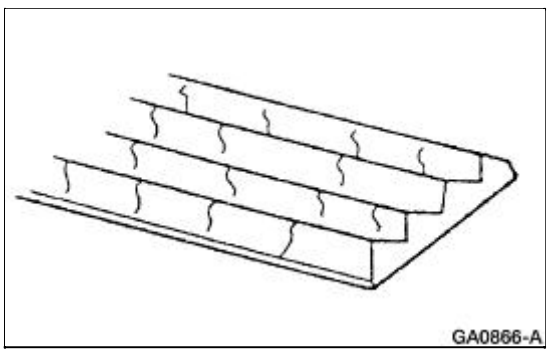
Accessory Drive

Inspection and Verification

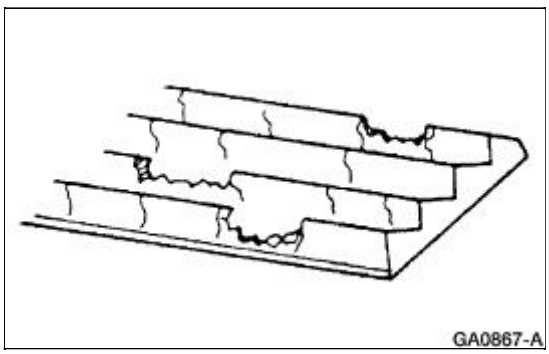
1. Verify customer concern by running the engine.
2. Inspect the drive belt (8620) for chunking, fraying and wear.
3. Check the drive belt for correct routing.

Drive Belt Cracking/Chunking/Wear

V Ribbed Serpentine Drive Belt With Cracks Across Ribs



V Ribbed Belt With Chunks of Rib Missing



Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• Drive belt noise, chirping, flutter	• Defective/worn drive belt. • Misaligned pulley.	• REFER to Drive Belt Noise/Flutter diagnosis in this section.

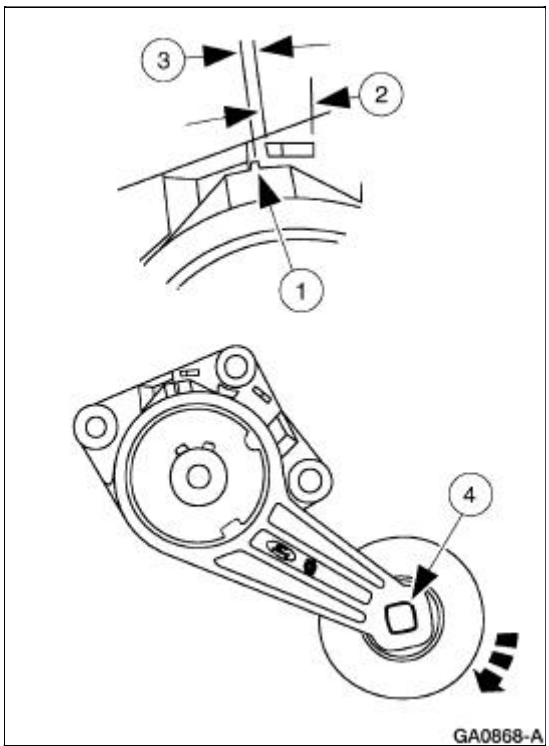
	• Pulley runout. • Damaged accessories. • Fluid contamination of drive belt. • Damaged or worn drive belt tensioner (6B209).	• REFER to Belt Tensioner, Automatic diagnosis in this section.
• Premature drive belt wear	• Defective drive belt. • Misaligned pulley. • Pulley runout. • Damaged accessories. • Improperly installed drive belt.	• REFER to Drive Belt Noise/Flutter and Drive Belt Misalignment diagnosis in this section.

Component Tests

Drive Belt Noise/Flutter

NOTE: Tensioner is shown in free-state position against arm travel stops.

Drive Belt Tensioner/Belt Length Indicator



Item	Part Number	Description
1	—	Belt Length Indicator
2	—	Acceptable Belt Installation and Wear Range
3	—	Belt Replacement Range
4	—	Belt Tension Relief Point (Use 1/2 Inch Ratchet)

Drive belt chirp occurs due to pulley misalignment or excessive pulley runout. It can be the result of a damaged pulley or an incorrectly aligned pulley.

To correct, determine the area where the noise comes from. Check each of the pulleys in that area with a straightedge to the crankshaft pulley (6312), look for accessory pulleys out of position in the fore/aft direction or at an angle to the straightedge.

Drive belt squeal is an intermittent noise that occurs when the drive belt slips on a pulley during certain conditions, such as: engine start up, rapid engine acceleration, or A/C clutch engagement.

Drive belt squeal can occur under certain conditions:

- If the A/C discharge pressure goes above specifications:
  - the A/C system is overcharged.
  - the A/C condenser core airflow is blocked.
- If the A/C OFF equalized pressure (the common discharge and suction pressure that occurs after several minutes) exceeds specifications.
- If any of the accessories are damaged, have a worn or damaged bearing, internal torsional resistance above normal. All accessories should be rotatable by hand in the unloaded condition. If not, inspect the accessory.
- If fluid gets on the drive belt. This includes power steering fluid, engine coolant, engine oil or air conditioning system lubricant. If fluid does get on the drive belt during service, clean the drive belt with soap and water and thoroughly rinse with clean water. The drive belt does not have to be replaced if no apparent damage has occurred.
- **NOTE:** The drive belt tensioner arm should rotate freely without binding.

  If the drive belt is too long. A drive belt that is too long will allow the drive belt tensioner arm to go all the way to the arm travel stop under certain load conditions, which will release tension to the drive belt. If the drive belt tensioner indicator is outside the installation wear range window, replace the drive belt.
- If the drive belt tensioner is worn or damaged.

Belt Tension

NOTE: Drive belt tension is not adjustable.

The drive belt tensioner automatically adjusts drive belt tension.

Belt Tensioner, Automatic

Check the automatic drive belt tensioner.

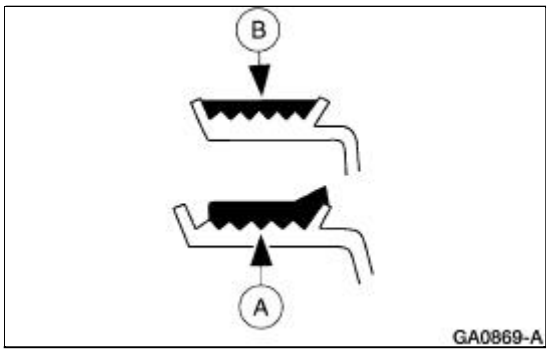
1. With the engine off, check for correct drive belt routing. Refer to the procedure in this section. Service as required.

2. Rotate the drive belt tensioner and check for a binding or frozen condition. Install new components as required.

Drive Belt Misalignment

CAUTION: Incorrect drive belt installation will cause excessive drive belt wear and may cause the drive belt to come off the drive pulleys.

Non-standard replacement drive belts may track differently or incorrectly. If a replacement drive belt tracks incorrectly, replace it with an original equipment drive belt to avoid performance failure or loss of drive belt.



With the engine running, check drive belt tracking. If the (A) edge of the drive belt rides beyond the edge of the pulleys, noise and premature wear may occur. Make sure the (B) drive belt rides correctly on the pulley. If a drive belt tracking condition exists, proceed with the following:

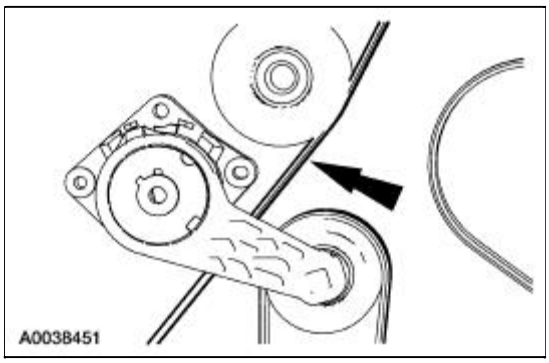
Visually check the drive belt tensioner for damage, especially the mounting pad surface. If the drive belt tensioner is not installed correctly, the mounting surface pad will be out of position. This will result in chirp and squeal noises.

- With the engine running, visually observe the grooves in the pulleys (not the pulley flanges or the pulley forward faces) for excessive wobble. Replace components as required.
- Check all accessories, mounting brackets and the drive belt tensioner for any interference that would prevent the component from mounting properly. Correct any interference condition and recheck the drive belt tracking.
- Tighten all accessories, mounting brackets, and drive belt tensioner retaining hardware to specification. Recheck the drive belt tracking.

Accessory Drive Belt

Removal and Installation

1. Remove the air cleaner outlet pipe. For additional information, refer to Section 303-12 .
2. Rotate the drive belt tensioner clockwise and remove the drive belt.

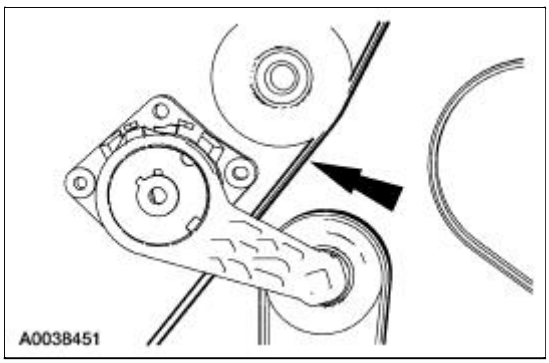


3. Refer to the Component Locations—4.6L, 5.4L(2V), 5.4L(4V) illustration for the drive belt routing.
4. To install, reverse the removal procedure.

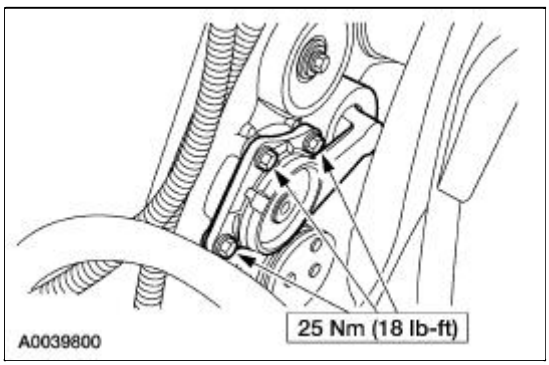
Accessory Drive Belt Tensioner

Removal and Installation

1. Rotate the drive belt tensioner clockwise and remove the drive belt.



2. Remove the bolts and the drive belt tensioner.



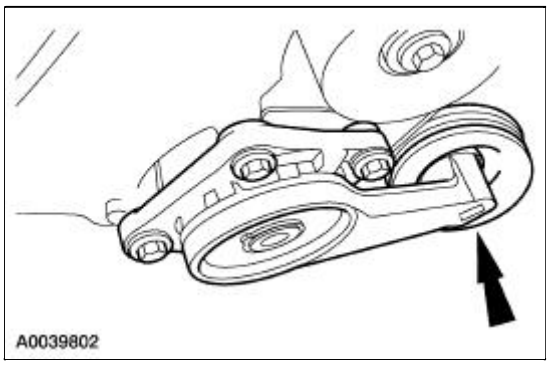
3. **NOTE:** Refer to the Component Locations—4.6L, 5.4L(2V), 5.4L(4V) illustration for the drive belt routing.

   To install, reverse the removal procedure.

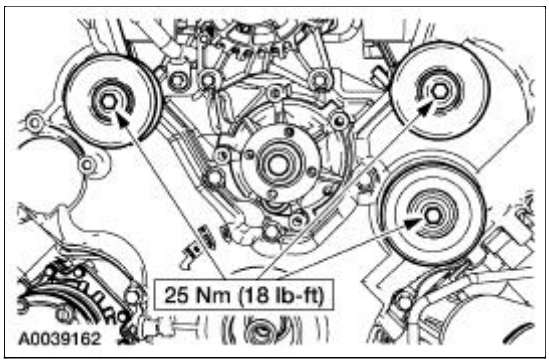
Accessory Drive Belt Idler Pulley

Removal and Installation

1. Remove the air cleaner outlet pipe. For additional information, refer to Section 303-12 .
2. Rotate the drive belt tensioner clockwise and remove the drive belt.



3. Remove the bolts and the belt idler pullies.



4. **NOTE:** Refer to the Component Locations—4.6L, 5.4L(2V), 5.4L(4V) illustration for the drive belt routing.

   To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-ft	lb-in
Starter motor bolts	25	18	—
Starter motor stud bolt	25	18	—
Starter motor ground cable nut	20	15	—
Starter S terminal nut	8	—	71
Starter B+ terminal nut	13	10	—

Starting System

The starting system consists of the:

- starter motor.
- starter switch, part of the ignition switch.
- digital transmission range (TR) sensor (automatic transmission-equipped vehicles).
- starter motor solenoid relay switch.
- starter solenoid.
- starter drive.

The starter motor:

- is a permanent magnet, gear reduction, 12 V DC motor.
- has an integral starter solenoid.
- has an over-running clutch in the starter drive.
- is serviced as an assembly.

The starter motor solenoid relay switch:

- controls current to the starter solenoid.
- is engaged by the ignition switch.
- connects the battery to the starter motor.

The digital TR sensor on automatic transmission-equipped vehicles prevents starter motor engagement unless the transmission is in the NEUTRAL or PARK position.

The starter drive:

- is operated by the starter solenoid.
- engages the flywheel to turn the engine.
- has an internal over-running clutch to disengage the starter motor when the engine starts.

The starter solenoid:

- is an electromagnet.
- engages the starter drive to the flywheel.
- when energized, the contacts close, connecting the battery to the starter motor. This causes the starter motor to turn the starter drive.
- is kept in the energized condition by a hold-in winding until the starter switch is released.

When the ignition switch is turned to the START position, the starter motor solenoid relay switch is energized, connecting the battery to the starter solenoid. The starter solenoid moves the drive lever and pin to engage the starter drive with the flywheel ring gear and connects the battery to the starter

motor.

Starting System

Refer to Wiring Diagrams Cell 20 , Starting System for schematic and connector information.

Special Tool(s)

 ST1137-A	73 Digital Multimeter 105-R0051 or equivalent
 ST2626-A	SABRE Premium Battery and Electrical System Tester 010-00736 or equivalent

Inspection and Verification

WARNING: When servicing starter motor or performing other underhood work in the vicinity of the starter motor, be aware that the heavy gauge battery input lead at the starter solenoid is "electrically hot" at all times. A protective cap or boot is provided over the terminal of this lead and must be installed after servicing.

WARNING: When working in area of the starter motor, be careful to avoid touching hot exhaust components.

NOTE: When working on the starter system, make sure the anti-theft system is deactivated, if equipped.

1. Verify the customer concern by operating the starting system.
2. Visually inspect for obvious signs of mechanical and electrical damage. Refer to the following chart:

Visual Inspection Chart

Mechanical	Electrical
● Starter motor ● Brackets ● Anti-theft relay	● Battery ● Failed fuse 24 (10A) ● Damaged wiring harness ● Loose or corroded connections

3. If the concern is not visually evident, verify the symptom. GO to Symptom Chart .

Symptom Chart

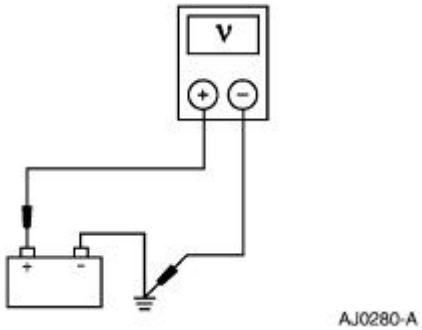
SYMPTOM CHART

Condition	Possible Sources	Action
• The engine does not crank or the relay clicks	• Battery. • Starter motor. • Starter motor relay. • Ignition switch. • Damaged fuse. • Anti-theft system. • Circuitry.	• Go To Pinpoint Test A .
• The engine cranks slowly	• Battery. • Starter motor. • Circuitry.	• CARRY OUT the Starter Motor—Voltage Drop Test Component Test.
• Unusual starter noise	• Starter mounting. • Flywheel/ring gear. • Starter motor.	• Go To Pinpoint Test B .
• The starter spins but the engine does not crank	• Starter motor. • Damaged flywheel/ring gear teeth.	• INSPECT the starter motor mounting and engagement. INSTALL a new starter motor. • INSPECT the flywheel/ring gear for damaged, missing or worn teeth. REPAIR as required.

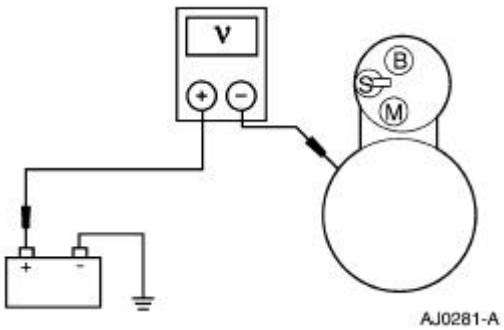
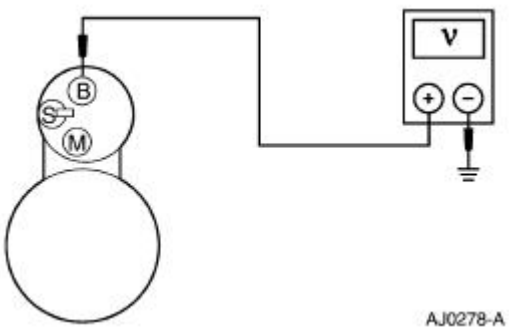
Pinpoint Tests

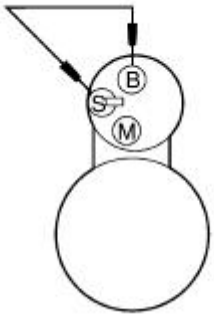
PINPOINT TEST A: THE ENGINE DOES NOT CRANK OR RELAY CLICKS

Test Step	Result / Action to Take
A1 CHECK THE BATTERY	
• Check the battery condition and charge. REFER to Section 414-00 . • **Is the battery OK?**	**Yes** GO to A2 . **No** CHARGE or INSTALL a new battery as required. TEST the system for normal operation.
A2 CHECK THE BATTERY GROUND CABLE	
• Measure the voltage between the positive battery post and the battery ground cable connection at the cylinder block.	**Yes** GO to A3 . **No** INSTALL a new the battery ground cable. TEST the system for normal operation.



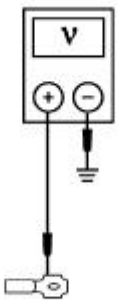
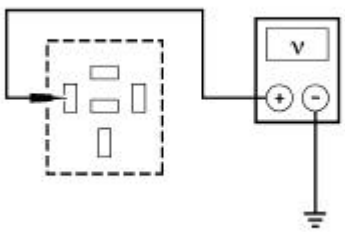
- **Is the voltage reading greater than 10 volts?**

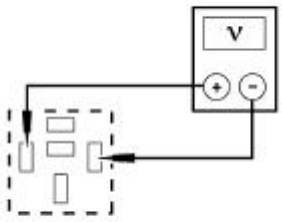
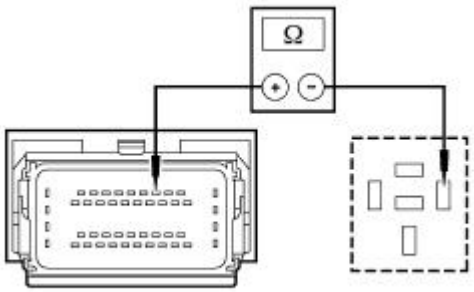
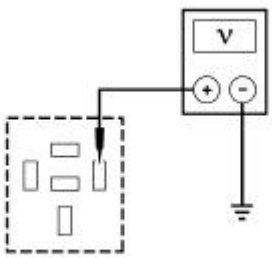
A3 CHECK THE STARTER MOTOR GROUND • Measure the voltage between the positive battery post and the starter motor case.  • **Is the voltage reading greater than 10 volts?**	**Yes** GO to A4 . **No** CLEAN the starter motor mounting flange and make sure the starter motor is correctly mounted. TEST the system for normal operation.
A4 CHECK THE POWER SUPPLY TO THE STARTER MOTOR • Key in OFF position. • Measure the voltage at the starter motor B terminal.  • **Is the voltage reading greater than 10 volts?**	**Yes** GO to A5 . **No** INSTALL a new the positive battery cable. TEST the system for normal operation.
A5 CHECK THE STARTER MOTOR • Connect one end of a jumper wire to the B terminal of the starter motor and momentarily connect the other end to the starter solenoid S-terminal.	**Yes** GO to A6 . **No** INSTALL a new starter motor. TEST the system for normal operation.

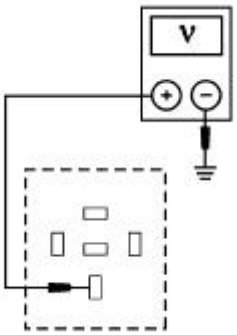
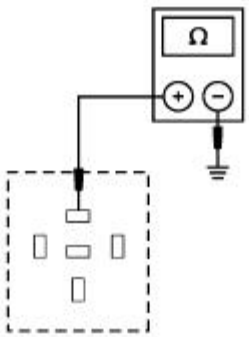
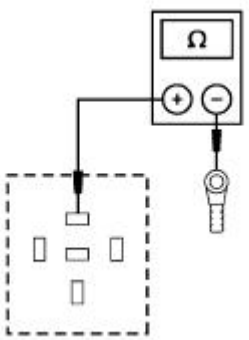


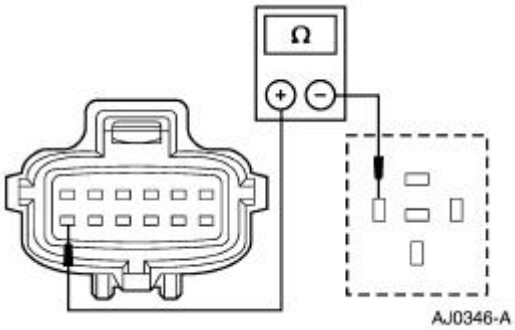
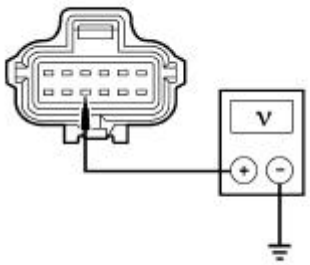
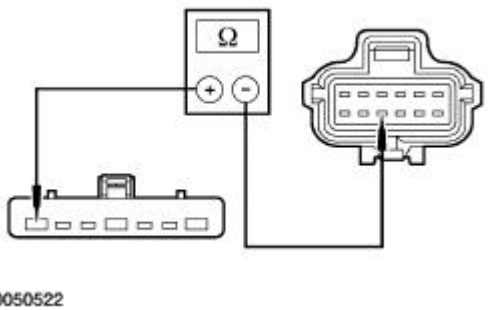
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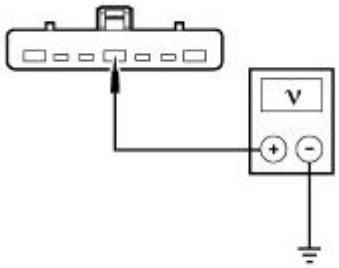
- **Does the starter motor engage and the engine crank?**

A6 CHECK START INPUT TO THE STARTER MOTOR	
• Disconnect: Starter S Connector. • Hold the ignition switch in the START position. • Measure the voltage at the starter motor solenoid S connector.  AJ0285-A • **Is the voltage reading greater than 10 volts?**	**Yes** CLEAN the starter solenoid S terminal and connector. CHECK the wiring and the starter motor for a loose or intermittent connection. TEST the system for normal operation. **No** GO to A7 .
A7 CHECK THE IGNITION SWITCH VOLTAGE TO THE STARTER RELAY	
• Key in OFF position. • Disconnect: Starter Relay. • Key in ACCESSORY position. • Place the transmission range selector in PARK or NEUTRAL. • Hold the ignition switch in the START position. • Measure the voltage at the starter relay connector pin 86, circuit 1093 (TN/RD).  A0052285 • **Is the voltage reading greater than 10 volts?**	**Yes** GO to A8 . **No** GO to A14 .
A8 CHECK THE PCM MODULE	
• Hold the ignition switch in the START position. • Measure the voltage between the starter relay socket, pin 86, circuit 1093 (TN/RD) and the starter relay socket, pin 85, circuit 325 (DB/OG).	**Yes** GO to A11 . **No**

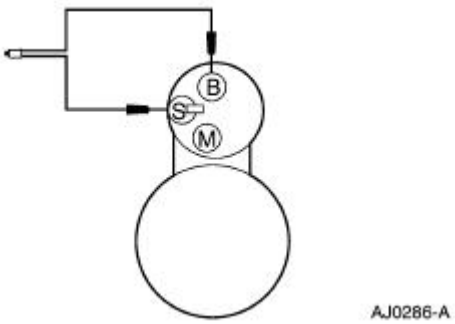
 A0052286 ● **Is the voltage reading greater than 10 volts?**	GO to A9 .
A9 CHECK CIRCUIT 325 (DB/OG) FOR A SHORT TO GROUND ● Key in OFF position. ● Disconnect: PCM C1756. ● Measure the resistance between the PCM connector C1756 pin 4, circuit 325 (DB/OG) and the starter relay socket pin 85, circuit 325 (DB/OG).  A0052287 ● **Is the resistance less than 5 ohms?**	**Yes** GO to A10 . **No** REPAIR circuit 325 (DB/OG). TEST the system for normal operation.
A10 CHECK CIRCUIT 325 (DB/OG) FOR A SHORT TO VOLTAGE ● Disconnect: PCM C1756. ● Key in ON position. ● Measure the voltage between the starter motor relay socket pin 85, circuit 325 (DB/OG) and ground.  A0052288 ● **Is the voltage greater than 10 volts?**	**Yes** REPAIR circuit 325 (DB/OG). TEST the system for normal operation. **No** REFER to Section 419-01 to diagnose a passive anti-theft system (PATS) concern.
A11 CHECK THE BATTERY SUPPLY TO THE STARTER RELAY ● Key in OFF position. ● Measure the voltage at the starter relay connector pin 30.	**Yes** GO to A12 . **No** REPAIR the open circuit. TEST the system for normal operation.

 AJ0295-A ● **Is the voltage reading greater than 10 volts?**	
A12 CHECK CIRCUIT 113 (YE/LB) FOR A SHORT TO GROUND	**Yes** GO to A13 . **No** REPAIR circuit 113 (YE/LB). TEST the system for normal operation.
● Key in OFF position. ● Measure the resistance between the starter relay connector pin 87, circuit 113 (YE/LB) and ground.  AJ0297-A ● **Is the resistance greater than 10,000 ohms?**	
A13 CHECK CIRCUIT 113 (YE/LB) FOR AN OPEN	**Yes** INSTALL a new starter relay. TEST the system for normal operation. **No** REPAIR circuit 113 (YE/LB). TEST the system for normal operation.
● Measure the resistance of circuit 113 (YE/LB) between the starter relay connector pin 87 and the starter S connector.  AJ0298-A ● **Is the resistance less than 5 ohms?**	
A14 CHECK CIRCUIT 1093 (TN/RD) FOR AN OPEN	**Yes** GO to A15 . **No** REPAIR circuit 1093 (TN/RD) TEST the system for normal operation.
● Disconnect: Digital transmission range sensor C167. ● Measure the resistance of circuit 1093 (TN/RD) between the starter relay connector pin 86 and the digital transmission range sensor C167 pin 12.	

 ● **Is the resistance reading less than 5 ohms?**	
A15 CHECK VOLTAGE TO THE DIGITAL TRANSMISSION RANGE SENSOR	
● Key in ON position. ● Measure the voltage between the digital transmission range sensor C167 pin 10, circuit 33 (WH/PK) and ground.  ● **Is the voltage reading greater than 10 volts?**	**Yes** CHECK the digital transmission range sensor adjustment. REFER to Section 307-01A . If the digital transmission range sensor is adjusted correctly, INSTALL a new digital transmission range sensor. TEST the system for normal operation. **No** GO to A16 .
A16 CHECK CIRCUIT 33 (WH/PK) AND CIRCUIT 32 (RD/LB) FOR AN OPEN	
● Key in OFF position. ● Disconnect: Ignition switch C250. ● Measure the resistance between the digital transmission range sensor C167 pin 10, circuit 33 (WH/PK) and the ignition switch C250 pin 7, circuit 32 (RD/LB).  ● **Is the resistance less than 5 ohms?**	**Yes** GO to A17 . **No** REPAIR circuit 33 (WH/PK) or circuit 32 (RD/LB). TEST the system for normal operation.
A17 CHECK THE VOLTAGE AT THE IGNITION SWITCH	
● Key in ON position. ● Measure the voltage between the ignition switch C250, circuit 1050 (LG/VT) and ground.	**Yes** INSTALL a new ignition switch. TEST the system for normal operation. **No**

 A0050523 ● **Is the voltage greater than 10 volts?**	REPAIR circuit 1050 (LG/VT). TEST the system for normal operation.

PINPOINT TEST B: UNUSUAL STARTER NOISE

Test Step	Result / Action to Take
B1 CHECK STARTER MOUNTING ● Inspect the starter mounting bolts and brackets for looseness, and the starter housing for a flush, tight fit to rear cover plate. ● **Is the starter motor mounted correctly?**	**Yes** GO to B2 . **No** INSTALL the starter motor correctly, REFER to Starter Motor in this section. TEST the system for normal operation.
B2 CHECK FOR ENGINE NOISE ● Key in OFF position. ● Connect a remote starter switch between the starter solenoid B and S terminals.  AJ0286-A ● Engage the starter motor and verify the noise is due to the starter operation. ● **Is the noise due to the starter motor engagement?**	**Yes** GO to B3 . **No** REFER to Section 303-00 to continue the diagnosis.
B3 CHECK FOR UNUSUAL WEAR ● Remove the starter motor. Refer to Starter Motor in this section. ● Inspect the ring gear for damaged or worn teeth. ● **Is the noise due to ring gear tooth damage?**	**Yes** INSTALL a new ring gear. EXAMINE the starter pinion teeth. If damaged, INSTALL a new starter motor. TEST the system for normal operation. **No** INSTALL a new starter motor. TEST the system for normal operation.

Component Tests

Starter Motor—Voltage Drop Test

WARNING: When servicing the starter motor or performing other underhood work in the vicinity of the starter motor, be aware that the heavy gauge battery input lead at the starter solenoid is "electrically hot" at all times.

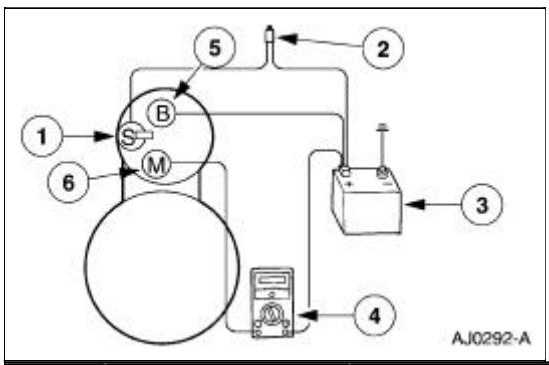
CAUTION: A protective cap or boot is provided over the battery input terminal on all vehicle lines and must be installed after servicing. Be sure to disconnect the battery ground cable before servicing the starter motor.

Always make the Rotunda 73 Digital Multimeter connections at the component terminal rather than at the wiring end connector. Making a connection at the wiring end connector could result in false readings because the meter will not pick up a high resistance between the wiring connector and the component.

Starter Motor—Motor Feed Circuit

1. Make sure the battery is fully charged. Refer to Section 414-00 .
2. Disconnect the inertia fuel shutoff (IFS) switch.
3. Connect a remote starter switch between the starter solenoid S-terminal and the battery positive (+) terminal.
4. Connect the Rotunda 73 Digital Multimeter positive lead to the battery positive (+) post. Connect negative lead to the starter solenoid M-terminal.

Motor Feed Circuit



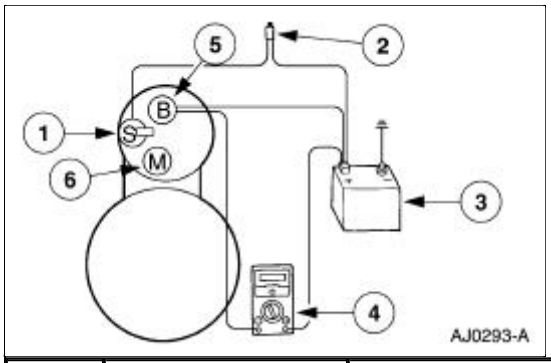
Item	Part Number	Description
1	—	S-terminal (part of 11002)
2	—	Remote starter switch
3	10653	Battery
4	—	Rotunda 73 digital multimeter
5	—	B-terminal (part of 11002)
6	—	M-terminal (part of 11002)

5. Engage the remote starter switch. Read and record the voltage. The voltage reading should be 0.5 volt or less.

6. If the voltage reading is 0.5 volt or less, go to the Starter Motor—Motor Ground Circuit Component Test.

7. If the voltage reading is greater than 0.5 volt, indicating excessive resistance, move the Rotunda 73 Digital Multimeter negative lead to the starter solenoid B-terminal and repeat the test. If the voltage reading at the B-terminal is lower than 0.5 volt, the concern is either in the connections at the starter solenoid or in the solenoid contacts.

Motor Feed Circuit



Item	Part Number	Description
1	—	S-terminal (part of 11002)
2	—	Remote starter switch
3	10653	Battery
4	—	Rotunda 73 digital multimeter
5	—	B-terminal (part of 11002)
6	—	M-terminal (part of 11002)

8. Remove the cables from solenoid B-, S- and M-terminals. Clean the cables and connections and reinstall the cables to the correct terminals. Repeat Steps 3 through 6. If the voltage drop reading is still greater than 0.5 volt when checked at the M-terminal or less than 0.5 volt when checked at the B-terminal, the concern is in the solenoid contacts. Install a new starter motor.

9. If the voltage reading taken at the solenoid B-terminal is still greater than 0.5 volt after cleaning the cables and connections at the solenoid, the concern is either in the positive (+) battery cable connection or in the positive battery cable itself.

10. By moving the Rotunda 73 Digital Multimeter negative lead toward the battery and checking each mechanical connection point, the excessive voltage drop can be located. When the high reading disappears, the last mechanical point that was checked is the concern. Repair or install a new connection as required.

Starter Motor—Motor Ground Circuit

A slow cranking condition can be caused by resistance in the ground or return portion of the cranking circuit. Check the voltage drop in the ground circuit as follows:

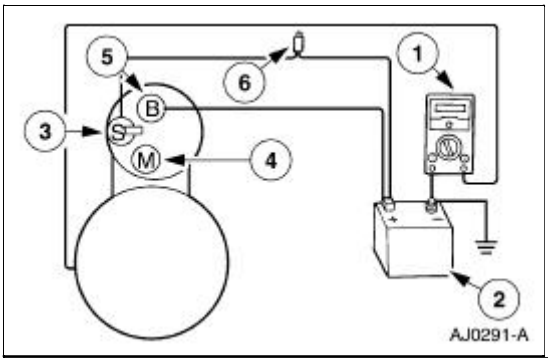
1. Disconnect the inertia fuel shutoff switch.

2. Connect a remote starter switch between the starter solenoid S-terminal and the battery positive

(+) terminal.

3. Connect the Rotunda 73 Digital Multimeter positive lead to the starter motor housing (the connection must be clean and free of rust or grease). Connect the negative lead to the negative (-) battery terminal.

Motor Ground Circuit



Item	Part Number	Description
1	—	Rotunda 73 digital multimeter
2	10653	Battery
3	—	S-terminal (part of 11002)
4	—	M-terminal (part of 11002)
5	—	B-terminal (part of 11002)
6	—	Remote starter switch

4. Engage the remote starter switch and crank the engine. Read and record the voltage reading. The reading should be 0.2 volt or less.

5. If the voltage drop is more than 0.2 volt, clean the negative cable connections at the battery and body connections, and retest.

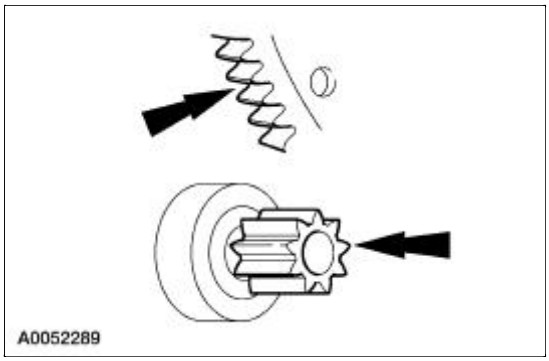
6. If the voltage drop is greater than 0.2 volt, determine which way the current is flowing in the cable. Connect the Rotunda 73 Digital Multimeter positive lead to the end of the cable nearest battery positive.

7. Connect the multimeter negative lead to the terminal at the other end of the cable.

8. Crank the engine and observe the voltage reading. The voltage reading should be 0.2 volt or lower. If the voltage drop is too high, clean the terminal ends. Retest, and if still high, install a new cable. If the voltage reading is less than 0.2 volt and the engine still cranks slowly, install a new starter motor.

Starter Drive and Flywheel Ring Gear Inspection

1. Check the wear patterns on the starter drive and the flywheel ring gear. If the wear pattern is normal, install the starter motor. For additional information, refer to Starter Motor in this section.



2. If the starter drive gear and the flywheel ring gear are not fully meshing or the gears are milled or damaged, install a new starter motor. For additional information, refer to Starter Motor in this section. Install a new flywheel ring gear. For additional information, refer to Section 303-01A or Section 303-01B .

Starter Motor

Removal

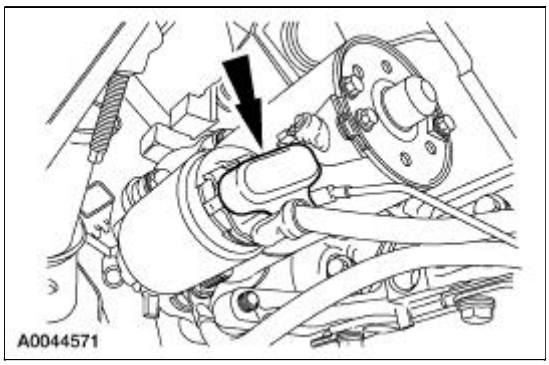
WARNING: When carrying out maintenance on the starting system be aware that heavy gauge leads are connected directly to the battery. Make sure protective caps are in place when maintenance is complete. Failure to follow these instructions may result in personal injury.

1. Disconnect the battery ground cable.

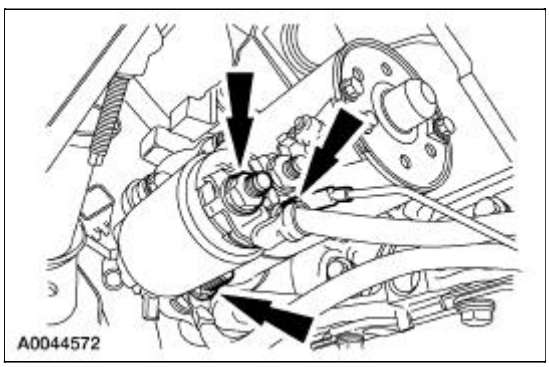
2. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the RH kick panel area. Failure to do so may result in unexpected inflation or deflation of the air springs which may result in shifting of the vehicle during these operations.**

   Raise and support the vehicle; refer to Section 100-02 .

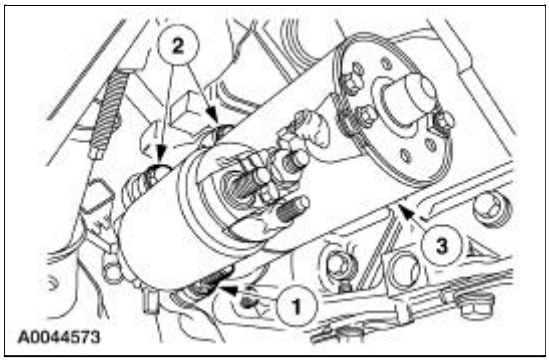
3. Remove the starter motor solenoid terminal cover.



4. Disconnect the starter motor electrical connections.



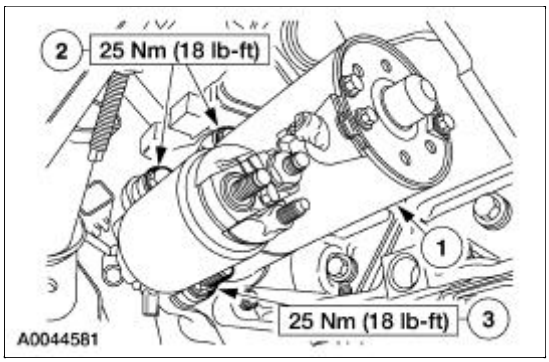
5. Remove the starter motor.
   1. Remove the stud bolts.
   2. Remove the two bolts.
   3. Remove the starter.



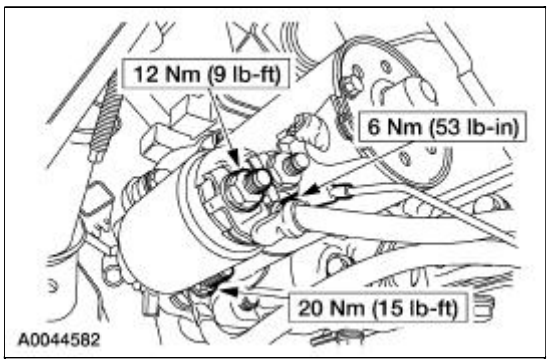
Installation

WARNING: When carrying out maintenance on the starting system be aware that heavy gauge leads are connected directly to the battery. Make sure protective caps are in place when maintenance is complete. Failure to follow these instructions may result in personal injury.

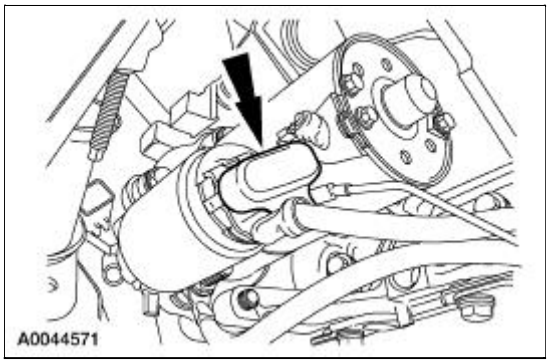
1. Install the starter motor.
    1. Position the starter.
    2. Install the two bolts.
    3. Install the stud bolt.



2. Connect the starter motor electrical connections.



3. Install the starter motor solenoid terminal cover.



4. Lower the vehicle.

5. **NOTE:** If equipped with air suspension, reactivate the system by turning on the air suspension switch.

   Connect the battery ground cable.

General Specifications

Item	Specification
Base ignition timing	Not adjustable
Firing order	1-3-7-2-6-5-4-8
Spark plug gap (4.6L and 5.4L)	1.32-1.42 mm (0.052-0.056 inch)
Spark plug type (4.6L)	AWSF-32P
Spark plug type (5.4L)	AWSF-22W

Torque Specifications

Description	Nm	lb-ft	lb-in
Ignition coil bolt	7	—	62
Spark plugs	11	—	89

Engine Ignition

The electronic ignition (EI) system is a coil-on-plug (COP) ignition system. The COP ignition system consists of the following components:

- crankshaft position (CKP) sensor
- ignition coils
- spark plugs

The CKP sensor:

- is a variable reluctance sensor.
- is triggered by a 36-minus-1 tooth trigger wheel mounted on the crankshaft.
- provides base timing and crankshaft speed (rpm) to the powertrain control module (PCM). For additional information, refer to Section 303-14 .

The eight separate ignition coils:

- change low voltage signals from the PCM to high voltage pulses.
- produce the high voltage pulses to the spark plugs.
- are connected directly to each spark plug.

The spark plugs:

- change a high voltage pulse into a spark which ignites the fuel and air mixture.
- originally equipped on the vehicle have a platinum-enhanced electrode for long life.

Engine Ignition

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

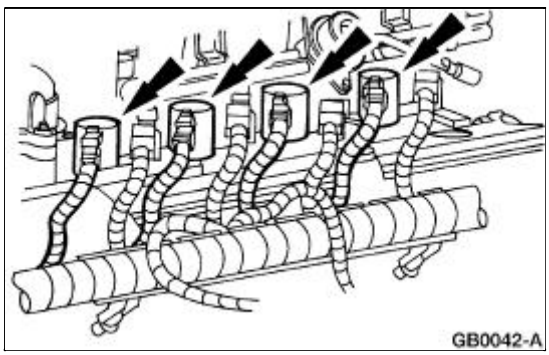
Ignition Coil

Material

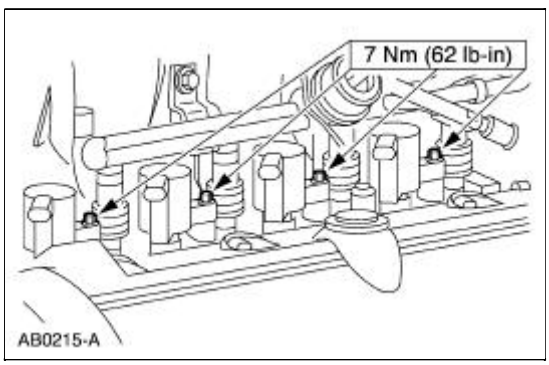
Item	Specification
Silicone Brake Caliper Grease and Dielectric Compound D9AZ-19A331-A	ESE-M1C171-A

Removal and Installation

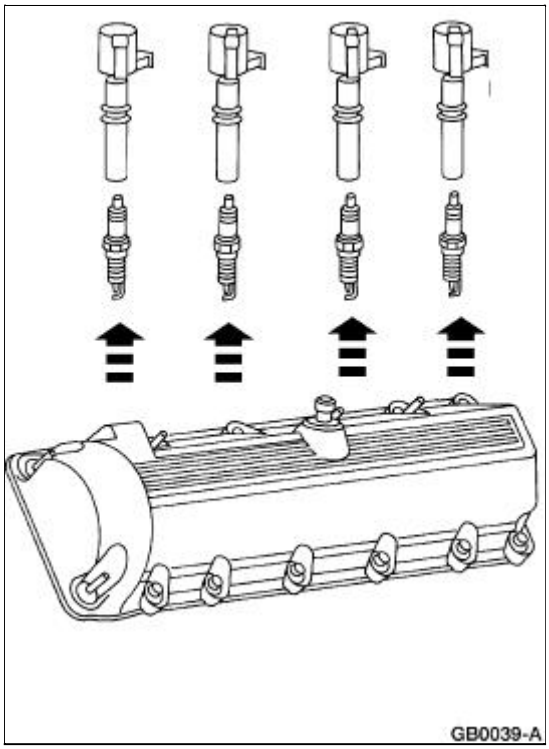
1. Disconnect the coil on plug (COP) electrical connectors.



2. Remove the bolts.



3. Remove the coil on plugs.



4. **NOTE:** Apply silicone brake caliper grease and dielectric compound to the inside of the coil boots.

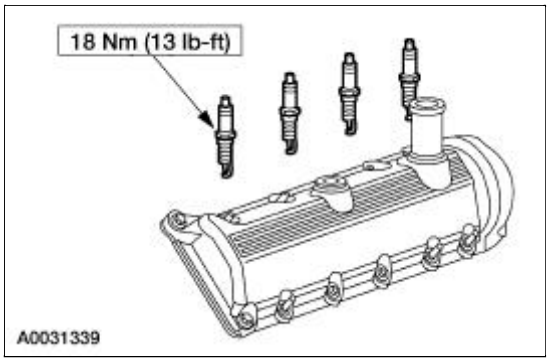
   To install, reverse the removal procedure.

Spark Plug

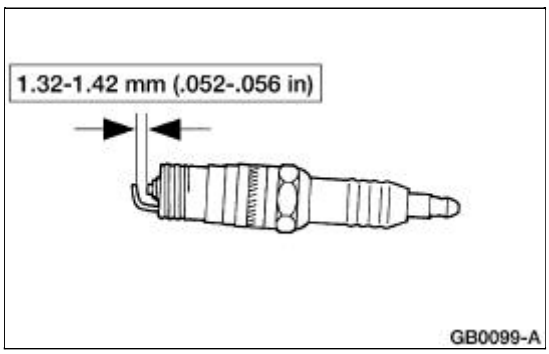
Removal and Installation

1. Remove the coil on plugs. For additional information, refer to Ignition Coil in this section.
2. **NOTE:** Remove any foreign material from the spark plug wells with compressed air before removing the spark plugs.

   Remove the spark plugs.



3. Inspect the spark plugs. For additional information, refer to Section 303-00 .
4. Adjust the spark plug gap as necessary.



5. To install, reverse the removal procedure.

General Specifications

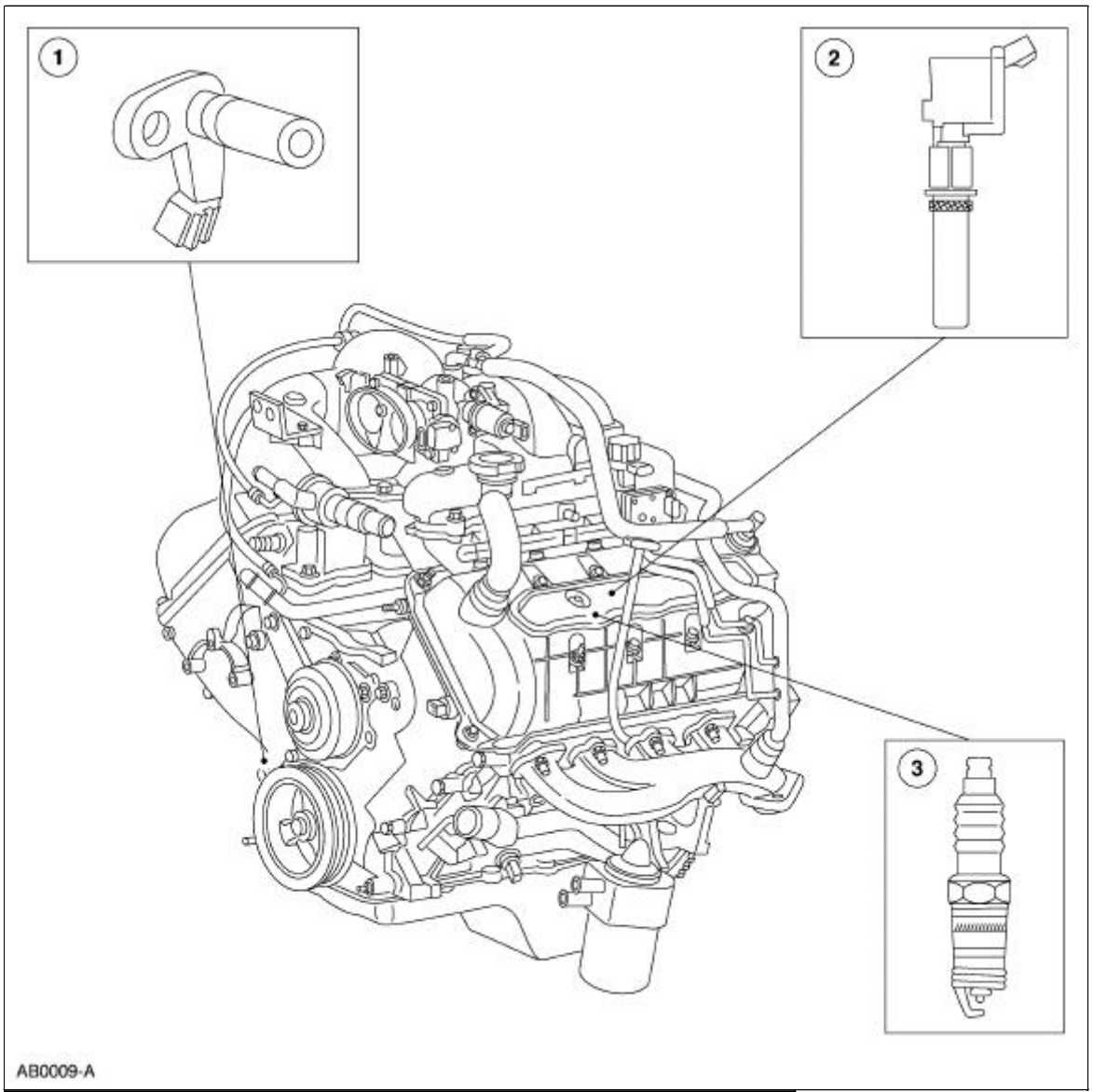
Item	Specification
Base ignition timing	10 degrees BTDC
Firing order	1-3-7-2-6-5-4-8
Spark plug gap	1.32-1.42 mm (0.052-0.056 inch)
Spark plug type—original	AWSF32P
Spark plug type—replacement	AWSF32P

Torque Specifications

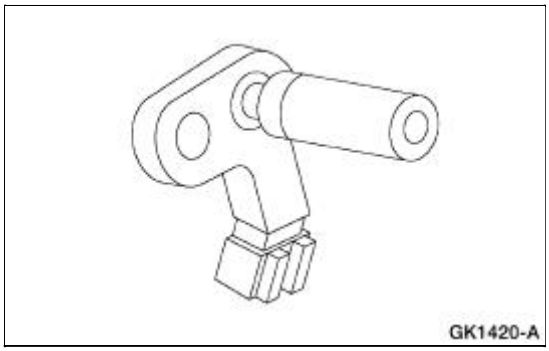
Description	Nm	lb-ft	lb-in
Spark plugs	20	15	—
Ignition coil cover bolts	12	9	—

Engine Ignition

Component Locations

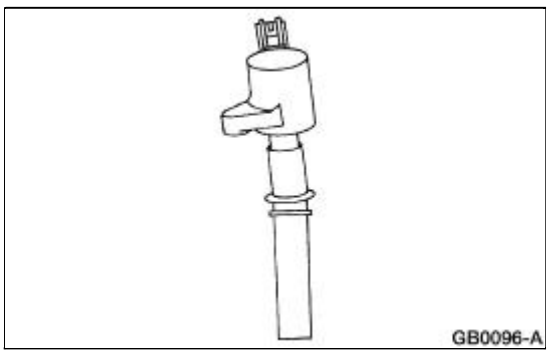


Item	Part Number	Description
1	6C315	Crankshaft position sensor (CKP)
2	12029	Ignition coil
3	12405	Spark plug



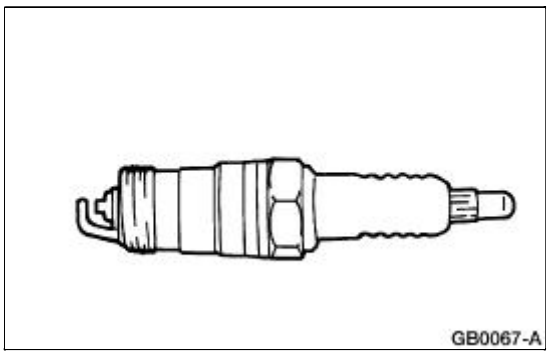
The crankshaft position sensor:

- is a variable reluctance sensor.
- is triggered by a 36-minus-1 tooth trigger wheel mounted on the crankshaft (6303).
- provides base timing and crankshaft speed (RPM) to the powertrain control module (PCM) (12A650). Refer to Section 303-14 for removal and installation of the crankshaft position sensor.



The eight separate ignition coils:

- change low voltage signals from the powertrain control module to high voltage pulses.
- produce the high voltage pulses to the spark plugs.
- are connected directly to each spark plug.



The spark plugs:

- change a high voltage pulse into a spark which ignites the fuel and air mixture.
- originally equipped on the vehicle have a platinum-enhanced electrode for long life.

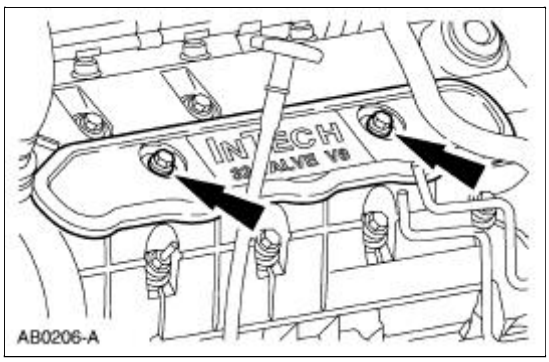
Engine Ignition

Refer to Powertrain Control/Emissions Diagnosis (PC/ED) manual.

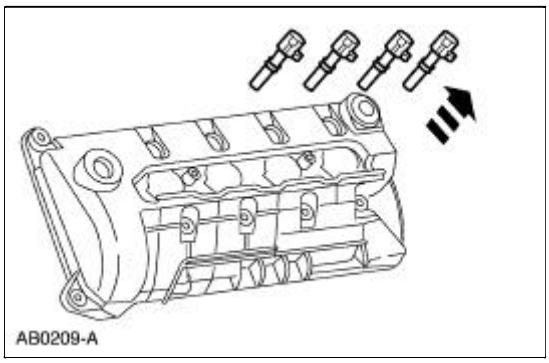
Ignition Coil

Removal and Installation

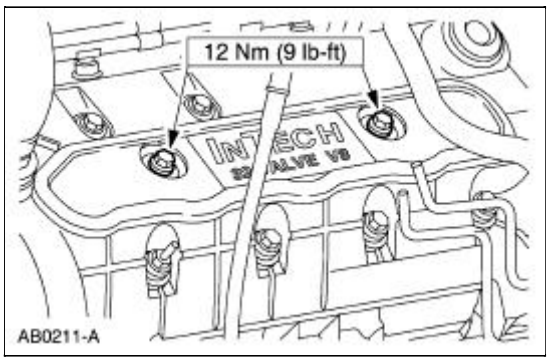
1. Remove the bolts and the ignition coil cover.



2. Disconnect the electrical connector from the ignition coil (12029).
3. Remove the ignition coils (12029).



4. To install, reverse the removal procedure.

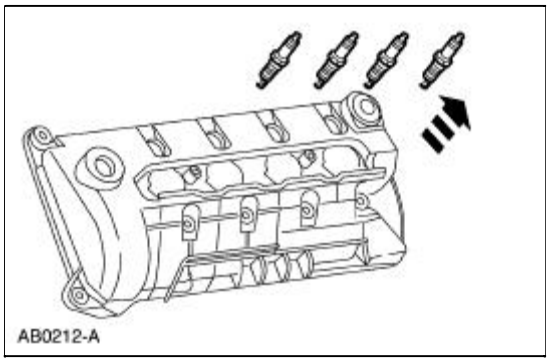


Spark Plug

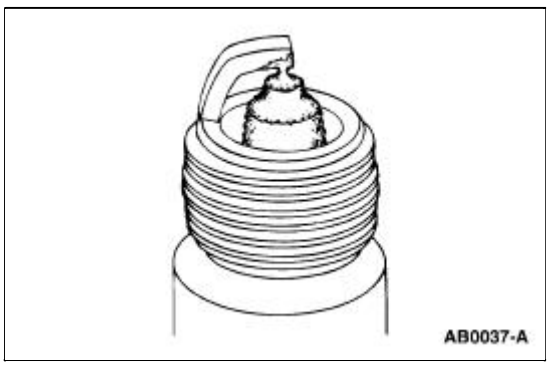
Removal

1. Remove the ignition coil (12029). For additional information, refer to Ignition Coil in this section.
2. **NOTE:** Remove any foreign material from the spark plug wells with compressed air before removing the spark plugs (12405).

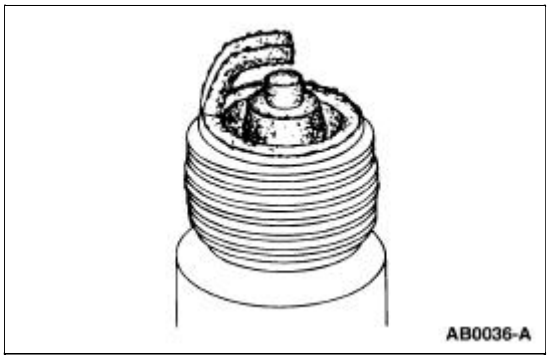
   Remove the spark plugs.



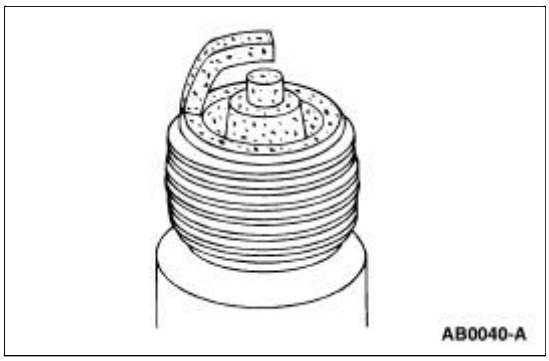
3. Inspect the spark plugs for a bridged gap.
   - Check for deposit build-up closing the gap between the electrodes. Deposits are caused by oil or carbon fouling.
   - Clean the spark plug.



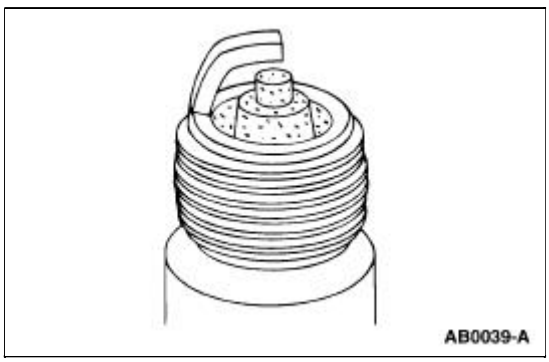
4. Check for oil fouling.
   - Check for wet, black deposits on the insulator shell bore electrodes, caused by excessive oil entering the combustion chamber through worn rings and pistons, excessive valve-to-guide clearance or worn or loose bearings.
   - Correct the oil leak concern.
   - Install a new spark plug.



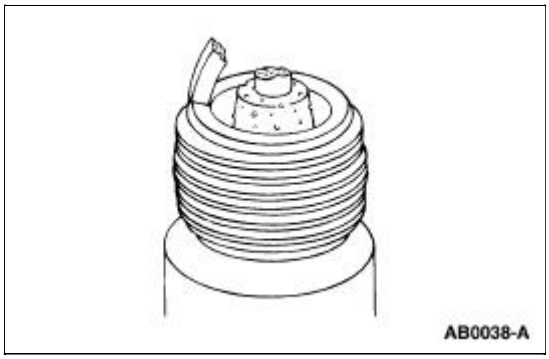
5. Inspect for carbon fouling. Look for black, dry, fluffy carbon deposits on insulator tips, exposed shell surfaces and electrodes, caused by a spark plug with an incorrect heat range, dirty air cleaner, too a rich fuel mixture or excessive idling.
    - Clean the spark plug.



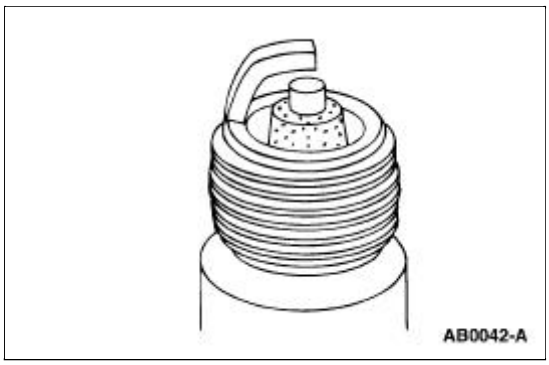
6. Inspect for normal burning.
    - Check for light tan or gray deposits on the firing tip.



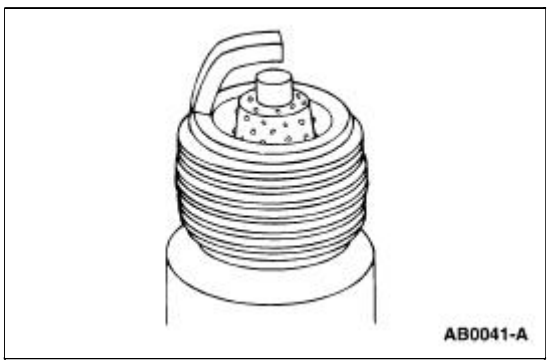
7. Inspect for pre-ignition, identified by melted electrodes and a possibly damaged insulator. Metallic deposits on the insulator indicate engine damage. This may be caused by incorrect ignition timing, wrong type of fuel or the installation of a heli-coil insert in place of the spark plug threads.
    - Install a new spark plug.



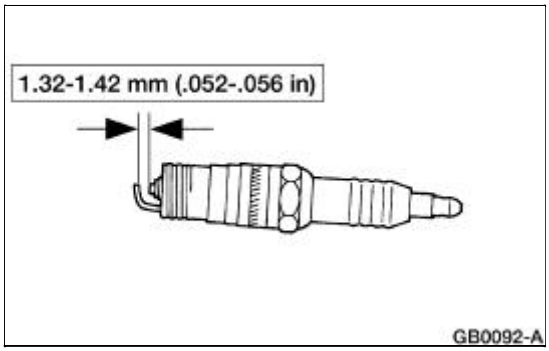
8. Inspect for overheating, identified by a white or light gray-brown spots and with bluish-burnt appearance of electrodes. This is caused by engine overheating, wrong type of fuel, loose spark plugs, spark plugs with an incorrect heat range, low fuel pump pressure or incorrect ignition timing.
    - Install a new spark plug.



9. Inspect for fused deposits, identified by melted or spotty deposits resembling bubbles or blisters. These are caused by sudden acceleration.
    - Clean the spark plug.

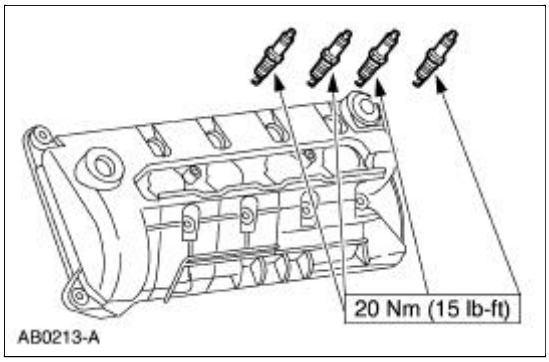


10. Adjust the spark plug gap as required.



Installation

1. To install, reverse the removal procedure.



Torque Specifications

Description	Nm	lb-ft	lb-in
Brake booster tube bracket nut	11	8	—
Differential pressure feedback exhaust gas recirculation (EGR) bolts	6	—	53
Engine appearance cover bolts	10	—	89
EGR vacuum regulator solenoid bolts/nuts	6	—	53
EGR valve adapter bolts	25	18	—
EGR valve bolts—4.6L, 5.4L	[a]	—	—
EGR valve tube fittings—4.6L	35-45	26-33	—
EGR valve tube fittings—5.4L	40-60	30-44	—
Engine appearance cover bolts	10	—	89

[a] Refer to the procedure in this section.

Engine Emission Control

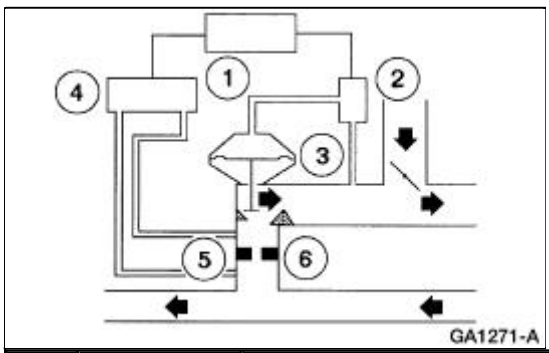
CAUTION: Do not remove any part of the engine emission control system. Operating the engine without the engine emission control system will reduce fuel economy and engine ventilation. This will weaken engine performance and shorten engine life.

The engine emission control consists of the:

- positive crankcase ventilation (PCV) system.
- exhaust gas recirculation (EGR) system.

The PCV system uses intake manifold vacuum to ventilate the crankcase and return the fumes to the intake manifold (9424) for combustion.

EGR System Components



Item	Part Number	Description
1	12A650	Powertrain control module (PCM)
2	9J459	Exhaust gas recirculation (EGR) vacuum regulator solenoid
3	9D475	EGR valve
4	9J433	Differential pressure feedback EGR sensor
5	—	Metering orifice
6	9D477	EGR valve tube

The exhaust gas recirculation (EGR) system returns a portion of the exhaust gas to the intake manifold to reduce the combustion temperature. This results in lower nitrous oxide formation.

The powertrain control module (PCM) controls the EGR vacuum regulator solenoid. The EGR vacuum regulator solenoid controls the vacuum to the EGR valve. When the EGR valve opens, exhaust gas flows to the intake manifold. The EGR transducer measures the flow through the EGR valve to exhaust manifold tube and sends a signal to the powertrain control module. A metering orifice in the EGR valve to exhaust manifold tube restricts the flow rate when the EGR valve is open.

The PCV valve:

- controls the amount of ventilating air and blow-by gases going to the intake manifold.

- prevents a backfire from reaching the crankcase.

The EGR valve tube:

- connects the exhaust manifold (9430) to the EGR valve.
- has two tubes connecting to the differential pressure feedback EGR sensor for EGR flow monitoring.

The differential pressure feedback EGR sensor:

- monitors the EGR flow rate through the EGR valve tube.
- sends an EGR flow rate signal to the powertrain control module (PCM).

The EGR vacuum regulator solenoid uses input from the PCM to control the EGR valve flow.

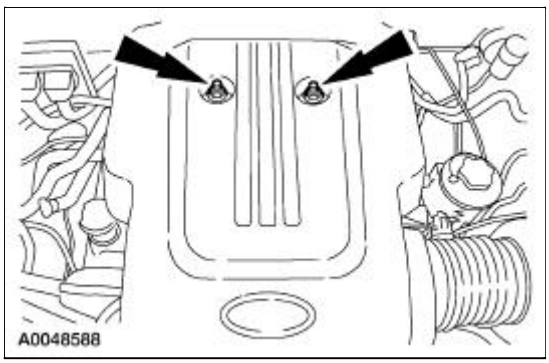
Engine Emission Control

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

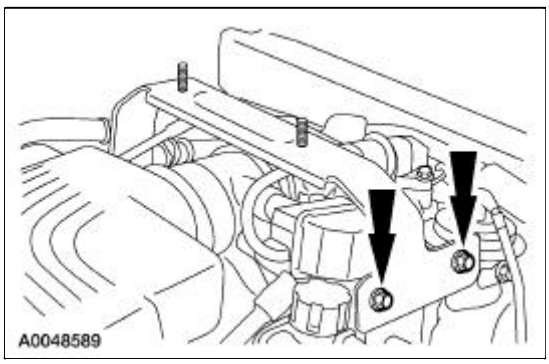
Exhaust Gas Recirculation (EGR) Valve —4.6L

Removal

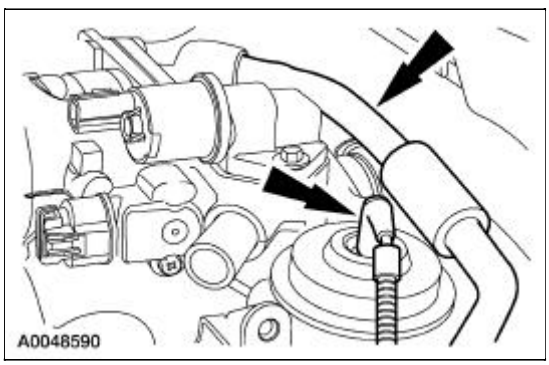
1. Remove the appearance cover.



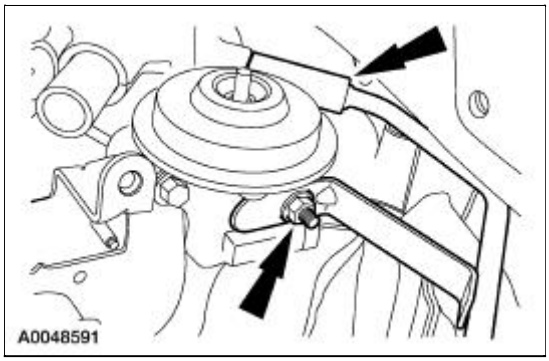
2. Remove the appearance cover bracket.



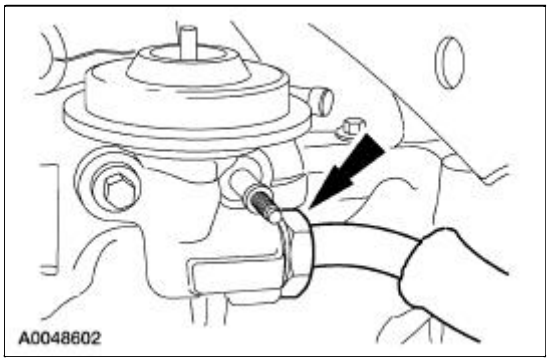
3. Disconnect the following:
   - Exhaust gas recirculation (EGR) valve vacuum hose.
   - Evaporative emissions (EVAP) canister purge solenoid vapor hose.



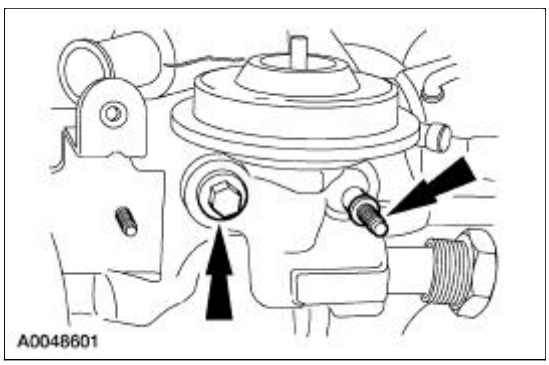
4. Remove the brake booster bracket and tube.



5. Disconnect the EGR valve tube upper fitting.



6. Remove the EGR valve. Discard the gasket.

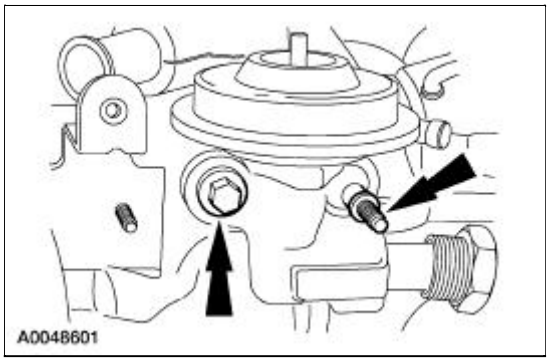


Installation

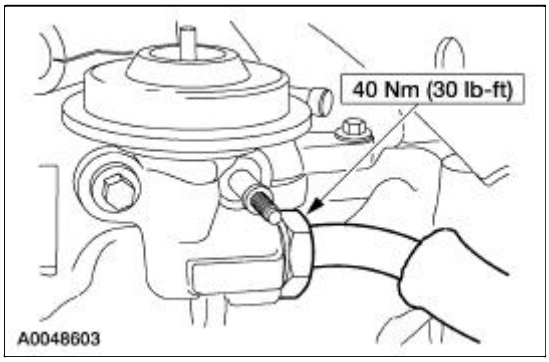
1. **NOTE:** The EGR valve sealing surfaces are soft metals.

   Carefully clean both sealing surfaces.
   - Install a new gasket.

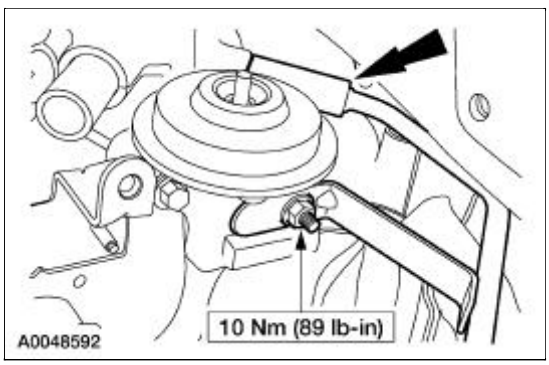
2. Install the EGR valve.
   Tighten the bolts in two stages:
   - Stage 1: Tighten to 20 Nm (15 lb-ft).
   - Stage 2: Tighten an additional 90 degrees.



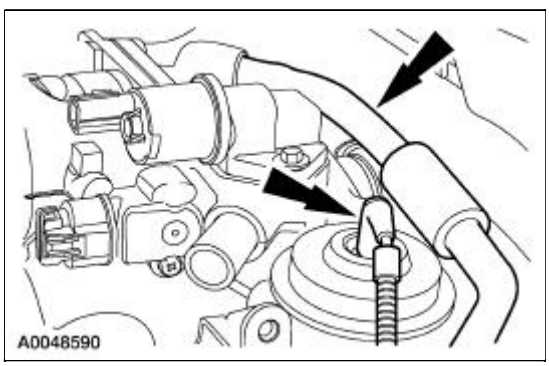
3. Connect the EGR valve tube upper fitting.



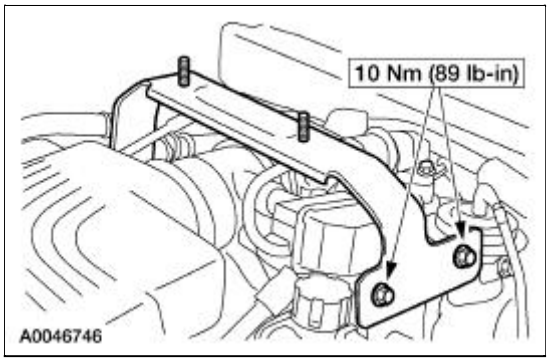
4. Install the brake booster bracket and tube.



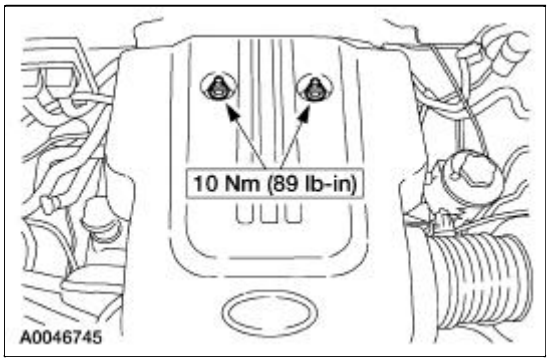
5. Connect the following:
    - EGR valve vacuum hose.
    - EVAP canister purge solenoid vapor hose.



6. Install the appearance cover bracket.



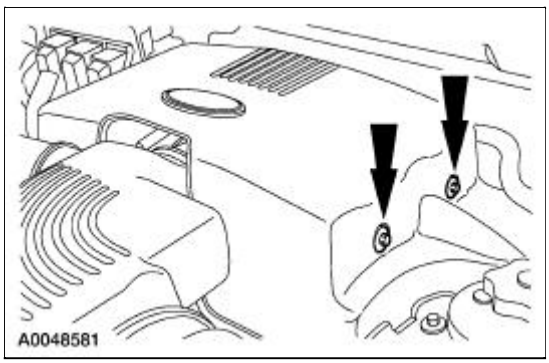
7. Install the appearance cover.



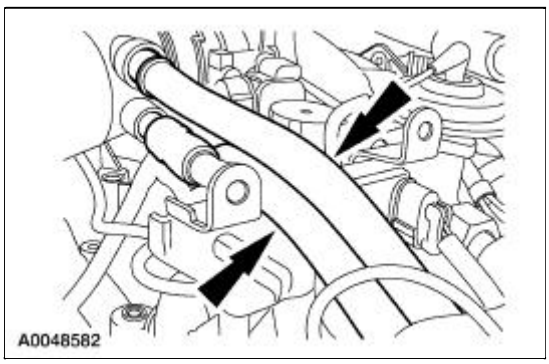
Exhaust Gas Recirculation (EGR) Valve —5.4L (2V)

Removal

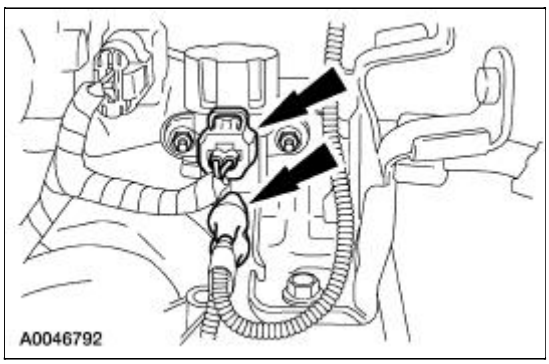
1. Remove the appearance cover.



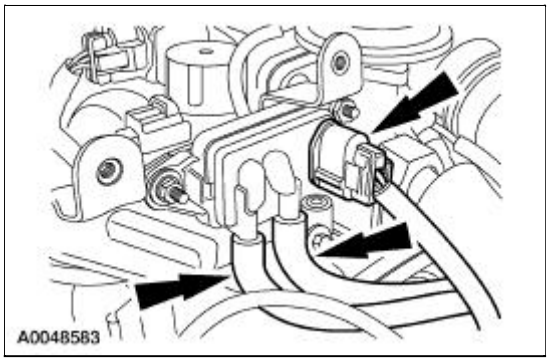
2. Remove the clean air tubes.



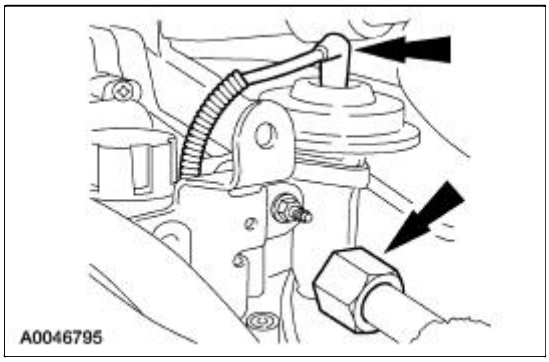
3. Disconnect the exhaust gas recirculation (EGR) vacuum regulator solenoid vacuum and electrical connections.



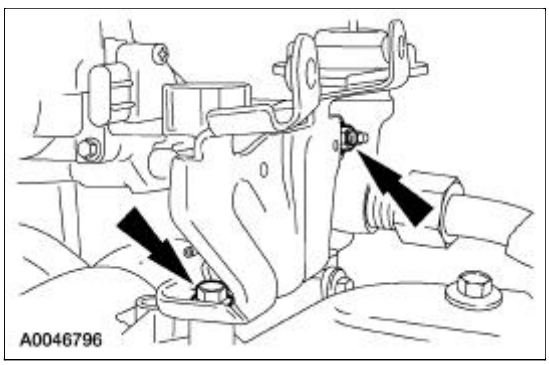
4. Disconnect the differential pressure feedback EGR system vacuum and electrical connections.



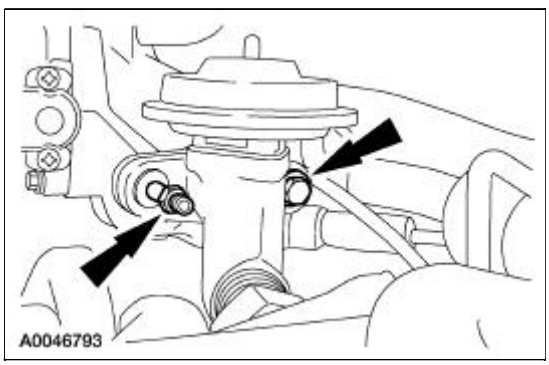
5. Disconnect the EGR valve vacuum hose and the EGR tube upper fitting.



6. Remove the EGR vacuum regulator solenoid bracket.



7. Remove the bolts and the EGR valve.
    - Discard the gasket.



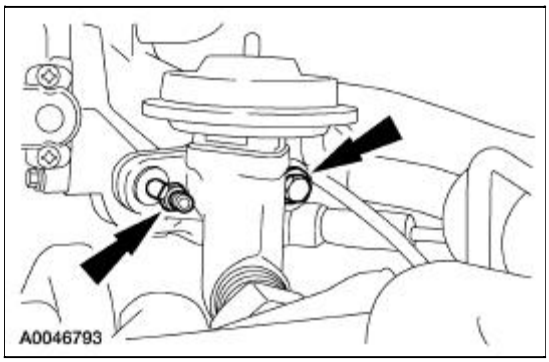
Installation

1. **NOTE:** The exhaust gas recirculation (EGR) valve sealing surfaces are soft metals.

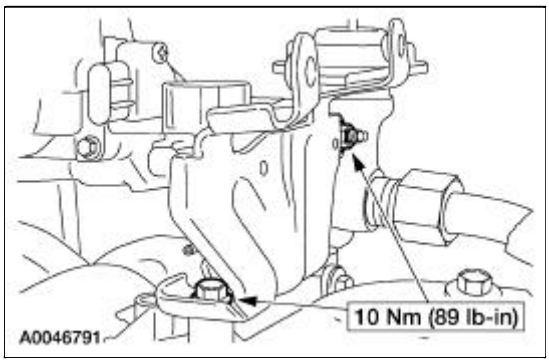
Carefully clean both of the sealing surfaces.

- Install a new gasket.

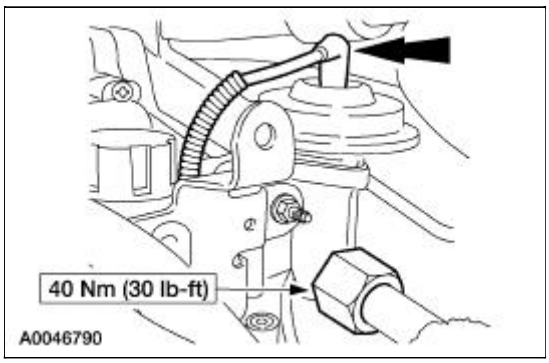
2. Install the EGR valve.
   Tighten the bolts in two stages:
   - Stage 1: Tighten to 20 Nm (15 lb-ft).
   - Stage 2: Tighten an additional 90 degrees.



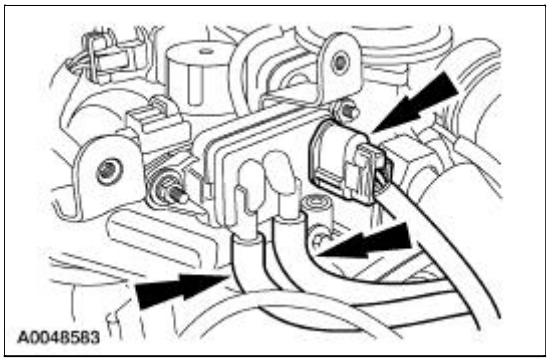
3. Install the EGR vacuum regulator solenoid bracket.



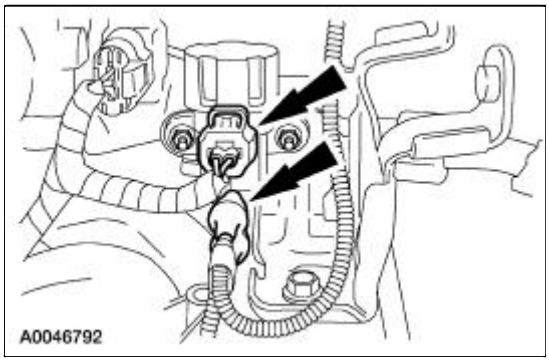
4. Connect the EGR valve vacuum hose and the EGR tube upper fitting.



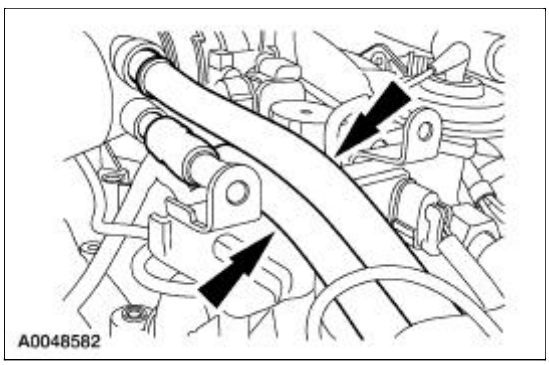
5. Connect the differential pressure feedback EGR system vacuum and electrical connections.



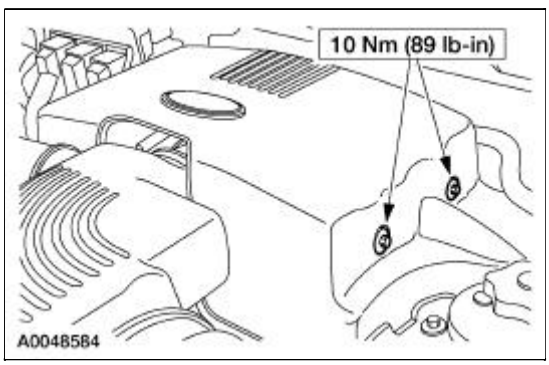
6. Connect the EGR vacuum regulator solenoid vacuum and electrical connections.



7. Install the clean air tubes.



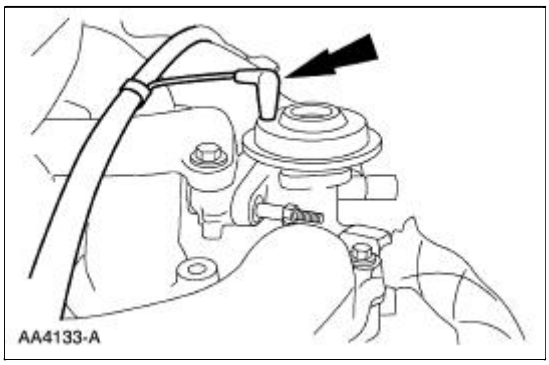
8. Install the appearance cover.



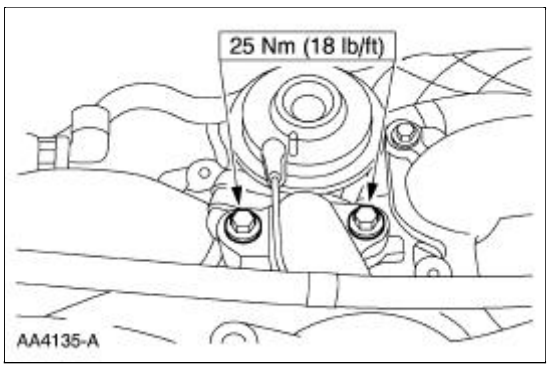
Exhaust Gas Recirculation (EGR) Valve —5.4L (4V) Valve and Tube

Removal and Installation

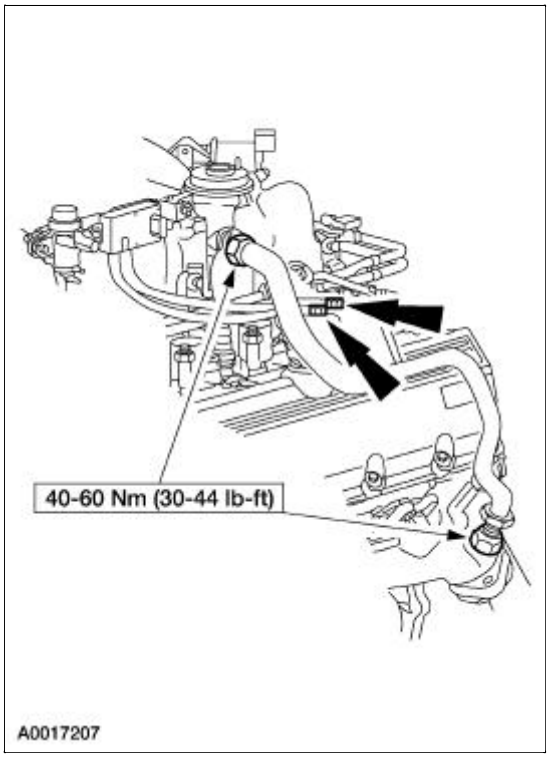
1. Remove the upper intake manifold. For additional information, refer to Section 303-01B .
2. Disconnect the exhaust gas recirculation (EGR) valve vacuum line.



3. Remove the bolts from the EGR adapter.



4. Disconnect the differential pressure feedback (EGR) hoses and the EGR valve tube fittings.

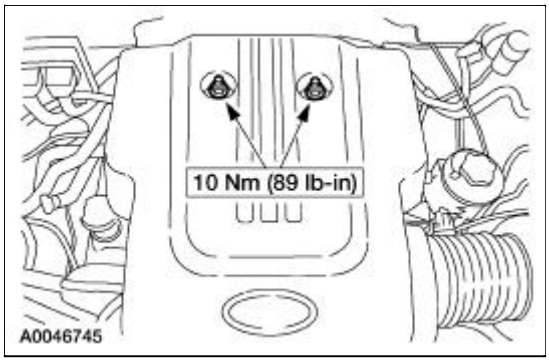


5. Remove the EGR valve and tube as an assembly.
6. To install, reverse the removal procedure.

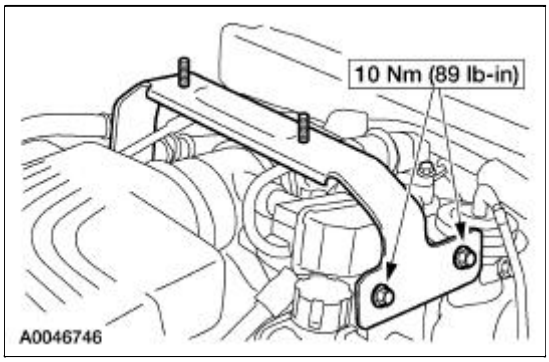
Exhaust Manifold to Exhaust Gas Recirculation (EGR) Valve Tube —4.6L

Removal and Installation

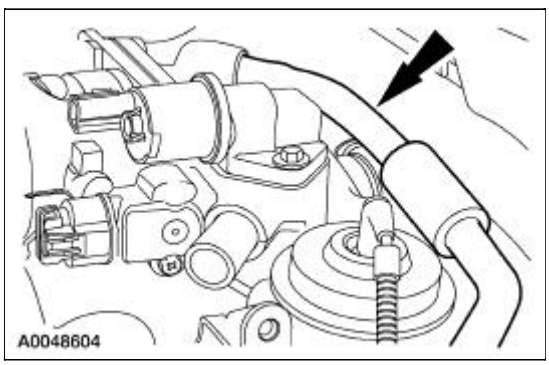
1. Remove the appearance cover.



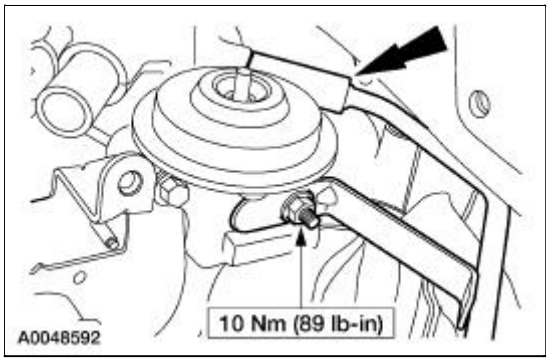
2. Remove the appearance cover bracket.



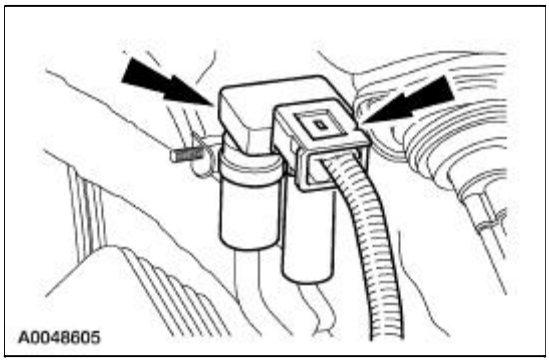
3. Disconnect the evaporative emission (EVAP) canister purge solenoid vapor hose.



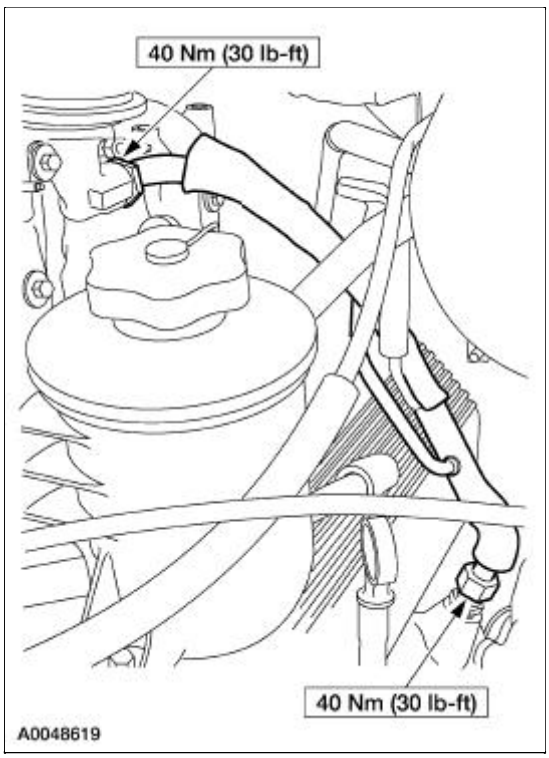
4. Remove the brake booster bracket and tube.



5. Disconnect the electrical connector and remove the differential pressure feedback EGR transducer from the tube.



6. Remove the EGR tube.

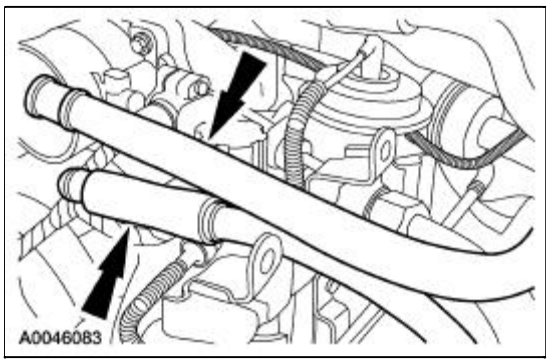


7. To install, reverse the removal procedure.

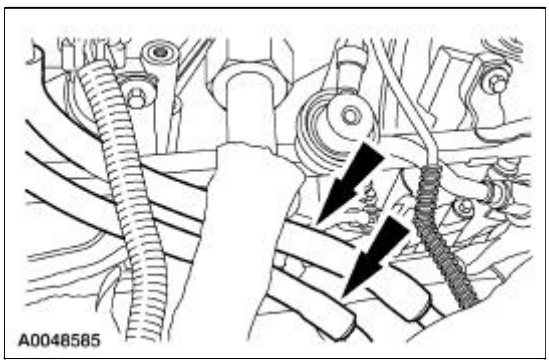
Exhaust Manifold to Exhaust Gas Recirculation (EGR) Valve Tube —5.4L (2V)

Removal and Installation

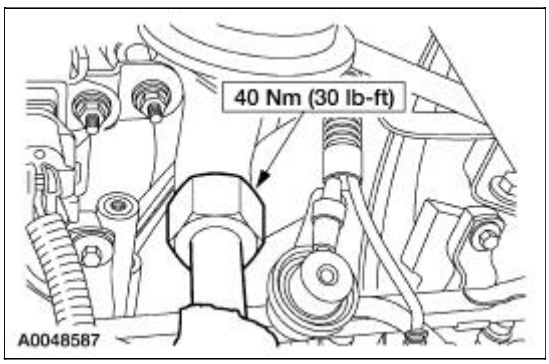
1. Remove the air cleaner outlet pipe. For additional information, refer to Section 303-12 .
2. Remove the clean air tubes.



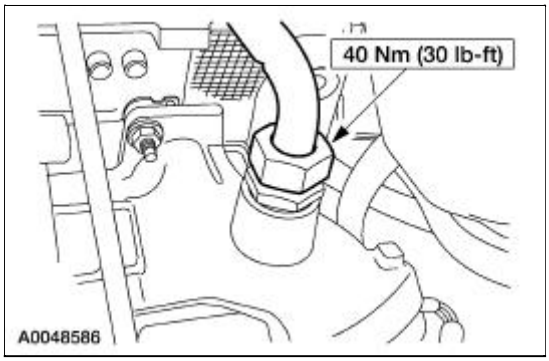
3. Detach differential pressure feedback (DPFE) exhaust gas recirculation (EGR) transducer vacuum hoses from the EGR tube.



4. Disconnect the EGR tube upper fitting from the EGR valve.



5. Disconnect the EGR tube lower fitting from the exhaust manifold and remove the EGR tube.

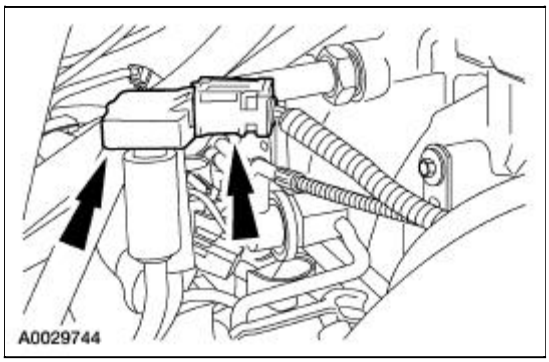


6. To install, reverse the removal procedure.

Differential Pressure Feedback Exhaust Gas Recirculation (EGR) System —4.6L

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Disconnect the electrical connector and remove the differential pressure feedback EGR sensor from the EGR tube.



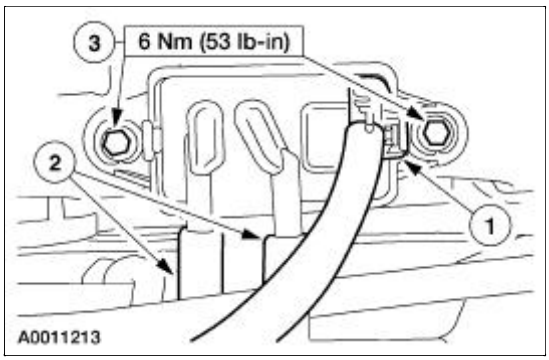
3. To install, reverse the removal procedure.

Differential Pressure Feedback Exhaust Gas Recirculation (EGR) System —5.4L (2V), 5.4L (4V)

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

2. Remove the differential pressure feedback (EGR) sensor.
   1. Disconnect the electrical connector.
   2. Disconnect the hoses.
   3. Remove the bolts.



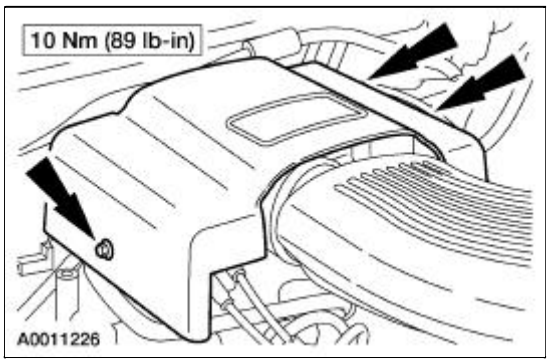
3. To install, reverse the removal procedure.

Exhaust Gas Recirculation (EGR) Vacuum Regulator Solenoid —4.6L, 5.4L (2V), 5.4L (4V)

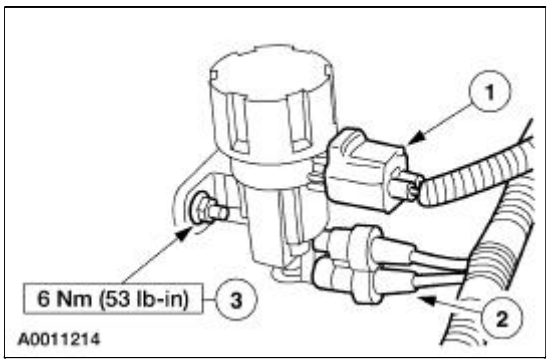
Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. **NOTE:** The 4.6L engine is shown, the 5.4L engines are similar.

   Remove the bolts and remove the engine appearance cover (if equipped).



3. Remove the exhaust gas recirculation (EGR) vacuum regulator solenoid.
   1. Disconnect the electrical connector.
   2. Disconnect the vacuum lines.
   3. Remove the bolts (nuts if applicable).



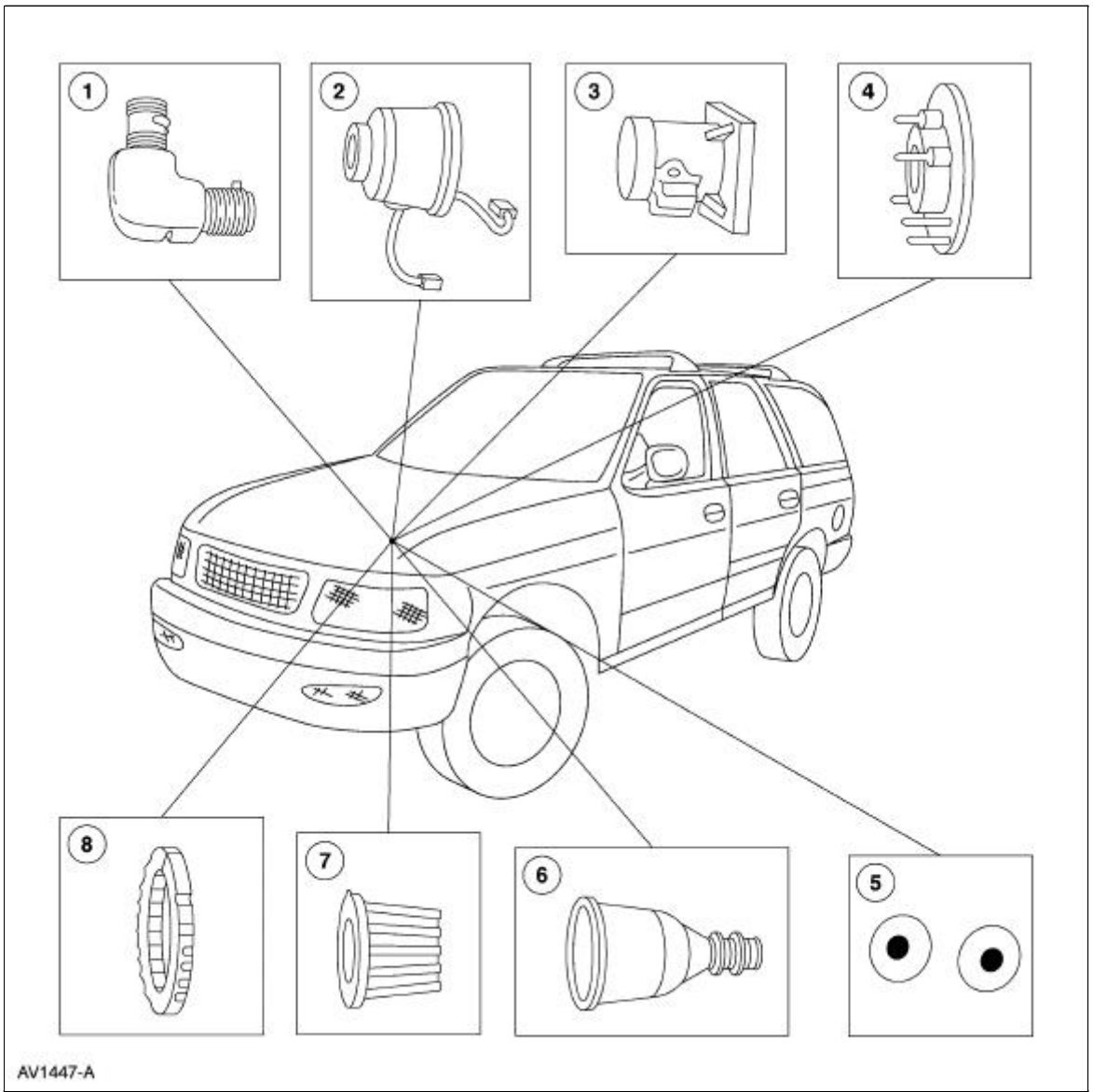
4. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-in
Engine appearance cover bolts	10	89

Intake Air Distribution And Filtering

Component Locations



Item	Part Number	Description
1	9F805	Air cleaner outlet tube and resonator
2	9600	Air cleaner, outlet
3	12B579	Mass air flow sensor
4	—	Mass air flow sensor plate (part of 9600)
5	9P686	Air cleaner support insulator (2 req'd)
6	9600	Air cleaner, inlet
7	9601	Air cleaner element
8	9628	Air cleaner clamp

The air intake system consists of the:

- air cleaner (ACL) (9600) (inlet and outlet).
- air cleaner (ACL) element (9601)
- mass air flow (MAF) sensor (12B579).
- intake air (IAT) temperature (IAT) sensor (12A697).
- air cleaner outlet tube (9B659).
- engine control sensor extension wiring (12A690).

The air intake system:

- cleans intake air with a replaceable, air cleaner element.
- measures air flow with a mass air flow sensor. For additional information, refer to Section 303-14 .
- measures air temperature with an intake air temperature sensor.

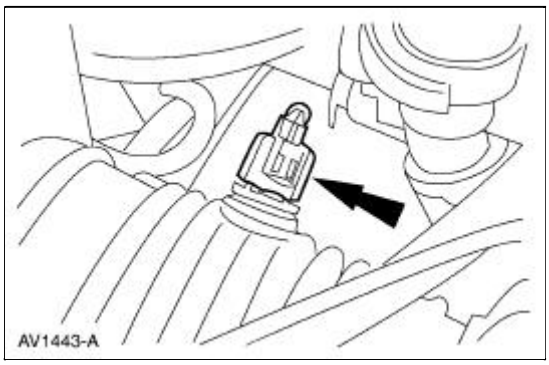
Intake Air Distribution And Filtering

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

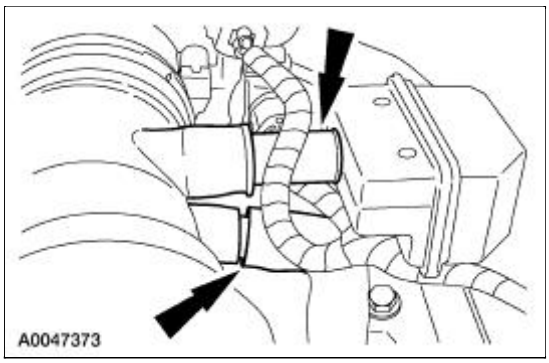
Air Cleaner Outlet Pipe

Removal and Installation

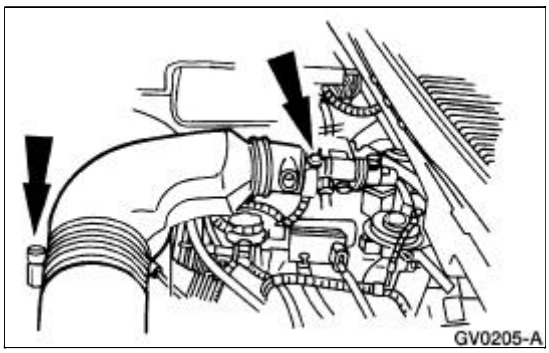
1. Remove the engine appearance cover.
2. Disconnect the intake air temperature (IAT) sensor electrical connector.



3. Disconnect the positive crankcase ventilation hose and the idle air control valve inlet tube.



4. Loosen the clamps and remove the air cleaner outlet pipe and resonator.



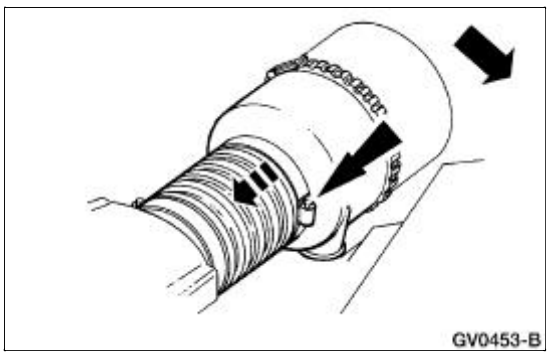
5. **CAUTION: The air cleaner outlet pipe should be securely sealed to prevent unmetered air from entering the engine.**

   To install, reverse the removal procedure.

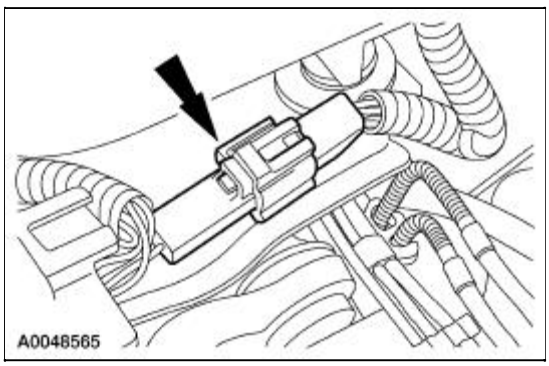
Air Cleaner

Removal and Installation

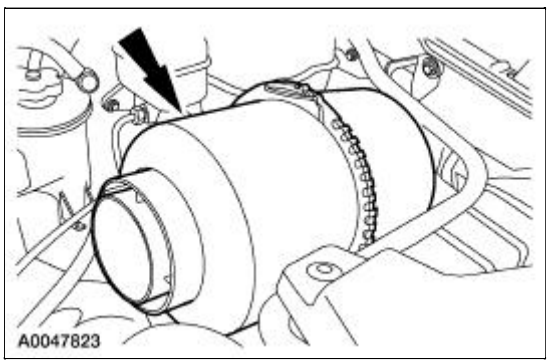
1. Loosen the clamp and separate the air cleaner outlet tube and resonator from the air cleaner.



2. Disconnect the mass air flow (MAF) sensor electrical connector.

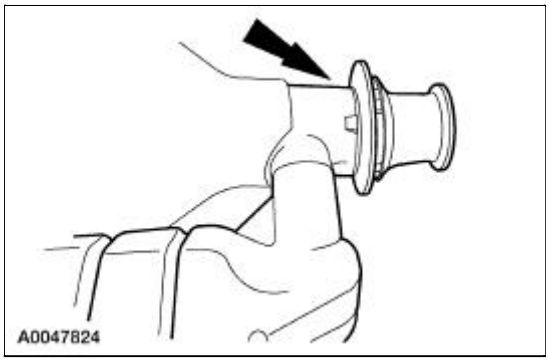


3. Lift the air cleaner assembly from the air cleaner tray.



4. Remove the MAF sensor from the outlet side of the air cleaner. For additional information, refer to Section 303-14 .

5. Separate the air cleaner inlet resonator from the air cleaner assembly.



6. **CAUTION: The grommet used to seal the air cleaner housing at the extension must be fully seated. Failure to do so will result in unmetered air entering the engine.**

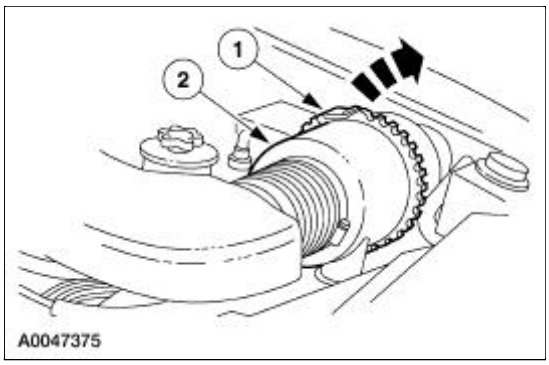
   NOTE: Use the alignment notch to correctly align the inlet side and outlet side of the air cleaner.

   To install, reverse the removal procedure.

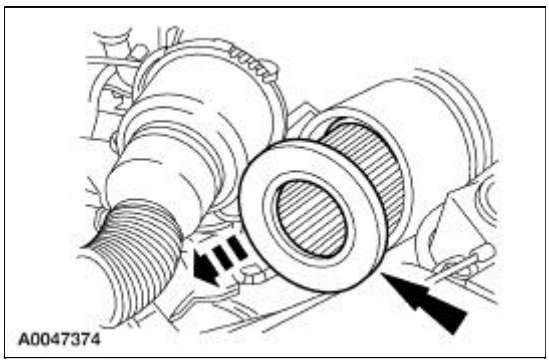
Air Cleaner Element

Removal and Installation

1. Separate the air cleaner assembly.
    1. Open the air cleaner clamp.
    2. Position the air cleaner outlet aside.



2. Remove the air cleaner element from the open end of the air cleaner inlet.



3. **CAUTION: The grommet used to seal the air cleaner housing at the extension must be fully seated. Failure to do so will result in unmetered air entering the engine.**

   NOTE: Use the alignment notch to correctly align the inlet side and outlet side of the air cleaner.

   To install, reverse the removal procedure.

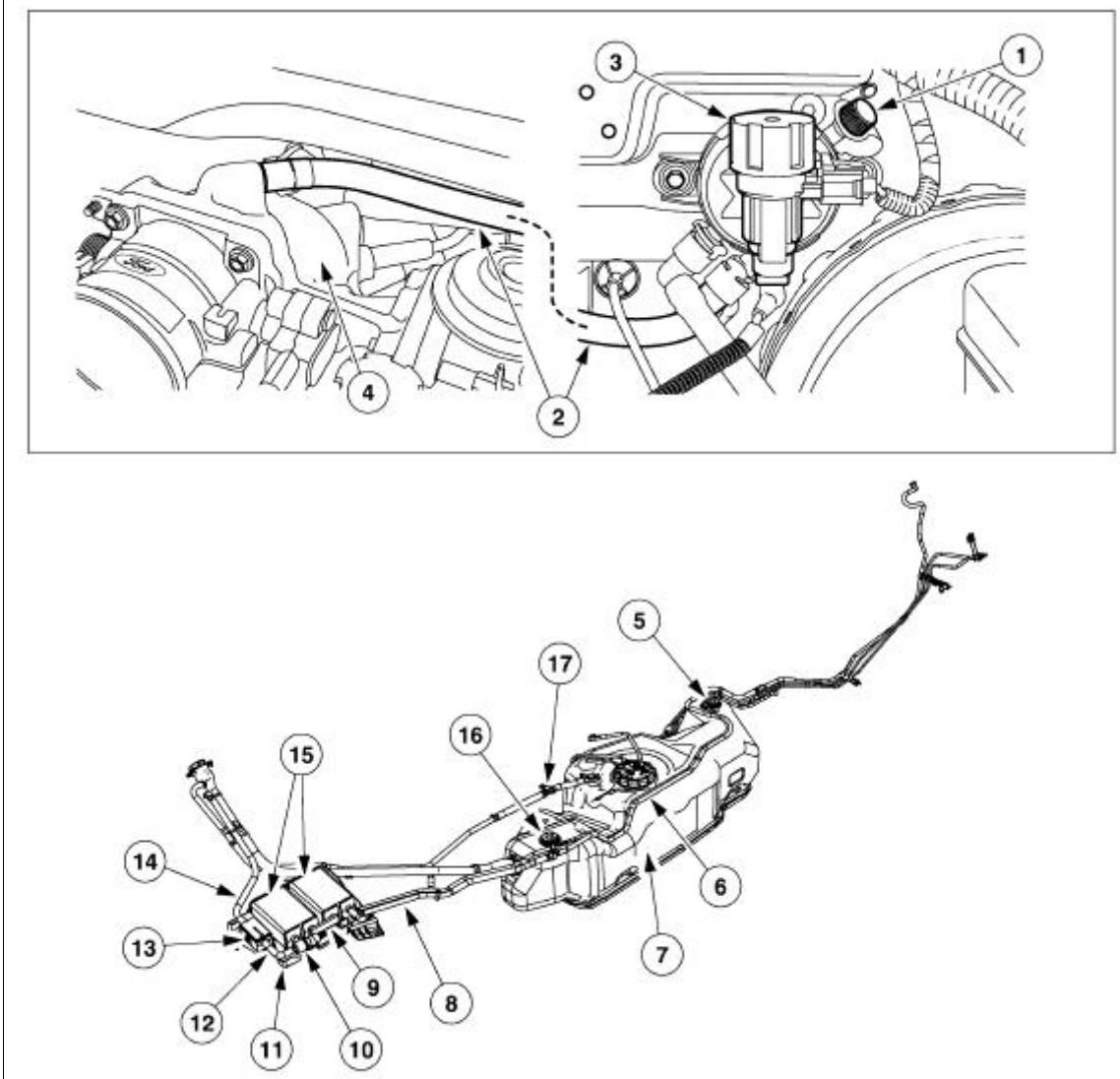
General Specifications

Item	Specification
Lubricants	
MERPOL® O-ring Seal Lubricant	ESE-M99B144-B

Torque Specifications

Description	Nm	lb-ft	lb-in
Evaporative emissions canister purge valve bolts	10	—	89
Evaporative emissions canister bracket bolts (3)	12	9	—

Evaporative Emissions



Item	Part Number	Description
1	—	Evaporative emissions test port
2	—	Evaporative emissions return tube
3	9C915	Evaporative emissions canister purge valve
4	—	Throttle body spacer
5	9B593	Fuel vapor vent valve
6	9C015	Tank vapor line assembly
7	9K007	Fuel tank assembly
8	9C016	Canister vapor line
9	9D925	Vapor line connector sleeve
10	9F945	Evaporative emissions canister vent solenoid

11	9D665	Evaporative emissions canister bracket
12	9K324	Rear vapor hose
13	9B328	Dust separator
14	9S320	Canister remote hose
15	9D653	Evaporative emissions canister
16	9B593	Fuel vapor vent valve
17	9C052	Fuel tank pressure sensor

The evaporative emissions (EVAP) system:

- prevents hydrocarbon emissions from reaching the atmosphere.
- stores fuel vapors in the evaporative emissions (EVAP) canister that are generated during vehicle operation or hot soak, until they can be consumed by the engine during normal engine operation.
- routes the stored fuel vapors to the engine during engine operation.
- is controlled by the powertrain control module (PCM), which uses various sensor inputs to calculate the desired amount of purge flow. The PCM regulates the purge flow, induced by the application of intake manifold vacuum, by varying the duty cycle applied to the EVAP canister purge valve.
- has an evaporative emissions (EVAP) test port for test purposes.

The fuel vapors are routed:

- from the fuel tank through the fuel vapor vent valves.
- to the (EVAP) canister through a vapor line.
- to the engine when the EVAP canister purge valve is opened by the PCM.

The fuel tank pressure (FTP) sensor:

- monitors the pressure levels in the fuel tank.
- communicates the pressure reading to the PCM during the OBD II leak test.

The evaporative emissions (EVAP) canister:

- is located above the spare tire carrier behind the fuel tank.
- contains activated carbon.
- stores fuel vapors.

The fuel tank filler cap:

- relieves system pressure above 14 kPa (56.21 inches H_2O).
- relieves system vacuum below 3.8 kPa (15.26 inches H_2O).

The canister vent solenoid:

- is normally open.
- seals the evaporative emissions system for the OBD II leak and pressure tests.

- is mounted to the evaporative emissions canister.
- is repaired as a separate item.

The evaporative emissions (EVAP) canister purge valve:

- is normally closed.
- regulates the purging of the EVAP canister.
- is controlled by the PCM.

The evaporative emissions (EVAP) system test port:

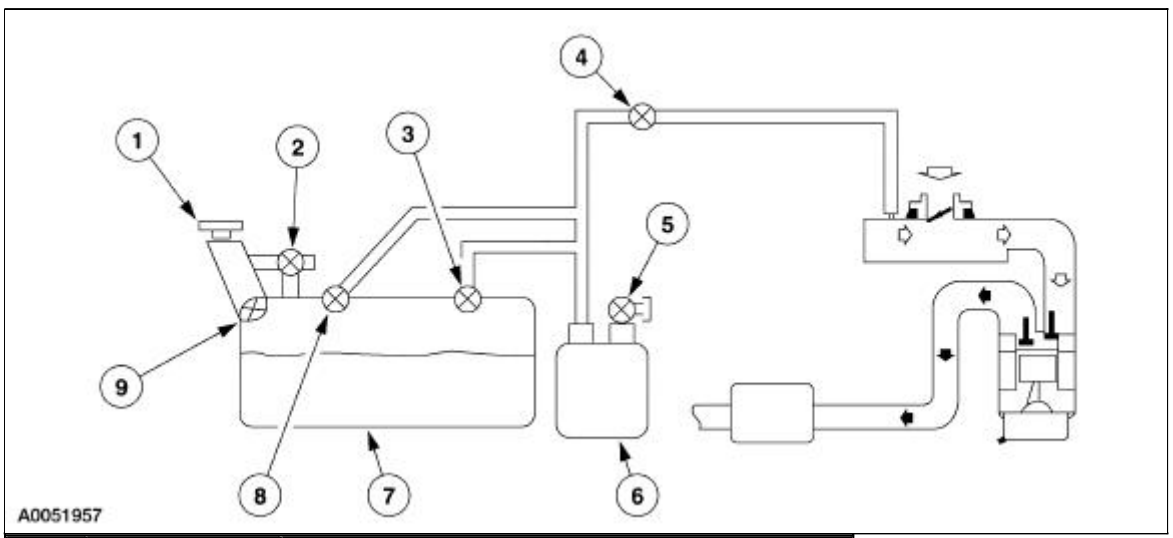
- is located in the EVAP canister purge valve.
- is used to connect the Evaporative Emissions System Leak Tester to the EVAP system.

Evaporative Emissions

Special Tool(s)

 ST2116-A	Evaporative Emission System Leak Tester 310-F007 (134-00056) or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418–F224, New Generation STAR (NGS) Tester 418–F052, or equivalent scan tool

Evaporative Emission System



Item	Part Number	Description
1	9030	Fuel filler cap
2	9C052	Fuel tank pressure sensor
3	9B593	Fuel vapor vent valve
4	9C915	Evaporative emission canister purge valve
5	9F945	Canister vent solenoid
6	9D653	Evaporative emission canister
7	9002	Fuel tank
8	9B593	Fuel vapor vent valve
9	9189	Fuel filler pipe check valve

Principles of Operation

Evaporative Emissions (EVAP) Canister Purge Valve

The EVAP canister purge valve is controlled by the powertrain control module (PCM). The EVAP canister purge valve controls the flow of fuel vapors from the EVAP canister to the engine intake manifold during various engine-operating modes. The EVAP canister purge valve is normally closed.

Evaporative Emission (EVAP) Canister

Fuel vapors from the fuel tank are stored in the EVAP canister. When the engine is running, the vapors are purged from the EVAP canister for combustion.

Canister Vent Solenoid

During the Evaporative Emission Running Loss System Monitor Test, Evaporative Emissions Repair Verification Drive Cycle and the Evaporative Emission System Leak Test the canister vent solenoid is closed to allow either a vacuum to be drawn on the fuel tank or to hold a specified pressure in the system. The canister vent solenoid is normally open.

Fuel Tank Pressure (FTP) Sensor

The fuel tank pressure sensor is used to measure the fuel tank pressure during the Evaporative Emissions Monitor Test. It is also used to control excessive fuel tank pressures by forcing the system to purge. The FTP sensor is mounted on the tank vent hose.

Fuel Vapor Vent (FVV) Valve Assembly

The fuel vapor vent (FVV) valve assembly is mounted on the top of the fuel tank. It is used to control the flow of fuel vapors entering the EVAP system. The head portion of the assembly prevents the fuel tank from overfilling during refueling. The assembly also has a spring float, which prevents liquid fuel from entering the vapor delivery system under severe handling or vehicle rollover conditions. In the upright position the open bottom of the float will lift and shut off the orifice. Under severe handling conditions, the spring will push the float closed when angles allow liquid fuel to reach the orifice. In a rollover condition the weight of the open bottom float and spring pressure will close the orifice.

Fuel Filler Pipe Check Valve

The fuel filler pipe check valve is an intricate part of the fuel tank. It is intended to prevent liquid fuel from re-entering the fuel filler pipe from the fuel tank on refueling or rollover conditions.

Fuel Filler Cap

The fuel filler cap is used to prevent fuel spill and to close the EVAP system to the atmosphere.

Evaporative Emissions System Monitor

When a fault occurs, the EVAP System Monitor is reset to NO and a diagnostic trouble code (DTC) is set in the PCM memory. After the DTC is repaired the vehicle drive cycle must be completed to reset the monitor in preparation for inspection and maintenance testing.

EVAP Running Loss System Test

To start the testing, conditions of stable purging and vehicle speed must be satisfied. During the first stage, the EVAP canister vent solenoid is closed while the EVAP canister purge valve remains open, applying and building vacuum in the system as indicated by the FTP sensor. This phase checks for major leaks in the EVAP system.

In the second stage, the EVAP canister purge valve closes and the system looks for minimal decay

rate in the EVAP vacuum, indicating the absence of any small EVAP system leaks.

The last stage is entered only if stage two of the leak test has failed and checks whether the failed test was due to excess vapor generation. It monitors fuel vapor generation rate. Initially the canister vent solenoid is opened to equalize EVAP system pressure to atmosphere. Then the canister vent solenoid is closed allowing pressure to build, if vapor generation is present in sufficient quantity. If the rate of generation is found to be too high, the EVAP running loss system leak test is aborted. If not, then a small leak is diagnosed.

Inspection and Verification

1. Verify the customer concern is with the evaporative emission (EVAP) system.

2. Visually inspect for the following obvious signs of mechanical damage.

Visual Inspection Chart

Mechanical
● Fuel filler cap ● EVAP test port ● EVAP canister or vent solenoid ● EVAP lines or hoses ● Vacuum lines or hoses

3. If the concern remains after the inspection, connect the scan tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the scan tool menu. If the scan tool does not communicate with the vehicle:

- check that the program card is correctly installed.
- check the connections to the vehicle.
- check the ignition switch position.

4. If the scan tool still does not communicate with the vehicle, refer to the scan tool manual.

5. Carry out the DATA LINK DIAGNOSTICS test. If the scan tool responds with:

- CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
- NO RESP/NOT EQUIP for PCM, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
- SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out the PCM KOEO self-test.

6. If the DTCs retrieved are related to the concern, go to the PCM Diagnostic Trouble Code (DTC) Index to continue diagnostics.

7. If the concern remains after the inspection, determine the symptom. GO to Symptom Chart .

PCM Diagnostics Trouble Code (DTC) Index

DTC	Description	Source	Action

P0442	Small Leak Detected in EVAP System (as small as 1.02 mm (0.040 inch).	PCM	Go To Pinpoint Test A .
P0455	Major Leak or No Flow Detected.	PCM	Go To Pinpoint Test B .
P0456	Very Small Leak Detected in EVAP System (as small as 0.51 mm (0.02 in) .	PCM	Go To Pinpoint Test A
P0457	Loose or Missing Fuel Cap.	PCM	Go To Pinpoint Test A
P1443	Very Small or No Purge Flow Detected.	PCM	Go To Pinpoint Test B .
P1450	Excessive Vacuum Detected in the Fuel Tank.	PCM	Go To Pinpoint Test C .
—	Any Other PCM DTC.	PCM	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Symptom Chart

SYMPTOM CHART

Condition	Possible Sources	Action
● Hiss when opening fuel cap	● Canister vent solenoid. ● Evaporative emissions canister. ● EVAP canister tube. ● EVAP canister purge outlet tube.	● Go To Pinpoint Test D .
● Excessive fuel odor	● Canister vent solenoid. ● Evaporative emissions canister. ● Evaporative emissions test port. ● EVAP canister purge outlet tube.	● Go To Pinpoint Test E .

Pinpoint Tests

PINPOINT TEST A: DTC P0442 SMALL LEAK IN EVAP SYSTEM, DTC P0456 VERY SMALL LEAK IN EVAP SYSTEM, DTC P0457 FUEL CAP LOOSE OR MISSING

Test Step	Result / Action to Take
A1 VISUALLY INSPECT THE COMPONENTS FOR SMALL LEAKS ● Check for the presence of a fuel filler cap. Do not tighten or check for correct installation at this time. ● Verify the canister vent solenoid is correctly seated on the EVAP canister. ● Check for cut or loose	**Yes** REPAIR or INSTALL new components as necessary. GO to A2 . **No** GO to A2 .

connections to fuel vapor hoses, tubes and connections in the following locations: ● EVAP canister to EVAP canister purge valve ● EVAP canister to fuel vapor vent valve assembly ● Check the fuel filler pipe for damage. ● **Is a concern with a hose, tube, connection or valve visually evident?**	
A2 CHECK AT THE EVAP TEST PORT FOR SMALL SYSTEM LEAKS ● Disconnect and plug the evaporative emission return tube at the intake manifold. ● Complete the evaporative emission system leak test. Refer to Evaporative Emission System Leak Test in this section. ● **Does the system pass the leak test?**	**Yes** GO to A3 . **No** GO to A4 .
A3 VISUALLY INSPECT THE FUEL FILLER CAP ● Visually inspect the fuel filler cap for damage. ● **Is the fuel filler cap damaged?**	**Yes** INSTALL a new fuel filler cap. GO to A4 . **No** GO to A4 .
A4 CHECK FOR SMALL LEAKS AT THE FUEL FILLER CAP AND EVAP TEST PORT ● Connect the Evaporative Emission System Leak Tester to the fuel filler pipe. ● Key in ON position. ● Close the canister vent solenoid. Refer to Canister Vent Solenoid Closing Procedure in this section. ● Pressurize the EVAP system to 3.48 kPa (14 inches H_2O). ● Using the ultrasonic leak detector, check the fuel filler cap and EVAP test port for leaks. ● **Is a leak detected?**	**Yes** REPAIR or INSTALL new components as necessary. GO to A5 . **No** INSTALL the fuel filler cap. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emissions repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.
A5 CHECK FOR CONCERN OTHER THAN THE FUEL FILLER CAP ● Refer to previous test results. ● **Did the system pass the evaporative emission system leak test carried out in pinpoint test Step A2?**	**Yes** CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section. **No** INSTALL the fuel filler cap. GO to A6 .

A6 CHECK FOR SMALL LEAK WITH TESTER SET AT FILL POSITION • Connect the Evaporative Emission System Leak Tester to the EVAP test port. • Key in ON position. • Close the canister vent solenoid. Refer to Canister Vent Solenoid Closing Procedure in this section. • Turn the selector on the Evaporative Emission System Leak Tester to the FILL position. • Pressurize the EVAP system to 3.48 kPa (14 inches H_2O). • **Does the pressure on the EVAP system hold between 3.43 kPa and 3.53 kPa (13.80 inches and 14.20 inches H_2O)?**	**Yes** GO to A7. **No** DISCONTINUE pressurizing the system. GO to A8.
A7 CHECK FOR LEAKS IN THE COMPLETE EVAP SYSTEM • Connect the Evaporative Emission System Leak Tester to the EVAP test port. • Key in ON position. • Close the canister vent solenoid. Refer to Canister Vent Solenoid Closing Procedure in this section. • Pressurize the EVAP system to 3.48 kPa (14 inches H_2O). • Using the ultrasonic leak detector, check the following EVAP system locations: ◦ EVAP return tube to EVAP canister purge valve ◦ EVAP canister purge valve to EVAP canister—canister vent solenoid assembly ◦ EVAP canister — canister vent solenoid assembly to fuel tank ◦ Fuel filler cap and fuel filler tube • **Is a leak detected at EVAP return tube, EVAP canister purge outlet tube or EVAP canister tube or associated hose?**	**Yes** REPAIR or INSTALL new components as necessary. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emissions repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section. **No** DISCONTINUE pressurizing the system. GO to A8.
A8 CHECK FOR SMALL LEAK FROM THE EVAP RETURN TUBE TO THE EVAP CANISTER • Disconnect the fuel tank vapor tube (9C047) at the fuel vapor tee. Plug the opening in the tee. • Connect the Evaporative Emission System Leak Tester to the EVAP test port. • Key in ON position. • Close the canister vent solenoid. Refer to Canister Vent Solenoid	**Yes** REPAIR or INSTALL new components as necessary. REPEAT Step A6 to verify the repair. GO to A9. **No** OPEN the canister vent solenoid. GO to A9.

Closing Procedure in this section. • Pressurize the EVAP system to 3.48 kPa (14 inches H_2O). • Using the ultrasonic leak detector, check the EVAP system from the intake manifold to the EVAP canister vent solenoid. • **Is a leak detected?**	
A9 CHECK FOR SMALL LEAK BETWEEN FUEL TANK VAPOR TUBE (9C047) AND FUEL TANK FILLER PIPE • Connect the Evaporative Emission System Leak Tester to the fuel filler pipe. • Transfer the plug from the fuel vapor tee to the fuel tank vapor tube (9C047). • Turn the Evaporative Emission System Leak Tester selector to the FILL position. • Pressurize the EVAP system to 3.48 kPa (14 inches H_2O). • Using the ultrasonic leak detector, check the fuel tank vapor tube to the fuel tank for leaks. Check the fuel tank pressure sensor, fuel tank vapor tube and the fuel filler pipe. • **Is a leak detected?**	**Yes** REPAIR or INSTALL new components as necessary. GO to A10. **No** GO to A10.
A10 CHECK EVAP SYSTEM AT FUEL FILLER PIPE • Reconnect the fuel tank vapor tube (9C047) to the fuel vapor tee. • Complete the evaporative emission system leak test. Refer to Evaporative Emission System Leak Test in this section. • **Does the EVAP system pass the leak test?**	**Yes** RESTORE the system to normal operation. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emissions repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section. **No** GO to A6.

PINPOINT TEST B: DTC P0455 MAJOR LEAK OR NO FLOW DETECTED OR DTC P1443 VERY SMALL OR NO PURGE FLOW DETECTED IN SYSTEM

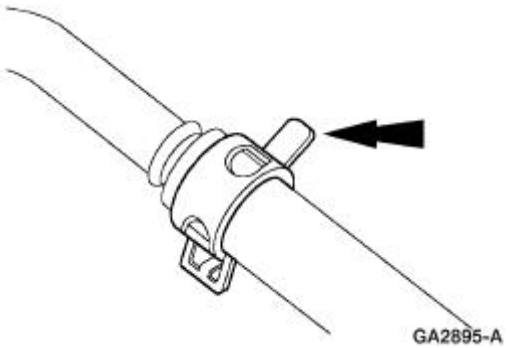
Test Step	Result / Action to Take
NOTE: Condition DTC P0455 set: –1.74 kPa (-7.0 inches H_2O) over 30 seconds.	
NOTE: Condition DTC P1443 set: –1.74 kPa (-7.0 inches H_2O) over 30 seconds with more than 0.02 lb/min. vapor flow.	
B1 CHECK FOR DIAGNOSTIC TROUBLE CODE P0455 OR	

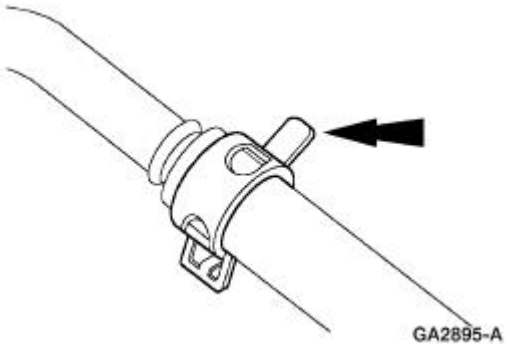
P1443 • Use the recorded results from the PCM DTCs. • **Is DTC P0455 present?**	**Yes** GO to B2 . **No** GO to B3 .
B2 VISUALLY CHECK FOR GROSS EVAP SYSTEM LEAKS • Check for the presence of a fuel filler cap. Do not tighten or check for correct installation at this time. • Check that the input port vacuum and EVAP return tube are connected to the EVAP canister purge valve. • Check that the canister vent solenoid is correctly attached to the EVAP canister. • Check for disconnected or cracked fuel vapor hoses or tubes between the intake manifold and following components: ◦ EVAP canister purge valve ◦ EVAP canister ◦ Fuel vapor vent valve assembly • Check for damaged fuel tank or fuel filler pipe. • **Is a concern with a hose, tube, connection or valve visually evident?**	**Yes** REPAIR or INSTALL new EVAP components as necessary. GO to B3 . **No** GO to B3 .
B3 CHECK FOR EVAP SYSTEM LEAKS • Disconnect the EVAP return tube from the intake manifold and plug the EVAP return tube. • Connect the Evaporative Emissions System Leak Tester to the EVAP test port. • Carry out the evaporative emissions system leak test. Refer to Evaporative Emission System Leak Test in this section. • **Does the system pressure stay above 1.99 kPa (8 inches H_2O)?**	**Yes** GO to B4 . **No** VERIFY that the fuel filler cap is installed correctly. REPAIR or INSTALL new components as necessary. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.
B4 CHECK FOR BLOCKAGE BETWEEN THE EVAP CANISTER PURGE VALVE AND FUEL VAPOR TEE • Key in ON position. • Close the canister vent	**Yes** GO to B5 .

solenoid. Refer to Canister Vent Solenoid Closing Procedure in this section. • Pressurize the EVAP system to 3.48 kPa (14 inches H_2O). • Open the canister vent solenoid. Refer to Canister Vent Solenoid Closing Procedure in this section. • **Does the pressure drop immediately?**	**No** INSTALL a new vapor line between the EVAP canister purge valve and the fuel vapor tee. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.
B5 CHECK FOR BLOCKAGE BETWEEN FUEL FILLER PIPE AND THE FUEL VAPOR TEE	
• Connect the Evaporative Emissions System Leak Tester to the fuel filler pipe. • Pressurize the EVAP system to 6.47 to 6.97 kPa (26 to 28 inches H_2O). • **Does the pressure drop immediately?**	**Yes** GO to B6. **No** INSTALL new fuel tank vapor line(s). REPEAT pinpoint test step B5 to verify the repair. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.
B6 CHECK FOR FAILED EVAP CANISTER PURGE VALVE OR FUEL TANK PRESSURE SENSOR	
• Use the recorded results from the PCM DTCs. • **Are DTC codes P0455 and P1443 present?**	**Yes** INSTALL a new EVAP canister purge valve. REFER to Evaporative Emission Canister Purge Valve in this section. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If no leak is detected, CARRY OUT the evaporative emissions repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section. **No** INSTALL a new fuel tank pressure sensor. REFER to Fuel Tank Pressure Sensor in this section. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY out the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.

PINPOINT TEST C: DTC P1450 EXCESSIVE VACUUM DETECTED IN THE FUEL TANK

Test Step	Result / Action to Take
NOTE: Condition P1450 DTC set: More than -1.79 kPa (-7.2 inches H_2O) over 30 seconds.	
C1 CHECK FOR VISUAL CAUSES OF EXCESSIVE	

FUEL TANK VACUUM ● Check for kinks or bends in the fuel vapor hoses and tubes. ● Visually check the EVAP canister inlet port, canister vent solenoid filter or outlet hose for contamination or foreign material. ● Check the canister vent solenoid for blockage or contamination. ● **Is a concern with a hose, tube, connection or component visually evident?**	**Yes** REMOVE any contamination or foreign material around fuel vapor hoses and tubes. REPAIR the hoses, tubes or components as necessary. After all visual concerns are repaired, GO to C2 . **No** GO to C2 .
C2 CHECK FOR BLOCKAGE BETWEEN EVAP TEST PORT AND CANISTER VENT SOLENOID ● Disconnect and plug the EVAP return tube at the intake manifold. ● Connect the Evaporative Emissions System Leak Tester to the EVAP test port. ● Pressurize the EVAP system to 3.48 kPa (14 inches H_2O). ● **Does the pressure drop immediately?**	**Yes** GO to C3 . **No** Go To Pinpoint Test D .
C3 CHECK FOR BLOCKAGE BETWEEN THE FUEL FILLER PIPE AND THE FUEL VAPOR TEE ● Connect the Evaporative Emission System Leak Tester to the fuel filler pipe. ● Pressurize the EVAP system to 3.48 kPa (14 inches H_2O). ● **Does the pressure drop immediately?**	**Yes** GO to C4 . **No** Go To Pinpoint Test D .
C4 CHECK FOR FUEL TANK PRESSURE SENSOR PID WITHOUT PRESSURE APPLIED ● Disconnect the EVAP canister outlet tube at the EVAP canister.  ● Key in ON position. ● Access PCM PID FTP V. ● Record the reading. ● **Is PID FTP V reading between 2.40 and 2.80 volts?**	**Yes** GO to C5 . **No** REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual to continue diagnosis.
C5 CHECK FOR STUCK OPEN EVAP CANISTER PURGE VALVE CONDITION AT IDLE ● Connect the EVAP canister outlet tube.	**Yes** INSTALL a new EVAP canister purge valve. REFER to Evaporative Emission Canister Purge Valve in this section. CARRY OUT an EVAP system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY

 ● Remove the plug from the EVAP return tube and reconnect the tube to the intake manifold. ● Verify that the fuel filler cap is correctly installed. ● Key in ON position. ● Access PCM PIDs FTP V and EVAPPDC. ● Start the engine and allow to idle. ● Monitor the FTP V and EVAPPDC PIDs. ● **When PID EVAPPDC is zero, is PID FTP V reading below 2.40 volts?**	OUT an evaporative emissions repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section. **No** CARRY OUT the EVAP system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emissions repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.

PINPOINT TEST D: HISS WHEN OPENING FUEL CAP

Test Step	Result / Action to Take
D1 TEST FOR EVAP CANISTER, CANISTER VENT SOLENOID AND CANISTER VENT HOSE ASSEMBLY BLOCKAGE	
● Connect the Evaporative Emission System Leak Tester to the fuel filler cap. ● Pressurize the EVAP system to 3.48 kPa (14 inches H_2O). ● **Does the pressure drop immediately?**	**Yes** The EVAP system has passed the EVAP canister and bracket assembly blockage test. GO to D6. **No** For vehicles equipped with a canister vent hose assembly, GO to D2. For vehicles equipped with a canister vent solenoid, GO to D3. For all others, GO to D4.
D2 TEST FOR CANISTER VENT HOSE ASSEMBLY BLOCKAGE	
● Disconnect the EVAP canister vent hose assembly from the EVAP canister. ● Connect the Evaporative Emission System Leak Tester to the fuel filler pipe. ● Pressurize the EVAP system to 3.48 kPa (14 inches H_2O). ● **Does the pressure drop immediately?**	**Yes** INSTALL a new EVAP canister vent solenoid vent hose assembly. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section. **No** GO to D4.
D3 TEST FOR CANISTER VENT SOLENOID BLOCKAGE	
● Remove the canister vent	**Yes** INSTALL a new canister vent solenoid. REFER to

solenoid from the EVAP canister. • Connect the Evaporative Emission System Leak Tester to the fuel filler pipe. • Pressurize the EVAP system to 3.48 kPa (14 inches H_2O). • **Does the pressure drop immediately?**	Evaporative Emission Canister Vent Solenoid in this section. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section. **No** GO to D4 .
D4 TEST FOR EVAP CANISTER BLOCKAGE • Disconnect the EVAP canister tube (from the fuel tank) at the F-fitting from the EVAP canister. • Connect the Evaporative Emission System Leak Tester to the fuel filler pipe. • Pressurize the EVAP system to 3.48 kPa (14 inches H_2O). • **Does the pressure drop immediately?**	**Yes** INSTALL a new EVAP canister. REFER to Evaporative Emission Canister in this section. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section. **No** GO to D5 .
D5 TEST FOR EVAP CANISTER TUBE OR FUEL VAPOR VENT VALVE ASSEMBLY BLOCKAGE • Disconnect the fuel vapor vent valve assembly from the EVAP canister tube. • Connect the Evaporative Emission System Leak Tester to the fuel filler pipe. • Pressurize the EVAP system to 3.48 kPa (14 inches H_2O). • **Does the pressure drop immediately?**	**Yes** INSTALL a new EVAP canister tube and/or fuel vapor tube (s) between the fuel tank and the EVAP canister and bracket assembly. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section. **No** INSTALL a new fuel vapor vent valve(s) or assembly. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.
D6 TEST FOR BLOCKAGE BETWEEN THE EVAP CANISTER PURGE VALVE AND THE FUEL TANK • Remove the fuel vapor hose (from the fuel tank) at the EVAP canister purge valve. • Connect the Evaporative Emission System Leak Tester to the fuel filler pipe. • Key in ON position. • For vehicles equipped with a canister vent solenoid, close the canister vent solenoid.	**Yes** The EVAP system has passed all the blockage tests. RECONNECT all components. For vehicles equipped with a canister vent solenoid, CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive

Refer to Canister Vent Solenoid Closing Procedure in this section. ● For vehicles without a canister vent solenoid, plug the canister vent hose assembly or plug the canister vent cap. ● Pressurize the EVAP system to 3.48 kPa (14 inches H_2O). ● **Does the pressure drop immediately?**	Cycle in this section. For vehicles without a canister vent solenoid, PLUG the canister vent hose assembly or the canister vent cap. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section. **No** INSTALL a new fuel vapor hose. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.

PINPOINT TEST E: EXCESSIVE FUEL ODOR

Test Step	Result / Action to Take
E1 TEST THE EVAPORATIVE EMISSION (EVAP) RUNNING LOSS SYSTEM MONITOR	
● Complete the evaporative emission repair verification drive cycle. Refer to Evaporative Emission Repair Verification Drive Cycle in this section. ● **Are PCM DTCs retrieved?**	**Yes** For DTC P0442, P0455, P1443 or P1450, REFER to the Diagnostic Trouble Code Index in this section. For all other DTCs, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of DTCs. **No** GO to E2.
E2 TEST FOR RESTRICTIONS IN THE EVAP SYSTEM FROM THE EVAPORATIVE EMISSION TEST PORT THROUGH THE CANISTER VENT SOLENOID	
● Connect the Evaporative Emission System Leak Tester to the evaporative emissions test port. ● Attempt to pressurize the EVAP system to 3.48 kPa (14 inches H_2O). ● **Does the pressure drop immediately?**	**Yes** CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section. GO to E3. **No** Go To Pinpoint Test D.
E3 TEST FOR A RESTRICTED TUBE BETWEEN THE FUEL TANK AND THE EVAPORATIVE EMISSION CANISTER	
● Connect the Evaporative Emission System Leak Tester to the fuel filler pipe. ● Attempt to pressurize the	**Yes** CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER

EVAP system to 3.48 kPa (14 inches H_2O). • **Does the pressure drop immediately?**	to Evaporative Emission Repair Verification Drive Cycle in this section. **No** GO to E4 .
E4 TEST FOR EVAP CANISTER TUBE OR FUEL VAPOR VENT VALVE ASSEMBLY BLOCKAGE	
• Disconnect the fuel vapor vent valve assembly from the EVAP canister tube. • Connect the EVAP System Leak Tester to the fuel filler pipe. • Pressurize the EVAP system to 3.48 kPa (14 inches H_2O). • **Does the pressure drop immediately?**	**Yes** INSTALL a new EVAP canister tube and/or fuel vapor tube (s) between the fuel tank and the EVAP canister and bracket assembly. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section. **No** INSTALL a new fuel vapor vent valve(s) or assembly. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.

Canister Vent Solenoid Closing Procedure

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

CAUTION: The canister vent solenoid must not be energized for more than nine minutes at one time. Once the canister vent solenoid is energized and de-energized, adequate time must be allowed for the component to cool adequately. Failure to allow the component to cool may create a false failure in the diagnostics, causing unnecessary repairs.

1. Connect the scan tool and select the output test mode.
2. If PID monitors are not active, select PIDs.
3. Select the fuel tank pressure (FTP) and the volts (V) parameter identification (PID) for monitoring.
4. Select the ALL OFF mode.
5. Close the canister vent solenoid by pushing the START button on the scan tool.

Evaporative Emission System Leak Test

Special Tool(s)

 ST2116-A	Evaporative Emission System Tester 310-F007 (134-00056) or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

CAUTION: The evaporative emission system must not be pressurized to more than 3.48 kPa (14 inches H_2O) or damage to the evaporative emission system may occur.

1. Connect the Evaporative Emission System Leak Tester to the evaporative emission test port.
2. Close the canister vent solenoid. For additional information, refer to Canister Vent Solenoid Closing Procedure in this section.
3. Pressurize the evaporative emission system to 3.48 kPa (14 inches H_2O).
4. Monitor the system for two minutes. The system fails the leak test if the pressure falls below 2.0 kPa (8 inches H_2O).
5. Repair any leaks as necessary.
6. Repeat the leak test until the system remains above 2.0 kPa (8 inches H_2O) after the two-minute test period.

Evaporative Emission Repair Verification Drive Cycle

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

Drive Cycle Recommendations

NOTE: The following procedure is designed to execute and complete the evaporative emission repair verification drive cycle and to clear the Ford P1000, inspection and maintenance (I/M) readiness code. When the ambient air temperature is below 4.4°C (40°F) or above 37.8°C (100°F), or the altitude is above 2,438 meters (8,000 feet), the EVAP monitor will not run. If the P1000 must be cleared in these conditions, the powertrain control module (PCM) must detect them once (twice on some applications) before the EVAP monitor can be bypassed and the P1000 cleared. The EVAP bypassing procedure is described in the following drive cycle.

1. Most OBD II monitors will complete more readily using a steady foot driving style during cruise or acceleration modes. Operating the throttle in a smooth fashion will minimize the time necessary for monitor completion.

2. Fuel tank level should be between one-half and three-quarters full with three-quarters full being the most desirable.

3. The evaporative monitor can only operate during the first 30 minutes of engine operation. When executing the procedure for this monitor, stay in part throttle mode and drive in a smooth fashion to minimize fuel slosh.

Drive Cycle Preparation

NOTE: For best results, follow each of the following steps as accurately as possible.

4. **NOTE:** This step bypasses the engine soak timer and resets OBD II monitor status.

   Install the scan tool. Turn the key ON with the engine OFF. Cycle the key off, then on. Select the appropriate vehicle and engine qualifier. Clear all diagnostic trouble codes (DTCs) and carry out a PCM reset.

5. Begin to monitor the following PIDs: ECT, EVAPDC, FLI (if available) and TP MODE. Press Diagnostic Data Link, PCM, PID/Data monitor and record, press trigger to select each PID, then start.

6. Start the engine without returning the key to the OFF position.

Preparation for Monitor Entry

WARNING: Strict observance of posted speed limits and attention to driving conditions

are mandatory when proceeding through the following drive cycle.

7. **NOTE:** This step allows engine warm-up and provides intake air temperature (IAT) input to the PCM.

   Idle the vehicle for 15 seconds. Drive at 64 km/h (40 mph) until the ECT is at least 76.7°C (170° F).

8. Is IAT above 4.4°C (40°F) and below 37.8°C (100°F)? If not, continue with the following steps but note that the EVAP Monitor Bypass portion of the drive cycle (Step 13) will be required to bypass the EVAP monitor and clear the P1000.

9. **NOTE:** This step executes the heated oxygen sensor (HO2S) monitor.

   Cruise at 64 km/h (40 mph) for 60 seconds.

10. **NOTE:** This executes the EVAP monitor if IAT is above 4.4°C (40°F) and below 37.8°C (100°F).

    NOTE: To initiate the monitor, TP MODE should equal PT, EVAPDC must be greater than 75%, and FLI must be between 15 and 85%.

    NOTE: Avoid sharp turns and hills.

    Cruise at 72 to 104 km/h (45 to 65 mph) for 10 minutes.

11. **NOTE:** This step executes the ISC portion of the Secondary Air/CCM.

    Bring the vehicle to a stop. Idle with the transmission in DRIVE (for automatic transmission) or NEUTRAL (for manual transmission) for two minutes.

Pending Code and EVAP Monitor Bypass Check

12. **NOTE:** This determines if a pending code is preventing the clearing of P1000.

    NOTE: If the EVAP monitor is not complete and IAT was below 4.4°C (40°F) or above 37.8°C (100°F) temperature range in Step 8, or the altitude is above 2,438 meters (8,000 feet), the EVAP Monitor Bypass (Step 13) must be carried out.

    Using the scan tool, check for pending codes. Conduct normal repair procedures for any pending code concerns. Rerun any incomplete monitor.

EVAP Monitor Bypass

13. **NOTE:** This allows the bypass counter to increment to two.

    NOTE: Do not repeat Step 4.

    Park the vehicle for a minimum of eight hours. Repeat Steps 5 through 12.

Evaporative Emission Canister

Material

Item	Specification
MERPOL® —	ESE-M99B144-B

Removal and Installation

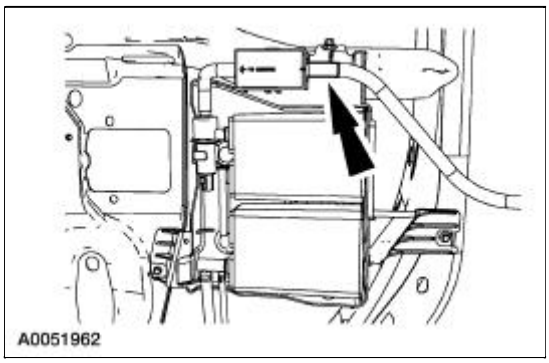
1. **WARNING: The evaporative emissions system contains fuel vapor and condensed fuel vapor. Although not present in large quantities, it still presents the danger of explosion or fire. Disconnect the battery ground cable from the battery to minimize the possibility of an electrical spark occurring, possibly causing a fire or explosion if fuel vapor or liquid fuel are present in the area.**

   Disconnect the battery ground cable.

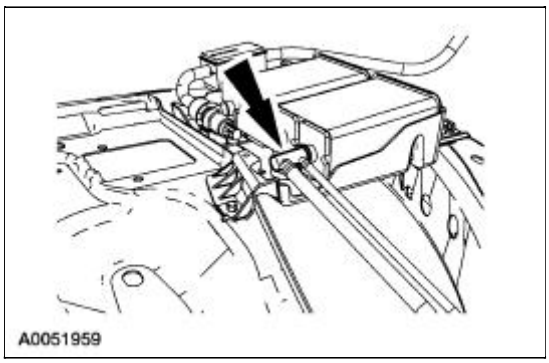
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .

3. Remove the spare tire.

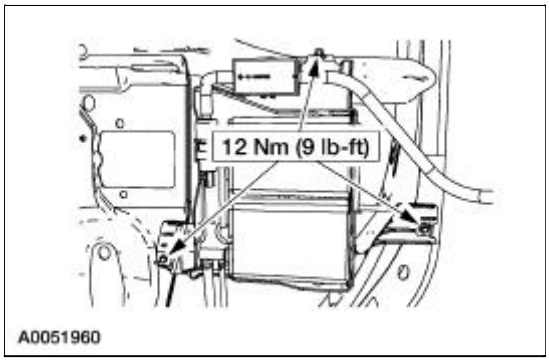
4. Disconnect the fuel filler pipe remote vapor hose.



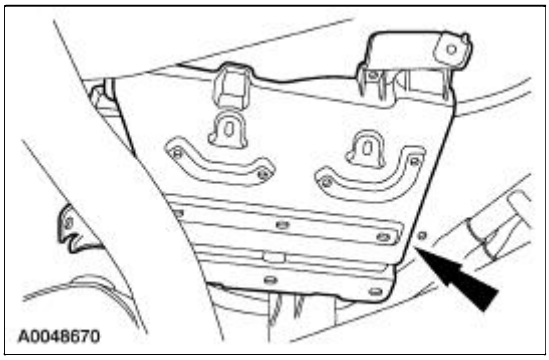
5. Disconnect the fuel vapor hoses from the evaporative emissions (EVAP) canister.



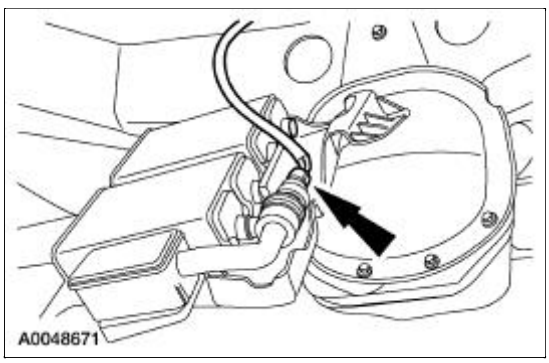
6. Remove the canister assembly mounting bolts.



7. Remove the EVAP canister bracket assembly.

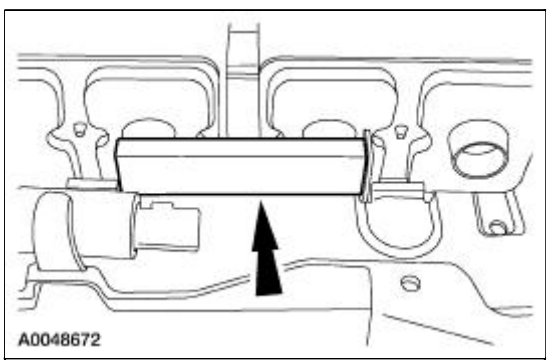


8. Disconnect the EVAP canister vent solenoid electrical connector.

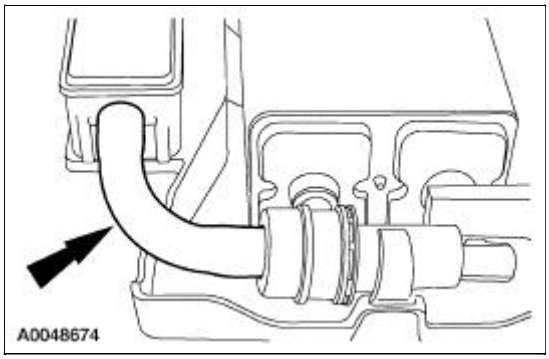


9. Place the EVAP canister bracket assembly on a clean work surface.

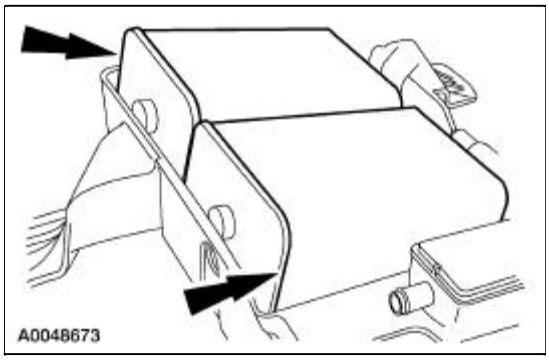
10. Remove the vapor connector sleeve.



11. Disconnect the vapor hose from the EVAP canister vent solenoid.



12. Remove the EVAP canisters.



13. **NOTE:** Lubricate the O-rings with MERPOL®.

To install, reverse the removal procedure.

- Leak test the system. For additional information, refer to Evaporative Emission System Leak Test in this section.
- Carry out the evaporative emissions repair verification drive cycle. For additional information, refer to Evaporative Emission Repair Verification Drive Cycle in this section.

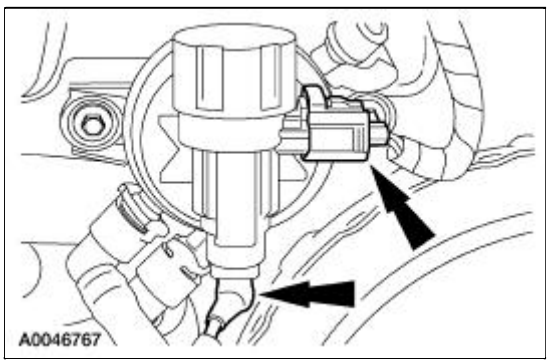
Evaporative Emission Canister Purge Valve

Removal and Installation

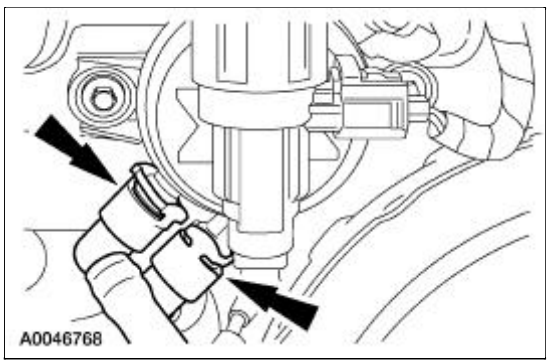
1. **WARNING: The evaporative emissions system contains fuel vapor and condensed fuel vapor. Although not present in large quantities, it still presents the danger of explosion or fire. Disconnect the battery ground cable from the battery to minimize the possibility of an electrical spark occurring, possibly causing a fire or explosion if fuel vapor or liquid fuel are present in the area.**

   Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

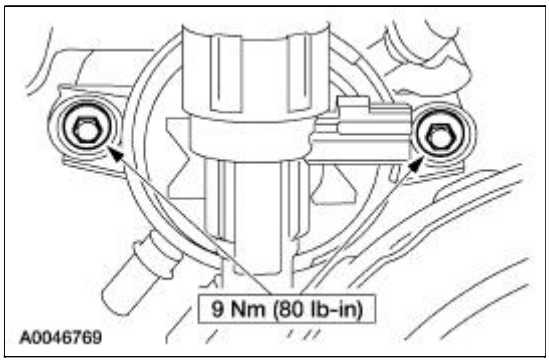
2. Disconnect the EVAP canister purge solenoid electrical connector and the vacuum hose.



3. Disconnect the two fuel vapor tubes.



4. Remove the bolts and the solenoid.

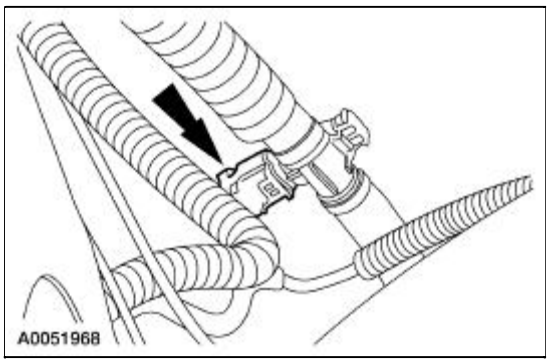


5. To install, reverse the removal procedure.
    - Leak Test the system. For additional information, refer to Evaporative Emission System Leak Test in this section.
    - Carry out the evaporative emissions repair verification drive cycle. For additional information, refer to Evaporative Emission Repair Verification Drive Cycle in this section.

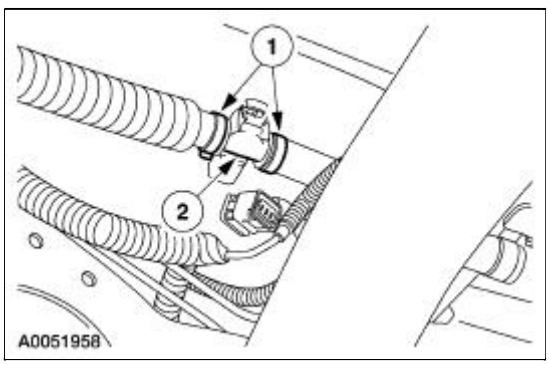
Fuel Tank Pressure Sensor

Removal and Installation

1. Remove the fuel tank. For additional information, refer to Section 310-01 .
2. Disconnect the fuel tank pressure sensor (FTP) electrical connector.



3. Remove the fuel tank pressure sensor:
   1. Remove the clamps.
   2. Remove the fuel tank pressure sensor.



4. To install, reverse the removal procedure.
   - Leak test the system. For additional information, refer to Evaporative Emission System Leak Test in this section.
   - Carry out the evaporative emission repair verification drive cycle. For additional information, refer to Evaporative Emission Repair Verification Drive Cycle in this section.

Evaporative Emission Canister Vent Solenoid

Material

Item	Specification
MERPOL® —	ESE-M99B144-B

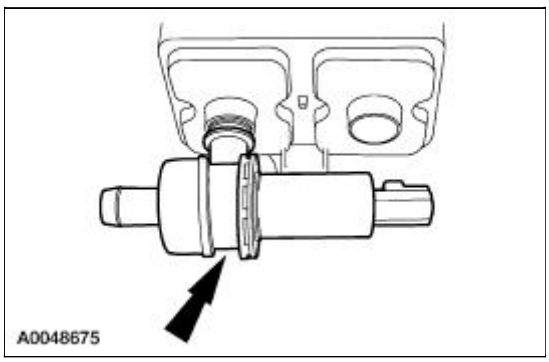
Removal and Installation

1. Remove the evaporative emissions canister. For additional information, refer to Evaporative Emission Canister in this section.

2. **NOTE:** Inspect and install a new O-ring as necessary.

   NOTE: A twisting and pulling motion is required to remove the canister vent solenoid.

   Remove the evaporative emissions canister vent solenoid.



3. **NOTE:** Lubricate the O-rings with MERPOL®.

   To install, reverse the removal procedure.

   - Carry out the evaporative emission system leak test. For additional information, refer to Evaporative Emission System Leak Test in this section.
   - Carry out the evaporative emissions repair verification drive cycle. For additional information, refer to Evaporative Emission Repair Verification Drive Cycle in this section.

Torque Specifications

Description	Nm	lb-ft	lb-in
Accelerator splash shield bolts — 5.4L 4V	10	—	89
Accelerator splash shield bolts — 4.6L, 5.4L 2V	7	—	62
Cylinder head temperature (CHT) sensor	26	19	—
Engine coolant temperature (ECT) sensor	20	15	—
Heated oxygen sensor	46	34	—
Idle air control (IAC) valve bolts	a	a	a
Knock sensor (KS)	20	15	—
Powertrain control module (PCM) mounting bolts	7	—	62
PCM bracket mounting bolts to cowl	7	—	62
Camshaft position (CMP) sensor bolt	10	—	89
Mass air flow (MAF) sensor plate nuts	10	—	89
Crankshaft position (CKP) sensor bolt	10	—	89

[a] Refer to the procedure in this section.

Electronic Engine Controls

The electronic engine controls consist of the:

- powertrain control module (PCM)
- throttle position (TP) sensor
- idle air control (IAC) valve
- engine coolant temperature (ECT) sensor
- camshaft position
- camshaft position (CMP) sensor
- crankshaft position (CKP) sensor
- mass air flow (MAF) sensor
- intake air temperature (IAT) sensor
- heated oxygen sensor (HO2S)
- knock sensor (KS)
- vehicle speed sensor (VSS)
- cylinder head temperature (CHT) sensor

The PCM needs the following inputs to calibrate the engine correctly:

- camshaft position sensor (CMP)
- engine rpm
- engine coolant temperature
- amount of engine detonation
- crankshaft position
- air temperature
- throttle position
- cylinder head temperature
- mass air flow

The TP sensor:

- sends the PCM a signal indicating the throttle plate angle.
- is the main input to the PCM from the driver.

The IAC valve:

- controls bypass air around the throttle plate at low speeds.
- is controlled by the PCM.

The ECT sensor:

- sends the PCM a signal indicating engine temperature.
- resistance decreases as coolant temperature increases.

The CMP sensor:

- sends the PCM a signal indicating camshaft position used for fuel synchronization.

The CKP sensor:

- sends the PCM a signal indicating crankshaft position.
- is essential for calculating spark timing.

The MAF sensor:

- sends the PCM a signal indicating mass airflow rate of air entering the engine.

The IAT sensor:

- sends the PCM a signal indicating the temperature of the air entering the engine.
- resistance decreases as temperature increases.

The HO2S:

- has the ability to create a voltage signal dependent on exhaust oxygen content.
- provides feedback information to the PCM used to calculate fuel delivery.

The 4.6L KS is located in the lifter valley. The 5.4L has a unique linear KS located in the lifter valley.

- The KS sends a signal to the PCM indicating engine detonation.

The CHT sensor:

- is mounted into the wall of the cylinder head and is not connected to any coolant passages.
- sends a signal to the PCM indicating cylinder head temperature.
    - If the temperature exceeds 126°C (258°F) 5.4L, 130°C (265°F) 4.6L, the PCM disables four fuel injectors at a time. The PCM will alternate which four fuel injectors are disabled every 32 engine cycles. The four cylinders that are not being fuel injected act as air pumps to aid in cooling the engine.
    - If the temperature exceeds 154°C (310°F) 5.4L, 166°C (330°F) 4.6L, the PCM disables all of the fuel injectors until the engine temperature drops below 154°C (310°F) 5.4L, 153°C (308°F) 4.6L.

The VSS:

- is gear driven by the transmission.
- sends a signal to the PCM indicating vehicle speed. For additional information, refer to Section 307-01A R4100 and/or Section 307-01B 4R70W.

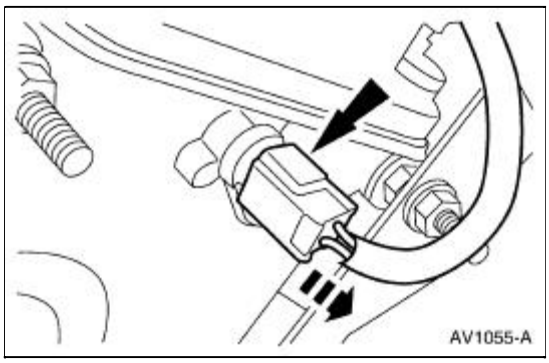
Electronic Engine Controls

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

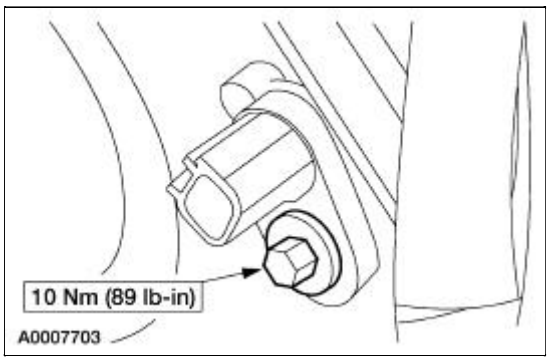
Camshaft Position (CMP) Sensor

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Disconnect the camshaft position (CMP) sensor electrical connector.



3. Remove the bolt and the CMP sensor.



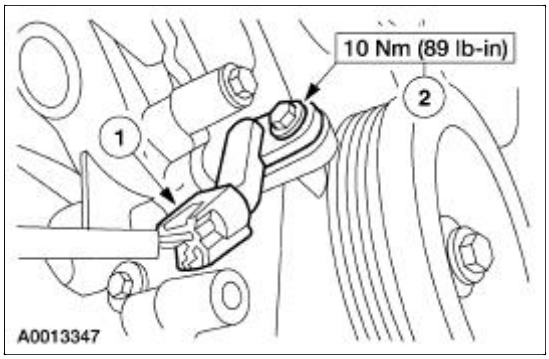
4. To install, reverse the removal procedure.

Crankshaft Position (CKP) Sensor

Removal and Installation

1. Remove the A/C compressor. For additional information, refer to Section 412-03A or Section 412-03B .

2. Remove the crankshaft position (CKP) sensor.
   1. Disconnect the electrical connector.
   2. Remove the bolt and the sensor.

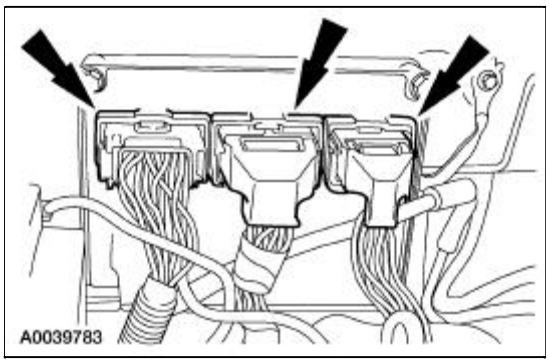


3. To install, reverse the removal procedure.

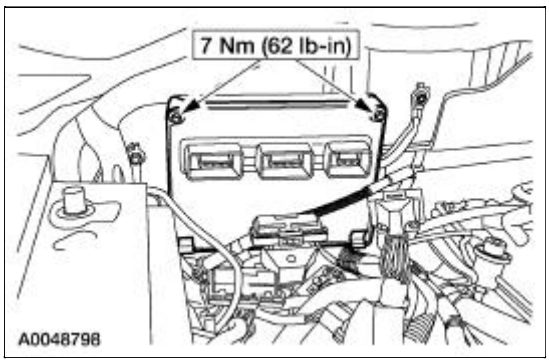
Powertrain Control Module (PCM)

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-00 .
2. Disconnect the powertrain control module (PCM) electrical connectors.



3. Remove the bolts and the PCM.



4. To install, reverse the removal procedure.

Throttle Position (TP) Sensor —4.6L and 5.4L (2V)

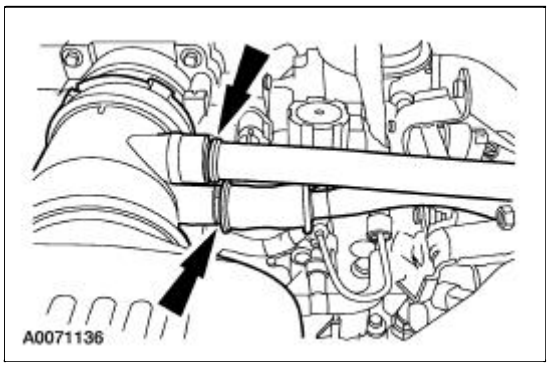
Removal and Installation

All vehicles

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

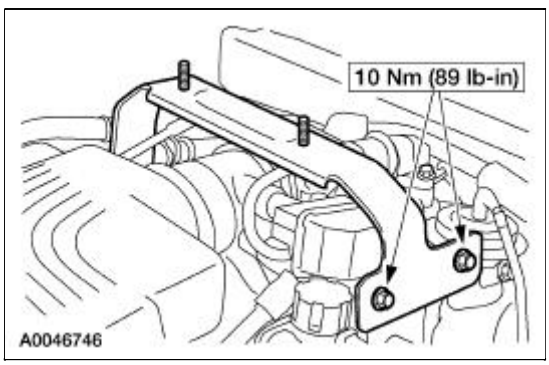
2. **NOTE:** 5.4L shown, 4.6L similar.

   Disconnect the engine breather hose and the idle air control (IAC) valve hose, and position aside.



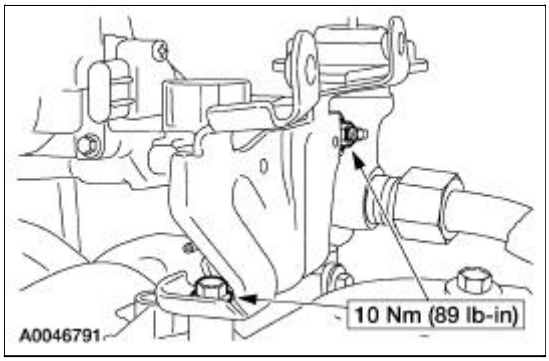
4.6L vehicles

3. Remove the engine appearance cover bolts and bracket.



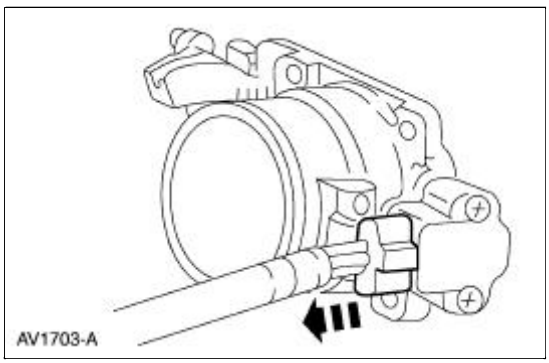
5.4L vehicles

4. Remove the differential pressure feedback exhaust gas recirculation (EGR) system bracket nut and bolt, and position the bracket aside.

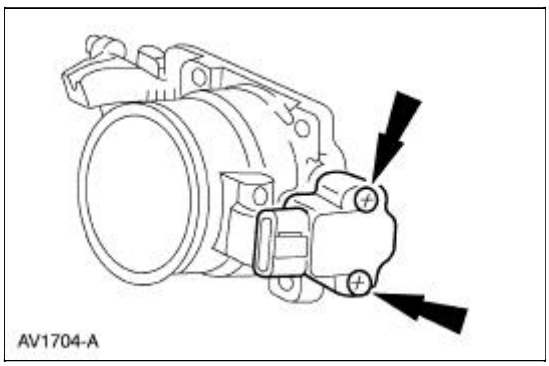


All vehicles

5. Disconnect the throttle position (TP) sensor electrical connector.



6. Remove the screws and the TP sensor.

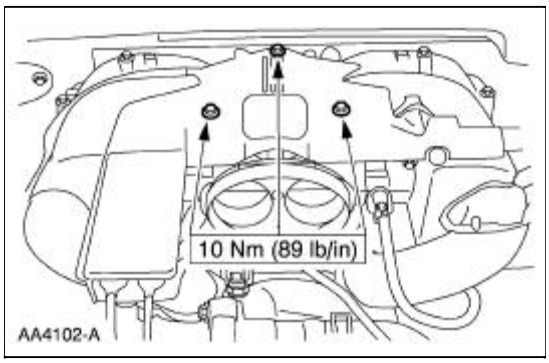


7. To install, reverse the removal procedure.

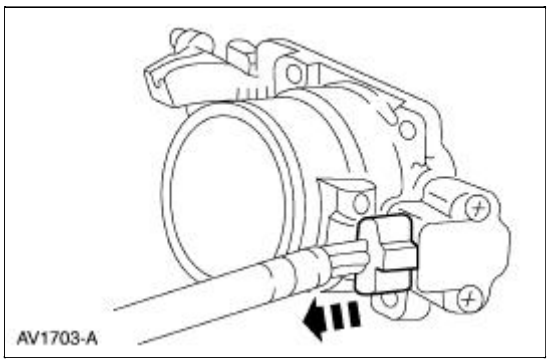
Throttle Position (TP) Sensor —5.4L (4V)

Removal and Installation

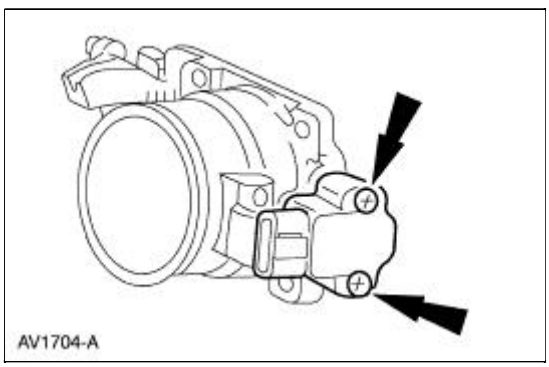
1. Disconnect the battery ground cable. For additional information, refer to Section 414-00 .
2. Remove the bolts and the accelerator splash shield.



3. Disconnect the throttle position (TP) sensor electrical connector.



4. Remove the screws and the TP sensor.

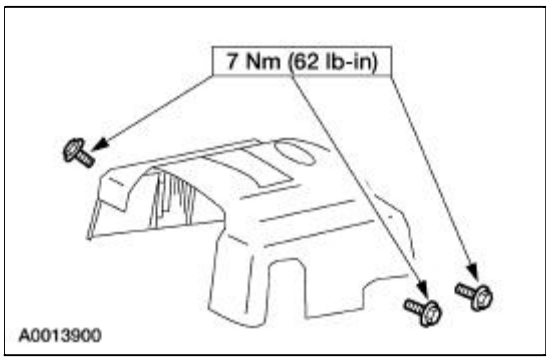


5. To install, reverse the removal procedure.

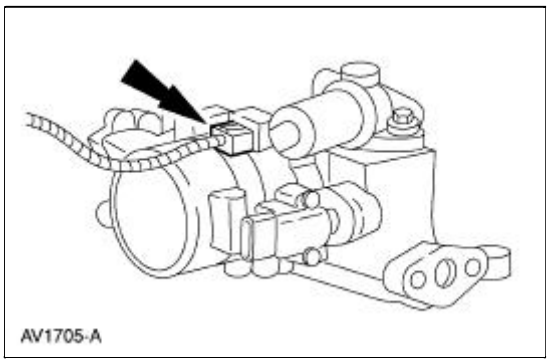
Idle Air Control (IAC) Valve —4.6L and 5.4L (2V)

Removal and Installation

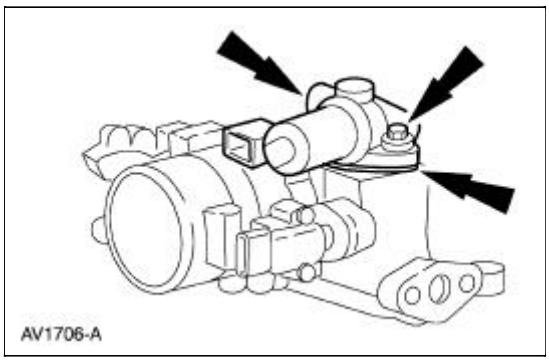
1. Disconnect the battery ground cable. For additional information, refer to Section 414-00 .
2. Remove the bolts and the accelerator splash shield.



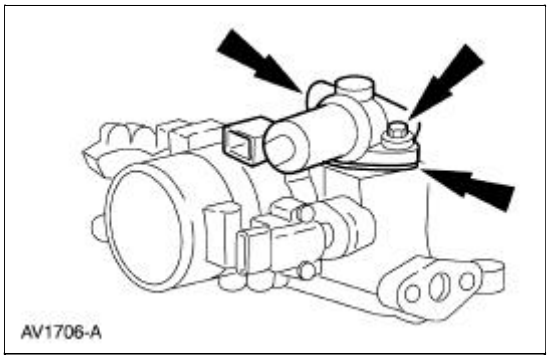
3. Disconnect the idle air control (IAC) valve electrical connector.



4. Remove the two bolts and the IAC valve.



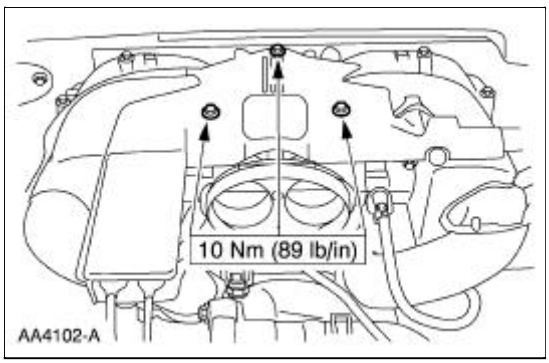
5. To install, reverse the removal procedure. Install a new IAC valve gasket. Tighten the two bolts in 2 stages.
   - Stage 1: Tighten to 10 Nm (89 lb-in).
   - Stage 2: Rotate 90 degrees.


AV1706-A

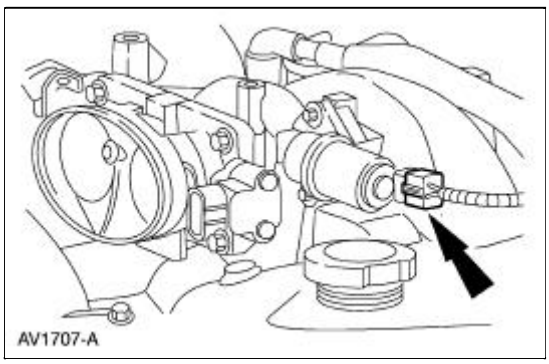
Idle Air Control (IAC) Valve —5.4L (4V)

Removal and Installation

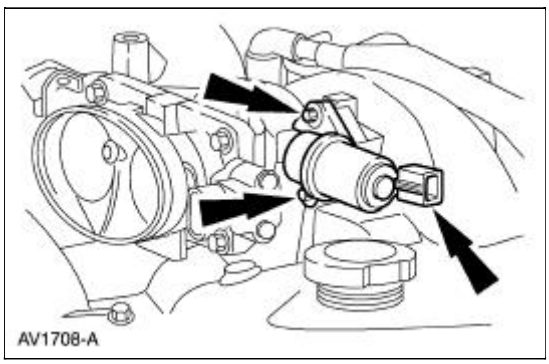
1. Remove the bolts and the accelerator control snow shield.



2. Disconnect the idle air control (IAC) valve electrical connector.



3. Remove the bolts, IAC valve and gasket.



4. To install, reverse the removal procedure. Install a new IAC gasket. Tighten the bolts in two stages.
    - Stage 1: Tighten to 10Nm (89 lb-in).
    - Stage 2: Rotate an additional 90 degrees.

Mass Air Flow (MAF) Sensor

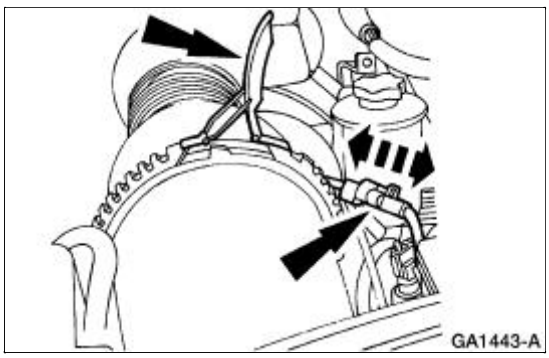
Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-00 .

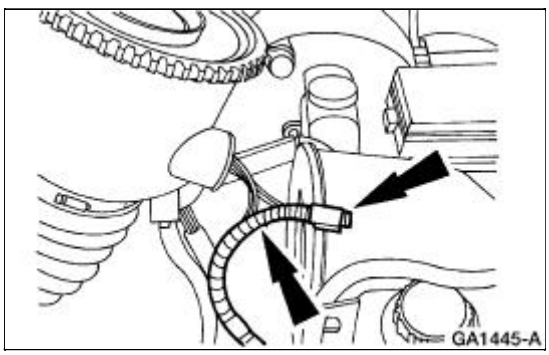
2. **CAUTION: Do not tamper with the sensing elements located in the mass air flow (MAF) sensor. Tampering may result in unit failure.**

   NOTE: The MAF sensor module and body are calibrated and serviced as a unit.

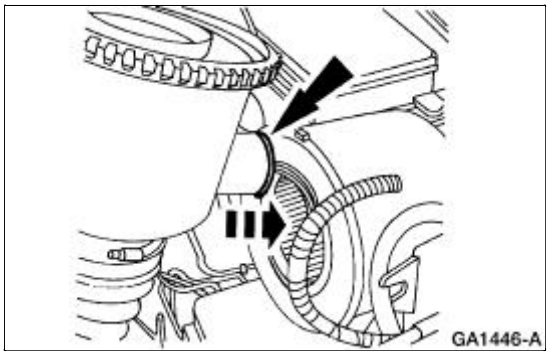
   Open the air cleaner.
   - Disconnect the MAF sensor extension harness connector from the wiring harness.
   - Release the air cleaner clamp.
   - Separate the inlet side of the air cleaner from the outlet side of the air cleaner.



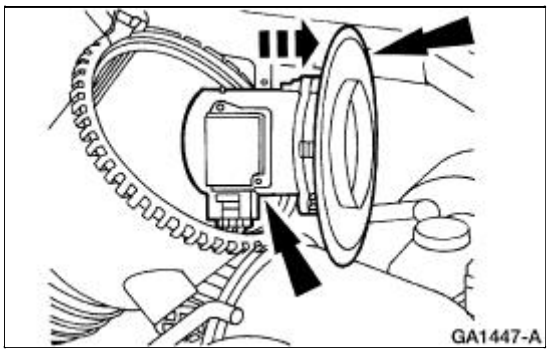
3. Cut the tape on the wire loom of the extension harness.
   - Peel back the wire loom from the extension harness near the grommet in the air cleaner.



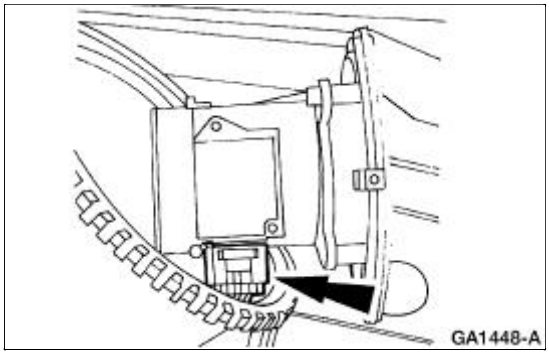
4. Remove the grommet from the outlet side of the air cleaner and slide the grommet down the extension harness.



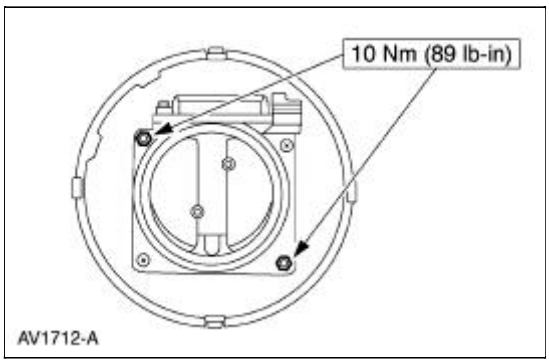
5. Remove the MAF sensor plate and the MAF sensor from the outlet side of the air cleaner.



6. Disconnect the MAF sensor electrical connector from the extension harness.



7. Separate the MAF sensor plate from the MAF sensor.
   - Remove the nuts from the MAF sensor plate.



8. **CAUTION: The grommet used to seal the engine air cleaner housing at the extension harness must be fully seated. Failure to do so will result in unmetered air entering the engine.**

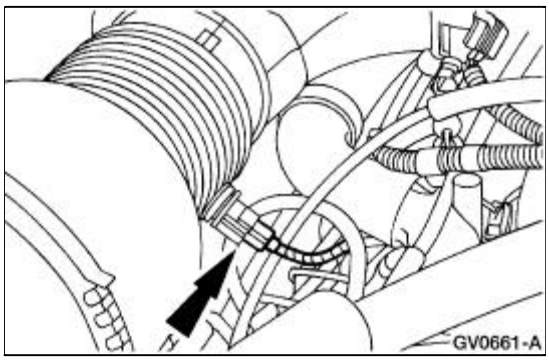
NOTE: Use the alignment notch to correctly align the inlet side and the outlet side of the air cleaner.

To install, reverse the removal procedure.

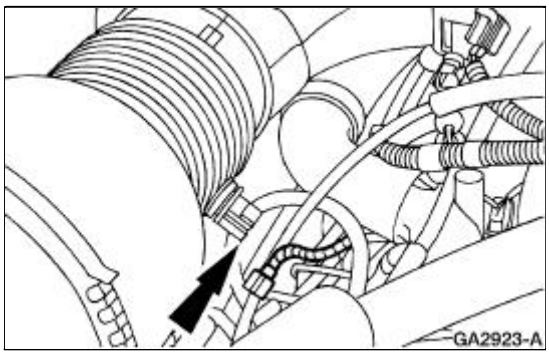
Intake Air Temperature (IAT) Sensor

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-00 .
2. Disconnect the intake air temperature (IAT) sensor electrical connector.



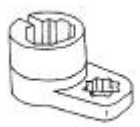
3. Remove the IAT sensor.



4. To install, reverse the removal procedure.

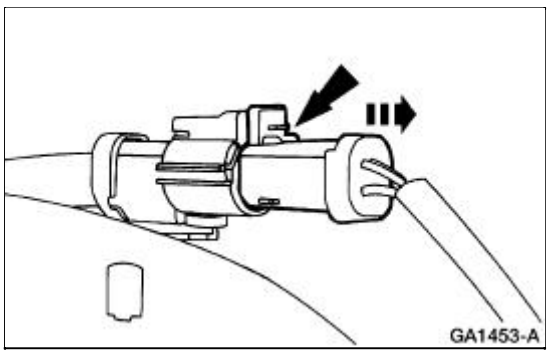
Heated Oxygen Sensor (HO2S)

Special Tool(s)

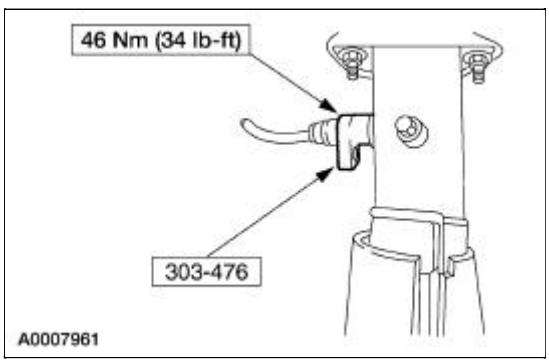
 ST1447-A	Socket, Exhaust Gas Oxygen Sensor 303-476 (T94P-9472-A)

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. Disconnect the heated oxygen sensor (HO2S) electrical connector.



4. Using the special tool, remove the HO2S.



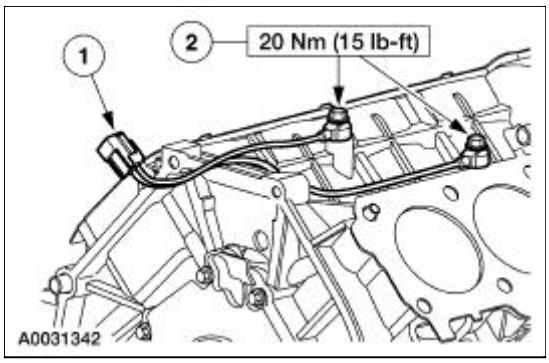
5. To install, reverse the removal procedure.

Knock Sensor (KS) —4.6L, 5.4L

Removal and Installation

1. Remove the intake manifold. For additional information, refer to Section 303-01A .

2. Remove the knock sensor (KS).
    1. Disconnect the electrical connector.
    2. Remove the bolts and the KS.

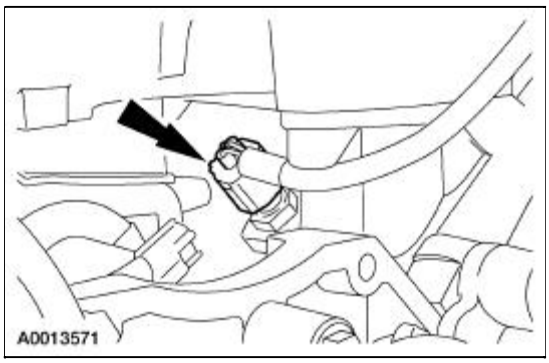


3. To install, reverse the removal procedure.

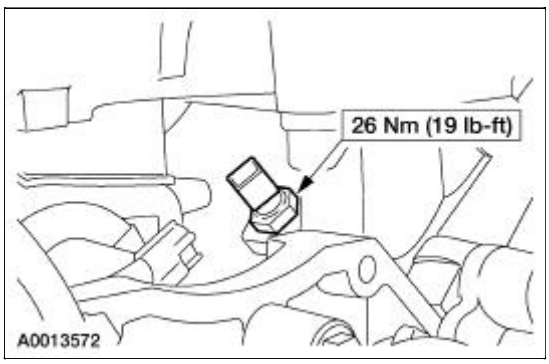
Cylinder Head Temperature (CHT) Sensor —4.6L and 5.4L (2V)

Removal and Installation

1. Remove the intake manifold. For additional information, refer to Section 303-01A .
2. Disconnect the cylinder head temperature (CHT) sensor.



3. Remove the CHT sensor.

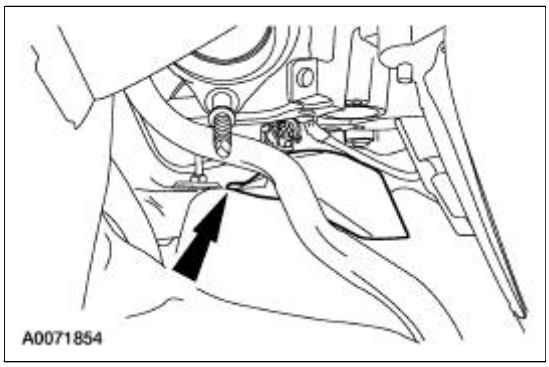


4. To install, reverse the removal procedure.

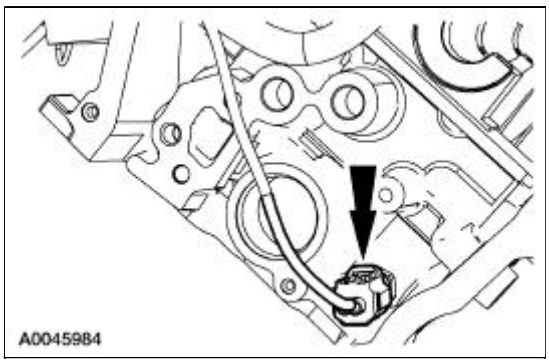
Cylinder Head Temperature (CHT) Sensor —5.4L (4V)

Removal and Installation

1. Drain the engine coolant. For additional information, refer to Section 303-03 .
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
3. Remove the RH catalytic converter. For additional information, refer to Section 309-00 .
4. Remove the air conditioning water deflector retainer and position the deflector aside.

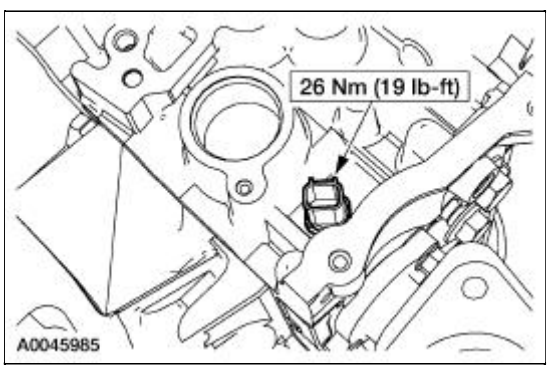


5. Disconnect the cylinder head temperature (CHT) sensor electrical connector.



6. **NOTE:** The CHT sensor is located at the back of the right side cylinder head.

   Remove the CHT sensor.



7. To install, reverse the removal procedure.

General Specifications

Item	Specification
Fluid [a]	
Motorcraft MERCON® Multipurpose (ATF) Transmission Fluid XT-2-QDX	MERCON®
Fluid Capacities [b]	
4R100 4x2	15.0L (15.9 Quarts) Approximately Dry Fill Capacity
4R100 4x4	15.5L (15.9 Quarts) Approximately Dry Fill Capacity
Fluid Filter	
Inline Transmission Fluid Filter Kit	XC3Z-7B155-AA
Inline Transmission Fluid Filter	XC3Z-7B155-BA
Lubricants	
Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A (Motorcraft WA-10)	ESE-M1C171-A
Multi-Purpose Grease D0AZ-19584-AA	ESB-M1C93-B

[a] CAUTION: Using a transmission fluid that indicates a dual usage MERCON ® and MERCON V® in a transmission application requiring MERCON®, may cause transmission damage. Use of any fluid other than the recommended fluid may cause transmission damage. NOTE: Refer to the transmission fluid level indicator and the Owner's Guide for the type of transmission fluid required. Some fluid labels may indicate dual usage such as MERCON® and MERCON V®. These dual-usage fluids are not to be used in transmissions that use only the MERCON®-type fluid. These dual-usage fluids may be used in transmissions that require MERCON V® use.

[b] The fluid capacities are approximate dry fill capacity and include fluid coolers and fluid cooler tubes. Fluid level indicator should be used to determine actual fluid requirement and fluid specifications. Check level at operating temperature. DO NOT OVERFILL. The transmission fluid should be changed every 30,000 miles (48,000 km) regardless of normal or special operating conditions.

Band/Clutch Application Chart A

	Friction Elements						
Gear	**Intermediate Band**	**Coast**	**Overdrive**	**Intermediate**	**Direct**	**Forward**	**Reverse**
(D) first	—	a b	—	—	—	apply	—
(D) second	—	ab	—	apply	—	apply	—
(D) third	—	ab	—	apply	apply	apply	—
(D) forth	—	—	apply	apply	apply	apply	—
1	—	apply	—	—	—	apply	apply
2	apply	apply	—	apply	—	apply	—
Reverse	—	apply	—	—	apply	—	apply

[a] In (D) range the transmission control switch pressed, the coast clutch is applied and the overdrive one-way clutch is bypassed.
[b] On certain applications in (D) range, the coast clutch solenoid and clutch is controlled by the PCM.

Band/Clutch Application Chart B

	One-Way Clutches					
	Overdrive		Intermediate		Low	
Gear	Drive	Coast	Drive	Coast	Drive	Coast
(D) first	HOLD	a b		—	HOLD	O/R
(D) second	HOLD	ab	HOLD	O/R	O/R	O/R
(D) third	HOLD	ab	O/R	O/R	O/R	O/R
(D) forth	O/R	O/R	O/R	O/R	O/R	O/R
1	HOLD	CC	—	—	HOLD	—
2	HOLD	CC	HOLD	BA	O/R	O/R
Reverse	HOLD	CC	O/R	O/R	—	—

[a] In (D) range the transmission control switch pressed, the coast clutch is applied and the overdrive one-way clutch is bypassed.
[b] On certain applications in (D) range, the coast clutch solenoid and clutch is controlled by the PCM.

O/R — Overrunning

CC — Coast Friction Clutch Applied

BA — Band Applied

Line Pressure Chart

	Line Pressure — Idle		Line Pressure — Stall	
Gear	kPa	PSI	kPa	PSI
P, N	345-448	50-65	—	—
R	483-690	70-100	1,689-2,000	245-290
(D), 2	345-448	50-65	1,138-1,276	165-185
1	483-690	70-100	1,270-1,448	175-210

Stall Speed

Engine	Min.	Max.
5.4L 2V	2,248	2,631
5.4L 4V	2,274	2,736
6.8L	1,894	2,252
7.3L DI Diesel	2,049	2,381

Shift Speed — Km/h (mph)

Throttle Opening	Range	Shift	Vehicle Speed [1] Axle Ratio 3.73
Closed Throttle	(D)	4-3	42-47 (26-29)
	(D), D	3-2	27-31 (17-19)
	(D), D	2-1	11-14 (7-9)
Light Throttle	(D), D	1-2	18-21 (11-13)
TP Voltage	(D), D	2-3	29-32 (18-20)
1.25 Volts	(D)	3-4	43-48 (27-30)
Wide Open Throttle	(D), D	1-2	72-79 (45-49)
	(D), D	2-3	125-137 (78-85)
	(D)	3-4	159-171 (99-106)
	(D)	4-3	148-159 (92-99)
	(D), D	3-2	114-122 (71-76)
	(D), D	2-1	60-64 (37-40)

[1] Nominal shift speed at sea level is shown. Actual shift speed will depend on tire size, brand and altitude.

Forward Clutch Pack

Clutch	Steel	Friction	Clearance mm (inch)	Selective Snap Rings	
				Part Number	Thickness
All	4 [a]	4	1.40-0.76 (0.055-0.030)	377437-S	1.42-1.52 (0.056-0.060)
				377127-S	1.87-1.98 (0.074-0.078)
				377444-S	2.33-2.43 (0.092-0.096)
				386841-S	2.79-2.89 (0.110-0.114)
				386842-S	3.25-3.35 (0.128-0.132)

[a] Plus a steel wave cushion spring installed between the front pressure plate and a steel separator plate.

Direct Clutch Pack

Clutch	Steel	Friction	Clearance mm (inch)	Selective Snap Rings	
				Part Number	Thickness
All	4	4	2.06-1.14 (0.081-0.045)	377128-S	2.20-2.10 (0.087-0.083)
				377127-S	1.18-1.87 (0.078-0.074)
				377126-S	1.75-1.65 (0.069-0.065)
				377437	15.24-1.42 (0.600-0.056)

Intermediate Clutch Pack

Clutch	Steel	Friction	Clearance mm (inch)	Selective Snap Rings	
				Part Number	Thickness

All	3	3		E9TP-7B421-BA [a]	1.80-1.90 (0.071-0.075)

[a] A non-selective snap ring.

Coast Clutch Pack

Clutch	Steel	Friction	Clearance mm (inch)	Selective Snap Rings	
				Part Number	Thickness
All	2	2	1.12-0.74 (0.044-0.029)	F81P-7N169-BA	1.90-1.80 (0.075-0.071)
				F81P-7N169-CA	1.65-1.54 (0.065-0.061)
				F81P-7N169-BA	1.37-1.27 (0.054-0.050)

Low/Reverse Clutch Pack

Clutch	Steel	Friction	Clearance mm (inch)	Selective Snap Rings	
				Part Number	Thickness
5.4L	5 [a]	5	2.90-0.30 (0.114-0.012)	N805207 [b]	1.87-1.98 (0.074-0.078) [b]

[a] Plus a steel wave cushion spring installed between the reverse clutch piston and a steel separator plate.

[b] A non-selective snap ring.

Overdrive Clutch Pack

Clutch	Steel	Friction	Clearance mm (inch)	Selective Snap Rings	
				Part Number	Thickness
All	3	3		E9TP-7B421-CA	2.59-2.48 (0.102-0.098)
			1.50-.84 (0.059-0.033)	E9TP-7B421-BA	2.057-1.95 (0.081-0.077)
				E9TP-7B421-AA	1.54-1.44 (0.061-0.057)

Torque Specifications

Description	Nm	lb-ft	lb-in
Intermediate/overdrive cylinder fluid feed bolts (front)	16	10	—
Center support feed bolts (two rear)	16	12	—
Front CBV fitting-to-case	30	22	—
Rear CBV fitting-to-case	37	27	—
Cooler line fittings-to-CBV	30	22	—
Control assembly-to-pump body bolts	28	21	—
Torque converter drain plug	25	18	—
Flexplate inspection cover bolts	35	26	—
Extension housing-to-case bolts	46	34	—
Transmission insulator and retainer-to-case bolts	98	72	—
Transmission insulator and retainer-to-crossmember nuts	95	70	—
Torque converter-to-flexplate nut	12	9	—
Heat shield-to-crossmember	15	11	—

Manual valve detent lever inner nut	48	35	—
Manual valve detent lever spring	10	—	89
Low/reverse OWC inner race to case	29	21	—
Line pressure to case plug	12	9	—
Main and lower control body to case	10	—	89
Main accumulator solenoid body to case	10	—	89
Digital transmission TR sensor	9	7	—
Transmission pan	15	11	—
Transmission pan drain plug	25	18	—
Pump body to case	28	21	—
Parking pawl abutment	25	18	—
Parking rod guide plate bolts	25	18	—
Reinforcing plate-to-case bolts	10	—	89
Stator to support-to-pump body bolts	27	20	—
Transmission-to-engine bolts	48	35	—
Transmission support crossmember to frame	90	66	—
Output shaft speed (OSS) sensor bolt	9	7	—
Turbine shaft speed (TSS) sensor bolt	9	7	—
Shift cable bracket	35	26	—
Fill tube bracket	12	9	—
Exhaust hanger bracket	40	30	—
Fuel line bracket	25	18	—

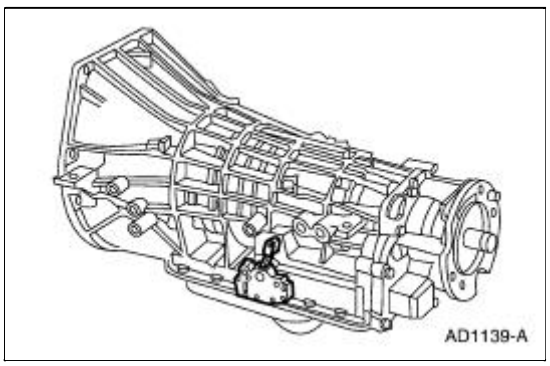
Transmission Description

The 4R100 features include:

- four speeds.
- fully automatic.
- electronically controlled.

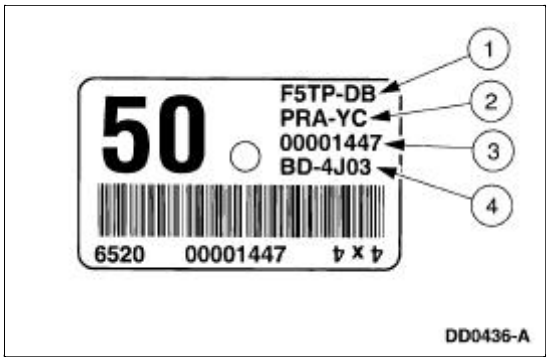
The main operating components include:

- Torque converter clutch.
- Six multiple-disc friction clutches.
- One band.
- One sprag one-way clutch.
- Two roller one-way clutches that provide for the desired function of three planetary gearsets.



Identification Tags

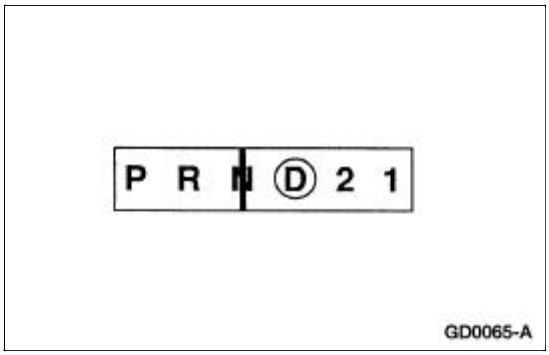
An identification tag is located on the left side of the transmission, rearward of the transmission range digital (TR) sensor.



Item	Description
1	Assembly part number prefix and suffix
2	Transmission model
3	Serial
4	Build date (year, month and day).

Range Selection

The transmission has six range positions: P, R, N, (D), 2 and 1.



Park

In the PARK position:

- there is no powerflow through the transmission.
- the parking pawl locks the output shaft to the case.
- the engine may be started.
- the ignition key may be removed.

Reverse

In the REVERSE position:

- the vehicle may be operated in a rearward direction, at a reduced gear ratio.

Neutral

In the NEUTRAL position:

- there is no powerflow through the transmission.
- the output shaft is not held and is free to turn.
- the engine may be started.

Overdrive

Overdrive is the normal position for most forward driving.

The OVERDRIVE position provides:

- automatic shifts.
- apply and release of the torque converter clutch.

- maximum fuel economy during normal operation.

Second Position

This position provides:

- second gear start and hold.
- the torque converter clutch to apply and release.
- improved traction and engine braking on slippery roads.

First Position

If this position is selected at normal road speeds, the transmission will shift into second gear, then into first when the vehicle reaches a speed within first gear range.

This position provides:

- first gear operation only.
- engine braking for descending steep grades.

Shift Patterns

Upshifts

NOTE: This vehicle has been equipped with a special cold weather shift strategy. This was designed to maximize heater output. This new strategy operates under the following conditions: ambient air temperature at start-up is -4°C (25°F) or below and the engine coolant temperature at start-up is 38°C (100°F) or below. During this condition, the vehicle may experience slightly delayed shifts under light throttle. Medium and heavy throttle shifts will be normal. Once the engine coolant reaches 71°C (160° F) or above, normal shift scheduling will resume. If, during the diagnosing of a delayed shift concern, the concern goes away after the engine coolant reaches 71°C (160°F) or above, this is a normal operation of the special cold weather shift strategy. If this condition does not go away after the engine coolant reaches 71°C (160°F), refer to Diagnosis By Symptom in this section.

NOTE: All gasoline vehicles will have new adaptive shift strategies. Whenever the vehicles battery has been disconnected for any type of service or repair, the strategy parameters that are stored in the keep alive memory (KAM) will be lost. The strategy will start to relearn once the battery is reconnected and the vehicle is driven. This is a temporary condition and will return to normal operating condition once the powertrain control module (PCM) relearns all the parameters from the driving operating conditions. There is no time frame set for this process. If this concern is present during downshifts or converter clutch apply, it is not the shift strategy and will require diagnosis as outlined in the workshop manual.

The customer must be notified that they may experience slightly different upshifts (either soft or firm) and that this condition is temporary and will eventually return to normal operating condition.

Transmission upshifting is controlled by the PCM. The PCM receives inputs from various engine or vehicle sensors and driver demands to control shift scheduling, shift feel and torque converter clutch (TCC) operation.

Downshifts

Under certain conditions the transmission will downshift automatically to a lower gear range (without moving the transmission range selector lever). There are three categories of automatic downshifts: Coastdown, Torque Demand and Forced or Kickdown shifts.

Coastdown

The coastdown downshift occurs when the vehicle is coasting down to a stop.

Torque Demand

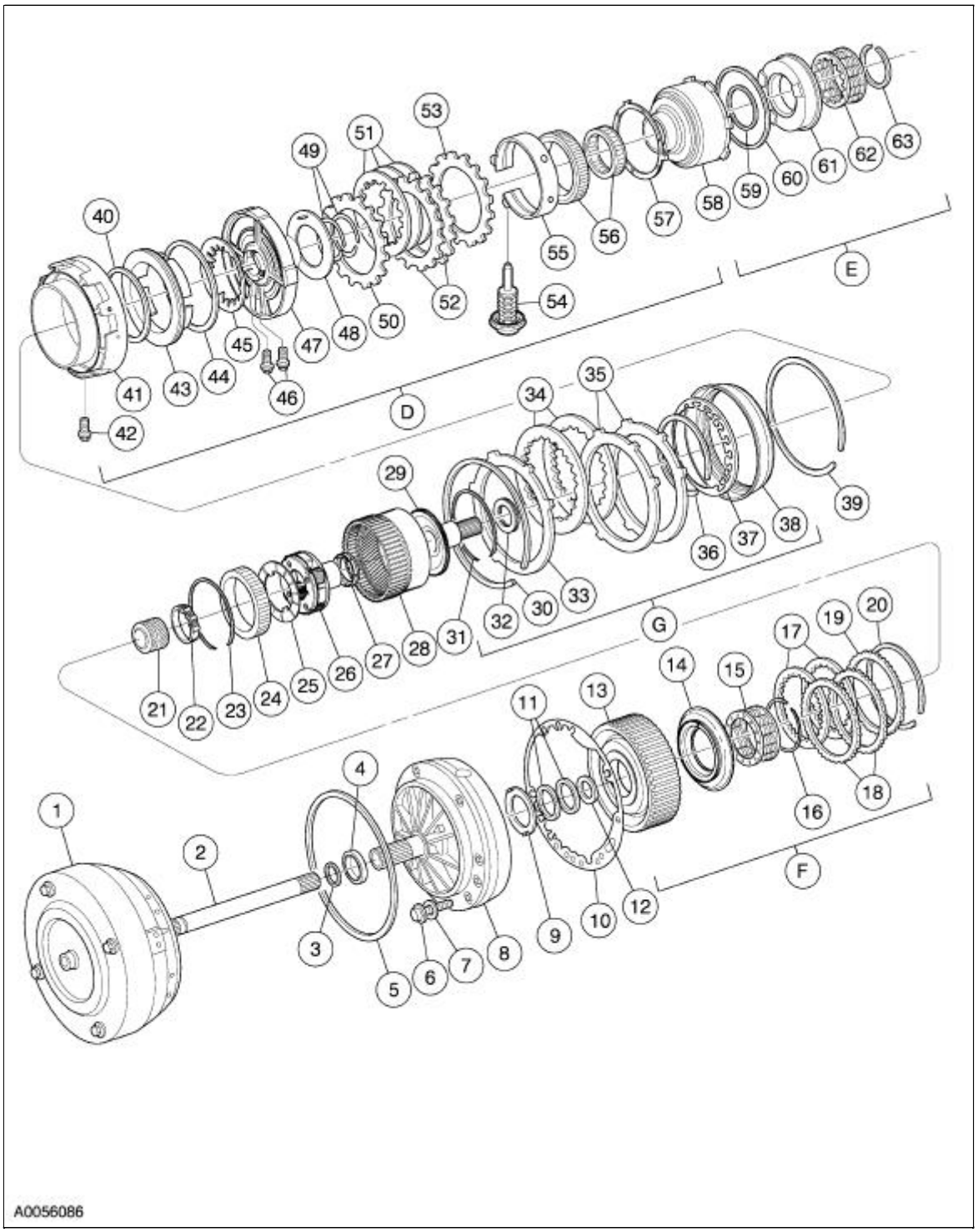
The torque demand downshift occurs (automatically) during part throttle acceleration when the demand for torque is greater than the engine can provide at that gear ratio.

Kickdown

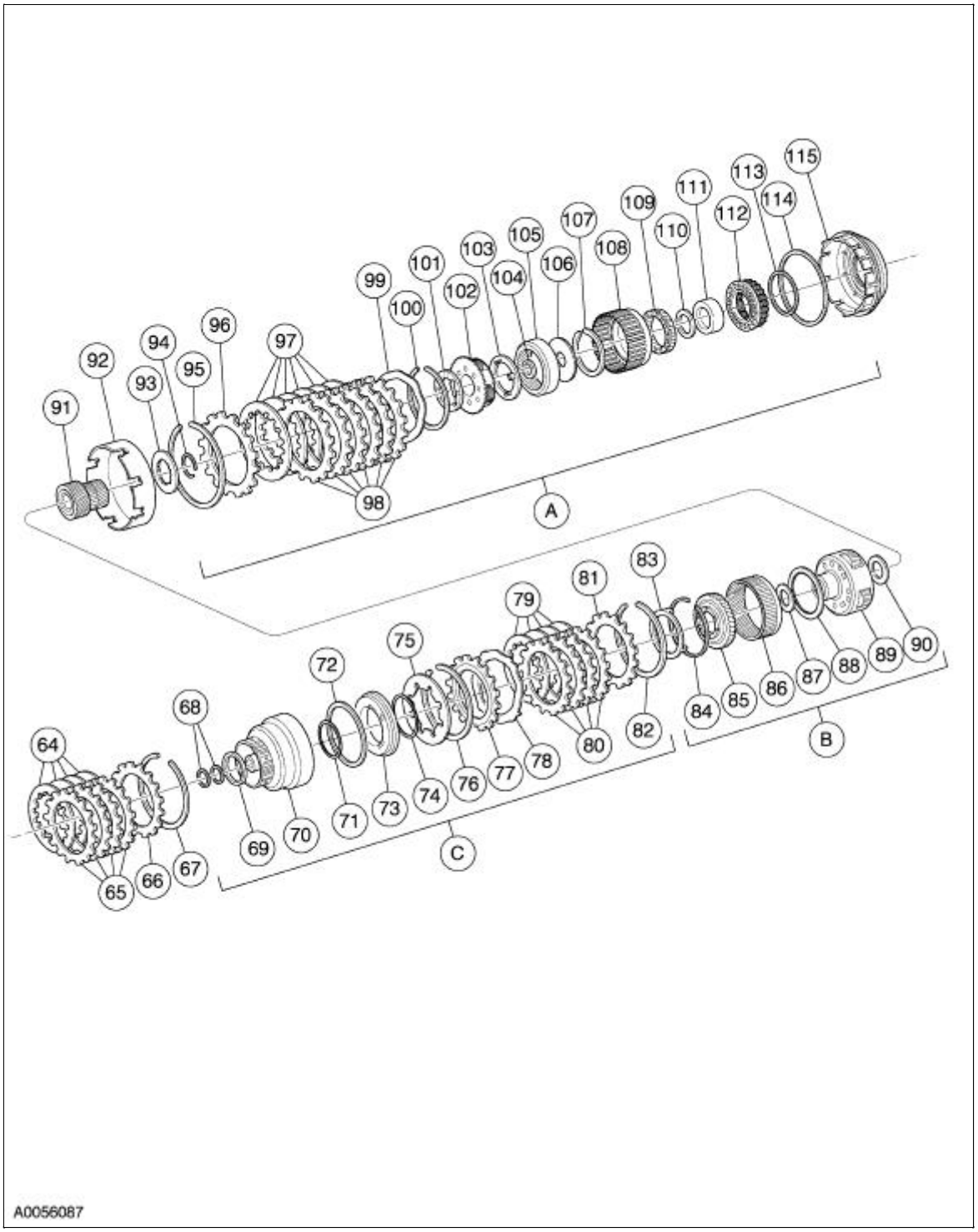
For maximum acceleration, the driver can force a downshift by pressing the accelerator pedal to the floor. A forced downshift into a lower gear is possible below calibrated speeds. Specifications for downshift speeds are subject to variations due to tire size, engine, axle ratio and transmission calibration requirements.

Disassembled Views

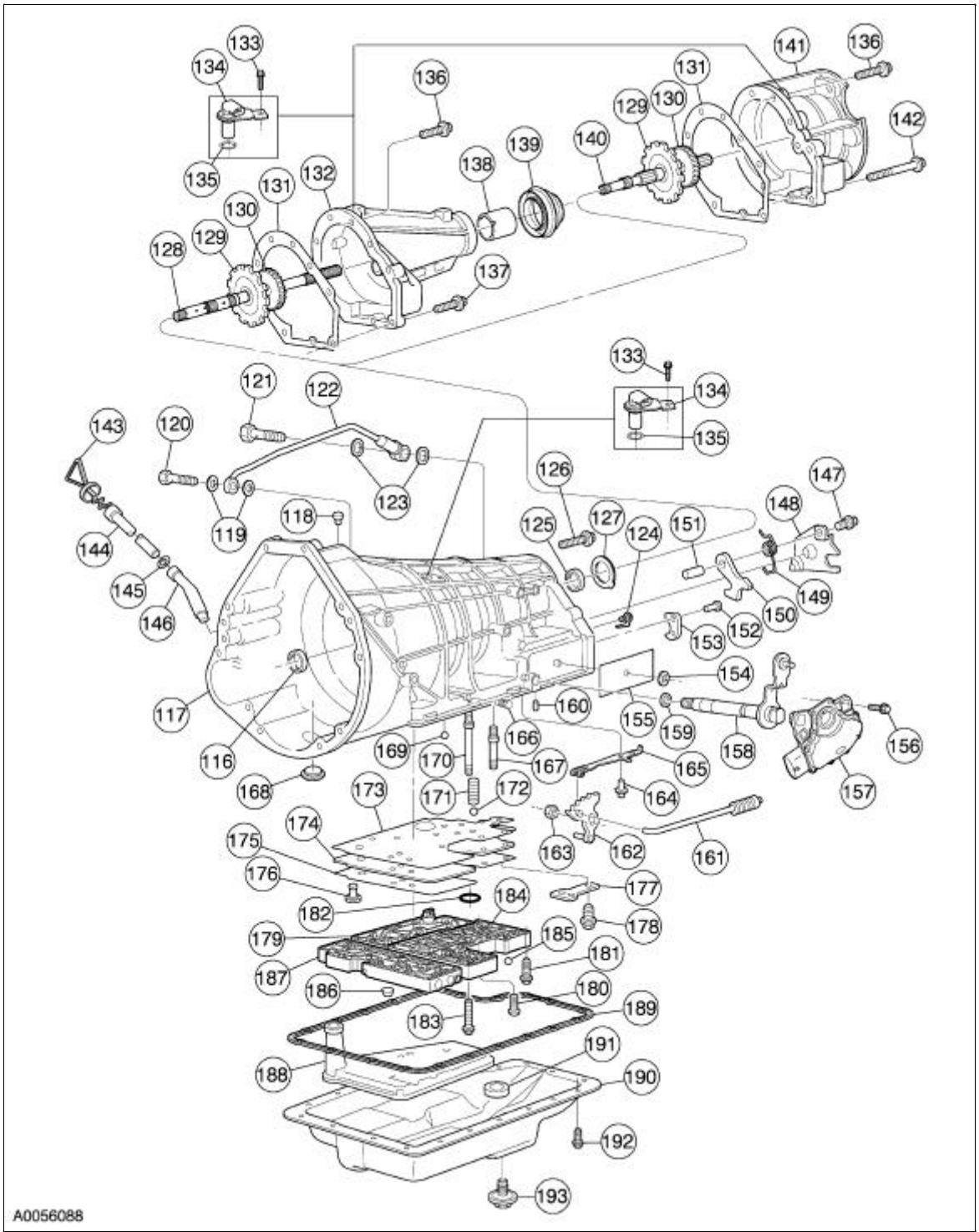
Transmission, Disassembled View



Transmission, Disassembled View



Transmission, Disassembled View



Item	Part Number	Description
1	7902	Converter assembly (vehicle-dependent)
2	7017	Shaft — input
3	7L323	Seal — front pump support
4	7A248	Seal — front pump
5	7A248	Seal — front pump square-cut O.D.
6	N805260-S	Screw and washer assembly — front pump to case
7	7G379	Washer — replacement (9 req'd)

8	7A103	Pump assembly — front (vehicle-dependent)
9	7D014	Washer — front pump support thrust No. 1
10	7A136	Gasket —front pump
11	7G402	Seal — coast clutch ring — Teflon® (2 req'd)
12	7E486	Bearing assembly — overdrive sun gear No. 2
13	7G387	Cylinder assembly — coast clutch
14	7A262	Piston and seal assembly — coast clutch
15	7B070	Spring — coast clutch piston disc
16	7A527	Ring — coast clutch spring retainer
17	7B164	Plate — coast clutch internal spline — friction
18	7B442	Plate — coast clutch external spline — steel
19	7B437	Plate — coast clutch pressure
20	7D483	Ring — coast clutch press plate retaining (selective fit)
21	7D063	Gear assembly — overdrive sun
22	7A089	Clutch assembly — overdrive one-way
23	7G375	Ring — retaining flat (outer race to overdrive ring gear)
24	7G389	Race — overdrive one-way clutch outer
25	7L339	Washer — overdrive one-way clutch No. 3
26	7B446	Planet assembly — overdrive
27	7F240	Bearing assembly — thrust No. 4
28	7A153	Gear — overdrive ring
29	7A658	Shaft — overdrive center
30	7D483	Ring — overdrive retaining (selective fit)
31	7G375	Ring — wavy retaining (center shaft to overdrive ring gear)
32	7G178	Bearing assembly — center shaft No. 5
33	7B066	Plate — overdrive clutch pressure
34	7B164	Plate — overdrive clutch internal spline friction (vehicle-dependent)
35	7B442	Plate — overdrive clutch external spline steel
36	7A527	Ring — overdrive clutch disc spring retaining
37	7B070	Spring — overdrive clutch piston disc
38	7A262	Piston and seal assembly — overdrive clutch (bonded)
39	7D483	Ring — intermediate cylinder retaining

40	7F225	Seal — intermediate clutch piston inner
41	7G384	Cylinder — intermediate and overdrive clutch
42	7Z059	Bolt — M10-1.5 x 2 mm (0.08 in) overdrive cylinder fluid feed
43	7E005	Piston — intermediate clutch
44	7F224	Seal — intermediate clutch piston outer
45	7B070	Spring — intermediate clutch piston disc
46	7Z059	Bolt — M12-1.75 x 31 mm (1.24 in) center support fluid feed (2 req'd)
47	7A130	Support assembly — center
48	7I326	Washer — center support thrust No. 6
49	7D025	Seal — direct clutch cast iron (2 req'd)
50	7B066	Plate — intermediate clutch apply
51	7B164	Plate — intermediate clutch internal spline
52	7B442	Plate — intermediate clutch external spline
53	7B066	Plate — intermediate clutch pressure
54	7D021	Servo assembly — intermediate brake band
55	7D034	Band assembly — intermediate
56	7A089	Clutch assembly — intermediate one-way
57	7G401	Washer — intermediate one-way clutch thrust No. 7
58	7D044	Drum assembly — intermediate brake
59	7A548	Seal — direct clutch inner
60	7A548	Seal — direct clutch outer
61	7A262	Piston assembly — direct clutch
62	7F235	Retainer and spring assembly — direct clutch
63	7C122	Ring — direct clutch support spring retaining
64	7B164	Plate — direct clutch internal spline friction
65	7B442	Plate — direct clutch external spline steel
66	7B066	Plate — direct clutch pressure
67	377126-S , 377127-S, 377128-S, 377437-S,	Ring — direct clutch pressure plate retaining (selective fit)
68	7D019	Seal — forward clutch cylinder (2 req'd)
69	7F374	Bearing assembly — forward clutch cylinder thrust No. 8B
70	7A360	Cylinder assembly — forward clutch
71	7A548	Seal — forward clutch piston inner
72	7A548	Seal — forward clutch piston outer

73	7A262	Piston assembly — forward clutch
74	7D256	Ring — piston apply
75	7B070	Spring — piston return
76	377127-S	Ring — retaining forward clutch spring (forward clutch piston spring to forward clutch cylinder assembly)
77	7B066	Plate — forward clutch pressure
78	7E085	Spring — forward clutch wave
79	7B164	Plate — forward clutch internal spline friction
80	7B442	Plate — forward clutch external spline steel
81	7B066	Plate — forward clutch pressure rear
82	377127-S, 377437-S, 377444-S, 386841-S, 386842-S	Ring — forward clutch pressure plate retaining (selective fit)
83	7D090	Washer — forward clutch hub thrust No. 8C
84	377132-S	Ring — forward hub retaining (forward ring gear hub to forward ring gear)
85	7B067	Hub — forward ring gear
86	7D392	Gear — forward ring
87	7D234	Bearing assembly — forward clutch thrust (between forward ring gear and forward planet assembly) No. 9A
88	7A166	Bearing assembly — forward planet carrier thrust No. 10A
89	7A398	Planet assembly — forward
90	7D234	Bearing assembly — forward clutch thrust (between forward planet assembly and forward sun gear assembly) No. 9B
91	7D063	Gear assembly — forward/reverse sun
92	7D064	Shell — input
93	7D066	Washer — input shell thrust No. 14
94	377300-S	Ring — retaining (attaches forward/reverse sun gear assembly to input shell)
95	7D483	Ring — reverse clutch pressure plate retaining
96	7B066	Plate — reverse clutch pressure
97	7B164	Plate — reverse clutch internal spline friction
98	7B442	Plate — reverse clutch external spline steel
99	7E085	Spring — transmission reverse clutch cushion
100	377155-S	Ring — reverse planet retaining
101	7A166	Washer — planet carrier thrust (between

		reverse planet assembly and input shell) No. 10B
102	7D006	Planet assembly — reverse
103	7A166	Washer — planet carrier thrust (between reverse planet assembly and output shaft hub) No. 11
104	387031-S	Ring — retaining (retaining output shaft hub to output shaft assembly)
105	7A153	Gear — output shaft ring
106	7D164	Hub — output shaft
107	377132-S	Ring — retaining (retaining output shaft hub to output shaft ring gear)
108	7B067	Hub assembly — reverse clutch
109	7A089	Clutch assembly — reverse one-way
110	7G178	Low/reverse one-way clutch inner race thrust bearing assembly No. 12
111	7D171	Race-low reverse one way inner
112	7D406	Retainer and spring assembly — reverse clutch
113	7D404	Seal — reverse clutch piston inner
114	7D403	Seal — reverse clutch piston outer
115	7D402	Piston — reverse clutch
116	7025	Bushing — case front (3 lube grooves)
117	7005	Case assembly
118	7034	Vent assembly — case
119	391933-S100	Sealing washers — case outlet (part of 7H322 CBV assembly)
120	7Z152	Cooler line — case fitting (part of 7H322 CBV assembly) (vehicle-dependent)
121	7G118	Cooler line — case fitting (part of 7H322 CBV assembly) (vehicle-dependent)
122	7H322	Valve assembly — transmission cooler bypass (vehicle-dependent)
123	391932-S100	Sealing washers — case outlet (part of 7H322 CBV assembly) (vehicle-dependent) (2 req'd)
124	7E380	Plug — case fluid filler
125	7025	Bushing — case — rear (1 lube groove)
126	7D167	Bolt — 5/16 x 1.9 (one-way clutch to case) (5 req'd)
127	7B368	Washer — parking gear thrust rear No. 13
128	7060	Output shaft assembly (4x2)
129	7A233	Gear — output shaft — parking
130	7H150	Wheel — tone
131	7086	Gasket — extension housing

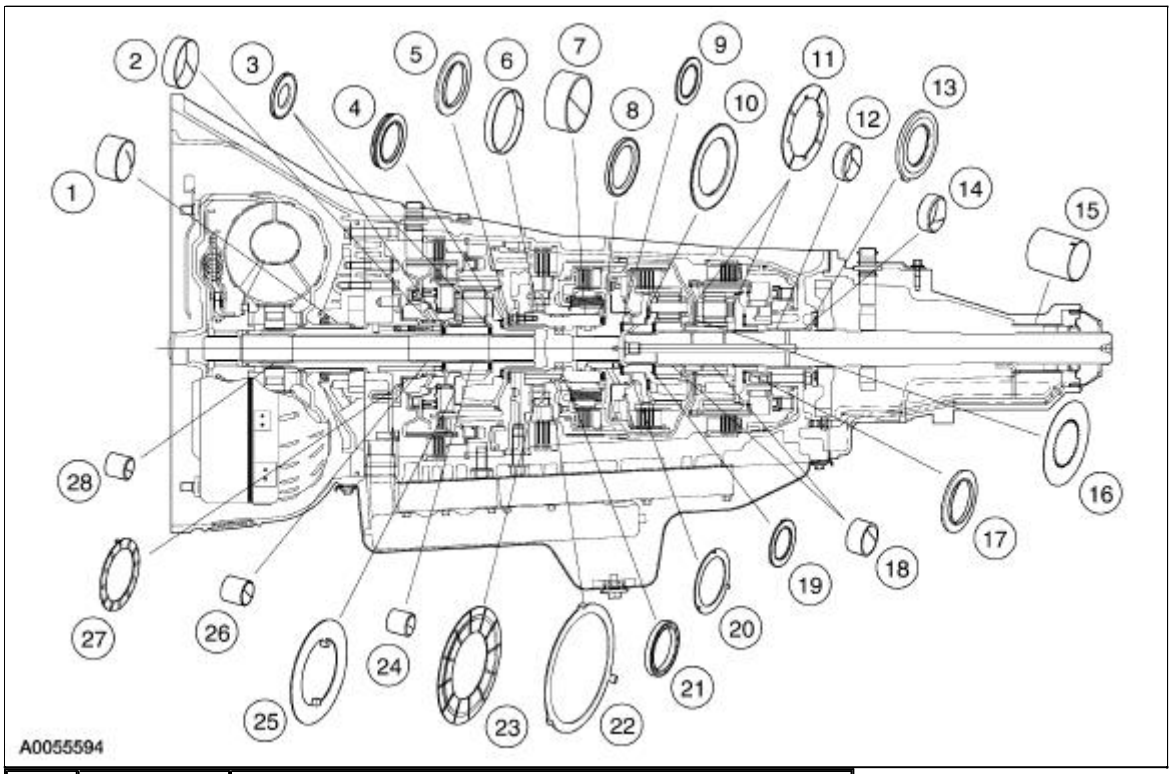
132	7A039	Extension housing (4x2)
133	N605769-S101	Bolt — M6-1 x 10 hex flange
134	7M101	Sensor — turbine/output shaft speed (TSS/OSS)
135	N811757-S100	O-ring — sensor
136	N605803-S427	Bolt — extension assembly to case (top) (7 req'd)
137	N605802-S427	Bolt — extension housing to case (bottom) (2 req'd)
138	7A034	Bushing — extension housing (4x2)
139	7052	Seal — extension housing (4x2)
140	7060	Output shaft assembly (4x4)
141	7A039	Extension assembly (4x4)
142	N606569-S427	Bolt — extension assembly to case (4x4 bottom) (2 req'd)
143	7A020	Indicator assembly — fluid level
144	7A228	Tube assembly — fluid filler
145	391308-S	O-ring — filler tube
146	7A160	Tube fluid inlet — short
147	N805232-S	Screw and washer assembly M8-1.25 x 23.8 (attaches 7D419 to 7005)
148	7D419	Plate — parking rod guide
149	7D070	Spring — parking pawl return
150	7A441	Pawl — parking
151	387640-S	Shaft — parking pawl
152	N805261-S191	Bolt — M8-1.25 x 25.9 mm (1.03 in) (attaches park pawl actuator abutment to case)
153	7G101	Abutment — parking pawl actuating
154	372552-S2	Nut — 3/8 spring (attaches service identification tag to case)
155	7B148	Tag — transmission service identification
156	N811382-S100	Bolt assembly — transmission range sensor to case (2 req'd)
157	7F293	Sensor assembly — transmission range (TR)
158	7A256	Lever assembly — manual control
159	7B498	Seal — manual control lever
160	7B210	Pin — manual lever retaining
161	7A232	Rod assembly — parking pawl actuating
162	7A115	Lever — manual control valve detent — inner
163	N800287-S36	Nut M14-1.5 hex inner detent lever (7A115 to 7A256)
164	N805503-S	Bolt — manual valve detent spring assembly to case

165	7E332	Spring assembly — manual valve detent
166	390685-S	Plug — test port — 1/8-27 hex-head
167	N805330-S	Stud — valve body assembly to case — solenoid valve body to case — accumulator body assembly to case
168	7N171	Plug — converter access
169	7E195	Ball — rubber check (8 req'd) (brown)
170	N805331-S	Stud — main control assembly to case
171	7D017	Spring — EPC blow-off
172	353078-S	Ball — EPC blow-off
173	7C155	Gasket — valve body separator plate
174	7A008	Plate — valve body separator
175	7D100	Gasket — valve body separator plate to case
176	7G308	Screen assembly — solenoid
177	7F282	Plate — valve body reinforcing
178	N805503-S	Bolt — valve body reinforcing plate to case (3 req'd)
179	7G391	Solenoid valve body — transmission control
180	N805329-S	Bolt — solenoid valve body to case (9 req'd)
181	N805326-S	Bolt — valve body assembly to case and accumulator body assembly to case (18 req'd)
182	N705409	O-ring — seal solenoid body
183	N805327-S	Bolt — valve body assembly to case
184	7A100	Valve body assembly
185	7E195	Ball — rubber check (2 req'd) green
186	N805328-S	Nut — valve body assembly to case — solenoid valve body to case — accumulator body assembly to case
187	7G422	Control assembly — accumulator body
188	7A098	Filter and seal assembly (4x2) (model dependent)
189	7A191	Reusable gasket — transmission pan
190	7A264	Pan assembly — transmission (4x2) (model dependent)
191	7l027	Magnet — transmission pan
192	N811266-S427	Bolt — pan assembly to case (20 req'd)
193	7F033	Fluid drain plug
A	—	Reverse clutch and planetary
B	—	Forward planetary assembly
C	—	Forward clutch assembly
D	—	Intermediate clutch assembly

E	—	Direct clutch assembly
F	—	Coast clutch assembly (vehicle-dependent)
G	—	Overdrive clutch assembly

Bushings, Bearing and Thrust Washer Locator

Bushings, Bearing and Thrust Washer Locator

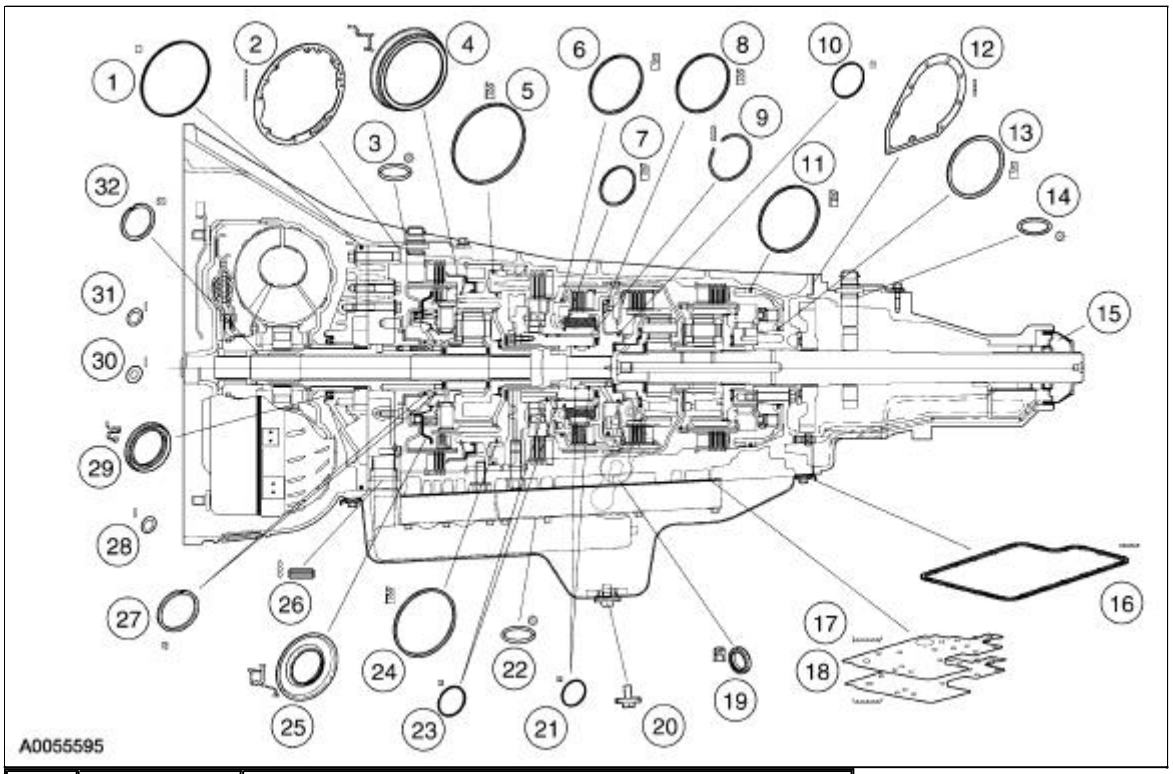


Item	Part Number	Description
1	7B258	Front pump bushing
2	7A620	Coast clutch bushing (part of 7G387)
3	7E486	Overdrive sun gear (front/rear) thrust bearing No. 2A and 2B
4	7F240	Overdrive carrier to center shaft thrust bearing No. 4
5	7G178	Center shaft to center support thrust bearing No. 5
6	—	Intermediate brake drum front bushing (part of 7D044)
7	—	Intermediate brake drum rear bushing (part of 7D044)
8	7F374	Forward clutch hub to center support hub thrust bearing No. 8B
9	7F078	Forward carrier (front) thrust bearing No. 9A
10	7H334	Planet carrier needle bearing No. 10A
11	7D423	Planet carrier thrust washer No. 10B, No. 11
12	7025	Front case bushing
13	7B368	Parking gear thrust washer No. 13

14	7025	Rear case bushing
15	7A034	Extension housing bushing
16	7D066	Input shell thrust washer No. 14
17	7G178	Output shaft hub rear thrust bearing No. 12
18	—	Forward/reverse (front/rear) sun gear bushing (part of 7D063)
19	7F078	Forward carrier (rear) thrust bearing
20	7D090	Forward clutch hub thrust washer No. 8C
21	—	Ball bearing — center shaft (part of 7A130)
22	7G401	Thrust washer — one-way clutch intermediate brake drum No. 7
23	7L326	Center support thrust washer No. 6
24	7B261	Overdrive sun gear bushing
25	7L339	One way clutch to overdrive carrier thrust washer No. 3 (model dependent)
26	7D018	Front pump bushing
27	7D014	Front pump support thrust washer No. 1
28	7B261	Front pump support front bushing (part of 7A103)

Seals, Rings and Gasket Locator

Seals, Rings and Gasket Locator

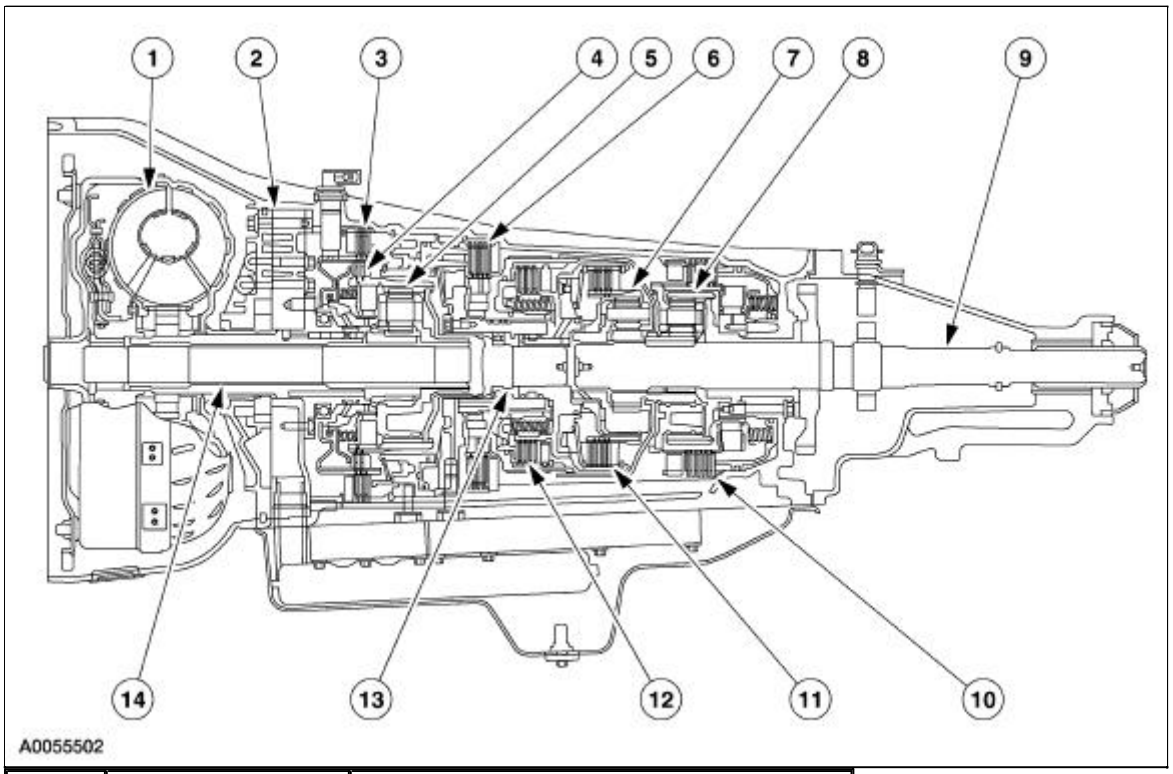


Item	Part Number	Description
1	7A248	Front pump square cut outside diameter seal
2	7A136	Pump gasket
3	N811757-S100	Turbine shaft speed (TSS) sensor O-ring
4	7A262	Overdrive clutch piston and seal assembly (inner and outer seals bonded to the piston)
5	7F224	Intermediate clutch piston outer seal
6	7A548	Direct clutch outer seal
7	7A548	Direct clutch inner seal
8	7A548	Forward clutch piston outer seal
9	7C122	Direct clutch support spring retaining ring
10	7A548	Forward clutch piston inner seal
11	7D403	Reverse clutch piston outer lip seal
12	7086	Extension housing gasket
13	7D404	Reverse clutch piston inner lip seal
14	N811757-S100	Sensor O-ring — turbine shaft speed (TSS)

15	7A191	Reusable transmission pan gasket
16	7052	Extension housing seal
17	7C155	Case to separator plate gasket
18	7D100	Separator plate to control body gasket
19	7B498	Manual control lever seal
20	7F033	Drain plug gasket (model dependent)
21	7D019	Forward clutch cylinder seal (2 req'd)
22	N705409	Solenoid body O-ring
23	7D429	Forward clutch seal cast iron (2 req'd)
24	7F225	Intermediate clutch piston seal
25	7A262	Coast clutch seal bonded on piston (model dependent)
26	7Z302	Pump inlet seal
27	7G402	Coast clutch ring seal, Teflon® (2 req'd)
28	391308-S	Fluid filler tube O-ring
29	7A248	Front pump seal assembly
30	391933-S100	Front CBV sealing washer (2 req'd)
31	391932-S100	Rear CBV sealing washer (2 req'd)
32	7L323	Front pump stator support seal

Main Components and Functions

Automatic Transmission — Sectional View



Item	Part Number	Description
1	7902	Torque converter
2	7A103	Pump assembly
3	—	Overdrive clutch assembly
4	—	Coast clutch assembly
5	7B446	Overdrive planet assembly
6	—	Intermediate clutch assembly
7	7A398	Forward planet assembly
8	7D006	Reverse planet assembly
9	7060	Output shaft assembly
10	—	Reverse clutch assembly
11	—	Forward clutch assembly
12	—	Direct clutch assembly
13	7A658	Center shaft
14	7017	Input shaft

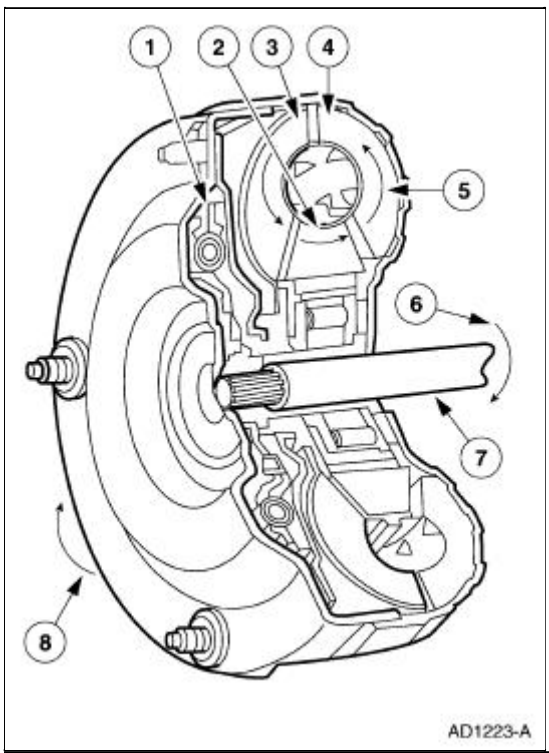
Torque Converter

The torque converter transmits and multiplies torque. The torque converter is a four-element device:

- Impeller assembly
- Turbine assembly
- Reactor assembly
- Clutch and damper assembly

The standard torque converter components operate as follows:

- Rotation of the converter housing and impeller set the fluid in motion.
- The turbine reacts to the fluid motion from the impeller, transferring rotation to the geartrain through the input shaft.
- The reactor redirects fluid going back into the impeller, providing for torque multiplication.
- The clutch and damper assembly dampens powertrain torsional vibration and provides a direct mechanical connection for improved efficiency.
- Power is transmitted from the torque converter to the planetary gearsets and other components through the input shaft.



Item	Part Number	Description
1	—	Converter clutch and damper (part of 7902)
2	—	Reactor (part of 7902)
3	—	Turbine (part of 7902)

4	—	Impeller (part of 7902)
5	—	Fluid motion
6	—	Transmission input rotation
7	—	Input shaft
8	—	Engine rotation

Geartrain

Power is transmitted from the torque converter to the geartrain components through the input shaft and forward clutch cylinder.

- By holding or driving certain members of the gearset, four forward ratios and one reverse ratio are obtained and transmitted to the output shaft. The ratios are as follows:

Gear Ratio	
1ST	2.71 to 1
2ND	1.54 to 1
3RD	1.00 to 1
4TH	0.71 to 1
REVERSE	2.18 to 1

Input Shaft

The input shaft is supported by two bushings in the stator support. End positioning of the input shaft is controlled by the splines in the converter turbine and the overdrive planet assembly.

Output Shaft

The output shaft is supported by two bushings in the case and by the slip-yoke and bushing in the extension housing. End positioning is controlled by the parking pawl gear and snap ring or shoulder and by the reverse ring gear hub and snap ring.

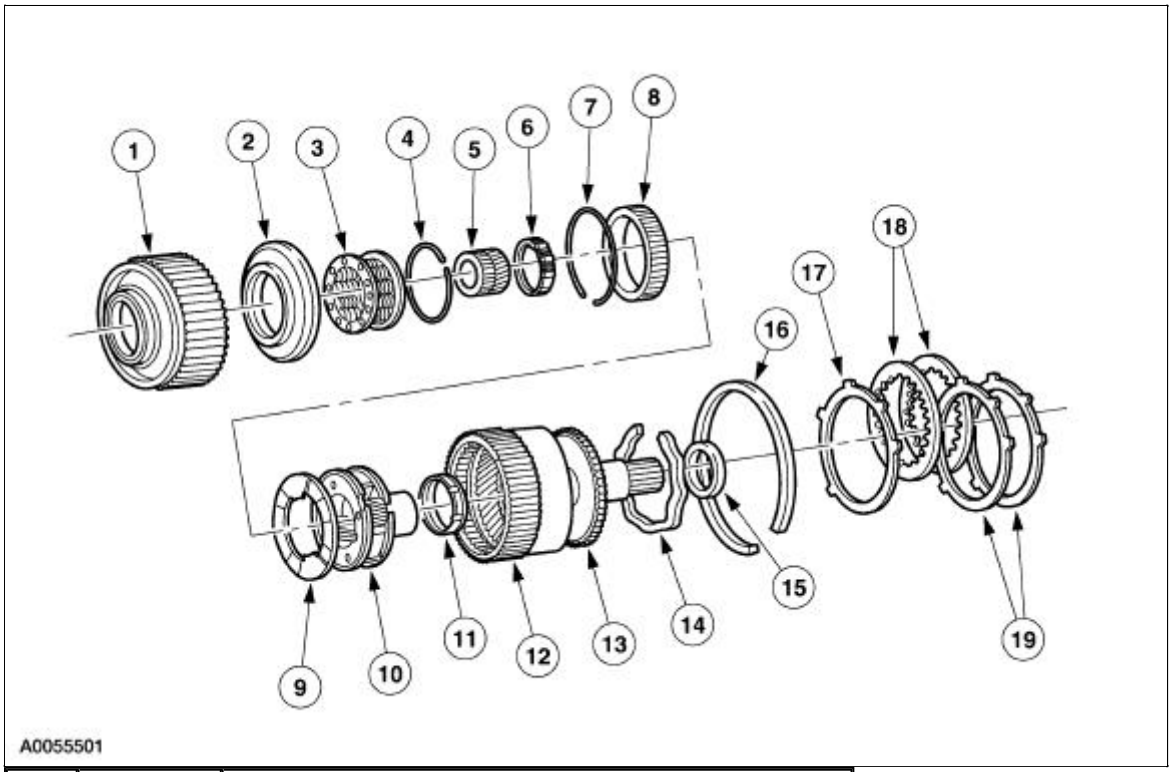
Overdrive System

The overdrive planetary system consists of the overdrive planet assembly, overdrive sun gear, overdrive ring gear, coast clutch cylinder, overdrive one-way clutch assembly and the center shaft, as shown in the following illustration. The overdrive planet assembly is splined to the input shaft. The overdrive sun gear is centered by a bushing on the input shaft and held in place laterally by needle bearings on the reactor support and the overdrive planet assembly. The overdrive sun gear is splined to the coast clutch cylinder, which in turn is splined to the overdrive one-way clutch inner race.

The outer race of the one-way clutch is splined to the overdrive ring gear, which is splined to the center shaft. The center shaft is centered by the forward planetary assembly and is laterally held by needle bearings on the center support and the overdrive planet assembly. The center shaft is splined into the forward clutch cylinder.

The coast clutch is splined between the coast clutch cylinder and the overdrive ring gear. The coast clutch is activated to carry out engine braking in MANUAL 1, MANUAL 2 and third gear with the transmission control switch engaged.

The overdrive clutch steel plates are splined to the case, the friction plates are splined to the coast clutch cylinder. The overdrive clutch holds the coast clutch cylinder and, in turn, the overdrive sun gear, to permit the planet assembly to overdrive the ring gear.



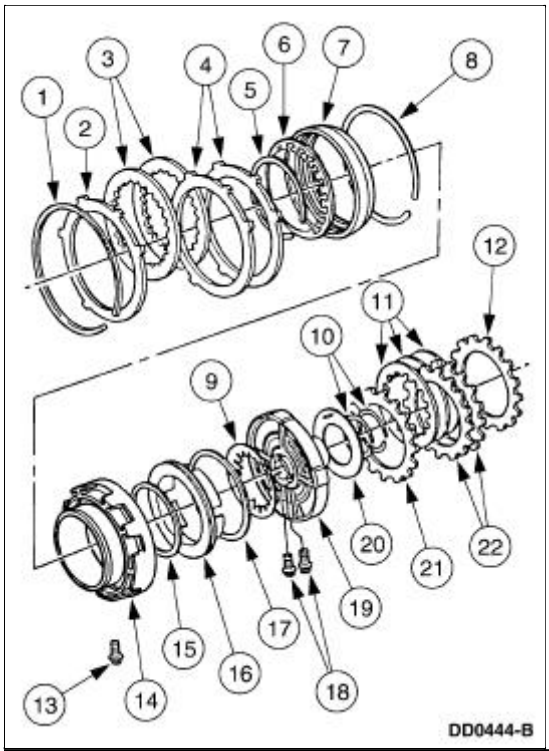
Item	Part Number	Description
1	7G387	Coast clutch cylinder (vehicle dependent)
2	7A262	Piston and seal assembly — coast clutch (vehicle dependent)
3	7B070	Spring — coast clutch piston disc (vehicle dependent)
4	7A527	Ring — coast clutch spring retainer (vehicle dependent)
5	7D063	Gear assembly — overdrive sun (vehicle dependent)
6	7A089	Clutch assembly — overdrive one-way (vehicle dependent)
7	7G375	Ring — retaining (attaches clutch assembly — O/D one-way to O/D ring gear) (vehicle dependent)
8	7G389	Race — overdrive one-way clutch outer (vehicle dependent)
9	7L339	Washer — overdrive — overrun clutch thrust No. 3 (vehicle dependent)
10	7B446	Planet assembly— overdrive (vehicle dependent)
11	7F240	Bearing assembly — overdrive planet — thrust No. 4 (vehicle dependent)
12	7A153	Gear — overdrive ring (vehicle dependent)
13	7A658	Shaft — overdrive center (vehicle dependent)
14	7G375	Ring — wavy retaining (retaining center O/D shaft assembly to O/D ring gear) (vehicle dependent)
15	7G178	Bearing assembly — overdrive center shaft — thrust No. 5 (vehicle dependent)
16	7D483	Ring — overdrive CL pressure plate retainer

		(selective fit) (vehicle dependent)
17	7B066	Plate — overdrive clutch pressure
18	7B164	Plate — overdrive clutch internal spline friction
19	7B442	Plate — overdrive clutch external spline steel

Center Support and Intermediate/Overdrive Clutch Cylinder

The center support provides a pilot for the forward clutch and direct clutch cylinders. It also provides fluid for clutch application and lube flow. The center support is held radially and laterally by the case. Fluid supply enters through feed bolts into the center support and supplies the forward clutch and the intermediate lube circuits. The direct clutch is fed by the center support.

The intermediate/overdrive clutch cylinder is radially supported by the case. Laterally, the cylinder is held in the case by a snap ring. The overdrive circuit is fed through a feed bolt into the cylinder. The intermediate clutch circuit is fed through nearby orifices.



Item	Part Number	Description
1	7D483	Ring — overdrive CI pressure plate retainer (selective fit)
2	7B066	Plate — overdrive clutch pressure
3	7B164	Plate — overdrive clutch internal spline friction
4	7B442	Plate — overdrive clutch external spline steel
5	7A527	Ring — overdrive clutch disc spring retaining
6	7B070	Spring — overdrive clutch piston
7	7A262	Piston and (bonded) seal assembly — overdrive clutch
8	7D483	Ring — intermediate cylinder retaining
9	7B070	Spring — intermediate clutch piston

10	7D025	Seal — direct clutch (2 req'd)
11	7B164	Plate — intermediate clutch internal spline friction
12	7B066	Plate — intermediate clutch pressure rear
13	7Z059	Bolt — M10-1.5 x 24 mm (0.96 in) overdrive cylinder fluid feed
14	7G384	Cylinder — overdrive and intermediate clutch
15	7F225	Seal — intermediate clutch piston inner
16	7E005	Piston — intermediate clutch
17	7F224	Seal — intermediate clutch piston outer
18	7Z059	Bolt — M12-1.75 x 31 mm (1.24 in) center support fluid feed (2 req'd)
19	7A130	Support assembly — center
20	7L326	Washer — center support thrust No. 6
21	7B066	Plate — intermediate clutch pressure apply
22	7B066	Plate — intermediate clutch external spline steel

Forward Drive System

The forward drive system consists of the forward clutch cylinder, intermediate brake drum, intermediate one-way clutch, input shell, forward ring gear, forward ring gear hub, forward/reverse sun gear and the forward planetary carrier and forward planetary gears.

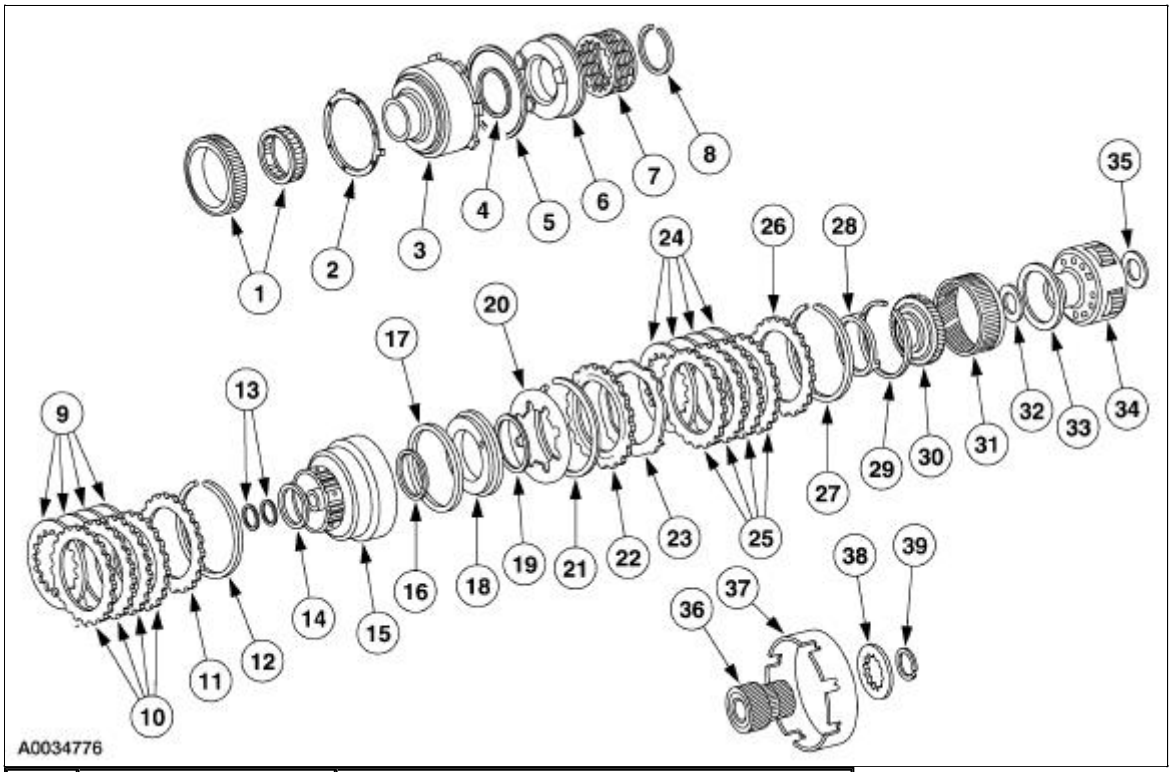
The forward clutch cylinder is splined on the center shaft. The forward ring gear is piloted on the forward ring gear hub. Thrust bearings on the forward planet assembly and forward clutch cylinder hold the forward ring gear hub in place.

The intermediate brake drum is radially supported by bushings on the center support and is laterally controlled by a thrust washer on the forward clutch cylinder and center support. The intermediate brake drum has the inner race of the intermediate one-way clutch press-fitted on its pilot. The intermediate one-way clutch's outer race is splined to the intermediate friction clutch, which is splined to the case. The intermediate brake drum has lugs that are slotted into the input shell to form a mechanical connection. The input shell is splined into the forward/reverse sun gear. The forward/reverse sun gear is common to two planetary gearsets. The forward planet is splined to the output shaft and is laterally positioned by needle bearings on the sun gear and on the forward clutch cylinder, as shown in the following illustration.

Two friction clutch assemblies, the direct clutch and the forward clutch, are shown with the forward planetary assembly. The direct clutch assembly splines the forward clutch cylinder to the intermediate brake drum. The forward clutch assembly splines the forward clutch cylinder to the forward ring gear. The forward clutch is activated during all forward gears. While in third or fourth gear, both the direct and forward clutches are applied to hold the forward planetary assembly and enable it to act as a solid shaft.

In second gear, the intermediate clutch assembly holds the forward/reverse sun gears. It is applied, along with the intermediate one-way clutch, to hold the intermediate brake drum, input shell and forward/reverse sun gear. In higher gears, the one-way clutch overruns.

Forward Drive System Components



Item	Part Number	Description
1	7A089	Clutch assembly — intermediate one-way
2	7G401	Washer — intermediate one-way clutch thrust No. 7
3	7D044	Drum assembly — intermediate brake
4	7A548	Seal — direct clutch piston — inner
5	7A548	Seal — direct clutch piston — outer
6	7A262	Piston assembly— direct clutch
7	7F235	Retainer and spring assembly— direct clutch
8	7C122	Ring — direct clutch support spring retaining
9	7B164	Plate — direct clutch internal spline — friction
10	7B442	Plate — direct clutch external spline — steel
11	7B066	Plate — direct clutch pressure
12	377126-S, 377127-S, 377128-S, 377437-S	Ring — direct clutch pressure plate retaining (selective fit)
13	7D019	Seal — forward clutch cylinder (2 req'd)
14	7F374	Bearing assembly — forward clutch cylinder thrust No. 8B
15	7A360	Cylinder assembly — forward clutch
16	7A548	Seal — forward clutch piston inner
17	7A548	Seal — forward clutch piston outer
18	7A262	Piston assembly— forward clutch

19	7D256	Ring — piston apply
20	7B070	Spring — piston return
21	377127-S	Ring — forward clutch spring (forward clutch piston spring to forward clutch cylinder assembly)
22	7B066	Plate — forward clutch pressure
23	7E085	Spring — forward clutch pressure
24	7B164	Plate — forward clutch internal spline friction
25	7B442	Plate — forward clutch external spline steel
26	7B066	Plate — forward clutch pressure rear
27	377127-S, 377437-S, 377444-S, 386841-S, 386842-S	Ring — forward clutch pressure plate retaining (selective fit)
28	7D090	Washer — forward clutch hub thrust No. 8C
29	377132-S	Ring — forward hub retaining (forward ring gear hub to forward ring gear)
30	7B067	Hub — forward ring gear
31	7D392	Gear — forward ring
32	7D234	Bearing assembly — forward clutch thrust (between forward ring gear and forward planet assembly) No. 9A
33	7A166	Bearing assembly — forward planet carrier — thrust No. 10A
34	7A398	Planet assembly — forward
35	7D234	Bearing assembly— forward clutch thrust (between forward planet assembly and forward sun gear assembly) No. 9B
36	7D063	Gear assembly — forward/reverse sun
37	7D064	Shell — input
38	7D066	Washer — input shell thrust No. 14
39	377300-S	Ring — retaining (attaches forward/reverse sun gear assembly to input shell)

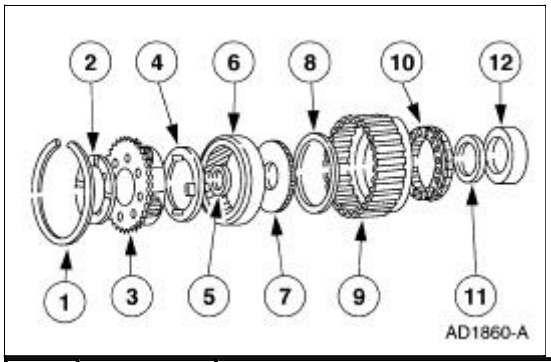
Low and Reverse Drive System

The reverse planetary assembly consists of the reverse planetary carrier, reverse planet gears, the reverse ring gear, the reverse ring gear hub, the reverse clutch hub and the low-reverse one-way clutch assembly.

The reverse ring gear hub is splined to the output shaft and to the reverse ring gear. The reverse ring gear hub is laterally held by a needle bearing on the inner race of the low-reverse one-way clutch and a snap ring on the output shaft. The reverse planet assembly is splined to the low-reverse clutch hub. The low-reverse clutch hub is connected by the reverse clutch to the case. The inner race of the one-way clutch is bolted to the case.

The reverse clutch assembly is activated in REVERSE gear and in MANUAL 1. The reverse clutch

bypasses the reverse one-way clutch during coast and MANUAL 1. The reverse clutch holds the reverse planet assembly in REVERSE gear to enable the sun gear to drive the reverse ring gear in the opposite direction.



Item	Part Number	Description
1	377155-S	Ring — reverse planet retaining (vehicle dependent)
2	7A166	Washer — planet carrier thrust (between reverse planet assembly and input shell) No. 10B (vehicle dependent)
3	7D006	Planet assembly— reverse (vehicle dependent)
4	7A166	Washer — planet carrier — thrust (between reverse planet assembly and output shaft hub) No. 11 (vehicle dependent)
5	387031-S	Ring — retaining (retaining output shaft hub to output shaft assembly) (vehicle dependent)
6	7A153	Gear — output shaft ring (vehicle dependent)
7	7D164	Hub — output shaft (vehicle dependent)
8	377132-S	Ring — retaining (retaining output shaft hub to output shaft ring gear) (vehicle dependent)
9	7B067	Hub assembly— reverse clutch (vehicle dependent)
10	7A089	Clutch assembly— reverse one-way (vehicle dependent)
11	7G178	Thrust bearing assembly No. 12 (vehicle dependent)
12	7G178	Low/reverse one-way clutch inner race (vehicle dependent)

Apply Components

The following information describes the operation of the three one-way clutches.

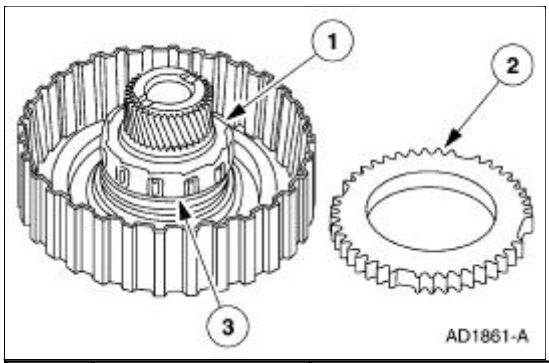
One-Way Clutch—Overdrive

The overdrive one-way clutch, shown in the following illustration, transmits engine torque from the overdrive sun gear to the overdrive ring gear in first, second and third gear range. The overdrive one-way clutch transmits power when the sprags are engaged between the inner and outer races. The inner race is splined to the coast clutch cylinder, which in turn is splined to the overdrive sun gear. The outer race is splined to the overdrive ring gear.

The overdrive one-way clutch engages whenever the overdrive planetary system attempts to drive the overdrive sun gear clockwise when the overdrive ring gear has a counterclockwise torque from the vehicle. When tightened counterclockwise, the overdrive one-way clutch engages and acts as a wedge to lock the sun gear and the ring gear together. During coast, the overdrive one-way clutch enables the ring gear to overrun or spin at a faster rate than the sun gear.

The overdrive one-way clutch overruns when in overdrive (fourth gear). In overdrive, the coast clutch cylinder is held by the overdrive one-way clutch, which in turn holds the overdrive sun gear. This causes the overdrive planet assembly to walk around the sun gear and overdrive the overdrive ring gear. The inner race of the overdrive one-way clutch is thus held stationary while the outer race is allowed to overrun clockwise.

One-Way Clutch—Overdrive (Roller Design)



Item	Part Number	Description
1	—	Overdrive one-way clutch inner race
2	—	Overdrive one-way outer race
3	—	Overdrive one-way clutch

One-Way Clutch Intermediate

The intermediate one-way clutch, shown in the following illustration, holds the forward/reverse sun gear stationary relative to the case in second gear. The outer race of the intermediate one-way clutch is splined to the intermediate clutch, which in turn is splined to the case. The inner race is part of the intermediate brake drum, which is connected to the sun shell. The sun shell is splined to the forward/reverse sun gear.

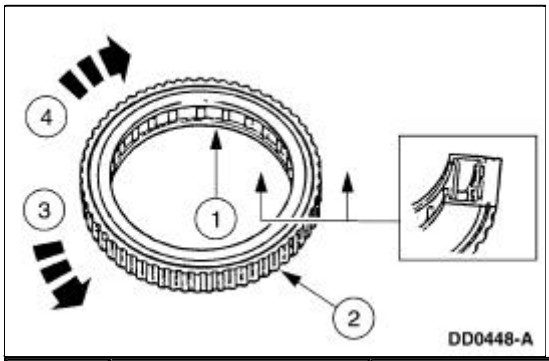
In second gear, the intermediate clutch holds the outer race of the intermediate one-way clutch. Torque from the vehicle acts counterclockwise on the output shaft, and in turn on the forward planetary carrier and the reverse ring gear. Torque from the center shaft is counterclockwise.

This combination applies a counterclockwise torque on the sun gear and likewise the intermediate one-way clutch. The intermediate one-way clutch engages, causing the forward ring gear to turn the forward planetary carrier clockwise at reduced speed. During coast, the intermediate one-way clutch allows the sun gear to spin clockwise as the engine rpm coasts down.

The intermediate one-way clutch overruns in third, fourth and REVERSE gears. The direct clutch is engaged, causing the intermediate brake drum to rotate clockwise with the center shaft. With the intermediate drum rotating clockwise, the inner race also rotates clockwise, causing the intermediate one-way clutch to overrun.

In first gear, the outer race of the intermediate one-way clutch is not held, and the intermediate one-way clutch is overrunning.

One-Way Clutch, Intermediate (Sprag Design)



Item	Part Number	Description
1	—	Sprags (part of 7A089)
2	—	Outer race (part of 7A089)
3	—	Overrunning
4	—	Engaged

One-Way Clutch Low-Reverse

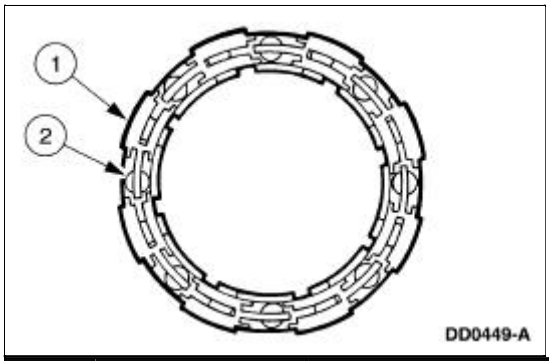
The low-reverse one-way clutch, shown in the following illustration, holds the reverse planetary carrier stationary to the case in first gear. The inner race of the low-reverse one-way clutch is bolted directly to the case. The outer race is splined to the reverse clutch hub, which is splined to the reverse planetary carrier.

In first gear, the center shaft drives the forward ring gear clockwise by way of the forward clutch. With the forward planetary carrier providing a counterclockwise resisting torque, the forward/reverse sun gear is driven counterclockwise.

As the sun gear is turned counterclockwise and the reverse ring gear is turned counterclockwise by the resistance of the vehicle, the reverse planetary carrier is also turned counterclockwise. Because the reverse planetary carrier is prevented from turning counterclockwise by the low-reverse one-way clutch, the torque is transferred from the sun gear to the reverse ring gear and the output shaft. During coast, the planetary carrier is allowed to overrun and spin clockwise.

The low-reverse one-way clutch overruns in second, third and fourth gears. In these cases the forward/reverse sun gear is stationary while the reverse ring gear turns clockwise with the output shaft. This turns the reverse planetary carrier clockwise, causing the low-reverse one-way clutch to run clockwise and overrun.

One-Way Clutch Low-Reverse



Item	Part Number	Description
1	—	Unitized plastic cage (part of 7A089)
2	—	Roller (part of 7A089)

Transmission Electronic Control System

Electronic System Description

The powertrain control module (PCM) and its input/output network control the following transmission operations:

- shift timing
- line pressure (shift feel)
- torque converter clutch (TCC) operation

The transmission control is separate from the engine control strategy in the PCM, although some of the input signals are shared. When determining the best operating strategy for transmission operation, the PCM uses input information from certain engine-related and driver-demand related sensors and switches.

Using all of these input signals, the PCM can determine when the time and conditions are right for a shift, or when to apply or release the torque converter clutch (TCC). It will also determine the best line pressure needed to optimize shift feel. To accomplish this, the PCM uses six output solenoids to control transmission operation.

The following provides a brief description of each of the sensors and actuators used by the PCM for transmission operation.

Mass Air Flow (MAF) Sensor

The mass air flow (MAF) sensor measures the mass of air flowing into the engine. The MAF sensor output signal is used by the powertrain control module (PCM) to calculate injector pulse width. For transmission strategies the MAF sensor is used to regulate electronic pressure control (EPC), shift and torque converter clutch (TCC) scheduling.

Throttle Position (TP) Sensor

The throttle position (TP) sensor is a potentiometer mounted on the throttle body. The TP sensor detects the position of the throttle plate and sends this information to the powertrain control module (PCM). The TP sensor is used for shift scheduling, electronic pressure control and torque converter clutch (TCC) control.

Intake Air Temperature (IAT) Sensor

The IAT sensor is installed in the air cleaner outlet tube. The IAT sensor is also used in determining electronic pressure control (EPC) pressures.

Powertrain Control Module (PCM)

The operation of the transmission is controlled by the powertrain control module (PCM). Many input sensors provide information to the PCM. The PCM then controls actuators which determine transmission operation.

Transmission Control Switch (TCS) and Transmission Control Indicator Lamp (TCIL)

The transmission control switch (TCS) is a momentary contact switch. When the switch is pressed, a signal is sent to the powertrain control module (PCM) to allow automatic shifts from first through fourth

gears or first through third gears only. The PCM energizes the transmission control indicator lamp (TCIL) when the switch is off. The TCIL indicates overdrive cancel mode activated (lamp on) and electronic pressure control (EPC) circuit shorted (lamp flashing) or monitored sensor failure.

Anti-Lock Brake Speed Sensor

The programmable speedometer/odometer module (PSOM) receives input from the rear brake anti-lock sensor. After processing the signal, the PSOM relays it to the powertrain control module (PCM) and the speed control module.

Turbine Shaft Speed (TSS) Sensor

The turbine shaft speed (TSS) sensor is a magnetic pickup that sends the powertrain control module (PCM) information on the rotation speed of the coast clutch cylinder assembly. The TSS sensor is mounted externally on the top of the transmission case. The PCM uses TSS sensor signals to help determine electronic pressure control (EPC) pressure, shift scheduling the torque converter clutch (TCC) operation.

Output Shaft Speed (OSS) Sensor

The output shaft speed (OSS) sensor is a magnetic pickup that provides transmission output shaft rotation speed information to the powertrain control module (PCM).

The OSS sensor is mounted externally on the top of the transmission extension housing. The PCM uses the OSS sensor signal to help determine electronic pressure control (EPC) pressure, shift scheduling and torque converter clutch (TCC) operation.

Transmission Solenoid Body Assembly

The powertrain control module (PCM) controls the transmission operation through three on/off shift solenoids, one pulse width modulated (PWM) shift solenoid, and one variable force shift solenoid. These solenoids and transmission fluid temperature (TFT) sensor are housed in the transmission solenoid body assembly. All are part of the transmission solenoid body and are not replaced individually.

Transmission Fluid Temperature (TFT) Sensor

The transmission fluid temperature (TFT) sensor is located on the solenoid body assembly in the transmission sump. It is a temperature-sensitive device called a thermistor. The resistance value of the TFT sensor will vary with temperature change.

The powertrain control module (PCM) monitors voltage across the TFT sensor to determine the temperature of the transmission fluid.

The PCM uses this signal to determine whether a cold start shift schedule is necessary. The cold start shift schedule lowers shift speeds to allow for better cold engine operation. The PCM also uses the TFT sensor input to adjust electronic pressure control (EPC) pressure for temperature effects and to inhibit torque converter clutch (TCC) operation during the warm-up period.

Coast Clutch Solenoid (CCS)

The coast clutch solenoid (CCS) provides coast clutch control by shifting the coast clutch shift valve. The solenoid is activated by pressing the transmission control switch (TCS) or by selecting the 1 or 2 range with the transmission range selector lever. In MANUAL 1 and 2, the coast clutch is controlled by the solenoid and also hydraulically as a fail-safe to ensure engine braking. In REVERSE, the coast clutch is controlled hydraulically and the solenoid is not on.

Torque Converter Clutch (TCC) Solenoid

The torque converter clutch (TCC) solenoid provides torque converter clutch control by shifting the converter clutch control valve to apply or release the TCC.

Electronic Pressure Control (EPC) Solenoid

CAUTION: The electronic pressure control (EPC) solenoid pressure output from the variable force solenoid is NOT adjustable. Any modification to the electronic pressure control solenoid may void the transmission warranty.

The EPC solenoid is a variable force solenoid. The variable-force type solenoid is an electrohydraulic actuator combining a solenoid and a regulating valve. It supplies electronic pressure control that regulates transmission line pressure and line modulator pressure. This is done by producing resisting forces to the main regulator and the line modulator circuits. These two pressures control clutch application pressures.

Shift Solenoids SSA and SSB

Shift solenoids SSA and SSB provide gear selection of first through fourth gears by controlling the pressure to the three shift valves.

Digital Transmission Range (TR) Sensor

The digital transmission range (TR) sensor is located on the outside of the transmission at the manual lever. The sensor completes the start circuit in PARK and NEUTRAL, the back-up lamp circuit in REVERSE and a neutral sense circuit for GEM control of 4x4 low engagement. The sensor also opens/closes a set of four switches that are monitored by the powertrain control module (PCM) to determine the position of the manual lever (P, R, N, (D), 2, 1).

4x4 Low (4x4L) Switch

The 4x4 low (4x4L) range switch is located on the transfer case cover. It provides an indication of when the 4x4 transfer case gear system is in the low range. The powertrain control module (PCM) then modifies shift schedule for 4x4L operation.

Brake Pedal Position (BPP) Switch

The brake pedal position switch (BPP) tells the powertrain control module (PCM) when the brakes are applied. The torque converter clutch (TCC) disengages when the brakes are applied. The BPP switch closes when the brakes are applied and opens when they are released.

Electronic Ignition (EI) System

The electronic ignition consists of a crankshaft position sensor, two four tower ignition coils and the powertrain control module (PCM). The ignition control module operates by sending crankshaft position information from the crankshaft position sensor to the ignition control module. The ignition control module generates a profile ignition pickup (PIP) signal (engine rpm) and sends it to the PCM. The PIP is one of the inputs that the PCM uses to determine transmission strategy, wide-open throttle (WOT) shift control, torque converter clutch control and EPC pressure.

Distributor Ignition (DI) System

The profile ignition pickup sensor sends a signal to the powertrain control module (PCM) indicating the engine rpm and the crankshaft position.

Air Conditioning (A/C) Clutch

An electromagnetic clutch is energized when the clutch cycling pressure switch closes. The switch is located on the suction accumulator/drier. The closing of the switch completes the circuit to the clutch and draws it into engagement with the compressor driveshaft. When the A/C clutch is engaged,

electronic pressure control (EPC) is adjusted by the powertrain control module (PCM) to compensate for additional load on the engine.

Manifold Absolute Pressure (MAP) Sensor

The manifold absolute pressure (MAP) sensor senses atmospheric pressure to produce an electrical signal. The frequency of this signal varies with intake manifold pressure. The powertrain control module (PCM) monitors this signal to determine altitude. The PCM then adjusts the transmission shift schedule and EPC pressure for altitude. On diesel engines, the MAP sensor measures boost pressure. The PCM monitors this signal and adjusts EPC pressure.

Diagnostic Strategy

NOTE: Do not take short cuts or assume that critical checks or adjustments have already been made.

Troubleshooting an electronically controlled automatic transmission is simplified by using the proven method of diagnosis. One of the most important things to remember is that there is a definite procedure to follow.

Follow the procedures as written to avoid missing critical components or steps.

To diagnose a concern correctly, the technician should have the following publications available:

- Transmission Reference Manual.
- Powertrain Control/Emissions Diagnosis (PC/ED) manual.
- OASIS messages.
- Technical Service Bulletins (TSBs).
- Wiring Diagram.

These publications provide the information required when diagnosing transmission concerns.

Using the Diagnostic Flowchart as a guide, follow the steps as indicated.

Preliminary Inspection

- Know and understand the customer's concern.
- Check the fluid level and condition.
- Verify the concern by operating the vehicle.
- Check for non-factory add-on items.
- Check shift linkages for correct adjustment.
- Check TSBs and OASIS messages for the concern.

Diagnostics

- Carry out on-board diagnostic procedures key on/engine off (KOEO) and key on/engine running (KOER).
- Record all diagnostic trouble codes (DTCs).
- Repair all non-transmission codes first.
- Repair all transmission codes second.
- Erase all continuous codes and attempt to repeat them.
- Repair all continuous codes which reappear.
- If only pass codes are obtained, proceed to Diagnosis By Symptom in this section for further information and diagnosis.

Follow the diagnostic sequence to diagnose and repair the concern the first time.

Diagnostic Flow Chart

Diagnostic Flow Chart

Diagnostic Flow Chart		
• Know and understand the customer concerns. • Check the fluid level and condition. • Verify the concern by operating the vehicle. • Check for non-factory-installed items and verify correct installation. • Check the shift linkage adjustments. • Check TSBs and OASIS messages for vehicle concerns. • Carry out quick test, both KOER and KOEO. • Record all codes. 1) Did you record any Diagnostic Trouble Codes?	Yes	· Repair all hard Diagnostic Trouble Codes. Follow the pinpoint tests. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual first, then this workshop manual.
	No	· Refer to Diagnosis By Symptom in this section, then GO to Step 5.
2) Are any continuous test memory codes present?	Yes	· Clear codes and carry out drive cycle test.
	No	· GO to Step 4.
3) Did the continuous test memory codes reappear?	Yes	· Repair all continuous test memory codes. Follow the pinpoint tests. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual then the transmission reference manual, then this workshop manual, then GO to Step 4.
	No	· GO to Step 4.
4) Is the concern repaired?	Yes	· Carry out the final quick test to verify that no Diagnostic Trouble Codes are present. Clear memory codes.
	No	· Refer to Diagnosis By Symptom in this section.
5) Are there any electrical concerns?	Yes	· Install the scan tool and carry out output state control test, then GO to Step 6.
	No	· Refer to the hydraulic and mechanical routine to diagnose and repair the concern, then GO to Step 7.
6) Was the transmission concern corrected when the scan tool was installed?	Yes	· Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual, intermittent fault diagnosis section and use the scan tool or WDS to diagnose cause of concern in the

		processor, vehicle harness or external inputs (sensors or switches).
	No	・Refer to the hydraulic and mechanical routine to diagnose the concern, then GO to Step 7.
7) Is the concern repaired?	Yes	・Carry out the final quick test to verify that no diagnostic trouble codes are present. Clear memory codes.
	No	・Get assistance from Technical Hotline.

Preliminary Inspection

The following items must be checked prior to beginning the diagnostic procedure:

Know/Understand the Concern

In order to diagnose a concern correctly, you must first understand the customer complaint or condition. Customer contact may be required in order for the technician to begin to verify the concern. You must also understand the conditions when the concern occurs, for example:

- Hot or cold vehicle temperature.
- Hot or cold ambient temperature.
- Vehicle driving conditions.

After understanding when and how the concern occurs, proceed to verify the condition.

Verification of Condition

This section provides information that must be used in both determining the actual cause of customer concerns and carrying out the appropriate procedures.

The following procedures must be used when verifying customer concerns for the transmission:

Determine Customer Concern

NOTE: Some transmission conditions can cause engine concerns. An electronic pressure control short circuit can cause engine misfiring. The torque converter clutch not disengaging will stall the engine.

Determine customer concerns relative to vehicle use and dependent driving conditions, paying attention to the following items:

- Hot or cold vehicle operating temperature.
- Hot or cold ambient temperatures.
- Type of terrain.
- Vehicle loaded/unloaded.
- City/highway driving.
- Upshift.
- Downshift.
- Coasting.
- Engagement.
- Noise/vibration — check for dependencies, either rpm dependent, vehicle speed dependent, shift dependent, gear dependent, range dependent, or temperature dependent.

Check Fluid Level and Condition

CAUTION: The vehicle should not be driven if the fluid level indicator shows the fluid

below the DO NOT DRIVE mark or internal failure could result.

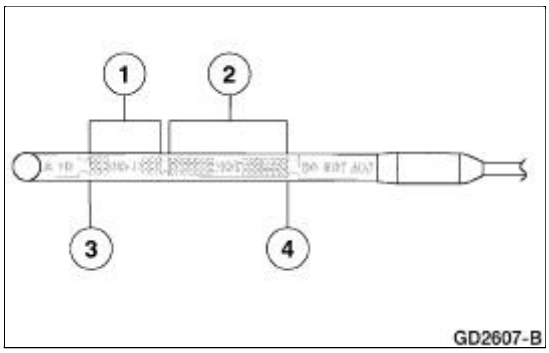
NOTE: If the vehicle has been operated for an extended period of time at highway speeds, in city traffic, in hot weather, or while pulling a trailer, the fluid needs to cool down to obtain an accurate reading.

NOTE: The fluid level reading on the indicator will differ depending on operating and ambient temperatures. The correct reading should be within the normal operating temperature range.

Under normal circumstances, the fluid level should be checked during normal maintenance. If the transmission starts to slip, shifts slowly, or shows of leaking, the fluid level should be checked.

Fluid Level Check

1. With the transmission in (P) PARK, the engine at idle and the brake pedal depressed, move the selector lever through each gear and allow engagement of each gear. Place the selector lever in the PARK position.
2. Wipe the fluid level indicator cap and remove the indicator.
3. Wipe the indicator with a clean cloth.
4. Install the indicator back in the filler tube until it is fully seated, then remove the indicator. The fluid level should be within the normal operating temperature range.



Item	Description
1	Cold Temperature Range
2	Normal Operating Temperature Range
3	DO NOT DRIVE IF BELOW THIS LEVEL AND OUTSIDE TEMPERATURE IS ABOVE 10°C (50°F) (Underfill). Recheck fluid level at normal operating temperature and adjust as required.
4	DO NOT DRIVE LEVEL (Overfill). Remove excess fluid. Recheck fluid level at normal operating temperature and adjust as required.

High Fluid Level

A fluid level that is too high may cause the fluid to become aerated due to the churning action of the rotating internal parts. This will cause erratic control pressure, foaming, loss of fluid from the vent tube and possible transmission malfunction and or damage. If an overfill reading is indicated refer to Transmission Fluid Drain and Refill in this section.

Low Fluid Level

A fluid level that is too low may also cause the fluid to become aerated due to the churning action of the rotating internal parts.

A low fluid level can result in poor transmission engagement, slipping, malfunction and/or damage. This can also indicate a leak in one of the transmission seals or gaskets.

Adding Fluid

CAUTION: The use of any other type of transmission fluid than specified can result in transmission malfunction and/or damage.

If fluid must be added, add fluid in 0.25L (1/2 pint) increments through the filler tube. Do not overfill the fluid. For fluid type, refer to the Fluid Type specification chart.

Fluid Condition Check

1. Check the fluid level.
2. Observe the color and the odor. The color under normal circumstances should be dark reddish, not brown, pink, black or have a burnt odor.
3. Hold the fluid level indicator over a white facial tissue and allow the fluid to drop onto the facial tissue and examine the stain.
4. If evidence of solid material is found, the transmission fluid pan should be removed for further inspection.
5. If the stain is a foamy pink color, this may indicate coolant or water in the transmission. The engine cooling system should also be inspected at this time.
6. If fluid contamination or transmission failure is confirmed by the sediment in the bottom of the fluid pan, the transmission must be disassembled and completely cleaned. This includes the torque converter, coolers, cooler lines and cooler bypass valve.
7. Carry out diagnostic checks and adjustments; refer to Diagnosis By Symptom in this section.

Road Testing Vehicle

The following Shift Point Road Test and Torque Converter Clutch Operation Test provide diagnostic information on transmission shift controls and torque converter operation.

Shift Point Road Test

NOTE: Always drive the vehicle in a safe manner according to driving conditions and obey all traffic laws.

This test verifies that the shift control system is operating correctly.

1. Bring engine and transmission up to normal operating temperature.

2. Operate the vehicle with the transmission range selector lever in (D).

3. Apply minimum throttle and observe the speeds at which the upshift occurs and the torque converter engages. Refer to Automatic Transmission Special Specification Bulletin Issue available from Ford Customer Service Division.

4. With the transmission in OVERDRIVE (fourth gear), depress the transmission control switch. The transmission should downshift to third gear. Remove foot from accelerator pedal; engine braking should occur.

5. Press the accelerator pedal to floor (wide-open throttle). The transmission should shift from third to second gear or third to first, depending on vehicle speed. Torque converter clutch should disengage and then reapply.

6. With vehicle (D) range above 80 km/h (50 mph) and less than half throttle, move the transmission range selector lever from (D) range to MANUAL 2 range and remove foot from the accelerator pedal. The transmission should immediately downshift into second gear. With the vehicle remaining in MANUAL 2 range, move the transmission range selector lever into MANUAL 1 range. Transmission should downshift into first gear at speeds BELOW 48-56 km/h (30-35 mph).

7. If the transmission fails to upshift/downshift or the torque converter clutch does not apply and release, refer to Diagnosis By Symptom in this section for concern diagnosis.

Shift Speed Application Charts

NOTE: This vehicle has been equipped with a special cold weather shift strategy. This was designed to maximize heater output. This new strategy operates under the following conditions: ambient air temperature at start-up is -4°C (25°F) or below and the engine coolant temperature at start-up is 38°C (100°F) or below. During this condition, the vehicle may experience slightly delayed shifts under light throttle. Medium and heavy throttle shifts will be normal. Once the engine coolant reaches 71°C (160° F) or above, normal shift scheduling will resume. If, during the diagnosing of a delayed shift concern, the concern goes away after the engine coolant reaches 71°C (160°F) or above, this is a normal operation of the special cold weather shift strategy. If this condition does not go away after the engine coolant reaches 71°C (160°F), refer to Diagnosis By Symptom in this section.

NOTE: All gasoline vehicles will have new adaptive shift strategies. Whenever the vehicles battery has been disconnected for any type of service or repair, the strategy parameters that are stored in the keep alive memory (KAM) will be lost. The strategy will start to relearn once the battery is reconnected and the vehicle is driven. This is a temporary condition and will return to normal operating condition once the powertrain control module (PCM) relearns all the parameters from the driving operating conditions. There is no time frame set for this process. If this concern is present during downshifts or converter clutch apply, it is not the shift strategy and will require diagnosis as outlined in the workshop manual.

The customer must be notified that they may experience slightly different upshifts (either soft or firm) and that this condition is temporary and will eventually return to normal operating condition.

Applications Shift Speeds — Approximate* Km/h (mph) 5.4L 4V Engine

NOTE: "D" is the same as (D) with the transmission control switch actuated (light on).

Throttle Opening	Range	Shift	Vehicle Speed (1) Km/h (mph) [1] Axle Ratio 3.73
Closed	(D)	4-3	42-47 (26-29)
Throttle	(D), D	3-2	27-31 (17-19)
	(D), D	2-1	11-14 (7-9)
Light	(D), D	1-2	18-21 (11-13)
Throttle	(D), D	2-3	29-32 (18-20)
TP	(D)	3-4	43-48 (27-30)
Voltage	(D)	4-3	42-47 (26-29)
1.25	(D), D	3-2	27-30 (17-19)
Volts	(D), D	2-1	13-16 (8-10)
Wide	(D), D	1-2	72-79 (45-49)
Open	(D), D	2-3	125-137 (78-85)
Throttle	(D)	3-4	159-171 (99-106)
	(D)	4-3	148-159 (92-99)
	(D), D	3-2	114-122 (71-76)
	(D), D	2-1	60-64 (37-40)

[1] Nominal shift speed at sea level is shown. Actual shift speed will depend on tire size, brand and altitude.

Applications Shift Speeds — Approximate* Km/h (mph) 5.4L 2V Engine

NOTE: "D" is the same as (D) with the transmission control switch actuated (light on).

Throttle Opening	Range	Shift	Vehicle Speed (1) Km/h (mph) [1] Axle Ratio 4.1	3.73	3.55	3.3
Closed	(D)	4-3	53 (33)	58 (36)	61 (38)	66 (41)
Throttle	(D), D	3-2	21 (13)	23 (14)	24 (15)	26 (16)
	(D), D	2-1	11 (7)	13 (8)	13 (8)	14 (9)
Light	(D), D	1-2	27 (17)	31 (19)	32 (20)	34 (21)
Throttle	(D), D	2-3	53 (33)	58 (36)	61 (38)	66 (41)
TP	(D)	3-4	72 (45)	80 (50)	84 (52)	90 (56)
Voltage	(D)	4-3	53 (33)	58 (36)	61 (38)	66 (41)
1.25	(D), D	3-2	23 (14)	24 (15)	26 (16)	27 (17)
Volts	(D), D	2-1	11 (7)	13 (8)	13 (8)	14 (9)

Wide	(D), D	1-2	63 (39)	68 (42)	72 (45)	77 (48)
Open	(D), D	2-3	103 (64)	113 (70)	117 (73)	127 (79)
Throttle	(D)	3-4	135 (84)	148 (92)	154 (96)	167 (104)
	(D)	4-3	124 (77)	137 (85)	143 (89)	154 (96)
	(D), D	3-2	93 (58)	101 (63)	106 (66)	114 (71)
	(D), D	2-1	51 (32)	56 (35)	58 (36)	63 (39)

[1] Nominal shift speed at sea level is shown. Actual shift speed will depend on tire size, brand and altitude.

Torque Converter Diagnosis

Prior to torque converter replacement, all diagnostic procedures must be followed. This is to prevent the unnecessary installation of new or remanufactured torque converters. Only after a complete diagnostic evaluation can the decision be made to install new or remanufactured torque converter.

Begin with the normal diagnostic procedures as follows:

1. Preliminary Inspection.
2. Know and Understand the Customer's Concern.
3. Verify the Concern—Carry out the Torque Converter Clutch Operation Test in this section.
4. Carry out Diagnostic Procedures.
    - Run on-board diagnostics, refer to On-Board Diagnostics with scan tool in this section.
        - Repair all non-transmission-related DTCs first.
        - Repair all transmission DTCs.
        - Rerun on-board diagnostics to verify repair.
    - Carry out Line Pressure Test in this section.
    - Carry out Stall Speed Test in this section.
    - Carry out Diagnostic Routines in this section.
        - Use the Diagnosis by Symptom Index to locate the appropriate routine that best describes the symptom(s). The routine will list all possible components that may cause or contribute to the symptom. Check each component listed; diagnose and repair as required, before repairing the torque converter.

Torque Converter Operation Test

This test verifies that the torque converter clutch control system and the torque converter are operating correctly.

5. Carry out Quick Test; refer to On-Board Diagnostics with scan tool in this section. Check for DTCs; Refer to the Diagnostic Trouble Code Chart.
6. Connect a tachometer to the engine.
7. Bring the engine to normal operating temperature by driving the vehicle at highway speeds for approximately 15 minutes in (D) position.
8. **NOTE:** The TCC will disengage during a 4-3 coast downshift.

   The correct operation of the TCC can be verified by using a scan tool and monitoring the TCC during the 4-3 coast downshift.

   Engine rpm should increase when brake pedal is tapped and decrease about five seconds after pedal is released. If this does not occur, refer to Diagnosis By Symptom — Torque Converter Clutch Operation Concerns in this section.
9. If the vehicle stalls in (D) or MANUAL 2 at idle with vehicle at a stop, move the transmission

range selector lever to MANUAL 1 position. If the vehicle stalls, refer to Diagnosis By Symptom — Torque Converter Clutch Operation Concerns in this section. Repair as required. If the vehicle does not stall in (D), refer to Diagnosis By Symptom in this section.

Visual Inspection

This inspection will identify modifications or additions to the vehicle operating system that may affect diagnosis and transmission operation.

Inspect vehicle for non-Ford approved add-on devices such as:

- Electronic add-on items
  - Air conditioning.
  - Generators (alternators).
  - Engine turbos.
  - Cellular telephones.
  - Cruise controls.
  - CB radios.
  - Linear amplifiers.
  - Backup alarm signals.
  - Electronic brakes for trailer towing.
  - Computers.
- Vehicle modifications.

These items, if not installed correctly, will affect powertrain control module (PCM) or transmission function. Pay particular attention to add-on wiring splices in the PCM harness or transmission wiring harness, abnormal tire size or axle ratio changes.

Leaks; refer to Leakage Inspection in this section.

Shift Linkage Check

Check for a misadjustment in shift linkage by matching the detents in the transmission range selector lever with those in the transmission. If they match, the misadjustment is in the indicator. Do not adjust the shift linkage.

Hydraulic leakage at the manual control valve can cause delay in engagements and/or slipping while operating if the linkage is not correctly adjusted; refer to Section 307-05 for shift linkage adjustment.

Check TSBs and OASIS

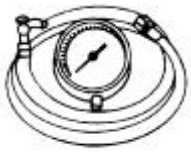
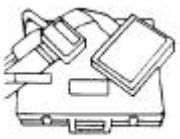
Refer to all Technical Service Bulletins and OASIS messages that pertain to the transmission concerns, and follow the procedure outlined.

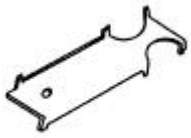
Carry Out On-Board Diagnostics (KOEO, KOER)

After a road test, with the vehicle warm and before disconnecting any connectors, carry out the Quick Test using the scan tool. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the powertrain control system.

Diagnostics

Special Tool(s)

 ST1300-A	UV Leak Detector Kit 164-R0756 or equivalent
 ST1565-A	Pressure Gauge, Transmission Fluid 307-004 (T57L-77820-A)
 ST1137-A	73 III Automotive Meter 105-R0057 or equivalent
 ST1532-A	E4OD Transmission Cable 418-F037 (007-00107) or equivalent
 ST1391-A	Breakout Box, EEC-V Control System 418-049 (T94L-50-EEC-V) or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052 or equivalent scan tool
 ST1389-A	Transmission Tester 307-F016 (007-00130) or equivalent
	Alignment Gauge, TR Sensor

 ST1633-A	307-351 (T97L-70010-A)
 ST1533-A	MLP-TR Cable 418 F107 (007-00111) or equivalent
	Trans Tester TR/MLP Overlay and Manual 007-00131 or equivalent

Diagnosing an electronically controlled automatic transmission is simplified by using the following procedures. One of the most important things to remember is that there is a definite procedure to follow. DO NOT TAKE SHORTCUTS OR ASSUME THAT CRITICAL CHECKS OR ADJUSTMENTS HAVE ALREADY BEEN MADE. Follow the procedures as written to avoid missing critical components or steps. By following the diagnostic sequence, the technician will be able to diagnose and repair the concern the first time.

On-Board Diagnostics with Diagnostic Tool

NOTE: For detailed instruction and other diagnostic methods using the scan tool, refer to the scan tool tester manual and the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

These Quick Tests should be used to diagnose the powertrain control module (PCM) and should be carried out in order.

- Quick Test 1.0-Visual Inspection
- Quick Test 2.0-Set Up
- Quick Test 3.0-Key On, Engine Off
- Quick Test 4.0-Continuous Memory
- Quick Test 5.0-Key On, Engine Running
- Special Test Mode
    - Wiggle Test
    - Output Test Mode
- PCM Reset Mode
- Clearing DTCs
- OBD II Drive Cycle
- Other Scan tool Features
- For further information on other diagnostic testing features using the scan tool, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Other diagnostic methods include the following.
    - Parameter Identification (PID) Access Mode

- Freeze Frame Data Access Mode
- Oxygen Sensor Monitor Mode

Output State Control (OSC) Mode

NOTE: In order to operate OSC, a KOEO On-Demand Self Test and a KOER On-Demand Self Test may need to be carried out to verify that no diagnostic trouble codes (DTCs) related to the digital transmission range (TR) sensor or the vehicle speed sensor (VSS) are present.

Output state control (OSC) allows the technician to operate the main components of the transmission quickly and easily and provides accurate information to correctly diagnose the transmission. OSC allows the technician to take control of certain parameters to operate the transmission. For example, OSC allows the technician to shift the transmission only when commanding a gear change. If the technician commands first gear in OSC, the transmission will remain in first gear until the technician commands the next gear. For another example, the technician can command a shift solenoid to turn on or off while carrying out an electrical circuit check. OSC has two modes of operation for transmission, the BENCH MODE and the DRIVE MODE. Each mode/parameter has a unique set of vehicle operating requirements that the technician is required to meet before being allowed to operate OSC.

OSC — Transmission BENCH MODES

The BENCH MODE is functional only when the vehicle range selector is in PARK or NEUTRAL. The BENCH MODE may be used when the engine is either ON (running) or OFF (not running).

The BENCH MODE allows the technician to operate the following components:

- SSA - Commands the PCM to turn Shift Solenoid 1 OFF or ON.
- SSB - Commands the PCM to turn Shift Solenoid 2 OFF or ON.
- CCS - Commands the PCM to turn Coast Clutch Solenoid OFF or ON.
- TCC - Commands the PCM to turn Torque Converter Solenoid OFF or ON.
- EPC - Commands the PCM to control the Electronic Pressure Control Solenoid to OSC value.

SSA, SSB, CCS and TCC in BENCH MODE:

These OSC functions are used to turn SSA, SSB, CCS and TCC solenoids OFF and ON when carrying out an electrical check.

These OSC functions for parameters SSA, SSB, CCS and TCC allow the technician to choose the following options:

- OFF - turns solenoid OFF.
- ON - turns solenoid ON.
- XXX - cancels OSC value sent.

The vehicle requirements for sending an OSC value for SSA, SSB, CCS and TCC are as follows:

- Key ON and engine OFF (not running).
- Range selector lever in PARK or NEUTRAL.

The vehicle requirements must be met when sending the OSC value for SSA, SSB, CCS and TCC. If the vehicle requirements are not met when sending the OSC value, an error message will appear.

When the error is received, OSC is aborted and must be restarted. After sending the OSC value, if the vehicle requirements are no longer met the error message will not appear but the OSC value will be canceled by the powertrain control module (PCM) (monitor corresponding PID). The OSC value XXX may be sent anytime to cancel OSC.

EPC in BENCH MODE:

The BENCH MODE is used to test the functionality of the transmission's electronic pressure control. During BENCH MODE the EPC solenoid can ramp in increments of 15 psi, from 0 to 90 psi and 90 to 0 psi. The technician should run the engine at approximately 1,500 rpm. The installation of a hydraulic pressure gauge is required to actually test whether the EPC solenoid and associated mechanical and hydraulic components are working correctly.

The OSC functions for the parameter EPC allow the technician to choose the following options:

- 00 - sets EPC pressure to 0 psi.
- 16 - sets EPC pressure to 15 psi.
- 30 - sets EPC pressure to 30 psi.
- 45 - sets EPC pressure to 45 psi.
- 60 - sets EPC pressure to 60 psi.
- 75 - sets EPC pressure to 75 psi.
- 90 - sets EPC pressure to 90 psi.
- XXX - cancels OSC for EPC.

The vehicle requirements for sending an OSC value for EPC in BENCH MODE are as follows:

- Key ON and engine ON (running at approximately 1,500 rpm).
- Range selector lever in PARK or NEUTRAL.

The vehicle requirements must be met when sending the OSC value for SSA, SSB, CCS and TCC. If the vehicle requirements are not met when sending the OSC value, an error message will appear. When the error is received, OSC is aborted and must be restarted. After sending the OSC value, if the vehicle requirements are no longer met the error message will not appear but the OSC value will be canceled by the powertrain control module (PCM) (monitor corresponding PID). The OSC value XXX may be sent anytime to cancel OSC.

OSC — Transmission DRIVE MODES:

The DRIVE MODE allows control of three transmission parameters. Each parameter has a unique set of vehicle operating requirements that the technician is required to meet before being allowed to operate OSC. The recommended procedure, when using the DRIVE MODE, is to control one parameter at a time.

The DRIVE MODE allows the technician to carry out the following functions on the transmission:

- GEAR - Commands the PCM to upshift or downshift.
- TCC - Commands the PCM to lock or unlock the torque converter clutch.
- EPC - Commands a high pressure value during an upshift or downshift.

GEAR in DRIVE MODE:

This OSC function is used to test the transmission gear changes. The advantage of using OSC for changing gears is to allow the technician to exactly duplicate the vehicle condition for the customer

complaint. For example, if the customer complains of 3-4 shift up a steep grade the technician can drive a vehicle up a steep grade and command a 3-4, 4-3 shift over and over again. Also, during the shift change the pressure is the exact pressure the vehicle normally produces. The transmission will stay in the gear that OSC has commanded until OSC commands another gear or OSC is canceled.

The OSC functions for the GEAR parameter allow the technician to choose the following options:

- 1 - PCM selects 1st gear.
- 2 - PCM selects 2nd gear.
- 3 - PCM selects 3rd gear.
- 4 - PCM selects 4th gear.
- XXX - Cancels OSC for GEAR and returns GEAR to normal mode.

The vehicle requirements must be met when sending the OSC value for GEAR. If the vehicle requirements are not met when sending the OSC value, an error message will appear. When the error is received, OSC is aborted and must be restarted. After sending the OSC value, if the vehicle requirements are no longer met the error message will not appear but the OSC value will be canceled by the powertrain control module (PCM) (monitor corresponding PID). The OSC value XXX may be sent anytime to cancel OSC.

Use the TCC parameter in OSC to first turn off the converter clutch before testing the transmission gear changes. This will allow evaluation of just the gear changes. If the torque converter clutch is not turned off, then the PCM may command the torque converter clutch to lock during a shift. This will make it difficult for the technician to tell whether a bad shift is the result of the torque converter clutch or the gear change itself.

The vehicle requirements for sending a GEAR value are as follows:

- Engine is running.
- Range selector lever is in OVERDRIVE.
- Vehicle speed is greater than 3km/h (2 mph).

TCC in DRIVE MODE:

This OSC function is used to test whether the torque converter clutch is engaging and disengaging correctly.

The OSC functions for the TCC parameter allow the technician to choose the following:

- ON - Commands TCC solenoid ON to lock the converter clutch.
- OFF - Commands TCC solenoid OFF to unlock the converter clutch.
- XXX - Cancels OSC for TCC and returns TCC to normal mode.

The vehicle requirements must be met when sending the OSC value for TCC. If the vehicle requirements are not met when sending the OSC value, an error message will appear. When the error is received, OSC is aborted and must be restarted. After sending the OSC value, if the vehicle requirements are no longer met the error message will not appear but the OSC value will be canceled by the powertrain control module (PCM) (monitor corresponding PID). The OSC value XXX may be sent anytime to cancel OSC.

The vehicle requirements for sending the TCC value OFF are as follows:

- Engine is running.

- Range selector lever is in OVERDRIVE.
- Vehicle speed is greater than 3 km/h (2 mph).

The vehicle requirements for sending the TCC value ON are as follows:

- Engine is running.
- Range selector lever is in OVERDRIVE.
- Vehicle speed is greater than 3 km/h (2 mph).
- Transmission fluid temperature (TFT) is between 16°C - 135°C (60°F - 275°F).
- Brake is off when vehicle speed is below 32 km/h (20 mph).
- No excessive load on the engine.

EPC in DRIVE MODE:

This OSC function is used to increase pressures during an upshift or downshift to determine whether the pressure control system is functioning correctly. Harsher shifts indicate that the pressure control system works at higher pressures. The best way to isolate pressure control system problems, is to control the EPC in the bench mode and monitor a pressure gauge.

The OSC functions for the parameter EPC allow the technician to choose the following options:

- 00 - sets EPC pressure to 0 psi.
- 16 - sets EPC pressure to 15 psi.
- 30 - sets EPC pressure to 30 psi.
- 45 - sets EPC pressure to 45 psi.
- 60 - sets EPC pressure to 60 psi.
- 75 - sets EPC pressure to 75 psi.
- 90 - sets EPC pressure to 90 psi.
- XXX - Cancels OSC for EPC.

The vehicle requirements for sending the EPC value in drive mode are as follows:

- Engine is running.
- Range selector lever is in OVERDRIVE.
- Vehicle speed is greater than 3 km/h (2 mph).
- OSC value being sent is greater than what the normal strategy is commanding.

For example: If the PCM is commanding a pressure of 344.75 kPa (50 psi), an OSC value greater than 50 must be sent, sending a value of 60 or 75 would work. If the PCM is commanding 517.125 kpa (75 psi), sending a value of 60 would not work, but sending a value of 90 would. This will make sure that OSC will only send a value greater than what the PCM is commanding, to prevent wear to the transmission due to inadequate pressures.

The vehicle requirements must be met when sending the OSC value for EPC. If the vehicle requirements are not met when sending the OSC value, an error message will appear. When the error is received, OSC is aborted and must be restarted. After sending the OSC value, if the vehicle requirements are no longer met the error message will not appear but the OSC value will be canceled by the powertrain control module (PCM) (monitor corresponding PID). The OSC value XXX may be sent anytime to cancel OSC.

Using Output State Control (OSC) and Monitoring PIDs

To confirm that the OSC value was sent by the Scan Tool and the powertrain control module (PCM) has accepted the OSC substitution, a corresponding PID for each OSC parameter must be monitored. After sending the OSC value the corresponding PID value should equal the OSC value. Additional PIDs should be monitored to help the technician adequately diagnose the transmission. The following is a list of PIDs to monitor while using OSC.

OSC Parameter	Corresponding PID	Additional PIDs
SSA	SSA	SS1F
SSB	SSB	SS2F
SSC	SSC	SS3F
CCS	CCS	CCSF
EPC	EPC	—
TCC	TCC	TCCF, TCCCMD, TCCACT
GEAR	GEAR	TP, RPM, TSS, OSS, TR, TFT, TRANRAT and VS

PID Name	PID description
CCS	Coast clutch solenoid commanded state (not actual state) — ON or OFF
CSSF	Coast clutch solenoid circuit fault — YES or NO
EPC	Electronic pressure control commanded pressure (not actual) — PSI
GEAR	GEAR commanded state (not actual) 1st, 2nd, 3rd or 4th
OSS	Output shaft speed sensor input — RPM
RPM	Engine speed sensor input — RPM
SSA	Shift solenoid No. 1 commanded state (not actual) — ON or OFF
SSB	Shift solenoid No. 2 commanded state (not actual) — ON or OFF
SSC	Shift solenoid No. 3 commanded state (not actual) — ON or OFF
SS1F	Shift solenoid No. 1 circuit fault — YES or NO
SS2F	Shift solenoid No. 2 circuit fault — YES or NO
SS3F	Shift solenoid No. 3 circuit fault — YES or NO
TCCACT	Torque converter clutch slippage (engine speed minus turbine speed) — RPM
TCCCMD	Torque converter clutch solenoid commanded state — duty cycle
TCCF	Torque converter clutch solenoid fault — YES or NO
TFT	Transmission fluid temperature — degrees F° or voltage
TP	Throttle position — voltage
TR	Transmission range sensor — PARK, NEUTRAL, OVERDRIVE
TRANRAT	Actual transmission gear ratio — unitless
TSS	Turbine shaft speed sensor input — RPM
VS	Vehicle speed sensor input — RPM

To confirm that the OSC substitution occurred, SEND the OSC value and monitor the corresponding PID value. If no ERROR MESSAGE was received and the value of the corresponding PID is the same as the value sent from OSC, the OSC substitution was successful.

Transmission Drive Cycle Test

NOTE: Always drive the vehicle in a safe manner according to driving conditions and obey all traffic laws.

NOTE: The Transmission Cycle Test must be followed exactly. Malfunctions must occur four times consecutively for the shift error DTC code to be set and five times consecutively for the continuous torque converter clutch code to set.

NOTE: When carrying out the Transmission Drive Cycle Test refer to the Solenoid Operation Chart for correct solenoid operation.

After carrying out the Quick Test, use the Transmission Drive Cycle Test for checking continuous codes.

1. Record and then erase the Quick Test codes.
2. Warm the engine to normal operating temperature.
3. Make sure the transmission fluid level is correct.
4. With the transmission in OVERDRIVE, moderately accelerate from stop to 80 km/h (50 mph). This allows the transmission to shift into fourth gear. Hold speed and throttle open steady for a minimum of 15 seconds.
5. With transmission in OVERDRIVE, press transmission control switch (TCS) (transmission control illuminator lamp [TCIL] should illuminate) and moderately accelerate from stop to 64 km/h (40 mph). This allows the transmission to shift into third gear. Hold speed and throttle open steady for a minimum of 15 seconds (30 seconds above 4,000 ft altitude).
6. Press TCS (TCIL should turn off) and accelerate from 64 km/h (40 mph) to 80 km/h (50 mph). This allows transmission to shift into fourth gear. Hold speed and throttle position steady for a minimum of 15 seconds.
7. With transmission in fourth gear and maintaining steady speed and throttle opening, lightly apply and release brake to operate stoplamps. Then hold speed and throttle steady for an additional 5 seconds (minimum).
8. Brake to a stop and remain stopped for a minimum of 20 seconds.
9. Repeat Steps 4 through 8 at least five times.
10. Carry out Quick Test and record continuous codes.

After On-Board Diagnostics

NOTE: The vehicle wiring harness, powertrain control module and non-transmission sensors can affect transmission operations. Repair these concerns first.

After the On-Board Diagnostics procedures are completed, repair all DTCs.

Repair all non-transmission-related DTCs first, then repair any transmission-related DTCs. Refer to the following Diagnostic Trouble Code Chart for information on condition and symptoms. This chart will be helpful in referring to the proper manual(s) and to aid in diagnosing internal transmission concerns and

external non-transmission inputs. The pinpoint tests are used in diagnosing electrical concerns of the transmission. Make sure the vehicle wiring harness and the powertrain control module (PCM) are diagnosed as well. The Powertrain Control/Emissions Diagnosis (PC/ED) manual will aid in diagnosing non-transmission-related electronic components.

Before Pinpoint Tests

NOTE: Prior to entering pinpoint tests, check the powertrain control module (PCM) wiring harness for correct connections, bent or broken pins, corrosion, loose wires, correct routing, proper seals and their condition. Check the PCM, sensors and actuators for damage. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

NOTE: If a concern still exists after electrical diagnosis has been carried out, refer to Diagnosis By Symptom in this section.

If DTCs appear while carrying out the on-board diagnostics, refer to the Diagnostic Trouble Code Chart for the appropriate procedure. Prior to entering pinpoint tests, refer to any TSBs and OASIS messages for transmission concerns.

Diagnostic Trouble Code Charts

Diagnostic Trouble Code Chart

Diagnostic Trouble Code	Component	Description	Condition	Symptom	Action
P1111	System	Pass	No concern detected.	Concern not detected by PCM.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0340, P0341, P0344	DI	DI system concern.	Engine rpm circuit failure.	CKP sensor failure/engine will stall or not run. May flash TCIL. [b]	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0237	Manifold Absolute Pressure (MAP) Sensor	MAP sensor out of On-Board Diagnostics range.	MAP sensor signal higher or lower than expected or no response during Dynamic Response (Goose) Test.	—	Rerun On-Board Diagnostics.
P0236	Manifold Absolute Pressure (MAP) Sensor	MAP sensor vacuum circuit failure.	MAP sensor signal higher or lower than expected or no response due to vacuum hose, circuit damaged, disconnected or restricted.	Firm shift feel, late shifts at altitude.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0235	Manifold Absolute Pressure (MAP) Sensor	MAP sensor inactive.	MAP sensor or circuit open, shorted to ground or 5V.	Firm shift feel, late shift at altitude.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1124	Throttle Position (TP) Sensor	TP sensor out of On-Board Diagnostics range.	TP sensor (gasoline engines) not at idle position during KOEO.	—	Rerun at appropriate TP sensor position per the engine application.
P0500, P1502	VSS/ABS	Insufficient or intermittent vehicle speed input.	PCM detected a loss of vehicle speed signal during operation.	Harsh engagements, firm shift feel, abnormal shift schedule, unexpected downshifts may occur at closed throttle, abnormal TCC operation or engages only	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

				at wide open throttle (WOT). May flash TCIL.	
P0500, P1502	VSS/ABS	Insufficient or intermittent vehicle speed input.	PCM detected a loss of vehicle speed signal during operation.	Harsh engagements, firm shift feel, abnormal shift schedule, unexpected downshifts may occur at closed throttle, abnormal TCC operation or engages only at WOT. May flash MIL.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0503	VSS/ABS	Vehicle speed sensor intermittent.	PCM detected a loss, or an unrealistic change of vehicle speed signal during operation.	Possible fluctuation in the speedometer. May flash TCIL.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0781, P0731 [a]	SSA, SSB or Internal Transmission Components	1-2 shift error.	Engine rpm drop not detected when 1-2 shift was commanded by PCM.	Incorrect gear selection depending on failure mode and transmission range selector lever position. Refer to the Solenoid Operation Chart. Shift errors may also be due to other internal transmission concerns such as stuck valves or damaged friction material. May flash TCIL.	Go To Pinpoint Test A .
P0782, P0732, P0733 [a]	SSA, SSB or Internal Transmission Components	2-3 shift error.	Engine rpm drop not detected when 2-3 shift was commanded by PCM.	Incorrect gear selection depending on failure mode and transmission range selector lever position. Refer to the Solenoid Operation Chart. Shift errors may also be due to other internal	Go To Pinpoint Test A .

				transmission concerns such as stuck valves or damaged friction material. May flash TCIL.	
P0783 [a]	SSA, SSB or Internal Transmission Components	3-4 shift error.	Engine rpm drop not detected when 3-4 shift was commanded by PCM.	Incorrect gear selection depending on failure mode and transmission range selector lever position. Refer to the Solenoid Operation Chart. Shift errors may also be due to other internal transmission concerns such as stuck valves or damaged friction material. May flash TCIL.	Go To Pinpoint Test A .
P0122	TP or AP Sensor	TP or AP sensor circuit below minimum voltage (open/shorted to ground).	Voltage above or below specification for On-Board Diagnostics or during normal vehicle operation.	Harsh engagements, firm shift feel, abnormal shift schedule, abnormal TCC operation or does not engage. May flash MIL.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0123	TP or AP Sensor	TP or AP sensor circuit above maximum voltage (short to vehicle power).	Voltage above or below specification for On-Board Diagnostics or during normal vehicle operation.	Harsh engagements, firm shift feel, abnormal shift schedule, abnormal TCC operation or does not engage. May flash MIL.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1120	Throttle Position (TP) Sensor	TP sensor voltage lower than expected.	Voltage below specification.	Harsh engagements, firm shift feel, abnormal shift schedule, abnormal TCC operation or does not engage.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1780	TCS	TCS not changing state.	TCS not cycled during On-Board	No overdrive cancel when	Rerun diagnostics and cycle switch.

			Diagnostics/circuit open or shorted.	switch is cycled.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0712	TFT Sensor	157°C (315°F) indicated, TFT sensor circuit grounded.	Voltage drop across TFT sensor exceeds scale set for temperature of 157°C (315°F).	TCC and stabilized shift schedule may be enabled sooner after cold start. May flash TCIL.	Go To Pinpoint Test B .
P0713	TFT Sensor	-40°C (-40°F) indicated, TFT sensor circuit open.	Voltage drop across TFT sensor exceeds scale set for temperature -40°C (-40°F).	TCC and stabilized shift schedule may be enabled sooner after cold start. May flash TCIL.	Go To Pinpoint Test B .
P1711	TFT Sensor	TFT sensor out of On-Board Diagnostics range.	Transmission not at operating temperature during On-Board Diagnostics.	—	Warm vehicle to normal operating temperature and rerun On-Board Diagnostics.
P1713	TFT	No change in TFT - Low range.	PCM has detected no TFT change at low range during operation.	May flash TCIL.	Go To Pinpoint Test B .
P1718	TFT	No change in TFT - High range.	PCM has detected no TFT change at high range during operation.	May flash TCIL.	Go To Pinpoint Test B .
P1783	TFT Sensor	Transmission overtemp condition.	Transmission fluid temperature exceeded 132°C (270°F).	Slight increase in electronic pressure control pressure when rpms are greater than 2,500. May flash TCIL.	Go To Pinpoint Test B .
P1460 P1463 P1464	A/C	A/C switch error.	DTC can result from A/C being ON during On-Board Diagnostics.	Failed on — electronic pressure control pressure slightly low with A/C OFF. Failed off — electronic pressure control pressure slightly low with A/C ON.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0705	Digital TR Sensor	Digital TR circuit failure.	Digital TR circuits, indicating an invalid pattern in TR_D. Condition	Increase in EPC pressure (harsh shifts). Defaults to (D)	Go To Pinpoint Test D .

			caused by a short to ground or an open in TR4, TR3A, TR2, and/or TR1 circuits.	or D for all gear positions. In (D) position transmission stuck in D or MANUAL 2. May flash MIL.	
P0708	Digital TR	Digital TR sensor circuit TR3A open.	Digital TR sensor circuit TR3A reading 2.6v - 5.0v (open circuit).	Increase in EPC pressure. Defaults to (D) or D for all gear ranges. May flash MIL.	Go To Pinpoint Test D .
P1702	Digital TR	Intermittent DTC codes P0705 or P0708.	Refer to DTC codes P0705 or P0708 condition.	Refer to DTC codes P0705 or P0708 symptom. May flash TCIL.	Go To Pinpoint Test D .
P1704	Digital TR	Digital TR circuit reading in between gear position during KOEO.	Digital TR sensor or shift cable incorrectly adjusted, or digital TR circuit failure.	Wrong commanded EPC pressure. Digital TR reading the wrong gear position.	Go To Pinpoint Test D .
P1705	Digital TR Sensor	Digital TR sensor circuits not reading PARK or NEUTRAL during KOEO/KOER.	KOEO/KOER not run in PARK or NEUTRAL, or Digital TR circuit failure.	Rerun on-board diagnostic in Park. KOEO/KOER.	Go To Pinpoint Test D .
P0102, P0103, P1100, P1101	MAF Sensor	MAF sensor DTC.	MAF sensor system fails to operate in a normal manner, which may cause a transmission concern.	High electronic pressure control pressure. Firm shifts and engagements. May flash TCIL.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0107	BARO	BARO circuit failure.	BARO signal lower than expected.	Firm shift feel, late shifts at altitude.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0108	BARO	BARO circuit failure.	BARO signal higher or lower than expected.	Firm shifts, late shifts at altitude.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1703	BPP Switch	Brake not actuated during On-Board Diagnostics.	Brake not cycled during KOER.	Failed on or not connected — TCC will not engage at less than one-third throttle.	Rerun On-Board Diagnostic and activate BPP switch. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

P0730, P0751	BPP	BPP switch circuit failed.	BPP circuit failure.	Failed off — TCC will not disengage when brake is applied.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0750 [b]	SSA	Shift solenoid circuit failure.	SSA circuit failed to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during KOEO.	Incorrect gear selection depending on failure mode and transmission range selector lever position. Refer to the Solenoid Operation Chart. May flash MIL.	Go To Pinpoint Test A .
P0753	SSA	Shift solenoid circuit failure.	SSA circuit failed to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during KOEO.	Incorrect gear selection depending on failure mode and transmission range selector lever position. Refer to the Solenoid Operation Chart. May flash TCIL.	Go To Pinpoint Test A .
P0755 [b]	SSB	SSB circuit failure.	SSB circuit fails to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during KOEO.	Incorrect gear selection depending on failure mode and transmission range selector lever position. Refer to the Shift Solenoid Operation Chart. May flash MIL.	Go To Pinpoint Test A .
P0758	SSB	SSB circuit failure.	SSB circuit fails to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during KOEO.	Incorrect gear selection depending on failure mode and transmission range selector lever position. Refer to the Shift Solenoid Operation Chart. May flash TCIL.	Go To Pinpoint Test A .
P1714	SSA	SSA malfunction.	Mechanical failure of the solenoid detected.	Incorrect gear selection depending on	Go To Pinpoint Test H .

				condition, mode and manual lever position. Refer to Solenoid Operation Chart. May flash TCIL. May flash MIL.	
P1715	SSB	SSB malfunction.	Mechanical failure of the solenoid detected.	Incorrect gear selection depending on condition, mode and manual lever position. Refer to Solenoid Operation Chart. May flash MIL.	Go To Pinpoint Test H .
P1636	SSA, SSB	Inductive signature chip communication error.	PCM has detected an internal error.	Incorrect gear selection depending on condition, mode and manual lever position. Refer to Solenoid Operation Chart. May flash MIL.	Go To Pinpoint Test H .
P1754 [b]	CCS	CCS circuit failure.	CCS failed to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during KOEO.	Failed off — no third gear engine braking in overdrive cancel. Failed on — third gear engine braking in OVERDRIVE range. Coast clutch may be damaged causing eventual failure. May flash TCIL.	Go To Pinpoint Test G .
P0740 [b]	TCC Solenoid	TCC solenoid circuit failure.	TCC solenoid circuit fails to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during KOEO.	Short circuit — engine stalls in DRIVE or MANUAL 2 at idle with brake applied. Open circuit — TCC never engaged. May flash TCIL.	Go To Pinpoint Test C .
P0741 [a]	TCC	TCC slippage detected.	The PCM picked up an excessive amount of TCC slippage during	TCC slippage erratic or no torque converter	Refer to Diagnosis By Symptom in this section.

			normal vehicle operation.	clutch operation. May flash TCIL.	
P0743 [b]	TCC Solenoid	TCC solenoid circuit failure.	TCC solenoid circuit fails to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during KOEO.	Short circuit — engine stalls in DRIVE or MANUAL 2 at idle with brake applied. Open circuit — TCC never engaged. May flash MIL.	Go To Pinpoint Test C .
P1740	TCC	TCC malfunction.	Mechanical failure of the solenoid detected.	Harsh shift, may flash TCIL.	Go To Pinpoint Test H .
P1744 [a]	TCC	TCC slippage detected.	The PCM picked up an excessive amount of TCC slippage during normal vehicle operation.	TCC slippage erratic or no torque converter clutch operation. May flash MIL.	Refer to Diagnosis By Symptom in this section.
P1746 [b]	EPC	PCM failure — electronic pressure control driver.	Current through EPC circuit is checked and compared after a time delay. An error will be noted if tolerance is exceeded during KOEO and continuous On-Board Diagnostics.	Open circuit — causes maximum electronic pressure control, harsh engagements and shifts. May flash TCIL.	Go To Pinpoint Test E .
P1747 [b]	EPC	EPC circuit failure, shorted circuit or PCM.	Current through EPC circuit is checked and compared after a time delay. An error will be noted if tolerance is exceeded during KOEO and continuous On-Board Diagnostics.	Short circuit — causes minimum electronic pressure control pressure (minimum capacity). Limits engine torque (partial fuel shut-off, heavy misfire). May flash MIL.	Go To Pinpoint Test E .
P1760	EPC	EPC Signal Intermittent Short.	PCM has detected an intermittent short.	Short circuit causes minimum EPC pressure (minimum capacity). May flash TCIL.	Go To Pinpoint Test E .
P1280	ICP Sensor	ICP sensor circuit failure. Out of range low.	Open/grounded circuit, biased sensor or PCM.	May result in firm shifts.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

P1281	ICP Sensor	ICP sensor circuit failure. Out of range high.	Short circuit to 5 volt reference, biased sensor or PCM.	May result in firm shifts.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0715	TSS	Insufficient Input from TSS sensor.	PCM Has detected a loss of TSS signal during operation.	Harsh shifts. Set DTC, May flash TCIL, May flash MIL Schedule Operation.	Go To Pinpoint Test F .
P0717	TSS	TSS Signal Intermittent	PCM has detected an intermittent TSS signal	Harsh shifts, or erratic shifts. Set DTC, May flash TCIL.	Go To Pinpoint Test F .
P0718	TSS	TSS Signal Noisy.	PCM has detected a noisy TSS sensor signal.	Harsh shifts, or erratic shifts. Set DTC May flash TCIL.	Go To Pinpoint Test F .
P0720	OSS	Insufficient Input from OSS Sensor.	PCM has detected a loss of OSS signal during operation.	Set DTC, Flash TCIL. May flash MIL.	Go To Pinpoint Test F .
P0721	OSS	OSS Signal Noisy.	PCM has detected a noisy OSS sensor signal.	Set DTC. May flash TCIL.	Go To Pinpoint Test F .
P0722	OSS	Insufficient Input from OSS Sensor.	PCM has detected a loss of OSS signal during operation.	Set DTC, Flash TCIL. May flash TCIL.	Go To Pinpoint Test F .
P1781	4x4L	4x4 low switch failure.	Switch closed or shorted during KOEO.	Early or delayed shifts.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1729	4x4L	4x4 low switch failure.	Circuit open/closed. Shorted during KOEO.	Early or delayed shifts.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

[b] Distributor ignition (DI) system.
[a] May also be generated by other non-electronic-related transmission hardware condition.
[b] Output circuit check, generated only by electrical conditions.

Rotunda Transmission Tester

The Transmission Tester is used to diagnose the electronically controlled transmission and is used in conjunction with the pinpoint tests. The tests should be carried out in order. Installing the Transmission Tester allows separation of the vehicle electronics from transmission electronics, refer to the Transmission Tester manual for these tests and instructions.

- Bench Testing—Engine Off
- Resistance/Continuity Test
- Solenoid Voltage Test
- Dynamic Testing—Engine On

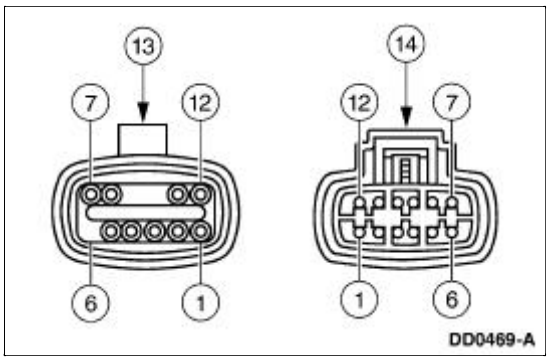
- EPC Solenoid
- Transmission Engagements
- Upshifts/Downshifts
- Torque Converter Clutch (TCC) Engagement
- Coast Clutch
- Digital Transmission Range (TR) Sensor Testing
- Resistance/Continuity Test
- Sensor Tests
- Switch Test—PARK/NEUTRAL, Backup Lamp and Optional Circuits

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Transmission Connector Layouts

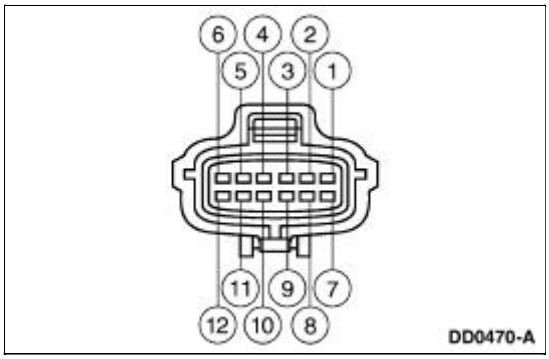
For connector number and pin location, refer to the Wiring Diagram Manual.

Transmission Vehicle Harness Connector



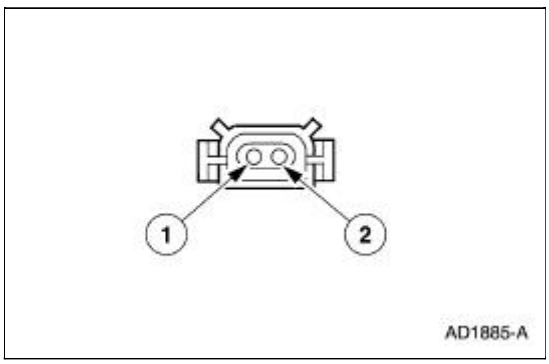
12-Pin Connector	Description	Connector Pin Gas
1	Vehicle Power (VPWR)	71, 97
2	Shift Solenoid 2	11
3	Shift Solenoid 1	6
4	Torque Converter Clutch	54
5	Coast Clutch Solenoid	20
6	—	—
7	Transmission Fluid Temperature Sensor	37
8	Signal Return (SIG RTN)	91
9	—	—
10	—	—
11	Electronic Pressure Control	81
12	Electronic Pressure Control Power	71, 97
13	Solenoid Body Connector	—
14	Harness Connector	—

Digital Transmission Range (TR) Sensor Connector



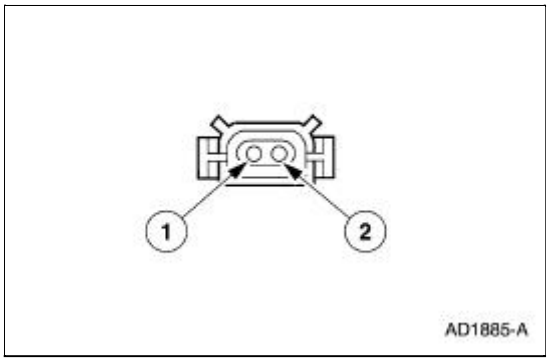
Pin Number	Circuit Function	EEC-V Pin
1	Not Used	—
2	SIG RTN	91
3	TR3A	64
4	TR1	34
5	TR2	49
6	TR4	50
7	Not Used	—
8	Not Used	—
9	FSD PWR FD	—
10	STR Control	—
11	Back Up	—
12	STR to INT	—

Turbine Shaft Speed Sensor (TSS) Harness Connector



Pin Number	Circuit	Circuit Function
1	59	Turbine Shaft Speed Sensor (TSS)
2	91	Signal Return

Output Shaft Speed Sensor (OSS) Harness Connector



Pin Number	Circuit	Circuit Function
1	84	Output Shaft Speed Sensor (OSS)
2	91	Signal Return

Digital Transmission Range (TR) Sensor Diagnosis Chart

Selector Position	PID: TR	PID: TR_D				PID: TR_V (volts)
		TR4	TR3A	TR2	TR1	TR3A (PCM pin 64 to SIG RTN)
PARK	P/N	0	0	0	0	0.0 volts
In Between	REV	0	1	0	0	1.3 - 1.8 Volts
REVERSE	REV	1	1	0	0	1.3 - 1.8 Volts
In Between	REV	0	1	0	0	1.3 - 1.8 Volts
NEUTRAL	NTRL	0	1	1	0	1.3 - 1.8 Volts
In Between	O/D [a]	1	1	1	0	1.3 - 1.8 Volts
OVERDRIVE	O/D [a]	1	1	1	1	1.3 - 1.8 Volts
In Between	MAN 2	1	0	1	1	0.0 Volts
MANUAL 2	MAN 2	1	0	0	1	0.0 Volts
In Between	MAN 2	1	0	1	1	0.0 Volts
MANUAL 1	MAN 1	0	0	1	1	0.0 Volts

[a] Will read DRIVE if O/D is canceled

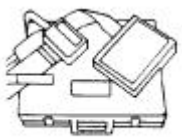
A. TR_V is the voltage at the PCM pin 64 (TR3A Circuit) to signal return.
B. "In Between" reading could be caused by a shift cable or digital TR sensor misaligned or a digital TR sensor circuit failure of TR1, TR2, TR3A, or TR4.
C. TR_D: 1= Open digital TR switch, 0= Closed digital TR switch.
D. EEC-V Control System Breakout Box Readings: Taken from PCM signal pins for TR1, TR2, TR3A, TR4 to signal return.
    - **Voltages for TR1, TR2, TR4:**
    - 0 = 0.0 volts.
    - 1 = 9.0 - 14.0 volts.
    - **Voltage for TR3A:**
    - 0 = 0.0 volts.
    - 1 = 1.3 - 1.8 volts.
    - 1.8 - 5.0 volts = Invalid Reading (open in wires or bad resistor in digital TR sensor).

Wiggle Test Information for Open/Shorts

A. TR4, TR3A, TR2, and TR1 are all closed in PARK. PARK is a good position to check for intermittent open circuits (with scan tool monitoring TR_D).
B. TR4, TR3A, TR2, and TR1 are all open in OVERDRIVE, so OVERDRIVE is a good position to check for shorts to ground. To determine the shorted components while observing TR_D, unplug the TR and see if the short goes away. If the short is still present, unplug the transaxle harness and see if the short goes away. If the short is still present, it is in the PCM or vehicle harness. Remove the suspect circuit(s) wire terminal from the PCM connector. If the short is still present, the PCM has an internal failure, otherwise the failure is in the vehicle harness.

Pinpoint Tests — OSC Equipped Vehicles

Special Tool(s)

 ST1565-A	Pressure Gauge, Transmission Fluid 307-004 (T57L-77820-A)
 ST1137-A	73 III Automotive Meter 105-R0057 or equivalent
 ST1532-A	E4OD Transmission Cable 418-F037 (007-00107) or equivalent
 ST1391-A	Breakout Box, EEC-V Control System 418-049 (T94L-50-EEC-V) or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052 or equivalent scan tool
 ST1389-A	Transmission Tester 307-F016 (007-00130) or equivalent
 ST1533-A	MLP-TR Cable 418 F107 (007-00111) or equivalent
	Trans Tester TR/MLP Overlay

	and Manual 007-00131 or equivalent

Any time an electrical connector or solenoid body is disconnected, inspect the connector for terminal condition, corrosion and contamination. Also inspect the connector seal for damage. Clean, repair or install a new connector as required.

Shift Solenoids Pre-Diagnosis

Use the following shift solenoid operation information when carrying out Pinpoint Test A.

Solenoid Operation Chart

Transmission Range Selector Lever Position	PCM Commanded Gear	SSA	SSB	TCC	CCS
P/R/N	1	ON	OFF	OFF	OFF
(D)	1	ON	OFF	a a	OFF
(D)	2	ON	ON	a	OFF
(D)	3	OFF	ON	a	OFF
(D)	4	OFF	OFF	a	OFF
(D) Cancel	First Through Third Gear Only, SSA, SSB, TCC, Same as OVERDRIVE, CCS Always On.				
MANUAL 2	2	ON	ON	a	ON
MANUAL 1	2	OFF	OFF	a	ON
MANUAL 1	1	ON	OFF	a	ON

[a] Powertrain control module-controlled.

Shift Solenoid Failure Mode Chart "Always Off"

Failed off due to powertrain control module (PCM) or vehicle wiring concerns, electrically or hydraulically stuck off.

	Gear Lever Position		
SSA ALWAYS OFF:	(D)	2	1
PCM Gear Commanded	Actual Gear Obtained		
1	4	2	2
2	3	2	2
3	3	2	2
4	4	2	2

SSB ALWAYS OFF:	Gear Lever Position		
	(D)	2	1
PCM Gear Commanded	Actual Gear Obtained		
1	1	2	1
2	1	2	1
3	4	2	2
4	4	2	1

Shift Solenoid Failure Mode Chart "Always On"

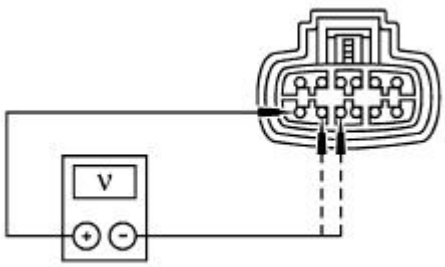
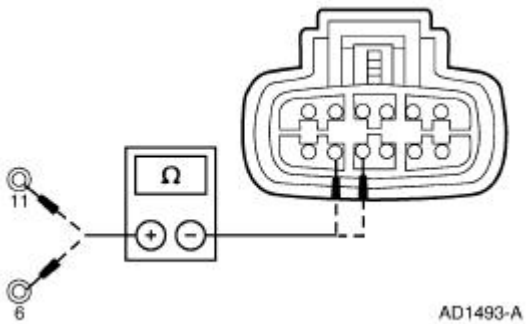
Failed on due to powertrain control module (PCM) or vehicle wiring concerns, electrically or hydraulically stuck off.

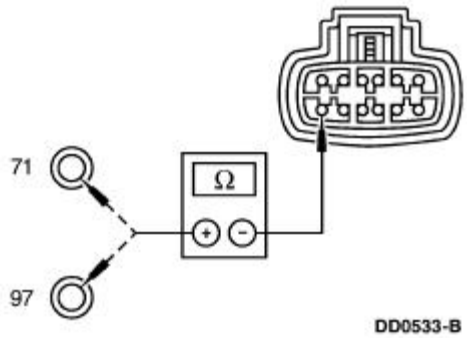
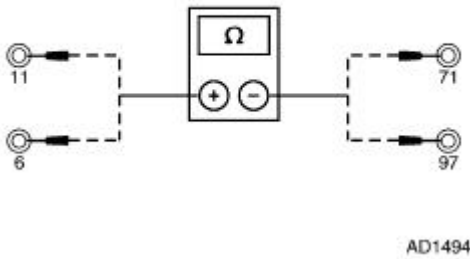
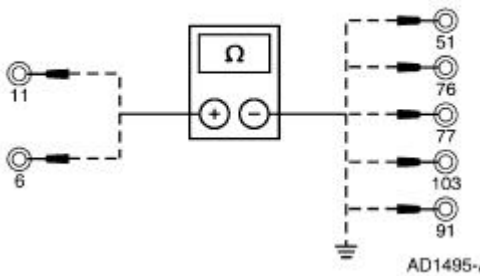
SSA ALWAYS ON:	Gear Lever Position		
	(D)	2	1
PCM Gear Commanded	Actual Gear Obtained		
1	1	2	1
2	2	2	2
3	2	2	2
4	1	2	1

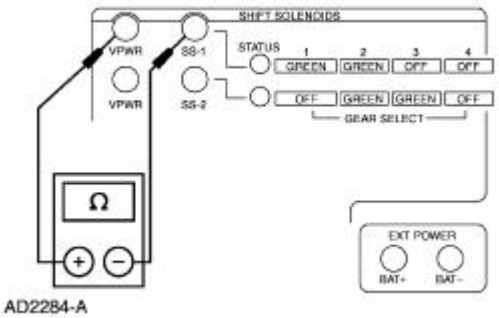
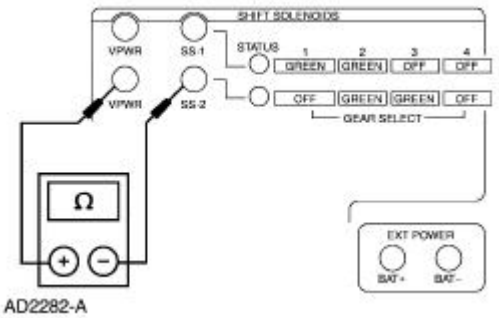
SSB ALWAYS ON:	Gear Lever Position		
	(D)	2	1
PCM Gear Commanded	Actual Gear Obtained		
1	2	2	2
2	2	2	2
3	3	2	2
4	3	2	2

PINPOINT TEST A: SHIFT SOLENOID

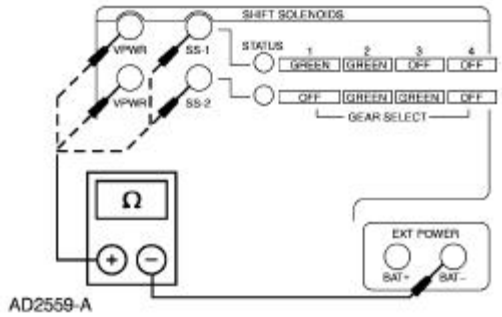
Test Step	Result / Action to Take
NOTE: Refer to the Transmission Connector Layouts preceding these pinpoint tests.	
A1 ELECTRONIC DIAGNOSTICS ● Check to make sure the transmission harness connector is fully seated, terminals are engaged in the connector and in good condition before proceeding. ● Install Scan Tool. ● Carry out the KOEO Test until continuous DTCs have been displayed.	**Yes** REMAIN in OTM. GO to A2 . **No** PRESS START. If the

• Enter the Output Test Mode (OTM). • Select the ALL ON Mode. Push START to turn outputs on. Push STOP to turn outputs off. • **Does the vehicle enter OTM?**	vehicle does not enter OTM, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
A2 CHECK THE ELECTRICAL SIGNAL OPERATION	
• Disconnect: Transmission Connector. • **CAUTION: Remove the heat shield, if so equipped, from the transmission before removing the connector. Remove the solenoid body connector by pushing on the center tab and pulling on the harness connector. Do not attempt to pry the tab with a screwdriver. Always install the heat shield when the procedure is completed.** • Use a mirror to inspect both ends of the connector for damage or pushed-out pins, corrosion, loose wires and missing or damaged seals. • Connect a VOM positive lead to the VPWR pin 1 and the negative test lead to the appropriate solenoid signal circuit pins 2 and 3 of the transmission vehicle harness connector.  DD0531-A • Place VOM on the 20-volt scale. • While observing the VOM, press START and STOP to cycle the solenoid output on and off. • **Is the solenoid output voltage changed to approximately battery voltage?**	**Yes** GO to A5 . **No** GO to A3 .
A3 CHECK THE CONTINUITY OF THE SOLENOID SIGNAL AND VPWR CIRCUITS	
• Key in OFF position. • Disconnect: Powertrain Control Module (PCM). • Inspect for damaged or pushed-out pins, corrosion or loose wires. • Install the EEC-V Control System Breakout Box. • Measure the resistance between the PCM signal test pins 11 and 6 at the EEC-V Control System Breakout Box and the signal pins 2 and 3 at the transmission harness connector.  AD1493-A • Measure the resistance between the VPWR test pins 71 or	**Yes** GO to A4 . **No** REPAIR the open circuit (s). REMOVE the EEC-V Control System Breakout Box. RECONNECT all of the components. REPEAT the Quick Tests.

97 at the EEC-V Control System Breakout Box and the VPWR pin 1 at the transmission harness connector.  ● **Is each resistance less than 5 ohms?**	
A4 CHECK THE SHIFT SOLENOID CIRCUITS FOR SHORTS TO POWER AND GROUND	
● Measure the resistance between PCM signal test pins 11 and 6 and the VPWR test pins 71 and 97 at the EEC-V Control System Breakout Box.  ● Measure the resistance between PCM signal test pins 11 and 6 and test pins 51, 76, 77, 103 and 91 at the EEC-V Control System Breakout Box and chassis ground.  ● **Is each resistance greater than 10,000 ohms?**	**Yes** GO to A5 . **No** REPAIR the short circuit (s). REMOVE the EEC-V Control System Breakout Box. RECONNECT all of the components. REPEAT the Quick Tests.
A5 SOLENOID FUNCTIONAL TEST	
● Install the Transmission Tester to the transmission connector. ● **NOTE:** The LED will turn GREEN when the solenoid activates and turn off when deactivated. The LED will turn RED if an ACTIVATED solenoid is shorted to battery positive. The LED will remain off if an ACTIVATED solenoid is shorted to ground or no continuity (open circuit). ● Carry out the Solenoid Voltage Test. ● **Does the solenoid (LED GREEN) activate?**	**Yes** GO to A6 . **No** GO to A7 .
A6 TRANSMISSION DRIVE TEST	
● Connect: Powertrain Control Module (PCM). ● Carry out the Dynamic Testing — Engine ON.	**Yes** INSTALL a new PCM.

• **Does the vehicle upshift when commanded by the tester?**	ERASE all codes and CARRY OUT the Transmission Drive Cycle Test. RERUN the Quick Tests. If DTCs are still present, REFER to Diagnosis By Symptom in this section. **No** GO to A7 .
A7 CHECK THE RESISTANCE OF THE SOLENOIDS	
NOTE: Refer to the Transmission Tester for terminal locations. • Place the bench/drive switch to the BENCH mode. • Rotate the gear select switch to the OHMS CHECK position. • Connect the ohmmeter negative lead to the SS1 jack and the positive lead to the VPWR jack on the tester. This is to test SSA.  AD2284-A • Record the resistance. The resistance should be between 17 and 22 ohms within a temperature range of 4°C - 66°C (40°F - 150°F). • Connect the ohmmeter negative lead to the SS2 jack and the positive lead to the VPWR jack on the tester. This to test SSB.  AD2282-A • Record the resistance. The resistance should be between 17 and 22 ohms within a temperature range of 4°C - 66°C (40°F - 150°F). • **Is the resistance for each solenoid between 17 and 22 ohms?**	**Yes** GO to A8 . **No** INSTALL a new solenoid body assembly. RECORD and ERASE the codes. REPEAT the Quick Tests.
A8 CHECK THE SOLENOIDS FOR SHORT TO GROUND	
• Check for continuity between the BAT(-) jack (engine ground) and the appropriate jack with a digital ohmmeter or other low current tester (less than 200 milliamps). Connection should show infinite resistance (no continuity). **Solenoid** | **Tester Jack**	**Yes** INSTALL a new solenoid body assembly. RECORD and ERASE the codes. REPEAT the Quick Tests. **No**

SSA	SS1/VPWR
SSB	SS2/VPWR

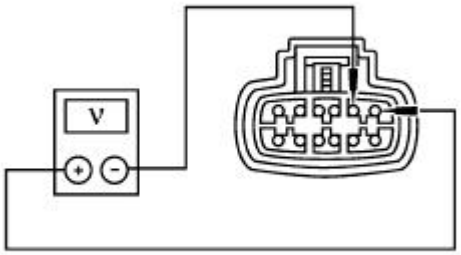


- **Does the connection show continuity?**

GO to Diagnosis By Symptom in this section.

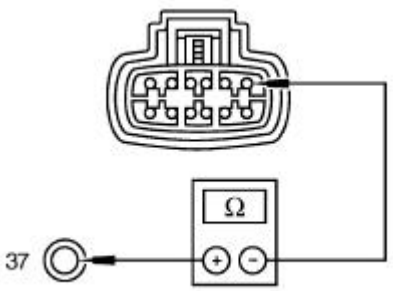
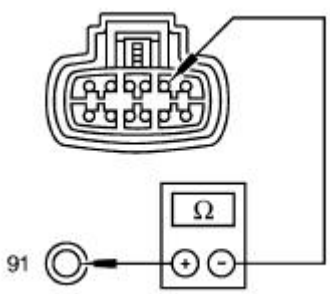
PINPOINT TEST B: TRANSMISSION FLUID TEMPERATURE (TFT) SENSOR

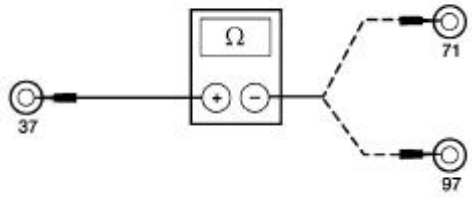
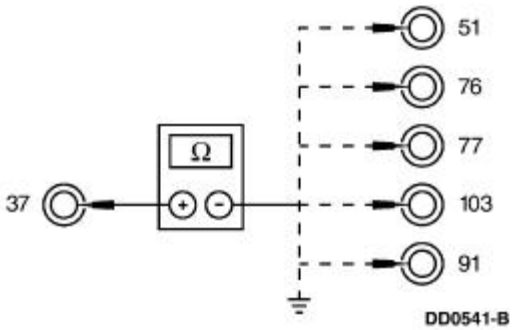
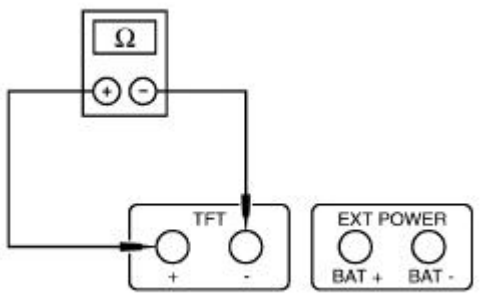
Test Step	Result / Action to Take
NOTE: Refer to the Transmission Connector Layouts preceding these pinpoint tests.	
B1 ELECTRONIC DIAGNOSTICS	
• Check to make sure the transmission harness connector is fully seated, terminals are fully engaged in the connector and in good condition before proceeding. • **Have the above items been checked?**	**Yes** GO to B2. **No** Carry out checks. ERASE the codes. REPEAT the Quick Tests.
B2 CHECK THE ELECTRICAL SIGNAL OPERATION	
• Key in OFF position. • Disconnect: Transmission Connector. • **CAUTION: Remove the heat shield, if so equipped, from transmission before removing the connector. Remove the solenoid body connector by pushing on the center tab and pulling on the harness connector. Do not attempt to pry the tab with a screwdriver. Always install the heat shield when the procedure is completed.** • Use a mirror to inspect both ends of the connector for damage or pushed-out pins, corrosion, loose wires and missing or damaged seals. • Connect a VOM positive lead to the TFT signal circuit pin 7 and the negative test lead to the SIG RTN circuit pin 8 of the transmission harness connector.	**Yes** GO to B6. **No** GO to B3.



DD0537-A

- Place the VOM on the 20-volt scale.
- Key in ON position.
- **Is the voltage between 4.75 and 5.25 volts?**

B3 CHECK THE CONTINUITY OF THE TFT SIGNAL AND SIG RTN CIRCUITS	
• Key in OFF position. • Disconnect: Powertrain Control Module (PCM). • Inspect for damaged or pushed-out pins, corrosion or loose wires. • Install the EEC-V Control System Breakout Box. • Measure the resistance between the PCM signal test pin 37 at the EEC-V Control System Breakout Box and the signal pin 7 at the transmission harness connector.  DD0538-B • Measure the resistance between the PCM SIG RTN test pin 91 at the EEC-V Control System Breakout Box and the SIG RTN pin 8 at the transmission harness connector.  DD0539-B • **Is each resistance less than 5 ohms?**	**Yes** GO to B4 . **No** REPAIR the open circuits. REMOVE the EEC-V Control System Breakout Box. RECONNECT all of the components. REPEAT the Quick Tests.
B4 CHECK THE TFT SIGNAL CIRCUIT FOR SHORT TO VPWR AND GROUND	
• Measure the resistance between the PCM signal test pin 37 and VPWR test pins 71 and 97 at the EEC-V Control System Breakout Box.	**Yes** GO to B5 . **No** REPAIR the short circuit(s). REMOVE the EEC-V Control System

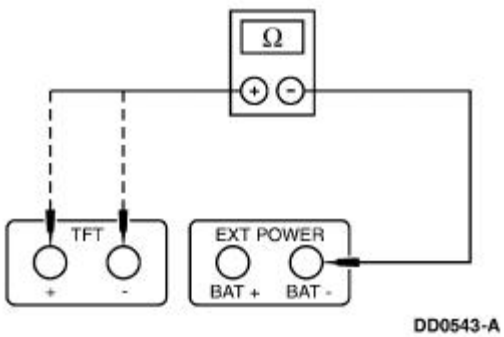
 D17682-A ● Measure the resistance between the PCM signal test pin 37 and test pins 51, 76, 77, 103, 91 at the EEC-V Control System Breakout Box and chassis ground.  DD0541-B ● **Is each resistance greater than 10,000 ohms?**	Breakout Box. RECONNECT all of the components. REPEAT the Quick Tests.
B5 CHECK THE RESISTANCE OF THE TFT SENSOR ● Install the Transmission Tester to the transmission connector. ● Set the bench/drive switch to the BENCH mode. ● Rotate the gear select switch to the OHMS CHECK position. ● **NOTE:** While carrying out Tests 1 and 2 below, observe resistance. DTC P0713 is set if the resistance value exceeds 1,062 k ohms (open circuit). DTC P0712 is set if the resistance value falls below 597 k ohms (short circuit). ● Connect the ohmmeter negative lead to the -TFT jack and the positive lead to the +TFT jack on the tester.  DD0542-A ● **TEST 1** ● Record the resistance. Resistance should be approximately in the following ranges: **Transmission Fluid Temperature** **°C** / **°F** / **Resistance (Ohms)** -40 to -20 / -40 to -4 / 1,062 k-284 k -19 to -1 / -3-31 / 284 k-100 k 0-20 / 32-68 / 100 k-37 k	**Yes** GO to B6 . **No** INSTALL a new solenoid assembly. RECORD and ERASE the codes. REPEAT the Quick Tests.

21-40	69-104	37 k-16 k
41-70	105-158	16 k-5 k
71-90	159-194	5 k-2.7 k
91-110	195-230	2.7 k-1.5 k
111-130	231-266	1.5 k-0.8 k
131-150	267-302	0.8 k-0.54 k

- **TEST 2**
- Check for an intermittent short or open.
- If the resistance was between 0.8k and 100k ohms, carry out the following test. If the transmission is cold, start and run the engine until transmission reaches its normal operating temperature. If the transmission is warm, allow the transmission to cool. Check the TFT sensor resistance again. Compare the resistance with the initial resistance. The resistance should decrease if the transmission was warmed and should increase if the transmission was allowed to cool. If the correct change in resistance occurs, repeat the Quick Test.
- **Is the resistance in the specified range?**

B6 CHECK THE TFT SENSOR FOR SHORT TO GROUND

- Check for continuity between the BAT(-) jack (engine ground) and the appropriate jack (-TFT or +TFT) with a digital ohmmeter or other low current tester (less than 200 milliamps). Connection should show infinite resistance (no continuity).



DD0543-A

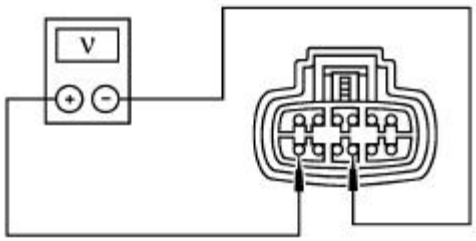
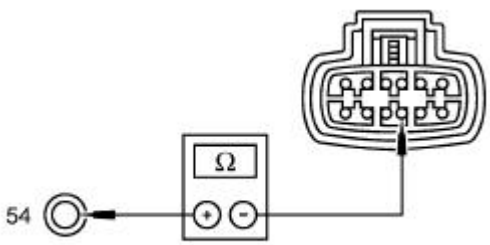
- **Does the connection show continuity?**

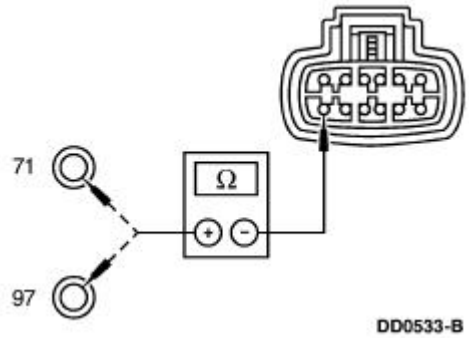
Yes
INSTALL a new solenoid assembly. REPEAT the Quick Tests.

No
INSTALL a new PCM. REPEAT the Quick Tests. If the DTC is still present and overtemp condition exists, CHECK the fluid condition. CHECK the overheat condition. REFER to Diagnosis By Symptom in this section. REPAIR as required. REPEAT the Quick Tests.

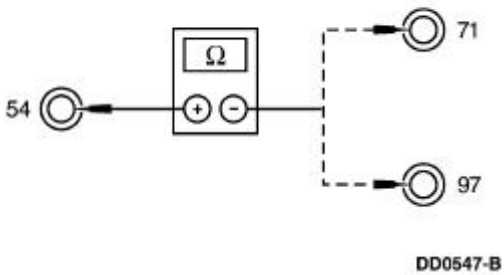
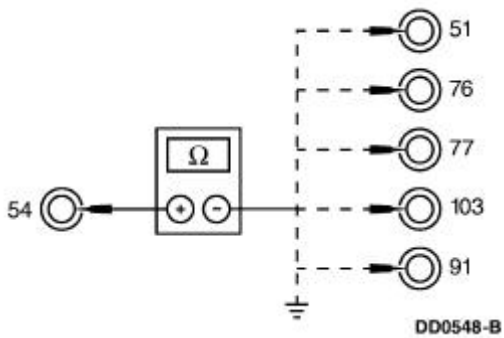
PINPOINT TEST C: TORQUE CONVERTER CLUTCH (TCC) SOLENOID

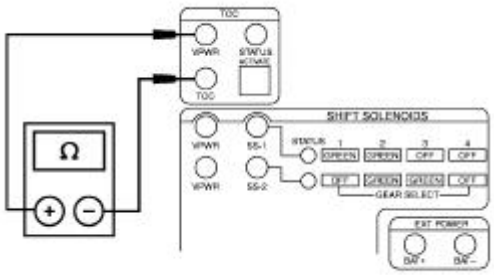
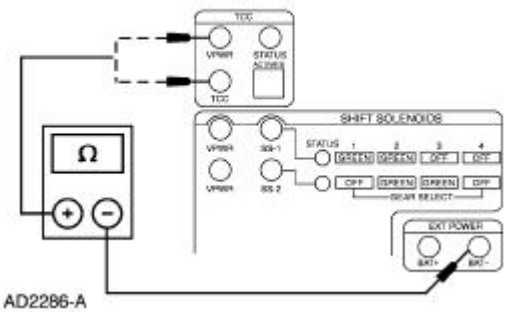
Test Step	Result / Action to Take
NOTE: Refer to the Transmission Connector Layouts preceding these pinpoint tests.	
C1 ELECTRONIC DIAGNOSTICS ● Check to make sure the transmission harness connector is fully seated, terminals are engaged in the connector and in good condition before proceeding. ● Install Scan Tool. ● Carry out KOEO Test until continuous DTCs have been displayed. ● Enter Output Test Mode (OTM).	**Yes** REMAIN in OTM. GO to C2 . **No** PRESS START. If vehicle does not enter OTM,

• Select the ALL ON Mode. Push START to turn the outputs on. Push STOP to turn the outputs off. • **Does the vehicle enter OTM?**	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
C2 CHECK THE ELECTRICAL SIGNAL OPERATION	
• Disconnect: Transmission Connector. • **CAUTION: Remove the heat shield, if so equipped, from the transmission before removing the connector. Remove the solenoid body connector by pushing on the center tab and pulling on the harness connector. Do not attempt to pry the tab with a screwdriver. Always install the heat shield when the procedure is completed.** • Use a mirror to inspect both ends of the connector for damaged or pushed-out pins, corrosion, loose wires and missing or damaged seals. • Connect a VOM positive lead to the VPWR circuit pin 1 and the negative test lead to the TCC signal circuit pin 4 of the transmission vehicle harness connector.  DD0545-A • Place the VOM on the 20-volt scale. • While observing the VOM, press start and stop to cycle the solenoid output on and off. • **Does the solenoid output voltage change to approximately battery voltage?**	**Yes** GO to C6 . **No** GO to C3 .
C3 CHECK THE CONTINUITY OF THE TCC SIGNAL AND VPWR CIRCUITS	
• Key in OFF position. • Disconnect: Powertrain Control Module (PCM). • Inspect for damaged or pushed-out pins, corrosion or loose wires. • Install the EEC-V Control System Breakout Box. • Measure the resistance between the PCM signal test pin 54 at the EEC-V Control System Breakout Box and the signal pin 4 at the transmission harness connector.  DD0546-B • Measure the resistance between the VPWR test pin 71 or 97 at the EEC-V Control System Breakout Box and the VPWR pin 1 at the transmission harness connector.	**Yes** GO to C4 . **No** REPAIR the open circuits. REMOVE the EEC-V Control System Breakout Box. RECONNECT all of the components. REPEAT the Quick Tests.



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

C4 CHECK THE TCC CIRCUIT FOR SHORT TO POWER	
• Measure the resistance between the PCM signal test pin 54 and VPWR test pins 71 and 97 at the EEC-V Control System Breakout Box.  • **Is each resistance greater than 10,000 ohms?**	**Yes** GO to C5 . **No** REPAIR the open circuits. REMOVE the EEC-V Control System Breakout Box. RECONNECT all of the components. REPEAT the Quick Tests.
C5 CHECK THE TCC CIRCUIT FOR SHORT TO GROUND	
• Measure the resistance between the PCM signal test pin 54 and test pins 51, 76, 77, 103 and 91 at the EEC-V Control System Breakout Box and chassis ground.  • **Is each resistance greater than 10,000 ohms?**	**Yes** GO to C6 . **No** REPAIR the short circuit (s). REMOVE the EEC-V Control System Breakout Box. RECONNECT all of the components. REPEAT the Quick Tests.
C6 SOLENOID FUNCTIONAL TEST	
• Install the Transmission Tester to the transmission connector. • **NOTE:** The LED will turn GREEN when the TCC solenoid activates and turn off when deactivated. The LED will turn RED if an ACTIVATED solenoid is shorted to battery positive. The LED will remain off if an ACTIVATED solenoid is shorted to ground or no continuity (open circuit). • Carry out the Solenoid Voltage Test. • **Does the solenoid (LED GREEN) activate when tester switch is pressed?**	**Yes** GO to C7 . **No** GO to C8 .
C7 TRANSMISSION DRIVE TEST	

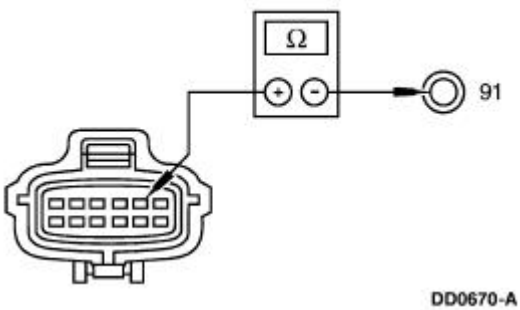
• Connect: Powertrain Control Module (PCM). • Carry out the Dynamic Testing. • **Does the torque converter clutch solenoid activate (LED GREEN) and does the engine rpm drop?**	**Yes** INSTALL a new PCM. ERASE all DTCs. CARRY OUT the Transmission Drive Cycle Test. REPEAT the Quick Tests. If the symptoms are still present, REFER to Diagnosis By Symptom in this section. **No** GO to C8.
C8 CHECK THE RESISTANCE OF THE SOLENOID	
NOTE: Refer to the Transmission Tester for terminal locations. • Place the bench/drive switch to the BENCH mode. • Rotate the gear select switch to the OHMS CHECK position. • Connect the ohmmeter negative lead to the TCC jack and the positive lead to the VPWR jack on the tester.  AD2285-A • Record the resistance. The resistance should be between 13 and 20 ohms within a temperature range of 4°C - 66°C (40°F - 150°F). • **Is the resistance between 13 and 20 ohms?**	**Yes** GO to C9. **No** INSTALL a new solenoid body assembly.
C9 CHECK THE SOLENOID FOR SHORT TO GROUND	
• Check for continuity between the BAT(-) jack (engine ground) and the appropriate jack with a digital ohmmeter or other low current tester (less than 200 milliamps). Connection should show infinite resistance (no continuity).  AD2286-A • **Does the connection show continuity?**	**Yes** INSTALL a new solenoid body assembly. **No** REFER to Diagnosis By Symptom in this section.

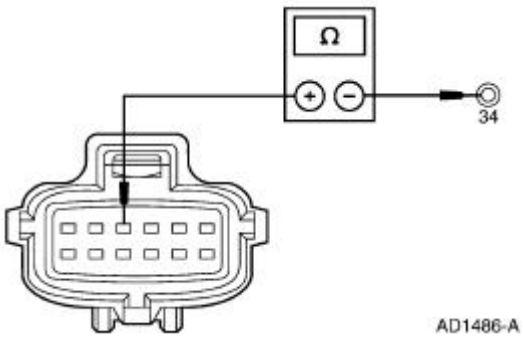
PINPOINT TEST D: DIGITAL TRANSMISSION RANGE (TR) SENSOR

Test Step	Result / Action to Take
NOTE: Refer to the Transmission Connector Layouts preceding these pinpoint tests.	

NOTE: Refer to the Digital Transmission Range (TR) Sensor Diagnosis Chart preceding these pinpoint tests.

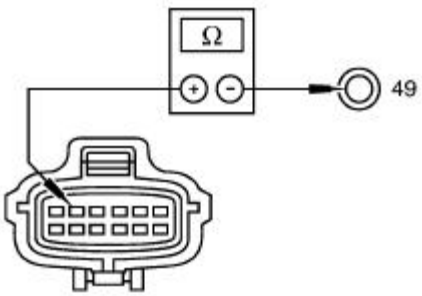
D1 VERIFY DIAGNOSTIC TROUBLE CODES	
• Key in OFF position. • Vehicle in park. • Carry out On-Board Diagnostic Test. DTC codes P0705 and P0708 cannot be set by a incorrectly adjusted digital TR sensor. • **Are only DTC codes P0705, P0708 present?**	**Yes** GO to D4 . **No** GO to D2 .
D2 VERIFY DIGITAL TRANSMISSION RANGE SENSOR ALIGNMENT	
• Key in OFF position. • Vehicle in park. • Check to make sure the digital TR sensor harness connector is fully seated, terminals are fully engaged in connector and in good condition before proceeding. • Apply the parking brake. • Vehicle in neutral. • Disconnect the shift cable/linkage from the manual lever. • Verify that the TR Sensor Alignment Gauge fits in the appropriate slots. • **Is the digital TR sensor correctly adjusted?**	**Yes** GO to D3 . **No** ADJUST the digital TR sensor. PLACE transmission range selector lever into PARK and CLEAR DTCs. RERUN OBD Tests.GO to D3 .
D3 VERIFY SHIFT CABLE/LINKAGE ADJUSTMENT	
• Place the manual lever in the overdrive position. • Reconnect the shift cable/linkage. • Verify that the shift cable/linkage is properly adjusted. REFER to Section 307-05 . • **Is the shift cable/linkage correctly adjusted?**	**Yes** GO to D4 . **No** ADJUST the shift cable/linkage. REFER to Section 307-05 . GO to D4 .
D4 CHECK ELECTRICAL SIGNAL OPERATION	
• Vehicle in park. • Disconnect: Digital TR Sensor. • **CAUTION: Do not pry on connector. This will damage the connector and result in a transmission concern.** • Press the button and pull out on the digital TR harness connector. • Inspect both ends of the connector for damage or pushed-out pins, corrosion, loose wires and missing or damaged seals. • **Is there damage to the connector, pins or harness?**	**Yes** REPAIR as required. CLEAR DTCs and RERUN OBD Tests. **No** If diagnosing a DTC, GO to D5 . If diagnosing a starting concern or a backup lamp concern,GO to D10 .
D5 CHECK ELECTRICAL SYSTEM OPERATION (DIGITAL TR AND PCM)	
• Key in OFF position. • Install Scan Tool. • Connect: Digital TR Sensor. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: TR PIDS TR, TR_D, TR_V. • Move transmission range selector lever into each gear and stop. • Observe any of the following PIDs, TR and TR_D, TR_V (vehicle dependent) while wiggling harness, tapping on sensor, and/or driving the vehicle. Use PIDs TR, and TR_D for DTCs P0705, P1704, and P1705. Use PIDs TR, and TR_V for DTC P0708.	**Yes** The problem is not in the digital TR sensor system. REFER to Diagnosis By Symptom in this section for further diagnosis. **No** If TR_D changes when wiggling harness, tapping on the sensor, or driving the vehicle, the problem may be intermittent.

• Compare the PIDs to the Digital Transmission Range (TR) Sensor Diagnosis Chart. • **Do the PIDs TR, TR_D and TR_V match the Digital Transmission Range (TR) Sensor Diagnosis Chart, and does the TR_D PID remain steady when the harness is wiggled, the sensor is tapped, or the vehicle driven?**	GO to D6 .
D6 CHECK THE DIGITAL TRANSMISSION RANGE SENSOR OPERATION	
• Disconnect: Digital TR Sensor. • **CAUTION: Do not pry on the connector. This will damage the connector and result in a transmission concern. Press the button and pull out on the harness connector.** • Connect the MLP-TR cable to the Transmission Tester. • Connect the MLP-TR cable (black connector marked DIGITAL) to the digital TR sensor. • Place the Trans Tester TR/MLP Overlay onto the Transmission Tester. • Carry out the sensor test as instructed on the Trans Tester TR/MLP Overlay. • **Do the status lamps on the tester MLP-TR cable match the selected gear positions?**	**Yes** The concern is not in the digital TR sensor. GO to D7 . **No** INSTALL a new and ADJUST the digital TR sensor. CLEAR the DTCs. REPEAT the Quick Tests.
D7 CHECK THE PCM HARNESS CIRCUITS FOR OPENS	
• Key in OFF position. • Disconnect: Powertrain Control Module. • Inspect for damaged or pushed-out pins, corrosion or loose wires. • Disconnect: Digital TR Sensor. • **CAUTION: Do not pry on the connector. This will damage the connector and result in a transmission concern. Press the button and pull out on the digital TR sensor harness connector.** • Disconnect digital TR sensor connector. • Install the EEC-V Control System Breakout Box. • Measure the resistance between PCM test pin 91 at the EEC-V Control System Breakout Box and the signal return circuit pin 2 at the vehicle harness connector.  DD0670-A • Measure the resistance between PCM test pin 34 at the EEC-V Control System Breakout Box, and TR1 circuit pin 4 at the vehicle harness connector.	**Yes** GO to D8 . **No** REPAIR the open circuit(s). RECONNECT all of the components. CLEAR the DTCs. REPEAT the Quick Tests.



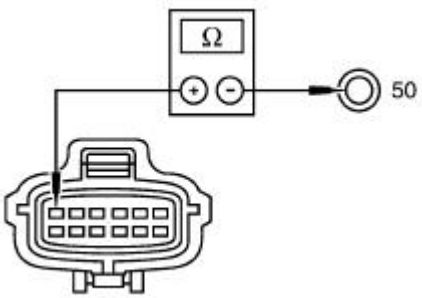
AD1486-A

- Measure the resistance between PCM test pin 49 at the EEC-V Control System Breakout Box and TR2 circuit pin 5 at the vehicle harness connector.



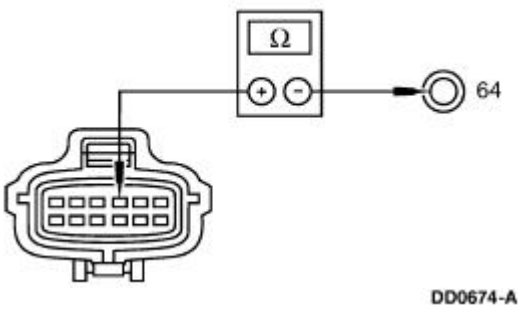
DD0672-A

- Measure the resistance between PCM test pin 50 at the EEC-V Control System Breakout Box and TR4 circuit pin 6 at the vehicle harness connector.



DD0673-A

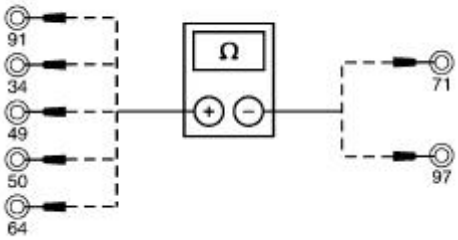
- Measure the resistance between PCM test pin 64 at the EEC-V Control System Breakout Box and TR3A circuit pin 3 at the vehicle harness connector.



DD0674-A

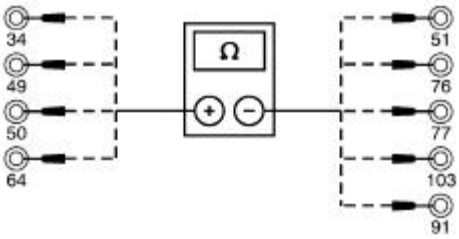
- **Is each resistance less than 5 ohms?**

D8 CHECK THE PCM HARNESS CIRCUITS FOR A SHORT TO GROUND OR TO POWER	
• Measure the resistance between PCM test pins 91, 34, 49, 50 and 64, and VPWR test pins 71 and 97 at the EEC-V Control System Breakout Box.	**Yes** GO to D9 .



AD1487-A

- Measure the resistance between PCM test pins 34, 49, 50 and 64, and test pins 51, 76, 77, 103 and 91 at the EEC-V Control System Breakout Box.



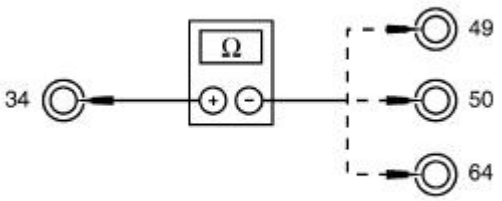
AD1488-A

- **Is each resistance greater than 10,000 ohms?**

No
REPAIR the short circuit(s). RECONNECT all of the components. CLEAR the DTCs. REPEAT the Quick Tests.

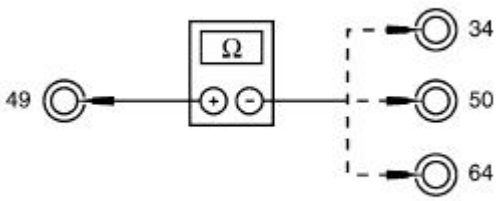
D9 CHECK FOR A SHORT BETWEEN THE TR/PCM INPUT SIGNAL CIRCUITS

- Measure the resistance between test pin 34 and test pins 49, 50 and 64 at the EEC-V Control System Breakout Box.



DD0677-A

- Measure the resistance between test pin 49 and test pins 34, 50 and 64 at the EEC-V Control System Breakout Box.

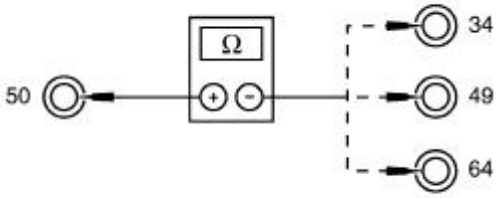
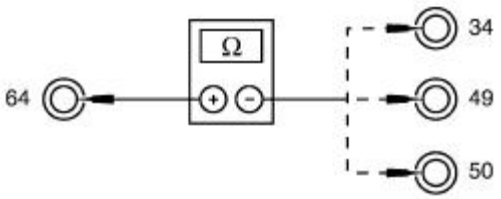


DD0678-A

- Measure the resistance between test pin 50 and Test pins 34, 49 and 64 at the EEC-V Control System Breakout Box.

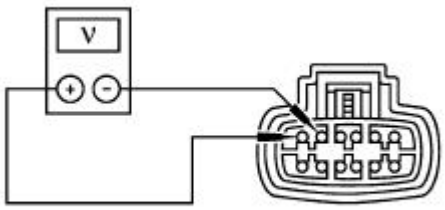
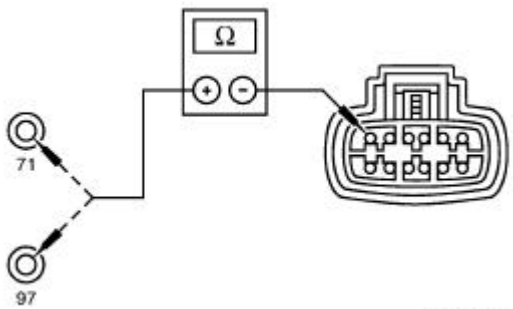
Yes
INSTALL a new PCM. RECONNECT all of the components. CLEAR the DTCs. RERUN the Quick Tests.

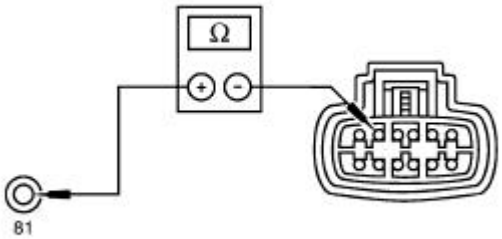
No
REPAIR shorts on the circuits having less than 10,000 ohms resistance between other TR/PCM input signal circuits. RECONNECT all of the components. CLEAR the DTCs. REPEAT the Quick Tests.

 DD0679-A ● Measure the resistance between test pin 64 and test pins 34, 49 and 50 at the EEC-V Control System Breakout Box.  DD0680-A ● **Is each resistance greater than 10,000 ohms?**	
D10 CHECK THE NON-PCM INTERNAL CIRCUITS OF SENSOR ● Connect the MLP-TR cable to the Transmission Tester. ● Connect the MLP-TR cable (black connector marked DIGITAL) to the digital TR sensor. ● Place the Trans Tester TR/MLP Overlay onto the Transmission Tester. ● Carry out the switch test as instructed on the Trans Tester TR/MLP Overlay. ● **Does the status lamp on the tester indicate RED for the correct gear position?**	**Yes** The concern is not in the digital TR sensor. For starter system concerns, REFER to Section 303-06 . For backup lamp concerns, REFER to Section 417-01 . **No** INSTALL a new and ADJUST the digital TR sensor. CLEAR the DTCs. REPEAT the Quick Tests.

PINPOINT TEST E: ELECTRONIC PRESSURE CONTROL (EPC) SOLENOID

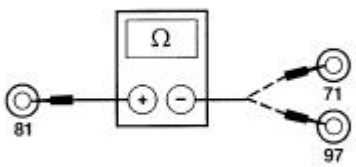
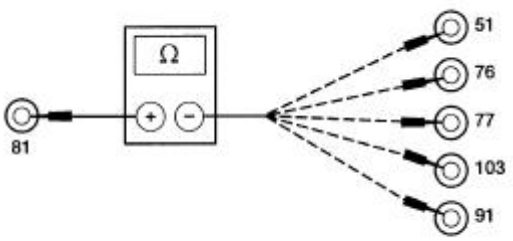
Test Step	Result / Action to Take
NOTE: Refer to the Transmission Connector Layouts preceding these pinpoint tests.	
E1 ELECTRONIC DIAGNOSTICS ● Check to make sure the transmission harness connector is fully seated, terminals are engaged in the connector and in good condition before proceeding. ● Install Scan Tool. ● Carry out KOEO Test until continuous DTCs have been displayed. ● ENTER Output Test Mode (OTM). ● Select the ALL ON Mode. Push START to turn the outputs on. Push STOP to turn the outputs off.	**Yes** REMAIN in OTM. GO to E2 . **No** PRESS START. If the vehicle does not enter OTM, REFER to the Powertrain

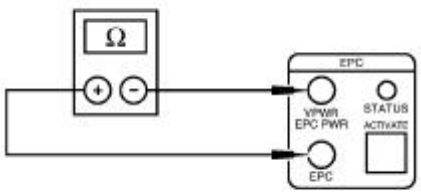
• **Does the vehicle enter OTM?**	Control/Emissions Diagnosis (PC/ED) manual.
E2 CHECK THE ELECTRICAL SIGNAL OPERATION	
• Disconnect: Transmission Connector. • **CAUTION: Remove the heat shield, if so equipped, from the transmission before removing the connector. Remove the solenoid body connector by pushing on the center tab and pulling on the harness connector. Do not attempt to pry the tab with a screwdriver. Always install the heat shield when the procedure is completed.** • Use a mirror to inspect both ends of the connector for damage or pushed-out pins, corrosion, loose wires and missing or damaged seals. • Connect a VOM positive lead to the EPC PWR pin 12 and the negative test lead to the EPC signal circuit pin 11 of the transmission vehicle harness connector.  DD0552-B • Place the VOM on the 20-volt scale. • While observing the VOM, press START and STOP to cycle the solenoid output on and off. • **Is the solenoid output voltage changed to approximately battery voltage?**	**Yes** GO to E5 . **No** GO to E3 .
E3 CHECK THE CONTINUITY OF THE SOLENOID SIGNAL AND VPWR CIRCUITS	
• Key in OFF position. • Disconnect: Powertrain Control Module (PCM). • Inspect for damaged or pushed-out pins, corrosion or loose wires. • Install the EEC-V Control System Breakout Box. • Measure the resistance between the VPWR test pins 71 and 97 at the EEC-V Control System Breakout Box and the EPC PWR circuit pin 12 at the transmission harness connector.  DD0553-A • Measure the resistance between the PCM signal test pin 81 at the EEC-V Control System Breakout Box and the EPC signal pin 11 at the transmission harness connector.	**Yes** GO to E4 . **No** REPAIR the open circuit (s). REMOVE the EEC-V Control System Breakout Box. RECONNECT all of the components. ERASE the codes. REPEAT the Quick Tests.

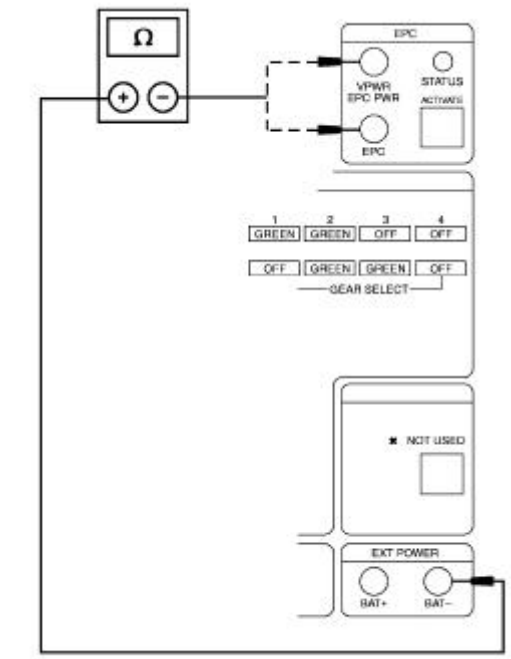


DD0554-A

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

E4 CHECK THE HARNESS FOR SHORTS TO POWER AND GROUND	
• Measure the resistance between the PCM signal test pin 81 and VPWR test pins 71 and 97 at the EEC-V Control System Breakout Box.  D17329-A • Measure the resistance between the PCM signal test pin 81 and test pins 51, 76, 77, 103 and 91 at the EEC-V Control System Breakout Box.  D17330-A • **Is each resistance greater than 10,000 ohms?**	**Yes** GO to E5 . **No** REPAIR the short circuit (s). REMOVE the EEC-V Control System Breakout Box. RECONNECT all of the components. ERASE the codes. REPEAT the Quick Tests.
E5 TRANSMISSION FUNCTIONAL TEST	
• Connect: Powertrain Control Module (PCM). • Install the Transmission Fluid Pressure Gauge at the line tap on the case. • Install the Transmission Tester to transmission connector. • Set the bench/drive switch to the DRIVE mode. • Rotate the gear select switch to the first gear position. • **NOTE:** The LED will turn GREEN when the EPC solenoid activates and turn off when deactivated. The LED will turn RED if an ACTIVATED solenoid is shorted to battery positive. The LED will remain off if an ACTIVATED solenoid is shorted to ground or no continuity (open circuit). • Carry out the EPC Solenoid Functional Test. • Observe line pressure on the gauge while pressing the EPC switch (engine must be running). • **Does the EPC (GREEN LED) activate and line pressure**	**Yes** INSTALL a new PCM. REPEAT the Quick Tests. **No** GO to E6 .

drop when the EPC switch is pressed?	
E6 CHECK THE RESISTANCE OF THE SOLENOID	
NOTE: Refer to the Transmission Tester for terminal locations. ● Set the bench/drive switch to the BENCH mode. ● Rotate the gear select switch to the OHMS CHECK position. ● **CAUTION: Make sure the tester power is off or damage to the ohmmeter can result.** ● Connect the ohmmeter negative lead to the VPWR jack and the positive lead to the EPC jack on the tester.  DD0557-A ● Record the resistance. The resistance should be between 3.0 and 5.0 ohms. ● **Is the resistance between 3.0 and 5.0 ohms?**	**Yes** GO to E7 . **No** INSTALL a new solenoid body assembly. RECORD and ERASE all codes. REPEAT the Quick Tests.
E7 CHECK THE SOLENOID FOR SHORT TO GROUND	
● Check for continuity between the BAT(-) jack (engine ground) and the appropriate jack with a digital ohmmeter or other low current tester (less than 200 milliamps). The connection should show infinite resistance (no continuity). **Solenoid** / **Tester Jack** EPC / VPWR, EPC PWR	**Yes** INSTALL a new solenoid body assembly. RECORD and ERASE codes. REPEAT the Quick Tests. **No** GO to Diagnosis By Symptom in this section.

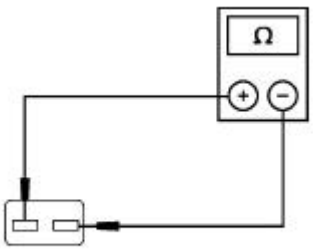


AD2287-A

- **Does the connection show continuity?**

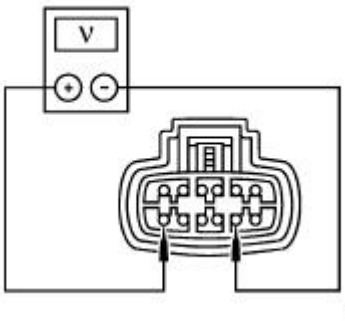
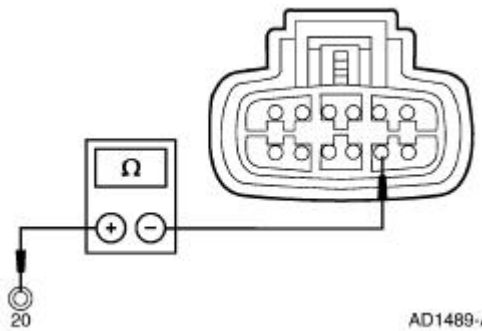
PINPOINT TEST F: TURBINE SHAFT SPEED (TSS) AND OUTPUT SHAFT SPEED (OSS) SENSORS

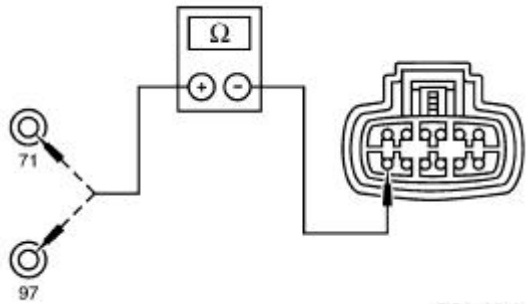
Test Step	Result / Action to Take
NOTE: Refer to the Transmission Connector Layouts preceding these pinpoint tests.	
F1 ELECTRONIC DIAGNOSTICS • Check to make sure the transmission harness connector is fully seated, terminals are fully engaged in connector and in good condition before proceeding. • Install Scan Tool. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Diagnostic Data Link. • Enter the following diagnostic mode on the diagnostic tool: PCM. • Select PID/Data Monitor and Record. • Select the following PIDs: TSS, OSS. • **Does vehicle enter PID/Data Monitor and Record?**	**Yes** REMAIN in PID/Data. GO to F2 . **No** REPEAT procedure to ENTER PID. If vehicle did not enter PID, REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of PCM or NGS.
F2 DRIVE CYCLE TEST • While monitoring the appropriate sensor PID, drive the vehicle so that the transmission upshifts and downshifts through all gears. • **Does the TSS, or OSS Speed PID increase and decrease with engine and vehicle speed or is the sensor signal erratic (drop to zero or near zero and return to normal operation)?**	**Yes** If the TSS or OSS Speed PID increase and decrease with engine and vehicle speed, CLEAR all DTCs. ROAD TEST to verify if concern is still present. If concern is still present, REFER to Diagnosis By Symptom in this section for diagnosis. If the sensor signal is erratic, INSPECT for intermittent

	concern in the internal/external harness, sensor, or connector. **No** If the TSS, or OSS Speed PID does not increase and decrease with engine and vehicle speed, INSPECT for open or short in vehicle harness, sensor, a PCM concern, or internal hardware concern. If the sensor signal is steady, GO to F3 .
F3 CHECK RESISTANCE OF TSS OR OSS SENSOR ● Disconnect the appropriate vehicle harness connector from the TSS and or OSS sensor. ● For TSS or OSS: Connect ohmmeter negative lead to one pin of the sensor and the positive lead to the other pin on the sensor.  AD1084-B ● Record the resistance. Resistance should be as follows: **Sensor** / **Resistance (ohms)** TSS Application: 781-1,979 OSS-All Application: 781-1,979 ● **Is the resistance within specification for the appropriate sensor?**	**Yes** REFER to Diagnosis By Symptom in this section for concern diagnosis. **No** For TSS and OSS, INSTALL a new sensor.

PINPOINT TEST G: COAST CLUTCH SOLENOID (CCS)

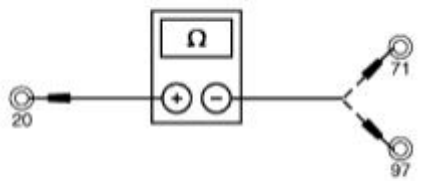
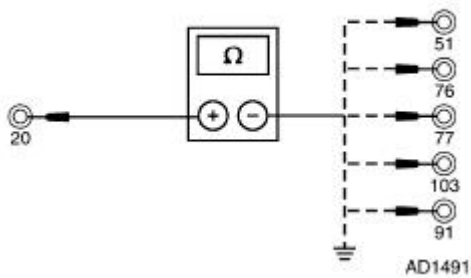
Test Step	Result / Action to Take
NOTE: Refer to the Transmission Connector Layouts preceding these pinpoint tests.	
G1 ELECTRONIC DIAGNOSTICS ● Check to make sure the transmission harness connector is fully seated, terminals are engaged in the connector and in good condition before proceeding. ● Install Scan Tool. ● Carry out the KOEO Test until continuous DTCs have been displayed. ● Enter the Output Test Mode (OTM). ● Select the ALL ON mode. Push START to turn the outputs on. Push STOP to turn the outputs off.	**Yes** REMAIN in OTM. GO to G2 . **No** PRESS START. If the vehicle does not enter OTM, REFER to the Powertrain

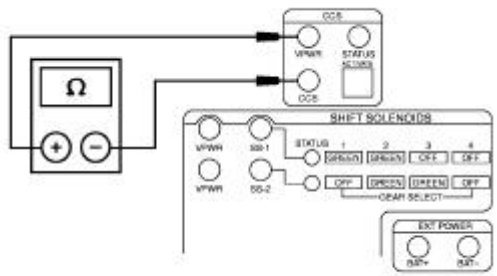
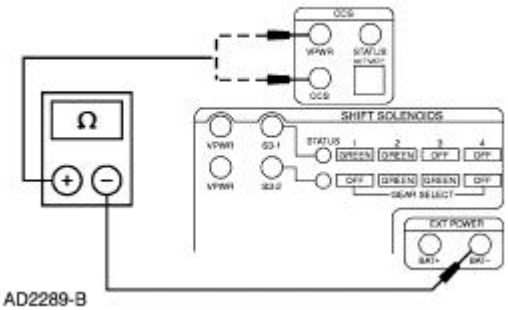
• **Does the vehicle enter OTM?**	Control/Emissions Diagnosis (PC/ED) manual.
G2 CHECK THE ELECTRICAL SIGNAL OPERATION	
• Disconnect: Transmission Connector. • **CAUTION: Remove the heat shield, if so equipped, from the transmission before removing the connector. Remove the solenoid body connector by pushing on the center tab and pulling on the harness connector. Do not attempt to pry the tab with a screwdriver. Always install the heat shield when the procedure is completed.** • Use a mirror to inspect both ends of the connector for damage or pushed-out pins, corrosion, loose wires and missing or damaged seals. • Connect a VOM positive lead to the VPWR circuit pin 1 and the negative test lead to the CCS signal circuit pin 5 of the transmission vehicle harness connector.  DD0560-A • Place the VOM on the 20-volt scale. • While observing the VOM, press start and stop to cycle the solenoid output on and off. • **Is the solenoid output voltage changed to approximately battery voltage?**	**Yes** GO to G5 . **No** GO to G3 .
G3 CHECK THE CONTINUITY OF THE CCS SIGNAL AND VPWR CIRCUITS	
• Key in OFF position. • Disconnect: Powertrain Control Module (PCM). • Inspect for damaged or pushed-out pins, corrosion or loose wires. • Install the EEC-V Control System Breakout Box. • Measure the resistance between the PCM signal test pin 20 at the EEC-V Control System Breakout Box and the signal pin 5 at the transmission harness connector.  AD1489-A • Measure the resistance between the VPWR test pin 71 or 97 at the EEC-V Control System Breakout Box and the VPWR pin 1 at the transmission harness connector.	**Yes** GO to G4 . **No** REPAIR the open circuits. REMOVE the EEC-V Control System Breakout Box. RECONNECT all of the components. REPEAT the Quick Tests.



DD0562-A

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

G4 CHECK THE CCS CIRCUIT FOR SHORTS TO POWER AND GROUND	
• Measure the resistance between the PCM signal test pin 20 and VPWR test pins 71 and 97 at the EEC-V Control System Breakout Box.  AD1490-A • Measure the resistance between the PCM signal test pin 20 and test pins 51, 76, 77, 103 and 91 at the EEC-V Control System Breakout Box and chassis ground.  AD1491-A • **Is each resistance greater than 10,000 ohms?**	**Yes** GO to G5 . **No** REPAIR the short circuit (s). REMOVE the EEC-V Control System Breakout Box. RECONNECT all of the components. REPEAT the Quick Tests.
G5 SOLENOID FUNCTIONAL TEST	
• Connect: Powertrain Control Module (PCM). • Install the Transmission Tester to the transmission connector. • **NOTE:** The LED will turn GREEN when the CCS activates and turn off when deactivated. The LED will turn RED if an ACTIVATED solenoid is shorted to battery positive. The LED will remain off if an ACTIVATED solenoid is shorted to ground or no continuity (open circuit). • Carry out the Solenoid Voltage Test. • **Does the solenoid (LED GREEN) activate when the tester switch is pressed?**	**Yes** GO to G6 . **No** GO to G7 .
G6 TRANSMISSION DRIVE TEST	
• Carry out the Dynamic Testing.	**Yes**

• **Does the CCS activate (LED GREEN) and engine braking occur?**	INSTALL a new PCM. ERASE all DTCs. CARRY OUT the Transmission Drive Cycle Test. REPEAT the Quick Tests. If symptoms are still present, REFER to Diagnosis By Symptom in this section. **No** GO to G7 .
G7 CHECK THE RESISTANCE OF THE SOLENOID	
NOTE: Refer to the Transmission Tester for terminal locations. • Place the bench/drive switch to the BENCH mode. • Rotate the Gear Select switch to the OHMS CHECK position. • Connect the ohmmeter negative lead to the CCS jack and the positive lead to the VPWR jack on the tester.  AD2288-A • Record the resistance. (The resistance should be between 17 and 22 ohms within a temperature range of 4°C - 66°C (40°F - 150°F). • **Is the resistance between 17 and 22 ohms?**	**Yes** GO to G8 . **No** INSTALL a new solenoid body assembly.
G8 CHECK THE SOLENOID FOR SHORT TO GROUND	
• Check for continuity between the BAT(-) jack (engine ground) and the appropriate jack with a digital ohmmeter or other low current tester (less than 200 milliamps). Connection should show infinite resistance (no continuity).  AD2289-B • **Does the connection show continuity?**	**Yes** INSTALL a new solenoid body assembly. **No** REFER to Diagnosis By Symptom in this section.

PINPOINT TEST H: SOLENOID MECHANICAL FAILURE

Test Step	Result / Action to Take
NOTE: Repair all other DTCs before repairing the following DTCs: P1714, P1715, P1740	
H1 ELECTRONIC DIAGNOSIS	

• Install Scan Tool. • Carry out the KOEO Test until continuous DTCs have been displayed. • If any of the following DTCs are present, continue with this test: P1714, P1715, P1740. • **Are other DTCs present for TFT or shift solenoids?**	**Yes** REPAIR the DTCs for TFT or shift solenoids first. CLEAR DTCs and CARRY OUT the transmission Drive Cycle Test. RERUN Quick Test. **No** INSTALL a new solenoid and or body. REFER to the Diagnostic Trouble Code chart for code description. GO to H2 .
H2 TRANSMISSION DRIVE CYCLE TEST	
• Carry out Transmission Drive Cycle Test. • Carry out the On-Board Diagnostic Test. • **Does the vehicle upshift and downshift OK?**	**Yes** GO to H3 . **No** REFER to Diagnosis By Symptom to diagnose shift concerns.
H3 RETRIEVE DTCS	
• Install Scan Tool. • Carry out KOEO Test until continuous DTCs have been displayed. • **Are DTCs P1714, P1715, P1740 still present?**	**Yes** INSTALL a new PCM. Road test and RERUN Quick Test. **No** Testing completed. If a concern still exists, REFER to Diagnosis By Symptom for concern diagnosis.

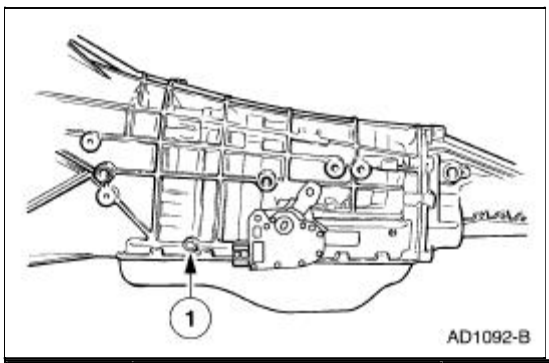
Special Testing Procedures

The special tests are designed to aid the technician in diagnosing the hydraulic and mechanical portions of the transmission.

Engine Idle Speed Check

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the engine idle speed.

Line Pressure Test



Item	Part Number	Description
1	—	Line Pressure Tap

CAUTION: Carry out the Line Pressure Test prior to carrying out the Stall Speed Test. If line pressure is low at stall, do not carry out the Stall Speed Test or further transmission damage will occur. Do not maintain wide-open throttle (WOT) in any transmission range for more than five seconds or transmission damage may occur.

NOTE: Carry out shift linkage check prior to carrying this test; refer to Section 307-05 .

This test verifies the line pressure is within specifications.

1. Connect the Transmission Fluid Pressure Gauge to the line pressure tap.
2. Start the engine and check the line pressures. Refer to the Line Pressure Chart to determine if the line pressure is within specification.
3. If the line pressure is not within specification, carry out On-Board Diagnostics and Go To Pinpoint Test E , air pressure check, and clean, inspect and install a new main control system or pump as required.

Line Pressure Chart

Gear	Line Pressure — Idle		Line Pressure — Stall	
	kPa	psi	kPa	psi

P, N	345-448	50-65	—	—
R	483-690	70-100	1,689-2,000	245-290
(D), 2	345-448	50-65	1,138-1,276	165-185
1	483-690	70-100	1,207-1,448	175-210

Line Pressure Diagnosis Chart

Low at Idle in All Ranges			**High at Idle in All Ranges**		
Check for low fluid level, restricted inlet filter, loose main body, solenoid body or accumulator body-to-case bolts, excessive leakage in pump, case, control bodies, sticking main regulator valve, damaged filter assembly and seal, damaged gaskets or valve body separating plate.			Check the main regulator valve, solenoid body and wiring harness. Run the Quick Test referred to in the Diagnostic portion of this section.		
Low Only in					
P	**R**	**N**	**(D)**	**2**	**1**
Check valve bodies 7A100	Check separator reinforcing plate, coast clutch, low/reverse clutch or direct clutch. Valve bodies 7A100, 7G422	Check valve bodies 7A100	Check forward clutch. Valve bodies 7A100, 7G422	Check forward clutch, coast clutch or intermediate clutch, band, servo assembly. Valve bodies 7A100, 7G422	Check forward clutch, low/reverse clutch or coast clutch. Valve bodies 7A100, 7G422

Stall Speed Test

WARNING: Apply the service and parking brakes firmly while carrying out each stall test.

CAUTION: Carry out the Line Pressure Test prior to carrying out the Stall Speed Test. If line pressure is low at stall, do not carry out the Stall Speed Test or further transmission damage will occur.

NOTE: The stall test should only be carried out with the engine and transmission at normal operating temperatures.

The stall test checks the operation of the following items:

- Torque converter one-way clutch.
- Forward clutch.
- Low one-way clutch.
- Reverse clutch.
- Overdrive one-way clutch.
- Direct clutch.
- Engine driveability concerns.

1. Connect a tachometer to the engine.

2. After testing each of the following ranges, (D), 2, 1 and R, move the transmission range selector lever to N (NEUTRAL) and run the engine for about 15 seconds to allow the torque converter to cool before testing the next range.

3. **CAUTION: If the engine rpm recorded by the tachometer exceeds the maximum specified rpm, release the accelerator pedal immediately. Clutch or band slippage is indicated.**

   CAUTION: Do not maintain wide-open throttle (WOT) in any gear range for more than 5 seconds or damage to the transmission may occur.

   Press the accelerator pedal to floor (WOT) in each range. Record the rpm reached in each range. Stall speeds should be in the appropriate range.

Stall Speed Chart

Series	Engine	Min.	Max.
Expedition/Navigator	5.4L 2V	2,297	2,725
Navigator	5.4L 4V	2,274	2,736

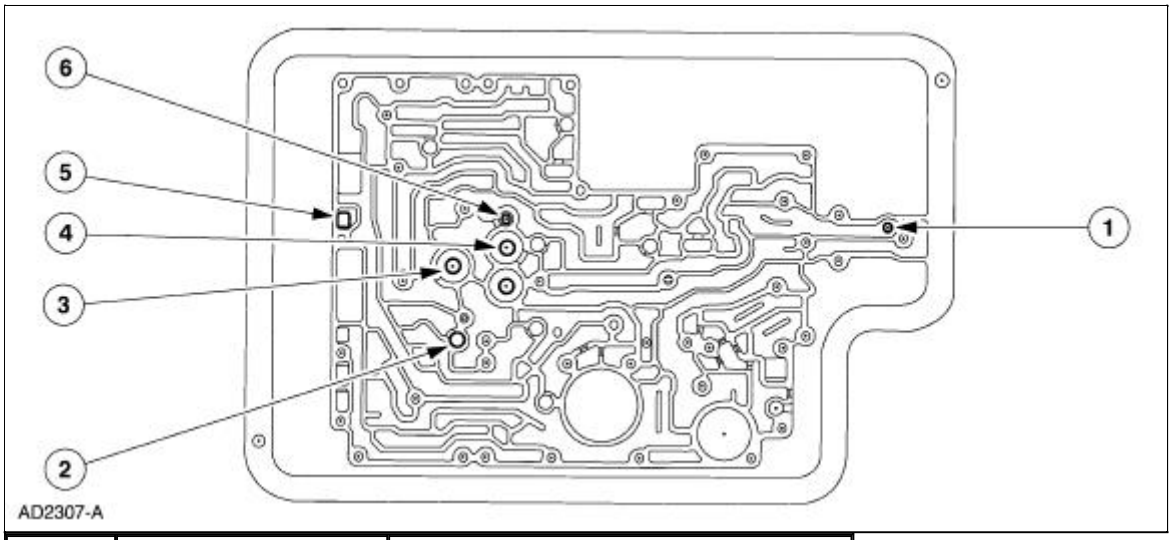
If the stall speeds were too high, refer to the following Stall Speed Diagnosis Chart. If the stall speeds were too low, check engine tune-up. If the engine is OK, remove the torque converter and check the torque converter reactor one-way clutch for slippage.

Stall Speed Diagnosis Chart

Range	Possible Source
(D)	• Forward Clutch • Overdrive One-Way Clutch • Low One-Way Clutch
R	• Direct Clutch • Overdrive One-Way Clutch and Coast Clutch • Reverse Clutch
2	• Forward Clutch • Overdrive One-Way Clutch and Coast Clutch
1	• Forward Clutch • Reverse Clutch and Low One-Way Clutch • Coast Clutch and Overdrive One-Way Clutch

Air Pressure Test

Air Pressure Test Port Locations



Item	Part Number	Description
1	—	Reverse clutch feed
2	—	Intermediate clutch feed
3	—	Overdrive clutch feed
4	—	Forward clutch feed
5	—	Coast clutch feed
6	—	Direct clutch feed

A no-drive condition can exist, even with correct transmission fluid pressure, because of inoperative clutches or bands. Refer to the Band/Clutch Application Chart to determine the appropriate elements. A clutch concern can be located through a series of checks by substituting air pressure for fluid pressure to determine the location of the concern.

Example: When the transmission range selector lever is in a forward gear range ((D), 2, 1), a no-drive condition may be caused by an inoperative forward clutch.

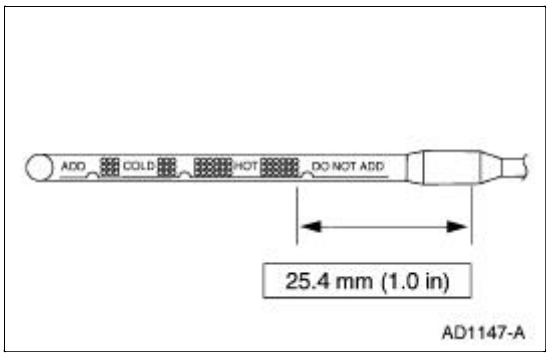
1. Drain the transmission fluid. Remove the transmission fluid pan.
2. Remove the filter and seal assembly, the solenoid body, the control assemblies and separator plate, upper/lower gaskets.
3. The inoperative clutches can be located by applying air pressure into the appropriate clutch port. See the Air Pressure Test Port Locations illustration for clutch port locations.
4. Apply air pressure to the appropriate clutch port (see diagram). A dull thud may be heard or movement felt when a clutch piston is applied. If the clutch seals or check ball are leaking, a hissing may be heard.
5. If the clutches fail to operate during the air check:
   - the piston seals are not seated, damaged, not installed.
   - plugged feed holes for clutch apply in the case and/or clutch cylinder.
   - damaged piston and/or clutch cylinder.
6. Service as required and recheck.

Torque Converter Drainback Test

7. Drive the vehicle for 30-60 minutes to attain normal operating temperature.

8. Check the transmission fluid level. Add fluid only if required.

9. Drive the vehicle through 8 to 10 cycles of 1/2 throttle, 1-2 upshifts to elevate the transmission temperature. Then proceed as follows:
    - Park the vehicle on level ground.
    - Allow the vehicle to sit for 30-60 minutes.
    - Check and note the fluid level on the fluid level indicator with the engine off, in PARK. The following example shows the fluid level after 45 minutes.



10. Allow the vehicle to sit for a minimum of 24 hours. Check and note the fluid level.

11. If the fluid has risen 25.4 mm (1 in) or more above the level in the first check, excessive converter drainback has occurred.

12. If excessive drainback has occurred:
    - stuck open check ball in rear cooler line case fitting.
    - no check ball in rear cooler line case fitting.
    - incorrect case cooler line case fitting (without check ball) installed.

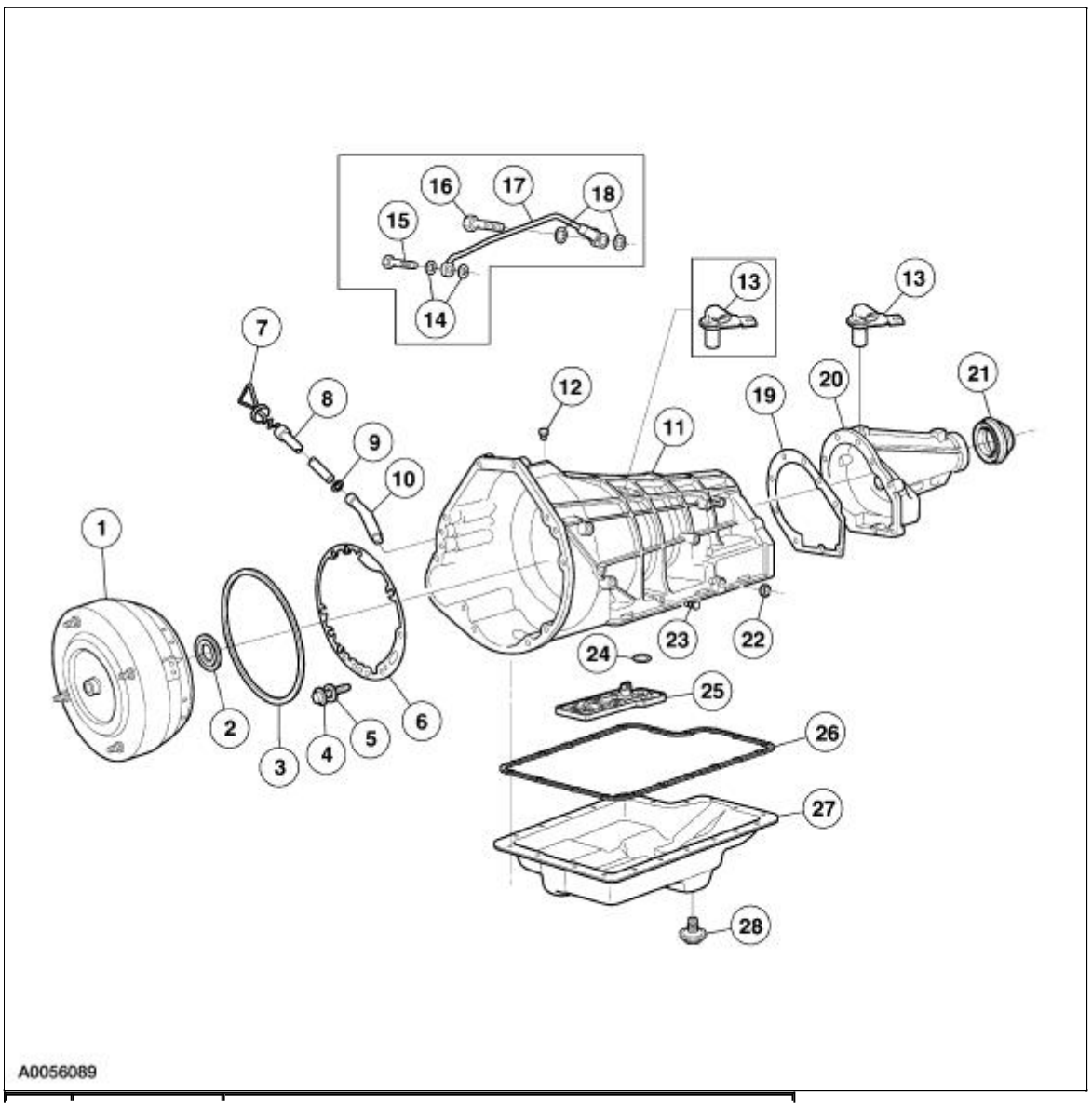
13. Service as required and recheck.

Leakage Inspection

The transmission has the following parts to prevent external fluid leakage:

- Gaskets
- Lip-type seals
- O-ring seals
- Seal rings
- Seal grommets
- Thread sealant
- Cooler bypass valve (CBV) sealing washers

External Sealing — 4R100



Item	Part Number	Description
1	7902	Torque converter assembly
2	7A248	Front pump seal
3	7A248	Front pump seal square-cut O.D. seal
4	N805260-S	Bolt and washer assembly
5	7G379	Washer
6	7A136	Pump gasket
7	7A020	Fluid level indicator
8	7A228	Fluid filler tube assembly
9	391308-S	Filler tube O-ring
10	7A160	Short fluid inlet tube assembly
11	7005	Case
12	7034	Case vent assembly
13	7M101	Turbine/output shaft speed (TSS/OSS) sensor (vehicle-dependent)
14	7H183	Plug assembly — case (vehicle-dependent)
15	7Z152	Cooler line — case fitting (part of 7H332 CBV assembly)
16	391933-S100	Sealing washers
17	7G118	Cooler line — case fitting (part of 7H332 CBV assembly)
18	7H322	Transmission cooler bypass valve assembly
19	391932-S100	Sealing washers
20	7052	Extension housing seal
21	7A039	Extension housing
22	7086	Extension housing gasket
23	7B498	Manual control lever seal
24	390685-S	Plug — test port 1/8-27 hex head
25	7G391	Solenoid valve body assembly
26	7A191	Transmission fluid pan gasket
27	7A194	Transmission fluid pan
28	7D479	Fluid pan drain plug assembly

Leakage at the transmission pan-to-case gasket often can be stopped by tightening the retaining bolts to specification. Refer to Torque Specifications in this section. If necessary, install a new pan-to-case gasket only if gasket is damaged.

If leakage is found by the solenoid body connector, refer to Main Control Valve Body—Accumulator Body Check in this section.

Check the transmission sealing washers on the cooler bypass valve (CBV), fluid filler tube connection at the transmission case. If leakage is found, install a new short fluid inlet tube.

Check the transmission sealing washers on the cooler bypass valve (CBV), fluid lines and fittings

between the transmission and the fluid inlet short tube in the radiator tank for looseness, wear or damage. If leakage cannot be stopped by tightening a fluid line tube nut, install new cooler lines. When fluid is found to be leaking between the case and the cooler line fitting, tighten the fitting to maximum specification. Refer to Section 307-02 .

CAUTION: Do not try to stop the fluid leak by increasing the torque beyond specification. This can cause damage to the case threads and/or case fittings.

If the leak continues, install a new cooler line fitting and/or sealing washers on cooler bypass valve and tighten to specification. The same procedure should be followed for fluid leaks between the radiator cooler and cooler line fittings.

Check the engine coolant in the radiator. If transmission fluid is present in the coolant, the transmission fluid cooler in the radiator is leaking.

The transmission fluid cooler can be further checked for leaks by disconnecting the lines from the cooler fittings and applying no more than 344.75 kPa (50 psi) air pressure to the fittings. Remove the radiator cap to relieve the pressure buildup at the exterior of the fluid cooler tank. If the transmission fluid cooler is leaking, will not hold pressure, or both, install a new transmission fluid cooler in the radiator.

If leakage is found at the manual control lever shaft, install a new seal.

When a converter drain plug leaks, remove the drain plug. Install and tighten a new drain plug to specification. Refer to Torque Specifications in this section.

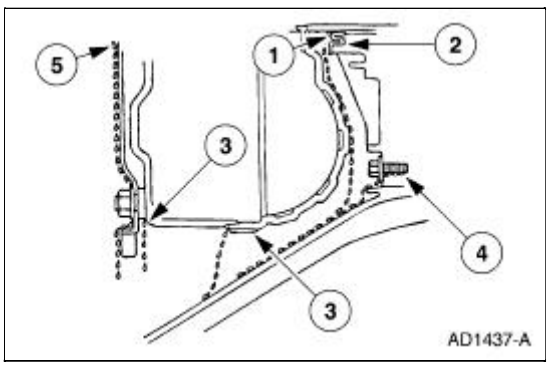
Check for fluid leaking from the end of the extension housing. Leakage can result from a damaged seal, missing garter spring or worn extension bushing, or damaged speed sensor plug. Install a new seal assembly, bushing, or both, as necessary.

Inspect the line pressure plug for leakage. Make sure it is tightened to specification. Refer to Torque Specifications in this section. If tightening the plug does not stop the leak the case threads and/or plug could be damaged. Remove the plug and inspect the plug and case thread for damage. Repair as necessary.

Check for leakage on or around the cooler bypass valve (CBV). Repair as required.

Fluid Leakage in Torque Converter Area

In diagnosing and correcting fluid leaks in the front pump assembly and torque converter area, use the following procedures to locate the exact cause of the leakage. Leakage at the front of transmission, as evidenced by fluid around the torque converter housing, may have several sources. By careful observation it is possible, in many instances, to pinpoint the source of leak before removing the transmission from the vehicle. The paths which the fluid takes to reach the bottom of the torque converter housing are shown in the illustration. The following five steps correspond with the numbers in the illustration.



1. Fluid leaking by the front pump seal lip will tend to move along the impeller hub and onto the back of the impeller housing. Except in the case of a total seal failure, fluid leakage by the lip of the seal will be deposited on the inside of the torque converter housing only, near the outside diameter of the housing.

2. Fluid leakage by the outside diameter of the front pump seal and front pump body will follow the same path that leaks by the inside diameter of the front pump seal follow.

3. Fluid leakage from the converter drain plug, converter seal weld or converter-to-flexplate stud weld will appear at the outside diameter of the torque converter, on the back face of the flexplate, and in the converter housing only near the flexplate. Fluid leaks from the torque converter will leave a ring of fluid around the inside of the torque converter housing.

4. Fluid that leaks by a front pump to case bolt or pump gasket will be deposited on the inside of the torque converter housing only. Fluid will not be deposited on the back of the torque converter.

5. **NOTE:** White facial tissue may aid in determining the color (red is transmission fluid) and source of the leaking fluid.

   Engine oil leaks are sometimes incorrectly diagnosed as transmission pump gasket leaks. The following areas of possible leakage should also be checked to determine if engine oil leakage is causing the concern.

   - Leakage at the valve cover gasket may allow oil to flow over the torque converter housing or seep down between the torque converter housing and cylinder block, causing oil to be present in or at the bottom of the torque converter housing.
   - Oil galley plug leaks will allow oil to flow down the rear face of the cylinder block to the bottom of the torque converter housing.
   - Leakage at the crankshaft rear oil seal will work back to the flexplate, and then into the torque converter housing.
   - Leakage at oil pressure sensor.

Leak Check Test

Determine the cause of the leakage before repair.

1. Remove the fluid level indicator and note the color of the fluid. Original factory fill fluid is dyed red to aid in determining if leakage is from the engine or transmission. The red color should assist in pinpointing the leak.

2. Remove the torque converter housing cover. Clean off any fluid from the top and bottom of the torque converter housing, front of the case, and rear face of the engine and oil pan. Clean the torque converter area by washing with a suitable non-flammable solvent, and blow dry with compressed air.

3. Wash out the torque converter housing, the front of the flexplate and the converter drain plug. The torque converter housing may be washed out using clean solvent and a squirt-type oil can. Blow-dry all washed areas with compressed air.

4. Start and run the engine until the transmission reaches its normal operating temperature. Observe the back of the cylinder block and top of the torque converter housing for evidence of fluid leakage. Raise the vehicle on a hoist and run the engine at fast idle, then at engine idle, occasionally shifting to the OVERDRIVE and REVERSE ranges to increase pressure within the transmission. Observe the front of the flexplate, back of the cylinder block (in as far as possible), and inside the torque converter housing and front of the case. Run the engine until fluid leakage is evident and the probable source of leakage can be determined.

Leak Check Test with Black Light

Oil-soluble aniline or fluorescent dyes premixed at the rate of 2.5 ml (1/2 teaspoon) of dye powder to 0.24 L (0.5 pint) of automatic transmission fluid have proven helpful in locating the source of fluid leakage. Such dyes can be used to determine whether an engine fluid or transmission fluid leak is present, or if the fluid in the transmission fluid cooler hose leaks into the engine coolant system. An ultraviolet light must be used to detect the fluorescent dye solution.

Transmission Fluid Cooler

CAUTION: Prior to this test, the in-line service filter (if equipped) must be removed. Failure to remove the in-line filter may result in a incorrect reading/diagnosis during this test.

CAUTION: Whenever a transmission has been disassembled to install new parts, the cooler bypass valve (CBV), all transmission fluid coolers (in tank and auxiliary) and transmission fluid cooler lines must be cleaned and backflushed. Use a torque converter/oil cooler cleaner.

NOTE: Cleaning and backflushing the transmission fluid cooling system, along with following all the normal cleaning and inspection procedures during disassembly and reassembly, will keep contaminants from entering the transmission, causing a repeat repair.

When internal wear or damage has occurred in the transmission, metal particles, clutch plate material, or band material may have been carried into the torque converter and transmission fluid cooler. These contaminants are a major cause of recurring transmission troubles and must be removed from the system before the transmission is put back into use.

Transmission Fluid Cooler Flow Test

NOTE: The transmission linkage/cable adjustment, fluid level and line pressure must be within specification before carrying out this test. Refer to Fluid Level Check under Verification of Condition in this section. Refer to Line Pressure Test under Special Testing Procedures in this section. For shift linkage/cable adjustment procedures, refer to Section 307-05 .

1. Remove the fluid level indicator from the fluid filler tube.
2. Place a funnel in the fluid filler tube.
3. Raise and support the vehicle.
4. Disconnect the cooler return tube (rear fitting) from the transmission cooler bypass valve (CBV). Refer to Section 307-02 .
5. Connect one end of a hose to the cooler return tube and route the other end of the hose up to a point where it can be inserted into the funnel at the fluid filler tube.
6. Remove the supports and lower the vehicle.
7. Insert the end of a hose into the funnel.
8. Start the engine and run at idle with the transmission in the NEUTRAL range.
9. Once a steady flow of fluid (without air bubbles) is observed, remove the hose from the funnel and place the hose in a measuring container for 15 seconds. After 15 seconds place the hose back into the funnel and turn the engine off. Measure the amount of fluid in the container. If adequate flow was observed, approximately 946.24 ml (32 oz) will be in the measuring container; the test is now complete.
10. If adequate flow is not observed, turn off the engine. Disconnect the hose from the cooler return line (transmission inlet).

11. Disconnect the fluid cooler line from the front case fitting and connect the hose to the case fitting (converter out) and repeat Steps 7, 8 and 9.

12. If adequate flow is observed from the transmission, look for a plugged cooler line and/or fluid cooler. Refer to Section 307-02 for diagnosis of the transmission fluid cooler.

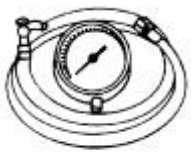
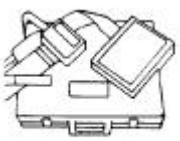
13. If adequate flow is still not observed, repair and/or installation of a new pump and/or torque converter may be required.

Transmission Fluid Cooler Tube Replacement

For installation of new transmission fluid cooler tube, refer to Section 307-02 .

Diagnosis By Symptom

Special Tool(s)

 ST1300-A	UV Leak Detector Kit 164-R0756 or equivalent
 ST1565-A	Pressure Gauge, Transmission Fluid 307-004 (T57L-77820-A)
 ST1137-A	73 III Automotive Meter 105-R0057 or equivalent
 ST1532-A	E4OD Transmission Cable 418-F037 (007-00107) or equivalent
 ST1391-A	Breakout Box, EEC-V Control System 418-049 (T94L-50-EEC-V) or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052 or equivalent scan tool
 ST1389-A	Transmission Tester 307-F016 (007-00130) or equivalent
	Alignment Gauge, TR Sensor

 ST1633-A	307-351 (T97L-70010-A)
 ST1533-A	MLP-TR Cable 418 F107 (007-00111) or equivalent
	Trans Tester TR/MLP Overlay and Manual 007-00131 or equivalent

The Diagnosis by Symptom Charts give the technician diagnostic information and direction and list possible components, using a SYMPTOM as a starting point.

The Diagnosis by Symptom Charts are divided into two categories: electrical routines, indicated by 200 series numbers, and hydraulic/mechanical routines, indicated by 300 series numbers. The electrical routines list the possible electrical components that could have caused or contributed to the symptom described. The hydraulic/mechanical routines list the possible hydraulic or mechanical components that could cause or contribute to the symptom described.

Diagnosis by Symptom Chart Directions

1. Using the Diagnosis by Symptom Index, select the concern/symptom that best describes the condition.

2. Refer to the routine indicated in the diagnosis by symptom index.

3. Always begin diagnosis of a symptom with:
   - Preliminary inspections.
   - Verification of condition.
   - Check the fluid level.
   - Carry out other test procedures as directed.

4. **NOTE:** Not all concerns and conditions with electrical components will set a diagnostic trouble code (DTC). Be aware that the components listed may still be the cause. Verify correct function of those components prior to proceeding to the hydraulic/mechanical routine listed.

   Begin with the electrical routine if indicated. Follow the reference or action required statements. Always carry out the On-Board Diagnostic Tests as required. NEVER SKIP STEPS. Repair as required. If the concern is still present after electrical diagnosis, proceed to the hydraulic/mechanical routine listed.

5. The hydraulic/mechanical routines list possible hydraulic or mechanical components that could cause the concern. These components are listed in the removal sequence and by most likely cause. You must inspect all components listed to make a correct repair.

Diagnosis by Symptom Index

Diagnosis by Symptom Index

4R100	Routines	
	Electrical [a]	Hydraulic/Mechanical
Engagement Concerns		
● No forward only	201	301
● No REVERSE only	202	302
● Harsh REVERSE only	203	303
● Harsh forward only	204	304
● Delayed/soft REVERSE only	205	305
● Delayed/soft forward only	206	306
● No forward and no REVERSE only	207	307
● Harsh forward and REVERSE	208	308
● Delayed/soft forward and REVERSE	209	309
Shift Concerns		
● Some or all shifts missing	210	310
● Timing concerns	211	311
■ Early/late (some/all)	212	312
■ Erratic/hunting (some/all)	213	313
● Feel concerns	214	314
■ Soft/slipping (some/all)	215	315
■ Harsh (some/all)	216	316
● No 1st gear in drive, engages in higher gear	217	317
● No MANUAL 1st gear		
● No MANUAL 2nd gear		
Torque Converter Clutch Operation Concerns		
● No apply	240	340
● Always applied/stalls vehicle	241	341
● Cycling/shudder/chatter	242	342
Other Concerns		
● Shift lever efforts high	251	351
● External leaks	252	352
● Driveability concerns	253	353
● Noise/vibration — forward or REVERSE	254	354
● Engine will not crank	255	355
● No PARK range	256	356
● Overheating	257	357
● No engine braking in MANUAL 2 position only	258	358
● No engine braking in MANUAL 1 position only	259	359
● No engine braking with OVERDRIVE cancelled	260	360
● No engine braking in MANUAL 1, 2 and 3	261	361
● Fluid venting or foaming	262	362

[a] Carry out electrical routines first.

Diagnostic Routines

Engagement Concern: No Forward Only

Possible Component	Reference/Action
201 — ELECTRICAL ROUTINE	
● No electrical concerns	
301 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
● Incorrect Level	● Adjust fluid to correct level.
● Condition	● Inspect according to instructions under Fluid Condition Check.

Shift Linkage (Internal/External) or Cable ● Damaged, incorrectly adjusted, disconnected	● Inspect and repair as required. Verify linkage adjustment. After linkage repair/adjustment, verify that the digital TR sensor is correctly adjusted. For additional information, refer to Digital Transmission Range (TR) Sensor in this section.
Incorrect Pressures ● Line Pressure — low	● Check pressure at line tap. Carry out Line Pressure and Stall Speed Tests. Refer to the Line Pressure Chart for specification. If pressures are low, check the following possible components: Pump inlet filter and seal assembly, main controls, pump assembly, forward clutch assembly.
Filter Assembly and Seal ● Plugged, damaged ● Filter Seal — damaged, cut	● Inspect filter assembly and seal for damage. Install new as required.
Main Controls	
● Manual Valve — stuck, damaged	● Inspect for damage. Repair as required.
● Control Body Housing — leaking	
● Bolts not tightened to specification	● Tighten bolts to specification.
● Gaskets — damaged	● Inspect gasket for damage. Install new as required.
Forward Clutch Assembly	
● Assembly	● Air Check Clutch Assembly; refer to Air Pressure Tests in this section.
● Piston, Seal, Check Ball — damaged, missing, not seating	● Inspect seals for damage, check ball seating, location. Install new piston assembly as required.
● Feed Bolt — loose, missing	● Install new feed bolts and tighten to specification.
● Center Support — damaged, holes blocked/missing	● Inspect for damage. Repair as required.
● Forward Clutch Sealing Rings — damaged	● Inspect for damage. Install new as required.
● Forward Clutch Ring Gear — damaged	● Inspect for damage. Install new as required.
● Friction Elements — damaged, worn; spline teeth damaged, missing	● Check for abnormal wear, damage. Install new as required.
Forward/Reverse Sun Gear Damaged	● **Inspect for damage. Install new as required.**
Front Planet Assembly Damaged	● **Inspect for damage. Install new as required.**
Output Shaft ● Splines — damaged	● Inspect for damage. Install new as required.
Low One-Way Clutch Assembly (Planetary) ● Worn, damaged or misassembled	● Inspect for damage. Install new as required.

Engagement Concern: No Reverse Only

Possible Component	Reference/Action
202 — ELECTRICAL ROUTINE	
● No electrical concerns	
302 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
● Incorrect Level ● Condition	● Adjust fluid to correct level. ● Inspect per instructions under Fluid Condition Check.
Shift Linkage (Internal/External) or Cable ● Damaged or incorrectly adjusted	● Inspect and repair as required. Verify linkage adjustment. After linkage repair/adjustment, verify that the digital TR sensor is correctly adjusted. For additional information, refer to Digital Transmission Range (TR) Sensor in this section.
Incorrect Pressures ● Line Pressure — low	● Check pressure at line pressure tap. Carry out Line Pressure and Stall Speed Tests. Refer to the Line Pressure Chart for specifications. If pressures are low, check the following possible components: Pump inlet filter and seal assembly, main control, pump assembly, reverse clutch assembly, coast clutch assembly, direct clutch assembly.
Filter Assembly and Seal ● Damaged or seal missing	● Inspect filter assembly and seal for damage. Install new as required.
Main Controls	
● Bolts not tightened to specification	● Tighten bolts to specification.
● Gaskets — damaged	● Inspect for damage and install a new gasket.
● Valve Springs, Main Control Valve Body, Direct Clutch Accumulator Valve — damaged, stuck, missing, or misassembled	● Inspect for damage. Repair as required.
● Reinforcing Plate — incorrectly installed; bolts not torqued to specification	● Inspect for correct installation. Tighten bolts to specification.
Direct Clutch Assembly	
NOTE: Only if third gear also is inoperative	
● Assembly	● Air Check Clutch Assembly; refer to Air Pressure Tests in this section.
● Seals or Piston — damaged	● Inspect for damage. Install new as required.
● Clutch Plates — burnt, missing	● Inspect for damage. Install new as required.
● Check Ball — damaged, missing	● Inspect for damage. Install new as required.

• Center Support — damaged or holes blocked • Center Support Hub — damaged	• Inspect for damage. Repair as required. • Inspect for damage. Install new as required.
Reverse Clutch Assembly	
• Assembly	• Air Check Clutch Assembly; refer to Air Pressure Tests in this section.
• Seals or Piston — damaged	• Inspect for damage. Install new as required.
• Piston Bore — damaged	• Inspect for damage. Install new as required.
• Friction Elements — damaged, worn; missing plates • Feed Hole — damaged, plugged, missing	• Inspect for damage. Install new as required. • Inspect for damage. Repair as required.

Engagement Concern: Harsh Reverse Only

Possible Component	Reference/Action
203 — ELECTRICAL ROUTINE	
Powertrain Control System • Electrical Inputs/Outputs, Vehicle Wiring Harnesses, PCM, Throttle Position Sensor, TSS, OSS, ABS Electronic Pressure Control	• Run On-Board Diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Carry out Engagement Test and Electronic Pressure Control Test. Go To Pinpoint Test E using the Transmission Tester and Cable and Overlay as outlined in this section. Repair as required. Clear codes, road test, rerun On-Board Diagnostics.
303 — HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures • Line Pressure — high	• Check pressure at line pressure tap. Carry out Line Pressure and Stall Speed Tests. Refer to the Line Pressure Chart for specification. If high, check the main controls.
Main Controls	
• Bolts not tightened to specification	• Tighten bolts to specification.
• Gasket — damaged	• Inspect for damage and install a new gasket.
• EPC Solenoid — stuck or damaged • Stuck Low Reverse Modular valve	• Carry out Electronic Pressure Control Tests described in routine No. 203. Install new as required. • Inspect for damage. Repair or install a new as required.
Pump Assembly	
• Bolts not tightened to specification	• Tighten bolts to specification.
• Gaskets — damaged • Main Regulator/Booster Valve — stuck, damaged, misassembled	• Inspect for damage and install a new gasket. • Inspect for damage. Repair as required.

Engagement Concern: Harsh Forward Only

NOTE: This vehicle has been equipped with a special cold weather shift strategy. This was designed to maximize heater output. This new strategy operates under the following conditions: ambient air temperature at start-up is -4°C (25°F) or below and the engine coolant temperature at start-up is 38°C (100°F) or below. During this condition, the vehicle may experience slightly delayed shifts under light throttle. Medium and heavy throttle shifts will be normal. Once the engine coolant reaches 71°C (160°F) or above, normal shift scheduling will resume. If, during the diagnosing of a delayed shift concern, the concern goes away after the engine coolant reaches 71°C (160°F) or above, this is a normal operation of the special cold weather shift strategy. If this condition does not go away after the engine coolant reaches 71°C (160°F), refer to Diagnosis By Symptom in this section.

NOTE: All gasoline vehicles will have new adaptive shift strategies. Whenever the vehicles battery has been disconnected for any type of service or repair, the strategy parameters that are stored in the keep alive memory (KAM) will be lost. The strategy will start to relearn once the battery is reconnected and the vehicle is driven. This is a temporary condition and will return to normal operating condition once the powertrain control module (PCM) relearns all the parameters from the driving operating conditions. There is no time frame set for this process. If this concern is present during downshifts or converter clutch apply, it is not the shift strategy and will require diagnosis as outlined in the workshop manual.
The customer must be notified that they may experience slightly different upshifts (either soft or firm) and that this condition is temporary and will eventually return to normal operating condition.

Possible Components	Reference/Action
204 — ELECTRICAL ROUTINE	
Powertrain Control System ● Electrical Inputs/Outputs, Vehicle Wiring Harnesses, PCM, Throttle Position Sensor, TSS, OSS, ABS Electronic Pressure Control	● Run On-Board Diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Carry out Engagement Test and Electronic Pressure Control Test. Go To Pinpoint Test E using the Transmission Tester and Cable and Overlay as outlined in this section. Repair as required. Clear codes, road test, rerun On-Board Diagnostics.
304 HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures ● Line Pressure — high	● Check pressure at line pressure tap. Carry out Line Pressure and Stall Speed Tests. Refer to the Line Pressure Chart for specification. If pressures are high, check main controls.
Main Controls	
● Bolts not tightened to specification	● Tighten bolts to specification.
● Gaskets — damaged	● Inspect for damage and install a new gasket.
● Electronic Pressure Control Solenoid — stuck or damaged ● Engagement Control Valve, Springs — damaged, stuck, misassembled, contaminated	● Carry out Electronic Pressure Control Tests described in routine No. 204. Install new as required. ● Inspect for damage. Repair as required.
Pump Assembly	
● Bolts not tightened to specification	● Tighten bolts to specification.
● Gaskets — damaged ● Main Regulator/Booster Valve	● Inspect for damage and install a new gasket. ● Inspect for damage. Repair as required.

— stuck, damaged, misassembled	
Forward Clutch Assembly	
• Assembly • Plates —burnt, missing. Check Ball — missing, damaged. Hub — damaged	• Air Check Clutch Assembly; refer to Air Pressure Tests in this section. • Inspect for damage. Install new as required.

Engagement Concern: Delayed/Soft Reverse Only

Possible Component	Reference/Action
205 — ELECTRICAL ROUTINE	
• No electrical concerns	
305 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage or Cable • Damaged, incorrectly adjusted	• Inspect and repair as required. Verify linkage adjustment. After linkage repair/adjustment, verify that the digital TR sensor is correctly adjusted. For additional information, refer to Digital Transmission Range (TR) Sensor in this section.
Main Controls	
• Bolts not tightened to specification	• Tighten bolts to specification.
• Gaskets — damaged	• Inspect for damage and install a new gasket.
• Direct Clutch Accumulator Regulator Valve, Low Reverse Modulator Valve, Springs — stuck, damaged, missing, misassembled	• Inspect for damage. Repair as required.
• Check Ball (BS1 BS3) — missing, damaged • Reinforcing Plate — incorrectly installed, bolts not tightened to specification	• Inspect for damage. Install new as required. • Inspect for correct installation. Tighten bolts to specification.
Coast Clutch Assembly	
• Assembly • Piston Seals — damaged, missing • Stator Support Seals — damaged	• Air Check Clutch Assembly, refer to Air Pressure Tests in this section. • Inspect for damage. Install new assembly as required. • Inspect for damage. Install new piston seals as required. • Inspect for damage. Install new stator support seals as required.
Reverse Clutch Assembly	
• Assembly	• Air Check Clutch Assembly; refer to Air Pressure Tests in this section.
• Seals, Piston — damaged	• Inspect for damage. Install new as required.
• Friction Elements — damaged, worn • Assembly leakage	• Inspect for damage. Install new as required. • Inspect for damage. Repair as required.

Engagement Concern: Delayed/Soft Forward Only

NOTE: This vehicle has been equipped with a special cold weather shift strategy. This was designed to maximize heater output. This new strategy operates under the following conditions: ambient air temperature at start-up is -4°C (25°F) or below and the engine coolant temperature at start-up is 38°C (100°F) or below. During this condition, the vehicle may experience slightly delayed shifts under light throttle. Medium and heavy throttle shifts will be normal. Once the engine coolant reaches 71°C (160°F) or above, normal shift scheduling will resume. If, during the diagnosing of a delayed shift concern, the concern goes away after the engine coolant reaches 71°C (160°F) or above, this is a normal operation of the special cold weather shift strategy. If this condition does not go away after the engine coolant reaches 71°C (160°F), refer to Diagnosis By Symptom in this section.

NOTE: All gasoline vehicles will have new adaptive shift strategies. Whenever the vehicles battery has been disconnected for any type of service or repair, the strategy parameters that are stored in the keep alive memory (KAM) will be lost. The strategy will start to relearn once the battery is reconnected and the vehicle is driven. This is a temporary condition and will return to normal operating condition once the powertrain control module (PCM) relearns all the parameters from the driving operating conditions. There is no time frame set for this process. If this concern is present during downshifts or converter clutch apply, it is not the shift strategy and will require diagnosis as outlined in the workshop manual.
The customer must be notified that they may experience slightly different upshifts (either soft or firm) and that this condition is temporary and will eventually return to normal operating condition.

Possible Component	Reference/Action
206 — ELECTRICAL ROUTINE	
• No electrical concerns	
306 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
• Incorrect Level • Condition	• Adjust fluid to correct level. • Inspect according to instructions under Fluid Condition Check.
Shift Linkage or Cable • Damaged, incorrectly adjusted	• Inspect and repair as required. Verify linkage adjustment. After linkage repair/adjustment, verify that the digital TR sensor is correctly adjusted. For additional information, refer to Digital Transmission Range (TR) Sensor in this section.
Incorrect Pressures • Line Pressure — low	• Check pressure at line tap. Carry out Line Pressure and Stall Speed Tests. Refer to the Line Pressure Chart for specification. If pressures are low, check the following possible components: pump inlet filter and seal assembly, main controls, pump assembly.
Filter Assembly and Seal • Plugged, damaged • Filter Seal — damaged	• Inspect filter assembly and seal for damage. Install new as required.
Main Controls	
• Bolt not tightened to specification	• Tighten bolts to specification.
• Gaskets —	• Inspect for damage and install a new gasket.

damaged	
Center Support Assembly	
• Feed Bolts — missing, incorrectly tightened	• Install new feed bolts and tighten to specification.
• Hub — damaged, holes blocked or missing	• Inspect for damage. Repair as required.
Forward Clutch Assembly	
• Assembly	• Air Check Clutch Assembly; refer to Air Pressure Tests in this section.
• Seals or Piston — damaged	• Inspect seals for damage. Install new as required.
• Check Balls — damaged, missing	• Inspect for mislocation, poor seating, damage. Install new cylinder as required.
• Clutch Hub — damaged	• Inspect for damage. Install new as required.
• Friction Elements — damaged, missing	• Inspect for damage. Install new as required.
• Forward Clutch Cylinder Seals — damaged	• Inspect for damage. Install new as required.

Engagement Concern: No Forward and No Reverse Only

Possible Component	Reference/Action
207 — ELECTRICAL ROUTINE	
• Electrical Connectors — not seated	• Check the electrical connectors for correct seating.
307 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
• Incorrect Level • Condition	• Adjust fluid to correct level. Inspect according to instructions under Fluid Condition Check.
• Converter Drainback Valve • Inspect converter drainback valve. Carry out Torque Converter Drainback Test. Install new as required. • Flow — restricted (case lube holes restricted, leaking, plugged, or missing cooler lines)	• Inspect, clean, or install new as required.
Shift Linkage (Internal/External) or Cable • Damaged, incorrectly adjusted or disconnected	• Inspect for damage. Repair as required. Verify linkage adjustment. After linkage repair/adjustment, verify that the digital TR sensor is correctly adjusted. For additional information, refer to Digital Transmission

	Range (TR) Sensor in this section.
Incorrect Pressures ● Line Pressure — low	● Check pressure at line tap. Carry out Line Pressure Test. Refer to the Line Pressure Chart for specification. If pressures are low, check the following possible components: pump inlet filter and seal assembly, main controls, pump assembly, forward clutch assembly.
Filter Assembly and Seal ● Filter — not correctly installed, loose, or seal missing ● Plugged, damaged ● Filter Seal — damaged or cut	● Inspect filter assembly and seal for damage, or correct installation. Install new as required.
Main Controls	
● Solenoids — damaged or stuck from contamination	● Inspect, install new solenoids as required. Go To Pinpoint Test A .
● Manual Valve — stuck, damaged ● Control Body Housing — leaking	● Inspect for damage. Repair as required.
● Bolts not tightened to specification ● Gaskets — damaged	● Tighten bolts to specification. ● Inspect for damage and install a new gasket.
Pump Assembly	
● Damaged from contamination	● Clean and inspect, install new pump as required.
● Valves — stuck from contamination	● Clean and inspect, install new valves as required.
● Bolts not tightened to specification	● Tighten bolts to specification.
● Gaskets — damaged	● Inspect for damage and install a new gasket.
● Main Regulator/Booster Valve — damaged, missing, misassembled	● Inspect for damage. Repair as required.
● Pump Gear End Clearance — excessive	● Carry out pump gear end clearance check.
Center Support Assembly	
● Damaged, holes blocked	● Inspect for damage. Repair as required.
● Feed Bolts — missing or incorrectly tightened	● Install new bolts and tighten to specification.
Forward/Reverse Sun Gear ● Damaged	● Inspect for damage. Install new as required.
Forward Planet Assembly ● Damaged	● Inspect for damage. Install new as required.
Input Shaft /Center Shaft/ Output Shaft ● Splines — damaged	● Inspect for damage. Install new as required.
Overdrive Carrier ● Damaged	● Inspect for damage. Install new as required.
Overdrive OWC	
● Misassembled, damaged	● Inspect for damage. Repair as required.
● Sprags or Races — damaged	● Inspect for damage. Install new as required.

Converter ● Damaged (not seated correctly in the engine crankshaft pilot)	● Inspect for damage. Install new or remanufactured as required.

Engagement Concern: Harsh Forward and Reverse

Possible Components	Reference/Action
208 — ELECTRICAL ROUTINE	
Powertrain Control System ● Electrical Inputs/Outputs, Vehicle Wiring Harnesses, Powertrain Control Module, Electronic Pressure Control, Throttle Position Sensor	● Run On-Board Diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Carry out Engagement Test and Electronic Pressure Control Test. Go To Pinpoint Test E using the Transmission Tester and Cable and Overlay. Repair as required. Clear codes, road test and rerun On-Board Diagnostics.
308 — HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures ● Line Pressure — high	● Check pressure at line pressure tap. Carry out Line Pressure Test. Refer to the Line Pressure Chart for specification. If high, check main controls.
Main Controls ● Bolts not tightened to specification ● Gasket — damaged ● EPC Solenoid — stuck or damaged ● Engagement Control Valve — stuck, damaged, contaminated, misassembled ● Main Control or Separator Plate — installed incorrectly	● Tighten bolts to specification. ● Inspect for damage and install a new gasket. ● Carry out Electronic Pressure Control Tests described in routine No. 208. Install new as required. ● Inspect for damage, contamination. Repair as required. ● Check the parts catalog for the correct parts used by vehicle application or year, install new components as required.
Pump Assembly ● Bolts not tightened to specification ● Gaskets — damaged ● Main Regulator/Booster Valve — stuck, damaged, misassembled	● Tighten bolts to specification. ● Inspect for damage and install a new gasket. ● Inspect for damage. Repair or install new as required.

Engagement Concern: Delayed/Soft Forward and Reverse

Possible Component	Reference/Action
209 — ELECTRICAL ROUTINE	
● No electrical concerns	
309 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage or Cable ● Damaged, incorrectly adjusted	● Inspect and repair as required. Verify linkage adjustment. After linkage repair/adjustment, verify that the digital TR sensor is correctly adjusted. For additional information, refer to Digital Transmission Range (TR) Sensor in this section.

Fluid ● Incorrect Level	● Adjust to correct level.
Incorrect Pressures ● Line Pressure — low	● Check pressure at line tap. Refer to the Line Pressure Chart for specification. If low check the following components: pump inlet filter/seal assembly, main control, pump assembly.
Filter Assembly and Seal ● Plugged, damaged ● Seal — damaged, cut	● Inspect filter assembly and seal for damage. Install new as required.
Main Controls	
● Bolts not tightened to specification	● Tighten bolts to specification.
● Gaskets — damaged	● Inspect for damage and install a new gasket.
● Springs — stuck, damaged, missing, misassembled	● Inspect for damage. Repair as required.
Torque Converter Drainback (Initial Engagement Only)	● Refer to Torque Converter Drainback Test procedures in this section for diagnosis.

Shift Concerns: Some or All Shifts Missing

Possible Component	Reference/Action
210 — ELECTRICAL ROUTINE	
Powertrain Control System ● Electrical Inputs/Outputs, Vehicle Wiring Harness, PCM, Throttle Position Sensor, Digital TR Sensor, TSS, OSS, ABS, SSA, SSB	● Carry out Shift Point Road Test. ● Run On-Board Diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Go To Pinpoint Test A and Go To Pinpoint Test D using the Transmission Tester, Cable and Overlay and the TRS-E Cable. Repair as required. Clear code, road test, rerun On-Board Diagnostics.
310 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid ● Incorrect Level ● Condition	● Adjust fluid to correct level. Inspect according to instructions under Fluid Condition Check.
Shift Linkage (Internal/External) or Cable ● Damaged, incorrectly adjusted, disconnected	● Inspect and repair as required. Verify linkage adjustment. After linkage repair/adjustment, verify that the digital TR sensor is correctly adjusted. For additional information, refer to Digital Transmission Range (TR) Sensor in this section.
Filter Assembly and Seal ● Plugged, damaged ● Filter Seal — damaged	● Inspect filter assembly and seal for damage. Install new as required.
Main Controls	
● Accumulator Valves — stuck, damaged, misassembled	● Inspect for damage. Repair as required.
For diagnosis related to a specific	● To diagnose specific No Shift, refer to the appropriate

shift, see Reference/Action.	shift routine. ■ No Shift 1-2, Routine 220/320 ■ No Shift 2-3, Routine 221/321 ■ No Shift 3-4, Routine 222/322 ■ No Shift 4-3, Routine 223/323 ■ No Shift 3-2, Routine 224/324 ■ No Shift 2-1, Routine 225/325

Shift Concerns: Shift Timing — Early/Late (Some/All)

Possible Component	Reference/Action
211 — ELECTRICAL ROUTINE	
Powertrain Control System ● Electrical Inputs/Outputs, Vehicle Wiring Harnesses, PCM, Throttle Position Sensor, TFT Sensor, TSS, OSS, ABS, SSA, SSB	● Carry out Shift Point Road Test. ● Run On-Board Diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Go To Pinpoint Test A and Go To Pinpoint Test B using the Transmission Tester and Cable and Overlay. Repair as required. Clear codes, road test and rerun On-Board Diagnostics.
Other Electrical Concerns ● No power to PCM, keep-alive memory erased from PCM	● Restore memory by carrying out Transmission Drive Cycle Test.
311 — HYDRAULIC/MECHANICAL ROUTINE	
Other	
● Tire size change	● Refer to the specification decal on door panel and verify that vehicle has original equipment. Changes in tire size or axle ratio may affect shift timing.
● Speedometer — gear change (vehicle-dependent) ● Axle Ratio — change	
Engine Driveability Concerns— Engine Runs Poor	● Refer to Routine No. 253/353.
Main Controls	
● Valves, Accumulators — stuck or damaged	● Inspect for damage, contamination. Repair as required.
● Gaskets — damaged	● Inspect for damage and install a new gasket.
● Bolts not tightened to specification	● Tighten bolts to specification.
For diagnosis related to a specific shift or if all above are OK, see Reference/Action.	● To diagnose specific shift/timing concern refer to Soft/Slipping routines: ■ Soft/Slipping Shift 1-2, Routine 226/326 ■ Soft/Slipping Shift 2-3, Routine 227/327 ■ Soft/Slipping Shift 3-4, Routine 228/328 ■ Downshifts, 229/329

Shift Concerns: Timing — Erratic/Hunting (Some/All)

Possible Component	Reference/Action

· 212 — ELECTRICAL ROUTINE	
· Powertrain Control System	
· Vehicle Wiring Harnesses, PCM, TP Sensor, TFT Sensor, SSA, SSB, Digital TR Sensor, TCC Solenoid	· Carry out Shift Point Road Test and Torque Converter Clutch Operation Tests. · Run On-Board Diagnostics. Refer to Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Go To Pinpoint Test A , Go To Pinpoint Test B , Go To Pinpoint Test C and Go To Pinpoint Test D using the Transmission Tester, Cable and Overlay and the TRS-E Cable. Install new as required. Clear codes, road test and rerun On-Board Diagnostics.
· With Speed Control On	
· Torque Converter Cycling	· Re-evaluate with speed control off or depress TCS (overdrive cancelled). If condition still exists, proceed with diagnosis.
· Shift Cycling (3-4 / 4-3 shifts)	· Re-evaluate with speed control off or depress TCS (overdrive cancelled). If condition still exists, proceed with diagnosis.
· 312 — HYDRAULIC/MECHANICAL ROUTINE	
· Fluid	
· Incorrect Level	· Adjust fluid to correct level.
· Filter Assembly and Seal	
· Plugged, damaged	· Inspect filter assembly and seal for damage. Install a new filter assembly and seal as required.
· Filter Seal — damaged	· Inspect filter assembly and seal for damage. Install a new filter assembly and seal as required.
· Main Control	
· Valves, Accumulators — damaged, stuck	· Inspect for damage. Repair or install new as required.
· Bolts not tightened to specification	· Tighten bolts to specification.
· Gaskets — damaged	· Inspect for damage and install new gasket.
· Wrong parts used in rebuild	· Verify that correct parts were used.
· Torque Converter Clutch	· Refer to Torque Converter Clutch Operation Concern: Cycling/Shudder/Chatter (No. 342).
· For further diagnosis of timing issues, refer to Reference/Action	· Refer to the following shift routine(s) for further diagnosis: ● No 1-2 shift see Routine 220/330 ● No 2-3 shift see Routine 221/331 ● No 3-4 shift see Routine 222/332 ● No 4-3 shift see Routine 233/323 ● No 3-2 shift see Routine 224/324 ● No 2-1 shift see Routine 225/325 ● Soft/Slip 1-2 shift see Routine 226/326 ● Soft/Slip 2-3 shift see Routine 227/327 ● Soft/Slip 3-4 shift see Routine 228/328 ● Soft/Slip 4-3 shift see Routine 229/329 ● Soft/Slip 3-2 shift see Routine 229/329 ● Soft/Slip 2-1 shift see Routine 229/329 ● Harsh 1-2 shift see Routine 232/332 ● Harsh 2-3 shift see Routine 233/333 ● Harsh 3-4 shift see Routine 224/334 ● Harsh 4-3 shift see Routine 235/335

	• Harsh 3-2 shift see Routine 236/336 • Harsh 2-1 shift see Routine 237/337

Shift Concerns: Feel — Soft/Slipping (Some/All)

NOTE: This vehicle has been equipped with a special cold weather shift strategy. This was designed to maximize heater output. This new strategy operates under the following conditions: ambient air temperature at start-up is -4°C (25°F) or below and the engine coolant temperature at start-up is 38°C (100°F) or below. During this condition, the vehicle may experience slightly delayed shifts under light throttle. Medium and heavy throttle shifts will be normal. Once the engine coolant reaches 71°C (160°F) or above, normal shift scheduling will resume. If, during the diagnosing of a delayed shift concern, the concern goes away after the engine coolant reaches 71°C (160°F) or above, this is a normal operation of the special cold weather shift strategy. If this condition does not go away after the engine coolant reaches 71°C (160°F), refer to Diagnosis By Symptom in this section.

NOTE: All gasoline vehicles will have new adaptive shift strategies. Whenever the vehicles battery has been disconnected for any type of service or repair, the strategy parameters that are stored in the keep alive memory (KAM) will be lost. The strategy will start to relearn once the battery is reconnected and the vehicle is driven. This is a temporary condition and will return to normal operating condition once the powertrain control module (PCM) relearns all the parameters from the driving operating conditions. There is no time frame set for this process. If this concern is present during downshifts or converter clutch apply, it is not the shift strategy and will require diagnosis as outlined in the workshop manual.
The customer must be notified that they may experience slightly different upshifts (either soft or firm) and that this condition is temporary and will eventually return to normal operating condition.

Possible Component	Reference/Action
213 — ELECTRICAL ROUTINE	
Powertrain Control System • Electrical Inputs/Outputs, Vehicle Wiring Harnesses, PCM, TP Sensor, Electronic Pressure Control, TFT Sensor	• Carry out Shift Point Road Test. • Run On-Board Diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Go To Pinpoint Test E and Go To Pinpoint Test B using the Transmission Tester and Cable and Overlay. Repair as required. Clear codes, road test, rerun On-Board Diagnostics.
313 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
• Incorrect Level • Adjust fluid to correct level. • Condition	• Inspect according to instructions in this section under Fluid Condition Check.
Incorrect Pressures • Line Pressure — low	• Check pressures at line pressure tap. Carry out Line Pressure Tests. Refer to the Line Pressure Chart for specifications. If pressures are low or all shifts are soft/slipping, go to Main Controls.
Main Controls	
• Bolts not tightened to specification	• Tighten bolts to specification.
• Gaskets — damaged	• Inspect for damage and install a new gasket.
• Line Modulator Valve Springs	• Inspect for damage, contamination. Repair as required.

— damaged, stuck, misassembled	
• EPC Solenoid — failure to operate in a normal manner • Accumulator Assembly — damaged or wrong assembly	• Refer to Electrical Routine No. 213. • Inspect for damage. Install new as required. Verify correct assembly is used.
Pump Assembly	
• Bolts not tightened to specification	• Tighten bolts to specification.
• Gaskets — damaged	• Inspect for damage and install a new gasket.
• Main Regulator/Booster Valve — damaged, misassembled	• Inspect for damage. Repair as required.
• Electronic Pressure Control Air Bleed Check Valve — damaged or missing For diagnostics related to specific shifts, see Reference/Action.	• Inspect for damage. Install new as required. • Refer to the following Shift Routine(s) for further diagnosis: ■ Soft/Slipping Shift 1-2, Routine 226/326 ■ Soft/Slipping Shift 2-3, Routine 227/327 ■ Soft/Slipping Shift 3-4, Routine 228/328 ■ Downshifts, 229/329

Shift Concerns: Feel — Harsh (Some/All)

NOTE: This vehicle has been equipped with a special cold weather shift strategy. This was designed to maximize heater output. This new strategy operates under the following conditions: ambient air temperature at start-up is -4°C (25°F) or below and the engine coolant temperature at start-up is 38°C (100°F) or below. During this condition, the vehicle may experience slightly delayed shifts under light throttle. Medium and heavy throttle shifts will be normal. Once the engine coolant reaches 71°C (160°F) or above, normal shift scheduling will resume. If, during the diagnosing of a delayed shift concern, the concern goes away after the engine coolant reaches 71°C (160°F) or above, this is a normal operation of the special cold weather shift strategy. If this condition does not go away after the engine coolant reaches 71°C (160°F), refer to Diagnosis By Symptom in this section.

NOTE: All gasoline vehicles will have new adaptive shift strategies. Whenever the vehicles battery has been disconnected for any type of service or repair, the strategy parameters that are stored in the keep alive memory (KAM) will be lost. The strategy will start to relearn once the battery is reconnected and the vehicle is driven. This is a temporary condition and will return to normal operating condition once the powertrain control module (PCM) relearns all the parameters from the driving operating conditions. There is no time frame set for this process. If this concern is present during downshifts or converter clutch apply, it is not the shift strategy and will require diagnosis as outlined in the workshop manual.
The customer must be notified that they may experience slightly different upshifts (either soft or firm) and that this condition is temporary and will eventually return to normal operating condition.

Possible Component	Reference/Action
214 — ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical Inputs/Outputs, Vehicle Wiring Harnesses, PCM, Electronic Pressure Control, TFT Sensor, TP Sensor, Digital TR Sensor	• Run On-Board Diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Go To Pinpoint Test B , Go To Pinpoint Test D and Go To Pinpoint Test E using the Transmission Tester, Cable and Overlay and the TRS-

	E Cable. Repair as required. Clear codes, road test and rerun On-Board Diagnostics.
Engine Driveability Concerns	• Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis.
314 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
• Incorrect Level • Condition	• Adjust fluid to correct level. • Inspect according to instructions in this section under Fluid Condition Check.
Incorrect Pressures • Line Pressure — high	• Check pressures at line pressure tap. Carry out Line Pressure and Stall Speed Tests. Refer to the Line Pressure Chart for specifications. If pressures are high or all shifts are harsh, go to Main Controls.
Main Controls	
• Main Control or Separator Plate — installed incorrectly	• Check the parts catalog for the correct parts used by vehicle application or year, install new components as required.
• Bolts not tightened to specification	• Tighten bolts to specification.
• Gaskets — damaged	• Inspect for damage and install a new gasket.
• Line Modulator Valve/Spring — misassembled, stuck, damaged	• Inspect for damage, contamination.
• EPC Solenoid — failure to operate in a normal manner	• Install new as required.
• Accumulator Assembly — damaged or wrong assembly	• Refer to Electrical Routine No. 214. • Inspect for damage. Install new as required. Verify correct assembly is used.
Pump Assembly	
• Bolts not tightened to specification	• Tighten bolts to specification.
• Gaskets — damaged	• Inspect for damage and install a new gasket.
• Main Regulator/Booster Valve — damaged, misassembled	• Inspect for damage. Repair as required.
For diagnostics related to a specific shift, see Reference/Action.	• Refer to the following Shift Routine(s) for further diagnosis: ■ Harsh Shift 1-2, Routine 232/332 ■ Harsh Shift 2-3, Routine 233/333 ■ Harsh Shift 3-4, Routine 234/334 ■ Harsh Shift 4-3, Routine 235/335 ■ Harsh Shift 3-2, Routine 236/336 ■ Harsh Shift 2-1, Routine 237/337

Shift Concerns: No 1st Gear in Drive, Engages in Higher Gear

Possible Component	Reference/Action
215 — ELECTRICAL ROUTINE	
Powertrain Control System • Electrical Inputs/Outputs, Vehicle Wiring Harnesses,	• Run On-Board Diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for

PCM, SSA, SSB, Digital TR Sensor	diagnosis. Go To Pinpoint Test A and Go To Pinpoint Test D using the Transmission Tester, Cable and Overlay and the TRS-E Cable. Repair as required. Clear codes, road test and rerun On-Board Diagnostics.
315 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage (Internal/External) or Cables, Digital Transmission Range (TR) Sensor ● Damaged, not connected, incorrectly adjusted	● Inspect and repair as required. Verify linkage adjustment. After linkage repair/adjustment, verify that the digital TR sensor is correctly adjusted. For additional information, refer to Digital Transmission Range (TR) Sensor in this section.
Main Controls	
● Bolts not tightened to specification	● Tighten bolts to specification.
● Gaskets — damaged, misaligned	● Inspect for damage and install a new gasket.
● SSA, SSB — stuck or damaged	● Refer to Electrical Routine No. 215.
● Solenoid Regulator Valve, 2-3 Shift Valve, 3-4 Shift Valve, D2 Valve — stuck, missing, misassembled, damaged	● Inspect for damage. Repair as required.
● Air Bleeds for S1-S2 Circuits — missing	● Inspect for damage. Install new case.
● Wrong components used in rebuild	● Verify that correct components were used. Install new as required.
Mechanical	
● Band Servo, Clutches — damaged	● Refer to correct disassembly procedures in this section.
For diagnosis related to a specific gear, use Transmission Tester to determine gear.	Refer to the following routine(s) for further diagnosis: No Shift 1-2, Routine 220/320 No Shift 2-3, Routine 221/321 No Shift 3-4, Routine 222/322.
Reverse Ring Gear ● Gear Lugs to Reverse Carrier — damaged	● Inspect for damage. Install new as required.
Low One-Way Clutch ● Damaged, misassembled	● Inspect for damage, correct assembly. Repair as required.

Shift Concerns: No Manual 1st Gear

Possible Component	Reference/Action
216 — ELECTRICAL ROUTINE	
Powertrain Control System ● Electrical Inputs/Outputs, Vehicle Wiring Harnesses, PCM, SSA, SSB, Digital TR Sensor	● Run On-Board Diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Go To Pinpoint Test A and Go To Pinpoint Test D using the Transmission Tester, Cable and Overlay and the TRS-E Cable. Repair

	as required. Clear codes, road test and rerun On-Board Diagnostics.
316 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage (Internal/External) or Cable • Damaged, incorrectly adjusted, not connected	• Inspect for damage. Repair as required. Verify linkage adjustment. After linkage repair/adjustment, verify that the digital TR sensor is correctly adjusted. For additional information, refer to Digital Transmission Range (TR) Sensor in this section.
Main Controls	
• Bolts not tightened to specification	• Tighten bolts to specification.
• Gaskets — damaged	• Inspect for damage and install a new gasket.
• Manual Control Lever Outer and Shaft Assembly, Manual Valve, Low Reverse Modulator Valve, 1-2 Shift Valve, 2-3 Shift Valve, BS1 Check Ball, 4-3-2 Timing Valve — stuck, damaged	• Inspect for damage. Repair as required.
• SSA — failure to operate in a normal manner	• Refer to Electrical Routine No. 216.
• Air Bleed for SSA Circuit — damaged or missing	• Inspect for damage. Install new case.
• Wrong parts used in rebuild	• Verify that correct parts were used.
Low One-Way Clutch Assembly • Damaged, misassembled	• Inspect for damage. Repair as required.

Shift Concerns: No Manual 2nd Gear

Possible Component	Reference/Action
217 — ELECTRICAL ROUTINE	
Powertrain Control System • Electrical Inputs/Outputs, Vehicle Wiring Harnesses, PCM, SSA, SSB, Digital TR Sensor	• Run On-Board Diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Go To Pinpoint Test A and Go To Pinpoint Test D using the Transmission Tester, Cable and Overlay and the TRS-E Cable. Repair as required. Clear codes, road test and rerun On-Board Diagnostics.
317 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage (Internal/External) or Cable • Damaged, incorrectly adjusted	• Inspect for damage. Repair as required. Verify linkage/cable adjustment. After linkage/cable repair/adjustment, verify that the digital TR sensor is correctly adjusted. For additional information, refer to Digital Transmission Range (TR) Sensor in this section.
Main Controls	
• Bolts not tightened to specification	• Tighten bolts to specification.

• Gaskets — damaged	• Inspect for damage and install a new gasket.
• 2-3 Shift Valve, 3-4 Shift Valve, 1-2 Shift Valve Manual 1-2 Transition Valve, Spring BS1, BS3— stuck, damaged, missing, misassembled	• Inspect for damage. Repair as required.
• BS2 — missing, leaks or seats damaged	• Inspect for damage. Install new as required.
• Incorrect parts used in rebuild	• Verify that correct parts were used.
Intermediate Clutch Assembly	
• Assembly	• Air Check Clutch Assembly; refer to Air Pressure Tests in this section.
• Seals or Piston — damaged	• Inspect for damage. Install new as required.
• Friction Elements — worn, missing, damaged, misassembled	• Inspect for damage. Install new as required.
• Ball Check — stuck/missing	• Inspect for damage. Repair as required.
• Feed Bolt — torque incorrect, leaks, missing	• Inspect and tighten bolts as required.
• Cylinder Assembly Outer Diameter/Case Bore — damaged, leaking	• Inspect for damage. Repair as required.
Intermediate One-Way Clutch Assembly • Housing — damaged	• Inspect for damage. Install new as required (a clicking sound heard when rotated by hand is normal).

Shift Concerns: No 1-2 Shift (Automatic)

Possible Component	Reference/Action
220 — ELECTRICAL ROUTINE	
Powertrain Control System • Electrical Inputs/Outputs, Vehicle Wiring Harnesses, PCM, TP Sensor, TSS, OSS, ABS, SSA, SSB	• Run On-Board Diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Go To Pinpoint Test A using the Transmission Tester and Cable and Overlay. Repair as required. Clear codes, road test and rerun On-Board Diagnostics.
320 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage (Internal/External) or Cable • Damage, incorrectly adjusted • Digital TR Sensor — damaged, incorrectly adjusted	• Inspect for damage. Repair as required. Verify linkage adjustment. After linkage repair/adjustment, verify that the digital TR sensor is correctly adjusted. For additional information, refer to Digital Transmission Range (TR) Sensor in this section.
Main Controls	
• Bolts not tightened to specification	• Tighten bolts to specification.
• Gaskets — damaged, misaligned	• Inspect for damage and install a new gasket.
• SSB — failure to operate in a	• Refer to Electrical Routine No. 220.

normal manner	
• D2 Valve, 1-2 Shift Valve, 1-2 Manual Transition Valve, Intermediate Clutch Accumulator Regulator Valves, Springs BS2 — stuck, damaged, missing or misassembled	• Inspect for damage. Repair as required.
• Air Bleed for SSB — circuit damaged or missing • Wrong parts used in rebuild	• Inspect for damage. Install new case. • Verify that correct parts were used.
Intermediate Clutch Assembly	
• Assembly	• Air Check Clutch Assembly; refer to Air Pressure Tests in this section.
• Seals or Piston — damaged	• Inspect for damage. Install new as required.
• Friction Elements — worn, missing, damaged, misassembled	• Inspect for damage. Repair as required.
• Ball Check — stuck/missing	• Inspect for damage. Repair as required.
• Feed Bolt — torque incorrect, leaks, missing • Cylinder Assembly Outer Diameter/Case Bore — damaged, leaking	• Inspect and tighten bolts as required. • Inspect for damage. Install new as required.
Intermediate One-Way Clutch Assembly • Housing — damaged	• Inspect for damage. Install new as required.

Shift Concerns: No 2-3 Shift (Automatic)

Possible Component	Reference/Action
221 — ELECTRICAL ROUTINE	
Powertrain Control System • Electrical Inputs/Outputs, Vehicle Wiring Harness, PCM, TP Sensor, TSS, OSS, ABS, SSA, SSB	• Run On-Board Diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Go To Pinpoint Test A using the Transmission Tester and Cable and Overlay. Repair as required. Clear codes, road test and rerun On-Board Diagnostics.
321 — HYDRAULIC/MECHANICAL ROUTINE	
Main Controls	
• Bolts not tightened to specification	• Tighten bolts to specification.
• Gaskets — damaged	• Inspect for damage and install a new gasket.
• SSA — failure to operate in a normal manner	• Refer to Electrical Routine No. 221.
• Direct Clutch Accumulator Regulator Valve, 2-3 Shift Valve, Springs — stuck, missing, damaged, misassembled	• Inspect for damage. Repair as required.
• Air Bleed for SSB Circuit — damaged or missing	• Inspect for damage. Install new case.

• Incorrect components used in rebuild	• Verify that correct components are used.
Center Support Assembly	
• Feed Bolts — missing, not tightened to specification	• Inspect, install new feed bolts and tighten to specification.
• Seal Rings — damaged	• Inspect for damage. Install new as required.
• Assembly damaged	• Inspect for damage. Install new as required.
• Outside Diameter or Case Bore — damaged or leaking	• Inspect for damage. Install new as required.
Direct Clutch Assembly	
• Assembly	• Air Check Clutch Assembly; refer to Air Pressure Tests in this section.
• Center Support Hub Seals — damaged	• Inspect for damage. Install new as required.
• Seals, Piston, Cylinder — damaged	• Inspect for damage. Install new as required.
• Friction Elements — missing or damaged	• Inspect for damage. Install new as required.
• Ball Check — missing, damaged	• Inspect for damage. Install new as required.

Shift Concerns: No 3-4 Shift (Automatic)

Possible Component	Reference/Action
222 — ELECTRICAL ROUTINE	
Powertrain Control System • Electrical Inputs/Outputs, Vehicle Wiring Harnesses, PCM, TP Sensor, TSS, OSS, ABS, SSA, SSB	• Run On-Board Diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Go To Pinpoint Test A using the Transmission Tester and Cable and Overlay. Repair as required. Clear codes, road test and rerun On-Board Diagnostics.
322 — HYDRAULIC/MECHANICAL ROUTINE	
Main Controls	
• Bolts not tightened to specification	• Tighten bolts to specification.
• Gaskets — damaged or misaligned	• Inspect for damage and install a new gasket.
• SSA, SSB — failure to operate in a normal manner	• Refer to Electrical Routine No. 222.
• Overdrive Accumulator Regulator Valve and Spring, 3-4 Shift Valve and Spring — damaged, stuck, misassembled, missing	• Inspect for damage. Repair as required.
• Incorrect components used in rebuild	• Verify that correct components were used in the rebuild.
Overdrive Clutch Assembly	
• Assembly	• Air Check Clutch Assembly; refer to Air Pressure Tests in this section.

• Clutch Plates — burnt, missing	• Inspect for damage. Install new as required.
• Cylinder — damaged	• Inspect for damage. Install new as required.
• Feed Bolts — loose, missing, leaking, seals damaged	• Install new feed bolts and tighten to specification.
• Cylinder Check Ball — missing	• Inspect for damage. Install new as required.
Overdrive One-Way Clutch Assembly	
• Damaged	• Inspect for damage. Install new as required.
Overdrive Planet Assembly	
• Damaged	• Inspect for damage. Install new as required.

Shift Concerns: No 4-3 Shift (Automatic)

Possible Component	Reference/Action
223 — ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical Inputs/Outputs, Vehicle Wiring Harnesses, PCM, TP Sensor, TSS, OSS, ABS, SSB	• Run On-Board Diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Go To Pinpoint Test A using the Transmission Tester and Cable and Overlay. Repair as required. Clear codes, road test and rerun On-Board Diagnostics.
323 — HYDRAULIC/MECHANICAL ROUTINE	
Main Controls	
• Bolts not tightened to specification	• Tighten bolts to specification.
• Gaskets — damaged, misaligned	• Inspect for damage and install a new gasket.
• SSB — failure to operate in a normal manner	• Refer to Electrical Routine No. 223.
• BS2, 3-4 Shift Valve — damaged, missing, misassembled, stuck	• Inspect for damage. Repair as required.

Shift Concerns: No 3-2 Shift (Automatic)

Possible Component	Reference/Action
224 — ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical Inputs/Outputs, Vehicle Wiring Harnesses, PCM, TP Sensor, TSS, OSS, ABS, SSA	• Run On-Board Diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Go To Pinpoint Test A and Go To Pinpoint Test D using the Transmission Tester and Cable and Overlay. Repair as required. Clear codes, road test and rerun On-Board Diagnostics.
324 — HYDRAULIC/MECHANICAL ROUTINE	
Main Controls	
• Bolts not tightened to specification	• Tighten bolts to specification.

• Gaskets — damaged, misaligned	• Inspect for damage and install a new gasket.
• SSA — failure to operate in a normal manner	• Refer to Electrical Routine No. 224.
• 2-3 Shift Valve — stuck, damaged	• Inspect for damage. Repair as required.

Shift Concerns: No 2-1 Shift (Automatic)

Possible Component	Reference/Action
225 — ELECTRICAL ROUTINE	
Powertrain Control System • Electrical Inputs/Outputs, Vehicle Wiring Harnesses, PCM, TP Sensor, TSS, OSS, ABS, SSB	• Run On-Board Diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Go To Pinpoint Test A using the Transmission Tester and Cable and Overlay. Repair as required. Clear codes, road test and rerun On-Board Diagnostics.
325 — HYDRAULIC/MECHANICAL ROUTINE	
Main Controls	
• Bolts not tightened to specification	• Tighten bolts to specification.
• Gaskets, Separator Plate — damaged, misaligned	• Inspect for damage and install a new gasket.
• SSB — failure to operate in a normal manner	• Refer to Electrical Routine No. 225.
• D2 Shift Valve — damaged, stuck	• Inspect for damage. Repair as required.

Shift Concerns: Soft/Slipping 1-2 Only (Automatic)

Possible Component	Reference/Action
226 — ELECTRICAL ROUTINE	
Powertrain Control System • Electrical Inputs/Outputs, Vehicle Wiring Harnesses, PCM	• Run On-Board Diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Repair as required.
326 — HYDRAULIC/MECHANICAL ROUTINE	
Main Controls	
• Bolts not tightened to specification	• Tighten bolts to specification.
• Gaskets — damaged, misaligned	• Inspect for damage and install a new gasket.
• Intermediate Clutch Accumulator Regulator Valve or Plunger, Springs — stuck, damaged, missing or misassembled	• Inspect for damage. Repair as required.
• Wrong parts used in rebuild	• Verify that correct parts were used.
Intermediate Clutch Assembly	
• Assembly	• Air Check Clutch Assembly; refer to Air

	Pressure Tests in this section.
• Seals or Piston — damaged	• Inspect for damage. Install new as required.
• Friction Elements — worn, missing, misassembled or damaged	• Inspect for damage. Repair as required.
• Feed Bolts — torque incorrect, missing	• Inspect and install new feed bolts and tighten to specification.
• Ball Check — missing, not seating • Cylinder Assembly Outer Diameter/Case Bore — damaged	• Inspect for damage. Repair as required. • Inspect for damage. Install new as required.

Shift Concerns: Soft/Slipping 2-3 Only (Automatic)

Possible Component	Reference/Action
227 — ELECTRICAL ROUTINE	
Powertrain Control System • Electrical Inputs/Outputs, Vehicle Wiring Harnesses, PCM	• Run On-Board Diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Repair as required.
327 — HYDRAULIC/MECHANICAL ROUTINE	
Main Controls	
• Bolts not tightened to specification	• Tighten bolts to specification.
• Gaskets — damaged	• Inspect for damage and install a new gasket.
• Direct Clutch Accumulator Regulator Valve, Plunger, Springs — stuck, missing, damaged, misassembled	• Inspect for damage. Repair as required.
• Incorrect parts used in rebuild	• Verify that correct parts were used.
Center Support Assembly	
• Feed Bolts — missing, not tightened to specification	• Inspect, install new feed bolts and tighten to specification.
• Seal Rings — damaged	• Inspect for damage. Install new as required.
• Assembly — damaged	• Inspect for damage. Install new as required.
• Outside Diameter or Case Bore — damaged or leaking	• Inspect for damage. Install new as required.
Direct Clutch Assembly	
• Assembly	• Air Check Clutch Assembly; refer to Air Pressure Tests in this section.
• Center Support Hub Seals — damaged	• Inspect for damage. Install new as required.
• Seals, Piston, Cylinder — damaged	• Inspect for damage. Install new as required.
• Friction Elements — burnt, missing	• Inspect for damage. Repair as required.
• Plates — incorrect quantity installed	• Inspect for correct quantity. Repair as required.
• Ball Check — missing, not seating • Intermediate Brake Drum Inner Diameter — damaged	• Inspect for damage. Repair as required. • Inspect for damage. Install new as required.

Shift Concerns: Soft/Slipping 3-4 Only (Automatic)

Possible Component	Reference/Action
228 — ELECTRICAL ROUTINE	
Powertrain Control System	
● Electrical Inputs/Outputs, Vehicle Wiring Harnesses, PCM	● Run On-Board Diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Repair as required.
328 — HYDRAULIC/MECHANICAL ROUTINE	
Main Controls	
● Bolts not tightened to specification	● Tighten bolts to specification.
● Gaskets — damaged or misaligned	● Inspect for damage and install a new gasket.
● Overdrive Accumulator Regulator Valve and Spring, Overdrive Accumulator Plunger and Springs — damaged, misassembled, stuck, missing	● Inspect for damage. Repair as required.
● Incorrect parts used in rebuild	● Verify that correct parts were used.
Overdrive Clutch Assembly	
● Assembly	● Air Check Clutch Assembly; refer to Air Pressure Tests in this section.
● Friction Elements — burnt, missing	● Inspect for damage. Install new as required.
● Cylinder —damaged; Seals — damaged	● Inspect for damage. Install new as required.
● Feed Bolts — loose, missing, leaking, not tightened to specification	● Install new feed bolts and tighten to specification.
● Cylinder Check Ball — not seating, missing	● Inspect for damage. Repair as required.

Shift Concerns: Soft/Slipping Downshifts (Automatic)

Possible Component	Reference/Action
229 — ELECTRICAL ROUTINE	
Powertrain Control System	
● Electrical Inputs/Outputs, Vehicle Wiring Harnesses, PCM	● Run On-Board Diagnostics. Refer to Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Repair as required.
329 — HYDRAULIC/MECHANICAL ROUTINE	
Main Controls	
● Bolts not tightened to specification	● Tighten bolts to specification.
● Gaskets — damaged, misaligned	● Inspect for damage and install a new gasket.
● Valve Body Separator Plate — damaged	● Inspect for damage. Install new as required.
● Incorrect parts used in rebuild (wrong separator plates, main controls, or gaskets)	● Verify that correct parts were used, refer to TSBs and the parts catalog.

Shift Concerns: Harsh 1-2 Shift Only (Automatic)

Possible Component	Reference/Action
232 — ELECTRICAL ROUTINE	
Powertrain Control System	
● Electrical Inputs/Outputs, Vehicle Wiring Harnesses, PCM	● Run On-Board Diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Repair as required.
332 — HYDRAULIC/MECHANICAL ROUTINE	
Main Controls	
● Bolts not tightened to specification	● Tighten bolts to specification.
● Gaskets — damaged, misaligned	● Inspect for damage and install a new gasket.
● Intermediate Clutch Accumulator Regulator Valve or Plunger Springs — stuck, damaged, missing or misassembled	● Inspect for damage. Repair as required.
● Wrong parts used in rebuild	● Verify that correct parts were used.
Intermediate Clutch Assembly	
● Assembly	● Air Check Clutch Assembly; refer to Air Pressure Tests in this section.
● Friction Plates — installed incorrectly	● Inspect the friction plates. Verify that the correct parts were used, refer to the parts catalog and TSBs.
● Seals or Piston — damaged	● Inspect for damage. Repair as required.
● Friction Elements — missing or misassembled, damaged or incorrect quantity of plates installed	● Inspect for damage. Repair as required.

Shift Concerns: Harsh 2-3 Shift Only (Automatic)

Possible Component	Reference/Action
233 — ELECTRICAL ROUTINE	
Powertrain Control System	
● Electrical Inputs/Outputs, Vehicle Wiring Harnesses, PCM	● Run On-Board Diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Repair as required.
333 — HYDRAULIC/MECHANICAL ROUTINE	
Main Controls	
● Bolts not tightened to specification	● Tighten bolts to specification.
● Gaskets — damaged	● Inspect for damage and install a new gasket.
● Direct Clutch Accumulator Regulator Valve, Plungers, Springs — stuck, missing, damaged, misassembled	● Inspect for damage. Repair as required.
● Wrong parts used in rebuild	● Verify that correct parts were used.
Center Support Assembly	
● Seal Rings — damaged	● Inspect for damage. Install new as required.

• Outside Diameter or Case Bore — damaged or leaking	• Inspect for damage. Install new as required.
Direct Clutch Assembly	
• Assembly	• Air Check Clutch Assembly; refer to Air Pressure Tests in this section.
• Seals, Piston, Cylinder — damaged • Friction Elements — damaged, missing or incorrect quantity of plates were installed	• Inspect for damage. Install new as required. • Inspect for damage. Repair as required.

Shift Concerns: Harsh 3-4 Shift Only (Automatic)

Possible Component	Reference/Action
234 — ELECTRICAL ROUTINE	
Powertrain Control System • Electrical Inputs/Outputs, Vehicle Wiring Harnesses, PCM	• Run On-Board Diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Repair as required.
334 — HYDRAULIC/MECHANICAL ROUTINE	
Main Controls	
• Bolts not tightened to specification	• Tighten bolts to specification.
• Gaskets — damaged or misaligned	• Inspect for damage and install a new gasket.
• Overdrive Accumulator Regulator Valve and Spring, Overdrive Accumulator Plunger and Springs — stuck, damaged, misassembled, missing	• Inspect for damage. Repair as required.
• Incorrect parts used in rebuild	• Verify that correct parts were used.
Overdrive Clutch Assembly	
• Assembly	• Air Check Clutch Assembly; refer to Air Pressure Tests in this section.
• Friction Elements — burnt, missing	• Inspect for damage. Install new as required.
• Cylinder — damaged, Seals — damaged, Retaining Ring — not seated	• Inspect for damage. Repair as required.

Shift Concerns: Harsh 4-3 Shift Only (Automatic)

Possible Component	Reference/Action
235 — ELECTRICAL ROUTINE	
Powertrain Control System • Electrical Inputs/Outputs, Vehicle Wiring Harnesses, PCM	• Run On-Board Diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Repair as required.
335 — HYDRAULIC/MECHANICAL ROUTINE	
Main Controls	
• Bolts not tightened to	• Tighten bolts to specification.

specification	
• Gaskets — damaged, misaligned	• Inspect for damage and install a new gasket.
• CB7 Check Ball — missing	• Inspect for damage. Install new as required.
• Separator Plate — damaged	• Inspect for damage. Install new as required.

Shift Concerns: Harsh 3-2 Shift Only (Automatic)

Possible Component	Reference/Action
236 — ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical Inputs/Outputs, Vehicle Wiring Harnesses, PCM	• Run On-Board Diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Repair as required.
336 — HYDRAULIC/MECHANICAL ROUTINE	
Main Controls	
• Bolts not tightened to specification	• Tighten bolts to specification.
• Gaskets — damaged, misaligned	• Inspect for damage and install a new gasket.
• CB6 Check Ball — missing	• Inspect for damage. Install new as required.
• Separator Plate — damaged	• Inspect for damage. Install new as required.

Shift Concerns: Harsh 2-1 Shift Only (Automatic)

Possible Component	Reference/Action
237 — ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical Inputs/Outputs, Vehicle Wiring Harnesses, PCM	• Run On-Board Diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Repair as required.
337 — HYDRAULIC/MECHANICAL ROUTINE	
Main Controls	
• Bolts not tightened to specification	• Tighten bolts to specification.
• Gaskets — damaged, misaligned	• Inspect for damage and install a new gasket.
• CB14 Check Ball — missing	• Inspect for damage. Install new as required.
• Separator Plate — damaged	• Inspect for damage. Install new as required.

Torque Converter Clutch Operation Concern: No Apply

Possible Component	Reference/Action
240 — ELECTRICAL ROUTINE	
Powertrain Control System	• **Carry out Torque Converter Clutch Operation Test.**

• Electrical Inputs/Outputs, Vehicle Wiring Harnesses, PCM, TCC Solenoid, BPP Switch, TP Sensor, TFT Sensor	• Run On-Board Diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Carry out Torque Converter Engagement Test. Go To Pinpoint Test B and Go To Pinpoint Test C using the Transmission Tester and Cable and Overlay. Repair as required. Clear codes, road test and rerun On-Board Diagnostics.
340 — HYDRAULIC/MECHANICAL ROUTINE	
Main Controls	
• Bolts not tightened to specification	• Tighten bolts to specification.
• TCC Solenoid or TFT Sensor — failure to operate in a normal manner	• Refer to Electrical Routine No. 240.
• Gaskets — damaged	• Inspect gasket for damage and install a new gasket.
Pump Assembly	
• Bolts not tightened to specification	• Tighten bolts to specification.
• Cross leaks, cup plugs missing	• Inspect for porosity/leaks, cup plugs missing, install a new pump as required.
• Gaskets — damaged	• Inspect and install new gaskets.
• Converter Clutch Control Valve and Regulator Valve — stuck, misassembled, damaged	• Inspect for damage. Install new pump.
Stator Support • Teflon® Seals — damaged, leaking	• Inspect for damage. Install new as required.
Torque Converter Assembly • Leakage, Friction Material — damaged, Internal Seals — damaged	• Inspect Torque Converter. For additional information, refer to Torque Converter in this section.

Torque Converter Clutch Operation Concern: Always Applied/Stalls Vehicle (See Note in No. 241 Before Proceeding)

Possible Component	Reference/Action
241 — ELECTRICAL ROUTINE	
NOTE: Stalls in DRIVE and MANUAL 2 only (MANUAL 1 and REVERSE are OK)	• Go to Hydraulic/Mechanical No. 341. • Carry out Torque Converter Clutch Operation Test.
Powertrain Control System • Electrical Inputs/Outputs, Vehicle Wiring Harnesses, PCM, TCC Solenoid • Stalls in any range.	• Run On-Board Diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Carry out Torque Converter Engagement Test. Go To Pinpoint Test C using the Transmission Tester and Cable and Overlay. Repair as required. Clear codes, road test and rerun On-Board Diagnostics. • Refer to 341 Fluid Filter.
341 — HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	

• Line Pressure — low	• Check line pressure at line tap. Carry out Line Pressure and Stall Speed Tests. Refer to the Line Pressure Chart for specification.
Fluid Filter • Filter or Seal — damaged • Filter/Seal — disengaged from pump inlet bore	• Install new filter and seal assembly.
Main Controls	
• Bolts not tightened to specification	• Tighten bolts to specification.
• Torque Converter Clutch Solenoid — failure to operate in a normal manner	• Refer to Electrical Routine No. 241.
• Gaskets — damaged	• Inspect for damage and install new gaskets.
Pump Assembly	
• Bolts not tightened to specification	• Tighten bolts to specification.
• Converter Clutch Control Valve — misassembled, stuck, damaged	• Inspect for damage. Repair as required.
• Porosity/cross leaks	• Inspect for porosity/leaks, valve damaged. Install new pump as required.
• Gaskets — damaged • Pump Gear End Clearance — excessive, wear	• Inspect for damage and install new gaskets. • Carry out pump gear end clearance check; refer to Pump Assembly in this section, or refer to any TSBs. Install new pump as required.
Torque Converter Assembly	
• End Play (none)	• Carry out End Play Check in this section.
• Piston Plate — damaged/stuck to cover	• Inspect for damage. Repair as required. • Inspect transmission cooling system for correct lube flow. Follow the procedures in this section.
• Internal Converter — wear • Install new or remanufactured torque converter, refer to TSBs.	

Torque Converter Clutch Operation Concern: Cycling/Shudder/Chatter

Possible Component	Reference/Action
242 — ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical Inputs/Outputs, Vehicle Harnesses, PCM, TCC Solenoid, Digital TR Sensor, BPP Switch, PCM	• Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Carry out Torque Converter Engagement Test. Go To Pinpoint Test C and Go To Pinpoint Test D using the Transmission Tester, Cable and Overlay and TRS-E Cable. Clear codes, road test and rerun

	On-Board Diagnostics.
Speed Control Equipped Vehicles	NOTE: Refer to Routine No. 212 before you proceed to No. 342.
342 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid Condition ● Fluid (water, dirt, metal, or particles) — contamination	● Inspect fluid condition. If burnt or contaminated drain fluid from the transmission assembly and converter assembly. Check control attaching bolts for correct torque. Tighten as required. Record and erase On-Board Diagnostics codes. Bring vehicle to normal operating temperature. Carry out Transmission Drive Cycle in this section. Carry out On-Board Diagnostics. If condition still exists, continue diagnosis.
Main Controls	
● Bolts not tightened to specification	● Tighten bolts to specification.
● Torque Converter Clutch Solenoid — failure to operate in a normal manner	● Refer to Electrical Routine No. 242.
● Gaskets — damaged	● Inspect for damage and install new gaskets.
Pump Assembly	
● Bolts not tightened to specification	● Tighten bolts to specification.
● Cross leaks	● Inspect for porosity/leaks, valve damage; install new pump as required.
● Gaskets — damaged	● Inspect for damage and install new gaskets.
● Converter Clutch Regulator Valve — damaged	● Inspect for damage. Install new as required.
Stator Support ● Teflon® Seal on Nose of Stator — damaged, cut, leaking	● Inspect for damage. Install new as required.
Torque Converter Assembly ● End Play — (excessive), internal leakage	● Inspect Torque Converter. For additional information, refer to Torque Converter One-Way Clutch Check in this section. Repair as required.

Other Concerns: Shift Lever Efforts High

Possible Component	Reference/Action
251 — ELECTRICAL ROUTINE	
● No electrical concerns	
351 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage (Internal/External) or Cable ● Damaged, incorrectly adjusted	● Inspect and repair as required. Verify linkage adjustment. After linkage repair/adjustment, verify that the digital TR sensor is correctly adjusted. For additional information, refer to Digital Transmission Range (TR) Sensor in this section.

Manual Control Lever Outer and Shaft Assembly ● Retaining Pin — damaged, Nut — loose, Detent Spring — bent/damaged, Park Mechanism — damaged	● Inspect for damage. Repair as required. Inspect locking nuts for correct torque, tighten to correct specification as required.
Main Controls	
● Manual Valve — sticking ● Bolts not tightened to specification	● Inspect for damage. Repair as required. ● Tighten bolts to specification.

Other Concerns: External Leaks

Possible Component	Reference/Action
252 — ELECTRICAL ROUTINE	
● No electrical concerns	
352 — HYDRAULIC/MECHANICAL ROUTINE	
Engine Rear Seal	● **Locate source and install new as required.**
Seals/Gaskets ● Torque Converter Assembly, Pump, Transmission Fluid Pan, Transmission Connector, Extension Housing — Gasket Seal, Manual Lever, Fluid Level Indicator, Fluid Filler Tube, Pump Bolts	● Locate source and repair as required.
Other	
● Cooler Fitting, Pressure Taps, Converter Drain Plug, Band Anchor Pins, Cooler Tubes — case porosity, case cracked	● Locate source and repair as required.
● Vent — blocked or damaged	● Check case vent assembly for damage or blockage. Repair as required.
● Overfilled Transmission	● Check level and adjust as required.
● Overheating	● Refer to routines No. 257/357.
● Pump assembly	● Locate source and repair as required.

Other Driveability Concerns:

NOTE: Check for engine running poor. It is possible that the transmission is functioning correctly based on input from the PCM. All non-transmission related DTCs should be repaired prior to any transmission repair.

Possible Component	Reference/Action
253 — ELECTRICAL ROUTINE	
Powertrain Control System ● Electrical Inputs/Outputs, Vehicle Wiring Harnesses, PCM, Other Engine-Related Items, TCC Solenoid, TP	● **Carry out Torque Converter Clutch Operation Test.** ● Run On-Board Diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Go To Pinpoint Test B , Go To Pinpoint Test C and Go To Pinpoint Test D using the Transmission

Sensor, Digital (TR) Sensor, TFT Sensor	Tester, Cable and Overlay and TRS-E Cable. Repair as required. Clear codes, road test and rerun On-Board Diagnostics.
353 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage (Internal/External) or Cable ● Damaged, incorrectly adjusted	● Inspect for damage. Repair as required. Verify linkage adjustment. After linkage repair/adjustment, verify that the digital TR sensor is correctly adjusted. For additional information, refer to Digital Transmission Range (TR) Sensor in this section.
Shift Scheduling ● Incorrect	● Carry out Shift Point Road Test in this section. ● Go to the appropriate diagnostic routines for shift concerns No. 210-211.
Engagements ● Gear Selection — incorrect	● Go to the appropriate diagnostic routines for shift concerns No. 215/315.
Converter Clutch Always Applied	● Go to routine No. 341.
Converter One-Way Clutch ● Damaged	● Go to Torque Converter One-Way Clutch Check in this section.

Other Concerns: Noise/Vibration — Forward or Reverse

Possible Component	Reference/Action
254 — ELECTRICAL ROUTINE	
● No electrical concerns	
354 — HYDRAULIC/MECHANICAL ROUTINE	
For Noises/Vibrations that change with engine speed: ● Torque Converter Components ● Fluid Level (Low) Pump — cavitation ● Pump assembly ● Engine drive accessories ● Transmission fluid cooler lines grounding out ● Flexplate ● Fluid filler tube grounding out	● Locate source of disturbance. Repair as required.
For Noise/Vibrations that change with vehicle speed: ● Engine mounts ■ Loose, damaged ● Driveline concerns ● U-joints ● Rear axle assembly ● Suspension ● Modifications/misalignment ● First gear ■ one-way clutch, gear set ■ friction elements ■ torque converter assembly ● Second gear ■ intermediate OWC	● Locate source of disturbance. Repair as required. ● For specific shifts or torque converter concern, refer to appropriate routines: ■ No Shift 1-2, Routine 320 ■ No Shift 2-3, Routine 321 ■ No Shift 3-4, Routine 322 ■ No Shift 4-3, Routine 323 ■ No Shift 3-2, Routine 324 ■ No Shift 2-1, Routine 325 ■ No Converter Cycling, Routine 242/342

■ friction elements ■ torque converter assembly ● Third gear ■ one-way clutch ■ torque converter assembly ■ friction elements ● Fourth gear ■ one-way clutch ■ gear set ■ friction elements ■ torque converter assembly ● REVERSE ■ gear set ■ friction elements ■ torque converter assembly ● Shaft spline fit ● Slip yoke, park gear	
Other Noises/Vibrations: ● Main controls ● Valve resonance ● Shift cable ● Vibration, grounding ■ Transmission fluid cooler lines or fluid filler tube	● Locate source of disturbance. Repair as required.

Other Concerns: Engine Will Not Crank

Possible Component	Reference/Action
255 — ELECTRICAL ROUTINE	
Powertrain Control System ● Electrical Inputs/Outputs, Vehicle Wiring Harnesses, PCM, Digital TR Sensor	● Run On-Board Diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Go To Pinpoint Test D using the Transmission Tester, Cable and Overlay and TRS-E Cable. Repair as required. Clear codes, and rerun On-Board Diagnostics.
355 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage (Internal or External), Cable, or Digital TR Sensor ● Damaged, incorrectly adjusted	● Inspect and repair as required. Verify linkage adjustment. After linkage repair/adjustment, verify that the digital TR sensor is correctly adjusted. For additional information, refer to Digital Transmission Range (TR) Sensor in this section.
Pump Assembly ● Seized	● Inspect for damage, repair or install new as required. For additional information, refer to Pump Assembly in this section.
Flexplate ● Damaged	● Inspect for damage. Install new as required.

Other Concerns: No Park Range

Possible Component	Reference/Action

256 — ELECTRICAL ROUTINE	
● No electrical concerns	
356 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage (Internal/External) or Cable ● Damaged, incorrectly adjusted	● Inspect for damage. Repair as required. Verify linkage adjustment. After linkage repair/adjustment, verify that the digital TR sensor is correctly adjusted. For additional information, refer to Digital Transmission Range (TR) Sensor in this section.
Park Mechanism ● Park Gear, Parking Pawl, Parking Pawl Return Spring, Park Guide Plate, Parking Pawl Shaft, Parking Pawl Actuating Rod, Manual Control Lever Outer and Shaft Assembly, Inner Manual Valve Detent Lever — damaged, misassembled	● Inspect for damage. Repair as required.
Super Duty Only ● Parking Brake Drum— damaged	● Inspect for damage. Install new as required.

Other Concerns: Transmission Overheating

Possible Component	Reference/Action
257 — ELECTRICAL ROUTINE	
Powertrain Control System ● Electrical Inputs/Outputs, Vehicle Wiring Harnesses, PCM, TCC Solenoid	● Run On-Board Diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Go To Pinpoint Test C using the Transmission Tester and Cable and Overlay. Repair as required. Clear codes, road test and rerun On-Board Diagnostics.
357 — HYDRAULIC/MECHANICAL ROUTINE	
Excessive Vehicle or Towing Loads, Severe Vehicle Usage	● Refer to the vehicle specification manual for load and GVW/GCW information. Refer to owner guide. ● NOTE: If auxiliary cooler is desired, use only Ford original factory equipment installed to factory specifications.
Fluid ● Incorrect Level ● Condition	● Adjust fluid to correct level. Inspect according to instructions under Fluid Condition Check.
Transmission Cooling System ● Damaged, blocked, restricted, or incorrectly installed ● Cooler Bypass Valve (CBV) — damaged, blocked, restricted or incorrectly installed	● Carry out Transmission Fluid Cooler Flow Test. ● Inspect for damage, restrictions. Repair as required.
Vehicle Concerns Causing Engine Overheating	● Refer to Section 303-03 .
Torque Converter Clutch ● Not engaging	● See Routine No. 240/340.

Other Concerns: No Engine Braking in MANUAL 2 Position Only

Possible Component	Reference/Action
258 — ELECTRICAL ROUTINE	
• No electrical concerns	
358 — HYDRAULIC/MECHANICAL ROUTINE	
Main Controls	
• Bolts not tightened to specification	• Tighten bolts to specification.
• BS1, BS2, BS3, and CB1 Check Balls — missing, seat damaged	• Inspect for damage. Install new as required.
• Valve Body Separator Plate — damaged	• Inspect for damage. Install new as required.
• 4-3-2 Timing Valve, D2 Valve, 2-3 Shift Valve, Coast Clutch Shift Valve, 1-2 Manual Transition Valve, 3-4 Shift Valve — damaged, stuck, misassembled	• Inspect for damage. Repair as required.
Coast Clutch Assembly	
• Assembly	• Air Check Clutch Assembly; refer to Air Pressure Tests in this section.
• Seals or Piston — damaged	• Inspect for damage. Install new as required.
• Stator Support — damaged or holes blocked. Seal Rings — damaged	• Inspect for damage. Repair as required.
• Cylinder Hub — damaged or holes blocked	• Inspect for damage. Repair as required.
• Friction Elements — damaged, burnt	• Inspect for damage. Install new as required.
Intermediate Servo/Band Assembly	
• Servo Piston or Bore — damaged	• Inspect for damage. Install new as required.
• Band or Drum — burnt, damaged	• Inspect for damage. Install new as required.

Other Concerns: No Engine Braking in MANUAL 1 Position Only

Possible Component	Reference/Action
259 — ELECTRICAL ROUTINE	
• No electrical concerns	
359 — HYDRAULIC/MECHANICAL ROUTINE	
Main Controls	
• Bolts not tightened to specification	• Tighten bolts to specification.
• Gaskets — damaged	• Inspect for damage and install new gasket.
• 3-4 Shift Valve, Low Reverse Clutch Modulator Valve, D2 Valve, 4-3-2 Timing Valve, 2-3 Shift Valve, Coast Clutch Shift Valve — damaged, misassembled, stuck	• Inspect for damage. Repair as required.
• BS3, BS1, CB16, and CB1 Check Ball — damaged,	• Inspect for damage. Install

missing	new as required.
• Valve Body Separator Plate — damaged	• Inspect for damage. Install new as required.
• Reinforcing Plate — bolts loose	• Tighten bolts to specification.
Coast Clutch Assembly	
• Assembly	• Air Check Clutch Assembly; refer to Air Pressure Tests in this section.
• Seal or Piston — damaged	• Inspect for damage. Install new as required.
• Stator Support — damaged or holes blocked, Seal Rings — damaged	• Inspect for damage. Repair as required.
• Cylinder Hub — damaged or holes blocked	• Inspect for damage. Repair as required.
• Friction Elements — damaged, burnt	• Inspect for damage. Install new as required.
Low One-Way Clutch Assembly	
• Assembly	• Air Check Clutch Assembly; refer to Air Pressure Tests in this section.
• Seals or Piston — damaged	• Inspect for damage. Install new as required.
• Friction Elements — damaged, worn	• Inspect for damage. Install new as required.
• Sealing Area in Case — damaged	• Inspect for damage. Install new case.

Other Concerns: No Engine Braking with Overdrive Cancelled (MANUAL 1st and MANUAL 2nd Have Engine Braking)

Possible Component	Reference/Action
260 — ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical Inputs/Outputs, Vehicle Wiring Harnesses, PCM, CCS	• Run On-Board Diagnostics. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Go To Pinpoint Test G using the Transmission Tester and Cable and Overlay. Repair as required. Clear codes, road test and rerun On-Board Diagnostics.
360 — HYDRAULIC/MECHANICAL ROUTINE	
Main Controls	
• Bolts not tightened to specification	• Tighten bolts to specification.
• Gaskets — damaged	• Inspect for damage and install a new gasket.
• CCS — damaged, stuck	• Refer to electrical routine No. 260.
• BS3 Check Balls — missing, Valve Body Separator Plate Seat — damaged	• Inspect for damage. Install new as required.
• 3-4 Shift Valve — stuck, damaged or	• Inspect for damage. Repair as required.

misassembled ● Coast Clutch Shift Valve — damaged or misassembled	● Inspect for damage. Repair as required.

No Engine Braking in Manual 1, 2 and 3

Possible Component	Reference/Action
261 — ELECTRICAL ROUTINE	
● No electrical concerns	
362 — HYDRAULIC/MECHANICAL ROUTINE	
Main Controls	
● Bolts not tighten to specification	● Tighten to specification.
● Valve body separator plate damaged	● Inspect for damage. Install new as required.
● Gaskets damaged	● Inspect for damage or missing gasket. Install new as required.
Coast Clutch Assembly	
● Coast clutch cylinder snap ring grove damaged	● Inspect cylinder for damage. Install new as required. Inspect flatness of grove. Install new cylinder as required.
● Not machined flat	● Inspect cylinder and snap ring for damage.
● Coast clutch cylinder snap ring loose installed	● Inspect new as required. Inspect for flatness of grove. Install new as required.

Other Concerns: Fluid Venting/Foaming

Possible Component	Reference/Action
262 — ELECTRICAL ROUTINE	
● No electrical concerns	
362 — HYDRAULIC/MECHANICAL ROUTINE	
● Case Vent Assembly — blocked or damaged	● Check case vent assembly for damage or blockage. Repair as required.
● Overfilled Transmission	● Check level and adjust as required.
● Fluid — contaminated (coolant, water)	● Check for contamination, locate source of contamination. Repair as required.
● Overheating	● Refer to Routine No. 257/357.
● Filter Assembly and Seal — damaged or misassembled	● Inspect filter assembly and seal for damage. Install new as required.
● Pump-to-Case Gasket — damaged, misaligned	● Inspect for damage and install a new gasket.

Transmission Fluid Cooler — Backflushing and Cleaning

1. Using a suitable torque converter/fluid cooler cleaner, flush the fluid cooler and lines.

2. **NOTE:** Rubber hoses must be attached to the ends of the fluid cooler tubes, to aid in connecting them to the cleaner.

   Connect the cleaner pressure and return lines appropriately.
   1. Connect the pressure line to fluid cooler inlet tube.
   2. Connect the return line to fluid cooler outlet tube.
   3. Place the outlet end of the return line in the solvent tank reservoir.

3. **NOTE:** Cycling the solvent pump on and off will help dislodge contaminants in the cooler system.

   Switch the solvent pumps on. Allow the solvent to circulate a minimum of five minutes.

4. Switch the solvent pump off.

5. Disconnect the cleaner pressure line at the fluid cooler tube.

6. Using compressed air, blow through the fluid cooler inlet tube until all solvent is removed.

7. Remove the rubber hoses from fluid cooler tubes.

Transmission Fluid Drain and Refill

Special Tool(s)

 ST2654-A	Automatic Transmission Flush and Fill Machine 211-00018
 ST2654-A	Automatic Transmission Flush and Fill Machine 199-00010 or equivalent

Material

Item	Specification
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®

1. **CAUTION: Always refer to the instructions supplied with the flush and fill machine.**

   CAUTION: Do not use any supplemental transmission fluid additives or cleaning agents. The use of these products could cause internal transmission components to fail; this will affect the operation of the transmission.

   NOTE: Draining fluid from the transmission by removing only the fluid pan is acceptable for vehicles that do not have a torque converter drain plug and for normal or severe duty fluid maintenance.

   A new procedure for draining and adding transmission fluid using a suitable transmission flush and fill machine has been added. The following is list of different methods for draining and refilling the transmission fluid:

   - All vehicles using a suitable flush and fill machine.
   - Vehicles equipped with a fluid pan and torque converter drain plug.
   - Vehicles not equipped with a fluid pan or a torque converter drain plug.
   - Vehicles equipped with a torque converter drain plug and without a fluid pan drain plug. Use the method that is applicable to your vehicle.

All vehicles using a suitable flush and fill machine

Draining

2. Position the vehicle on a hoist. Place in NEUTRAL. For additional information, refer to Section 100-02 .

3. Use a suitable flush and fill machine to change the fluid

4. When connecting the flush and fill machine, connect the machine to the fluid cooler line after the cooler on the cooler return line. This will help remove any debris trapped in the fluid coolers.

Refill

5. Use only clean automatic transmission fluid.

6. Once the fluid exchange has been completed, disconnect the flush and fill machine. Reconnect any disconnected fluid cooler lines.

7. Lower the vehicle. For additional information, refer to Section 100-02 .

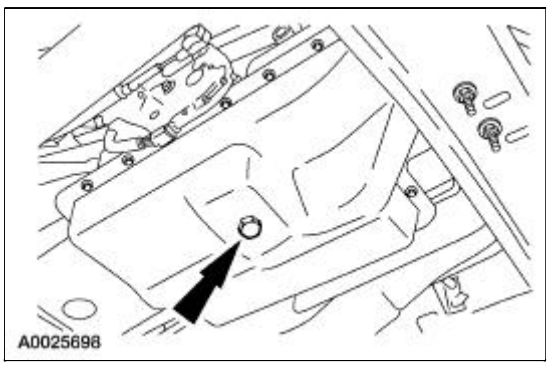
8. With the engine running and the transmission at normal operating temperature 66-77°C (150-170°F), check and adjust the transmission fluid level and check for any leaks. If fluid is needed, add fluid in increments of 0.24-liter (0.5-pint) until the correct level is achieved (fluid in the cross-hatched area of the fluid level indicator).

Vehicles equipped with a fluid pan and torque converter drain plug

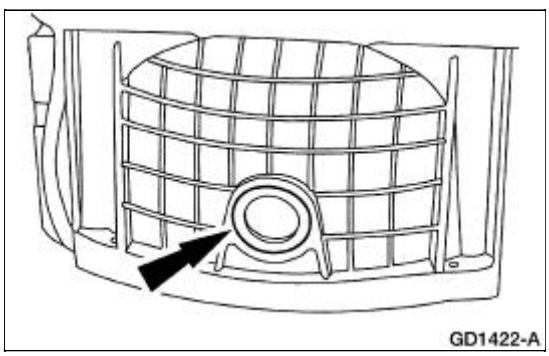
Draining

1. Raise the vehicle on a hoist. For additional information, refer to Section 100-02 .

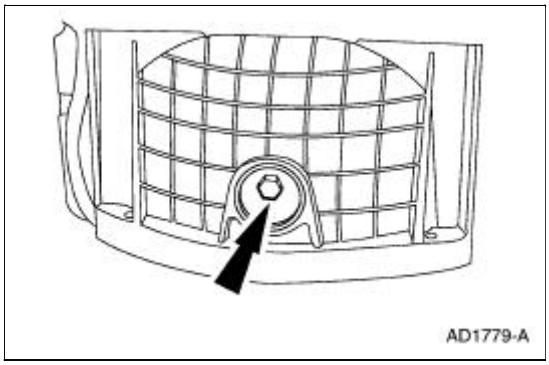
2. Remove the drain plug and allow the fluid to drain.



3. Remove the torque converter drain plug cover.



4. Remove the torque converter drain plug and discard.



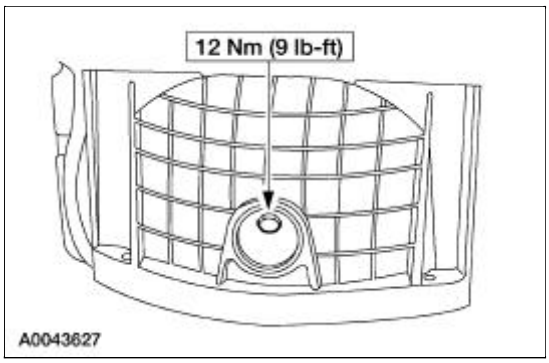
5. Allow the fluid to drain.

6. **NOTE:** If equipped with a radiator in-tank transmission fluid cooler, or an auxiliary cooler, the coolers will need to be flushed.

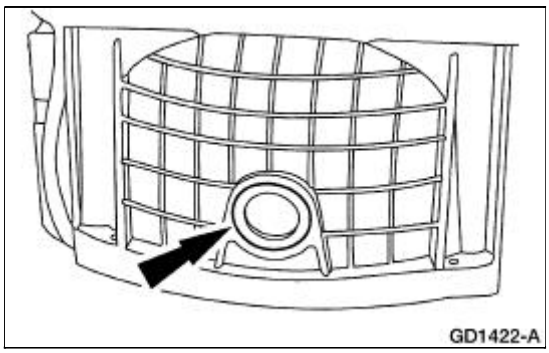
   Only flush the cooler lines, fluid coolers and the bypass valve if carrying out a transmission overhaul. For additional information, refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section.

Refill

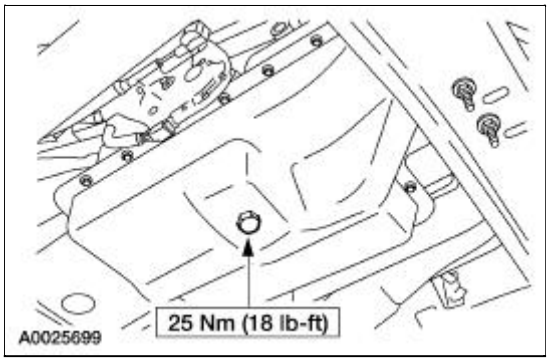
7. After the torque converter has drained, install a new drain plug.



8. Install the torque converter drain plug cover.



9. Install the drain plug.



10. Lower the vehicle. For additional information, refer to Section 100-02 .

11. **CAUTION: The use of any other fluids can result in the transmission failing to operate in a normal manner or failure.**

    Fill the transmission.

    - Add 6.2 liters (6.5 qts) of clean automatic transmission fluid to the transmission through the fluid filler tube.

12. Start the engine. Move the transmission range selector lever through all the gear ranges, checking for engagements.

13. With the engine running and the transmission at normal operating temperature 66-77°C (150-170°F) check and adjust the transmission fluid level and check for any leaks. If fluid is needed, add fluid in increments of 0.24-liter (0.5-pint) until the correct level is achieved (fluid in the cross-hatched area of the fluid level indicator).

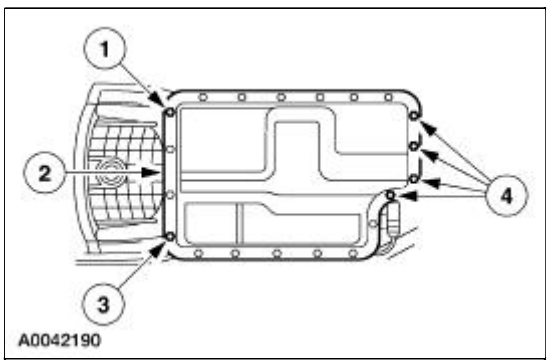
Vehicles not equipped with a fluid pan or a torque converter drain plug

Draining

1. Position the vehicle on a hoist. Place in NEUTRAL. For additional information, refer to Section 100-02 .

2. **NOTE:** Do not discard the fluid pan gasket unless damaged. This is a reusable gasket.

   Remove the transmission fluid pan and gasket.
   1. Loosen, but do not remove the bolts.
   2. Remove the front and side bolts.
   3. Lower the front of the fluid pan and allow the fluid to drain.
   4. Remove the remaining fluid pan bolts and the fluid pan.



3. Do not remove or install a new fluid filter.

4. **NOTE:** If equipped with a radiator in-tank transmission fluid cooler, or an auxiliary cooler, the coolers will need to be flushed.

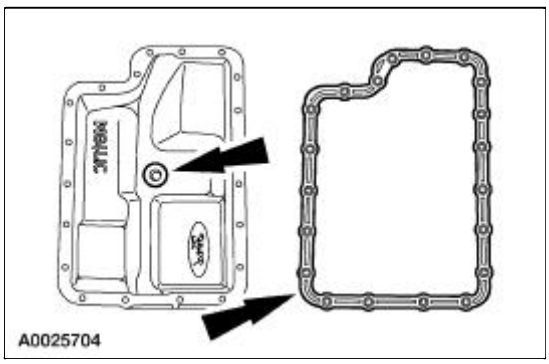
   Only flush the cooler lines, fluid coolers and the bypass valve if carrying out a transmission overhaul. For additional information, refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section.

Refill

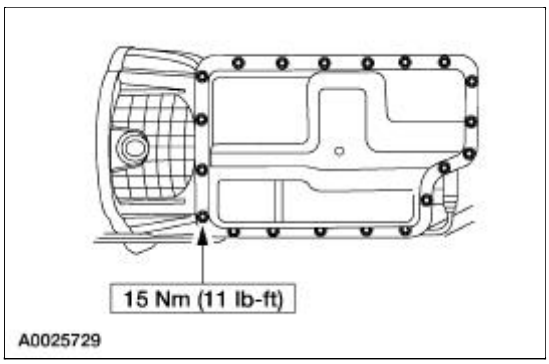
5. **NOTE:** Do not discard the gasket unless damaged. This is a reusable gasket.

   NOTE: Apply a light coat of petroleum jelly to hold the gasket to the fluid pan.

   Position the gasket onto the clean fluid pan. Make sure the magnet is positioned over the dimple in the fluid pan.



6. Install the pan with gasket. Alternately tighten the bolts.



7. Lower the vehicle. For additional information, refer to Section 100-02 .

8. **CAUTION: The use of any other fluids can result in the transmission failing to operate in a normal manner or failure.**

   Fill the transmission.

   - Add 6.2 liters (6.5 qts) of clean automatic transmission fluid to the transmission through the fluid filler tube.

9. Start the engine. Move the transmission range selector lever through all the gear ranges, checking for engagements.

10. With the engine running and the transmission at normal operating temperature 66-77°C (150-170°F), check and adjust the transmission fluid level and check for any leaks. If fluid is needed, add fluid in increments of 0.24-liter (0.5-pint) until the correct level is achieved (fluid in the cross-

hatched area of the fluid level indicator).

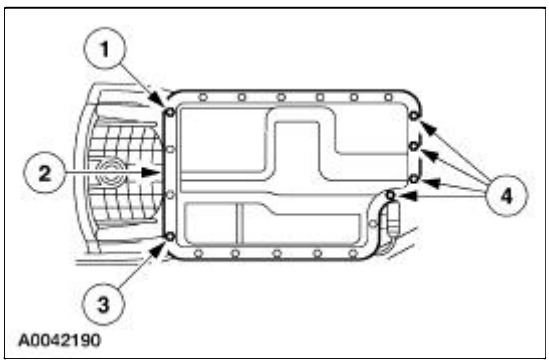
Vehicles equipped with a torque converter drain plug and without a fluid pan drain plug

Draining

1. Raise the vehicle on a hoist. For additional information, refer to Section 100-02 .

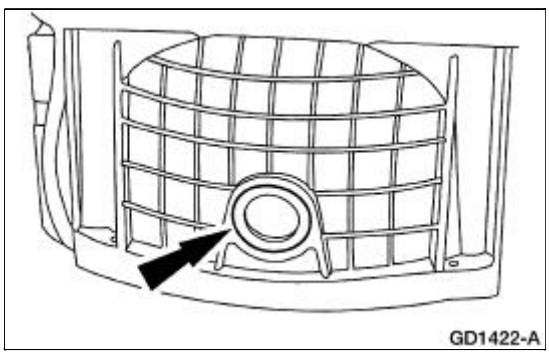
2. **NOTE:** Do not discard the fluid pan gasket unless damaged. This is a reusable gasket.

   Remove the transmission fluid pan and gasket.
   1. Loosen, but do not remove the bolts.
   2. Remove the front and side bolts.
   3. Lower the front of the fluid pan and allow the fluid to drain.
   4. Remove the remaining fluid pan bolts and the fluid pan.

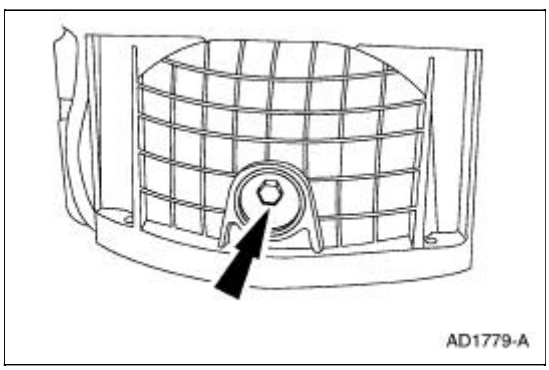


3. Do not remove or install a new fluid filter.

4. Remove the torque converter drain plug cover.



5. Remove the torque converter drain plug and discard.



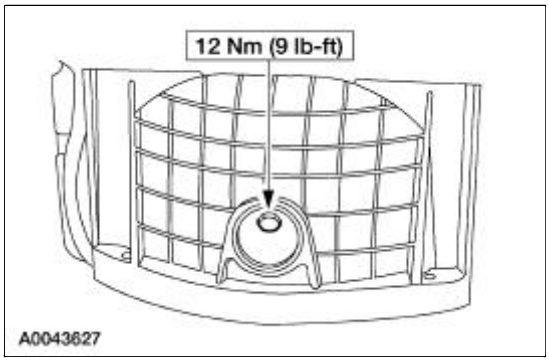
6. Allow the fluid to drain.

7. **NOTE:** If equipped with a radiator in-tank transmission fluid cooler, or an auxiliary cooler, the coolers must be flushed.

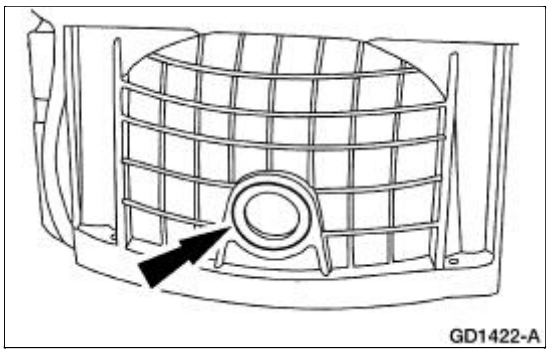
   Only flush the cooler lines, fluid coolers and the bypass valve if carrying out a transmission overhaul. For additional information, refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section.

Refill

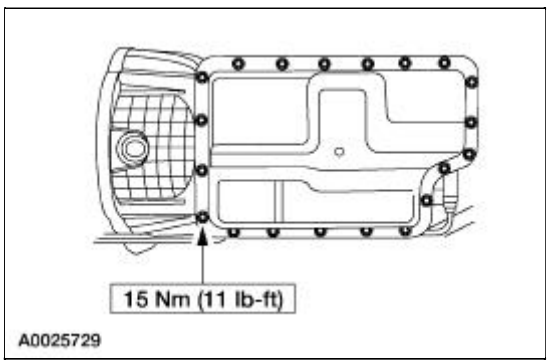
8. After the torque converter has drained, install a new drain plug.



9. Install the torque converter drain plug cover.



10. Install the pan with gasket. Alternately tighten the bolts.



11. Lower the vehicle. For additional information, refer to Section 100-02 .

12. **CAUTION: The use of any other fluids can result in the transmission failing to operate in a normal manner or failure.**

Fill the transmission.

- Add 6.2 liters (6.5 qts) of clean automatic transmission fluid to the transmission through the fluid filler tube.

13. Start the engine. Move the transmission range selector lever through all the gear ranges, checking for engagements.

14. With the engine running and the transmission at normal operating temperature 66-77°C (150-170°F), check and adjust the transmission fluid level and check for any leaks. If fluid is needed, add fluid in increments of 0.24-liter (0.5-pint) until the correct level is achieved (fluid in the cross-hatched area of the fluid level indicator).

Transmission Range (TR) Sensor Adjustment

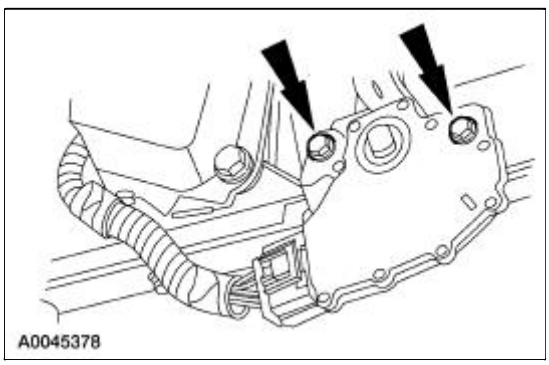
Special Tool(s)

 ST1633-A	Alignment Gauge, TR Sensor 307-351 (T97L-70010-A)

Adjustment

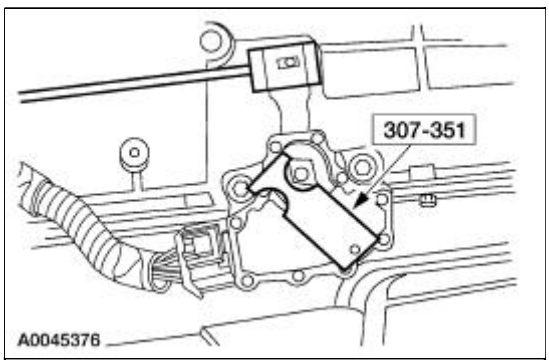
1. Position the vehicle on a hoist. Place in NEUTRAL. For additional information, refer to Section 100-02 .

2. Loosen the digital TR sensor bolts.

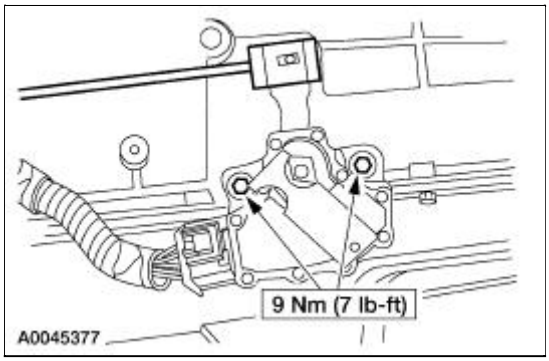


3. **NOTE:** Make sure that the manual control lever is in the NEUTRAL position.

   Using the special tool, align the digital TR sensor.



4. Tighten the bolts.

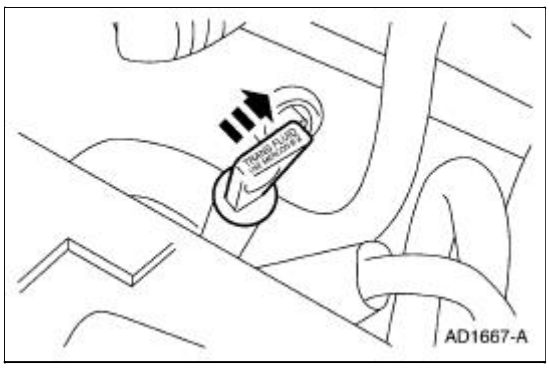


5. Lower the vehicle.

Transmission Filler Tube

Removal

1. Remove the fluid level indicator.



2. Position the vehicle on a hoist. Place in NEUTRAL. For additional information, refer to Section 100-02 .

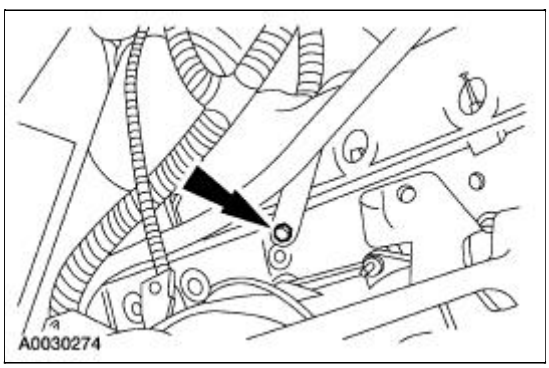
3. **NOTE:** All gasoline vehicles will have new adaptive shift strategies. Whenever the vehicles battery has been disconnected for any type of service or repair, the strategy parameters that are stored in the keep alive memory (KAM) will be lost. The strategy will start to relearn once the battery is reconnected and the vehicle is driven. This is a temporary condition and will return to normal operating condition once the powertrain control module (PCM) relearns all the parameters from the driving operating conditions. There is no time frame set for this process. If this concern is present during downshifts or converter clutch apply, it is not the shift strategy and will require diagnosis as outlined in the workshop manual.

   The customer must be notified that they may experience slightly different upshifts (either soft or firm) and that this condition is temporary and will eventually return to normal operating condition.

   Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

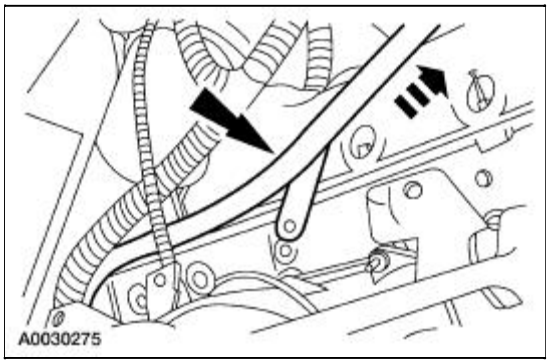
4. Remove the RH front wheel. For additional information, refer to Section 204-04 .

5. Remove the fluid filler tube bolt.



6. **NOTE:** It may be necessary to disconnect the wiring harness from the starter motor to remove the fluid filler tube.

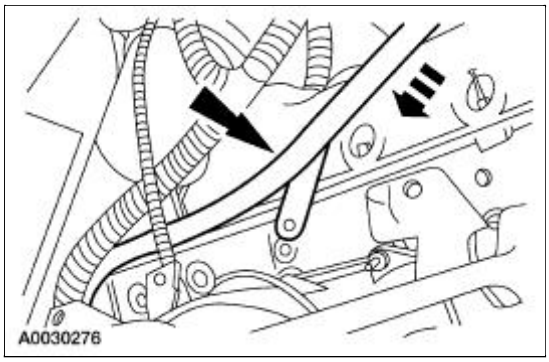
Remove the fluid filler tube.



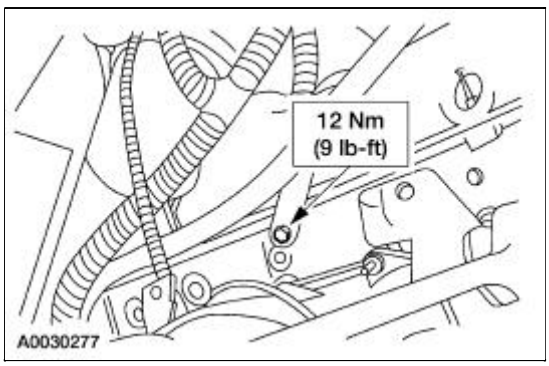
Installation

1. **NOTE:** Coat the O-ring seal at the bottom of the fluid filler tube with transmission fluid. If removed, install the starter wiring harness.

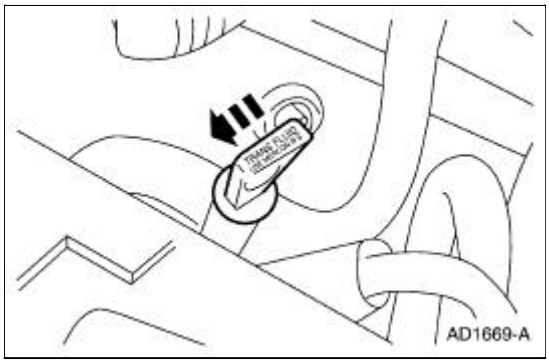
   Install the fluid filler tube.



2. Install the fluid filler tube bolt.



3. Install the RH front wheel. For additional information, refer to Section 204-04 .
4. Lower the vehicle.
5. Reconnect the battery ground cable.
6. Install the fluid level indicator.


AD1669-A

Main Control Valve Body —Accumulator Body, Solenoid Body

Material

Item	Specification
Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A	ESE-M1C171-A
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®

Removal

NOTE: If the transmission has been disassembled to install new parts, and the valves in the main control valve body stick repeatedly from foreign material, the torque converter must be removed and cleaned by using a suitable torque converter/fluid cooler cleaner.

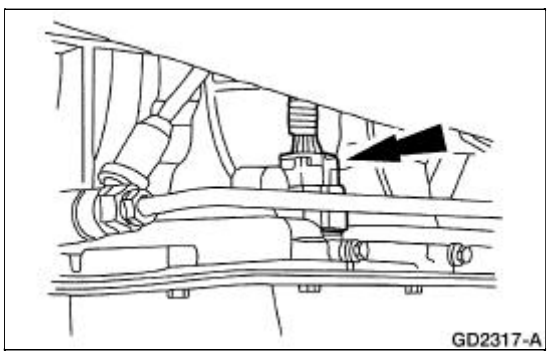
1. Position the vehicle on a hoist. Place in NEUTRAL. For additional information, refer to Section 100-02 .

2. **NOTE:** All gasoline vehicles will have new adaptive shift strategies. Whenever the vehicles battery has been disconnected for any type of service or repair, the strategy parameters that are stored in the keep alive memory (KAM) will be lost. The strategy will start to relearn once the battery is reconnected and the vehicle is driven. This is a temporary condition and will return to normal operating condition once the powertrain control module (PCM) relearns all the parameters from the driving operating conditions. There is no time frame set for this process. If this concern is present during downshifts or converter clutch apply, it is not the shift strategy and will require diagnosis as outlined in the workshop manual.

   The customer must be notified that they may experience slightly different upshifts (either soft or firm) and that this condition is temporary and will eventually return to normal operating condition.

   Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

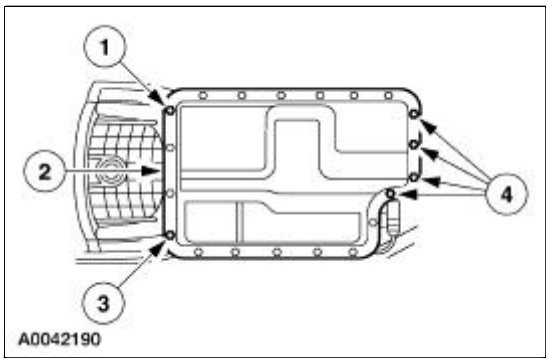
3. Disconnect the solenoid body electrical connector.



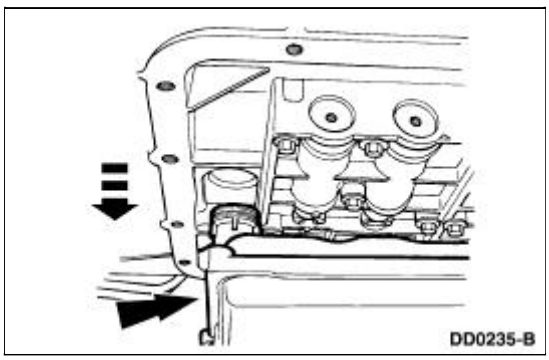
4. **NOTE:** Do not discard the fluid pan gasket unless damaged. This is a reusable gasket.

Remove the transmission fluid pan and gasket.

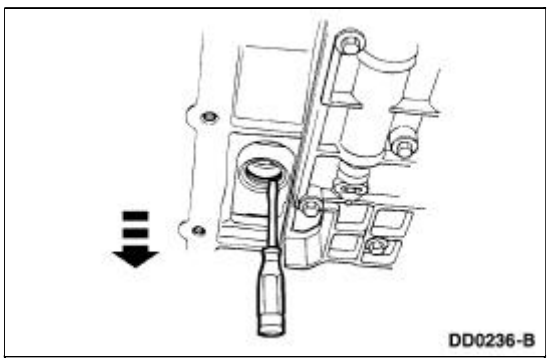
1. Loosen, but do not remove the bolts.
2. Remove the front and side bolts.
3. Lower the front of the fluid pan and allow the fluid to drain.
4. Remove the remaining fluid pan bolts and the fluid pan.



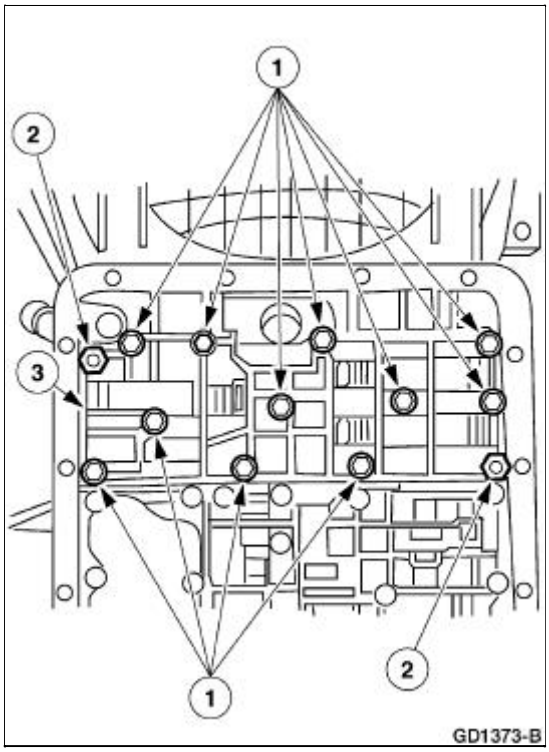
5. Remove and discard the fluid filter.
   - Remove the fluid filter and seal assembly by pulling and rotating the filter.



6. If the fluid filter seal remains in the pump bore, remove it carefully with a small screwdriver so as to not to scratch or damage the aluminum bore.

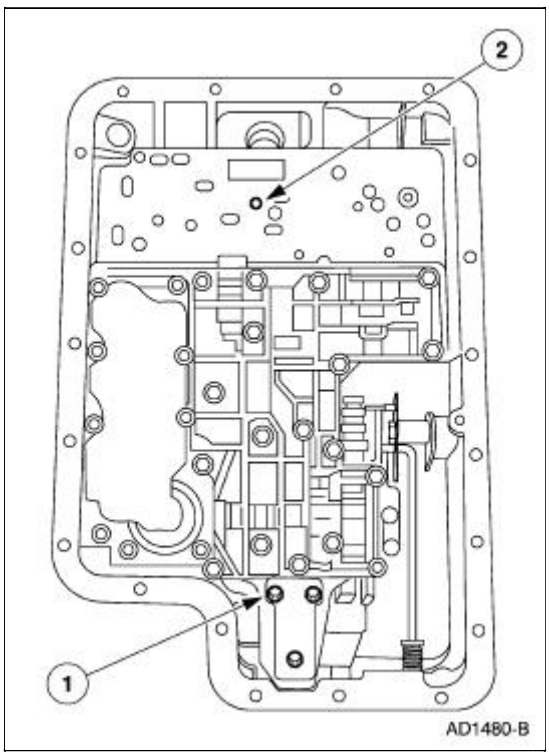


7. Remove the accumulator body.
   1. Remove the bolts.
   2. Remove the nuts.
   3. Remove the accumulator body.



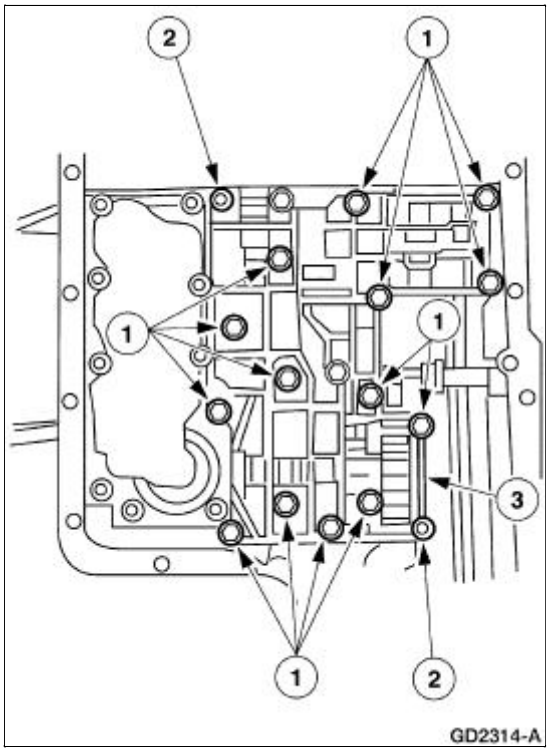
8. **CAUTION: Prevent the front of the valve body separator plate from sagging and displacing the check balls.**

   If the valve body separator plate is not being serviced:
   1. Remove the bolt.
   2. Install the bolt into any case-threaded bolt hole on the opposite end of the separator plate.

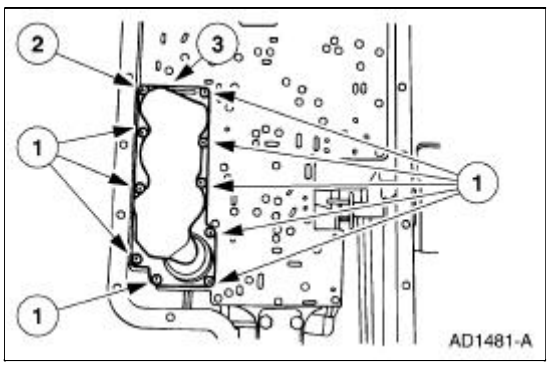


9. Remove the main control valve body assembly.
   1. Remove the bolts.

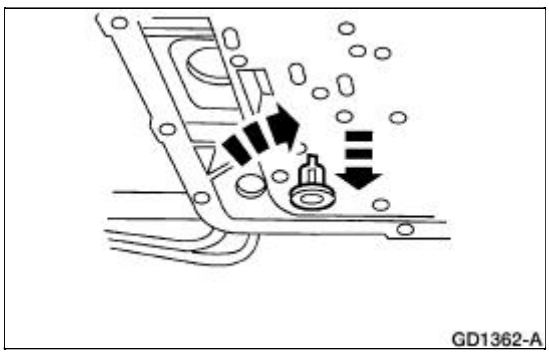
2. Remove the nuts.
3. Remove the main control valve body.



10. Remove the solenoid body assembly.
    1. Remove the bolts.
    2. Remove the nut.
    3. Remove the solenoid body assembly.



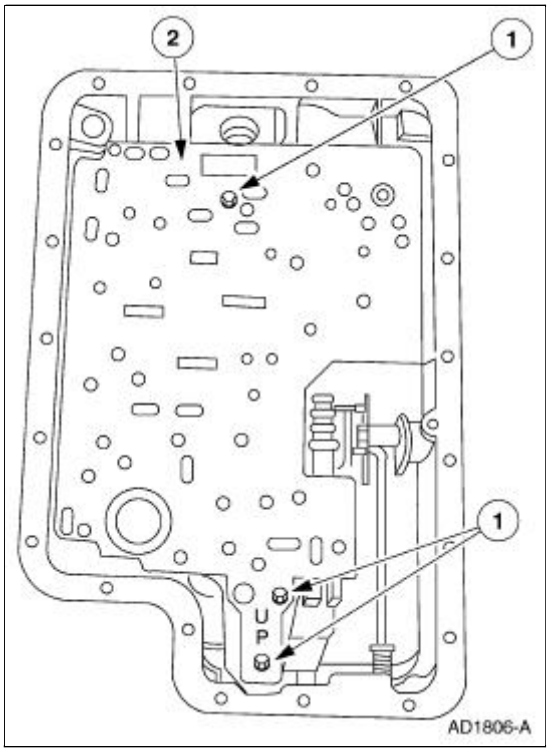
11. Remove the solenoid screen assembly by rotating and pulling.



12. **CAUTION: The steel electronic pressure control (EPC) check ball is spring-loaded under the valve body separator plate.**

    NOTE: If the valve body separator plates are not to be serviced, proceed to installation procedure.

    Remove the valve body separator plate reinforcement.
    1. Remove the bolts.
    2. Remove the separator plate reinforcement.



13. Lower and remove the valve body separator plate and gaskets.
    - The rubber check balls and the steel EPC check ball and spring assembly will fall out and may become lost or stick to the worm trail of the case.
    - Remove and discard separator plate gaskets.

Installation

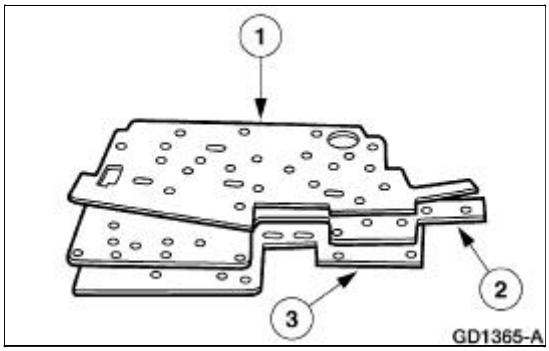
CAUTION: Using the incorrect gaskets can cause damage to the transmission.

1. **NOTE:** Refer to parts catalog for correct gasket usage.

   NOTE: If the valve body separator plate was not removed, proceed to Step 6.

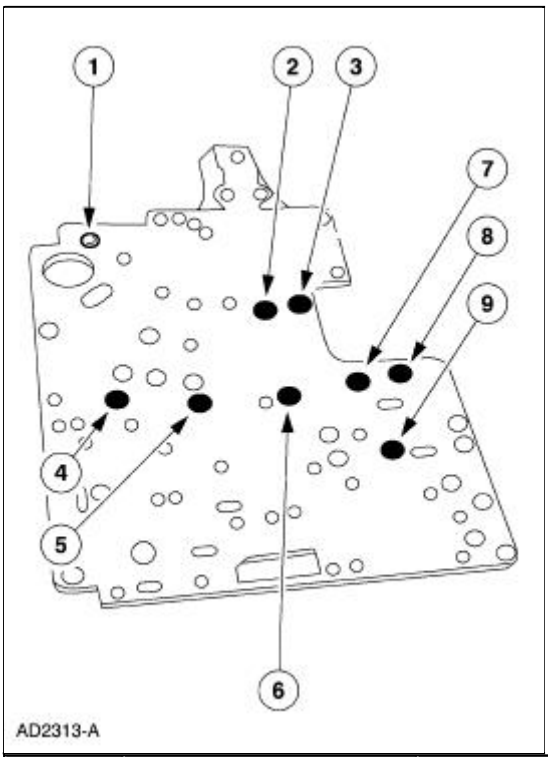
   NOTE: Apply a light film of petroleum jelly to the valve body separator plate prior to assembling the new gaskets.

   Assemble the new gaskets to the valve body separator plate.
   1. Main control-to-case gasket
   2. Valve body separator plate
   3. Main control-to-separator plate gasket



2. **NOTE:** Apply a small amount of petroleum jelly to each check ball prior to positioning them on the valve body separator plate.

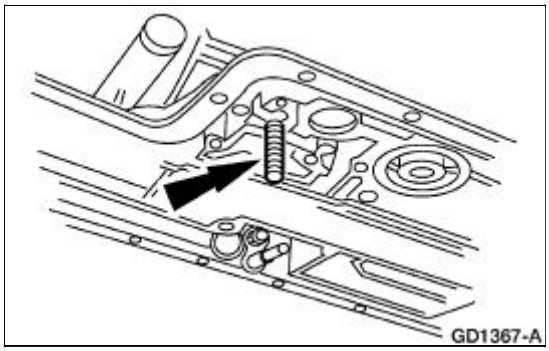
   Install eight rubber and one steel EPC check balls.



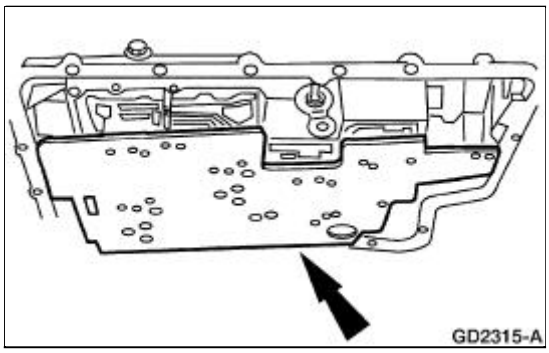
Item	Part Number	Description
1	—	EPC steel check ball
2	CB6	Check ball
3	BS1	Ball shuttle
4	CB9	Check ball
5	CB14	Check ball
6	CB1	Check ball
7	BS3	Ball shuttle
8	CB8	Check ball
9	CB7	Check ball

3. **NOTE:** Apply petroleum jelly to the EPC check ball spring prior to installing it into the case.

   Install the EPC check ball spring.

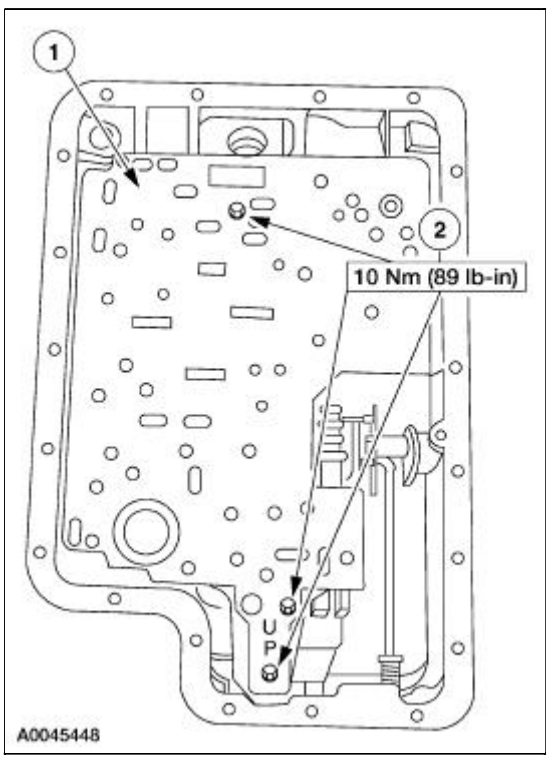


4. Position the valve body separator plate and the gaskets to the case carefully to retain the check balls.

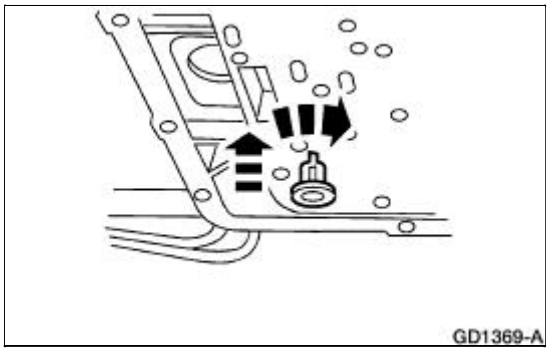


5. **NOTE:** The word "UP" stamped on the separator plate reinforcement must be visible when installed.

   Install the separator plate reinforcement plate.
   1. Position the separator plate reinforcement plate.
   2. Install the bolts.

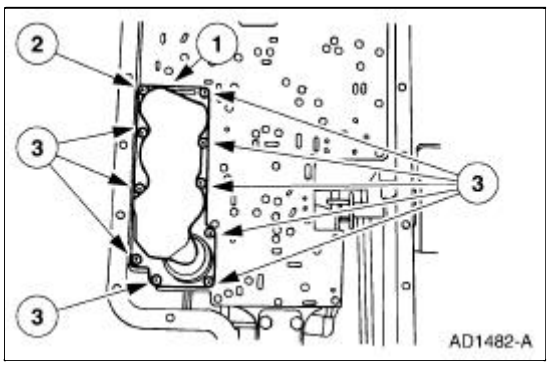


6. Install the solenoid screen assembly by pushing it in and rotating it to lock.

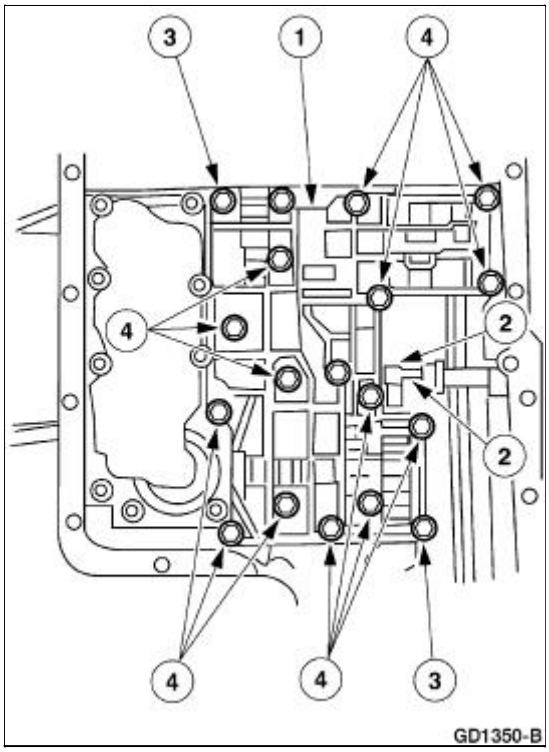


7. **NOTE:** Prior to installing the solenoid body assembly, coat the case connector bore with silicone grease.

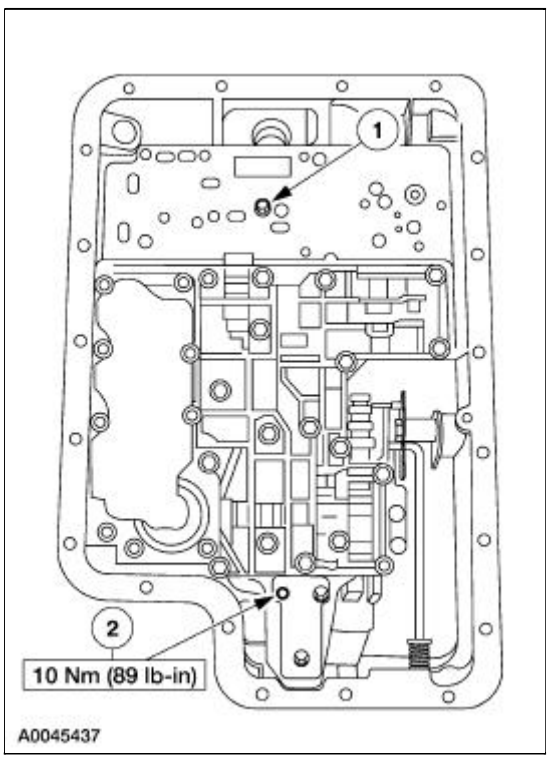
   Install the solenoid body assembly.
   1. Install the solenoid body assembly.
   2. Install the nut.
   3. Install the bolts and nut finger-tight.



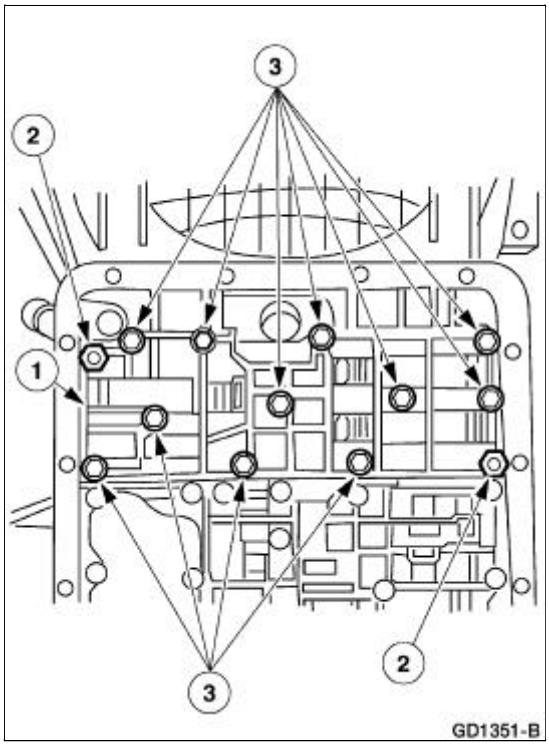
8. Install the main control valve body.
   1. Install the main control valve body.
   2. Aligning the manual shift valve with the manual valve detent lever.
   3. Install the nuts finger-tight.
   4. Install the bolts finger-tight.



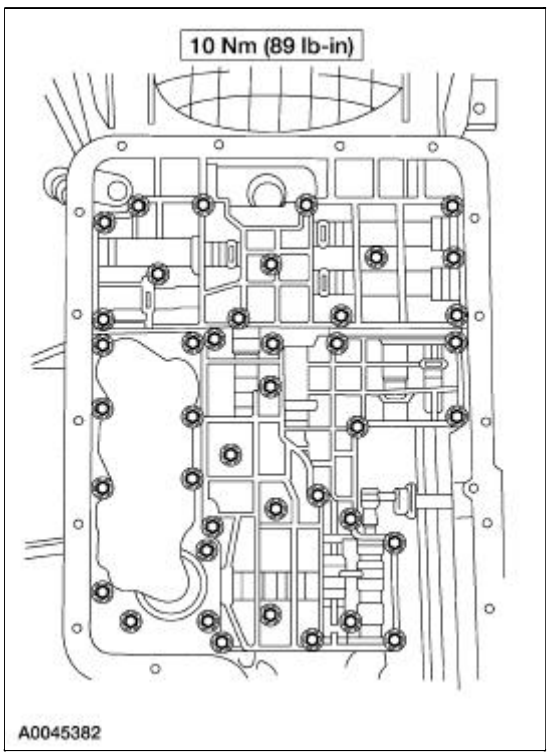
9. If previously installed, remove, then reinstall the bolt into the separator plate reinforcing plate.
    1. Remove the bolt.
    2. Install the bolt.



10. Install the accumulator body.
    1. Install the accumulator body.
    2. Install the nuts finger-tight.
    3. Install the bolts finger-tight.

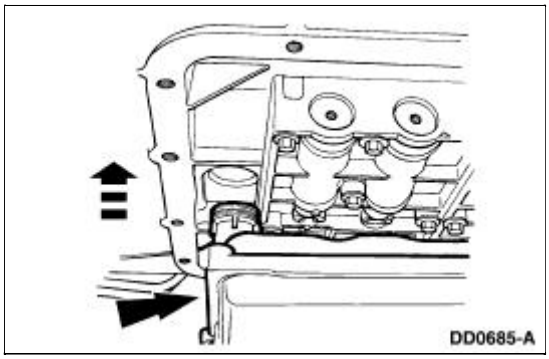


11. Tighten all the accumulator body, main control valve body, and solenoid body nuts and bolts. Tighten the bolts, working from the center to the outside.



12. **CAUTION: Make sure that the pump bore is clean and the old fluid filter seal has been removed. Damage to the new filter can occur.**

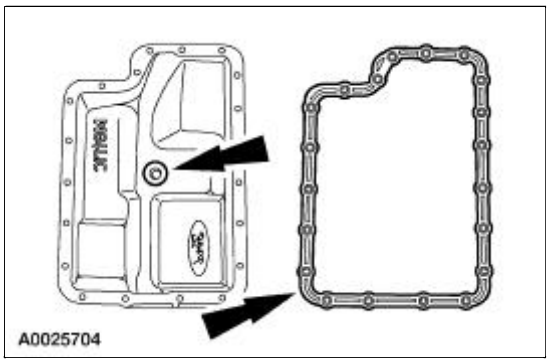
    Lubricate the new seal with clean automatic transmission fluid and install the new fluid filter and seal assembly.



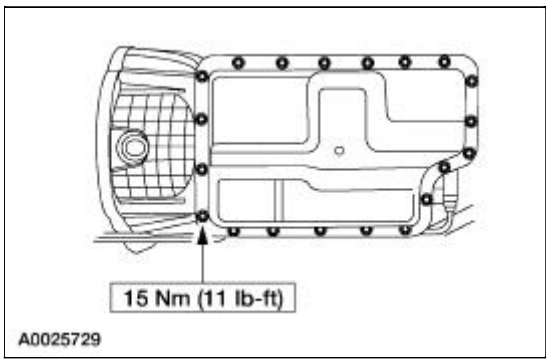
13. **NOTE:** Do not discard the gasket unless damaged. This is a reusable gasket.

    NOTE: Apply a light coat of petroleum jelly to hold the gasket to the fluid pan.

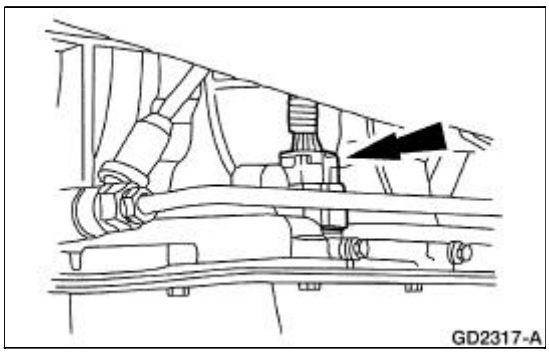
    Position the gasket onto the clean fluid pan. Make sure the magnet is positioned over the dimple in the fluid pan.



14. Install the pan with gasket. Alternately tighten the bolts.



15. Connect the solenoid body electrical connector.



16. Lower the vehicle.
17. Connect the battery ground cable.

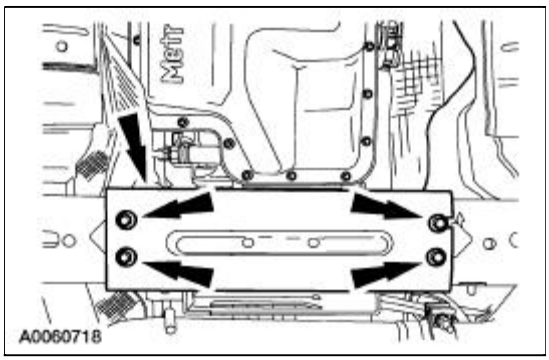
Turbine Shaft Speed (TSS) Sensor and Output Shaft Speed (OSS) Sensor

Removal

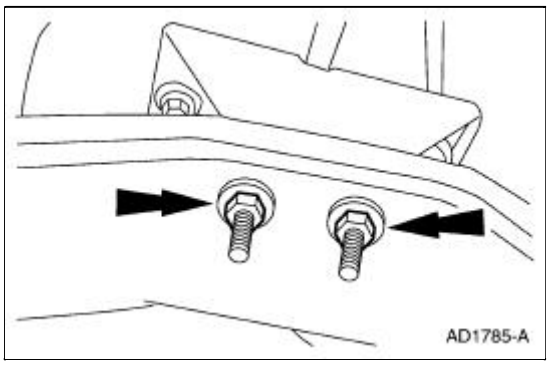
1. **NOTE:** The 4x2 application and the 4x4 application are similar.

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

2. Remove the bolts and remove the dampener.

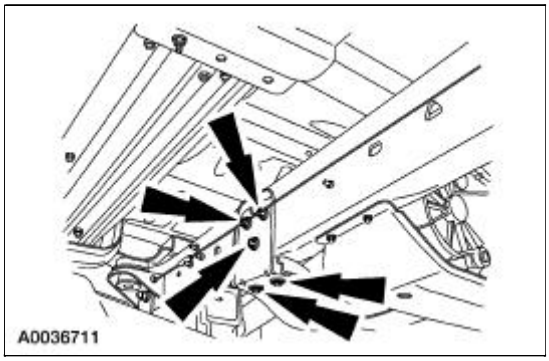


3. Remove the transmission insulator-to-crossmember support nuts.

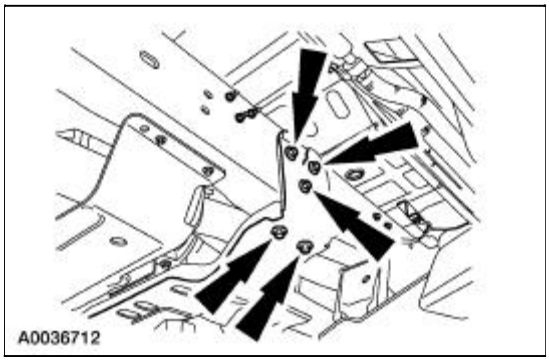


4. Attach a suitable high-lift transmission jack to the transmission.

5. Remove the crossmember bolts.

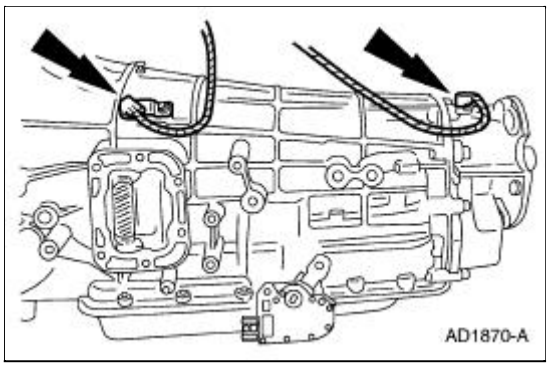


6. Remove the crossmember bolts and the crossmember.



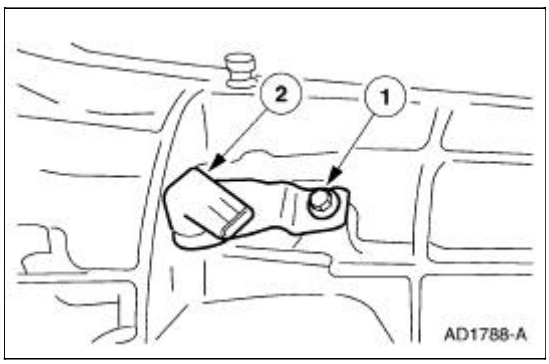
7. Lower the rear of the transmission to gain access to the sensors.

8. Disconnect the electrical connector of the affected sensor.

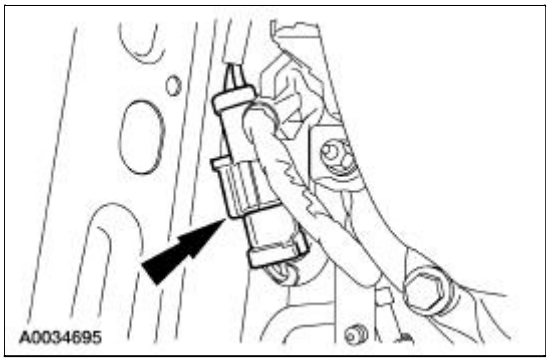


9. **CAUTION: Use care not to induce contamination in the form of dirt or foreign material when removing either of the sensors.**

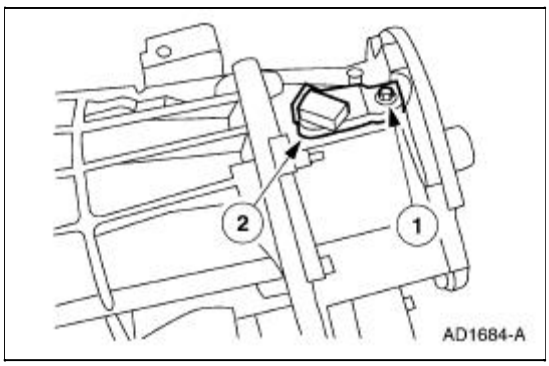
   If necessary, remove the turbine shaft speed (TSS) sensor.
   1. Remove the bolt.
   2. Remove the TSS.



10. Position the heated oxygen sensor (HO2S) connector aside.



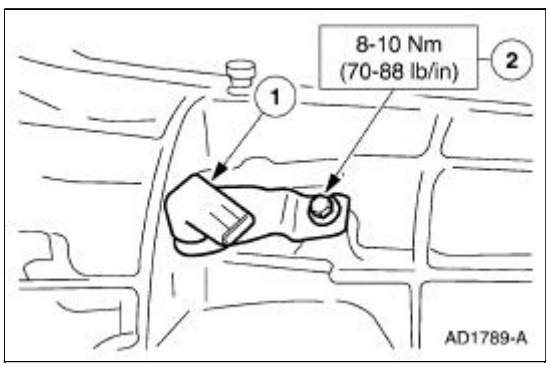
11. If necessary, remove the output shaft speed (OSS) sensor.
    1. Remove the bolt.
    2. Remove the OSS.



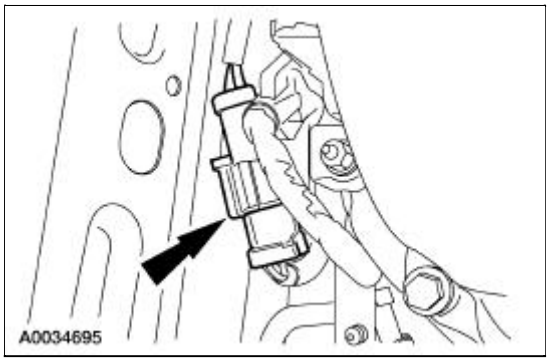
Installation

1. **CAUTION: Use care not to induce contamination in the form of dirt or foreign material when installing either of the sensors.**

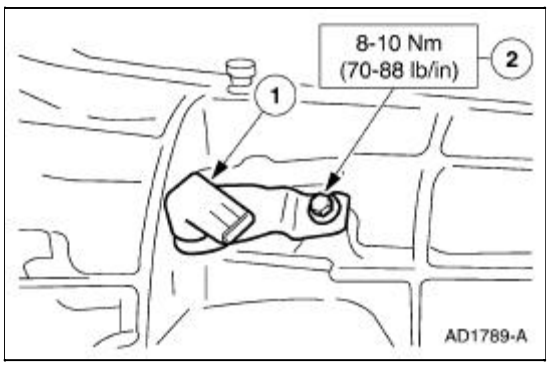
   If removed, install the OSS.
   1. Lubricate the O-ring and install the OSS.
   2. Install the bolt.



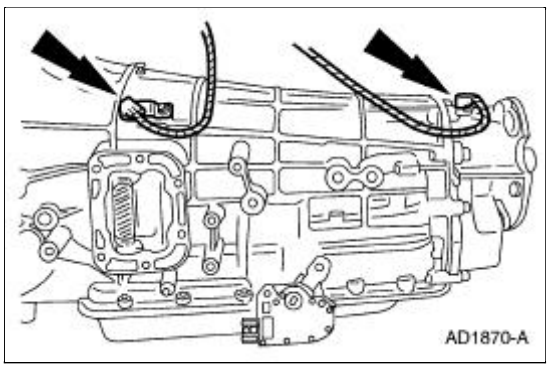
2. Position the heated oxygen sensor (HO2S) connector back in place.



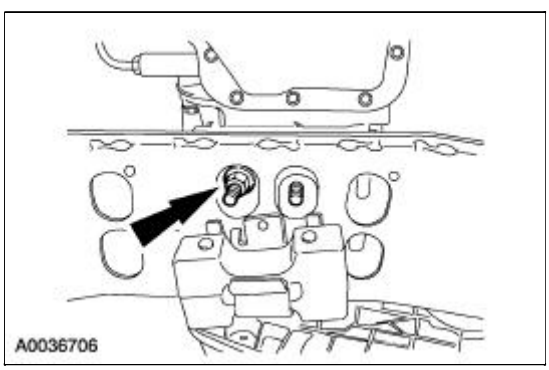
3. If removed, install the TSS.
    1. Lubricate the O-ring and install the TSS.
    2. Install the bolt.



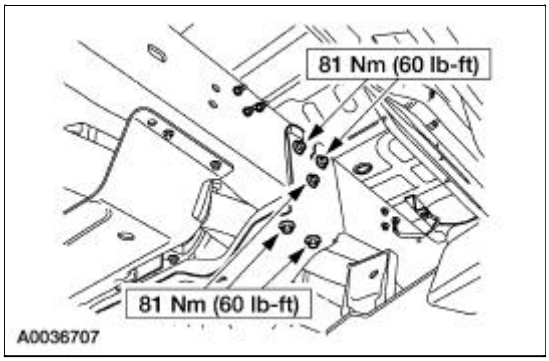
4. Connect the electrical connector to the affected sensor.



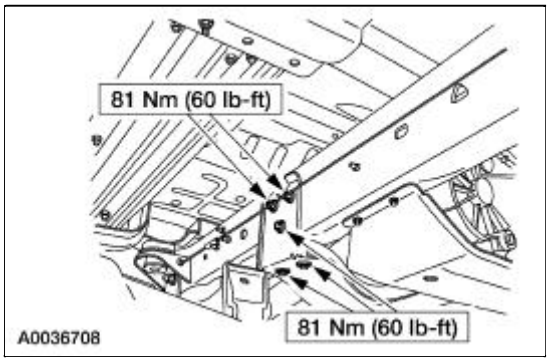
5. Install the crossmember to the transmission mount, using one nut to hold the crossmember in place. Raise the transmission and align the crossmember bolt holes.



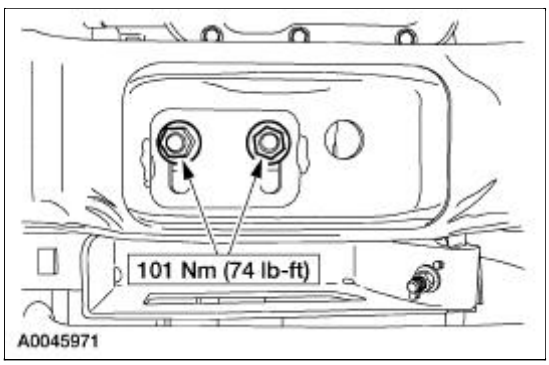
6. Install the bolts.



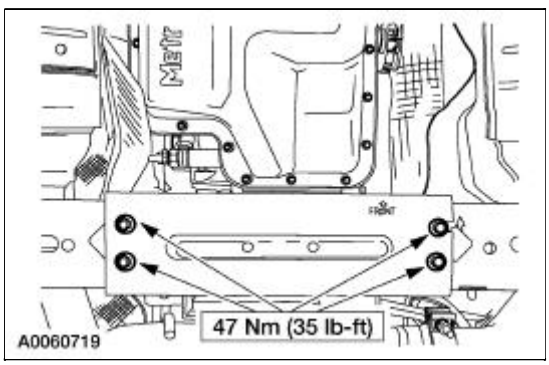
7. Install the bolts.



8. Install the remaining nut and tighten both nuts.



9. Install the dampener and install the bolts.

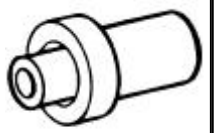
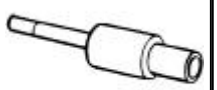
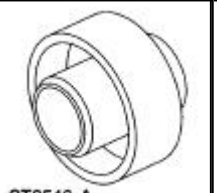


10. Remove the high-lift transmission jack.

11. Lower the vehicle.

Extension Housing Seal and Bushing

Special Tool(s)

 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
 ST1740-A	Installer, Transmission Extension Housing Fluid Seal 307-013 (T61L-7657-B)
 ST1192-A	Remover, Transmission Fluid Seal 307-048 (T74P-77248-A)
 ST1745-A	Installer, Transmission Extension Housing Bushing 307-063 (T77L-7697-C)
 ST2546-A	Installer, Output Shaft Fluid Seal 307-380
 ST2547-A	Installer, Output Shaft Bushing 307-381
 ST1746-A	Remover, Transmission Extension Housing Bushing 307-064 (T77L-7697-D) Remover, Output Shaft Bushing 307-382

Material

Item	Specification
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®

Removal

1. **NOTE:** All gasoline vehicles will have new adaptive shift strategies. Whenever the vehicles battery has been disconnected for any type of service or repair, the strategy parameters that are stored in the keep alive memory (KAM) will be lost. The strategy will start to relearn once the battery is reconnected and the vehicle is driven. This is a temporary condition and will return to normal operating condition once the powertrain control module (PCM) relearns all the parameters from the driving operating conditions. There is no time frame set for this process. If this concern is present during downshifts or converter clutch apply, it is not the shift strategy and will require diagnosis as outlined in the workshop manual.

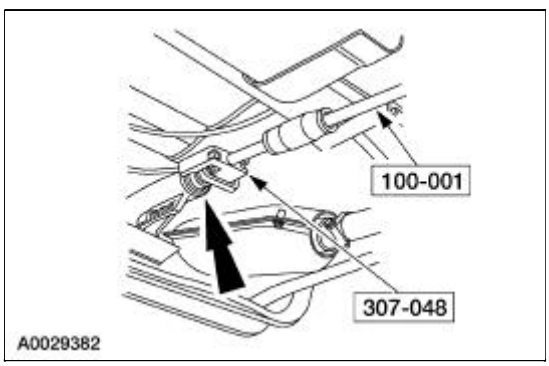
   The customer must be notified that they may experience slightly different upshifts (either soft or firm) and that this condition is temporary and will eventually return to normal operating condition.

   Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

2. Position the vehicle on a hoist. Place in NEUTRAL. For additional information, refer to Section 100-02 .

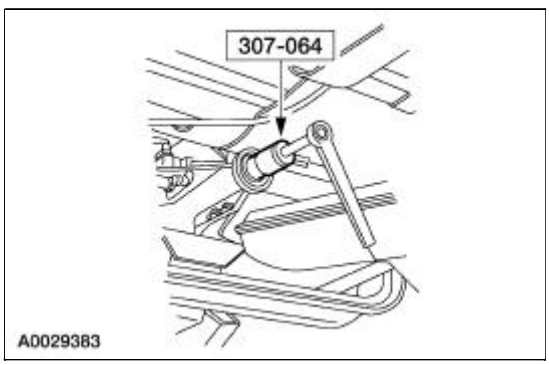
3. Remove the rear driveshaft. For additional information, refer to Section 205-01 .

4. Using the special tools, remove the extension housing seal.



5. **CAUTION: Do not damage any machined surfaces. Damage can cause the new seal to leak.**

   Using the special tool, remove the extension housing bushing.

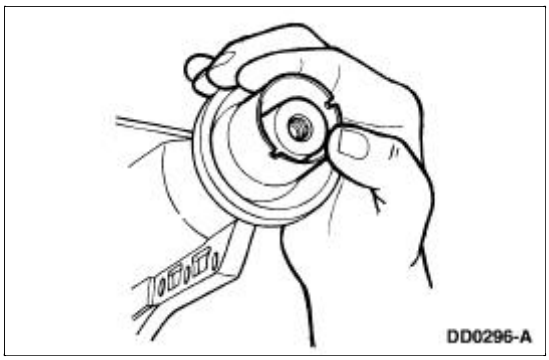


Installation

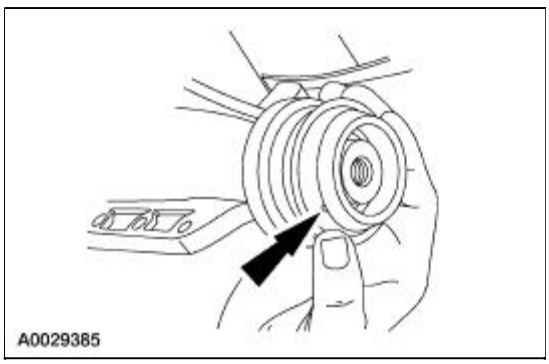
1. **CAUTION: Prior to installing the extension housing bushing, inspect the extension housing counterbore for burrs. If necessary, remove the burrs with an oil stone or damage to new bushing may occur.**

   NOTE: The extension housing bushing is model dependent.

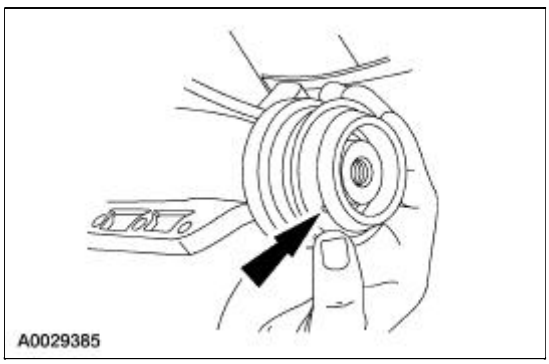
   Align the extension housing bushing in the extension housing so that the slots are in the 2 o'clock and 7 o'clock positions.



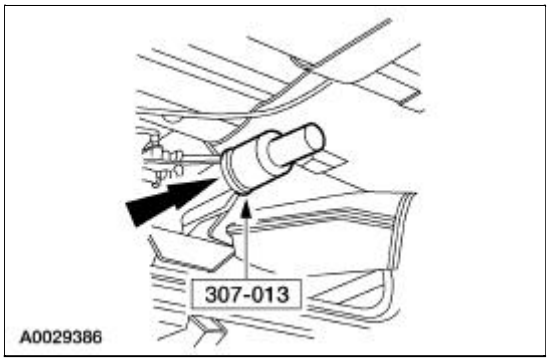
2. Using the special tool, install the extension housing bushing.



3. Align the extension housing seal in the extension housing, with the drain hole positioned downward.



4. Using the special tool, seat the extension housing seal.



5. Install the rear driveshaft. For additional information, refer to Section 205-01 .
6. Lower the vehicle.
7. Reconnect the battery ground cable.
8. Fill the transmission to the specified level with clean automatic transmission fluid. For additional information, refer to the Fluid Capacity chart in the Specifications portion of this section.

Extension Housing Gasket —4x2

Material

Item	Specification
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®

Removal

1. Position the vehicle on a hoist. Place in NEUTRAL. For additional information, refer to Section 100-02 .

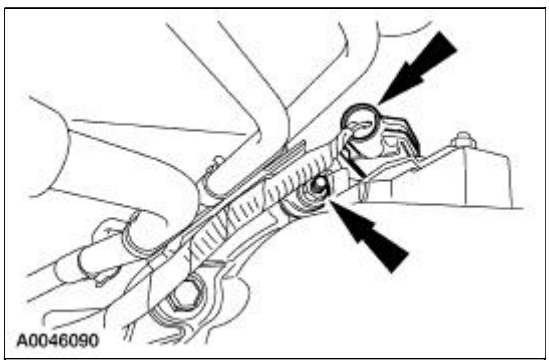
2. **NOTE:** All gasoline vehicles will have new adaptive shift strategies. Whenever the vehicles battery has been disconnected for any type of service or repair, the strategy parameters that are stored in the keep alive memory (KAM) will be lost. The strategy will start to relearn once the battery is reconnected and the vehicle is driven. This is a temporary condition and will return to normal operating condition once the powertrain control module (PCM) relearns all the parameters from the driving operating conditions. There is no time frame set for this process. If this concern is present during downshifts or converter clutch apply, it is not the shift strategy and will require diagnosis as outlined in the workshop manual.

   The customer must be notified that they may experience slightly different upshifts (either soft or firm) and that this condition is temporary and will eventually return to normal operating condition.

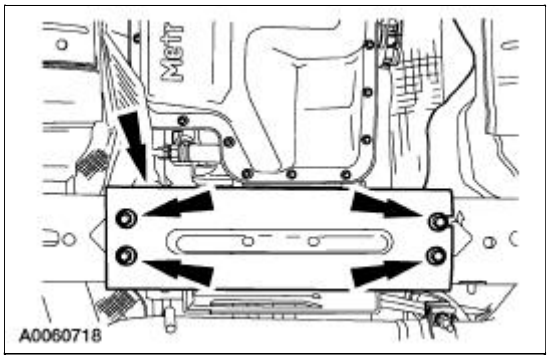
   Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3. Remove the rear driveshaft. For additional information, refer to Section 205-01 .

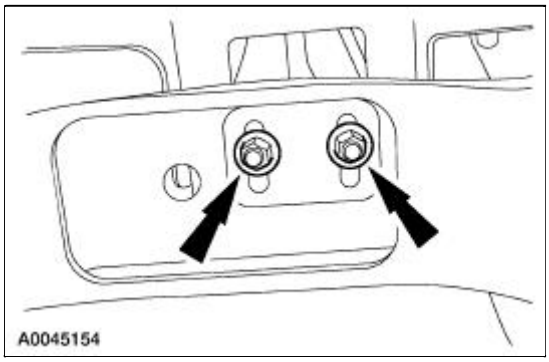
4. Disconnect the OSS sensor connector and remove the bolt for the fuel line bracket. Position the fuel line bracket out of the way.



5. Remove the bolts and remove the dampener.



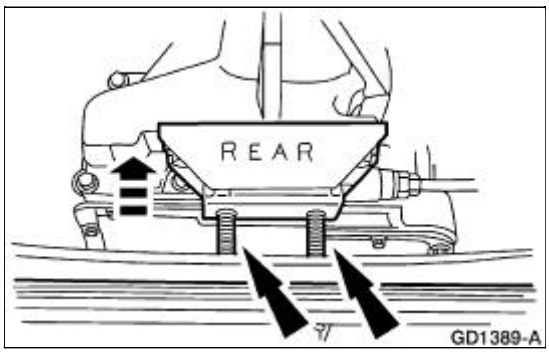
6. Remove the transmission insulator to crossmember support nuts.



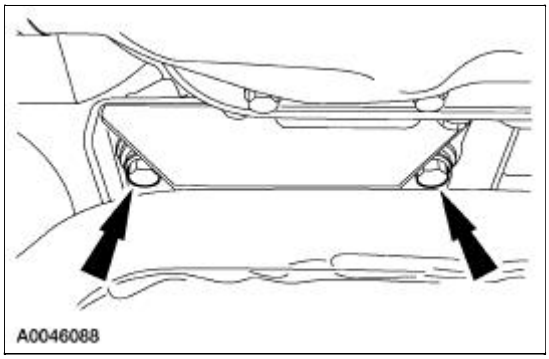
7. Install a suitable transmission jack.

8. **CAUTION: Be sure not to raise the back of the transmission too high. If it makes contact with the underbody, damage to the TSS and OSS sensors will occur.**

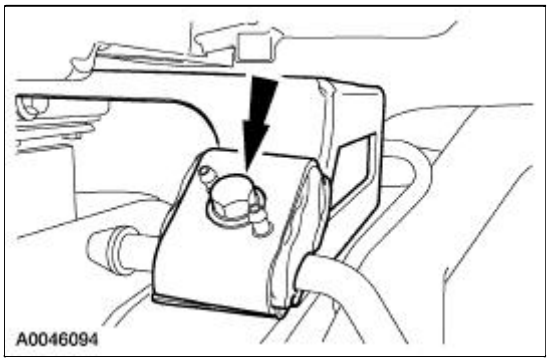
   Slightly raise the transmission up off the rear crossmember support.



9. Remove the bolts for the rear transmission support insulator and remove the transmission support insulator.

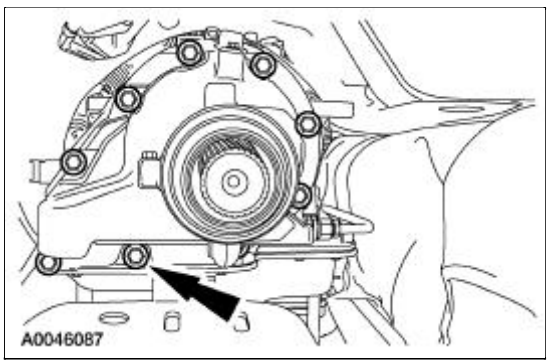


10. Remove the bolt for the exhaust bracket hanger and remove the hanger.



11. **NOTE:** As the fasteners are removed, note the size of each for correct location during installation.

    Remove the transmission extension housing bolts.



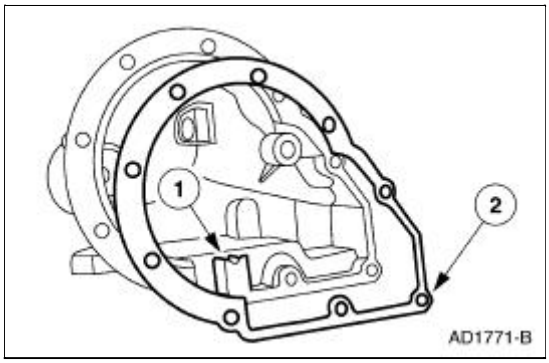
12. Remove and discard the extension housing gasket.

Installation

1. **CAUTION: The extension must have a shoulder or a boss cast in it to hold the orifice lube plug in the back of the case. If the wrong extension housing is used, the plug can become loose and/or fall out and cause transmission damage.**

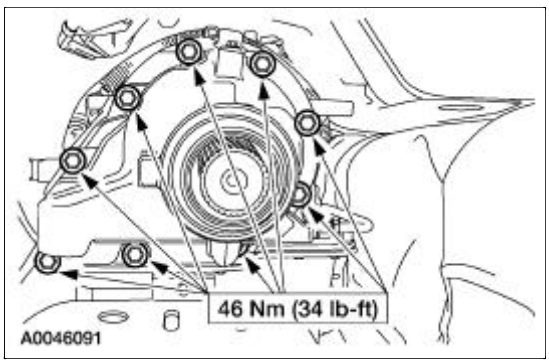
   NOTE: Lightly lubricate the gasket with petroleum jelly to hold it in place during assembly.

   Install the new extension housing gasket.
   1. Verify that the extension has a shoulder cast in it.
   2. Install the new extension housing gasket.

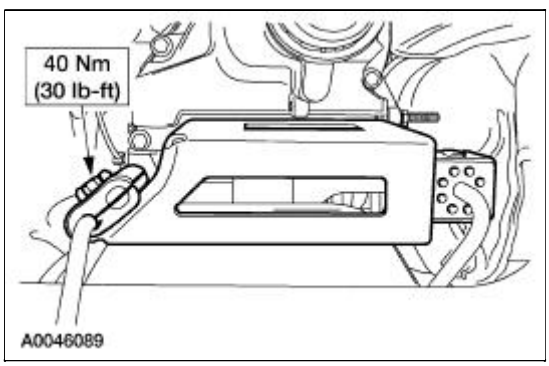


2. **NOTE:** Make sure the fasteners are installed in their correct locations as noted during removal.

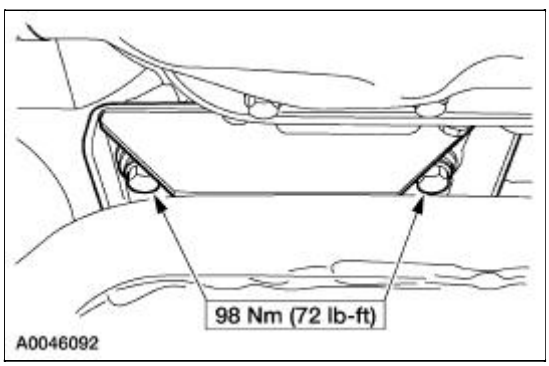
   Install the extension housing and bolts.



3. Position the exhaust bracket hanger on the exhaust and install the bolt.

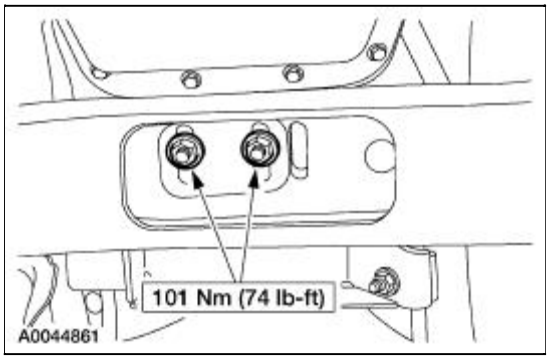


4. Install the rear transmission insulator and the bolts.

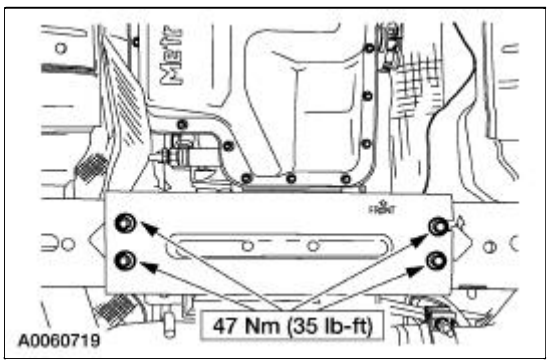


5. Lower the transmission onto the transmission support crossmember.

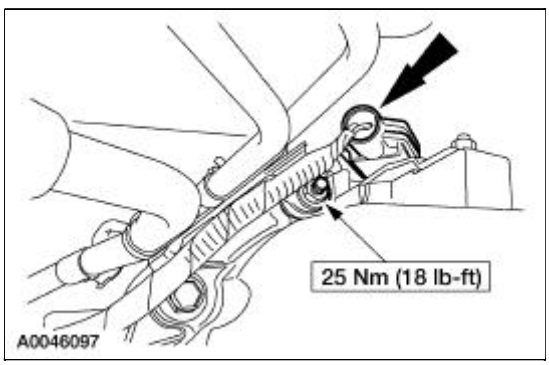
6. Install the transmission insulator and retainer-to-crossmember retaining nuts.



7. Install the dampener and install the bolts.



8. Remove the transmission jack.
9. Position the fuel line bracket on the stud and install the nut. Connect the OSS sensor connector.



10. Install the rear driveshaft. For additional information, refer to Section 205-01 .
11. Lower the vehicle.
12. Reconnect the battery ground cable.
13. Check fluid level, fill with clean automatic transmission fluid.
14. Check for correct operation.

Extension Housing Gasket —4x4

Material

Item	Specification
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®

Removal

1. Position the vehicle on a hoist. Place in NEUTRAL. For additional information, refer to Section 100-02 .

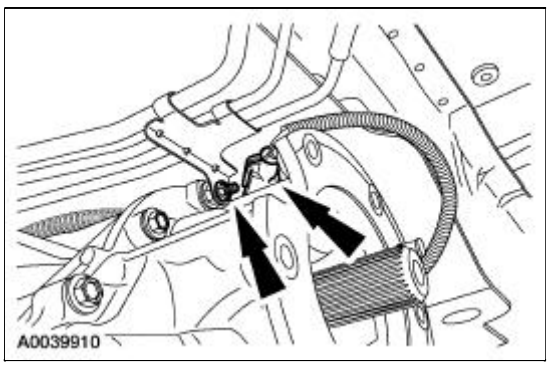
2. **NOTE:** All gasoline vehicles will have new adaptive shift strategies. Whenever the vehicles battery has been disconnected for any type of service or repair, the strategy parameters that are stored in the keep alive memory (KAM) will be lost. The strategy will start to relearn once the battery is reconnected and the vehicle is driven. This is a temporary condition and will return to normal operating condition once the powertrain control module (PCM) relearns all the parameters from the driving operating conditions. There is no time frame set for this process. If this concern is present during downshifts or converter clutch apply, it is not the shift strategy and will require diagnosis as outlined in the workshop manual.

   The customer must be notified that they may experience slightly different upshifts (either soft or firm) and that this condition is temporary and will eventually return to normal operating condition.

   Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

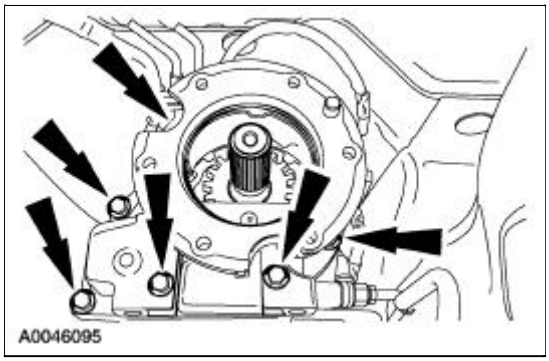
3. Remove the transfer case. For additional information, refer to Section 308-07B .

4. Disconnect the fuel lines and the output shaft speed sensor (OSS).



5. **NOTE:** As the fasteners are removed, note the size of each for correct location during installation.

   Remove the eight transmission extension housing bolts and the housing.



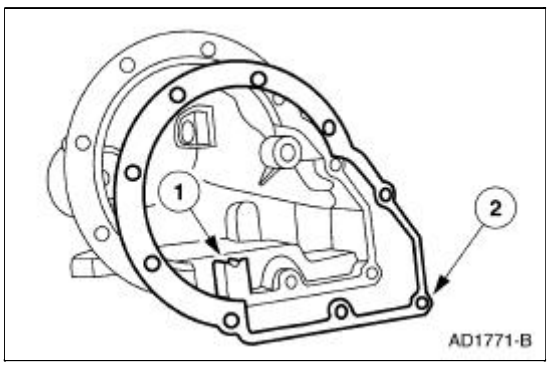
6. Remove and discard the extension housing gasket.

Installation

1. **CAUTION: The extension must have a shoulder or a boss cast in it to hold the orifice lube plug in the back of the case. If the wrong extension housing is used, the plug can become loose and/or fall out and cause transmission damage.**

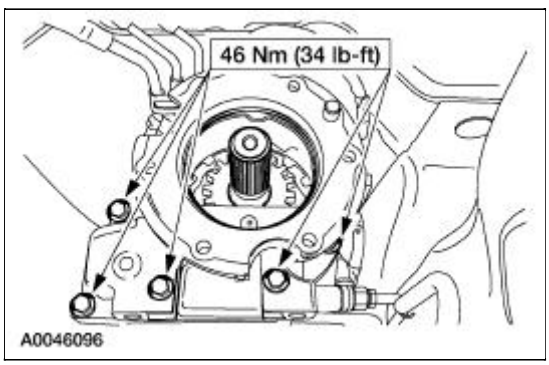
   NOTE: Lightly lubricate the gasket with petroleum jelly to hold it in place during assembly.

   Install the new extension housing gasket.
   1. Verify that the extension has a shoulder cast in it.
   2. Install the new extension housing gasket.

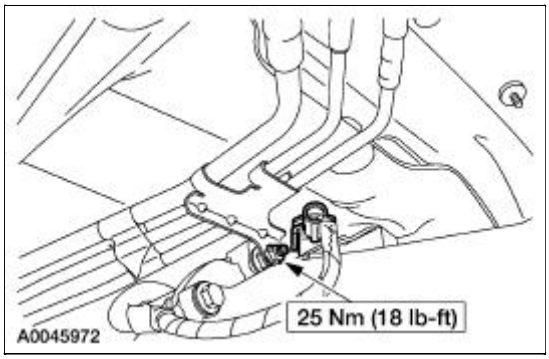


2. **NOTE:** Make sure the fasteners are installed in their correct locations as noted during removal.

   Install the eight extension housing bolts.



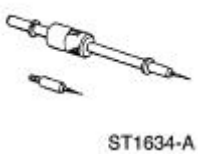
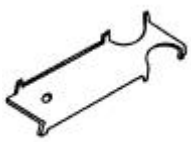
3. Install the fuel line bracket and connect the output shaft speed (OSS) sensor connector.



4. Install the transfer case. For additional information, refer to Section 308-07B .
5. Lower the vehicle.
6. Reconnect the battery ground cable.
7. Check fluid level, fill with clean automatic transmission fluid.
8. Check for correct operation.

Manual Control Lever Shaft and Seal

Special Tool(s)

 ST1634-A	Roll Pin Set 211-S060 (T78P-3504-N)
 ST1282-A	Remover, Pilot Bearing 308-001 (T58L-101-B)
 ST1199-A	Installer, Shift Shaft Fluid Seal 307-050 (T74P-77498-A)
 ST1633-A	Alignment Gauge, TR Sensor 307-351 (T97L-70010-A)

Material

Item	Specification
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®

Removal

1. Position the vehicle on a hoist. Place in NEUTRAL. For additional information, refer to Section 100-02 .

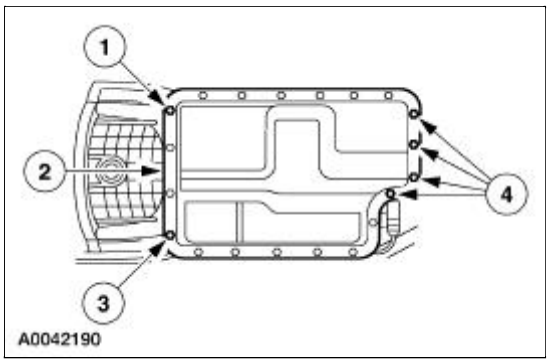
2. **NOTE:** All gasoline vehicles will have new adaptive shift strategies. Whenever the vehicles battery has been disconnected for any type of service or repair, the strategy parameters that are stored in the keep alive memory (KAM) will be lost. The strategy will start to relearn once the battery is reconnected and the vehicle is driven. This is a temporary condition and will return to normal operating condition once the powertrain control module (PCM) relearns all the parameters from the driving operating conditions. There is no time frame set for this process. If this concern is present during downshifts or converter clutch apply, it is not the shift strategy and will require diagnosis as outlined in the workshop manual.

The customer must be notified that they may experience slightly different upshifts (either soft or firm) and that this condition is temporary and will eventually return to normal operating condition.

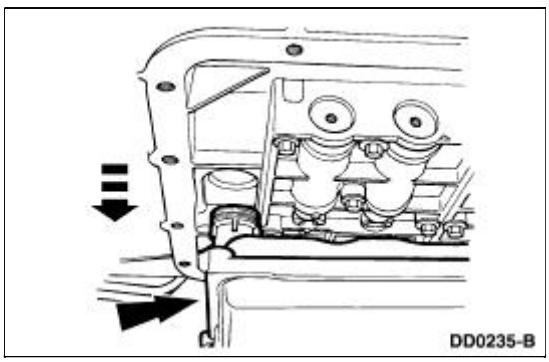
Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3. **NOTE:** Do not discard the fluid pan gasket unless damaged. This is a reusable gasket.

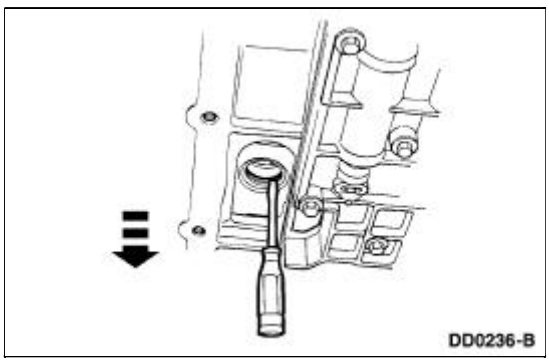
   Remove the transmission fluid pan and gasket.
   1. Loosen, but do not remove the bolts.
   2. Remove the front and side bolts.
   3. Lower the front of the fluid pan and allow the fluid to drain.
   4. Remove the remaining fluid pan bolts and the fluid pan.



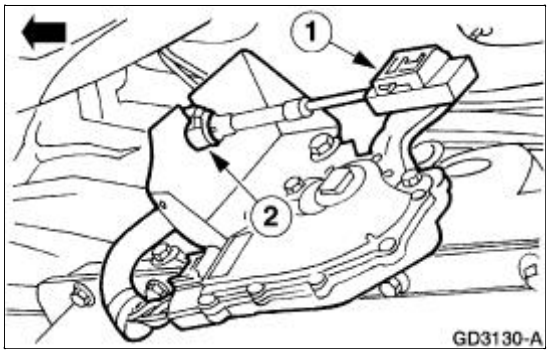
4. Remove and discard the fluid filter.
   - Remove the fluid filter and seal assembly by pulling and rotating the filter.



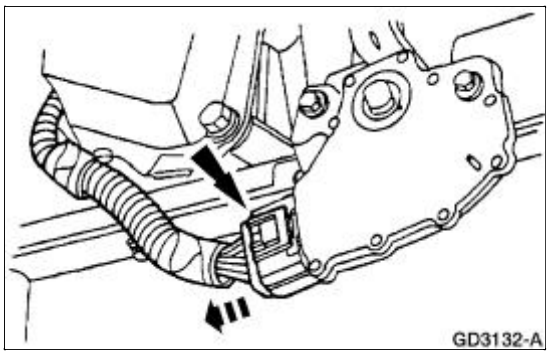
5. If the fluid filter seal remains in the pump bore, remove it carefully with a small screwdriver so as to not to scratch or damage the aluminum bore.



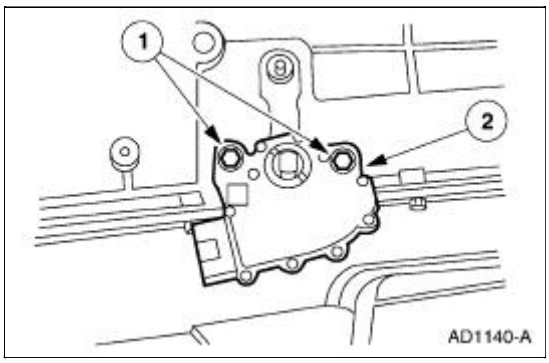
6. Disconnect the shift cable.
   1. Disconnect the shift cable from the manual lever.
   2. Disconnect the cable housing from the bracket and position aside.



7. Disconnect the digital transmission range (TR) sensor electrical connector.

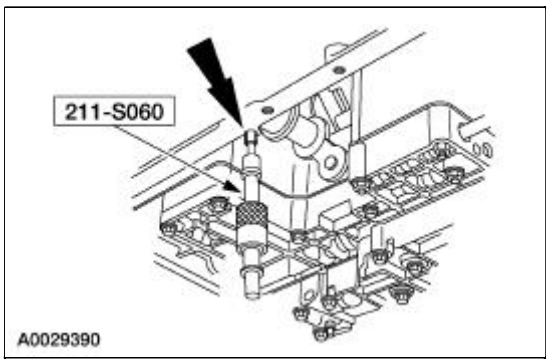


8. Remove the digital transmission (TR) sensor.
    1. Remove the bolts.
    2. Remove the digital transmission range (TR) sensor.



9. **NOTE:** A No. 53 drill bit (1/16 inch) can be used instead to remove the manual lever shaft retaining pin.

    Using the special tool, remove the manual lever shaft retaining pin.

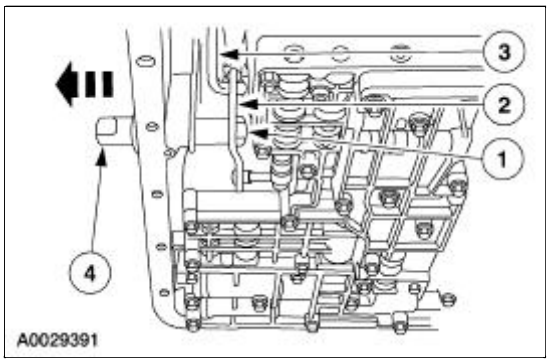


10. **CAUTION: Be careful not to damage the manual control lever bore.**

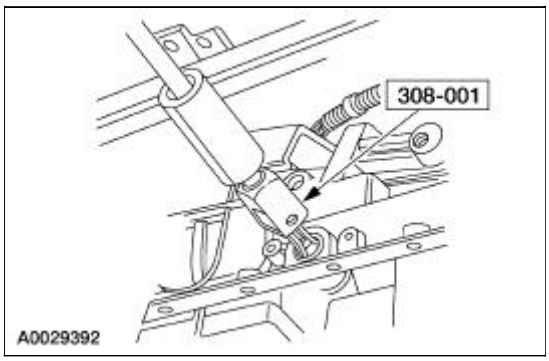
    NOTE: The manual control lever and manual control lever shaft are one piece.

    NOTE: Use a crescent wrench on the manual control lever or outer flats of manual control lever shaft assembly when removing the inner manual valve detent lever nut.

    Remove the manual control lever shaft assembly.
    1. Remove the inner manual valve nut.
    2. Remove the inner manual valve detent lever.
    3. Remove the parking pawl actuating rod.
    4. Remove the manual control lever shaft assembly.



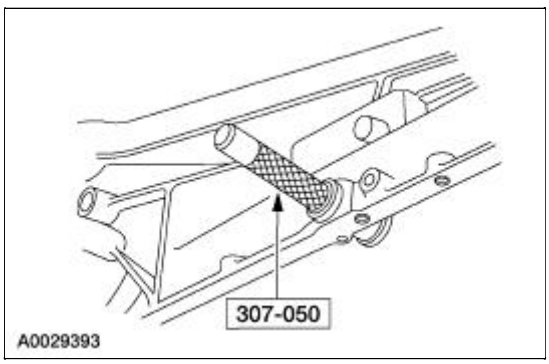
11. Using the special tool, remove the manual control lever seal.



Installation

1. **NOTE:** Prior to installing the manual control lever seal, clean the bore opening with mineral spirits.

   Using the special tool, install the manual control lever seal.

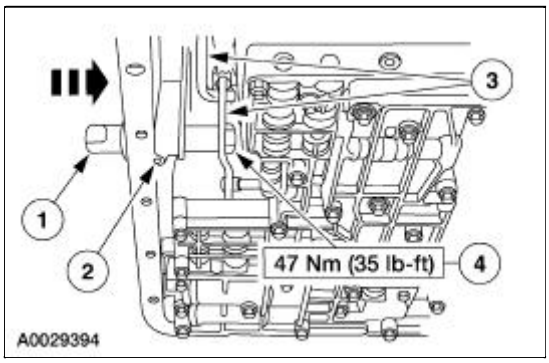


2. Install the manual control lever shaft assembly.
    1. Install the manual control lever shaft assembly.
    2. Install and seat the manual lever shaft retaining pin below the case surface.
    3. **NOTE:** The inner manual valve detent lever must be seated on the flats of the manual control lever shaft assembly, and the parking pawl actuating rod must be through the guide plate.

       NOTE: The manual control valve detent lever spring must be on the inner manual valve detent lever, and the detent lever pin must align with the manual shift valve.

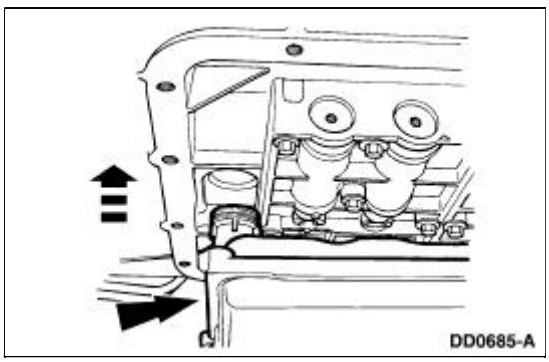
       Install the parking pawl actuating rod and the inner manual valve detent lever.
    4. **NOTE:** Use a crescent wrench on the manual control lever or the outer flats of the manual control lever shaft assembly when installing the inner manual valve detent lever nut.

       Install the inner manual valve detent lever nut.



3. **CAUTION: Make sure that the pump bore is clean and the old fluid filter seal has been removed. Damage to the new filter can occur.**

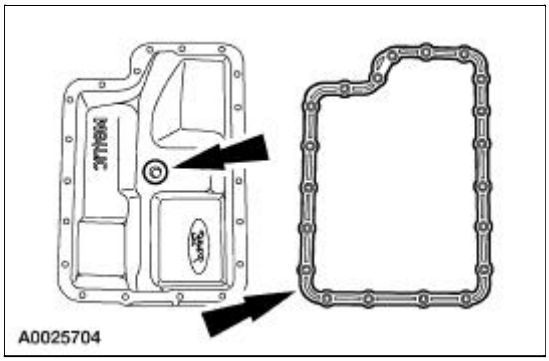
   Lubricate the new seal with clean automatic transmission fluid and install the new fluid filter and seal assembly.



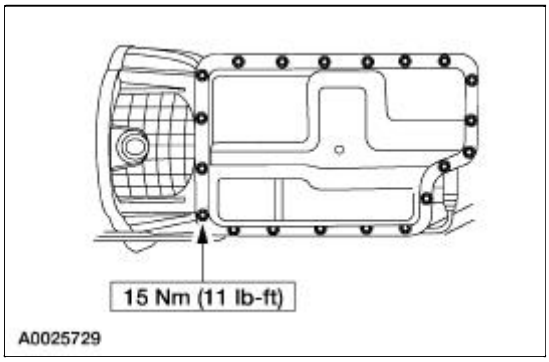
4. **NOTE:** Do not discard the gasket unless damaged. This is a reusable gasket.

   NOTE: Apply a light coat of petroleum jelly to hold the gasket to the fluid pan.

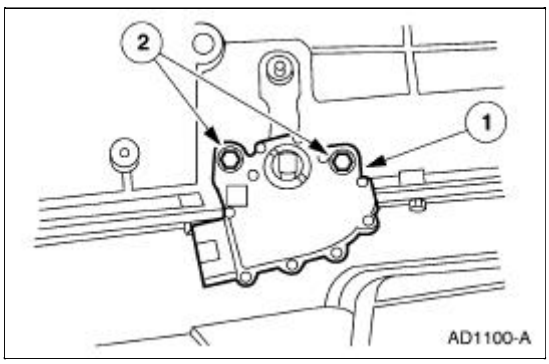
   Position the gasket onto the clean fluid pan. Make sure the magnet is positioned over the dimple in the fluid pan.



5. Install the pan with gasket. Alternately tighten the bolts.

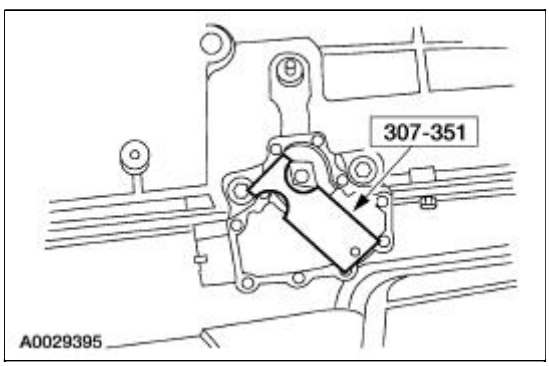


6. Install the digital transmission range (TR) sensor.
    1. Install the digital transmission range sensor.
    2. Loosely install the bolts.

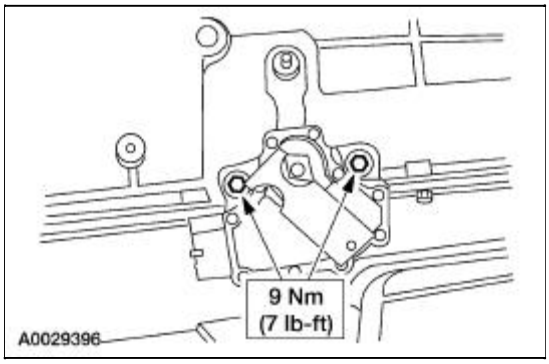


7. **NOTE:** Make sure that the manual control lever is in the NEUTRAL position.

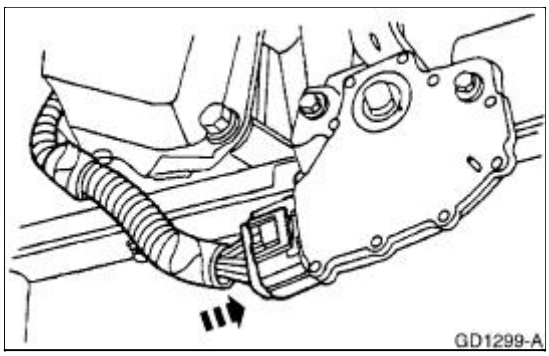
    Using the special tool, align the digital TR sensor. The tool is designed to fit snug.



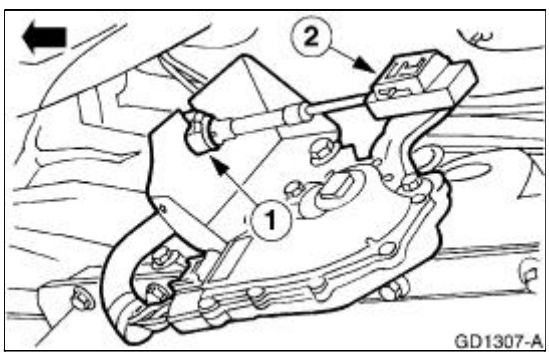
8. Tighten the bolts.



9. Connect the digital transmission range (TR) sensor electrical connector.



10. Connect the shift cable.
    1. Install the cable housing to the bracket.
    2. Install the shift cable to the manual lever.



11. Check fluid level, fill with clean automatic transmission fluid.

12. Check for correct operation.

Cooler Bypass Valve

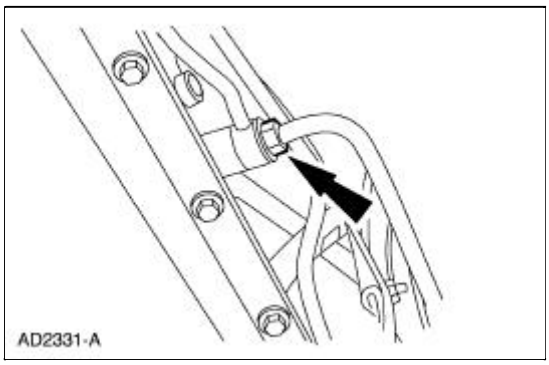
Material

Item	Specification
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®

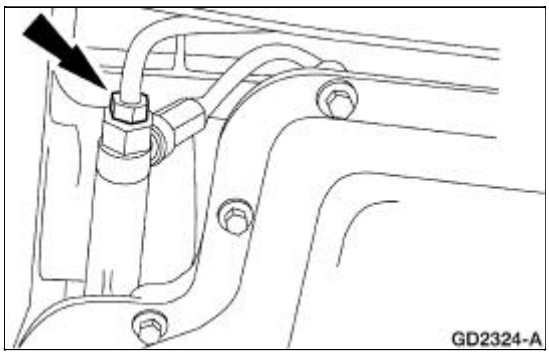
Removal

1. Position the vehicle on a hoist. Place in NEUTRAL. For additional information, refer to Section 100-02 .

2. Remove the front cooler tube from the front cooler bypass valve (CBV) fitting.

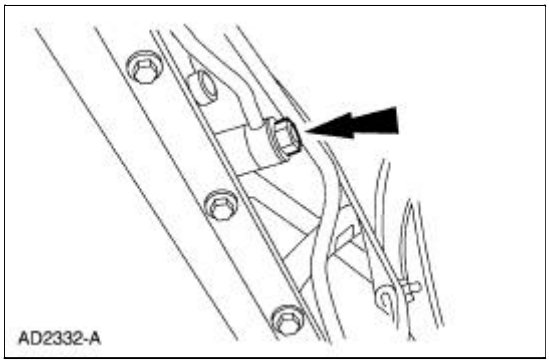


3. Remove the rear cooler tube from the rear CBV fitting.



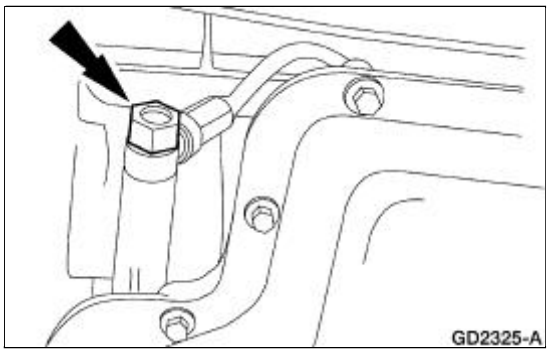
4. **NOTE:** The rubber-coated sealing washers can fall off during removal of the front CBV bolt cooler line case fitting.

   Remove the front CBV bolt cooler case fitting.



5. **NOTE:** The rubber-coated sealing washers can fall off during removal of the rear CBV bolt cooler line case fitting.

   Remove the rear CBV bolt cooler line case fitting.

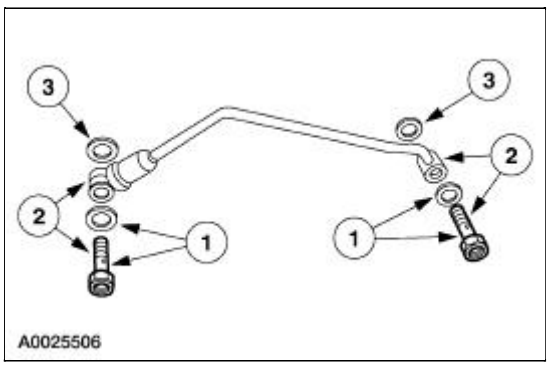


6. Remove, clean and flush the CBV. For additional information, refer to Cooler Bypass Valve Assembly in this section.

Installation

1. **CAUTION: Failure to correctly install the new rubber-coated sealing washers will result in transmission fluid leaks.**

   Install the new rubber-coated sealing washers and the new cooler line case fittings.
   1. Install one rubber-coated sealing washer on each cooler line case fitting.
   2. Install both cooler line case fittings into their respective ends of the CBV assembly.
   3. Install one rubber-coated sealing washer on each cooler line case fitting.



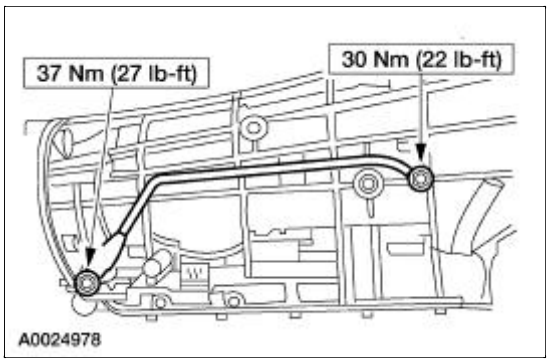
2. **CAUTION: Make sure the cooler bypass valve (CBV) is correctly backflushed. Use dry compressed air to remove solvent.**

CAUTION: If the cooler line case fitting is overtightened, the rubber-coated sealing washers and/or cooler line case fittings can be damaged, causing a transmission fluid leak.

NOTE: The CBV has a check ball in the rear fitting and will only allow flow in one direction. Make sure check ball moves freely.

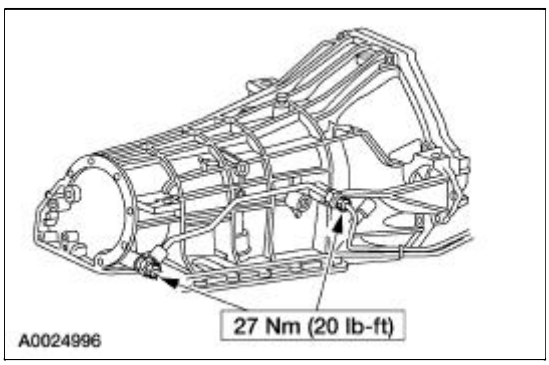
NOTE: Align the two rubber-coated sealing washers while assembling the rear cooler line case fitting.

Install the CBV fitting.



3. **NOTE:** The cooler lines must be flushed out at this time.

   Tighten the cooler tube nuts.



4. Lower the vehicle.
5. Fill the transmission with clean automatic transmission fluid. Check for correct operation.

Digital Transmission Range (TR) Sensor

Special Tool(s)

 ST1633-A	Alignment Gauge, TR Sensor 307-351 (T97L-70010-A)

Removal

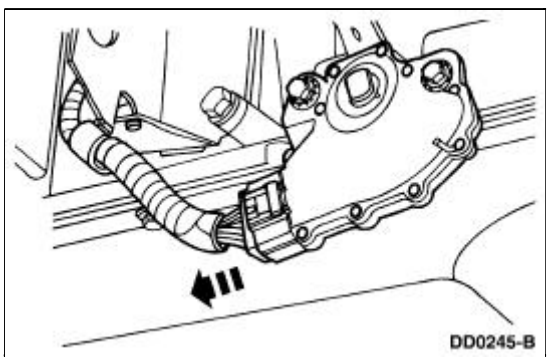
1. Position the vehicle on a hoist. Place in NEUTRAL. For additional information, refer to Section 100-02 .

2. **NOTE:** All gasoline vehicles will have new adaptive shift strategies. Whenever the vehicles battery has been disconnected for any type of service or repair, the strategy parameters that are stored in the keep alive memory (KAM) will be lost. The strategy will start to relearn once the battery is reconnected and the vehicle is driven. This is a temporary condition and will return to normal operating condition once the powertrain control module (PCM) relearns all the parameters from the driving operating conditions. There is no time frame set for this process. If this concern is present during downshifts or converter clutch apply, it is not the shift strategy and will require diagnosis as outlined in the workshop manual.

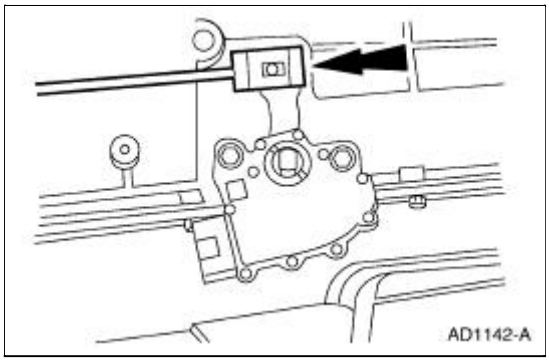
   The customer must be notified that they may experience slightly different upshifts (either soft or firm) and that this condition is temporary and will eventually return to normal operating condition.

   Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

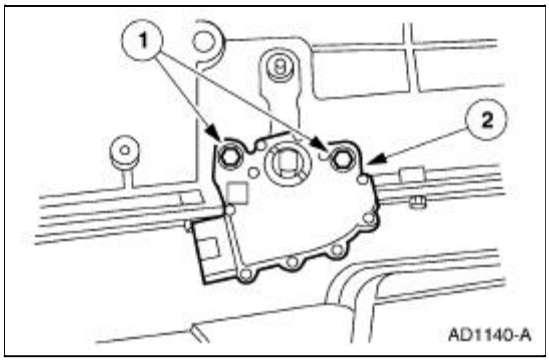
3. Disconnect the connector.



4. Disconnect the shift cable at the manual control lever.

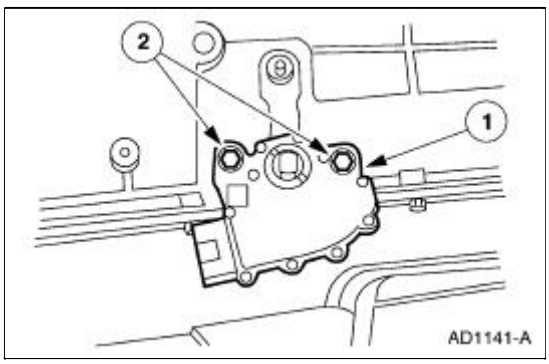


5. Remove the digital transmission range (TR) sensor.
    1. Remove the bolts.
    2. Remove the digital transmission range (TR) sensor.



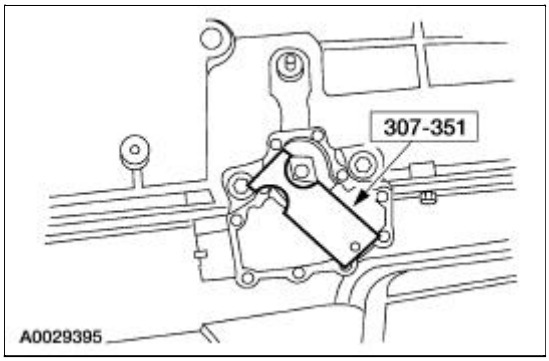
Installation

1. Install the digital transmission range (TR) sensor.
    1. Install digital transmission range (TR) sensor.
    2. Loosely install the bolts.

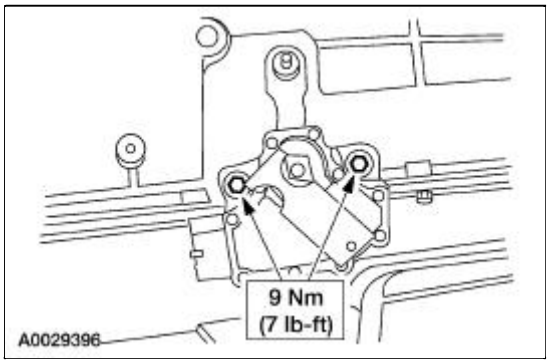


2. **NOTE:** Make sure that the manual control lever is in the NEUTRAL position.

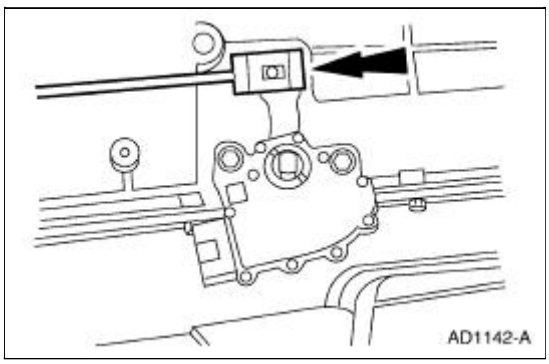
    Using the special tool, align the digital TR sensor.



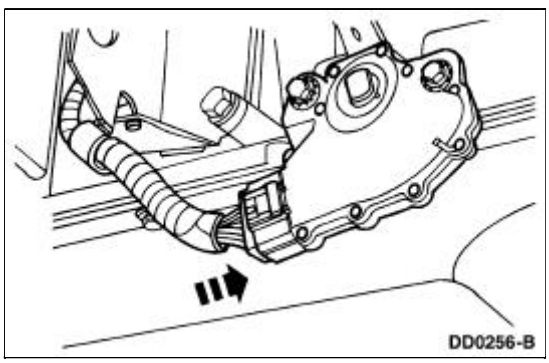
3. Tighten the bolts.



4. Reconnect the shift cable at the manual control lever.



5. Reconnect the connector.



6. Lower the vehicle.

7. Reconnect the battery ground cable.

Intermediate Servo

Material

Item	Specification
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®

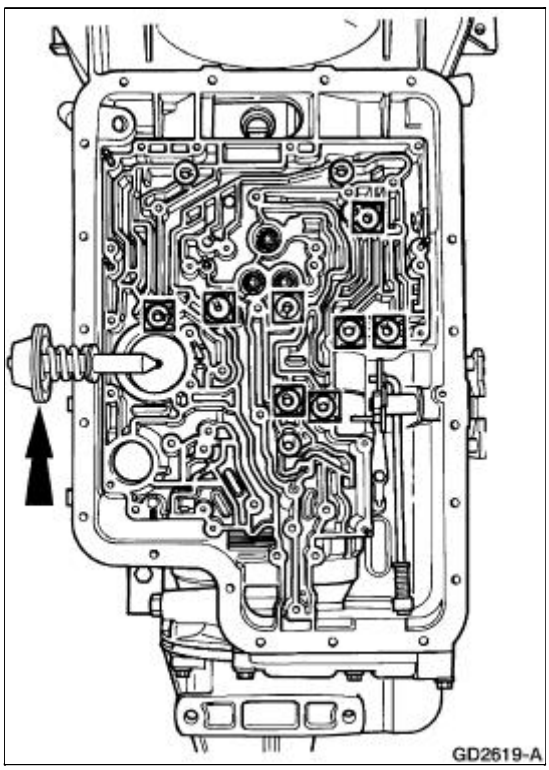
Removal

1. Remove the main control valve body. For additional information, refer to Main Control Valve Body—Accumulator Body, Solenoid Body in this section.

2. **WARNING: The intermediate servo is under spring pressure, care should be taken when removing it. It could cause bodily harm.**

   NOTE: Gently tap on the servo cover with a rubber mallet to compress and allow servo assembly to pop up.

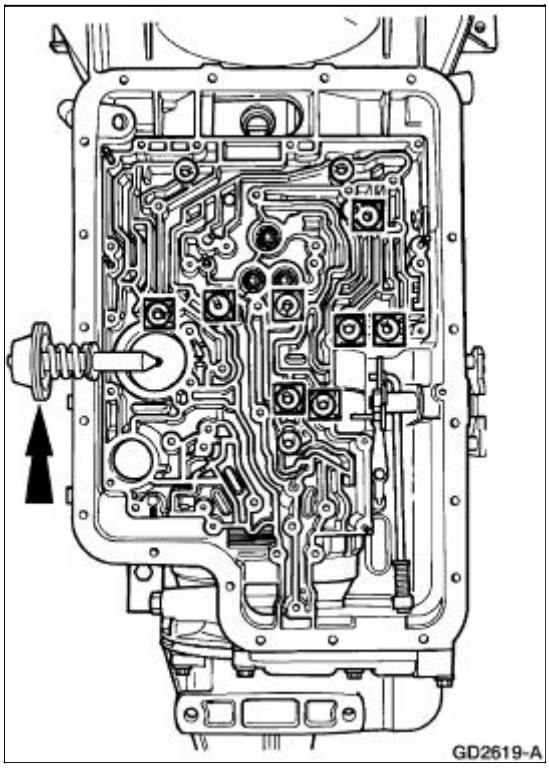
   Remove the intermediate servo.



Installation

1. **NOTE:** Lubricate the servo seal with clean automatic transmission fluid.

Install the intermediate band servo.



2. Install the main control valve body.

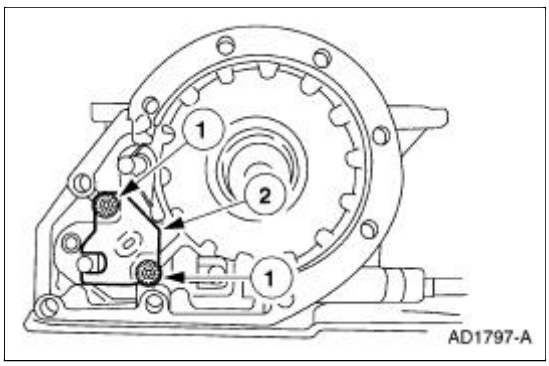
Park System

Removal

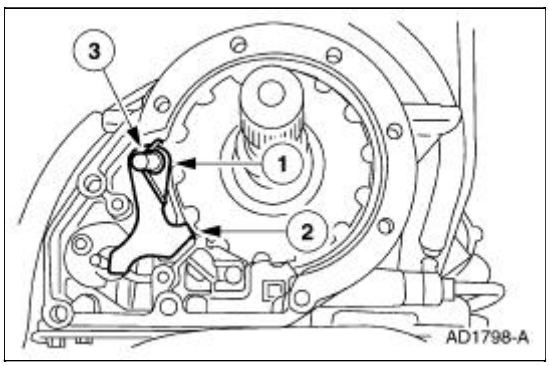
NOTE: For internal park mechanism service, refer to Manual Control Lever Shaft and Seal in this section.

1. Remove the extension housing and the extension housing gasket. For additional information, refer to Extension Housing Gasket—4x2 or Extension Housing Gasket—4x4 in this section.

2. Remove the parking rod guide plate.
    1. Remove the bolts.
    2. Remove the parking rod guide plate.



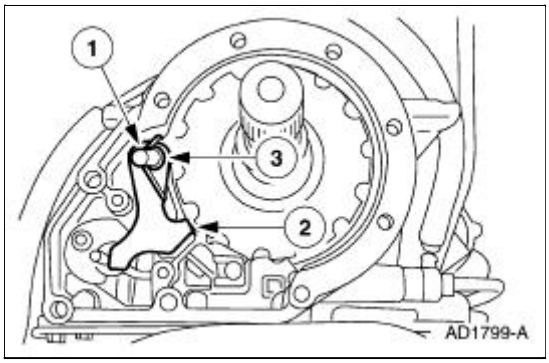
3. Remove the park pawl shaft.
    1. Remove the park pawl return spring.
    2. Remove the park pawl.
    3. Remove the park pawl shaft.



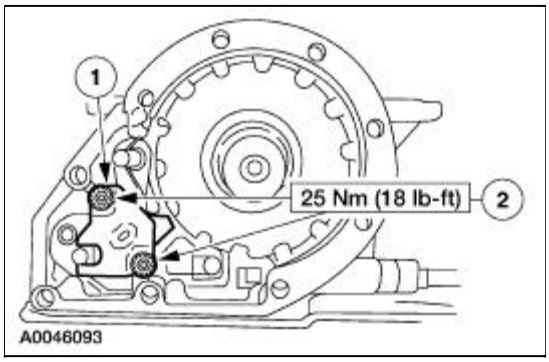
Installation

1. **NOTE:** If a new park gear needs to be installed, refer to Output Shaft—Check in this section.

   Install the park pawl shaft.
    1. Install the park pawl shaft.
    2. Install the park pawl.
    3. Install the park pawl return spring.



2. Install the parking rod guide plate.
    1. Install the parking rod guide plate.
    2. Install the bolts.



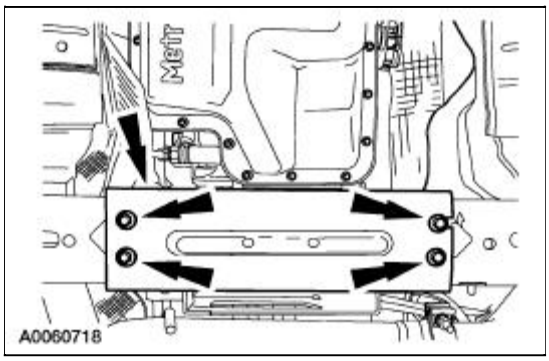
3. Install the extension housing gasket and the extension housing. For additional information, refer to Extension Housing Gasket—4x2 or Extension Housing Gasket—4x4 in this section.

Transmission Insulator and Retainer

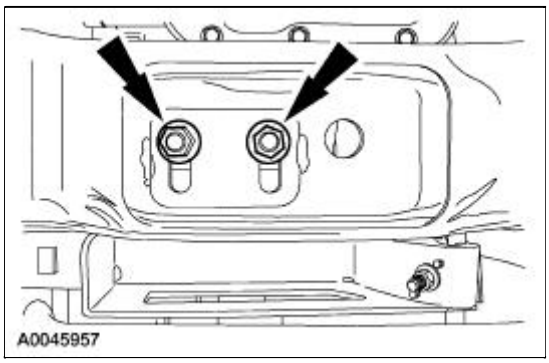
Removal

1. Position the vehicle on a hoist. Place in NEUTRAL. For additional information, refer to Section 100-02 .

2. Remove the bolts and remove the dampener.



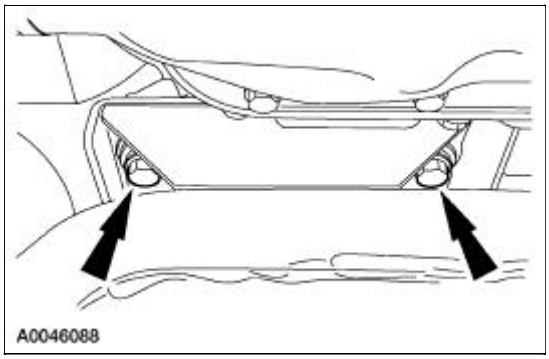
3. Remove the rear transmission support nuts.



4. Install a suitable transmission jack.

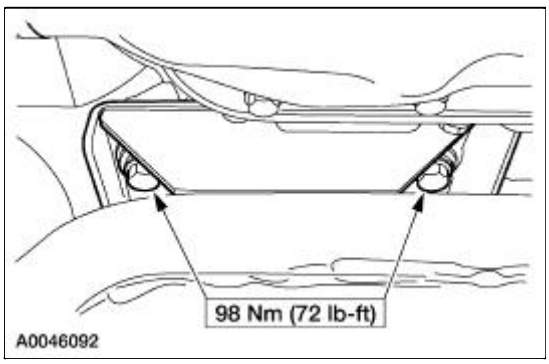
5. **CAUTION: Be sure not to raise the back of the transmission too high, if it makes contact with the underbody, damage to the TSS and OSS sensors will occur.**

   Slightly raise the rear of the transmission and remove the bolts. Remove the rear transmission mount.

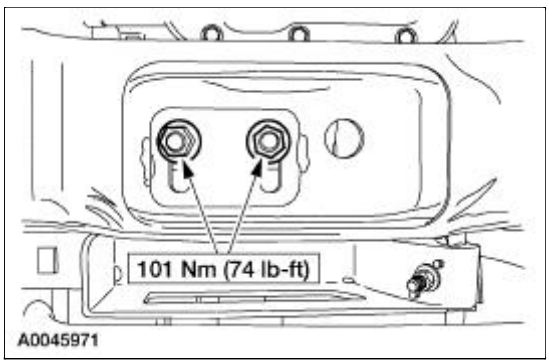


Installation

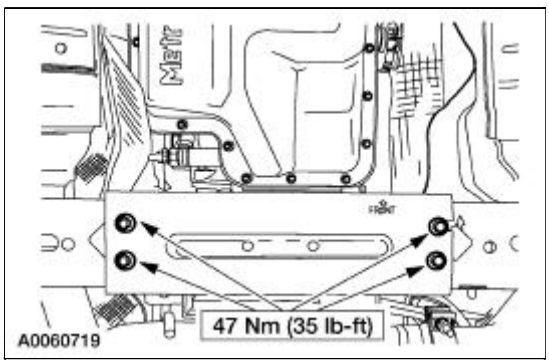
1. Install the rear transmission mount and the bolts.



2. Lower the transmission onto the crossmember and install the nuts.



3. Install the dampener and install the bolts.



4. Remove the high-lift transmission jack.

5. Lower the vehicle.

Transmission —4x4

Special Tool(s)

 ST1636-A	Retainer, Torque Converter 307-346 (T97L-7902-A)

Removal

NOTE: If the transmission is to be removed for an extended period of time, support the engine with a safety stand and a wood block.

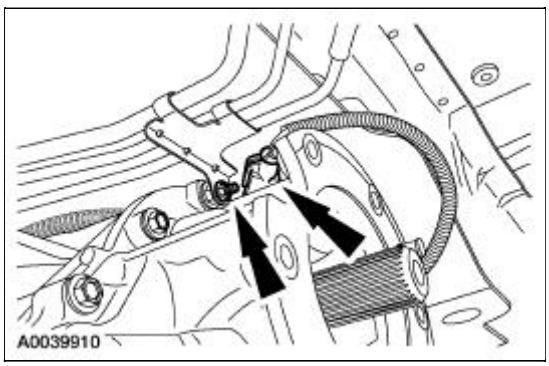
1. Position the vehicle on a hoist. Place in NEUTRAL. For additional information, refer to Section 100-02 .

2. **NOTE:** When the battery has been disconnected and reconnected, some abnormal drive symptoms can occur while the vehicle relearns its adaptive strategy. The customer must be notified that they may experience slightly different upshifts (either soft or firm) and this is a temporary condition that will eventually return to normal operating condition.

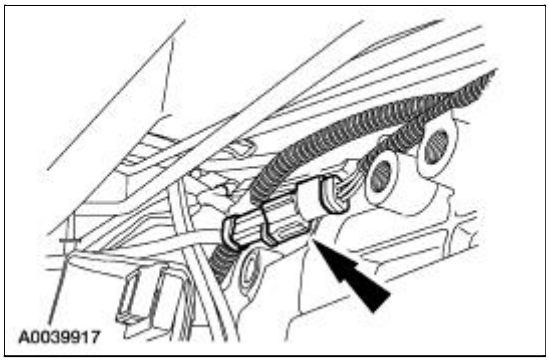
   Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3. Remove the transfer case. For additional information, refer to Section 308-07B .

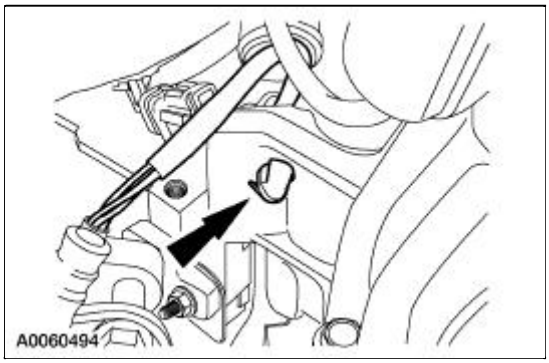
4. Disconnect the fuel lines and the output shaft speed sensor (OSS).



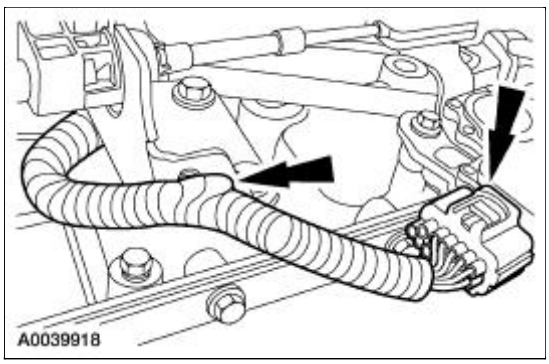
5. Disconnect the LH HO2S.



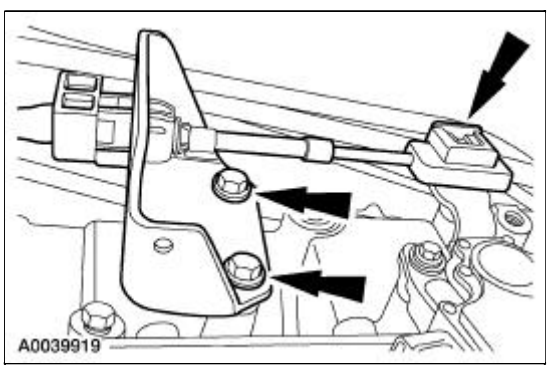
6. Disconnect the HO2S sensor clip from the transmission.



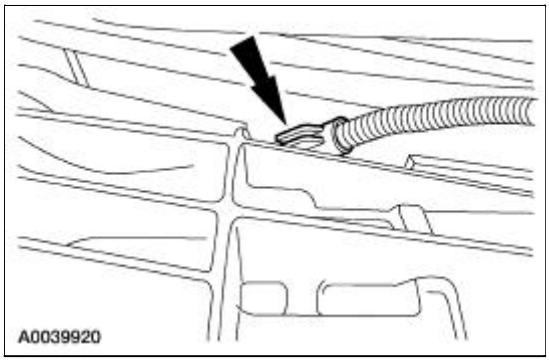
7. Disconnect the digital TR sensor electrical connector and the wire harness from the TR sensor bracket.



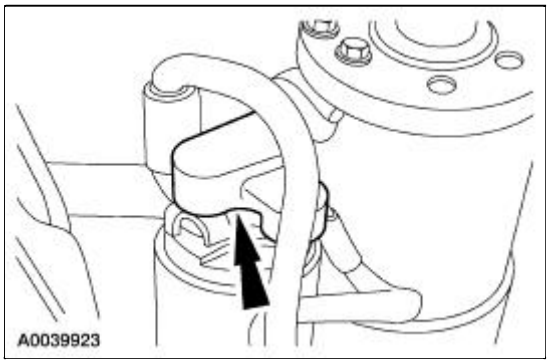
8. Disconnect the shift cable from the manual control lever and remove the shift cable and bracket from the transmission.



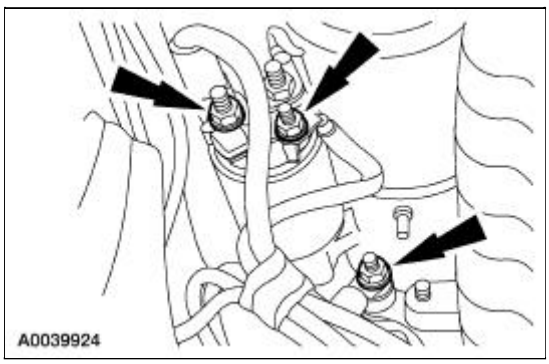
9. Disconnect the turbine shaft speed (TSS) sensor electrical connector.



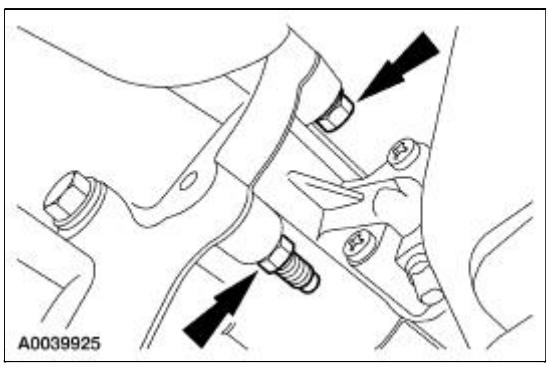
10. Remove the plastic cover from the starter motor electrical connector.



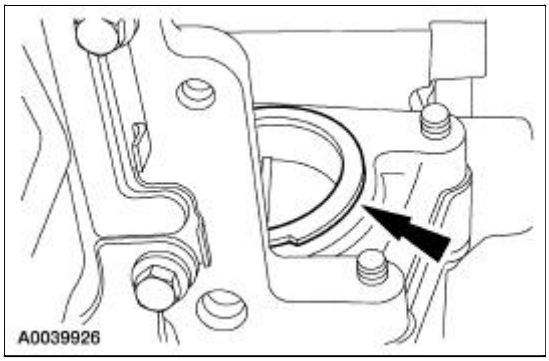
11. Remove the battery cables from the starter motor and disconnect the ground cable.



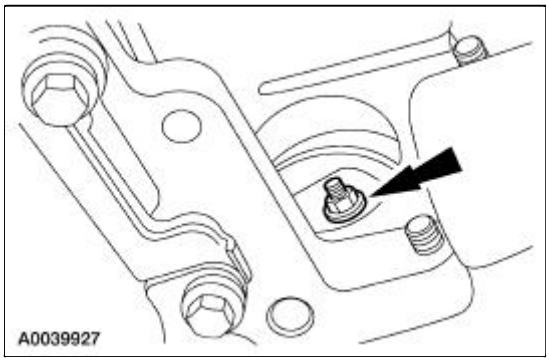
12. Remove three starter bolts and remove the starter motor.



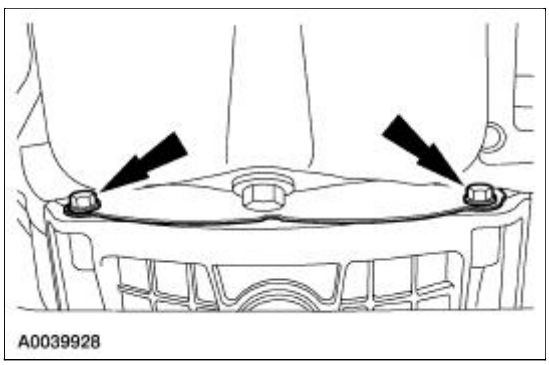
13. Remove the torque converter access cover.



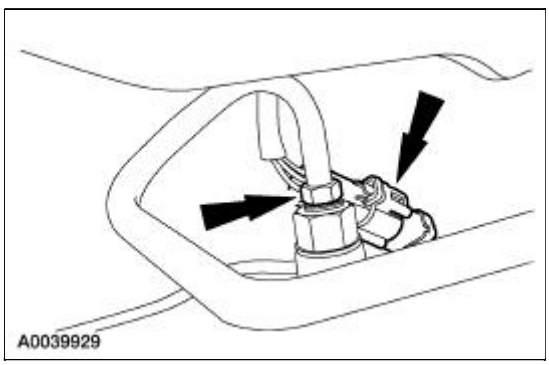
14. Remove and discard the four torque converter nuts.



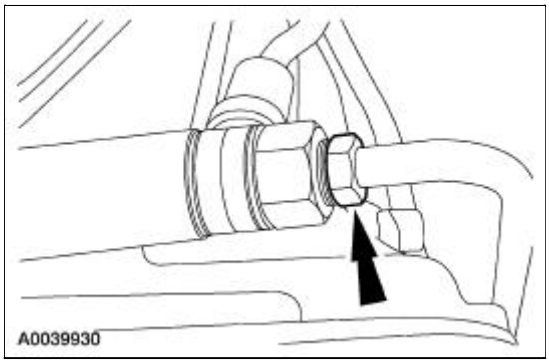
15. Remove the bolts and remove the shield.



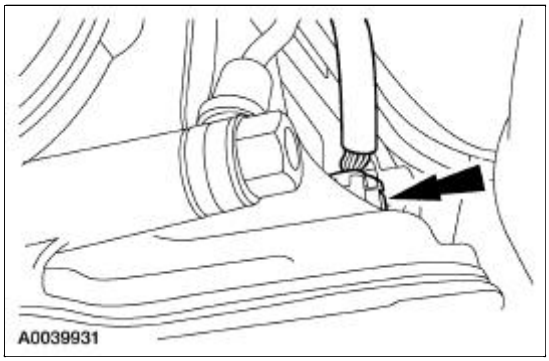
16. Disconnect the front transmission cooler line and the HO2S connector.



17. Disconnect the rear transmission cooler line.

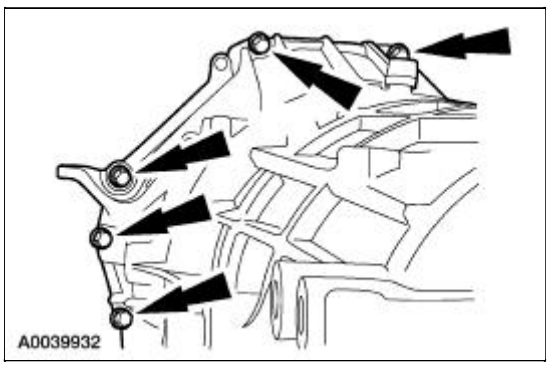


18. Disconnect the transmission harness connector.



19. Install a suitable transmission jack and secure the transmission to the jack. Remove the jack stand that was installed during the removal of the transfer case.

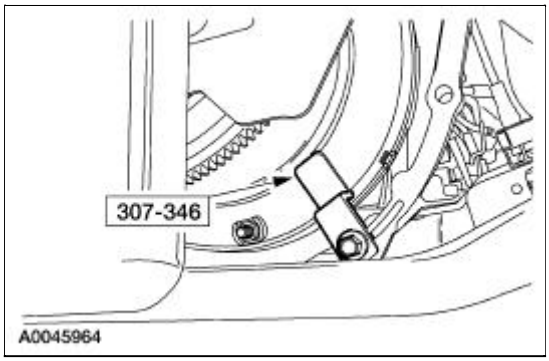
20. Remove the bolts from the LH side of the transmission.



21. Remove the bolts from the RH side of the transmission.

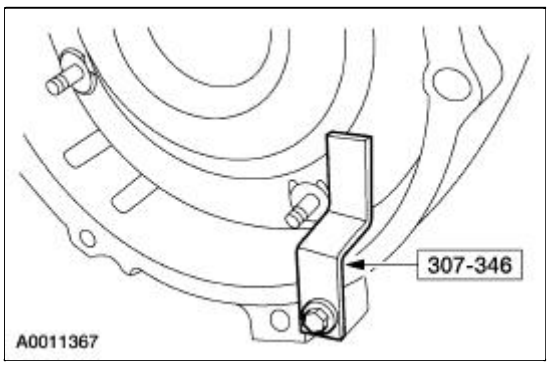
22. Separate and lower the transmission from the vehicle a small amount to gain access to the top of the transmission, and disconnect the wire harness from the top of the transmission.

23. Keeping the transmission in a horizontal position, slide the transmission back enough to install the special tool.



24. It will be necessary to tilt the transmission in a nose-down position in order for the transmission to clear the flexplate and the exhaust.

25. Remove the transmission from under the vehicle and remove the special tool.



26. Carry out the transmission fluid cooler-backflushing and cleaning if the transmission is being overhauled or install a new or remanufactured transmission. For additional information, refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section.

Transmission —4x2

Removal

NOTE: If the transmission is to be removed for a period of time, support the engine with a safety stand and a wood block.

1. Position the vehicle on a hoist. Place in NEUTRAL. For additional information, refer to Section 100-02 .

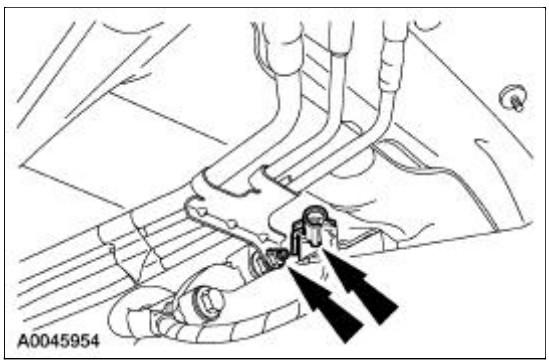
2. **NOTE:** When the battery has been disconnected and reconnected, some abnormal drive symptoms can occur while the vehicle relearns its adaptive strategy.

   The customer must be notified that they may experience slightly different upshifts (either soft or firm) and that this condition is temporary and will eventually return to normal operating condition.

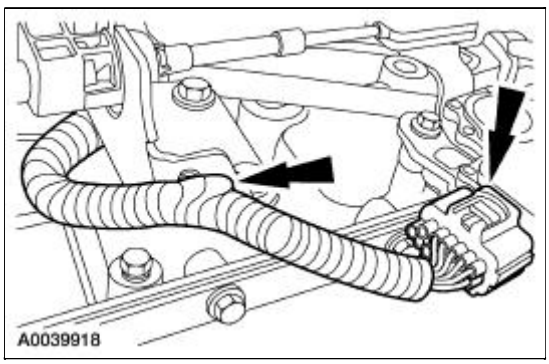
   Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3. Remove the rear driveshaft. For additional information, refer to Section 205-01 .

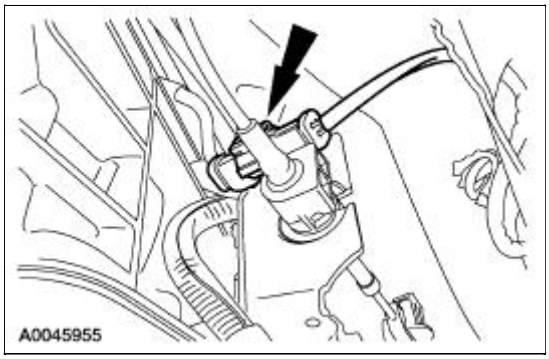
4. Disconnect the fuel line bracket and the output shaft speed sensor (OSS).



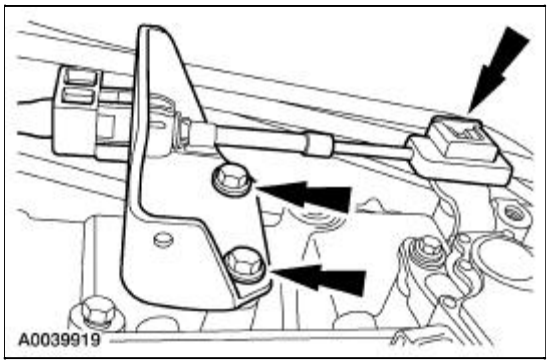
5. Disconnect the digital TR sensor electrical connector and the wire harness from the TR sensor bracket.



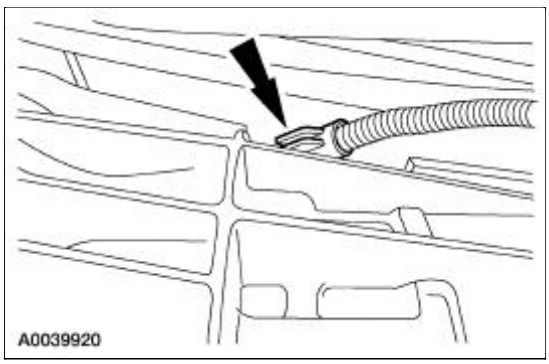
6. Disconnect the LH catalyst monitor sensor connector from the shift cable bracket.



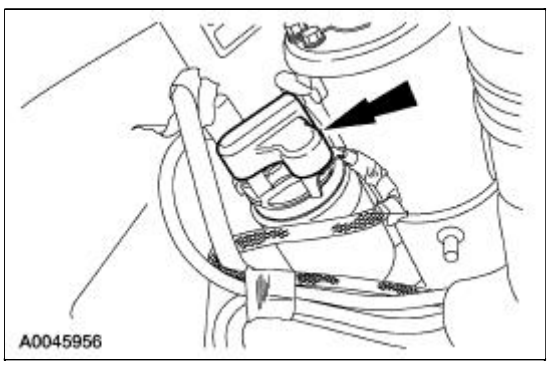
7. Disconnect the shift cable from the manual control lever and remove the shift cable and bracket from the transmission.



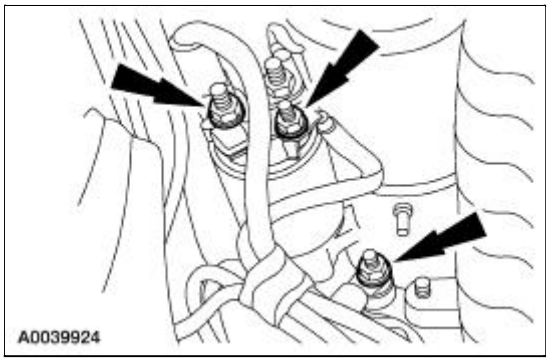
8. Disconnect the turbine shaft speed (TSS) sensor electrical connector.



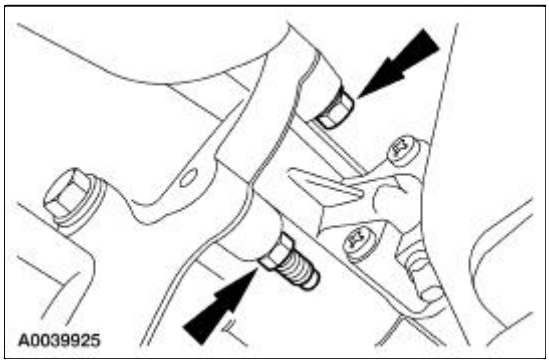
9. Remove the plastic cover from the starter motor electrical connector.



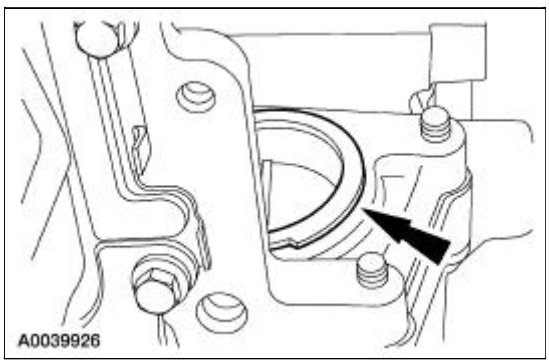
10. Remove the battery cables from the starter motor and disconnect the ground cable.



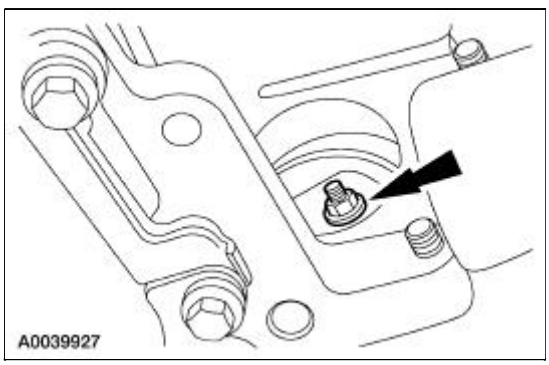
11. Remove the three starter bolts and the starter motor.



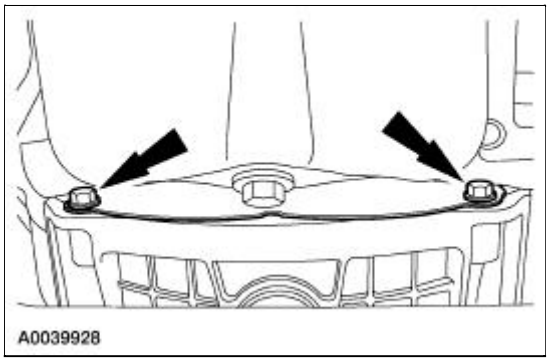
12. Remove the torque converter access cover.



13. Remove and discard the four torque converter nuts.

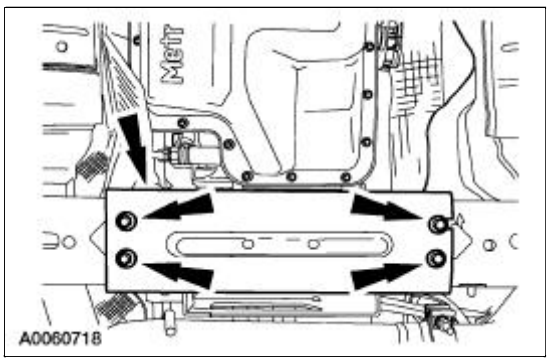


14. Remove the bolts and remove the shield.

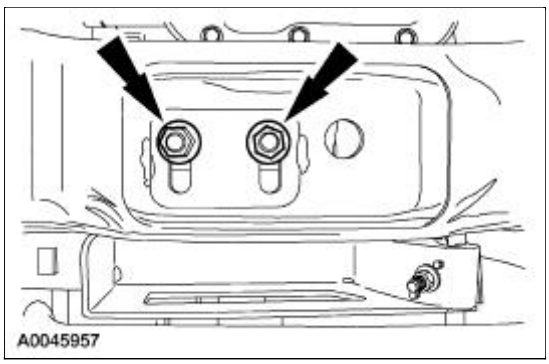


15. Install a suitable transmission jack.

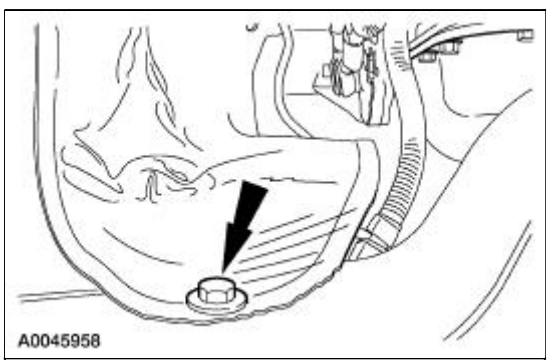
16. Remove the bolts and remove the dampener.



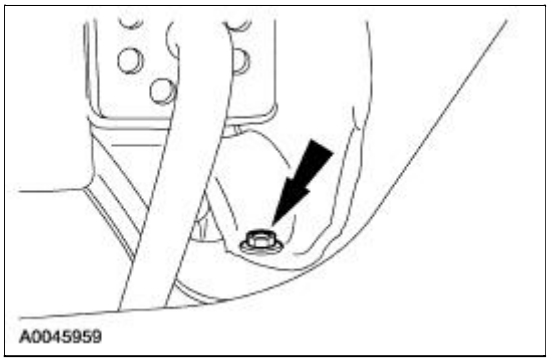
17. Remove the rear transmission support nuts.



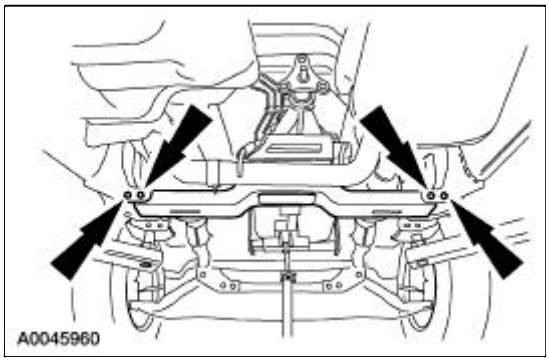
18. Remove the LH heat shield bolt.



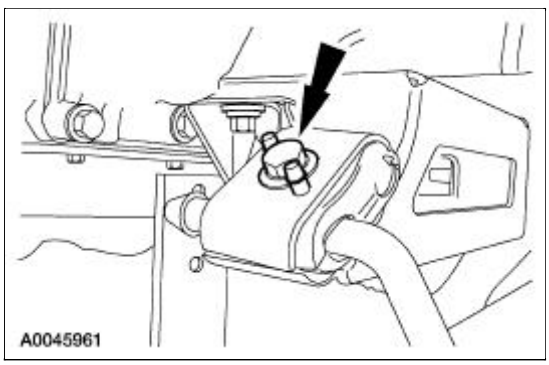
19. Remove the RH heat shield bolt.



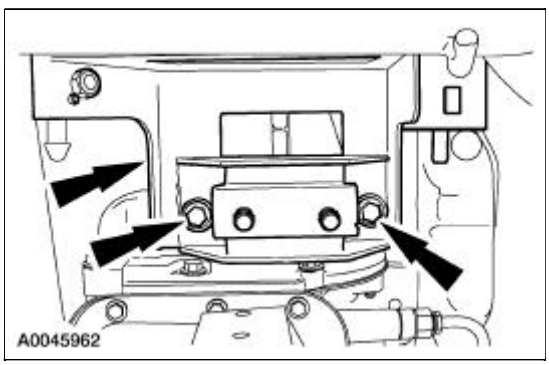
20. Remove the crossmember bolts and the crossmember.



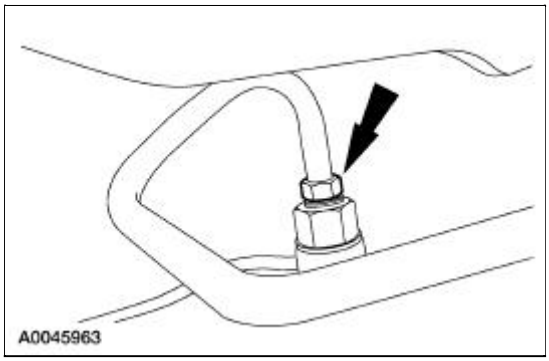
21. Remove the bolt for the exhaust bracket.



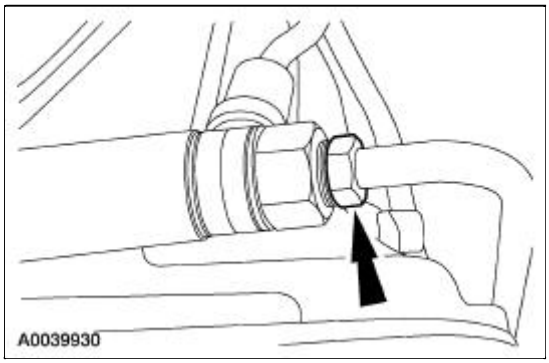
22. Remove the rear transmission support bolts and remove the support and the exhaust hanger bracket.



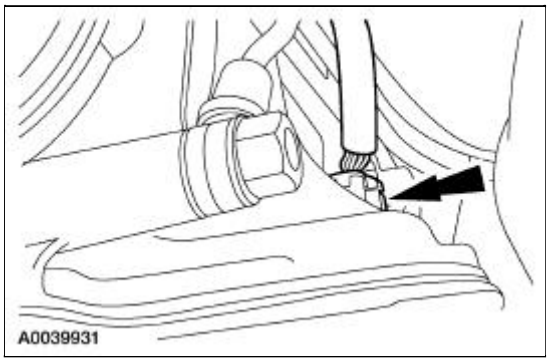
23. Disconnect the front transmission cooler line.



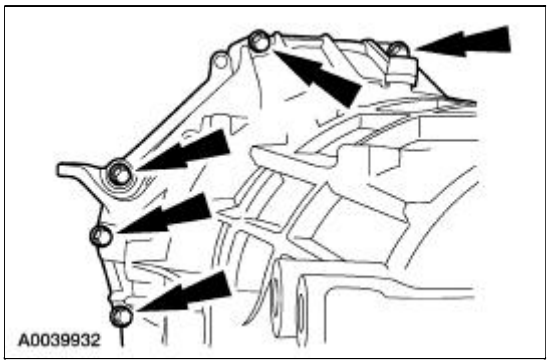
24. Disconnect the rear transmission cooler line.



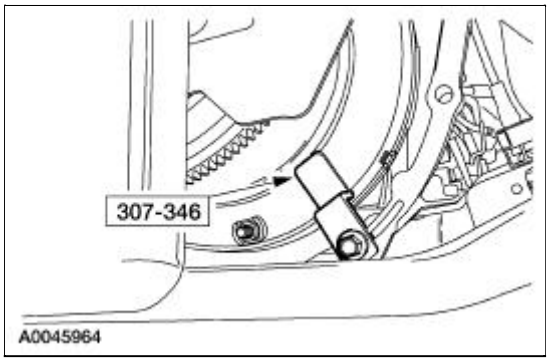
25. Disconnect the transmission harness connector.



26. Remove eight bolts from the transmission.



27. Keeping the transmission in a horizontal position, slide the transmission back enough to install the special tool.



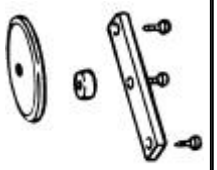
28. Lower the transmission from the vehicle a small amount to gain access to the top of the transmission, disconnect the wire from the top of the transmission.

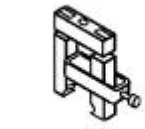
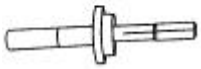
29. It will be necessary to tilt the transmission in a nose-down position in order for the transmission to clear the flexplate and the exhaust.

30. Carry out the transmission fluid cooler-backflusing and cleaning if the transmission is being overhauled or install a new or remanufactured transmission. For additional information, refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section.

Transmission

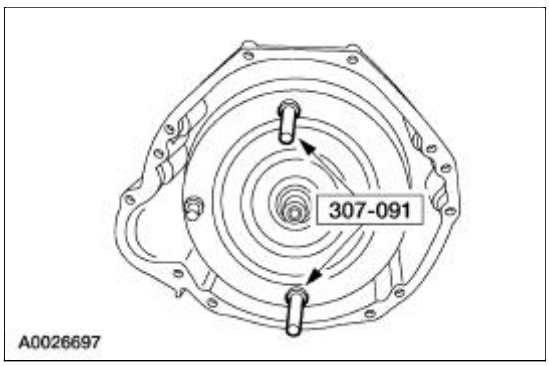
Special Tool(s)

 ST2544-A	Installer, Transmission Forward Clutch Assembly 307-436
 ST1851-A	Service Set, Clutch Spring 307-S223 (T89T-70010-C)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
 ST1187-A	Slide Hammer 307-005 (T59L-100-B)
 ST1738-A	Roll Pin Set 211-S060 (T78P-3504-N)
 ST1282-A	Remover, Pilot Bearing 308-001 (T58L-101-B)
 ST1208-A	Remover, Transmission Fluid Pump 307-221 (T89T-70010-A)
	Remover, Transmission Fluid Seal

 ST1192-A	307-048 (T74P-77248-A)
 ST2159-B	Loading Fixture, Clutch 307-S383
 ST1631-A	Handle, Torque Converter 307-091 (T81P-7902-C)
 ST1746-A	Remover, Transmission Extension Housing Bushing 307-064 (T77L-7697-D) Remover, Output Shaft Bushing 307-382

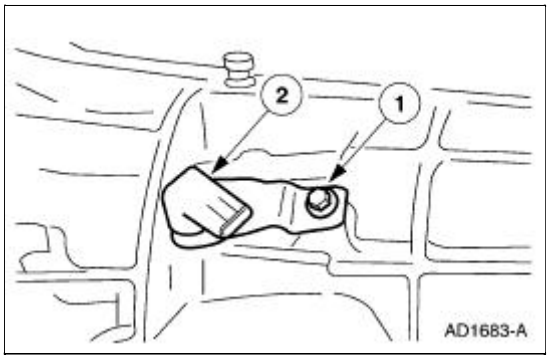
NOTE: Refer to the Disassembled Views for component location and orientation.

1. Using the special tools, remove the torque converter from the transmission.



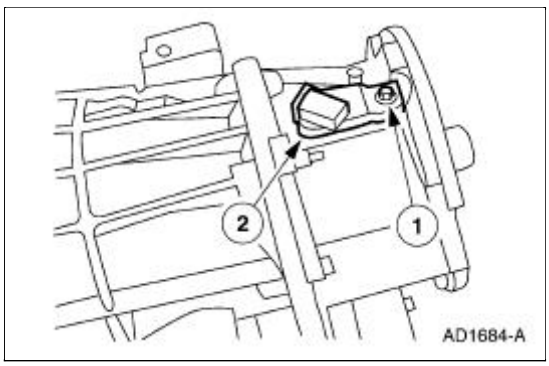
2. **CAUTION: The turbine shaft speed sensor (TSS) must be removed or damage to the sensors will occur.**

   Remove the turbine shaft sensor (TSS).
   1. Remove the bolt.
   2. Remove the turbine shaft sensor (TSS).



3. **CAUTION: The output shaft speed sensor (OSS) will need to be removed or damage to the sensors will occur.**

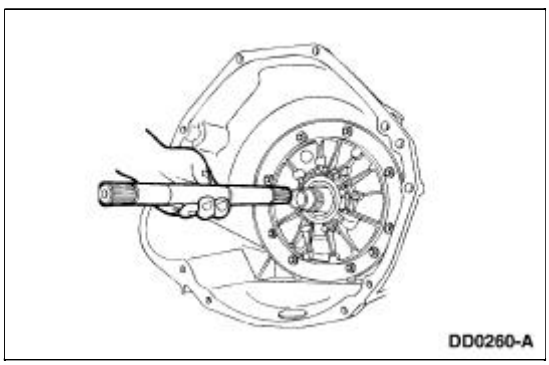
   Remove the output shaft speed sensor (OSS).
   1. Remove the bolt.
   2. Remove the output shaft speed sensor (OSS).



4. Mount the transmission to a suitable stand.

5. **CAUTION: The input shaft and overdrive planet assembly are replaced as mating components.**

   Remove the input shaft.

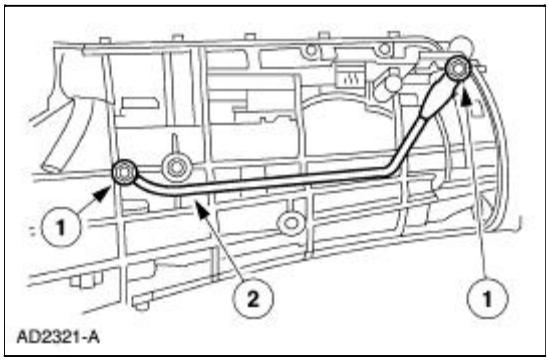


6. **CAUTION: The sealing washers may fall off the cooler line case fittings.**

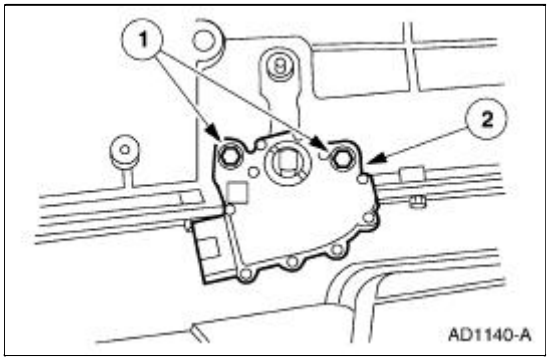
   NOTE: The bolts are part of the cooler bypass valve (CBV) assembly.

   Remove the cooler bypass valve.
   1. Remove the cooler line case fittings.

2. Remove the cooler bypass valve.

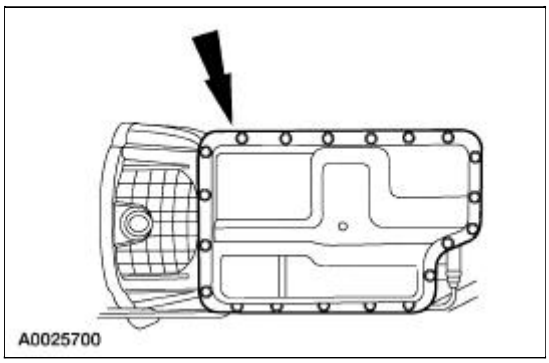


7. Remove the transmission range (TR) sensor.
   1. Remove the bolts.
   2. Remove the transmission range (TR) sensor.



8. **NOTE:** Do not discard the gasket unless damaged. This is a reusable gasket.

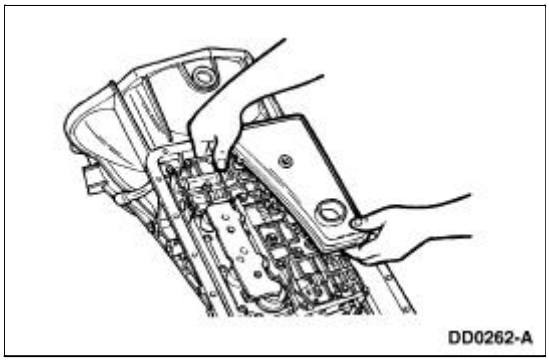
   Remove the transmission fluid pan and the gasket.



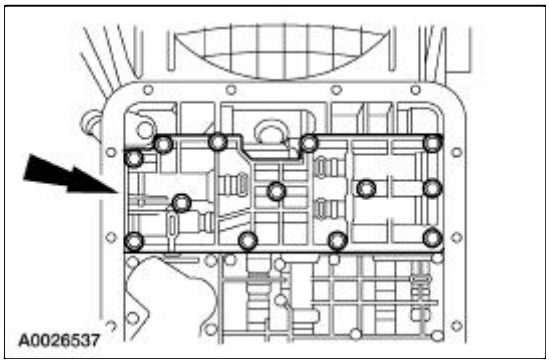
9. **CAUTION: If the seal remains in the pump bore, remove it carefully with a small screwdriver so as not to scratch or damage the aluminum bore.**

   NOTE: After removal, discard the filter and seal assembly.

   Remove the filter and seal assembly by carefully pulling and rotating the filter as necessary.

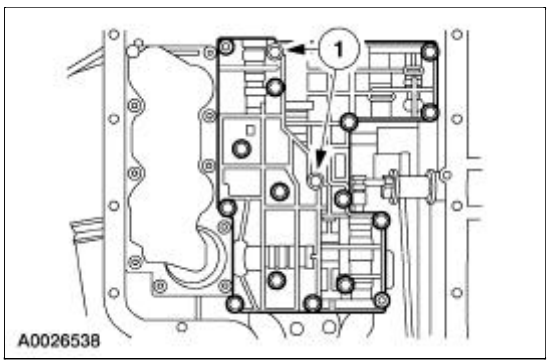


10. Remove the bolts, nuts and the accumulator body.

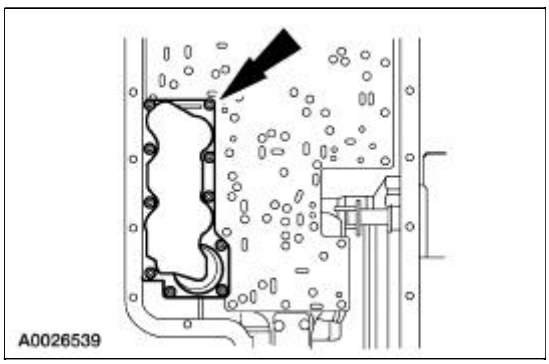


11. **NOTE:** Do not remove the lower-to-upper main control valve body assembly bolts. Keep the main control valve bodies attached as an assembly.

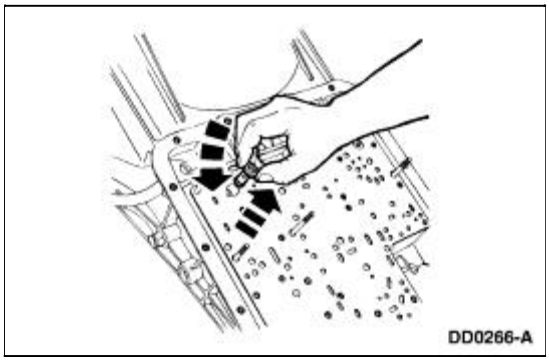
    Remove the main control valve body.
    1. Do not remove the two lower-to-upper main control valve body assembly bolts.



12. Remove the bolts, nut and the solenoid body assembly, by pushing the solenoid body connector upward to help separate the assembly from the case bore.

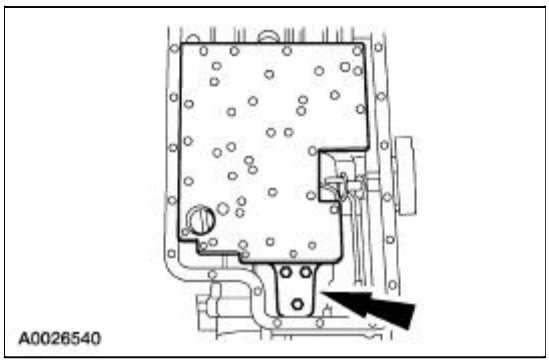


13. Remove the solenoid screen assembly by rotating and pulling.



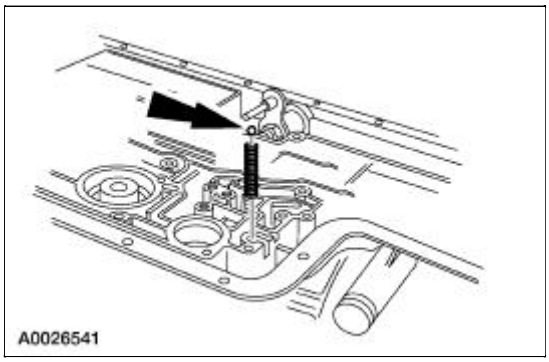
14. **CAUTION: The steel electronic pressure control (EPC) check ball is spring-loaded under the valve body separator plate.**

    Remove the separator plate reinforcing plate and the valve body separator plate with the two gaskets. Discard both gaskets.



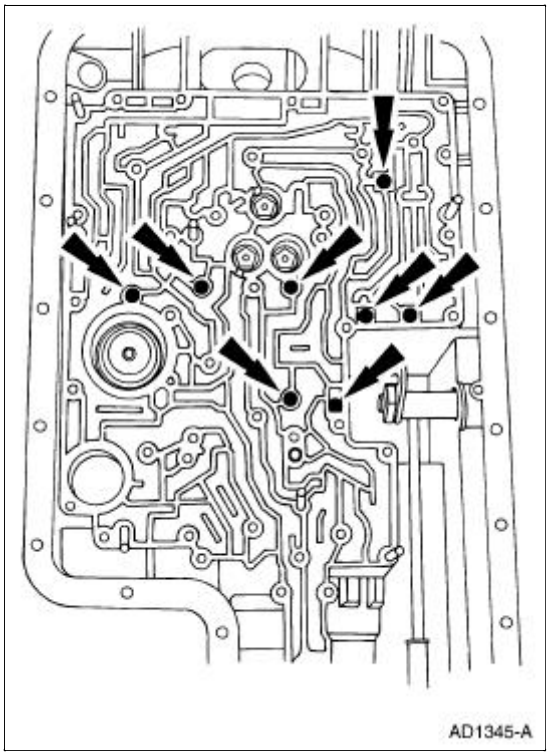
15. **NOTE:** The steel EPC check ball has a 0.5 mm (0.02 in) diameter and is smaller than the other check balls.

    Remove the steel EPC check ball and spring.

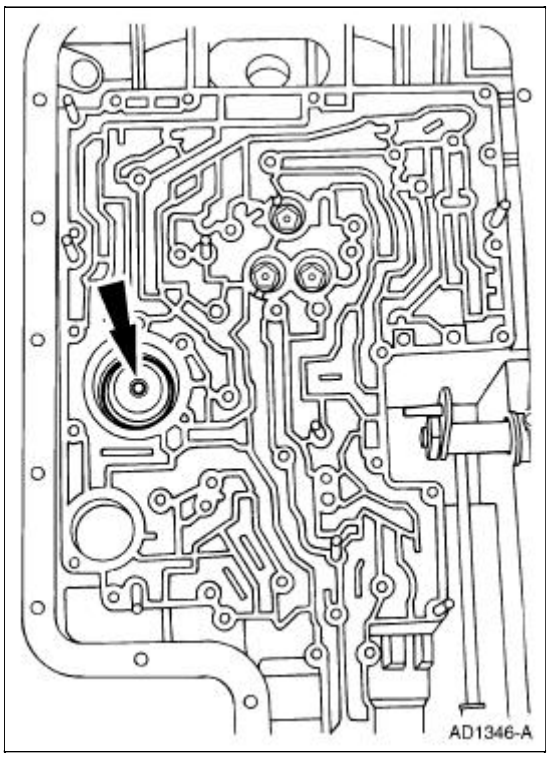


16. **CAUTION: Use care not to damage the rubber check balls. Transmission shift problems can occur.**

    Using a small screwdriver, carefully remove the eight rubber check balls.

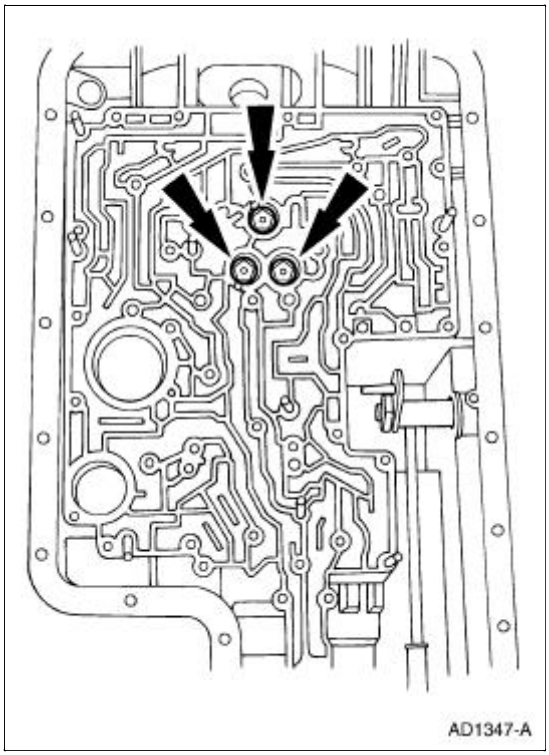


17. Using a plastic or rubber-headed hammer, tap gently on the intermediate band servo assembly piston. The downward force will compress the spring. The upward momentum of the spring will force the assembly to be released from the case bore.

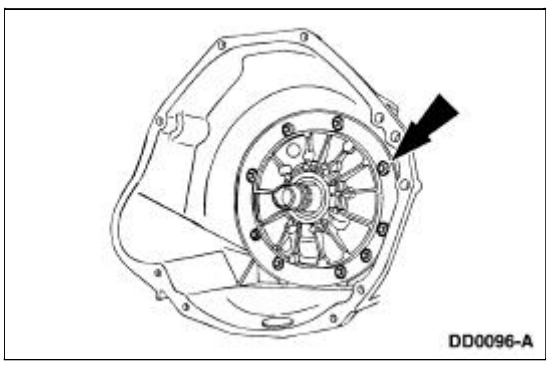


18. **CAUTION: After removal, discard the feedbolts. The bolts will not retain torque specification if reused.**

    Remove and discard the feedbolts.

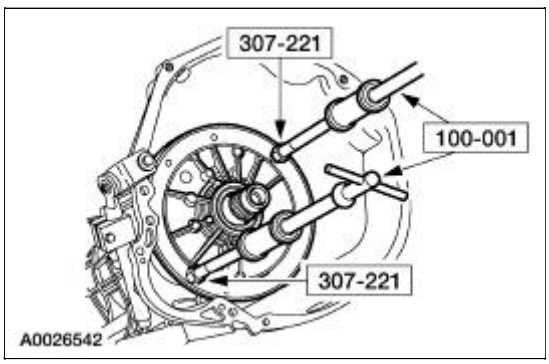


19. Remove the pump bolts and discard the washers.



20. **NOTE:** The special tools should be installed into the pump threaded holes as shown.

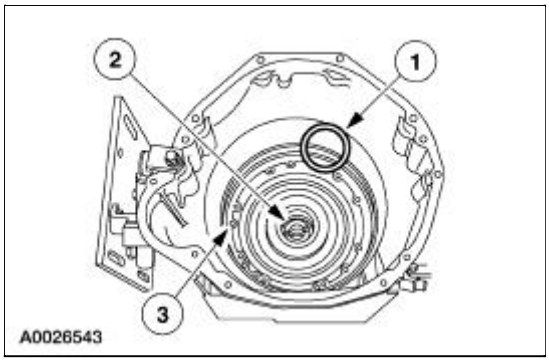
    Using the special tools, remove the pump.



21. **NOTE:** The No. 1 pump thrust washer and the No. 2A overdrive sun gear thrust bearing may stay with the pump.

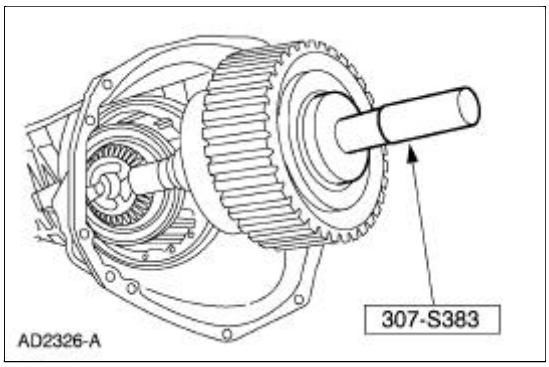
    Remove the No. 1 pump thrust washer.

1. Remove the No. 1 pump thrust washer.
2. Remove the No. 2A overdrive sun gear thrust bearing.
3. Remove the pump gasket and discard.



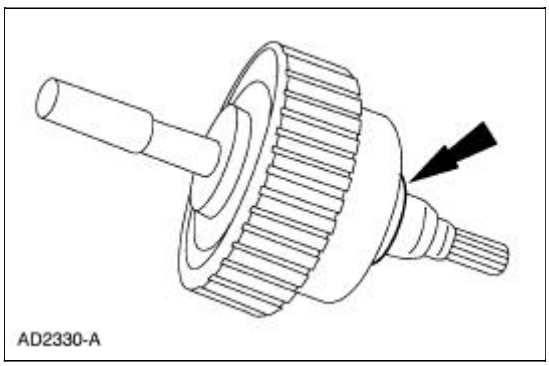
22. **CAUTION: The coast clutch, overdrive ring gear, centershaft assembly must be removed as an assembly, using special service tool or damage to the overdrive one-way clutch can occur.**

    Using the special tool remove the coast clutch, overdrive ring gear, centershaft assembly.

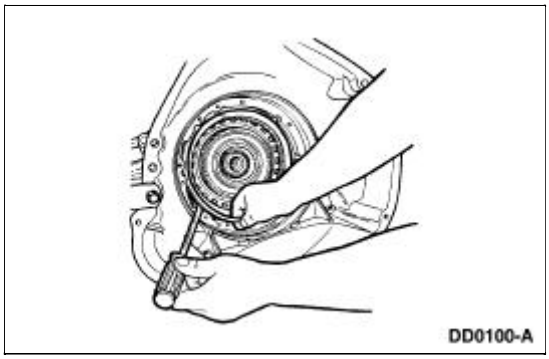


23. **NOTE:** The No. 5 thrust bearing may remaining on the center shaft or the center support.

    Remove the No. 5 overdrive center shaft thrust bearing assembly.

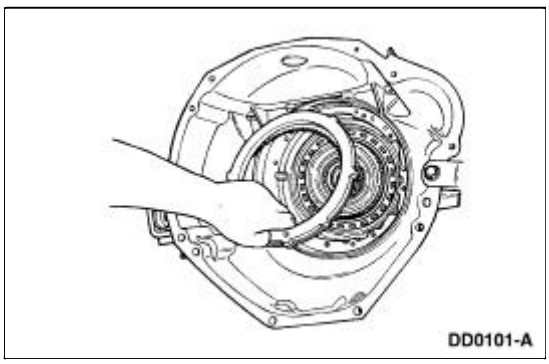


24. Remove the overdrive clutch pressure plate retainer snap ring.

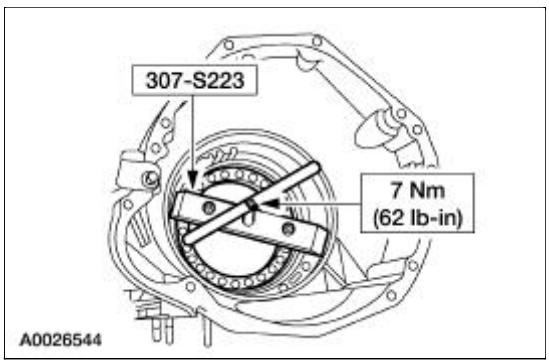


25. **NOTE:** Tag the parts for identification during installation.

    Remove the overdrive clutch pressure plate and the clutch pack.

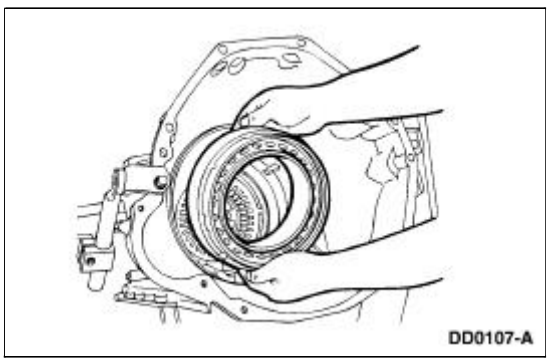


26. Using the special tool, remove the intermediate/overdrive cylinder retaining ring.

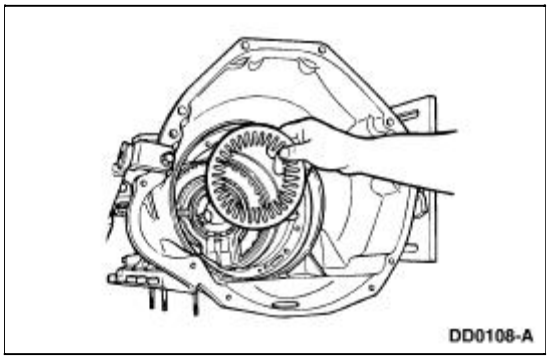


27. **CAUTION: During removal, do not misalign the intermediate/overdrive cylinder assembly in the case bore. This can damage the case bore.**

    Remove the intermediate/overdrive cylinder assembly.

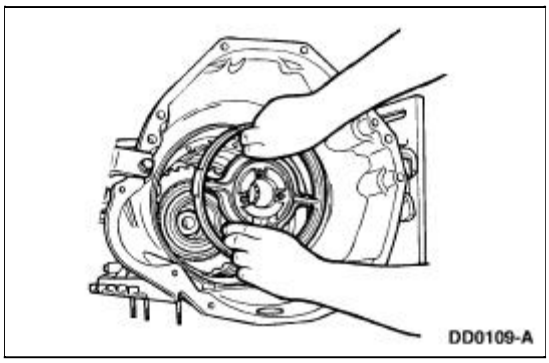


28. Remove the intermediate clutch piston return spring.

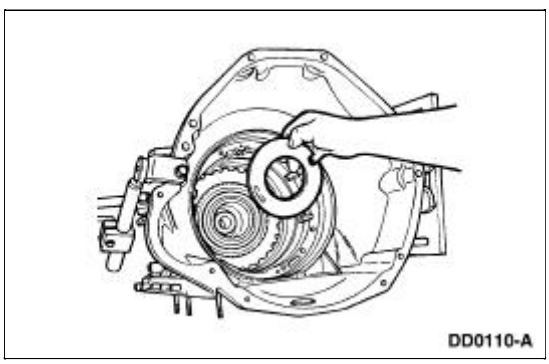


29. **CAUTION: During removal, do not misalign the center support in the case bore. This can damage the case bore.**

    Carefully remove the center support assembly.

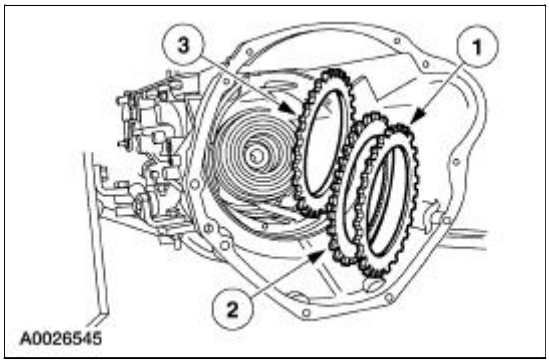


30. Remove the No. 6 center support thrust washer.

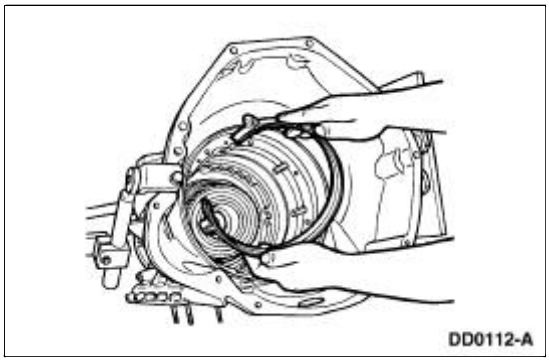


31. **NOTE:** Tag the parts for identification during installation.

    Remove the intermediate clutch rear pressure plate.
    1. Remove the intermediate clutch pressure apply plate.
    2. Remove the intermediate clutch pack.
    3. Remove the intermediate clutch rear pressure plate.

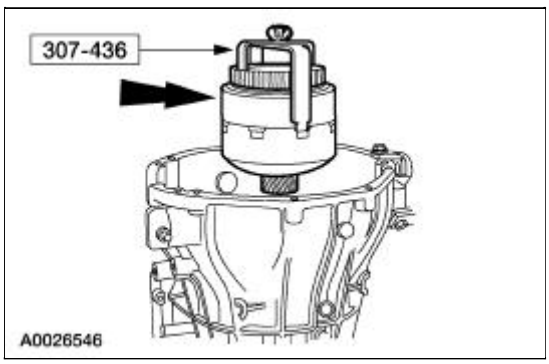


32. Remove the intermediate band.

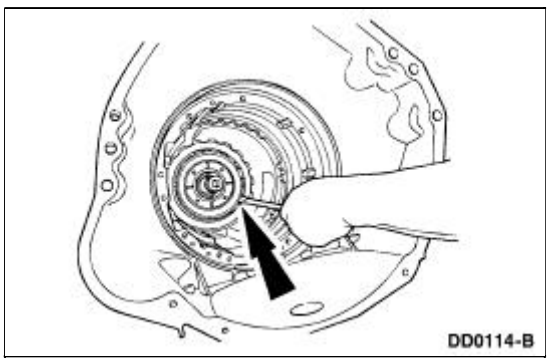


33. **NOTE:** When installing the special tool, each leg of the tool must be rotated separately to engage notches on the input shell prior to tightening the top cross bar.

    Using the special tool, remove the direct clutch, forward clutch and input shell as an assembly.

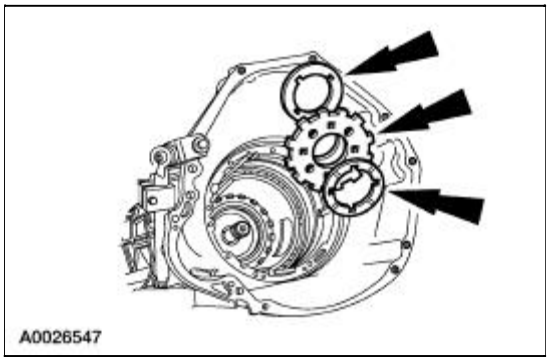


34. Remove the reverse planet retaining ring.



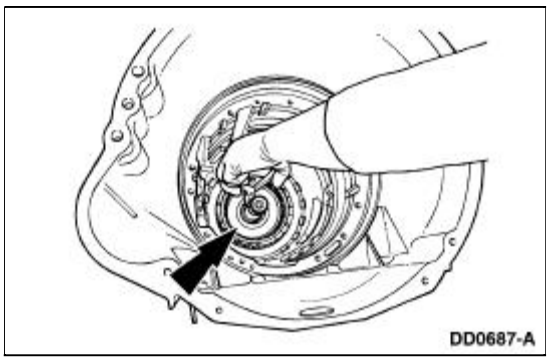
35. Remove the reverse planet assembly, No. 10B, and the No. 11 reverse planet carrier thrust

washers.

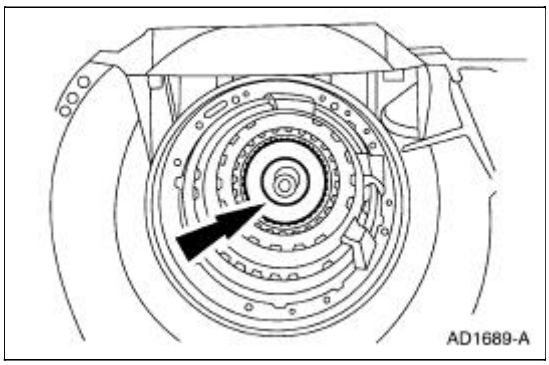


36. **WARNING: Use care when removing the output shaft retaining ring. The output shaft can fall out. Do not reuse the output shaft retaining ring.**

Remove the output shaft retaining ring.

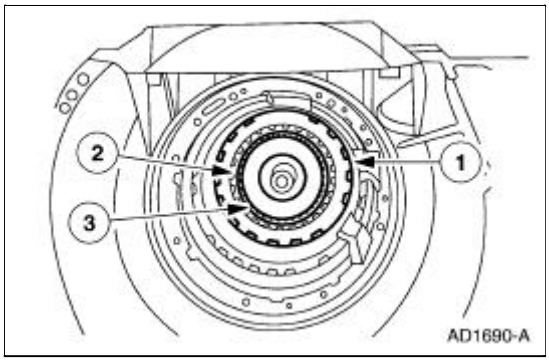


37. Remove the output shaft ring gear and hub assembly.

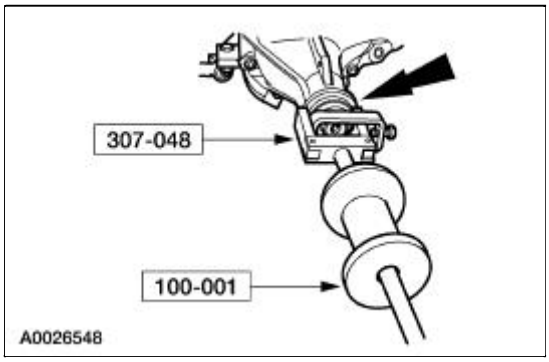


38. **WARNING: Use care not to drop the output shaft while rotating the transmission.**

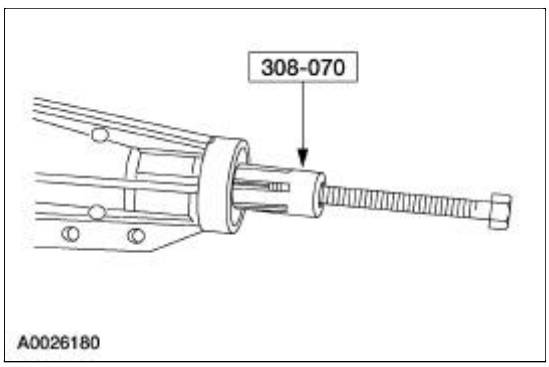
Remove the following parts as an assembly.
1. Reverse clutch pack (pressure plate, friction plate and seals).
2. Reverse clutch hub.
3. Low/reverse one way clutch assembly.



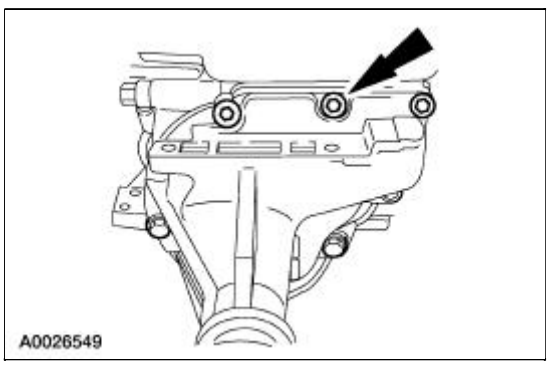
39. Using the special tools, remove the extension housing seal.



40. Using the special tool, remove the extension housing bushing.



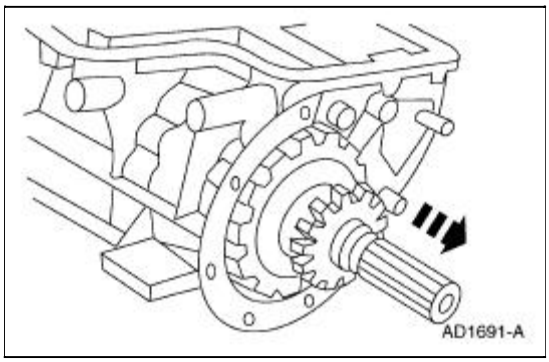
41. Remove the eight bolts, one stud and the extension housing. Remove and discard the extension housing gasket.



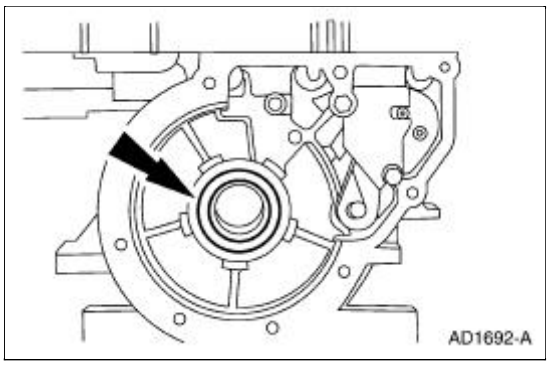
42. **NOTE:** Be sure not to damage the output shaft drive sprocket speed sensor wheel or the park gear.

NOTE: The parking gear and output shaft drive sprocket speed sensor wheel are a press fit to the output shaft.

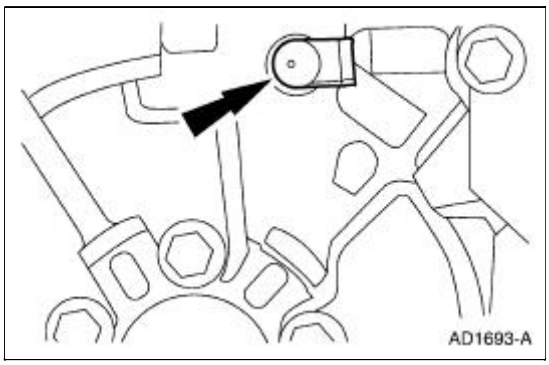
Remove the output shaft.



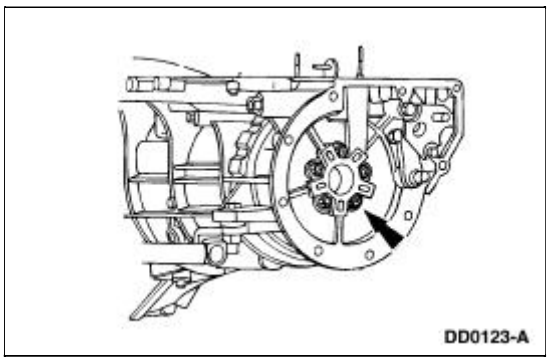
43. Remove the No. 13 thrust bearing.



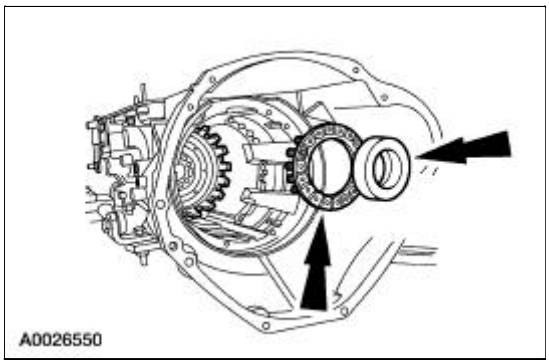
44. Remove the plastic orifice lube plug form the rear of the case and discard.



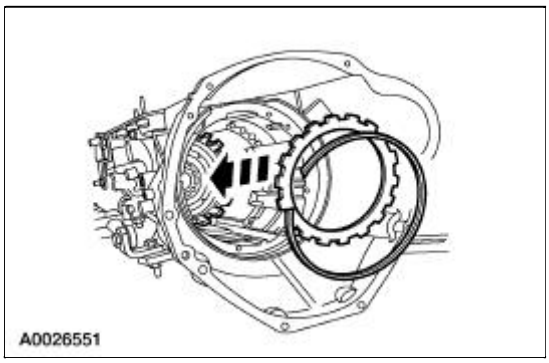
45. Remove the five bolts retaining the low/reverse one-way clutch inner race to the case.



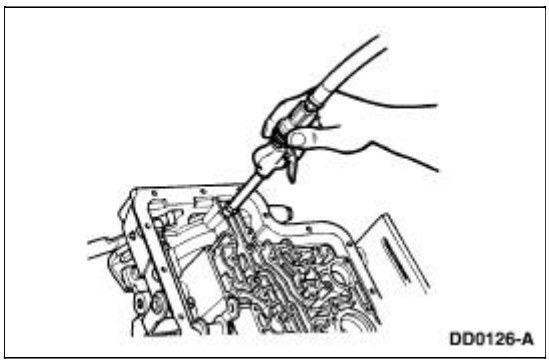
46. Remove the low/reverse one-way clutch inner race and the reverse clutch return spring assembly.



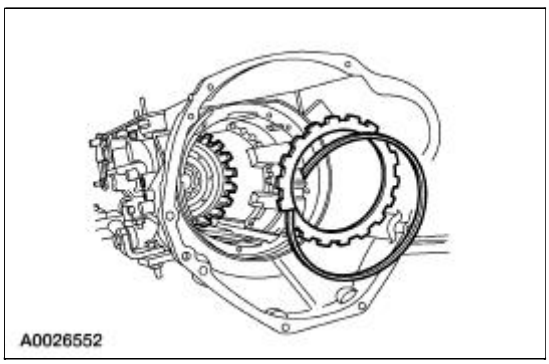
47. To remove the reverse clutch piston, reinstall the reverse clutch pressure plate and the reverse clutch pressure plate retainer snap ring to retain the reverse clutch piston.



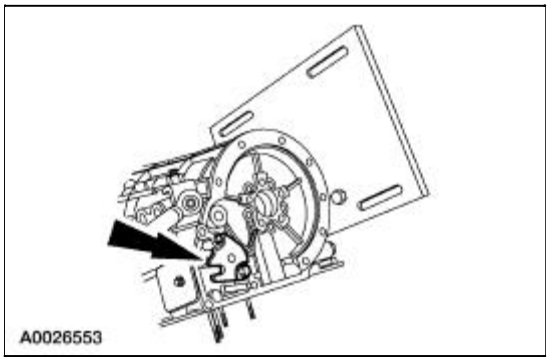
48. Using compressed air, blow into the reverse clutch feed port to blow out the reverse clutch piston against the reverse clutch pressure plate.



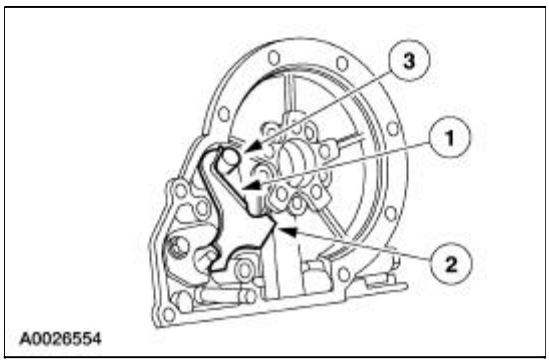
49. Remove the reverse clutch pressure plate retainer snap ring, the reverse clutch pressure plate and the reverse clutch piston.



50. If required, remove the parking rod guide plate.

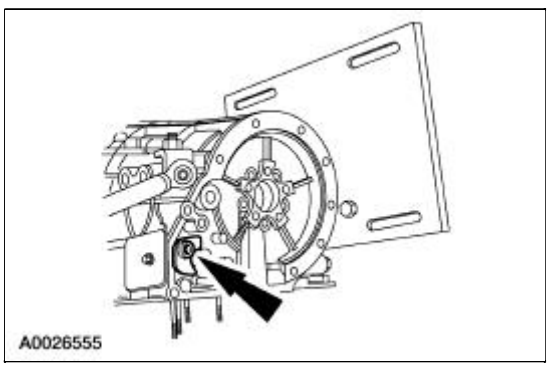


51. If required, remove the parking pawl.
    1. Remove the parking pawl return spring.
    2. Remove the parking pawl.
    3. Remove the parking pawl shaft.



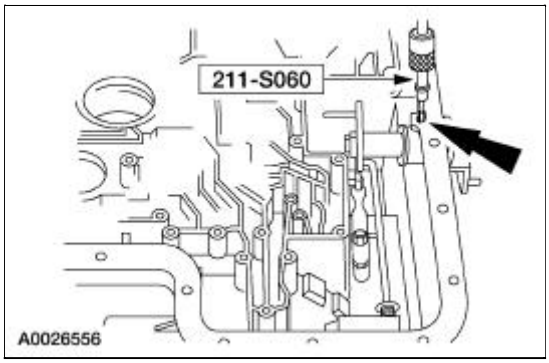
52. **CAUTION: The Torx®-head screw has a threadlocking compound and should be removed only if the case is being replaced. If the bolt is removed, it must be discarded and a new one installed.**

    If required, remove the parking pawl abutment.



53. **NOTE:** A No. 53 drill bit (1/16-inch) can be used instead to capture and remove the manual lever shaft retaining pin.

    Using the special tool, remove the manual lever shaft retaining pin.



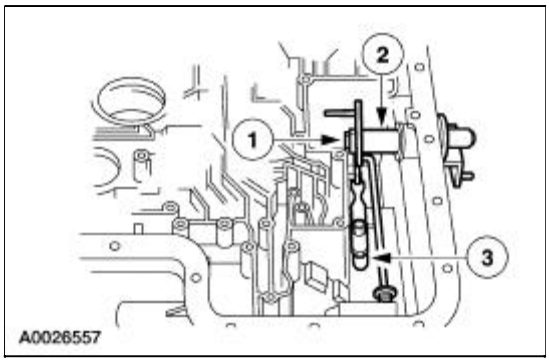
54. **CAUTION: Use care not to damage the manual control lever bore.**

NOTE: The manual control lever and manual control lever shaft are one piece.

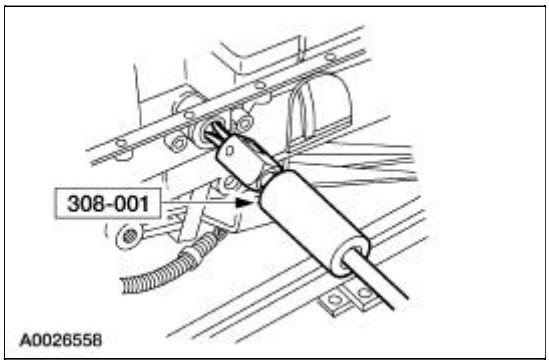
Remove the manual control lever shaft assembly.

1. **NOTE:** Use a crescent wrench on the manual control lever or outer flats of the manual control lever shaft assembly when removing the inner manual valve detent lever nut.

   Remove the nut, the inner manual valve detent lever and the parking pawl actuating rod.
2. Remove the manual control lever shaft assembly.
3. Remove the bolt and the manual control valve detent lever spring.

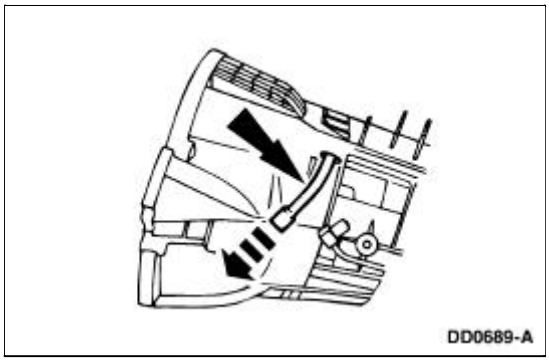


55. Using the special tool, remove the manual control lever seal.



56. **NOTE:** The short fluid inlet tube should be removed only if it is loose or damaged.

If required, remove the short fluid inlet tube.



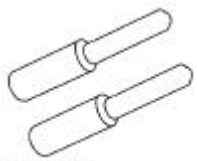
57. Inspect the case assembly for cracks and stripped threads. Inspect the gasket surfaces and mating surfaces for burrs. Check the case vent assembly for obstructions and check all fluid passages for obstructions.

58. Inspect the case assembly bushing for scores. Check all parking linkage parts for wear or damage.

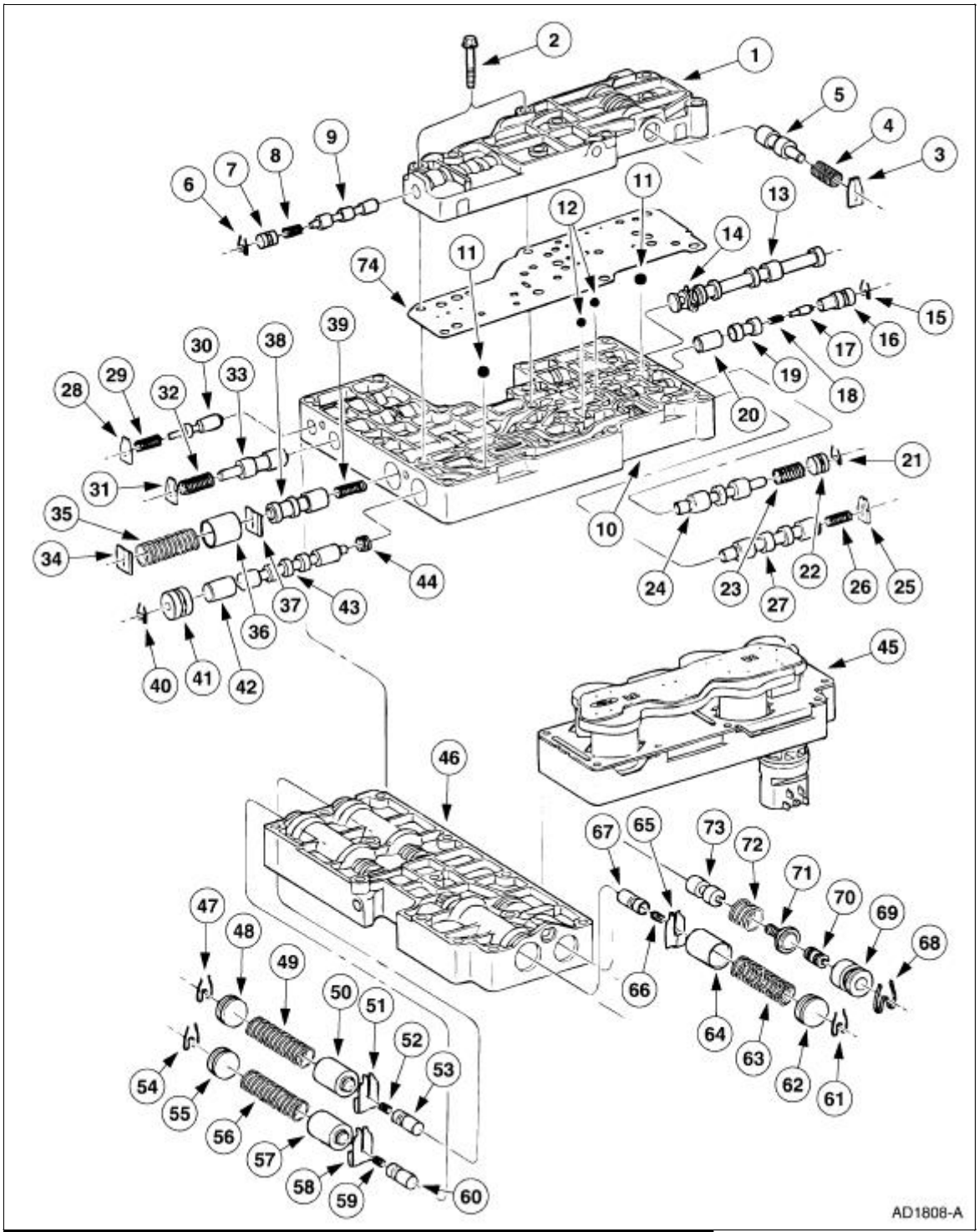
59. If the transmission case assembly thread is damaged, repair kits (helicoil) can be purchased from local jobbers. To repair a damaged thread, follow procedures furnished in the helicoil kit.

Main Control Valve Body —Disassembly and Assembly

Special Tool(s)

 ST2113-C	Aligner, Valve Body 307-359

Upper, Lower, Accumulator and Solenoid Bodies, Disassembled View



Item	Part Number	Description
1	—	Body control valve — lower
2	—	Bolt, M1-1x36 hex flange head (2 req'd)
3	—	Plate, spring retaining
4	—	Spring, shift valve
5	—	Valve, manual 1-2 transition
6	—	Retainer, valve plug
7	—	Plug, valve retainer
8	—	Spring, engagement valve

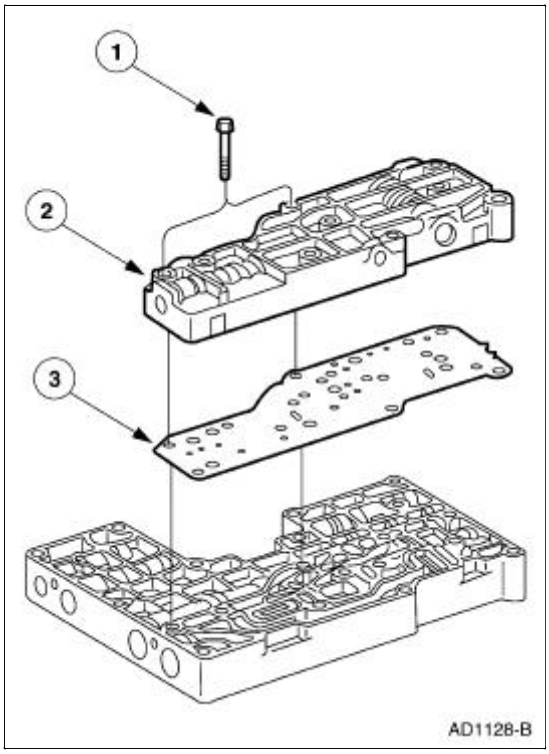
9	—	Valve, control engagement
10	—	Body, control valve — upper
11	7E195	Ball, 5/16-inch shuttle (2 req'd)
12	7E195	Ball, 1/4-inch shuttle (2 req'd)
13	—	Valve, control manual
14	—	Ring, retaining
15	—	Retainer, valve plug
16	—	Sleeve, low/reverse modulator valve
17	—	Plunger, low/reverse modulator valve
18	—	Spring, low servo modulator
19	—	Valve, low servo modulator
20	—	Valve, low/reverse modulator
21	—	Retainer, valve plug
22	—	Plug, valve retaining
23	—	Spring, shift valve
24	—	Valve, 3-4 shift
25	—	Plate, spring retaining
26	—	Spring, 2-3 shift valve
27	—	Valve, 2-3 shift
28	—	Plate, spring retaining
29	—	Spring solenoid regulator valve
30	—	Solenoid, regulator valve
31	—	Plate, spring retaining
32	—	Spring, shift valve
33	—	Valve, coast clutch shift
34	—	Plate, spring retaining
35	—	Spring, 4-3-2 shift timing
36	—	Plunger, control valve shift timing
37	—	Plate, spring retaining
38	—	Valve, 4-3-2 timing
39	—	Spring, 4-3-2 shift timing
40	—	Retainer, valve plug
41	—	Plug, valve retaining
42	—	Valve, 1-2 shift
43	—	Valve, drive 2
44	—	Spring, 1-2 shift valve
45	7G391	Solenoid body assembly (model-dependent)
46	7G422	Accumulator valve body control (model-dependent)
47	—	Retainer, valve plug
48	—	Plug, valve retainer
49	—	Spring, accumulator valve — outer

50	—	Plunger, accumulator regulator
51	—	Retainer, accumulator spring
52	—	Spring, accumulator regulator valve
53	—	Valve, accumulator regulator
54	—	Retainer, valve plug
55	—	Plug, valve retaining
56	—	Spring, accumulator valve — outer
57	—	Plunger, accumulator regulator
58	—	Retainer, accumulator spring
59	—	Spring, accumulator regulator valve
60	—	Valve, accumulator regulator
61	—	Retainer, valve plug
62	—	Plug, valve retaining
63	—	Spring, accumulator valve — outer
64	—	Plunger, accumulator regulator
65	—	Retainer, accumulator spring
66	—	Spring, accumulator regulator valve
67	—	Valve, accumulator regulator
68	—	Retainer, valve plug
69	—	Sleeve, line press modulator
70	—	Plunger, line press modulator
71	—	Spring and retainer assembly, press modulator
72	—	Spring, throttle press line modulator
73	—	Valve, line press modulator
74	7A008	Control valve body separator plate

Disassembly

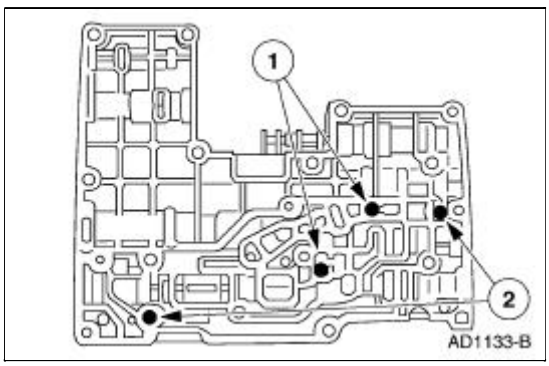
NOTE: If main control is being replaced, refer to the parts catalog for correct parts. The main control is model-dependent.

1. Remove the lower control valve body.
    1. Remove the bolts.
    2. Remove the lower control valve body.
    3. Remove the control valve body separator plate.

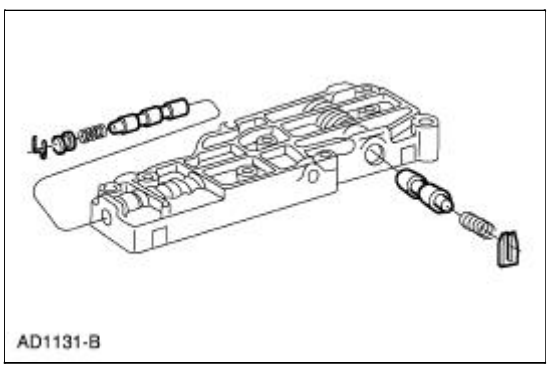


2. **CAUTION: Note the location of the check balls prior to removal. If the check balls are not installed in their correct location, shift problems will occur.**

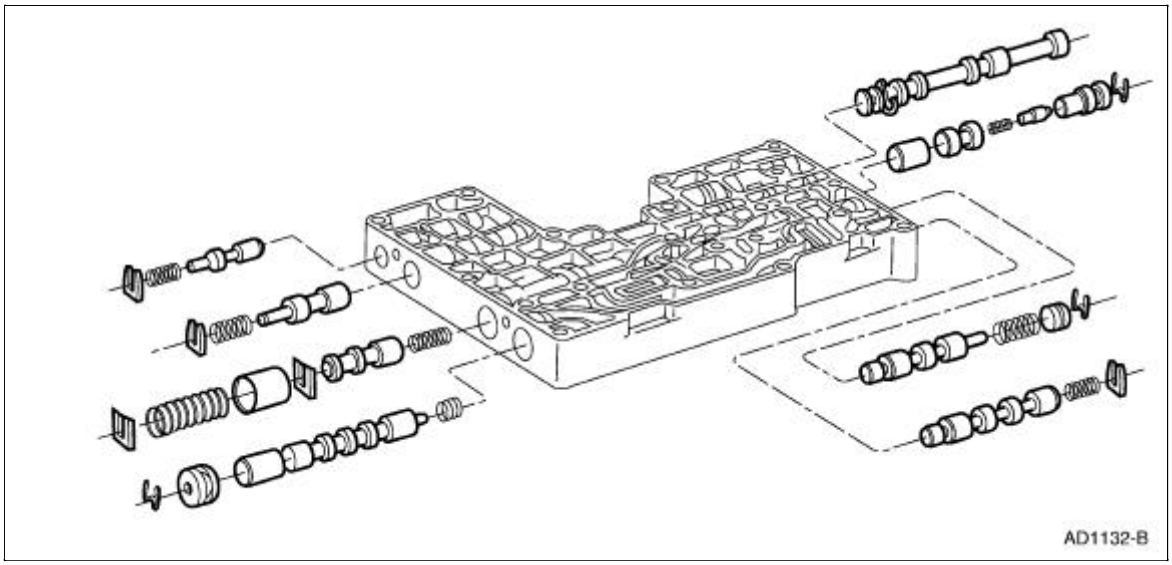
   Remove the check balls.
   1. Remove two small check balls.
   2. Remove two large check balls.



3. Remove the control valves and springs from the lower main control valve body. Inspect the valves for nicks and burrs. If the valves are damaged the main control valve body will need to be replaced.



4. Remove the control valves and springs from the upper main control valve body. Inspect the valves for nicks and burrs. If the valves are damaged, the main control valve body will need to be replaced.



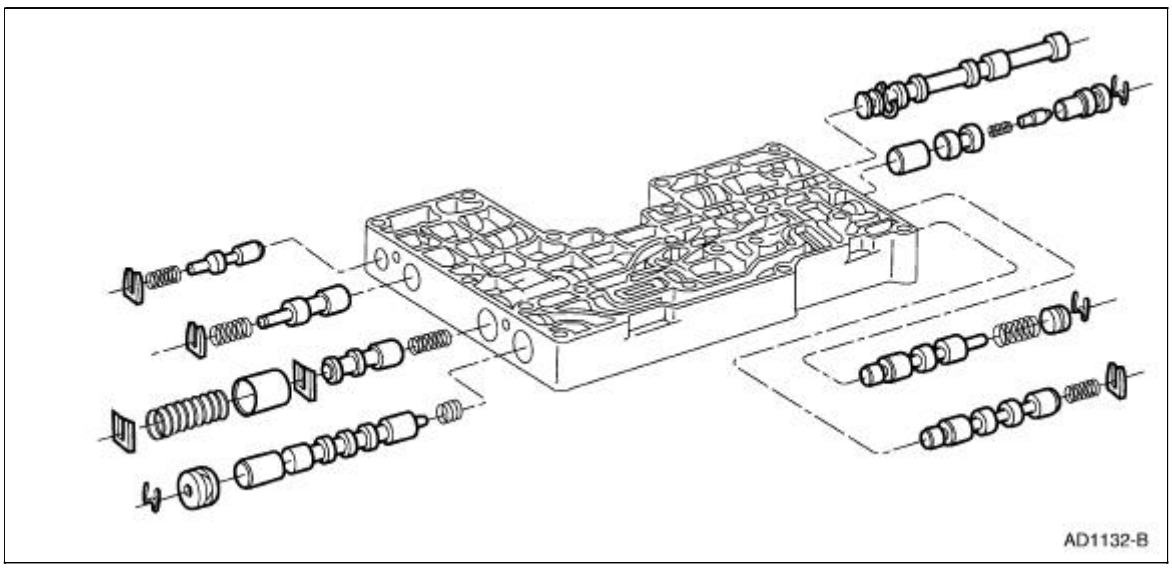
5. Inspect all valves, valve sleeves and valve bores for scores, nicks or burrs. Check all fluid passages for obstructions. Inspect all mating surfaces for burrs and scores.

6. Inspect all springs for distortion. Check all valves and plungers for free movement in their respective bores. When dry all the components must fall from their own weight in their respective bores.

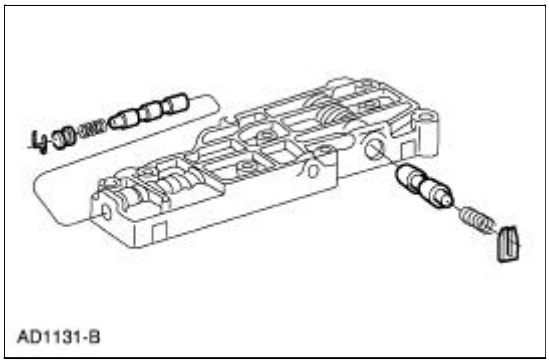
7. Roll the valves on a flat surface to check for bent or out-of-round condition.

Assembly

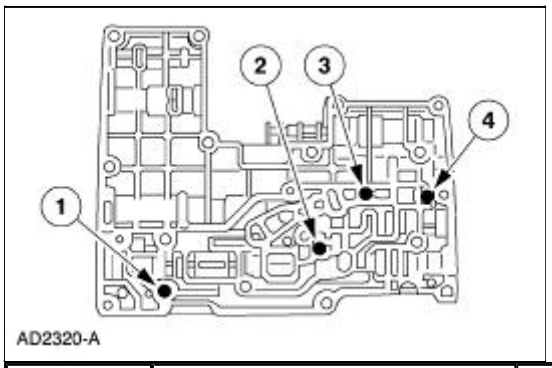
1. Install the control valves and springs from the lower main control valve body.



2. Install the control valves and springs from the upper main control valve body.

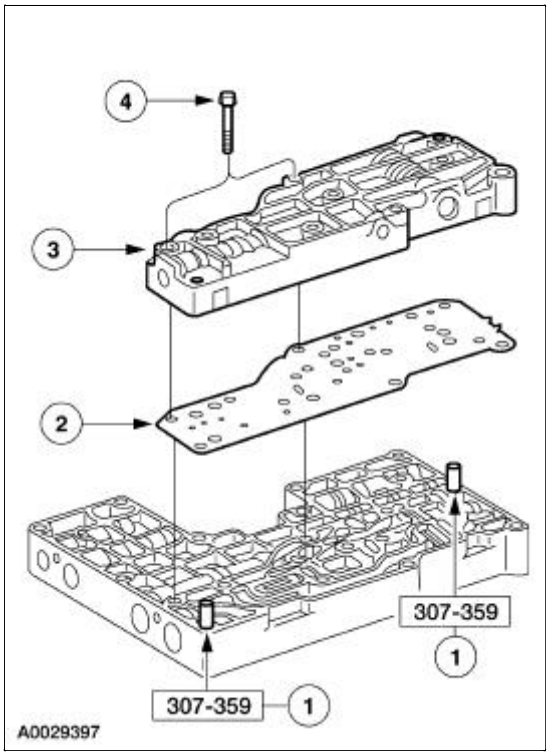


3. Install the check balls.



Item	Part Number	Description
1	CB13	Check ball
2	BS2	Ball shuttle
3	CB16	Check ball
4	CB15	Check ball

4. Using the special tools, install the lower control valve body.
    1. Install the special tools.
    2. Install the control valve body separator plate.
    3. Install the lower control valve body.
    4. Install the bolts.


4
3
2
307-359
1
307-359
1
A0029397

Main Control Valve Body —Solenoid Body Check

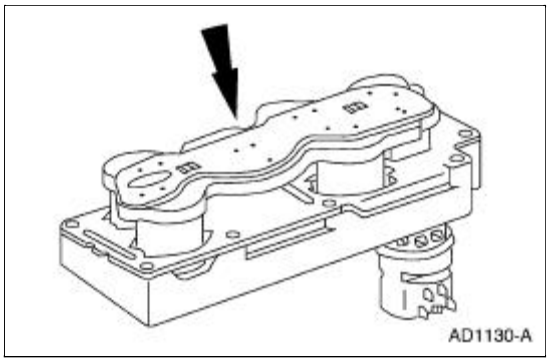
Disassembly

1. **NOTE:** Inspect and test the shift solenoids. Go To Pinpoint Test A .

   NOTE: The solenoid body cannot be disassembled to clean and to inspect for contamination. Contamination is a major source of solenoid body failure. Install a new solenoid body anytime contamination is evident.

   Clean and inspect the solenoid body.

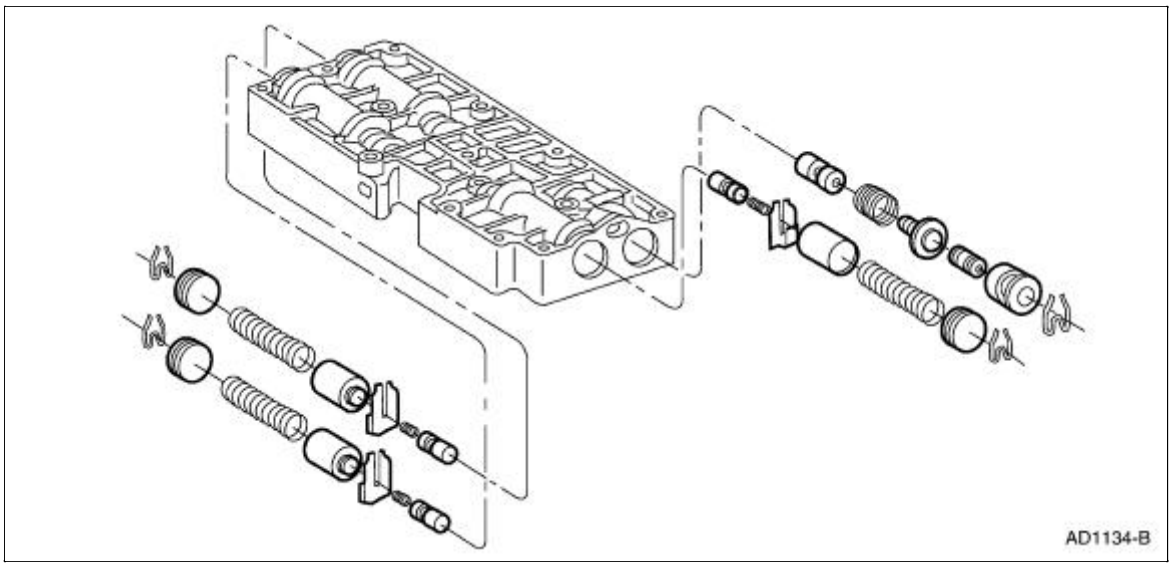
   - Check the connector pins for corrosion and possible bent condition.
   - If large amounts of contamination are present, a new solenoid body will need to be installed.
   - Remove O-ring and discard.
   - Install new O-ring and lubricate with petroleum jelly or equivalent.



Main Control Valve Body —Accumulator Body Check

Disassembly

1. Remove the control valves and springs. Inspect the valves for nicks and burrs. If the valves are damaged, the accumulator body will need to be replaced.

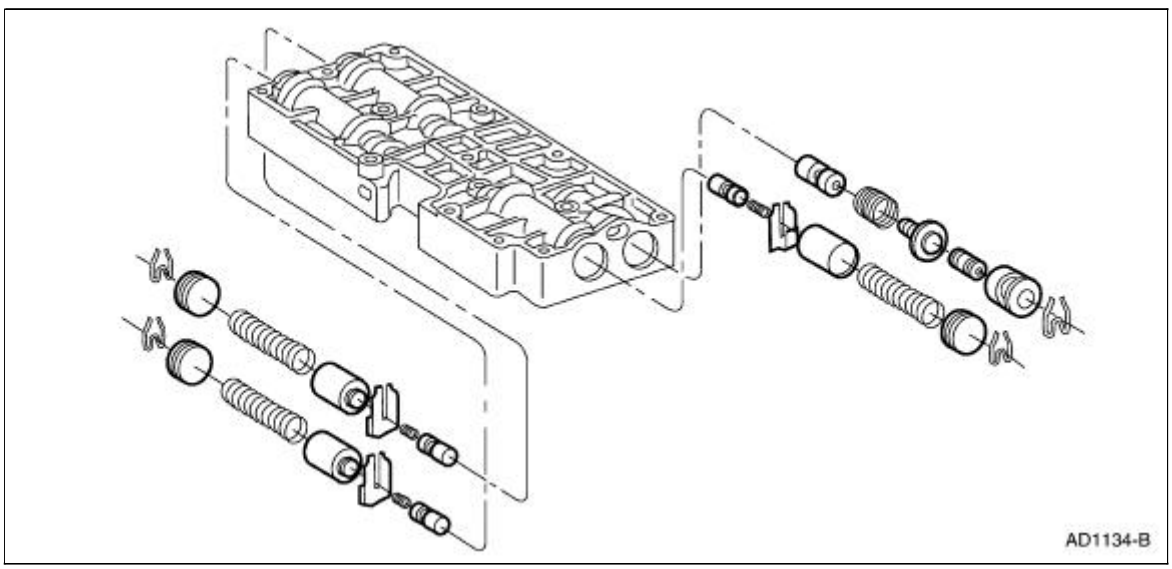


2. Inspect all valves, valve sleeves and valve bores for scores, nick or burrs. Check all fluid passages for obstructions. Inspect all mating surfaces for burrs and scores.

3. Inspect all springs for distortion. Check all valves and plungers for free movement in their respective bores. When dry, all the components must fall from their own weight in their respective bores.

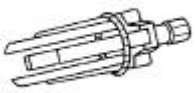
Assembly

1. Install the control valves and springs.



Pump Assembly

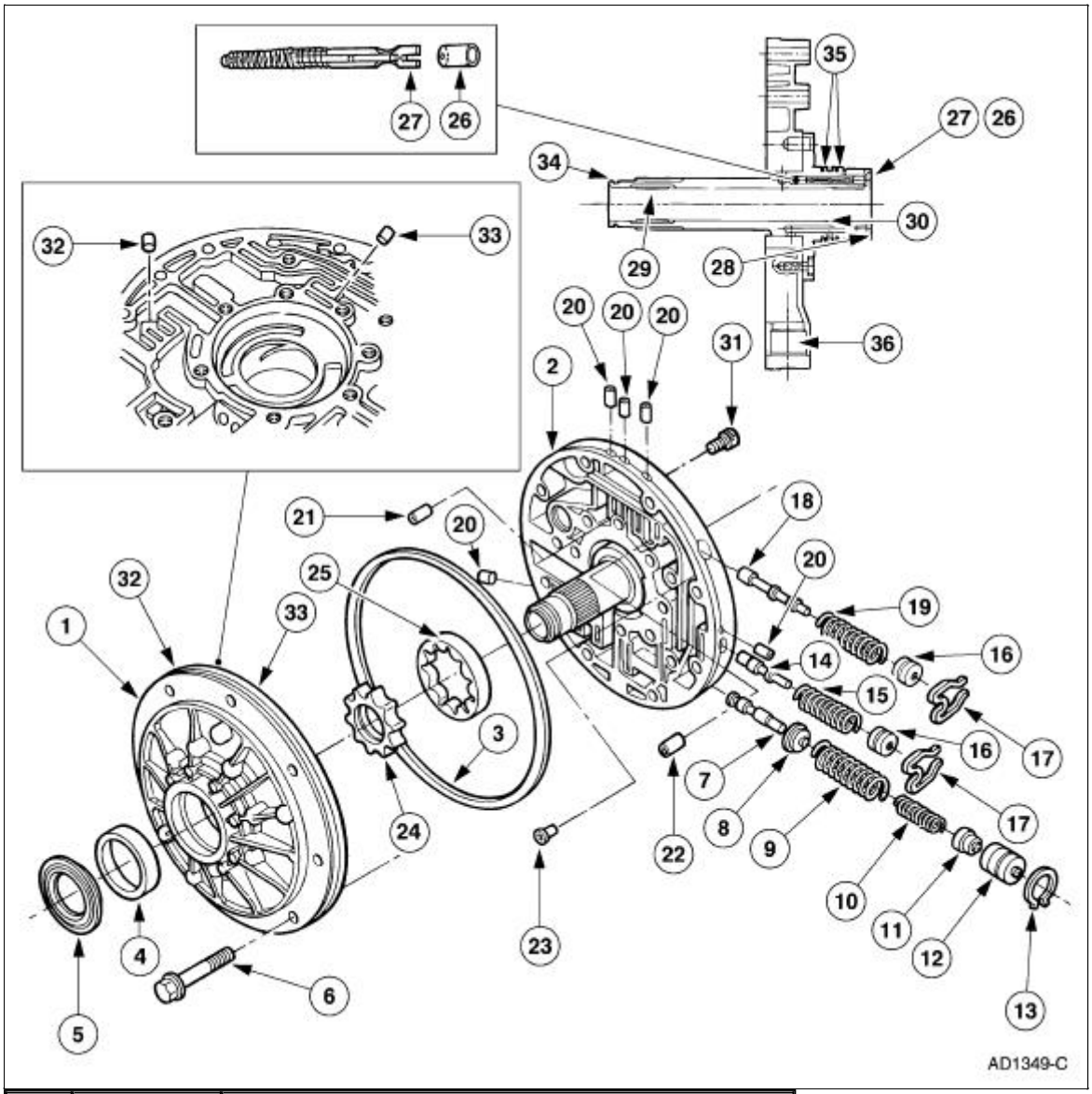
Special Tool(s)

 ST1189-A	Installer, Front Pump Fluid Seal 307-014 (T63L-77837-A)
 ST1187-A	Slide Hammer 307-005 (T59L-100-B)
 ST1664-A	Banding Tool, Transmission Pump 307-D004 (D89L-77000-A) or equivalent
 ST1213-A	Remover, Bushing 307-001 (TOOL-1175-AC) or equivalent
 ST1274-A	Depth Micrometer 303-D026 (D80P-4201-A) or equivalent

Material

Item	Specification
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®

Pump Assembly, Disassembled View



Item	Part Number	Description
1	—	Pump body (part of 7A103)
2	—	Control body (part of 7A103)
3	7A248	Square-cut front pump seal
4	—	Converter hub bushing
5	7A248	Front pump seal
6	N805260-S	Bolt and washer assembly (9 req'd)
7	—	Main regulator valve (part of 7A103)
8	—	Spring retainer (part of 7A103)
9	—	Outer spring (part of 7A103)
10	—	Inner spring (part of 7A103)
11	7D003	Main regulator booster valve
12	—	Main regulator booster sleeve (part of 7D003)
13	—	Retainer clip (part of 7A103)
14	—	Converter regulator valve (part of 7A103)

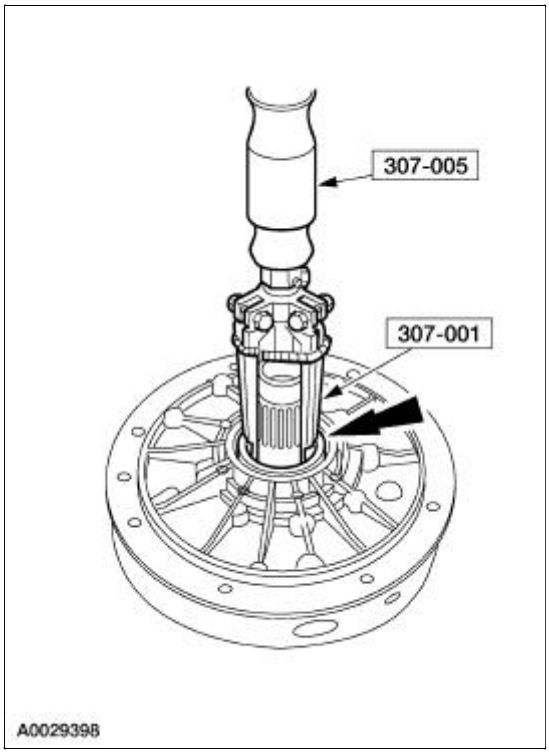
15	—	Spring (part of 7A103)
16	—	End plug (part of 7A103)
17	—	Retainer clip (part of 7A103)
18	—	Converter clutch control valve (part of 7A103)
19	—	Spring (part of 7A103)
20	—	Solid cup plug (part of 7A103)
21	—	Orificed cup plug (part of 7A103)
22	—	Orificed cup plug (part of 7A103)
23	—	Air bleed check valve assembly (part of 7A103)
24	—	Inner gerotor gear (part of 7A103)
25	—	Outer gerotor gear (part of 7A103)
26	—	Orifice cup plug (part of 7H132)
27	7H132	Spring and stop assembly
28	—	Orifice cup plug (part of 7A103)
29	—	Front input shaft bushing (part of 7A103)
30	—	Rear input shaft bushing (part of 7A103) or bearing (vehicle-dependent)
31	—	Bolt, M8 (11 req'd) (part of 7A103)
32	—	Orificed cup plug (part of 7A103)
33	—	Orificed cup plug (part of 7A103)
34	7L323	Front pump stator support seal
35	7G402	Coast clutch seal (2 req'd)
36	—	Inlet tube bore (part of 7A103)

Disassembly

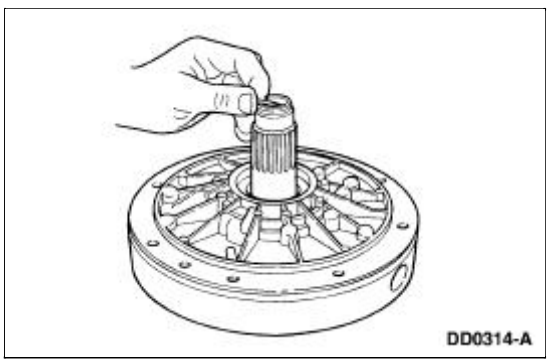
CAUTION: The pump assembly is vehicle-dependent. Failure to use the correct pump may cause transmission assembly damage. For additional information, refer to the parts catalog for the correct pump.

1. **NOTE:** Inspect and install a new front pump seal, if damaged.

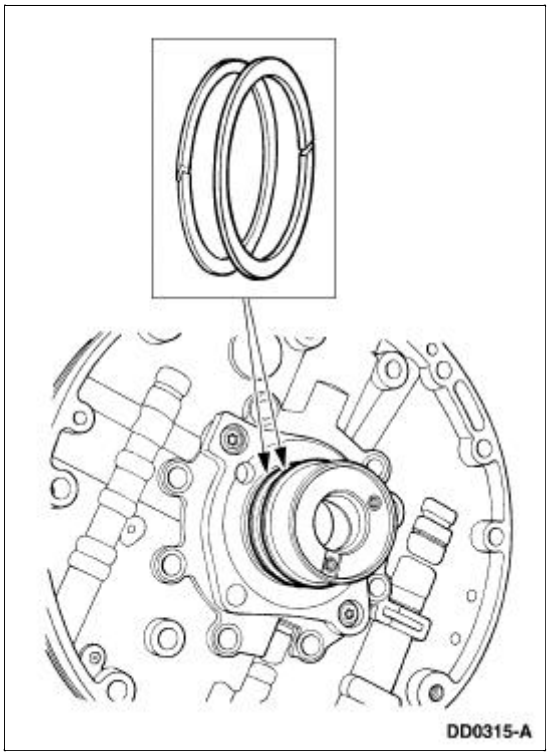
   Using the special tools, remove the front pump seal.



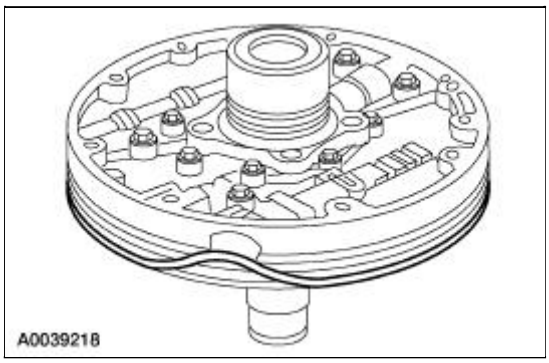
2. Remove the front pump stator support seal.



3. Remove the two Teflon® coast clutch seals.



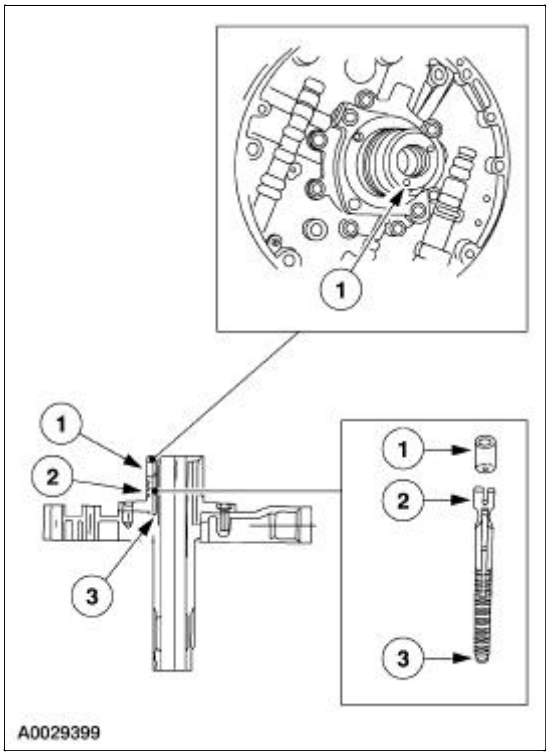
4. Remove the pump outer diameter square-cut front pump seal.



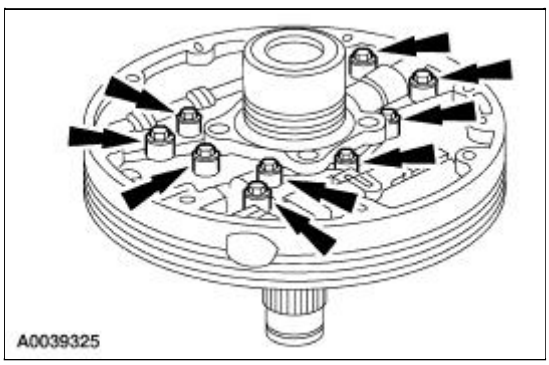
5. **CAUTION: Do not reuse the orifice cup plug or spring and stop assembly. Failure to install new parts may cause repeat repairs. Make sure the old rubber stop is removed (it may become separated from the spring assembly).**

   CAUTION: Use care not to damage any machined surfaces of the stator support.

   Remove and discard the orifice cup plug and the spring and stop assembly. Clean and inspect the bore, making sure it is clean of any debris.
   1. Remove the orifice cup plug.
   2. Remove the spring and stop assembly.
   3. Remove the old rubber stop.



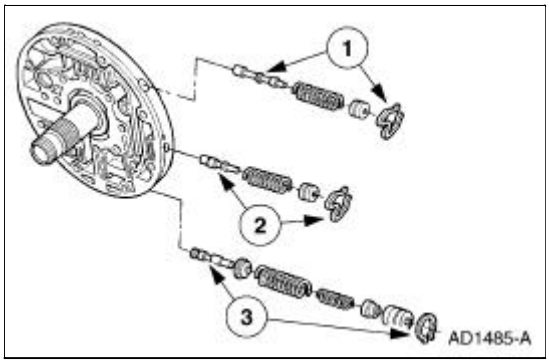
6. Remove 12 bolts and separate the pump control body from the pump body.



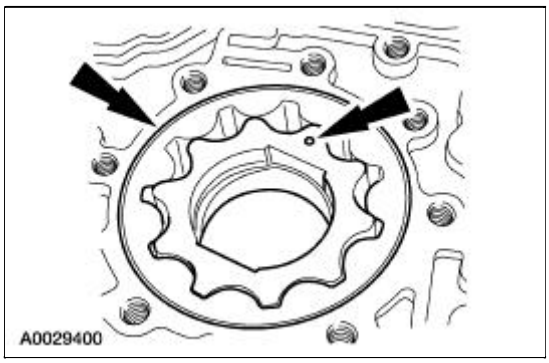
7. **CAUTION: Do not remove any of the remaining cup plugs unless directed to do so in other steps. Do not remove the stator support from the control body. This can distort the surface of the control body.**

   NOTE: Inspect the main regulator booster valve and sleeve assembly. If the pump valve bore is not damaged but the valve and sleeve are worn, install a new valve and sleeve. For additional information, refer to Pump Assembly , Disassembled View.

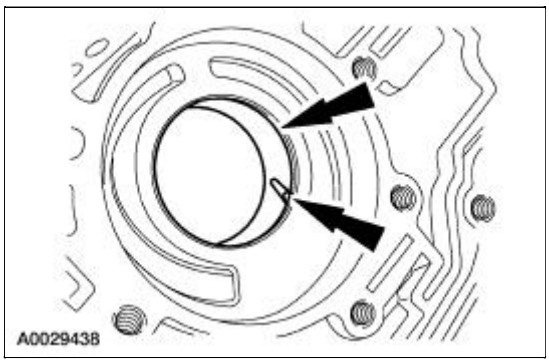
   Remove the converter clutch shift valve assembly, converter regulator valve assembly, and main regulator boost valve and sleeve assembly.
   1. Remove the retainer clip with a small screwdriver or tweezers, then remove the converter clutch shift valve assembly.
   2. Remove the retainer clip with a small screwdriver or tweezers, then remove the converter regulator valve assembly.
   3. Remove the retainer clip with a small screwdriver or tweezers, then remove the main regulator valve assembly.



8. Remove and inspect the inner and the outer gerotor gears.
    - Clean all pump parts in solvent.
    - Dry the parts with compressed air.
    - Inspect the pump gears, faces, gear teeth, pump housing and mating surfaces for damage or scoring.
    - Replace the entire pump if any part is damaged or worn.

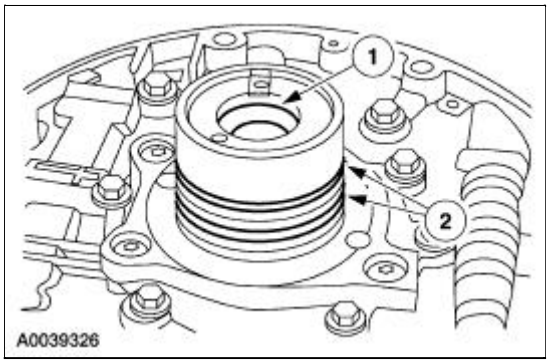


9. Inspect the converter hub bushing. If scored or excessively worn, replace the entire pump. Note the orientation of the lube groove.

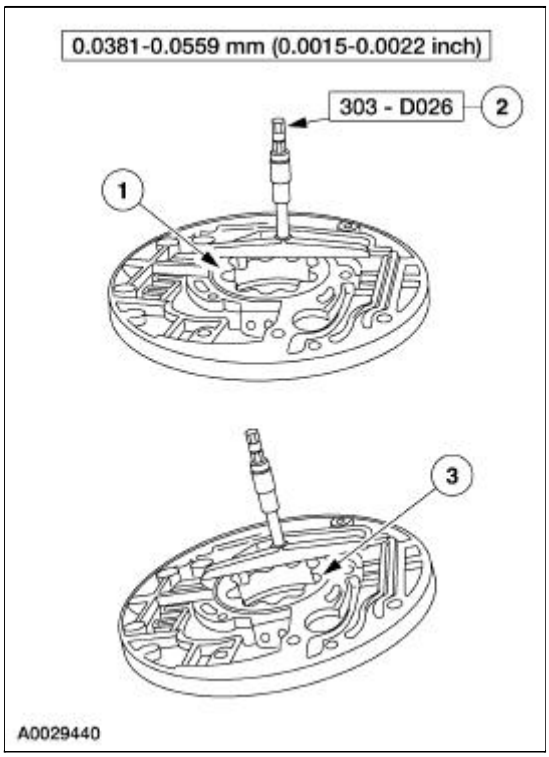


10. **NOTE:** The pump assemblies are model-dependent. Refer to the parts catalog for correct usage.

    Remove the coast clutch seals and discard.
    1. Inspect the bushing for wear. If scored or worn, replace the entire pump.
    2. Remove the coast clutch seals.



11. Measure and record the depth of the inner, then the outer, pump gerotor gear face-to-pump body machined surface.
    1. Place the pump gerotor gearset into the pump gear pocket and center it to the pump bushing diameter.
    2. Using the special tool, measure and record the depth of the inner gerotor gear face to the pump body machined surface. Repeat measurement for a total of three readings in equally spaced locations on the gear face. If the reading is not within specification, install a new front pump assembly.
    3. Remove the inner gear and reinstall the outer gear. Repeat Substep 2 for the outer gerotor gear face.



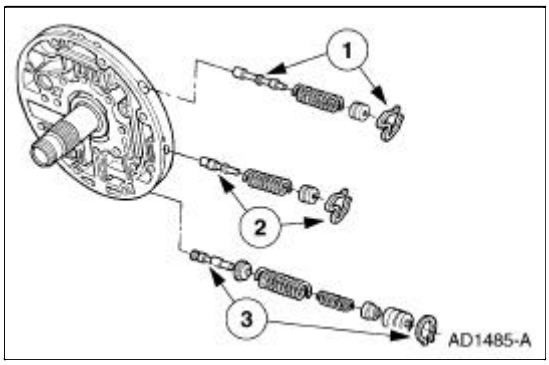
12. Inspect the following:
    - All valve and plug bores for scoring or damage.
    - All passages for obstructions.
    - Mating surfaces for burrs and scoring.
    - All springs for distortion.
    - When dry, check all valves and plugs for free movement in their respective bores.

Assembly

1. Install the main regulator valve and sleeve assembly, converter clutch shift valve assembly, and

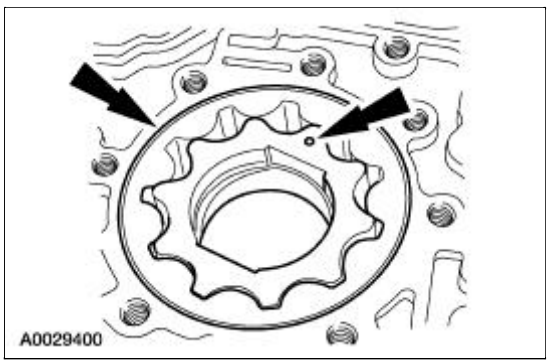
the converter regulator valve assembly.

1. Install the converter clutch control valve assembly. Then apply pressure to the end plug and install the retainer, making sure it is correctly seated.
2. Install the converter regulator valve assembly. Then apply pressure to the end plug and install the retainer, making sure it is correctly seated.
3. Install the main regulator boost valve and sleeve assembly. Then apply pressure to the main regulator booster sleeve and install the retainer, making sure it is correctly seated.



2. **NOTE:** Prior to installation, lightly lubricate the gerotor gears with clean automatic transmission fluid.

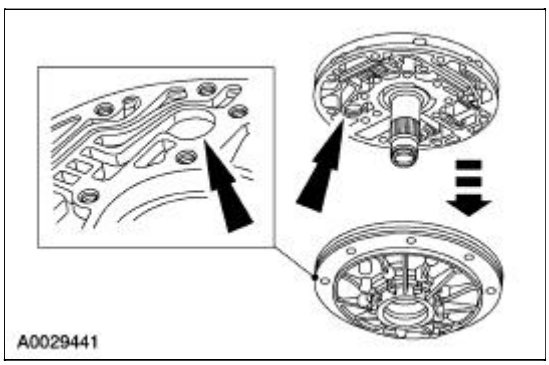
   Install the gerotor gearset, with the dot facing the control body assembly.



3. **CAUTION: Prior to pump assembly, make sure all cup plugs are installed.**

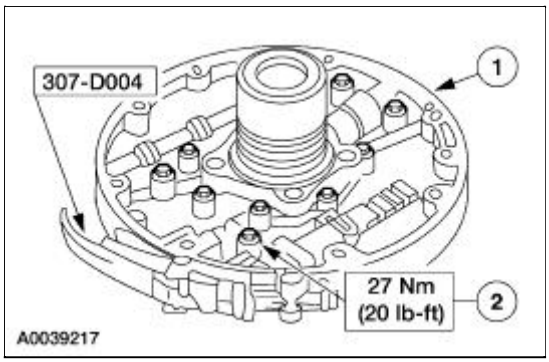
   CAUTION: Inspect mating surfaces of the pump body and the control body to make sure they are clean and free of nicks and burrs.

   Assemble the control body and stator assembly onto the pump body, aligning the 28 mm (1.12 in) hole in each body.



4. **NOTE:** Make sure that the outer edges of the pump body and the outer bolt holes are aligned during assembly.

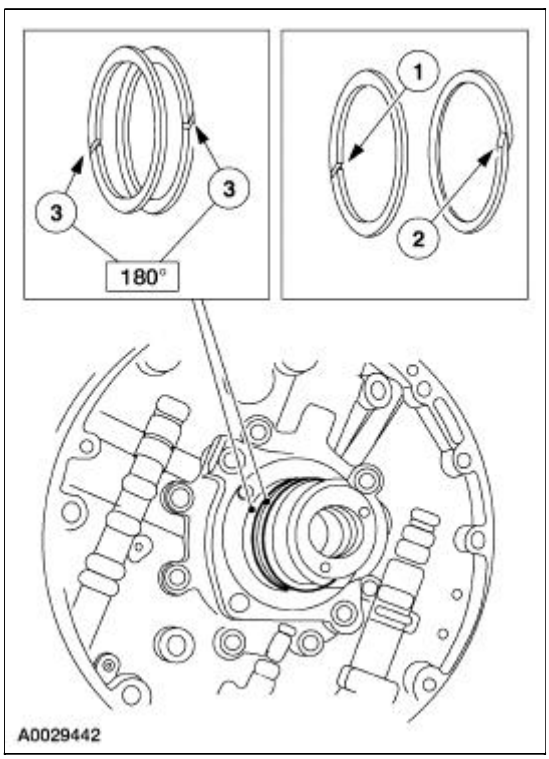
   Using the special tool, assemble the pump and loosely install 11 bolts.
   1. Install the 10 mm (0.4 in) alignment bolt.
   2. Tighten the bolts.



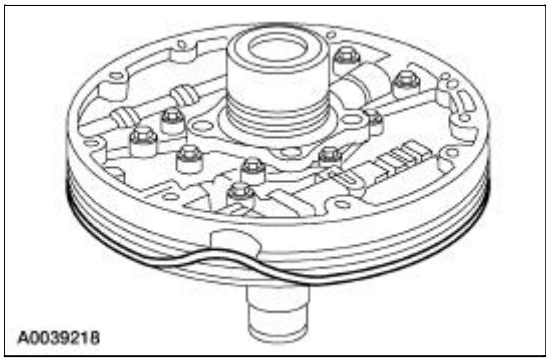
5. **CAUTION: Make sure the seal grooves in the stator support are clean and free of burrs.**

   CAUTION: Make sure the seal ends are correctly positioned together and not separated.

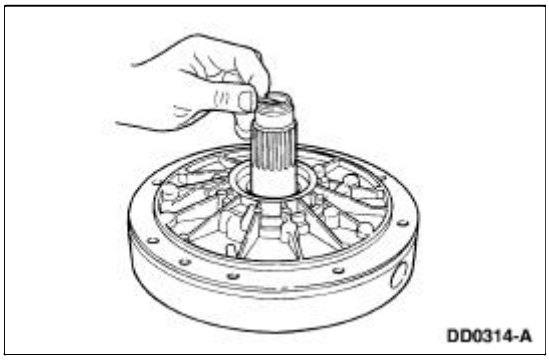
   Install the 2 coast clutch Teflon® seals. Make sure the seals are fully seated in the stator support seal grooves and the seal ends are oriented 180 degrees apart.
   1. Correct position of the seal ends.
   2. Incorrect position of the seal ends.
   3. Seals need to be installed 180 degrees apart.



6. Install the pump outer diameter square-cut front pump seal.



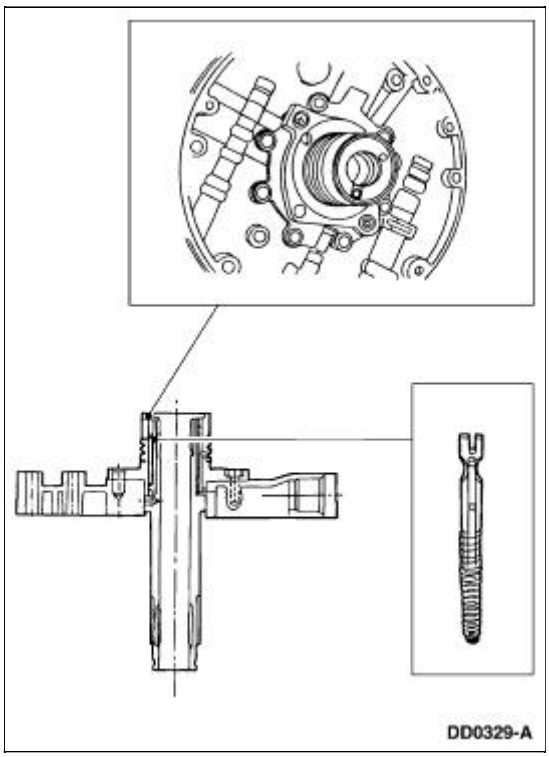
7. Install the front pump stator support seal.



8. **CAUTION: Failure to install new parts may cause repeat repairs.**

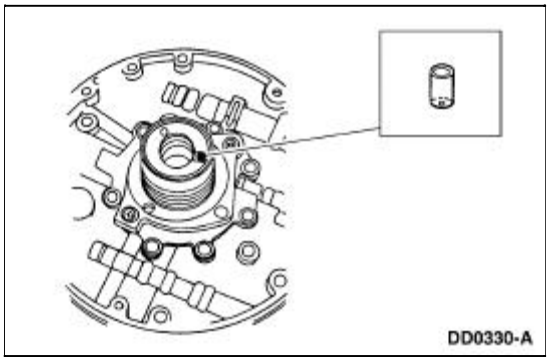
   NOTE: Install the rubber stop end into the bore first.

   Install the new spring and stop assembly.

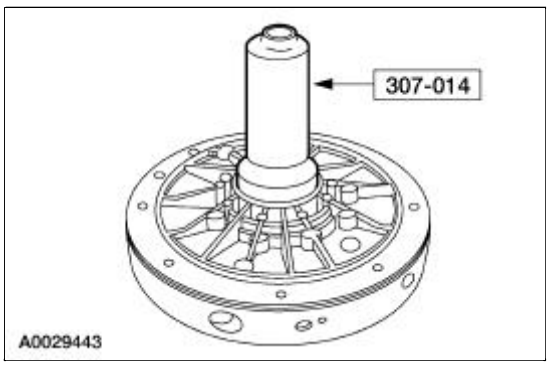


9. **NOTE:** Make sure the edge of the cup plug is seated just below the stator support surface that mates with the No. 2 needle bearing assembly.

Using a small drift and mallet, install the new orifice cup plug.

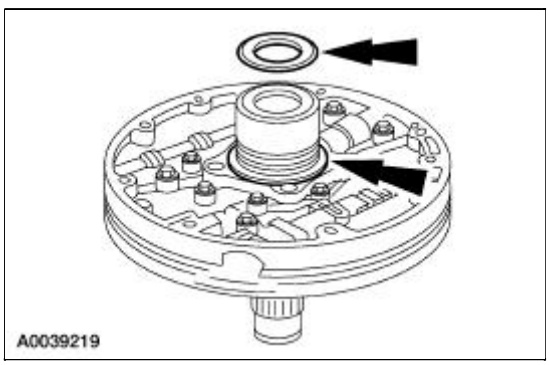


10. If removed, install the front pump seal, using the special tool.



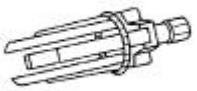
11. **NOTE:** Lightly lubricate the thrust washer and the bearing with petroleum jelly to hold them in place during assembly.

    Install the No. 1 pump thrust washer and the No. 2A overdrive sun gear thrust bearing.



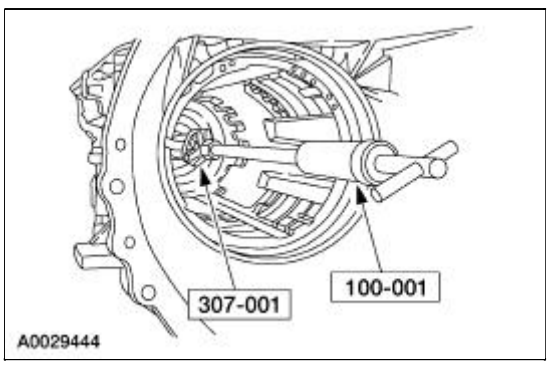
Front Case Bushings

Special Tool(s)

 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
 ST1360-A	Drawbar, (Heavy Duty Threaded) 204-029 (T77F-1176-A)
 ST1213-A	Remover, Bushing 307-001 (TOOL-1175-AC) or equivalent
 ST1856-A	Installer, Transmission Extension Housing Bushing 307-258 (T92T-77110-AH)

Disassembly

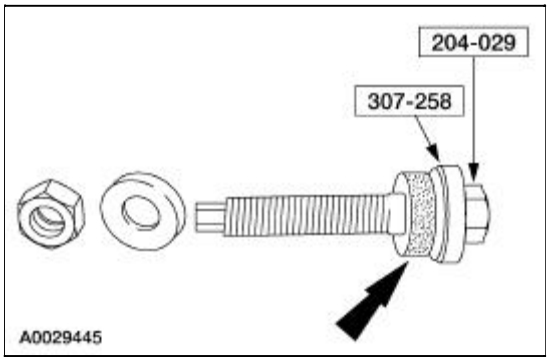
1. Using the special tools, remove the front case bushing.



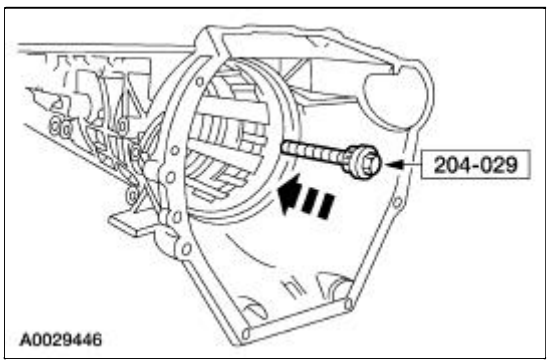
Assembly

1. **NOTE:** The front case bushing has three lube grooves. The rear case bushing has one lube groove.

Install the front case bushing onto the special tool.

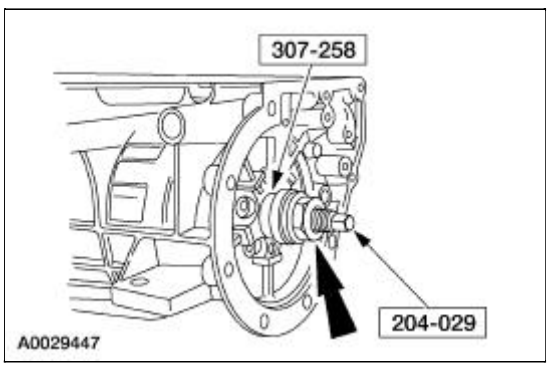


2. Place the special tool with the front case bushing through the case and into the rear case bushing.

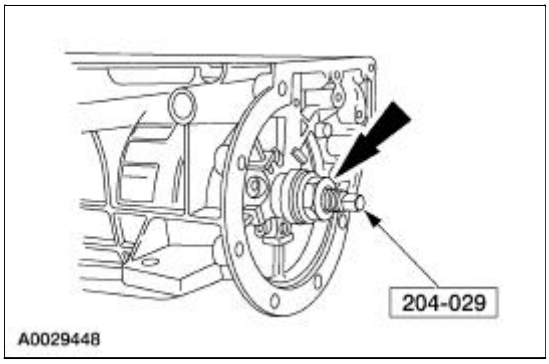


3. **CAUTION: Make sure the bushing and tool are centered in the bore.**

   Install the special tool, then install the washer and the nut hand-tight.

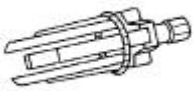


4. Hold the special tool while turning the nut until the front case bushing is fully seated. Remove the tools.


204-029
A0029448

Rear Case Bushings

Special Tool(s)

 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
 ST1360-A	Drawbar, (Heavy Duty Threaded) 204-029 (T77F-1176-A)
 ST1213-A	Remover, Bushing 307-001 (TOOL-1175-AC) or equivalent
 ST1856-A	Installer, Transmission Extension Housing Bushing 307-258 (T92T-77110-AH)

Disassembly

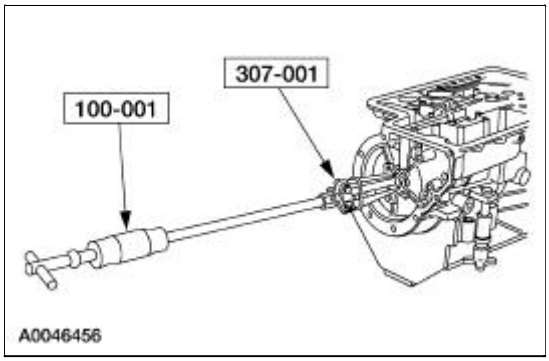
1. **NOTE:** Remove any minor nicks or burrs using a fine oil stone. Remove the case bushings only if they show signs of excessive wear or scoring.

   Inspect the case bushing bores for nicks or burrs.

2. **CAUTION: Be careful not to damage the case bore while removing the bushing.**

   NOTE: Always replace both bushings when either bushing is replaced. However, remove and replace only one bushing at a time. Use the other bushing in the case to help align the tool and replacement bushing during installation.

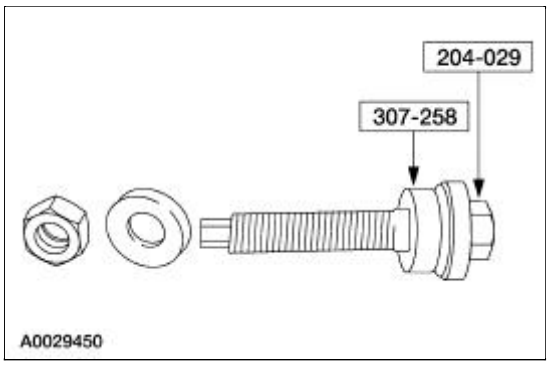
   Using the special tools, remove the rear case bushing.



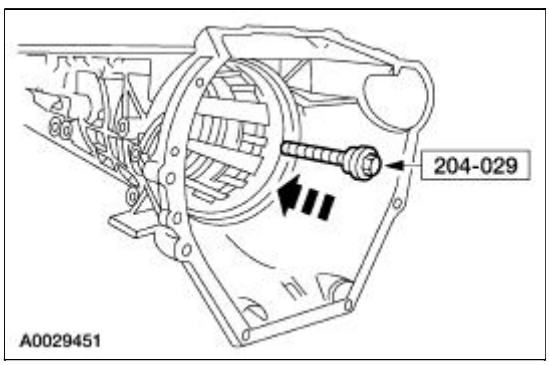
Assembly

1. **NOTE:** The rear case bushing has one lube groove. The front case bushing has three lube grooves.

   Assemble the special tools.

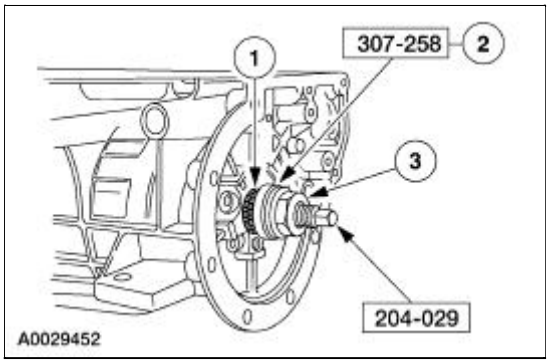


2. Place the assembled special tools through the case and into the front case bushing.

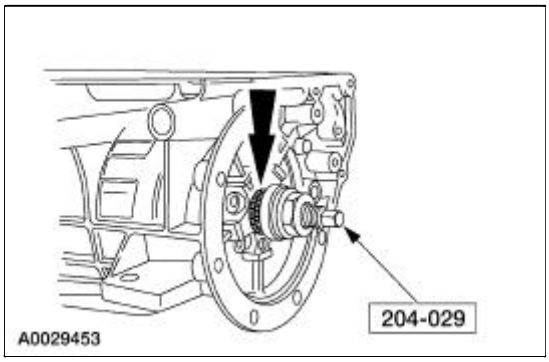


3. **CAUTION: Make sure the bushing and tool are centered in the bore.**

   Install the rear case bushing.
   1. Install the rear case bushing over the special tool into the case.
   2. Install the special tool.
   3. Install the washer and the nut hand-tight.



4. Hold the special tool while turning the nut until the rear case bushing is fully seated. Remove the tools.



Cooler Bypass Valve Assembly

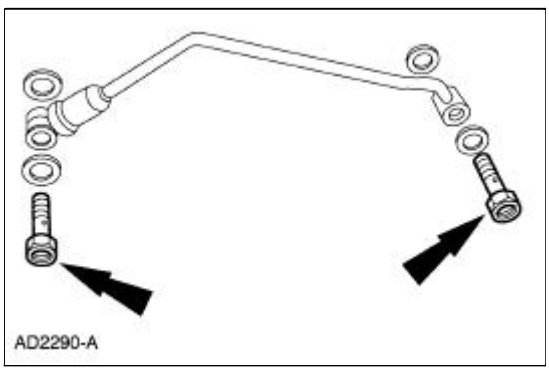
Special Tool(s)

 ST1859-A	Oil Flusher Cooler Kit 303-F053 (014-00752) or equivalent

Disassembly

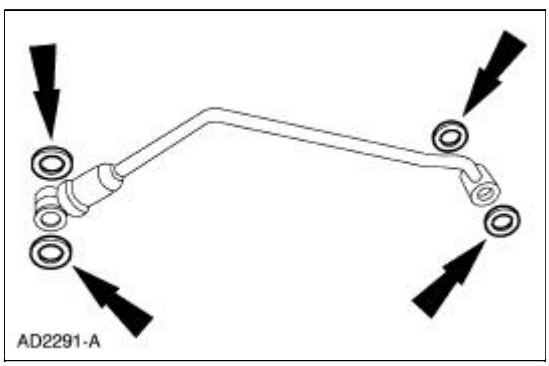
NOTE: The cooler bypass valve (CBV) needs to be thoroughly cleaned and flushed out at this time.

1. Remove and inspect the cooler line case fittings. If the cooler line case fittings are damaged, install new cooler line case fittings.

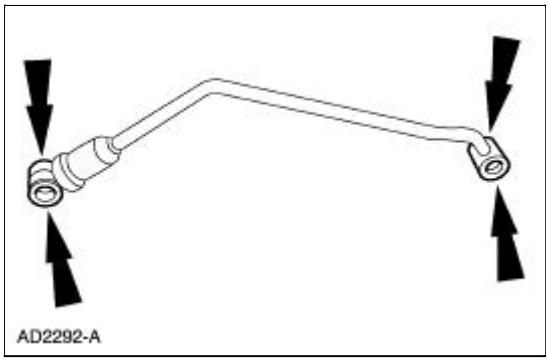


2. **NOTE:** Damaged sealing washers will cause transmission fluid to leak at the CBV.

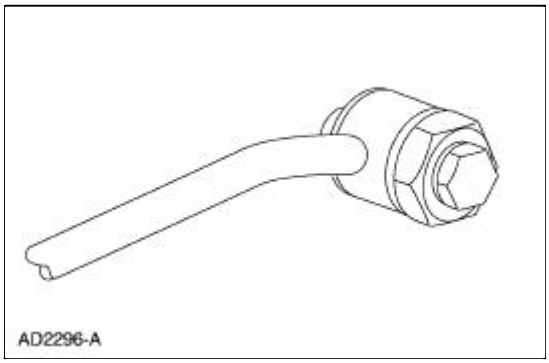
   Remove the rubber-coated sealing washers. Inspect the sealing washers. Install new as required.



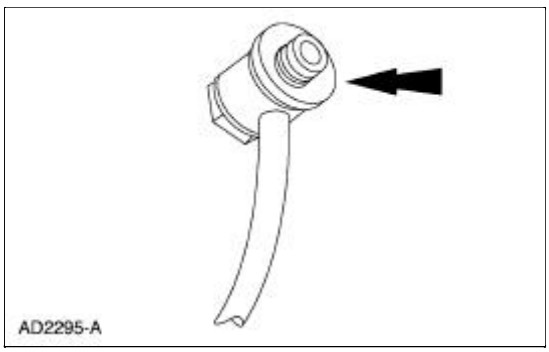
3. Inspect the sealing ends of the CBV. If the valve assembly is damaged, install a new CBV assembly.



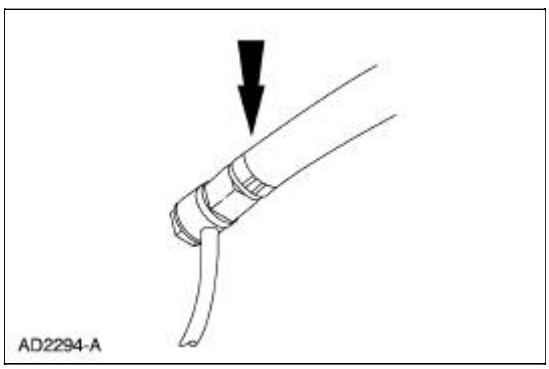
4. Assemble the CBV and plug the converter-out-to-cooler inlet with a 13 x 1.5 mm (0.06 in) plug.



5. Place a 0.5-inch flatwasher over the case converter-out fitting threads over the rubber coated sealing washer.

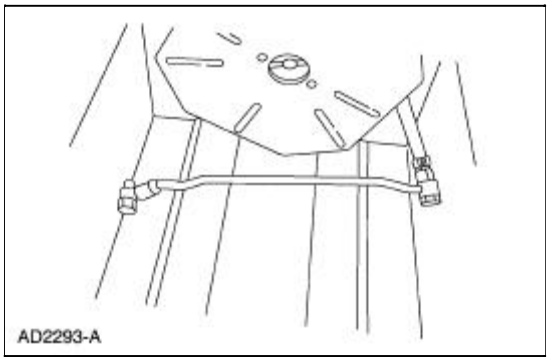


6. Connect the cleaner pressure line to the case converter-out fitting.



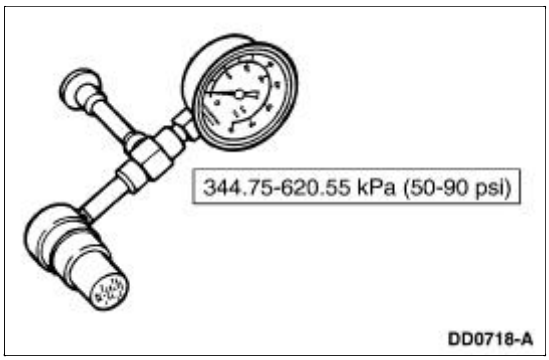
7. **CAUTION: Make sure the CBV is in the solvent tank before switching on the solvent pump. Also make sure the CBV fitting is pointing downward so the solvent does not spray up out of the tank.**

Place the CBV into the solvent tank.

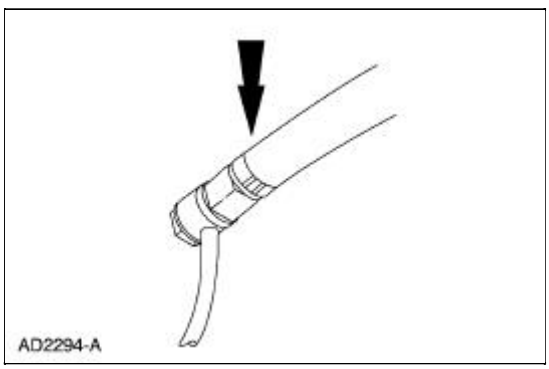


8. **CAUTION: The solvent pressure must be at least 344.75 kPa (50 psi) (minimum) to overcome the valve inside the CBV and let the solvent pass through it. Do not, however, exceed 620.55 kPa (90 psi) (maximum) solvent pressure.**

   Regulate the solvent pressure as specified. Switch on the solvent pump allowing the solvent to circulate through the CBV for 5 minutes. During this time, cycle the solvent pump on and off to help dislodge contaminants.

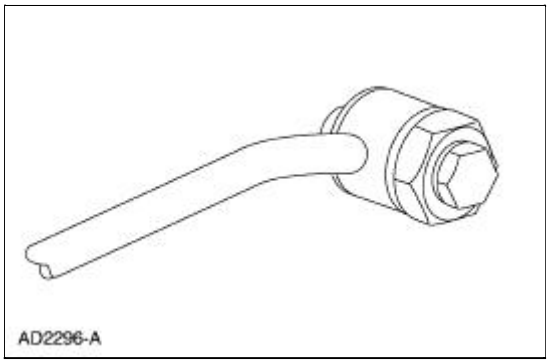


9. Disconnect the cleaner pressure line from the case converter-out fitting. Remove the 0.5-inch washer.



10. Using 344.75-620.55 kPa (50-90 psi) of regulated compressed air, blow through the CBV until all solvent is removed.

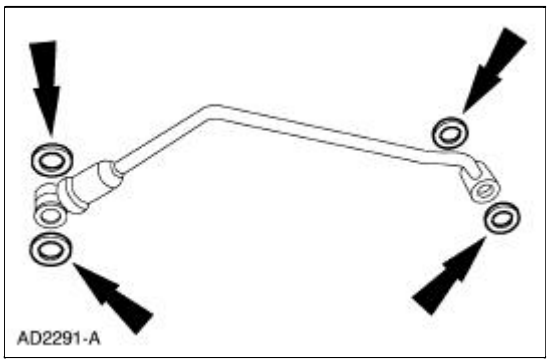
11. Remove the plug from the CBV converter-out-to-cooler inlet.



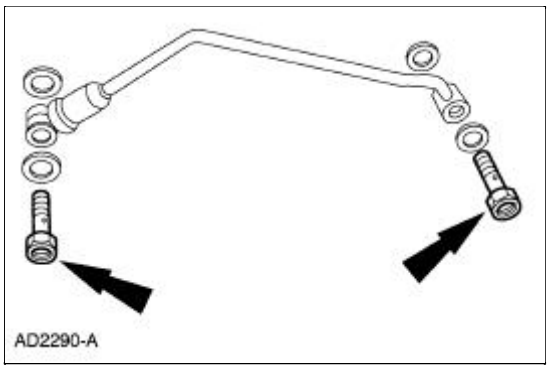
Assembly

1. **CAUTION: Failure to correctly install the new rubber-coated sealing washers will result in transmission fluid leaks.**

   Install new rubber-coated sealing washers.



2. Install new cooler line case fittings.



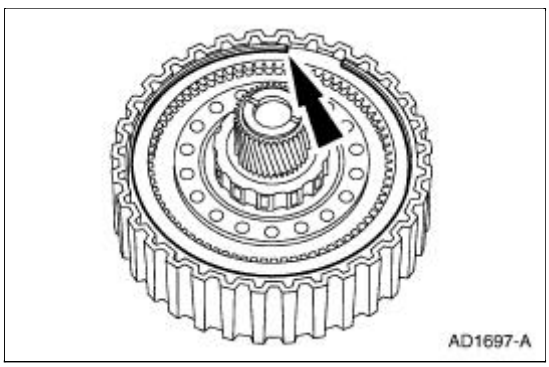
Coast Clutch Assembly

Special Tool(s)

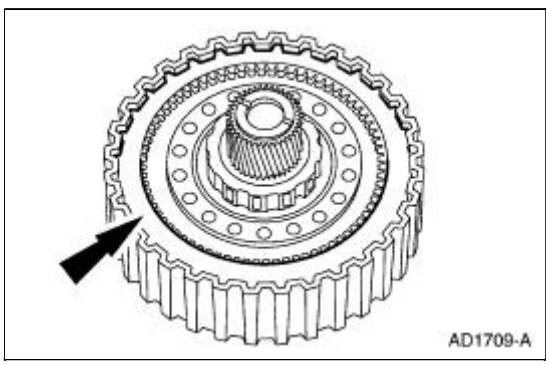
 ST1190-A	Compressor, Clutch Spring 307-015 (T65L-77515-A)
 ST1204-A	Protector, Clutch Piston Seal 307-387

Disassembly

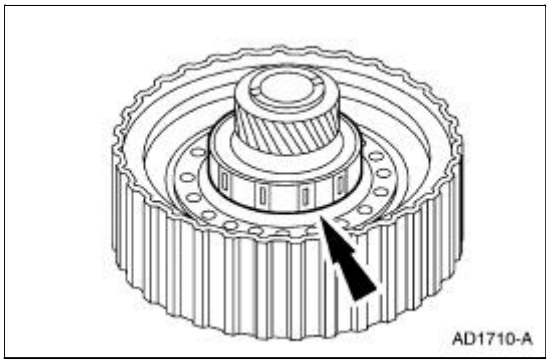
1. Remove the retaining ring.



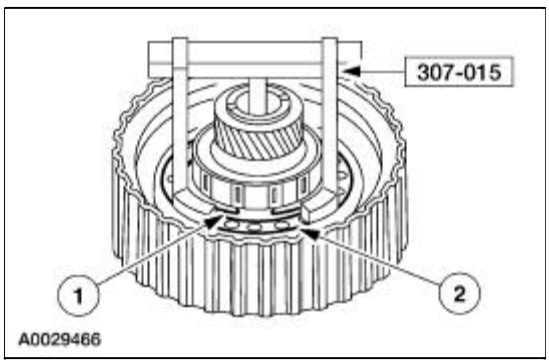
2. Remove the coast clutch pressure plate and the clutch plates.



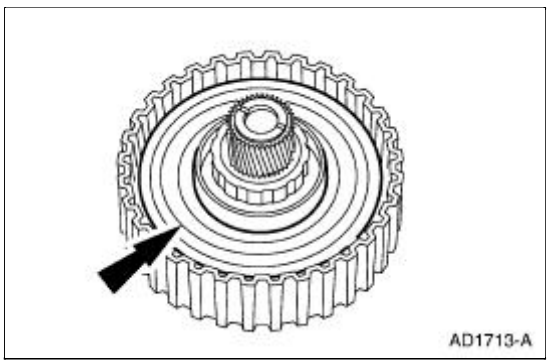
3. Inspect the overdrive one-way clutch (OWC) for damage to the plastic cage, springs, and rollers. Replace as necessary. Remove the overdrive one-way clutch.



4. Using the special tool, remove the coast clutch return spring.
    1. Remove the retaining ring.
    2. Remove the return spring.

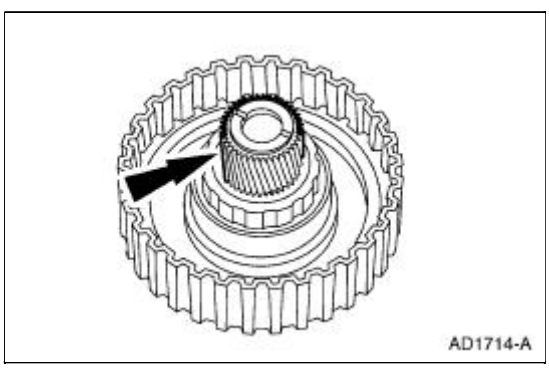


5. Remove the coast clutch piston and seal assembly.



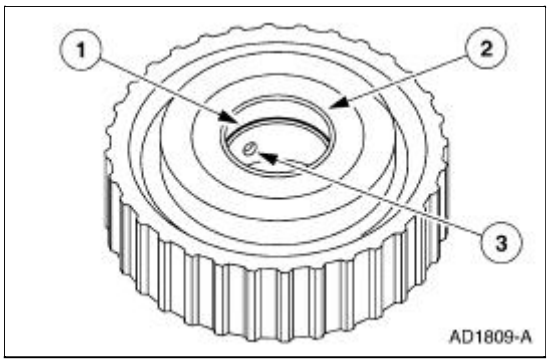
6. **NOTE:** If the teeth and/or bushing are damaged, the sun gear will need to be replaced.

   If required, use an arbor press to remove the sun gear.

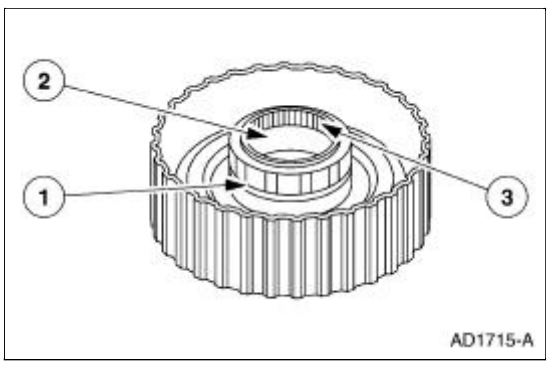


7. **NOTE:** If the coast clutch cylinder shows any signs of damage it will need to be replaced.

   Inspect the coast clutch assembly.
   1. Inspect the bushing.
   2. Inspect the No. 1 thrust washer.
   3. Inspect the lube hole.

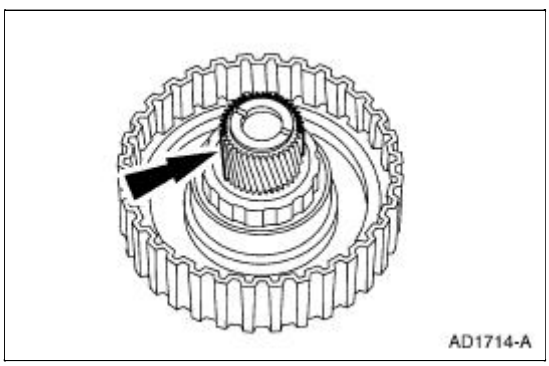


8. Inspect the OWC inner race.
   1. Inspect the coast clutch hub overdrive OWC inner race.
   2. Inspect all the sealing surfaces.
   3. Inspect the sun gear splines.

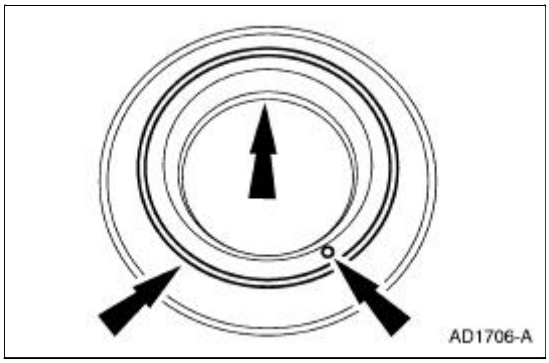


Assembly

1. If the sun gear was removed, install the sun gear.

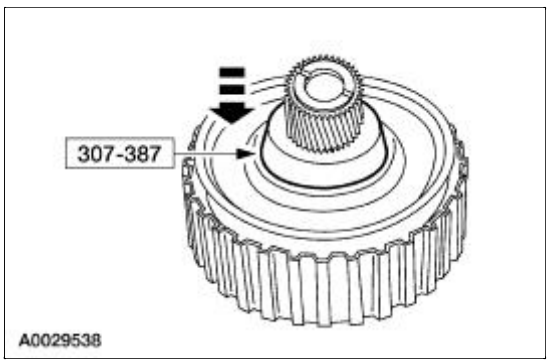


2. Inspect the coast clutch piston and seal assembly for damage and the check ball for free movement.
   Install a new clutch piston and seal assembly if damaged.

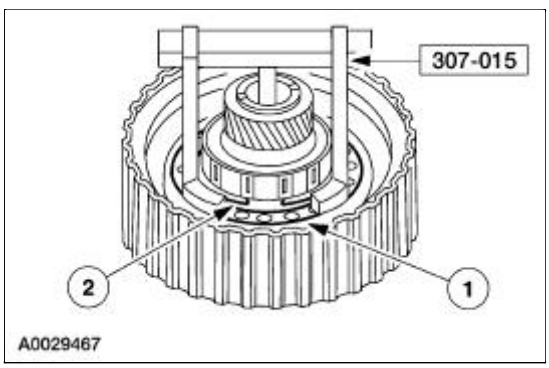


3. **NOTE:** Prior to installing the coast clutch piston, lubricate the piston seal with petroleum jelly.

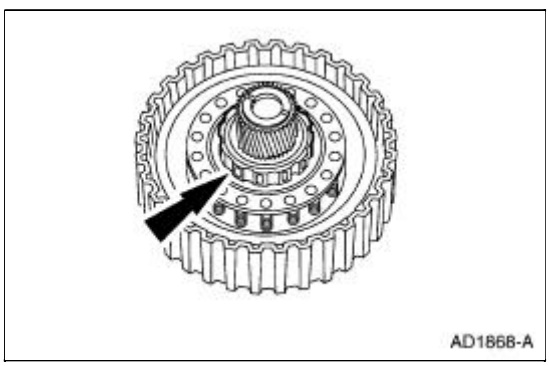
   Using the special tool, install the coast clutch piston.



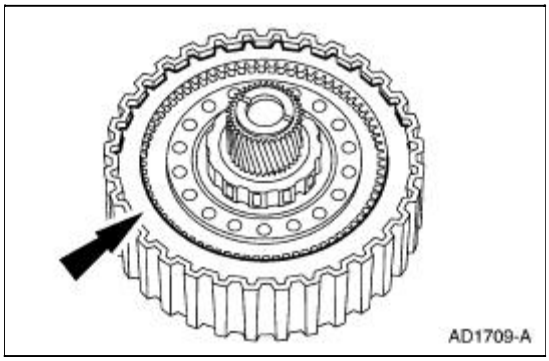
4. Using the special tool, install the coast clutch retaining ring.
   1. Install the return spring.
   2. Install the retaining ring.



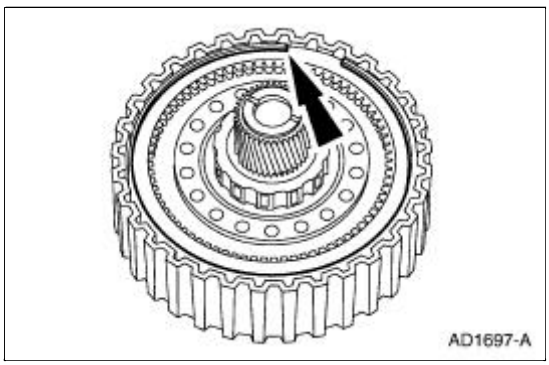
5. Make sure that the OWC is locked in place. Turn counterclockwise to lock in place. Install the overdrive one way clutch.



6. Install the coast clutch pressure plate and the clutch plates.

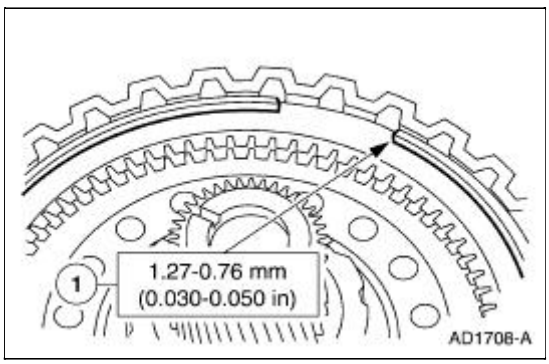


7. Install the retaining ring.



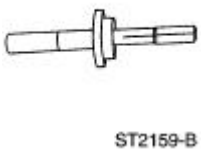
8. Check the stack-up clearance.
    1. Using a feeler gauge, measure the stack up clearance in three places, 120 degrees apart, between the snap ring and the coast clutch pressure plate.

    - If the clearance is not within specification, install the correct coast clutch pressure plate retainer snap ring and recheck the clearance.



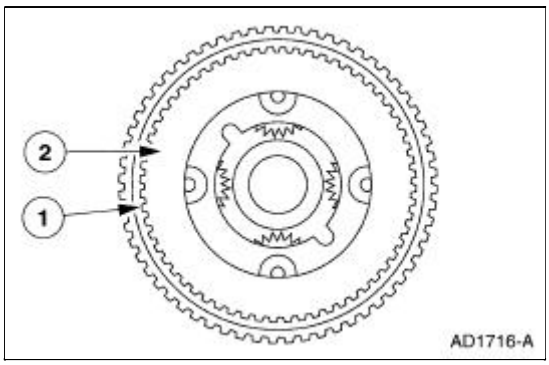
Overdrive Ring Gear and Center Shaft Assembly

Special Tool(s)

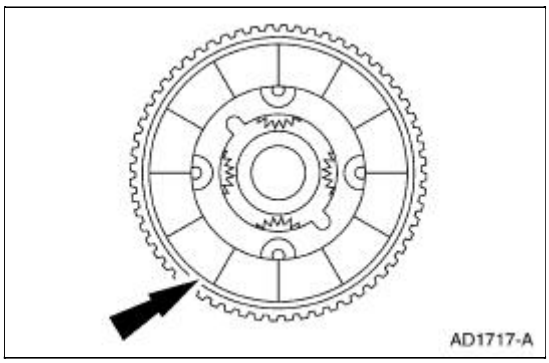
 ST2159-B	Loading Fixture, Clutch 307-S383

Disassembly

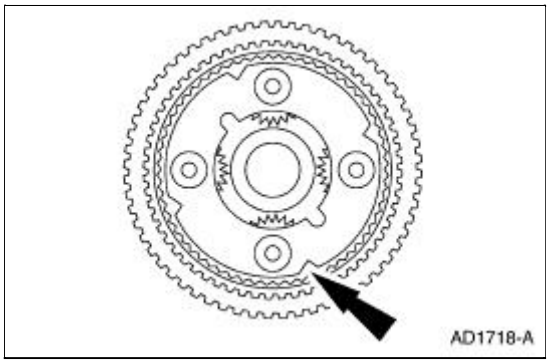
1. Remove the overdrive one-way clutch (OWC) outer race.
    1. Remove the retaining ring.
    2. Remove the overdrive OWC outer race.



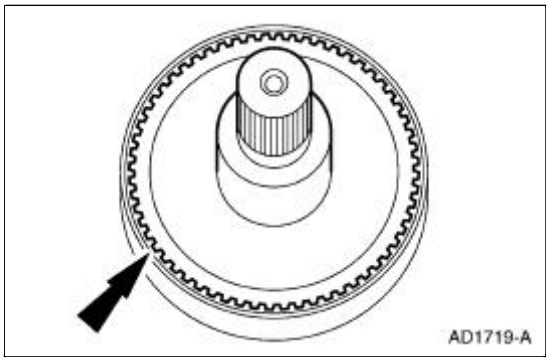
2. Remove the No. 3 overdrive overrunning clutch plastic thrust washer.



3. The No. 4 overdrive planet thrust bearing may stay in the ring gear. Remove the overdrive planet assembly.



4. Remove the wave retaining ring.



5. Remove the overdrive center shaft.

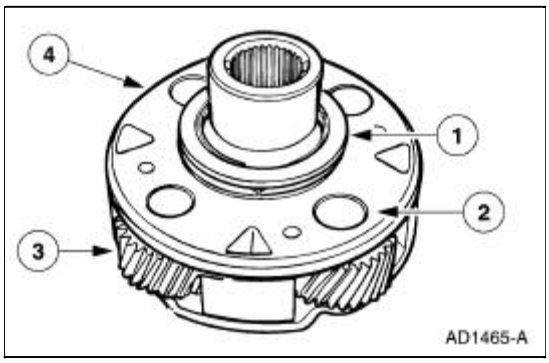


6. **CAUTION: Use care not to damage the thrust bearing or damage to transmission may occur.**

NOTE: The individual parts of the planet assemblies are not repairable.

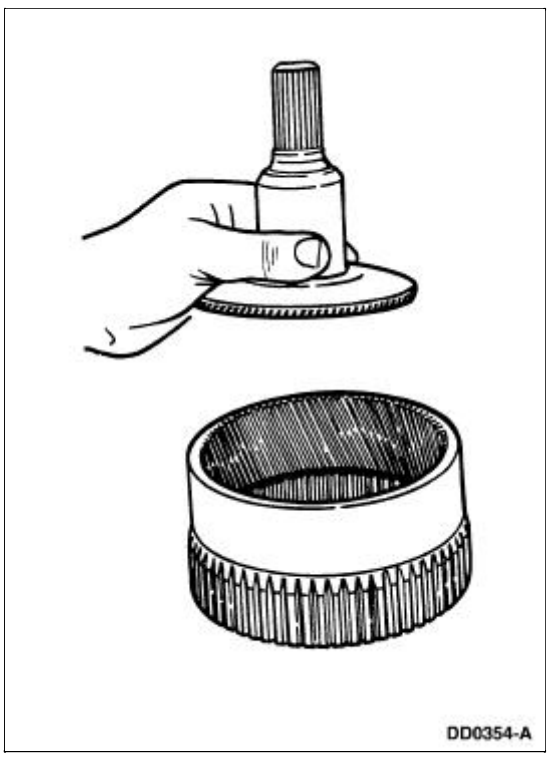
Inspect the No. 4 overdrive planet thrust bearing assembly.

1. Remove the No. 4 overdrive planet thrust bearing assembly. Wash the thrust bearing thoroughly in cleaning solvent. Blow dry the bearing with compressed air and lubricate with clean transmission fluid. Replace any bearing and race that show any sign of wear.
2. Inspect the pinion shafts in the planet assembly. Check for looseness and damage.
3. Inspect the pinion gears for damage and free rotation.
4. Inspect the planet carrier for damage.



Assembly

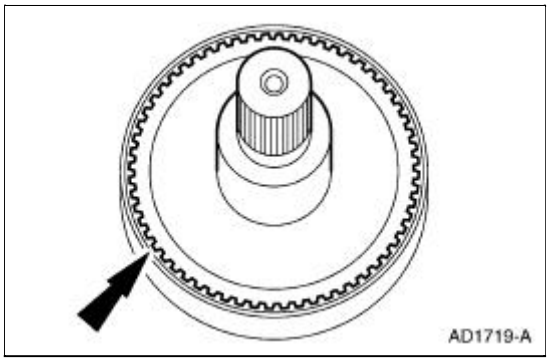
1. Install the overdrive center shaft.



2. **CAUTION: Make sure that the retaining ring is fully seated in the ring gear groove or transmission failure could occur.**

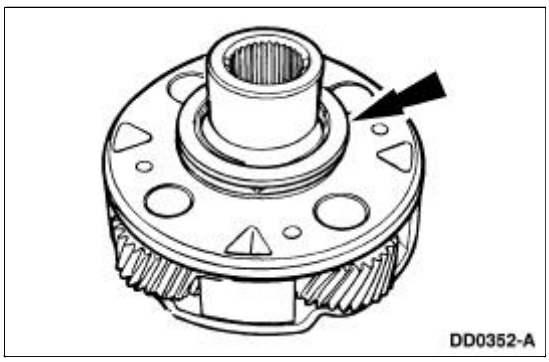
   NOTE: The retaining ring is used to hold the center shaft in the ring gear.

   Install the wavy retaining ring.



3. **NOTE:** Make sure the bearing outer lip faces the rear of the overdrive planet assembly.

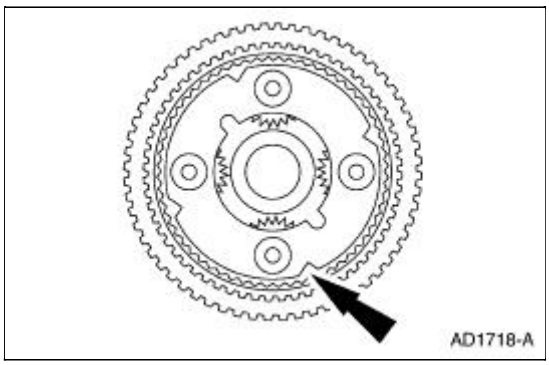
   Install the No. 4 overdrive planet thrust bearing assembly.



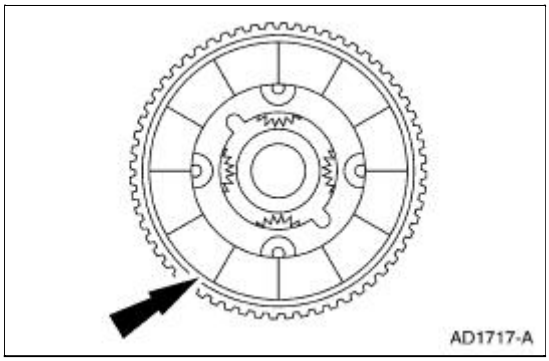
4. **CAUTION: The input shaft and overdrive planet assembly are repaired as mating components.**

   NOTE: The planet assemblies are model-dependent. Refer to the parts catalog for correct part.

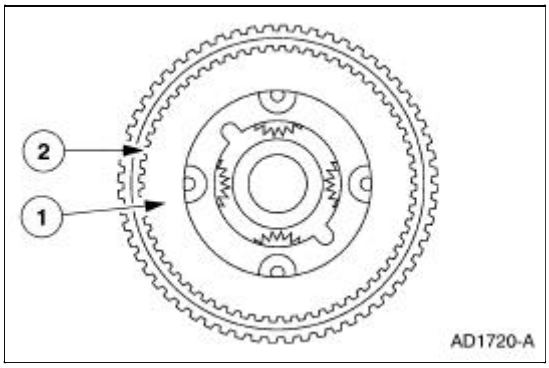
   Install the overdrive planet assembly.



5. Install the No. 3 overdrive overrunning clutch thrust washer. Make sure that the tab on the backside is locked down in place on the planet assembly.



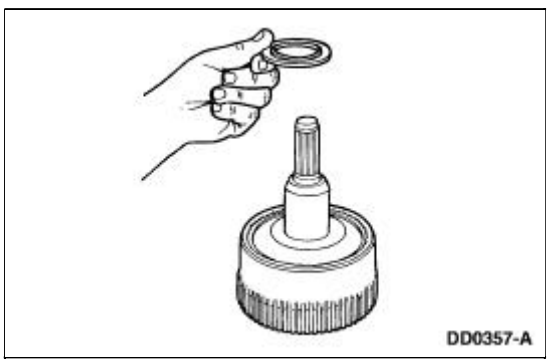
6. Install the retaining ring.
    1. Install the overdrive OWC outer race with the beveled edge facing up.
    2. Install the retaining ring; make sure that the ring is fully seated.



7. **NOTE:** Lightly lubricate the thrust bearing with petroleum jelly to hold it in place during assembly.

    NOTE: The inner bearing race lip must face upward.

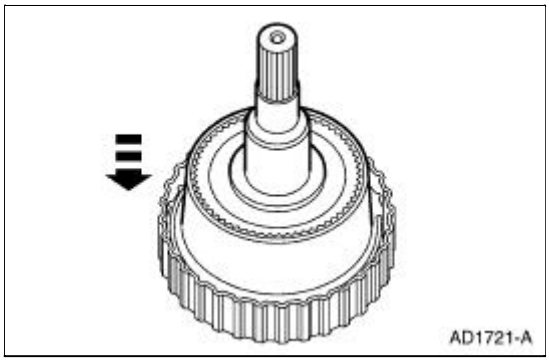
    Install the No. 5 overdrive center shaft thrust bearing assembly.



8. **CAUTION: Do not damage the overdrive OWC or damage to the transmission may occur.**

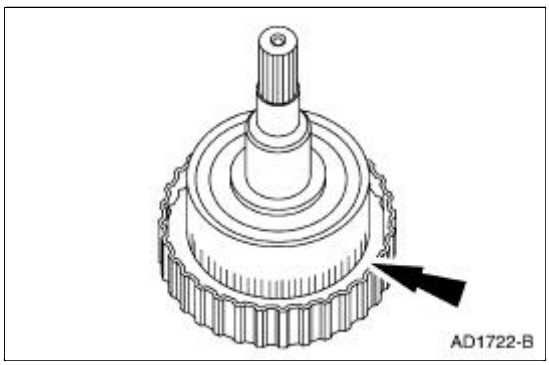
    NOTE: When the overdrive center shaft is correctly assembled, the overdrive center shaft and the ring gear should rotate counterclockwise and lock when rotated clockwise.

    Assemble the overdrive center shaft assembly into the coast clutch cylinder.

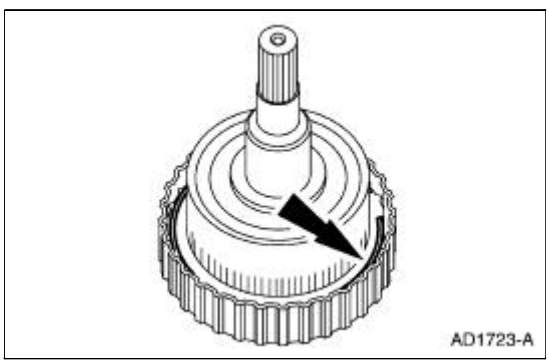


9. **NOTE:** The number of plates are model-dependent.

   Install the clutch pack and pressure plate.

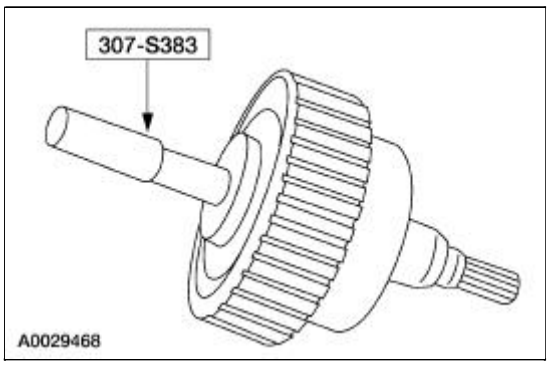


10. Install the retaining ring; make sure that the ring is fully seated.



11. **CAUTION: Not using the special tool can cause damage to the overdrive OWC assembly.**

    Install the special tool for use during assembly.

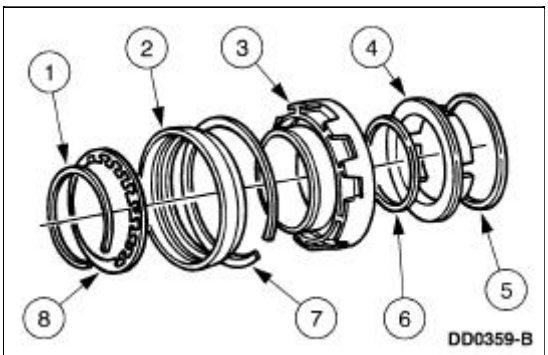


Intermediate/Overdrive Cylinder Assembly

Special Tool(s)

 ST1219-A	Remover, O-Ring Seal 100-010 (T71P-19703-C)
 ST1666-A	Compressor Plate, Clutch Spring 307-192 (T88C-77000-AH2)
 ST1665-A	Compressor Plate, Clutch Spring 307-225 (T89T-70010-C2)
 ST1853-A	Compressor Plate, Clutch Spring 307-228 (T89T-70010-F)

Intermediate/Overdrive Cylinder Assembly, Disassembled View

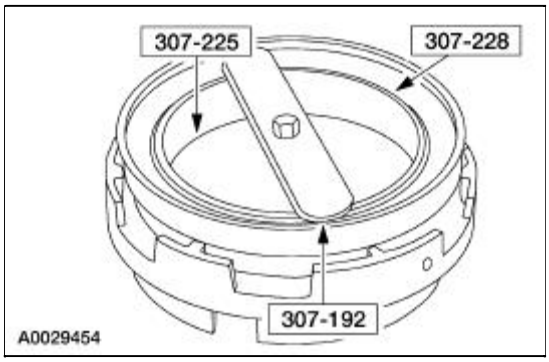


Item	Part Number	Description
1	7A527	Overdrive clutch piston return spring retainer
2	7A262	Overdrive clutch piston and (bonded) seal assembly
3	7G384	Intermediate/overdrive cylinder

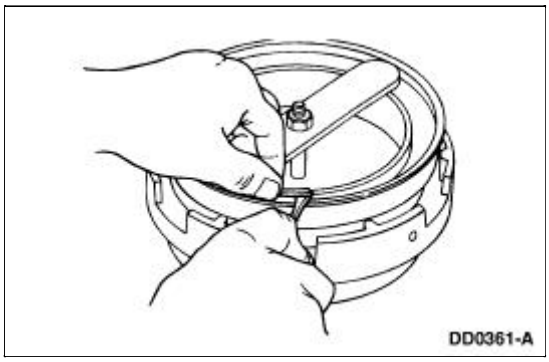
4	7E005	Intermediate clutch piston
5	7F224	Intermediate clutch piston outer seal
6	7F225	Intermediate clutch piston inner seal
7	7D483	Intermediate cylinder retaining ring
8	7B070	Overdrive clutch piston return spring

Disassembly

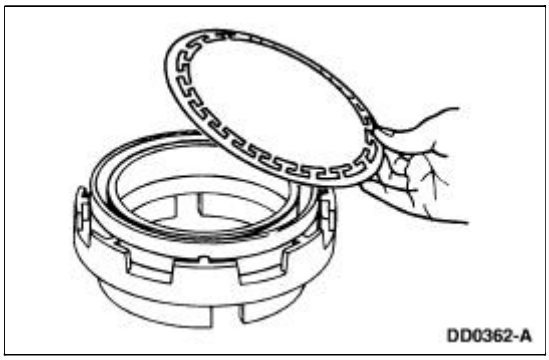
1. Using the special tools, compress the overdrive clutch piston return spring.



2. Remove the overdrive clutch piston return spring retainer. Remove the special tools.

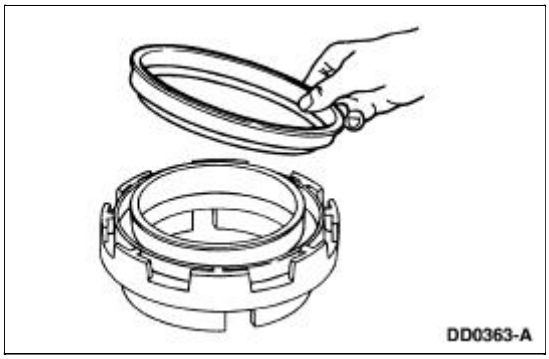


3. Remove the overdrive clutch piston return spring.

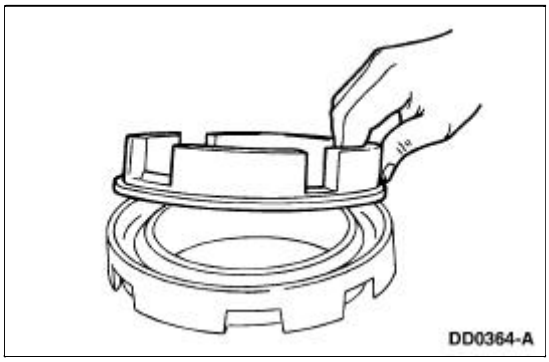


4. **NOTE:** The overdrive piston seals are bonded to the piston. If the seals are damaged, replace the piston assembly.

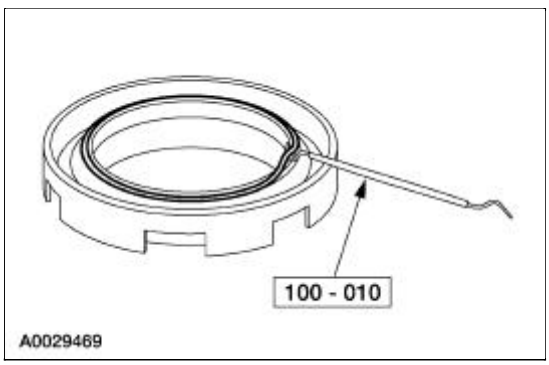
   Remove the overdrive clutch piston and seal assembly.



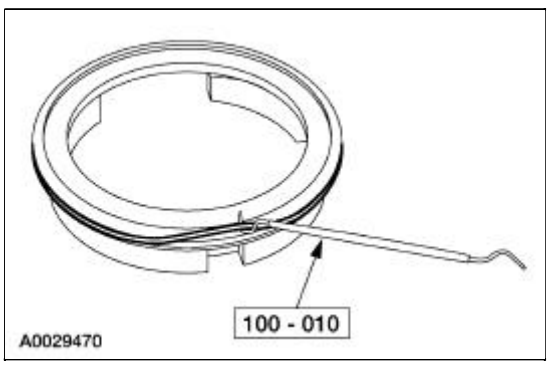
5. Remove the intermediate clutch piston.



6. Using the special tool, remove the intermediate clutch piston inner seal.



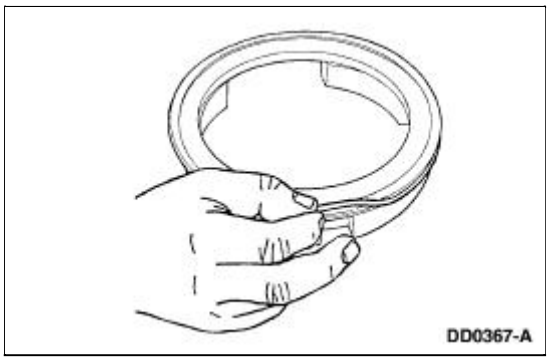
7. Using the special tool, remove the intermediate clutch piston outer seal.



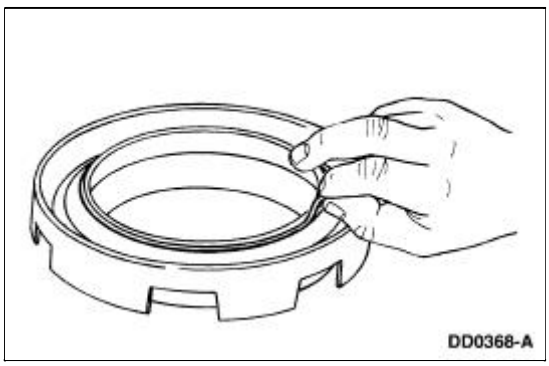
Assembly

1. **NOTE:** Prior to reassembly, inspect the check ball, the cup plugs and the feedbolt threads for contamination or damage. Clean or install new as necessary.

Lubricate with petroleum jelly or equivalent. Install the intermediate clutch piston outer seal, with the lip seal facing upward.

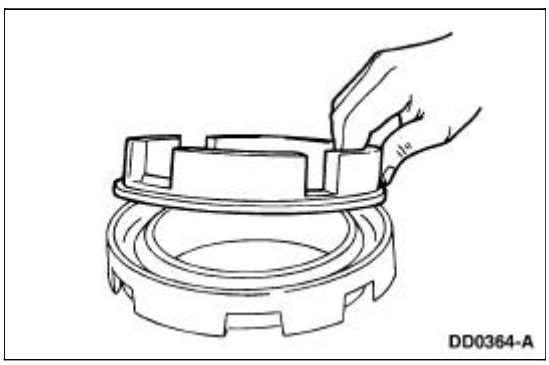


2. Lubricate with petroleum jelly or equivalent. Install the intermediate clutch piston inner seal, with the lip seal facing downward toward the cylinder.



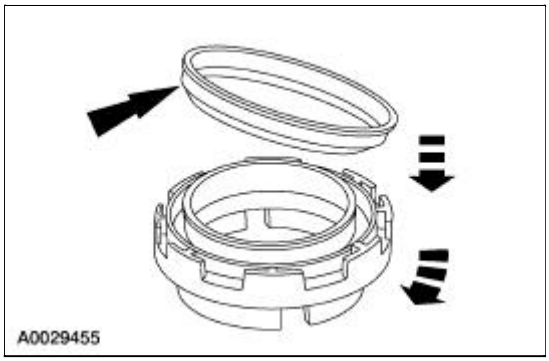
3. **NOTE:** The piston should rotate freely in the cylinder.

   Install the intermediate clutch piston.



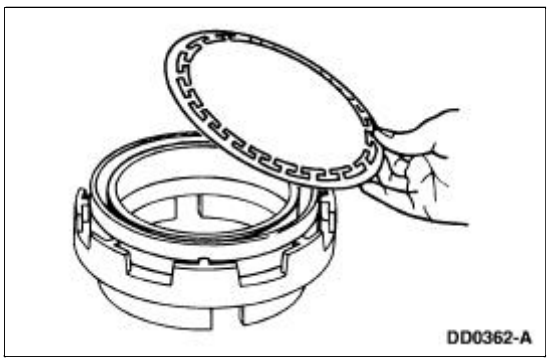
4. **CAUTION: The overdrive piston lip seals are bonded to the piston. Use care not to damage or roll the lip seal over.**

   Lubricate seal with petroleum jelly or equivalent. Position the overdrive clutch piston and seal assembly onto the intermediate/overdrive cylinder at a slight angle. Then, rotate the piston while pressing it down until fully seated onto the cylinder.

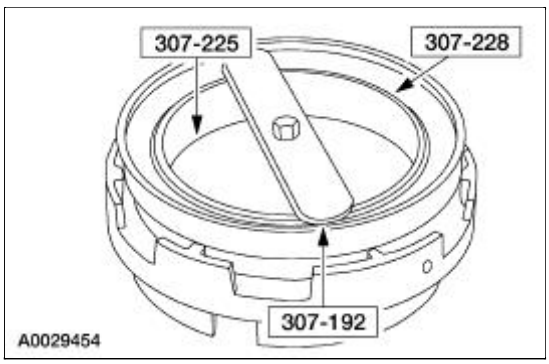


5. **NOTE:** The overdrive clutch piston return spring must be installed with fingers facing upward.

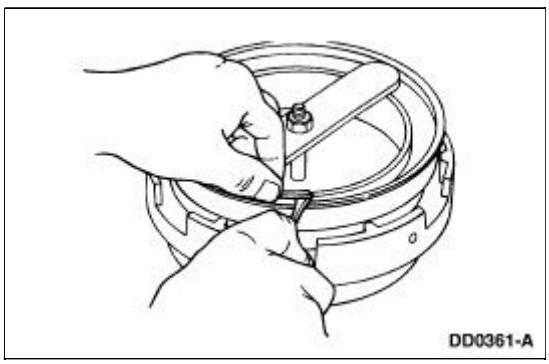
   Install the overdrive clutch piston return spring.



6. Using the special tools, compress the overdrive clutch piston return spring.



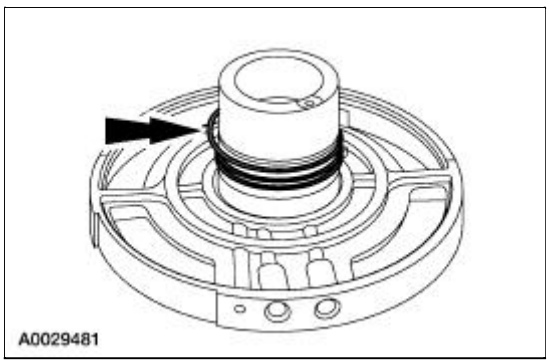
7. Install the overdrive clutch piston return spring retainer. Make sure the retainer is fully seated, then remove the tools.



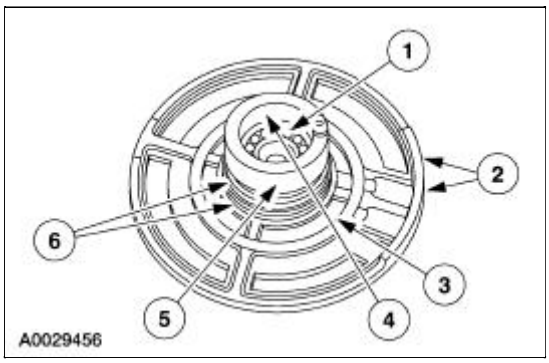
Center Support

Disassembly

1. Remove and discard the direct clutch seal rings.



2. Inspect the following for contamination or damage. Clean or install as necessary.
    1. Inspect the ball bearing.
    2. Inspect the feedbolt threads.
    3. Remove and inspect the No. 6 center support thrust washer.
    4. Inspect the inner hub diameter.
    5. Inspect the outer hub diameter.
    6. Inspect the seal ring grooves.



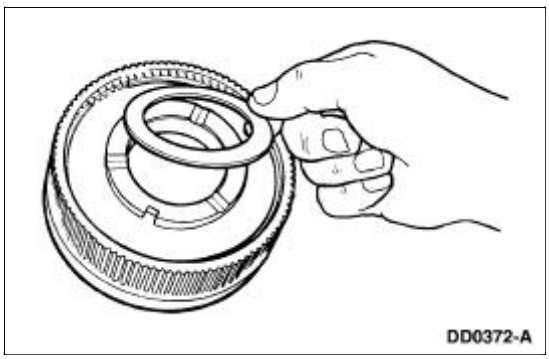
Assembly

1. Follow the disassembly procedure in reverse order.
    - Lightly lubricate the thrust washer with petroleum jelly to hold it in place during assembly.
    - Install new seals.

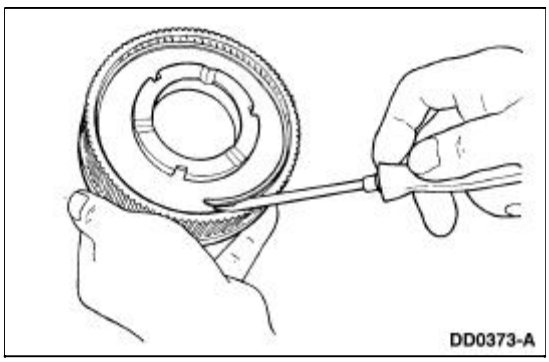
Forward Hub and Ring Gear

Disassembly

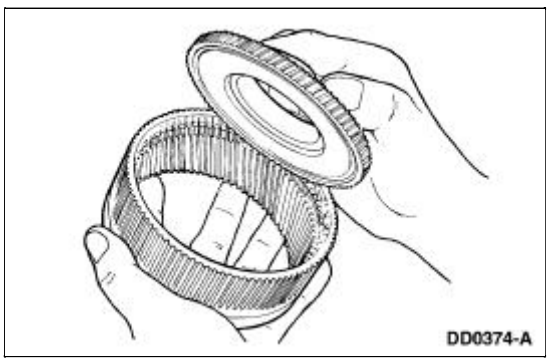
1. Remove the No. 8C forward clutch hub thrust washer.



2. Remove the forward hub retaining ring.



3. Remove the forward hub.



Assembly

1. Follow the disassembly procedure in reverse order.
   - Lightly lubricate the thrust washer with petroleum jelly to hold it in place during assembly.
   - When installed, make sure the retaining ring is fully seated in the forward ring gear ring groove.

Direct Clutch Assembly and Intermediate Brake Drum

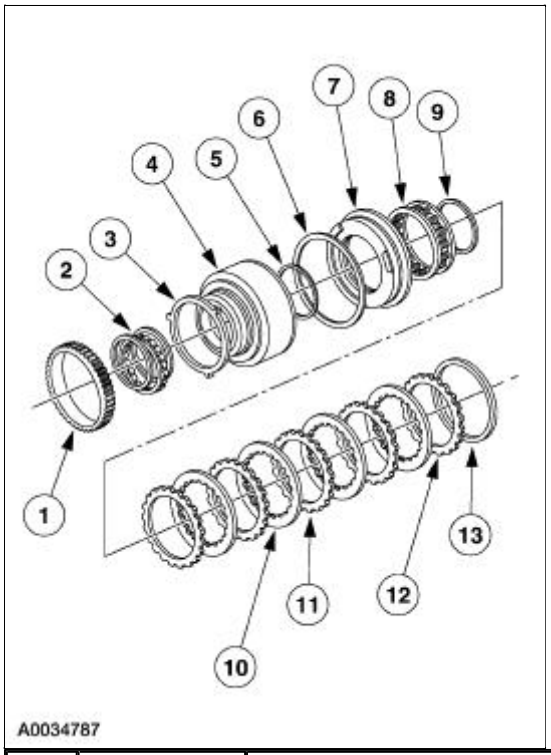
Special Tool(s)

 ST1190-A	Compressor, Clutch Spring 307-015 (T65L-77515-A)
 ST1219-A	Remover, O-Ring Seal 100-010 (T71P-19703-C)

Material

Item	Specification
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®

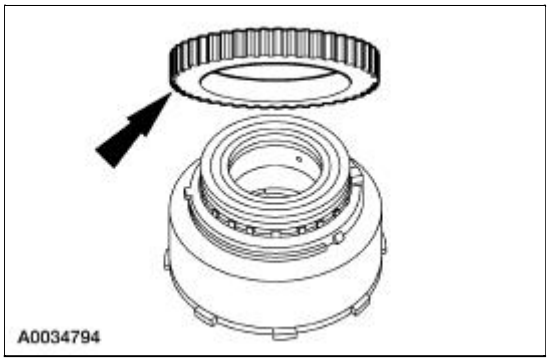
Direct Clutch Assembly and Intermediate Brake Drum, Disassembled View



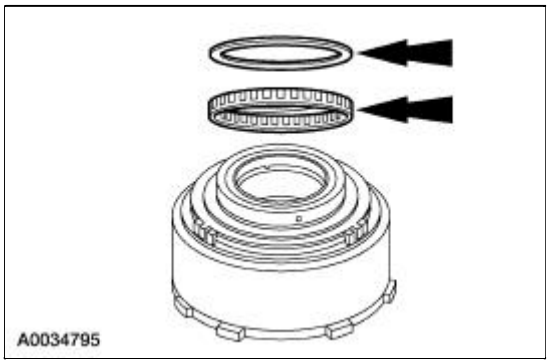
Item	Part Number	Description
1	—	Intermediate one-way clutch outer race (part of 7A089)
2	—	Intermediate one-way clutch inner race (part of 7A089)
3	7G401	Intermediate one-way clutch thrust washer No. 7
4	7D044	Intermediate brake drum
5	7A548	Direct clutch piston inner seal
6	7A548	Direct clutch piston outer seal
7	7A262	Direct clutch piston
8	7F235	Direct clutch return spring assembly
9	7C122	Direct clutch return spring retaining ring
10	7B164	Direct clutch internal spline plates — friction
11	7B442	Direct clutch external spline plates — steel
12	7B066	Direct clutch pressure plate
13	377126-S	Direct clutch pressure plate retaining ring (selective)

Disassembly

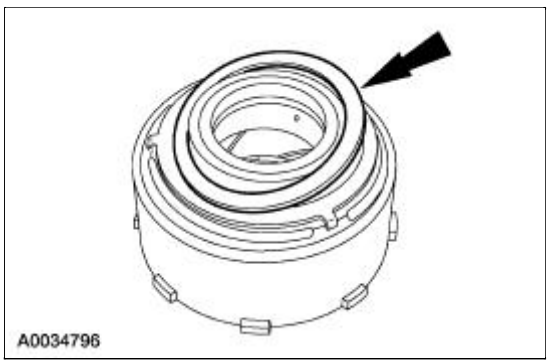
1. Remove the intermediate one-way clutch (OWC) outer race, and inspect for damage.



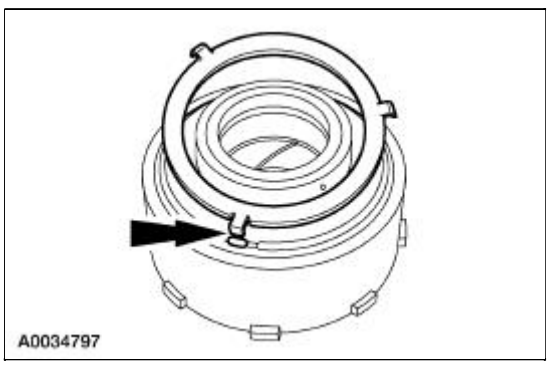
2. Remove the top end cap and the intermediate OWC. Inspect the sprags, cage, and top end cap for excessive wear or damage.



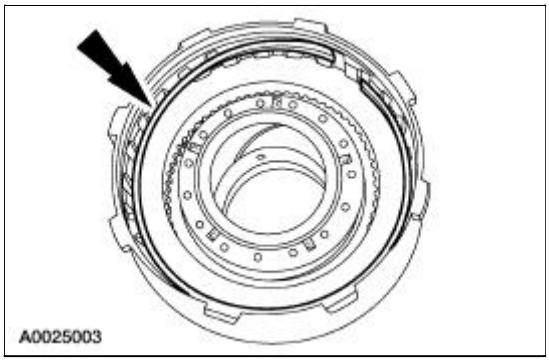
3. Remove the bottom end cap and inspect for damage.



4. Remove the No. 7 intermediate OWC thrust washer.

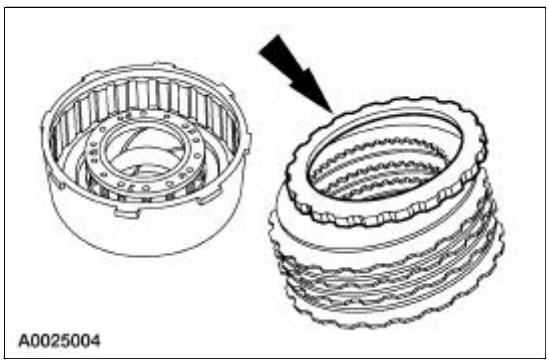


5. Remove the direct clutch pressure plate retaining ring.



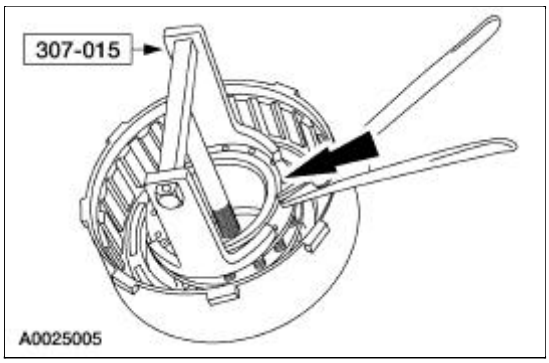
6. **NOTE:** Tag the parts for identification during installation.

   Remove the direct clutch pressure plate and the clutch pack.

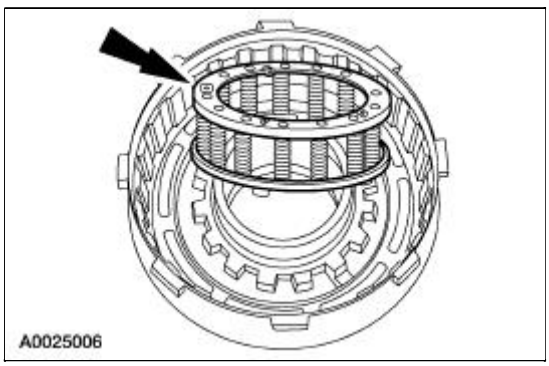


7. **CAUTION: Do not fully compress the return springs or the spring may break.**

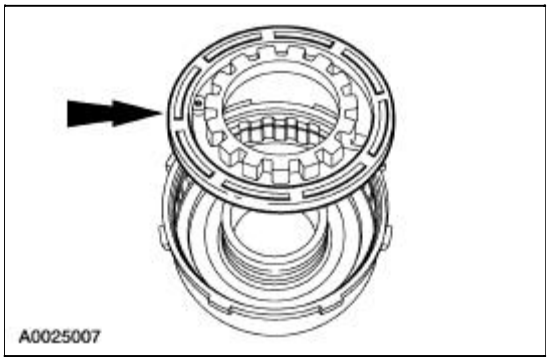
   Using the special tool, remove the direct clutch return spring retaining ring. Remove the tool.



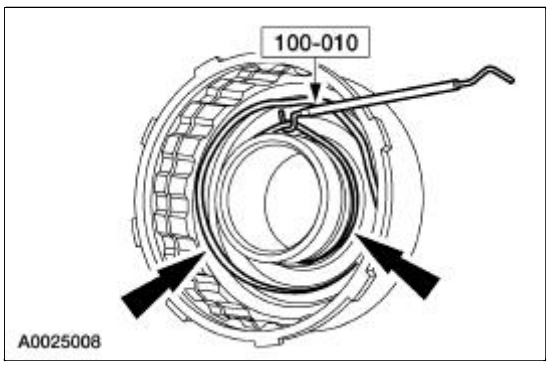
8. Remove the direct clutch return spring assembly.



9. Remove the direct clutch piston.



10. Using the special tool, remove the direct clutch piston inner and outer seals.



11. Inspect the clutch cylinder thrust surfaces, piston bore, and clutch plate splines for scores, burrs or wear. Install a new clutch cylinder if it is badly scored or damaged.

12. Check the fluid passage in the clutch cylinder for obstructions. Clean out all fluid passages. Inspect clutch piston for scores and install new if necessary. Inspect the check balls for freedom of movement.

13. Check the clutch release spring for distortion and cracks. Install a new spring if it is distorted or cracked.

14. Inspect the friction clutch plates, steel clutch plates, and clutch pressure plate for worn or scored surfaces. Install new parts that are scored, burred or burnt.

15. Check the clutch plates for flatness and wear on the clutch hub splines. Discard any plate that does not slide freely on the splines or is not flat.

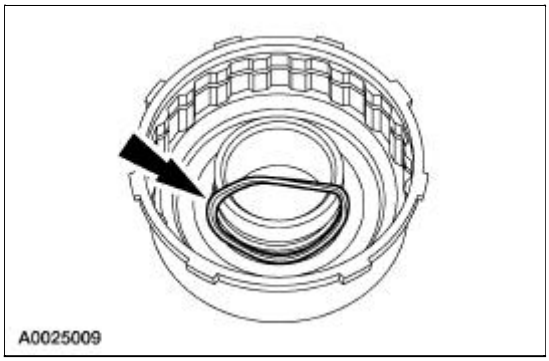
16. Check the clutch hub thrust surfaces for scores and the clutch hub splines for wear. Install new parts that are worn.

Assembly

NOTE: Soak the clutch plates for 15 minutes in clean automatic transmission fluid.

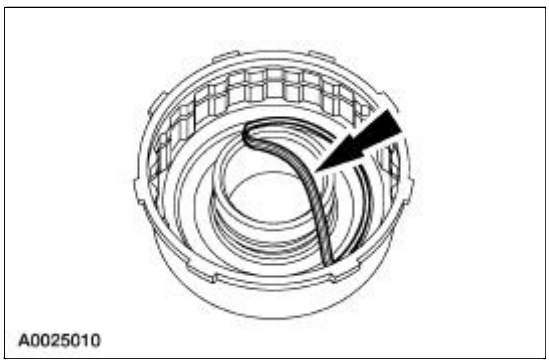
1. **NOTE:** The seal lip must face downward.

   Install the direct clutch piston inner seal.

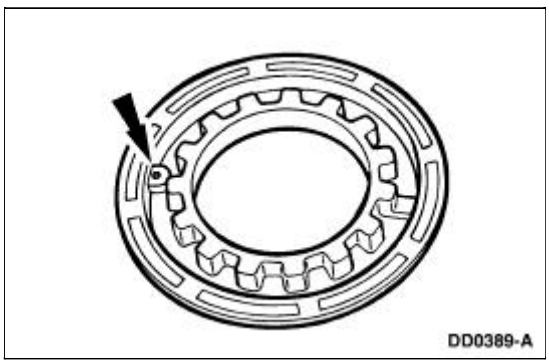


2. **NOTE:** The seal lip must face downward.

   Install the direct clutch piston outer seal.

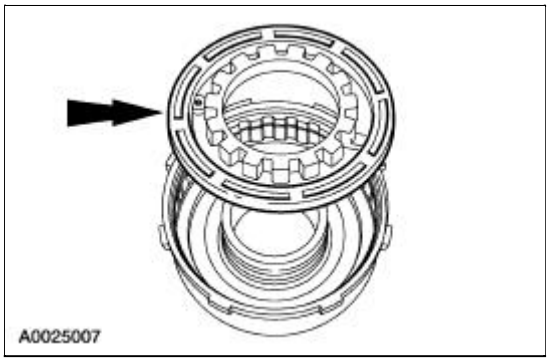


3. Inspect the direct clutch piston check ball.
   - Check for freedom of movement and correct seating.
   - Clean the direct clutch piston with solvent if necessary.
   - Install a new direct clutch piston if damaged.



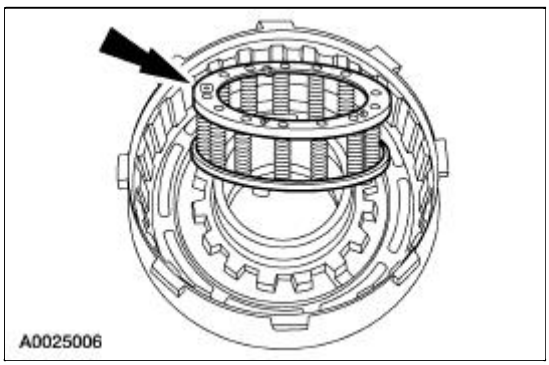
4. **NOTE:** The piston should rotate freely in the drum.

   Install the direct clutch piston.



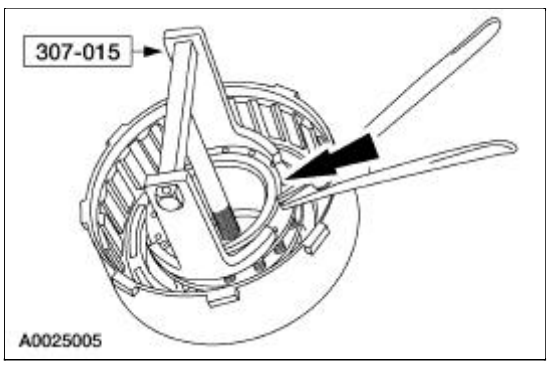
5. **NOTE:** Make sure the protrusions on the bottom of the direct clutch return spring assembly are correctly engaged with the lugs on the direct clutch piston.

   Install the direct clutch return spring assembly.



6. **CAUTION: Do not fully compress the return springs or damage to spring may occur.**

   Using the special tool, install the direct clutch return spring retaining ring. Remove the tool.



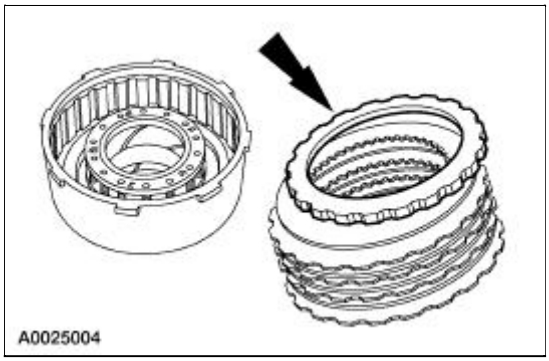
7. **CAUTION: Mixing or using friction plates without the grooves will cause shift concerns and can cause damage.**

   NOTE: Soak the clutch plates for 15 minutes in clean automatic transmission fluid.

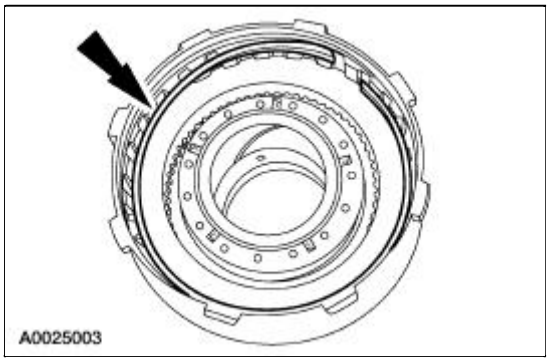
   NOTE: The direct clutch friction plates have lube grooves in the friction material.

   NOTE: The number of plates are model dependent.

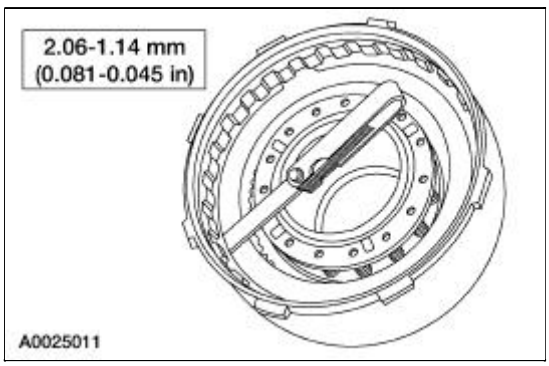
   Alternately install the steel and the friction clutch plates, beginning with a steel plate and ending with the direct clutch pressure plate.



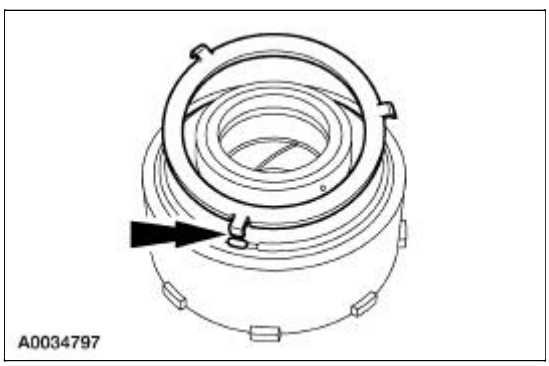
8. Install the selective direct clutch pressure plate retaining ring.



9. Check the stack-up clearance.
    1. Using a feeler gauge, check the stack-up clearance in three places, 120 degrees apart.
    2. If the clearance is not to specification, install the correct selective direct clutch pressure plate retaining ring and recheck the clearance. Refer to the Clutch Plate Usage and Clearance Specification Chart for selective snap ring thicknesses and part numbers.

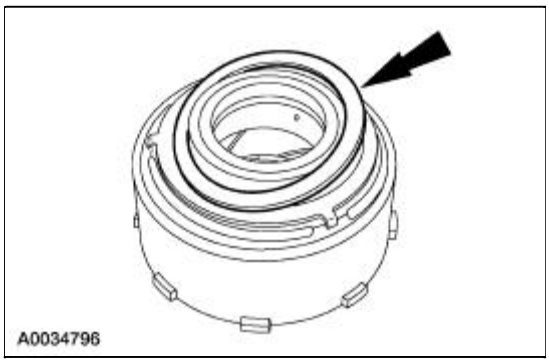


10. Install the No. 7 intermediate one-way clutch thrust washer. Make sure the tabs on the No. 7 intermediate one-way clutch thrust washer are aligned with the notches in the intermediate brake drum.



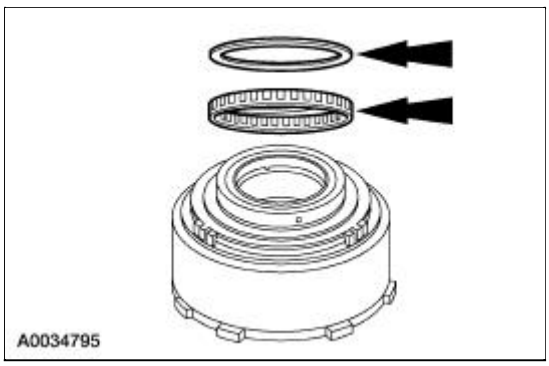
11. **NOTE:** The top and bottom end caps are identical.

    Install the bottom end cap.



12. **NOTE:** The lip on the intermediate one-way clutch must face upward.

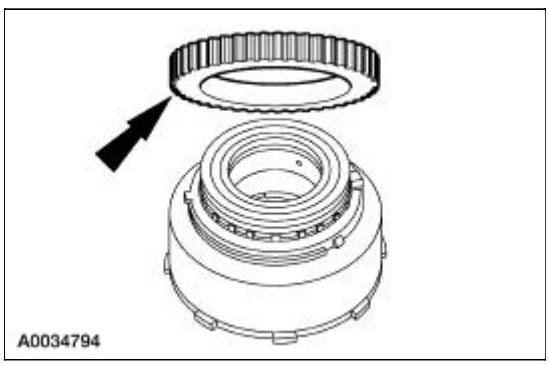
    Install the intermediate one-way clutch over the inner race and install the top end cap.



13. **NOTE:** The shoulder on the outer race must face upward.

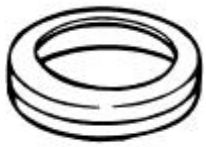
    NOTE: When installed correctly, the outer race must rotate counterclockwise.

    Install the intermediate one-way clutch outer race.



Forward Clutch Assembly

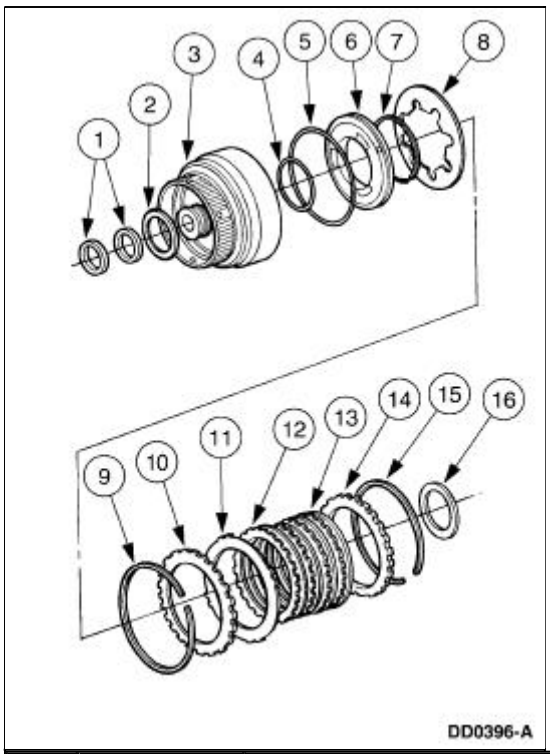
Special Tool(s)

 ST1219-A	Remover, O-Ring Seal 100-010 (T71P-19703-C)
 ST1747-A	Protector, Piston Seal 307-068 (T77L-77548-A)

Material

Item	Specification
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®

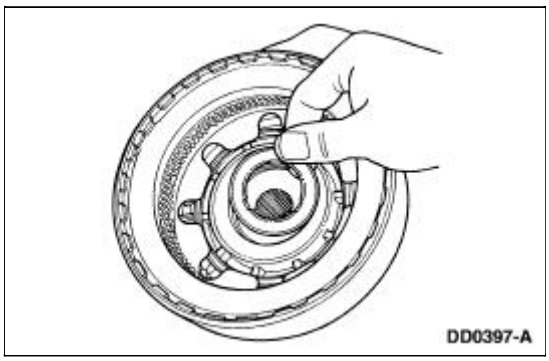
Forward Clutch Assembly, Disassembled View



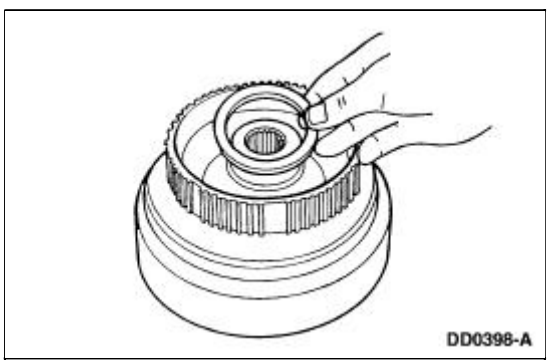
Item	Part Number	Description
1	7D019	Forward clutch cylinder seals
2	7F374	Forward clutch needle thrust bearing assembly (No. 8B)
3	7A360	Forward clutch cylinder
4	7A548	Forward clutch piston, inner seal
5	7A548	Forward clutch piston, outer seal
6	7A262	Forward clutch piston
7	7D256	Forward clutch piston apply ring
8	7B070	Forward clutch piston return spring
9	377127-S	Forward clutch piston return spring retaining ring
10	7B066	Forward clutch pressure plate — bottom
11	7E085	Forward clutch pressure spring
12	7B442	Forward clutch external spline, plate — steel
13	7B164	Forward clutch internal spline plates — friction
14	7B066	Forward clutch pressure plate — top
15	377127-S	Forward clutch pressure plate retaining ring (selective fit)
16	7D234	Forward clutch thrust bearing No. 9A)

Disassembly

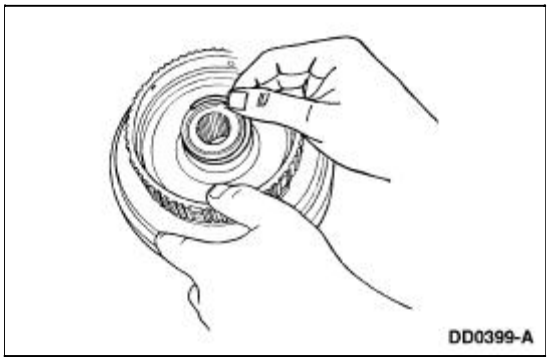
1. Remove the No. 9A forward clutch thrust bearing.



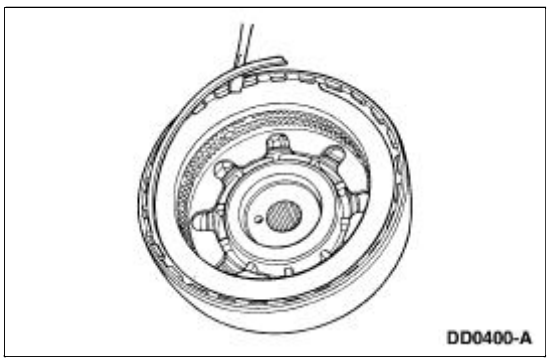
2. Remove the No. 8B forward clutch needle bearing assembly.



3. Remove the 2 interlocking cast iron forward clutch cylinder seals.

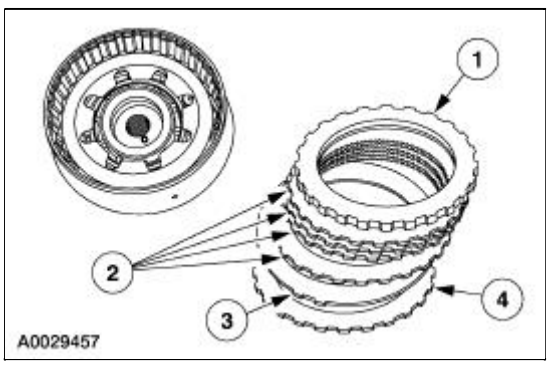


4. Remove the selective forward clutch pressure plate retaining ring.

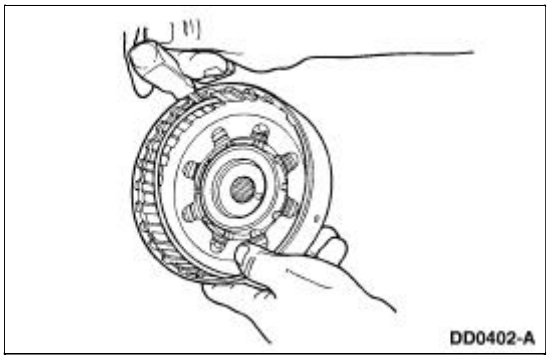


5. **NOTE:** Tag the parts for identification during installation.

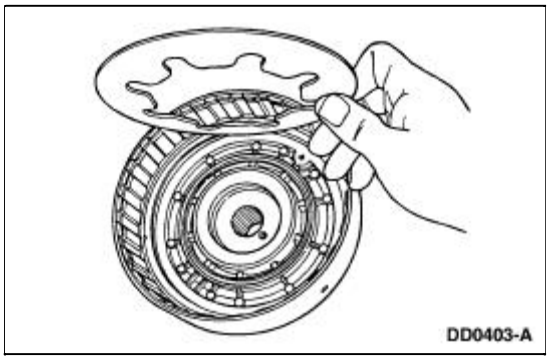
   Remove the forward clutch pressure plates.
   1. Remove the top forward clutch pressure plate.
   2. Remove the clutch plates.
   3. Remove the forward clutch pressure spring.
   4. Remove the bottom forward clutch pressure plate.



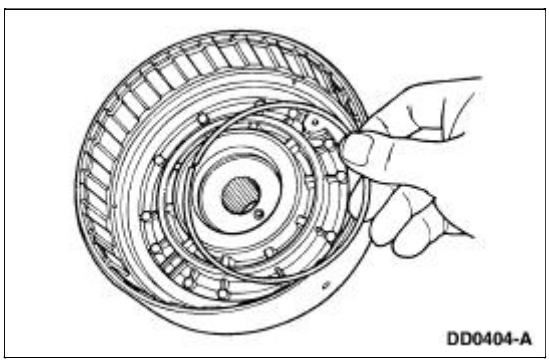
6. Remove the forward clutch piston return spring retaining ring.



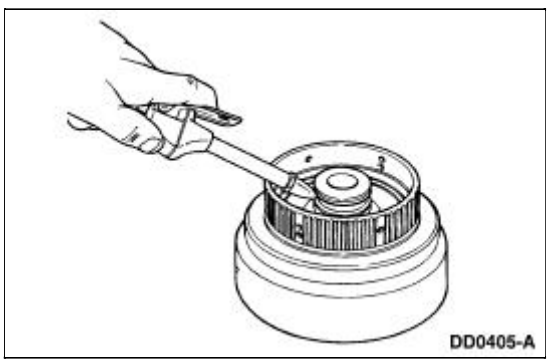
7. Remove the forward clutch piston return spring.



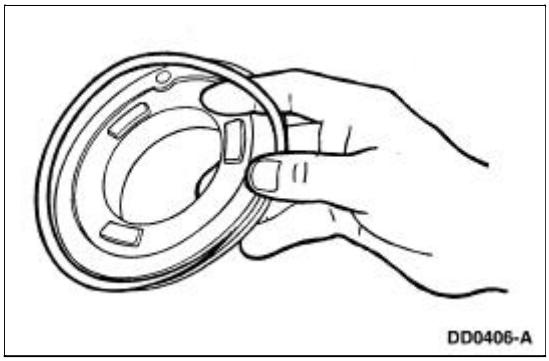
8. Remove the forward clutch piston apply ring.



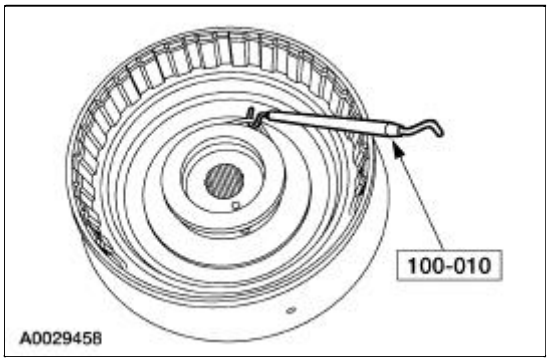
9. Using compressed air, remove the forward clutch piston.



10. Remove the outer forward clutch piston seal.



11. Using the special tool, remove the forward clutch piston inner seal.



12. Inspect the clutch cylinder thrust surfaces, piston bore, and clutch plate splines for scores, burrs or wear. Install a new clutch cylinder if it is badly scored or damaged.

13. Check the fluid passage in the clutch cylinder for obstructions. Clean out all fluid passages. Inspect clutch piston for scores and install new if necessary. Inspect the check balls for freedom of movement.

14. Check the clutch release spring for distortion and cracks. Install a new spring if it is distorted or cracked.

15. Inspect the friction clutch plates, steel clutch plates, and clutch pressure plate for worn or scored surfaces. Install new parts that are scored, burred or burnt.

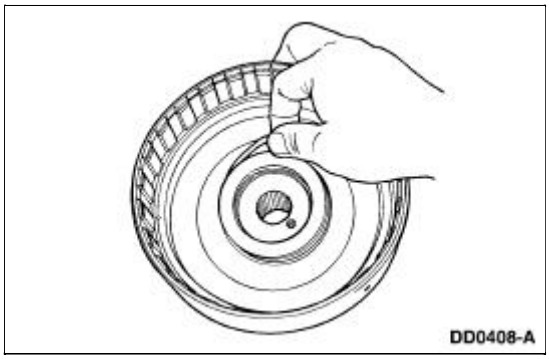
16. Check the clutch plates for flatness and wear on the clutch hub splines. Discard any plate that does not slide freely on the splines or that is not flat.

17. Check the clutch hub thrust surfaces for scores and the clutch hub splines for wear. Install new parts that are worn.

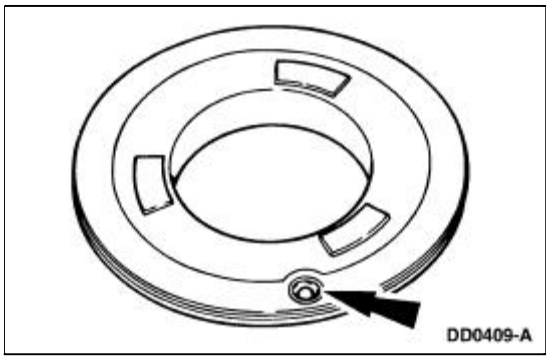
Assembly

NOTE: Soak the clutch plates for 15 minutes in clean automatic transmission fluid.

1. Install the forward clutch piston inner seal.

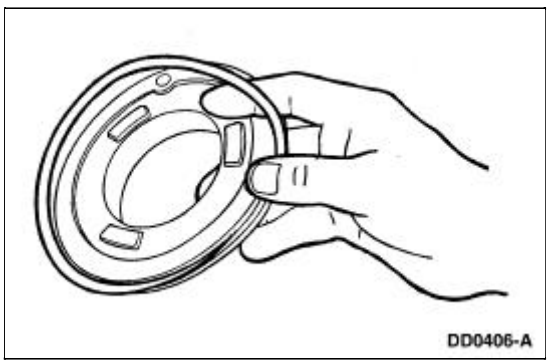


2. Inspect the forward clutch piston check ball.
    - Check for freedom of movement and correct seating.
    - Clean with a suitable solvent, if necessary.
    - Replace the forward clutch piston assembly, if necessary.

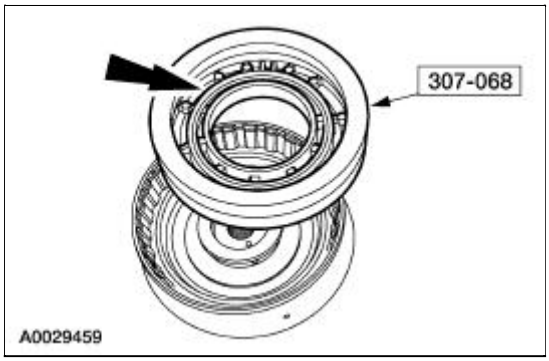


3. **NOTE:** Make sure the seal lip is facing upward.

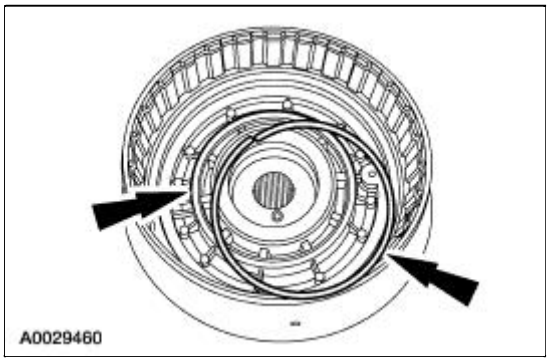
    Install the forward clutch piston outer seal.



4. Using the special tool, install the forward clutch piston.

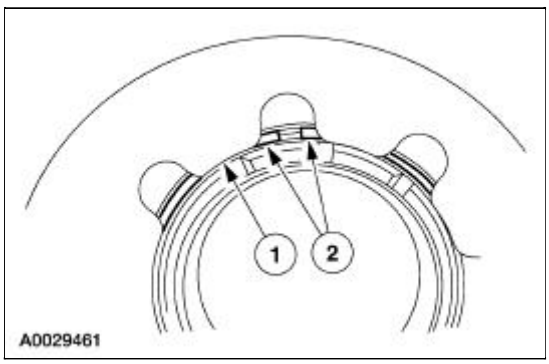


5. Install the steel forward clutch piston apply ring into the forward clutch piston groove.

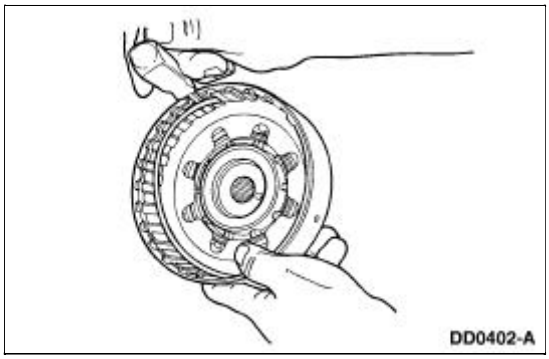


6. **CAUTION: To ensure durability, the notch between the spring fingers must be positioned so that both ends of the forward clutch piston apply ring are visible.**

   Install the forward clutch piston return spring.
   1. Install the forward clutch piston return spring, with the spring fingers against the forward clutch piston apply ring.
   2. Make sure the notch is positioned so that both ends of the forward clutch piston apply ring are visible.

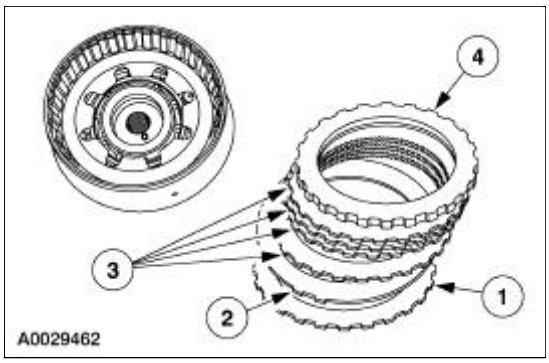


7. Install the forward clutch piston return spring retaining ring. Make sure it is correctly seated in the groove.

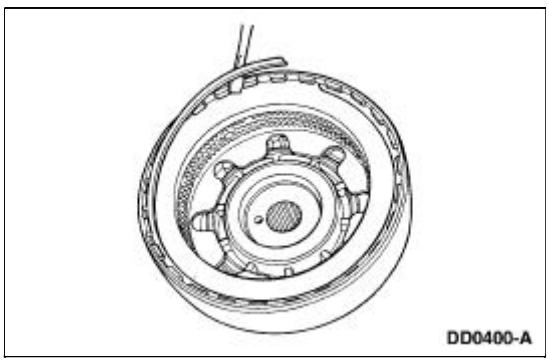


8. **NOTE:** Soak the clutch plates for 15 minutes in clean automatic transmission fluid.

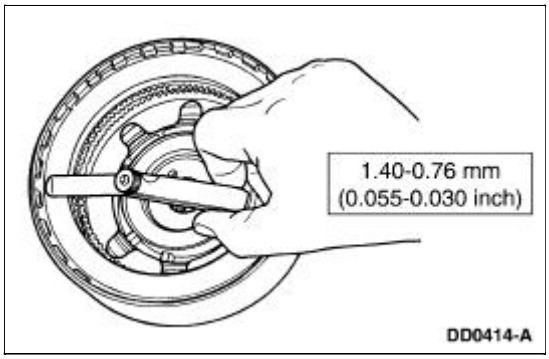
   Install the forward clutch pressure plates.
   1. Install the bottom forward clutch pressure plate.
   2. Install the forward clutch pressure spring.
   3. Install the forward clutch pressure plates.
   4. Install the top forward clutch pressure plate.



9. Install the selective forward clutch pressure plate retaining ring.



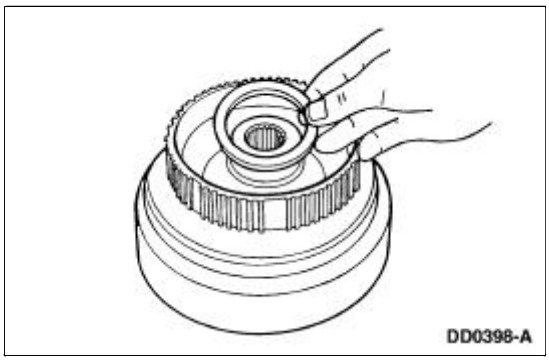
10. Check the stack-up clearance.
    - Using a feeler gauge, check the stack-up clearance in three places, 120 degrees apart.
    - If the clearance is not to specification, install the correct selective forward clutch pressure plate retaining ring and recheck the clearance. Refer to the Clutch Plate Usage and Clearance Specification Chart for selective snap ring thicknesses and part numbers.



11. **NOTE:** Lightly lubricate the needle bearing with petroleum jelly to hold it in place during assembly.

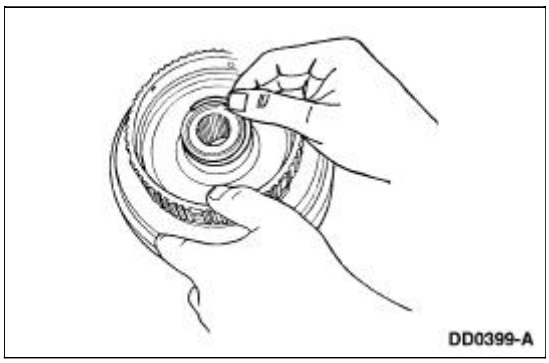
    NOTE: The bearing large inner diameter radius must face inward.

    Install the No. 8B forward clutch needle bearing.



12. **NOTE:** Stagger the interlocking opening on the seals 180 degrees apart.

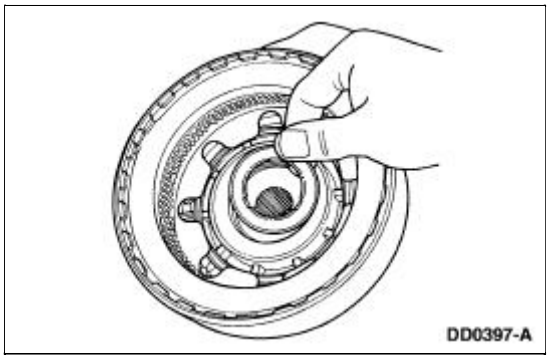
    Install the two new cast iron forward clutch cylinder seals in the grooves.



13. **NOTE:** Lightly lubricate the thrust bearing with petroleum jelly to hold it in place during assembly.

    NOTE: The black side of the bearing must face upward.

    Install the No. 9A forward clutch thrust bearing.


DD0397-A

Output Shaft —Check

Special Tool(s)

 ST2163-A	Remover/Installer, Bearing Tube 308-025 (T75L-7025-C)
 ST2161-A	Spacer, Output Shaft Speed Sensor 307-388

Disassembly

1. **CAUTION: Build-up of contamination can block the flow of lubricant behind the cup plug and cause transmission assembly damage.**

   NOTE: The anti-seepage seal is intended for shipping purposes only. It is not necessary to remove and reuse this seal when installing a new output shaft.

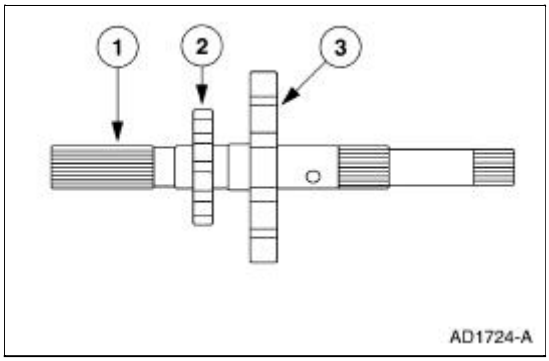
   NOTE: The output shaft cannot be disassembled. A new output shaft must be installed if damaged.

   Inspect the output shaft for wear. Make sure the cup plug orifice and lube passages through the output shaft are clean and free of debris. Install new as required.

2. Inspect the bearing surfaces of the output shaft for wear or scores. If excessive wear or scores are found, install a new output shaft and inspect mating components.

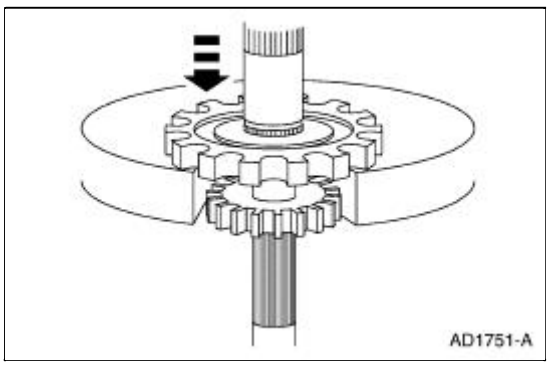
3. Check the splines on the output shaft for wear. Install a new output shaft if the splines are excessively worn. Inspect all the bushings for wear. Install new if worn or damaged.

4. Inspect the output shaft for damage. If damage is found, refer to the next two steps.
   1. Inspect the output shaft.
   2. Inspect the edges and the top of the output shaft drive sprocket speed sensor wheel.
   3. Inspect the park gear.



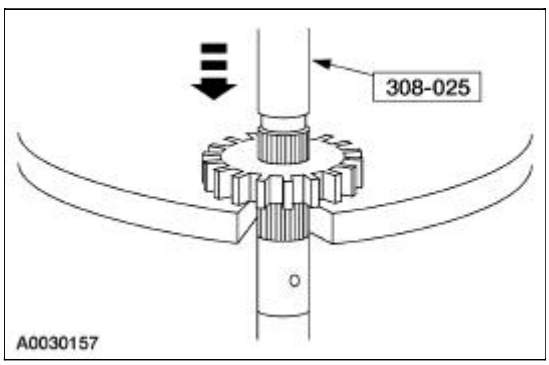
5. **NOTE:** The park gear and output shaft drive sprocket speed sensor wheel will only require removal or replacement if they are damaged.

   Using an arbor press, remove the park gear.



6. **NOTE:** If replacing the output shaft drive sprocket speed sensor wheel, the park gear will need to be removed first.

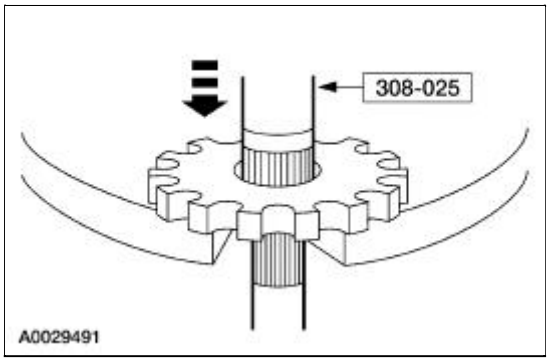
   If required, use an arbor press and the special tool to remove the park gear. Remove the park gear.



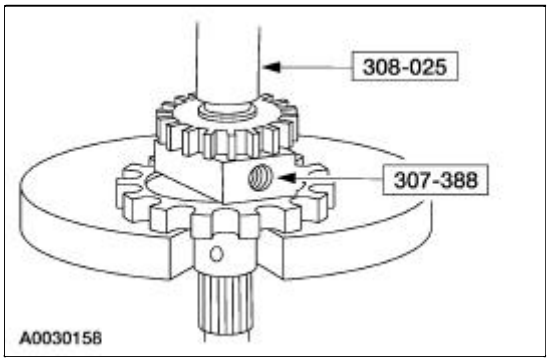
Assembly

1. **NOTE:** If any damage is found to the output shaft drive sprocket speed sensor wheel, a new output shaft drive sprocket speed sensor wheel will need to be installed.

   If removed, use the arbor press and the special tool to install the park gear. Press the park gear onto the output shaft until it stops at the shoulder on the output shaft.



2. If removed, install the output shaft drive sprocket speed sensor wheel using the special tool.

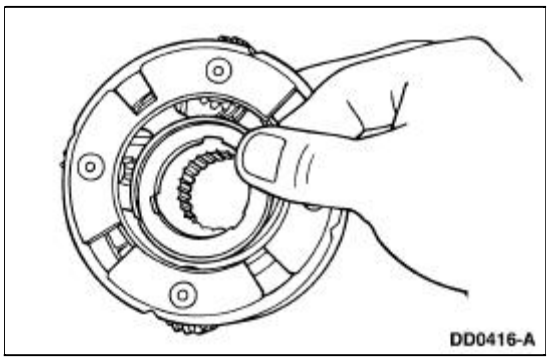


Forward Planet Assembly

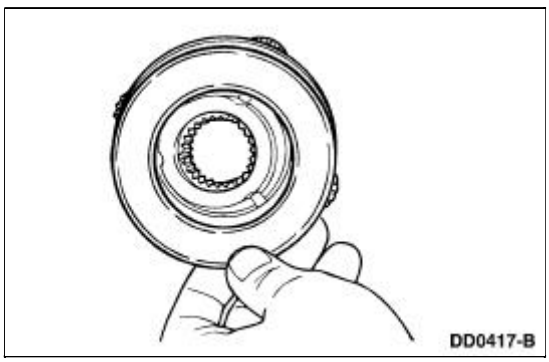
Disassembly

NOTE: Individual parts of the planet assemblies are not repairable.

1. Remove the No. 9B forward clutch thrust bearing.



2. Remove the No. 10A forward planet assembly thrust bearing.
   - The pins and shafts in the plant assemblies should be checked for loose fit/damage. Use a new planet assembly if either condition exists.
   - Inspect the pinion gears for damaged or excessively worn teeth.
   - Check for free rotation of the pinion gears.
   - Check for damage in the overdrive planet assembly.



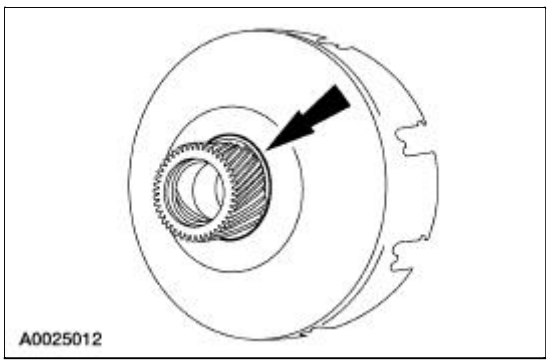
Assembly

1. Follow the disassembly procedure in reverse order.
   - Lightly lubricate the thrust bearing with petroleum jelly to hold it in place during assembly.
   - The No. 9B thrust bearing must be installed with the notched inner race facing outward.

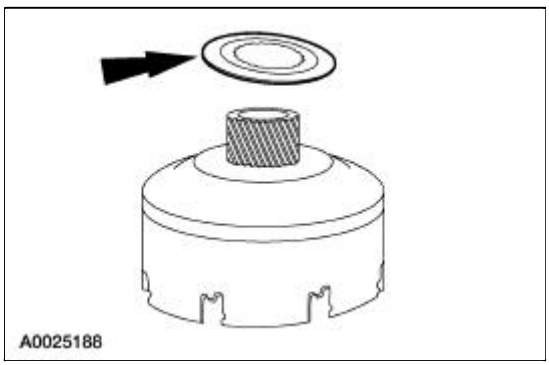
Input Shell

Disassembly

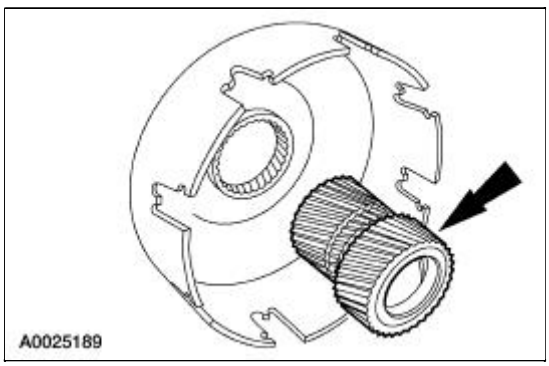
1. Remove and discard the forward/reverse sun gear retaining ring.



2. Remove the No. 14 input shell thrust washer.



3. Remove the forward/reverse sun gear.



Assembly

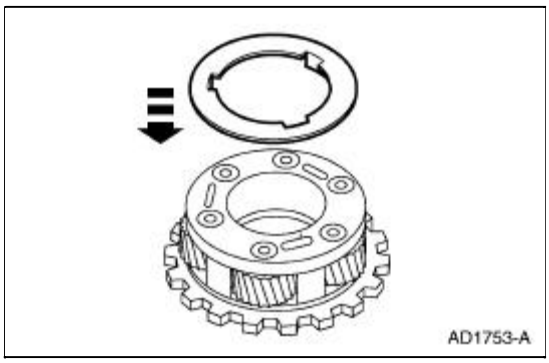
1. Follow the disassembly procedure in reverse order.
    - Install the sun gear with the lube hole between the stand-off pads on the input shell.
    - Use care not to overextend the new retaining ring.

Reverse Planet Assembly

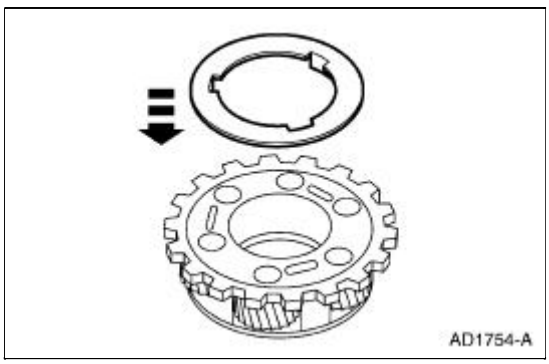
Disassembly

NOTE: Individual parts of the planet assemblies are not repairable.

1. Remove the No. 11 rear reverse planet thrust washer.



2. Remove the No. 10B front reverse planet thrust washer.
   - The pins and shafts in the planet assemblies should be checked for loose fit/damage. Use a new planet assembly if either condition exists.
   - Inspect the pinion gears for damaged or excessively worn teeth.
   - Check for free rotation of the pinion gears.
   - Check for damage in the overdrive planet assembly.

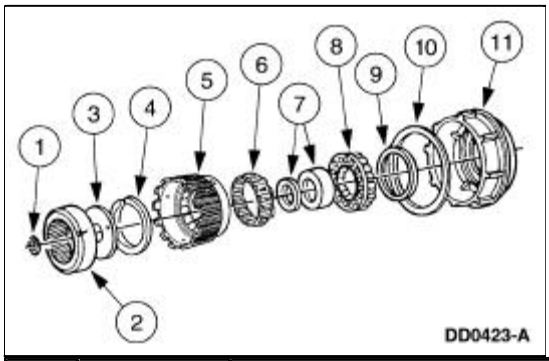


Assembly

1. Follow the disassembly procedure in reverse order.
   - Lightly lubricate the thrust washers with petroleum jelly to hold them in place during assembly.
   - The tabs on the thrust washers must engage the slots on the reverse planet assembly when installed.

Low One-Way Clutch Assembly

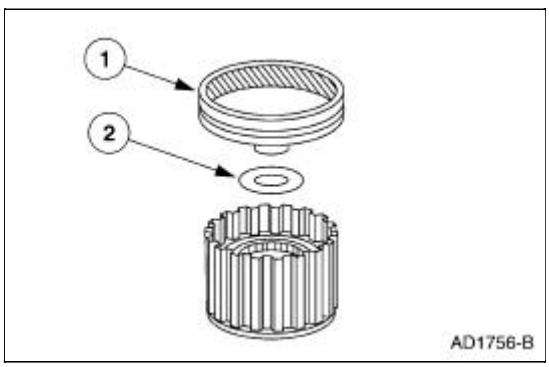
Low/Reverse One-Way Clutch Assembly and Piston, Disassembled View



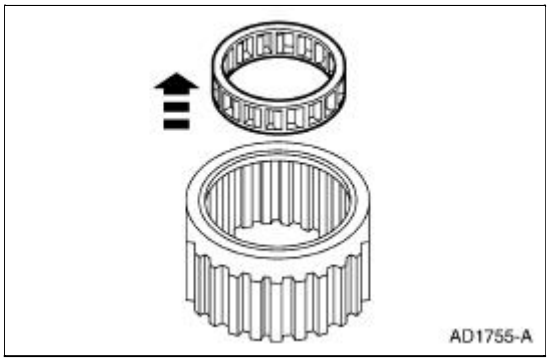
Item	Part Number	Description
1	387031-S	Output shaft retaining ring
2	7A153	Output shaft ring gear
3	7D164	Output shaft hub
4	377132-S	Retaining ring
5	7B067	Reverse clutch hub
6	7A089	Low one-way clutch assembly
7	7G178	Low/reverse one-way clutch inner race and thrust bearing assembly No. 12
8	7D406	Reverse clutch return spring assembly
9	7D404	Reverse clutch piston inner lip seal
10	7D403	Reverse clutch piston outer lip seal
11	7D402	Reverse clutch piston

Disassembly and Assembly

1. Remove the output shaft ring gear and the No. 12 thrust bearing.
    1. Remove the ring gear.
    2. Remove the bearing.



2. If necessary, remove the low one-way clutch (17 roller) assembly by rotating it counterclockwise to unlock the tabs.



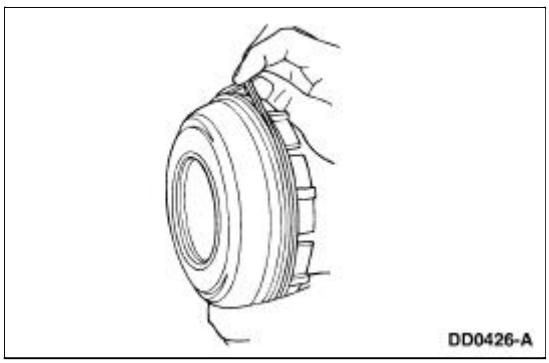
3. Inspect the following:
    - Reverse clutch hub thrust surfaces for scores.
    - Reverse clutch hub splines for wear.
    - Outer and inner low/reverse one-way clutch race for scores and damaged surface areas where rollers contact races.
    - Rollers and springs for excessive wear or damage.
    - Spring and cage.

4. For assembly, follow the disassembly procedure in reverse order.

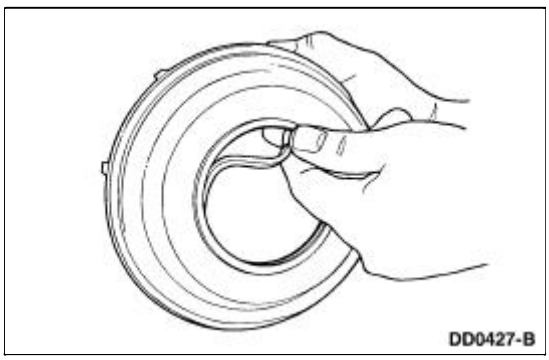
Reverse Clutch Piston

Disassembly and Assembly

1. Remove the reverse clutch piston outer lip seal.



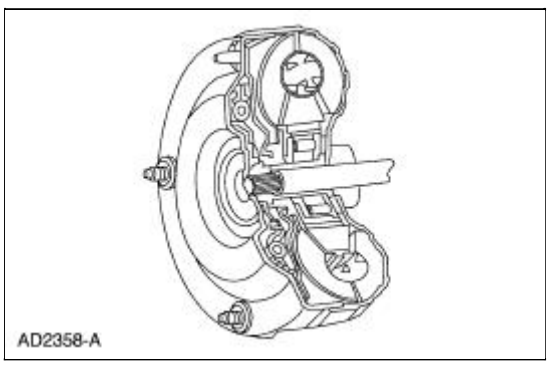
2. Remove the reverse clutch piston inner lip seal.



3. For assembly, follow the disassembly procedure in reverse order.
    - Make sure the lip on the seal faces the back side of the piston.

Torque Converter

1. The torque converter must be replaced if one or more of the following statements are true:
   - A torque converter malfunction has been determined based on the complete diagnostic procedures.
   - Converter stud(s), impeller hub or bushing is damaged.
   - Discoloration of the torque converter (due to overheating).
   - The torque converter is found to be out of specification when carrying out one of the following torque converter checks:
     - One-Way Clutch Check
     - End Play Check
     - Stator to Turbine Interference Check
     - Stator to Impeller Interference Check
     - Torque Converter Leak Check
   - Evidence of transmission assembly or fluid contamination due to the following transmission or converter failure modes:
     - major metallic failure
     - multiple clutches or clutch plate failures
     - sufficient component wear which results in metallic contamination



Torque Converter Cleaning And Inspection

Material

Item	Specification
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®

1. If installing a new torque converter, continue with sub-step 2 of Step 2.

2. If not installing a new torque converter, the following procedures must be carried out:
    1. The torque converter must be thoroughly cleaned.
        - Torque converter with drain plugs may be cleaned by using a suitable torque converter/transmission fluid cooler cleaner.
        - Torque converter without drain plugs may be cleaned by hand. Partially fill the torque converter using only the recommended transmission fluid for the applicable transmission. Hand-agitate the torque converter and then thoroughly drain the fluid. Refill the torque converter with new fluid specified for the transmission, and install.
    2. The in-tank and auxiliary coolers must be thoroughly cleaned by forward and backward flushing. For additional information, refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section.
    3. The cooler lines must be thoroughly cleaned by backward and forward flushing. For additional information, refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section.
    4. All cooler bypass valves (CBV), if equipped, must be thoroughly cleaned.
    5. Carry out the Transmission Fluid Cooler Flow Test.
    6. If the transmission cooling system fails the Transmission Fluid Cooler Flow Test, the auxiliary fluid cooler, cooler bypass valve, and or cooler lines may require installation of new components. For additional information, refer to Section 307-02 .
    7. If the internal cooler needs to be replaced, refer to Section 303-03 . If a new auxiliary cooler needs to be installed, refer to Section 307-05 . If a new CBV needs to be installed, use only factory-approved service parts.

Torque Converter Flushing

Material

Item	Specification
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®

1. **CAUTION: Mineral spirits used to clean the torque converter must be fresh, non-chlorinated and non-halogenated.**

   Following the instructions included with a suitable torque converter/transmission fluid cooler cleaner, flush the torque converter.

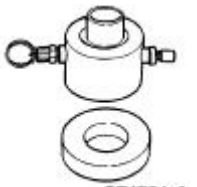
2. After flushing, drain the remainder of the solvent through the converter drain plug.

3. Add 1.9 liter (2 qt.) of clean automatic transmission fluid into the converter fluid filler tube and agitate by hand.

4. Thoroughly drain the solution.

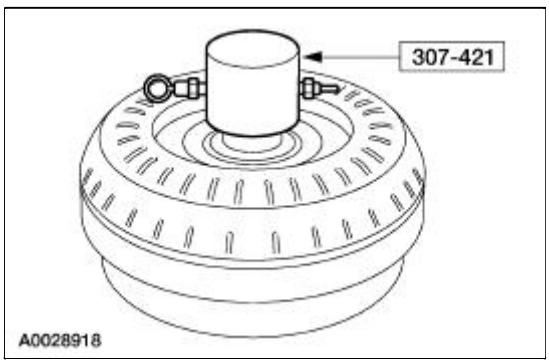
Torque Converter Leak Check

Special Tool(s)

 ST1731-A	Leak Tester, Torque Converter 307-421

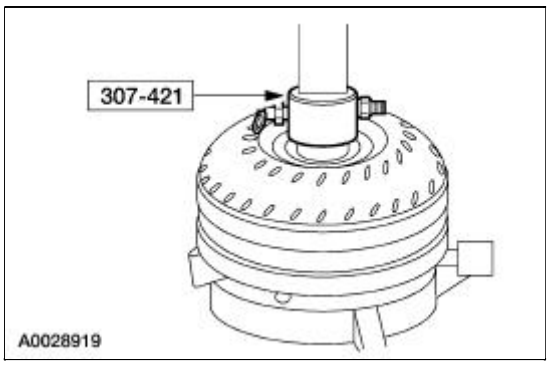
1. Clean the outside surface of the torque converter.

2. Install the special tool into the converter hub.



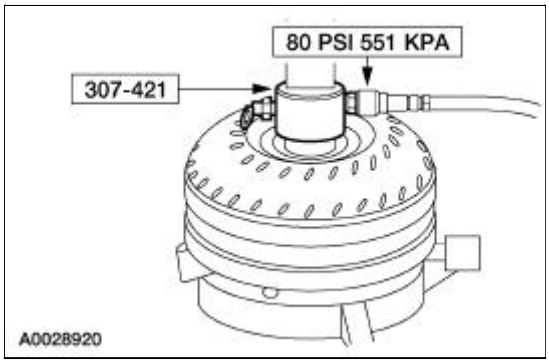
3. **WARNING: Always follow correct safety procedures while using the press.**

   Install the torque converter with the special tool into the Arbor press.
   Secure the press. Apply enough force from the press to seal the special tool into the torque converter.

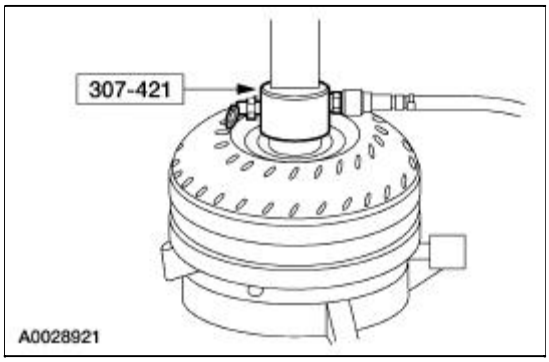


4. **NOTE:** Use clean, dry shop air.

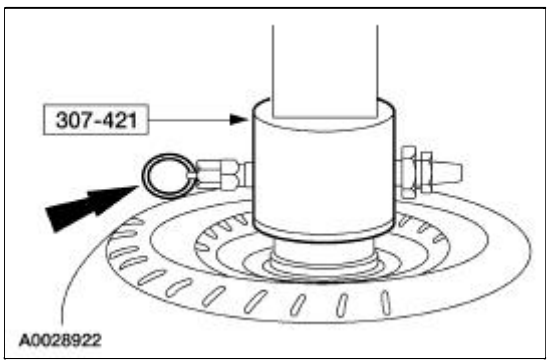
   Apply air pressure to the valve on the special tool.



5. With air pressure applied to the special tool, inspect for leaks at the converter hub, the seams and the studs. A soap bubble solution can be applied around those areas to aid in the diagnosis. If any leaks are present, install a new or remanufactured torque converter.



6. Remove the air hose. Release the pressure, and then slowly release the press. Remove the converter. Remove the special tool.



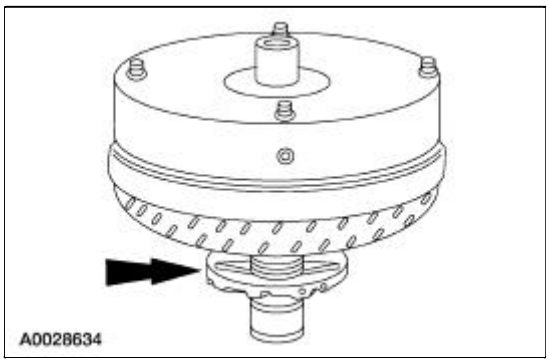
Torque Converter Impeller to Pump Stator Interference Check

1. **CAUTION: To carry out this check, do not use the pump stator support which will be installed in the transmission. Damage to the pump stator support, front pump seal or front pump stator seal may occur.**

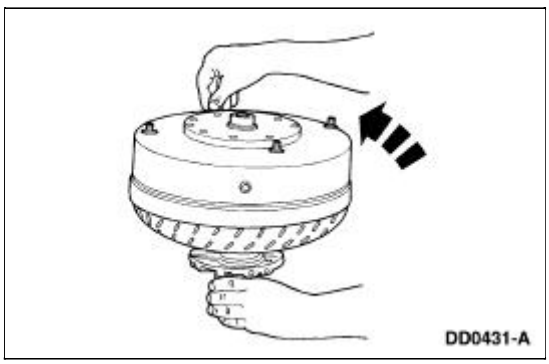
   NOTE: Obtain a scrapped pump. Remove the stator support. This can be used as a permanent tool to carry out this check.

   Position the stator support with the splines up.

2. Mount the torque converter on the stator support so that the splines on the one-way clutch inner race engage the mating splines of the stator support.

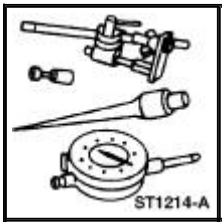


3. Hold the stator support stationary and rotate the torque converter counterclockwise.
   - The torque converter should rotate freely, with no signs of scraping.
   - If there are signs of scraping, install a new or remanufactured torque converter.

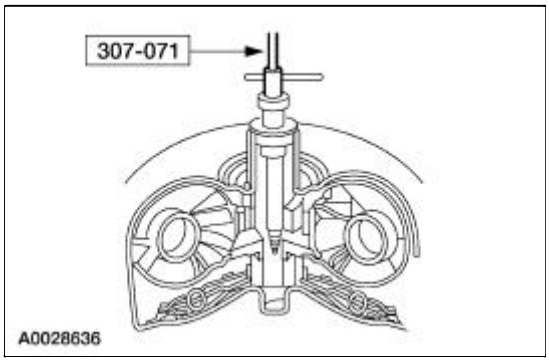


Torque Converter End Play Check

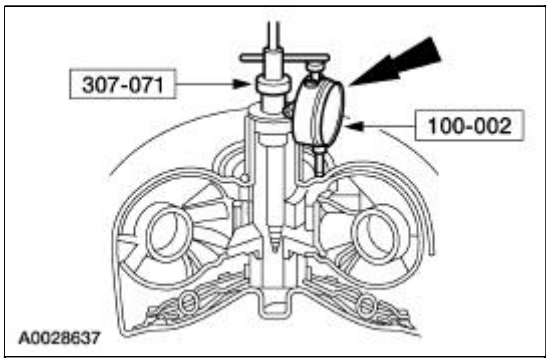
Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or Equivalent
 ST1196-A	End Play Gauge, Torque Converter 307-071 (T80L-7902-A)

1. Install the special tool into the torque converter pump drive.
   - Tighten the inner post until the tool is securely locked.



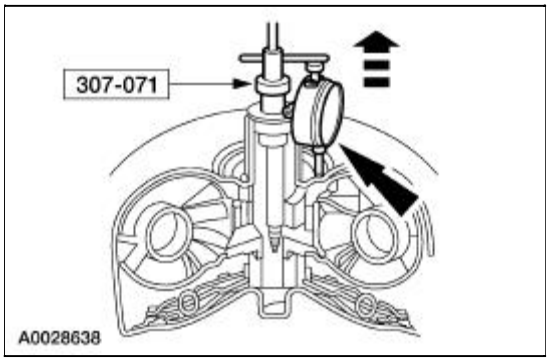
2. Install the special tool on the converter pump drive hub and zero the dial indicator.



3. Lift up on the special tool as far as it will move and note the dial indicator reading.
   - If the reading exceeds end play limits, replace the torque converter.

Torque Converter End Play

Engine	New or Rebuilt Torque Converter		Used Torque Converter	
	mm	Inch	mm	Inch
Gas	0.35- 0.96	0.014- 0.038	1.8 Max.	0.071 Max.



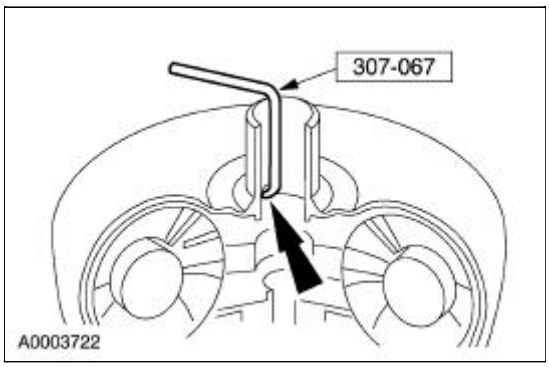
4. Remove the special tool.

Torque Converter One-Way Clutch Check

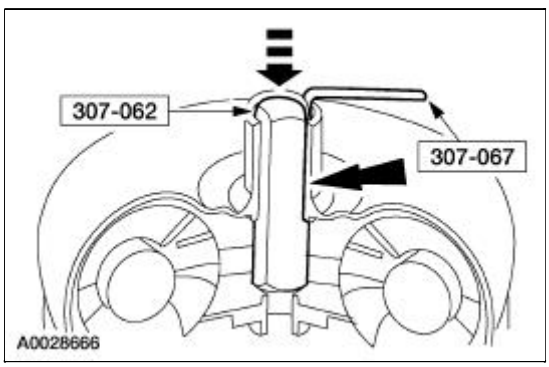
Special Tool(s)

 ST1193-A	Holding Tool, One-Way Clutch 307-062 (T76L-7902-C) or equivalent
 ST1195-A	Holding Tool, Torque Converter Clutch 307-067 (T77L-7902-R) or equivalent

1. Insert the special tool in one of the grooves in the stator thrust washer.

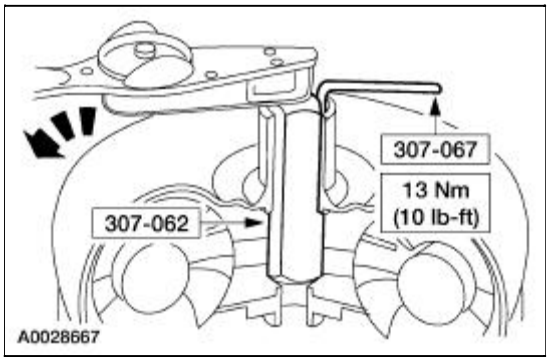


2. Install the special tool in the converter pump drive.



3. Using a torque wrench, turn the special tool counterclockwise while holding the special tool stationary.
   - The converter one-way clutch should lock up and hold the specified torque.
   - The torque converter one-way clutch should rotate freely in the clockwise direction.
   - Try the clutch for lockup and hold in at least five positions.

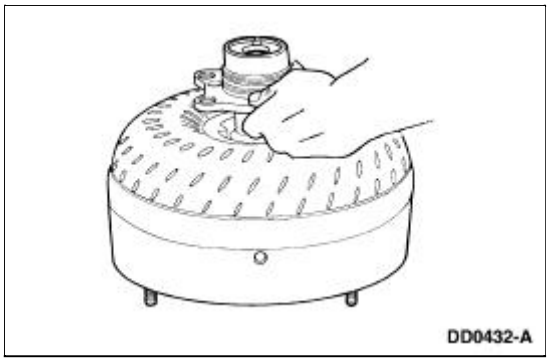
- If the clutch fails to lock up and hold the specified torque, install a new or remanufactured torque converter.



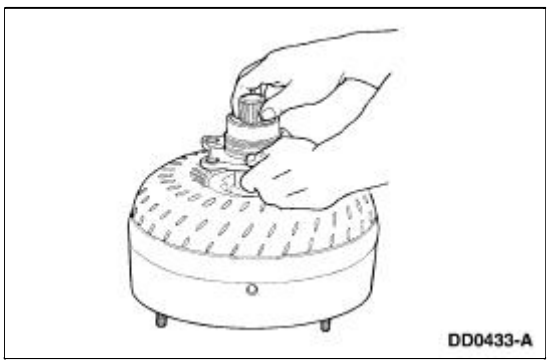
Torque Converter Turbine to Pump Stator Interference Check

1. Position the torque converter with the converter hub up.

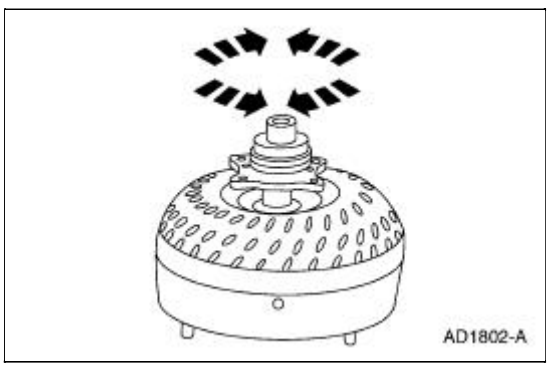
2. Install a pump stator support, engaging the mating splines of the stator support shaft.



3. Install the input shafts, engaging the splines with the turbine hub.



4. Hold the stator support stationary and attempt to rotate the turbine with the input shafts.
   - The turbine and lockup clutch assemblies should rotate in both directions, without any signs of interference or metallic scraping noise.

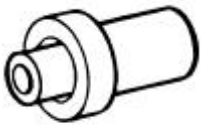
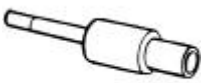
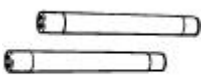


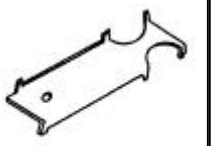
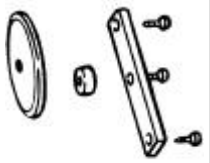
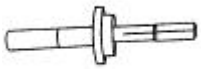
5. If interference exists, the stator front thrust washer may be worn, allowing the stator to hit the turbine. In such cases, a new or remanufactured torque converter must be installed.
   - Check the converter crankshaft pilot for nicks or damaged surfaces that could cause

interference when installing the torque converter into the crankshaft pilot. Check the converter front impeller hub for nicks or sharp edges that would damage the pump seal.

Transmission

Special Tool(s)

 ST1274-A	Depth Micrometer 303-D026 (D80P-4201-A) or equivalent
 ST1740-A	Installer, Transmission Extension Housing Fluid Seal 307-013 (T61L-7657-B)
 ST1190-A	Compressor, Clutch Spring 307-015 (T65L-77515-A)
 ST1199-A	Installer, Shift Shaft Fluid Seal 307-050 (T74P-77498-A)
 ST1745-A	Installer, Transmission Extension Housing Bushing 307-063 (T77L-7697-C)
 ST1748-A	Handle, Torque Converter 307-091 (T81P-7902-C)
 ST2549-A	Aligner, Transmission Fluid Pump 307-222 (T89T-70010-B)
	Alignment Gauge, TR Sensor 307-351 (T97L-70010-A)

 ST1633-A	
 ST1854-A	Installer, Fluid Filler Tube 307-376
 ST2547-A	Installer, Output Shaft Bushing 307-381 (Vehicle Dependent)
 ST2544-A	Installer, Transmission Forward Clutch Assembly 307-436
 ST1851-A	Service Set, Clutch Spring 307-S223 (T89T-70010-C)
 ST2159-B	Loading Fixture, Clutch 307-S383

Material

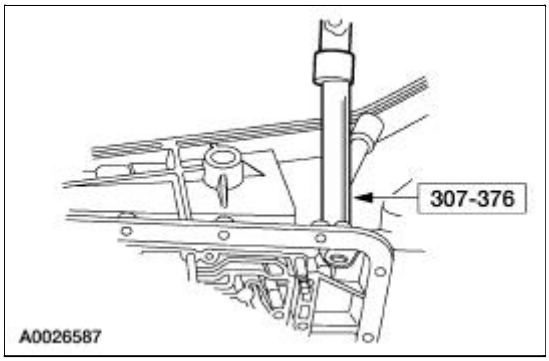
Item	Specification
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®

NOTE: Soak all friction clutch plates in clean automatic transmission fluid.

NOTE: Prior to installation, lightly lubricate all O-ring seals with clean automatic transmission fluid.

NOTE: Lightly lubricate all thrust washers with petroleum jelly to hold them in place during assembly.

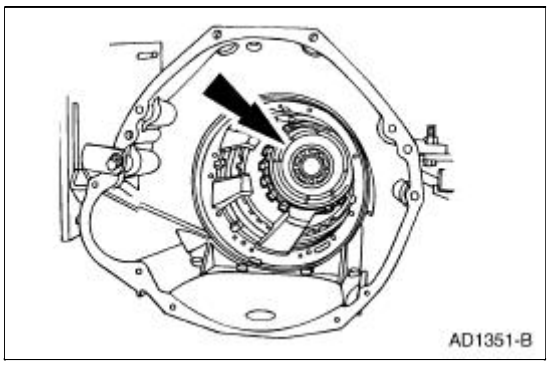
1. Mount the transmission case into suitable stand.
2. If removed, use the special tool to install the short fluid inlet tube.



3. **CAUTION: If equipped, use care not to misalign the reverse clutch piston in the case bore.**

   NOTE: Coat the reverse clutch piston seals with petroleum jelly.

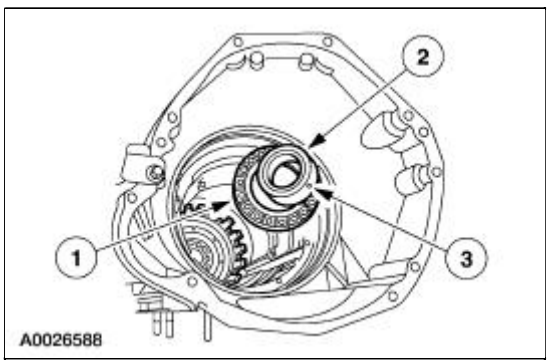
   Install the reverse clutch piston in the case until it is fully seated in the case.



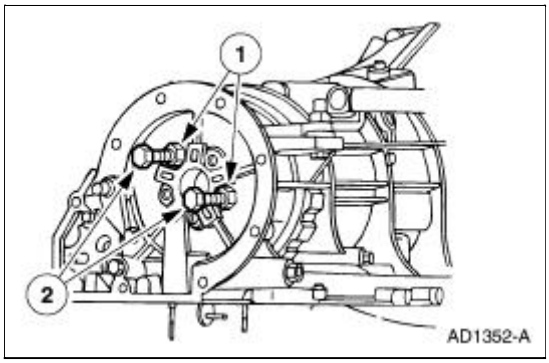
4. **CAUTION: The low/reverse clutch inner race is vehicle-dependent. Refer to parts catalog for the correct parts.**

   NOTE: Clock position is viewed looking into the converter housing with the top of the transmission in the 12 o'clock position.

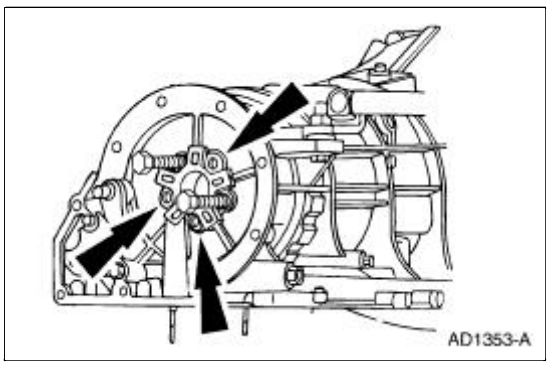
   Install the reverse clutch return spring assembly.
   1. Install the reverse clutch return spring assembly.
   2. Install the low/reverse one-way clutch inner race.
   3. Make sure that the lubrication hole on the face is in the 5 o'clock position.



5. Install two 5/16-24 x 3 inch bolts with nuts in to the low/reverse one-way clutch inner race.
   1. Hold the nut.
   2. Turn the bolt to compress the low/reverse piston return spring.

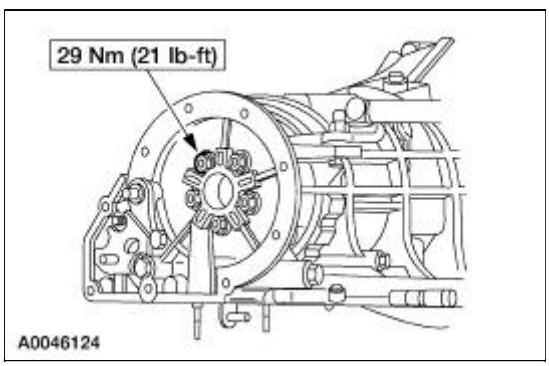


6. Install three of the one-way clutch inner race bolts and remove the two 5/16-24 x 3 bolts.



7. **NOTE:** Alternate tightening bolts from one side to the other (not in a circle).

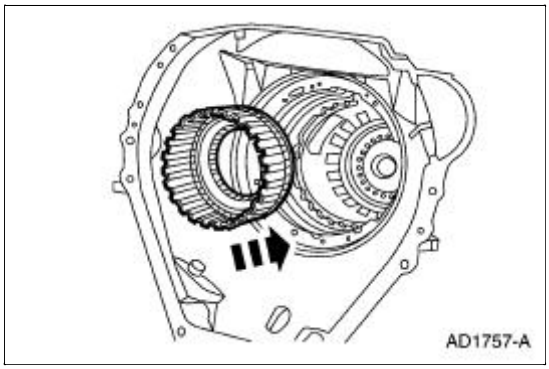
   Install the remaining bolts retaining the low/reverse one-way clutch inner race to the case.



8. **CAUTION: The low/reverse clutch, one-way clutch is vehicle-dependent. Refer to parts catalog for the correct parts.**

   NOTE: When the reverse clutch and the low one-way clutch are installed, the reverse clutch should rotate clockwise. The one-way clutch will hold and not let the clutch hub rotate counterclockwise.

   Install the reverse clutch hub and the low one-way clutch assembly over the low/reverse one-way clutch inner race by pressing the hub inward and rotating it clockwise to seat fully.

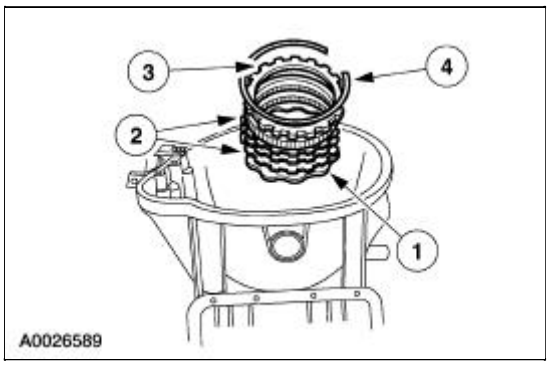


9. **CAUTION: The number of plates is vehicle-dependent.**

   NOTE: No stack-up clearance measurement is required.

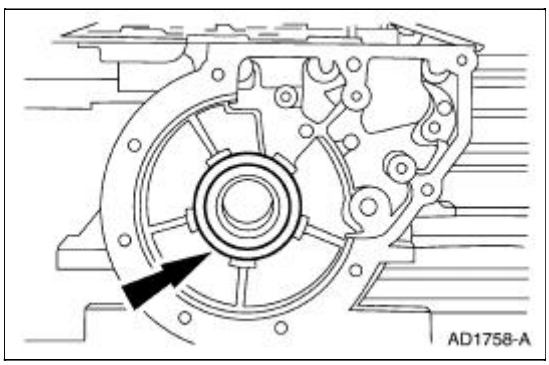
   NOTE: Clock position is viewed looking into the converter housing with the top of the transmission in the 12 o'clock position.

   Install the reverse clutch pack assembly.
   1. Install the cushion spring.
   2. Install the reverse clutch plates starting with an external spline steel plate and alternating with internal splined friction plates.
   3. Install the reverse clutch pressure plate.
   4. Install the reverse clutch pressure plate retainer snap ring with the ring opening between the 12 o'clock and 3 o'clock positions.



10. **NOTE:** Apply petroleum jelly to the No. 13 parking gear bearing to hold it in place.

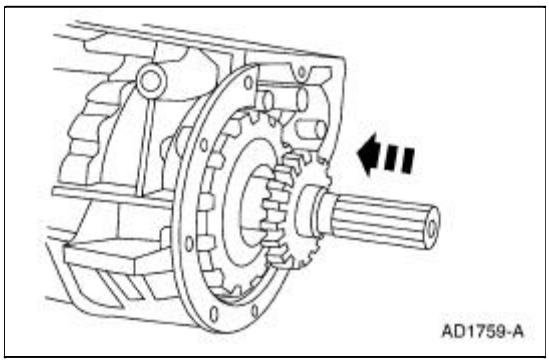
    Install the No. 13 parking gear bearing.



11. **CAUTION: Use care not to damage the output shaft drive sprocket speed sensor wheel. This will cause an incorrect reading at the output shaft speed (OSS) sensor, which**

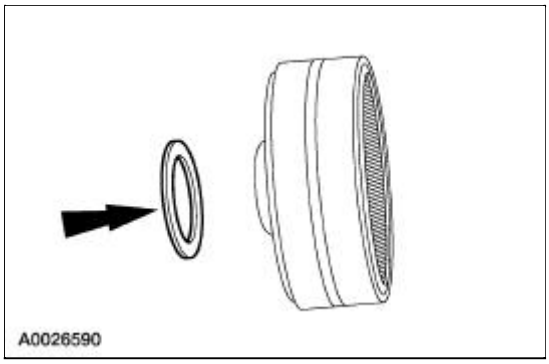
will cause a repeat repair.

Install the output shaft.

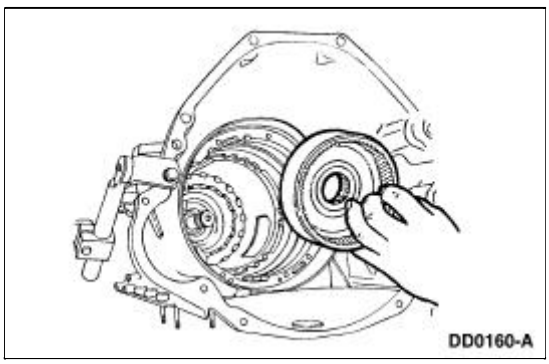


12. **NOTE:** Lubricate the thrust bearing with petroleum jelly to hold it in place during assembly.

    Install the No. 12 thrust bearing onto the rear surface of the hub assembly.

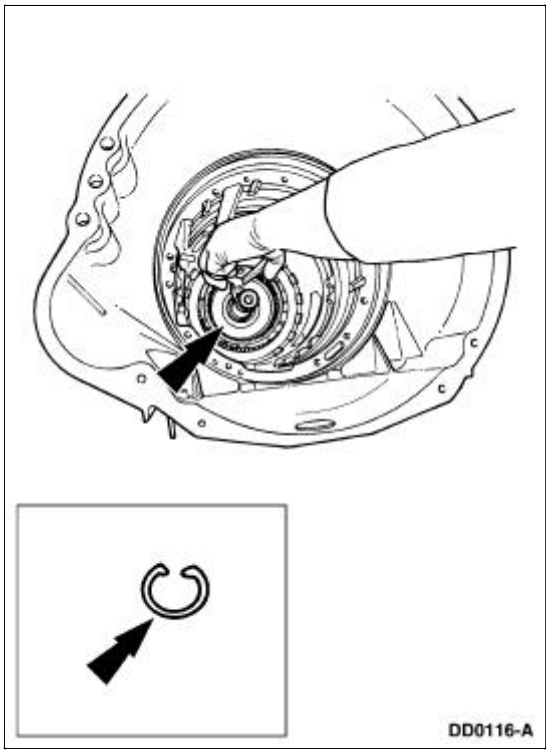


13. Install the output shaft ring gear assembly.

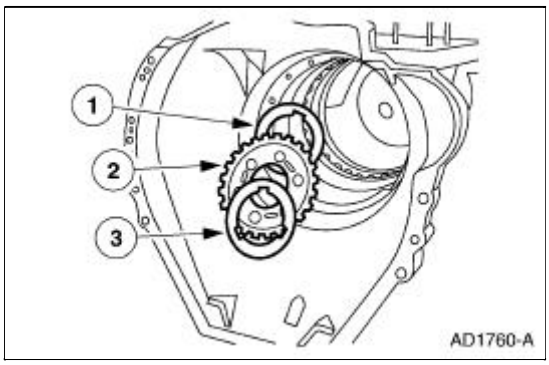


14. **WARNING: Do not overextend the output shaft retaining ring during installation. Make sure the output shaft retaining ring is securely seated in the groove. Failure to follow these instructions may result in personal injury.**

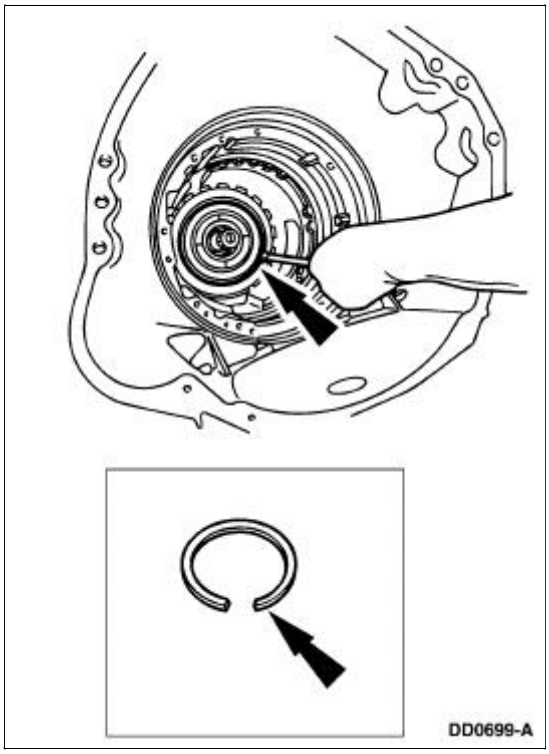
    Install the new output shaft retaining ring onto the output shaft.



15. Install the reverse planet assembly.
    1. Install the No. 11 thrust washer.
    2. Install the reverse planet.
    3. Install the No. 10B thrust washer.



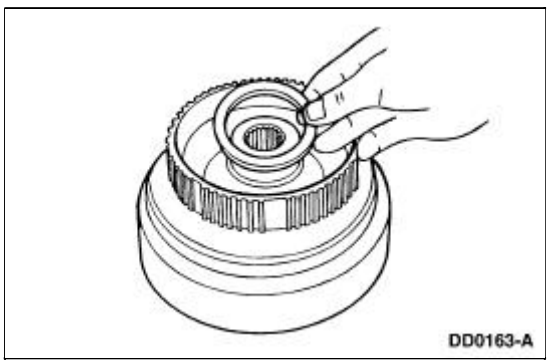
16. Install the reverse planet retaining ring into the reverse clutch hub, making sure the retaining ring is fully seated.



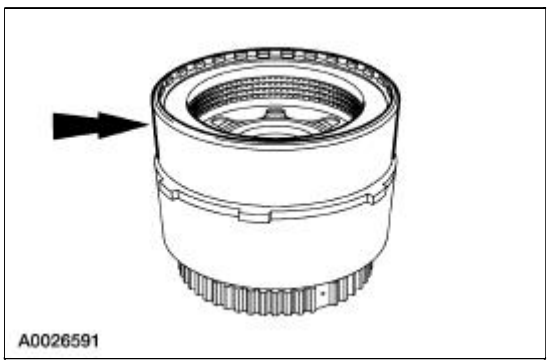
17. **NOTE:** The large outer diameter radius of the needle bearing must be installed facing inward.

    NOTE: Lightly lubricate the needle bearing with petroleum jelly to hold it in place during assembly.

    Verify the No. 8B forward clutch needle bearing is installed.

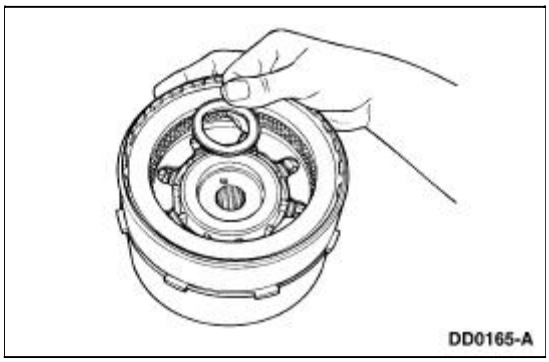


18. Install the forward clutch cylinder assembly onto the intermediate brake drum by rotating it until fully seated.



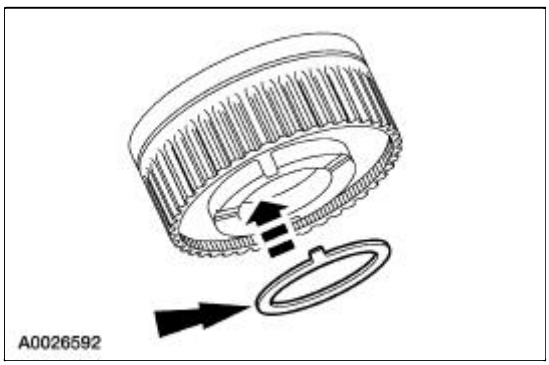
19. **NOTE:** Lightly lubricate the thrust bearing with petroleum jelly to hold it in place during assembly.

    Verify the No. 9A forward clutch thrust bearing is installed (black side facing up).

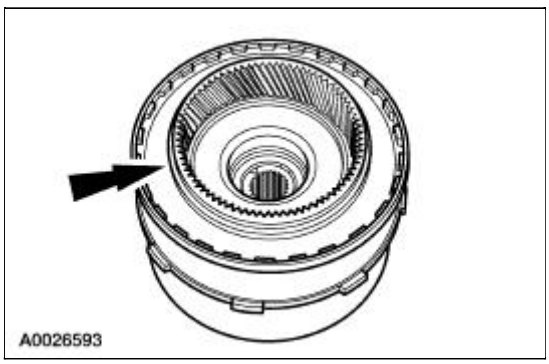


20. **NOTE:** Lightly lubricate the thrust washer with petroleum jelly to hold it in place during assembly.

    Place the No. 8C forward clutch hub thrust washer onto the forward hub and ring gear assembly.

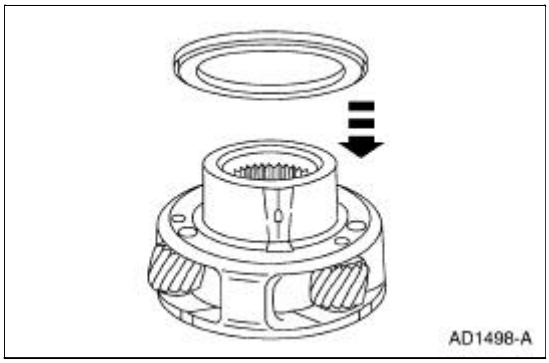


21. Place the forward hub and ring gear assembly into the intermediate brake drum and forward clutch cylinder assemblies.

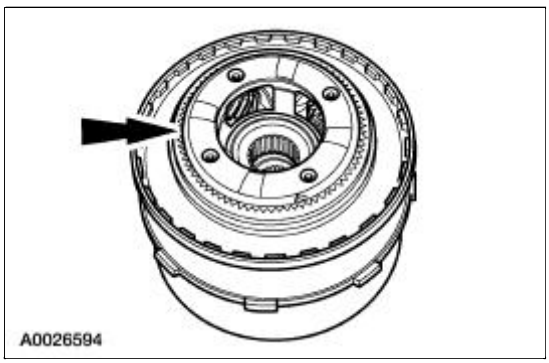


22. **NOTE:** Lightly lubricate the thrust bearing with petroleum jelly to hold it in place during assembly.

    Verify the No. 10A forward planet assembly thrust bearing is installed.

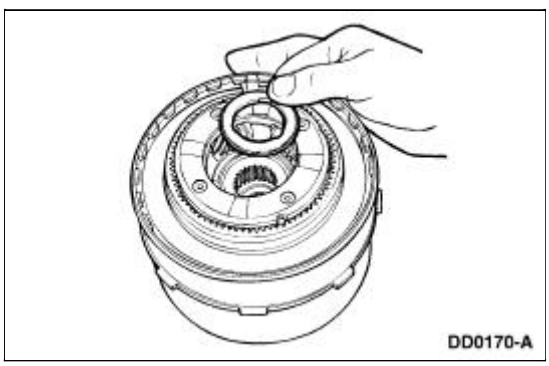


23. Place the forward planet assembly into the forward hub and ring gear assembly.

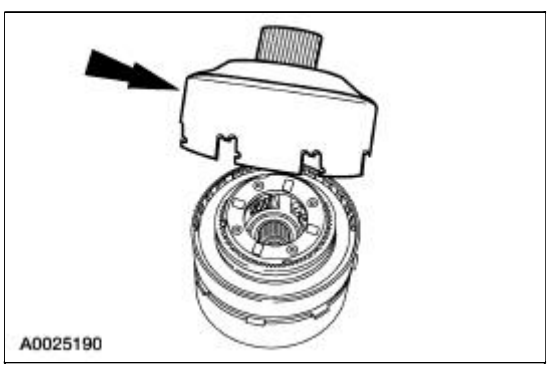


24. **NOTE:** The thrust bearing notched inner race must face outward and the large outer diameter radius must face inward.

    Verify the No. 9B forward clutch thrust bearing is installed.

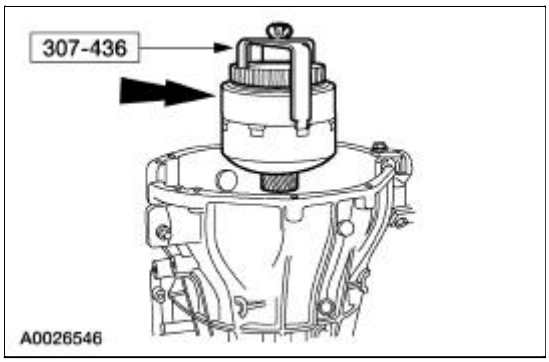


25. Align the notches with the lugs and position the input shell onto the intermediate brake drum. Rotate the input shell until fully seated.

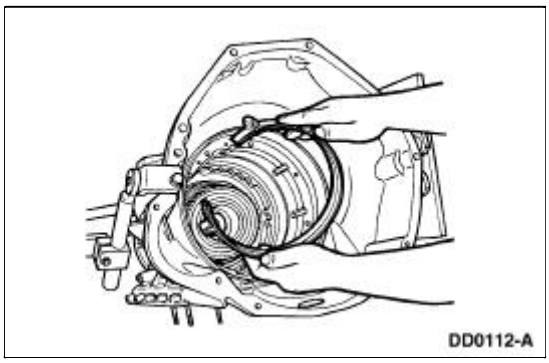


26. **NOTE:** When installing the special tool, each leg of the tool must be rotated separately to engage notches on the input shell, prior to tightening the top cross bar.

    Using the special tool, lower the direct clutch, forward clutch and input shell as an assembly into the case.

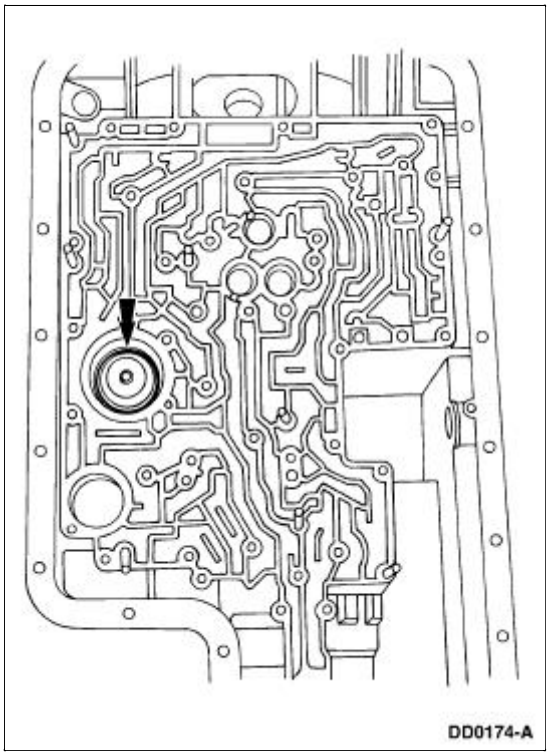


27. Install the intermediate band with the ear resting on the anchor pin.



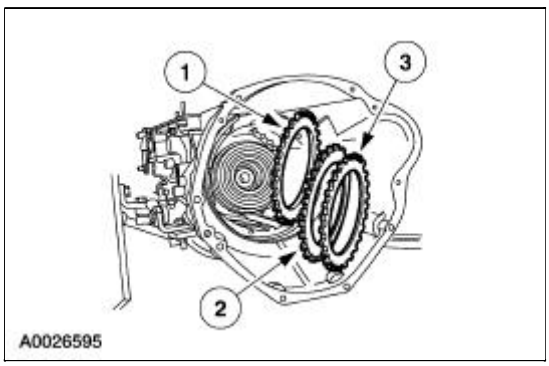
28. **NOTE:** Prior to installation, lightly lubricate the piston seal with clean automatic transmission fluid.

    Gently press the intermediate band servo assembly piston into the case bore.



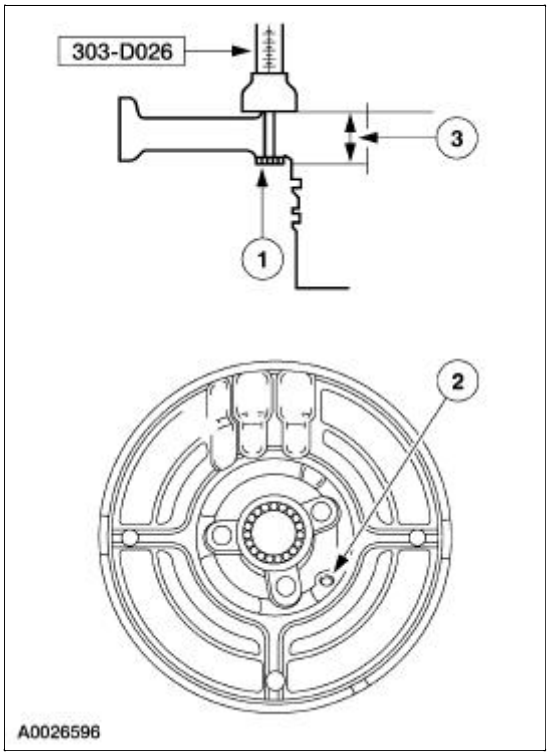
29. **NOTE:** Clock position is viewed looking into the converter housing with the top of the transmission in the 12 o'clock position.

    Install the intermediate clutch pack.
    1. Install the intermediate clutch pressure plate.
    2. Install the intermediate clutch pack starting with an internal spline plate and alternating with external spline plates.
    3. Install the intermediate clutch pressure apply plate with blank area (no teeth) in the 6 o'clock and 12 o'clock positions.



30. **NOTE:** The following stack-up check measurement indicates not only the amount of space existing between the center support assembly and the intermediate brake drum, it also will indicate if the unit has been correctly built to this point.

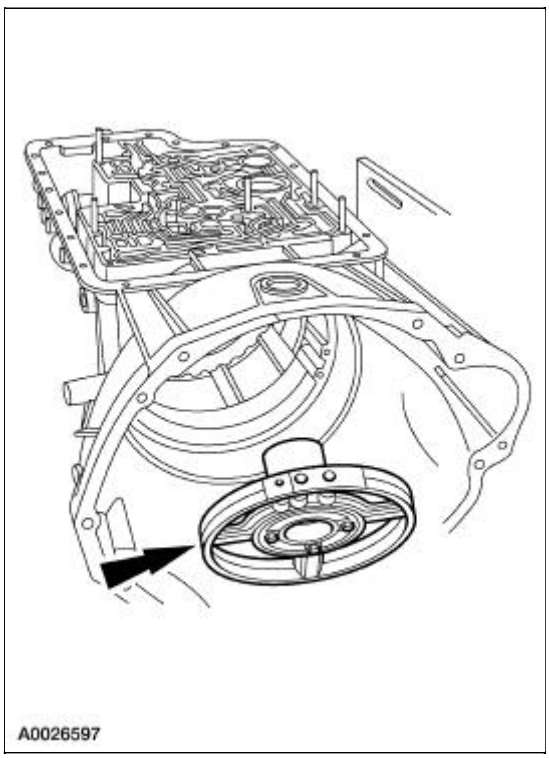
    Measure the stack up.
    1. Hold the thrust washer against the center support assembly.
    2. Extend the probe of the special tool into the hole until flush with the No. 6 center support thrust washer surface.
    3. Record this as reading 1.



31. **CAUTION: Do not misalign the center support in the case bore. This can cause case bore damage.**

    NOTE: Make sure the No. 6 center support thrust washer is on the center support prior to installation.

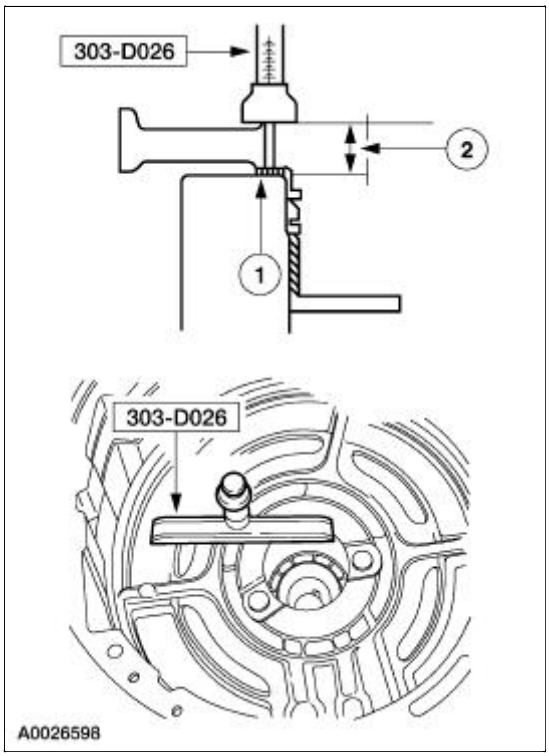
    Install the center support assembly with the feed holes aligned in the case.



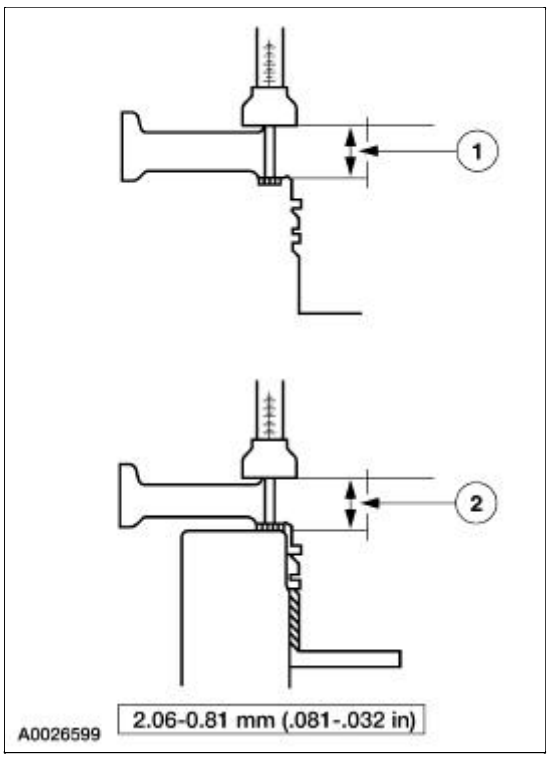
32. Make a second measurement after installation of the center support.
    1. Extend the probe of the special tool into the hole in the center support assembly until

flush with the No. 6 center support thrust washer.

2. Record this as reading 2.

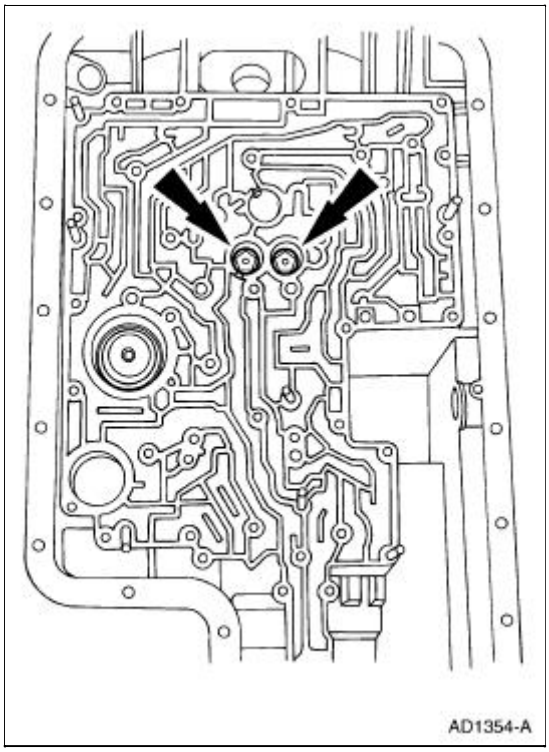


33. Subtract reading 1 from reading 2. Record this as reading 3. If the final dimension is outside specified limits, this indicates that the transmission has been assembled incorrectly.



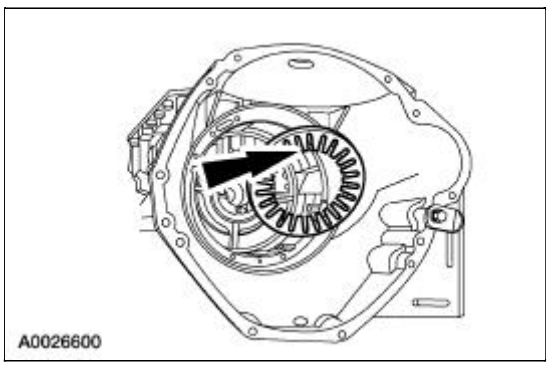
34. **CAUTION: Do not tighten the bolts at this time. This could cause transmission failure.**

Loosely install two new feedbolts.



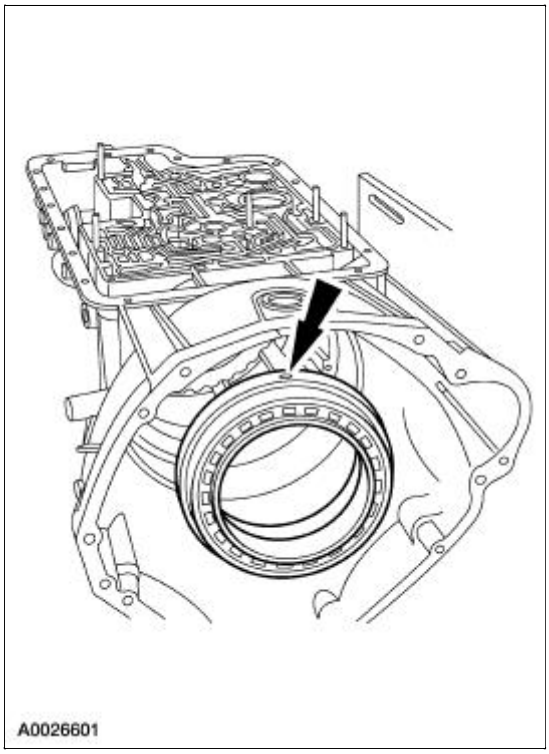
35. **NOTE:** Clock position is viewed looking into the converter housing with the top of the transmission in the 12 o'clock position.

    Install the intermediate clutch return spring with the dished surface inward and one spring leg in the 6 o'clock position.



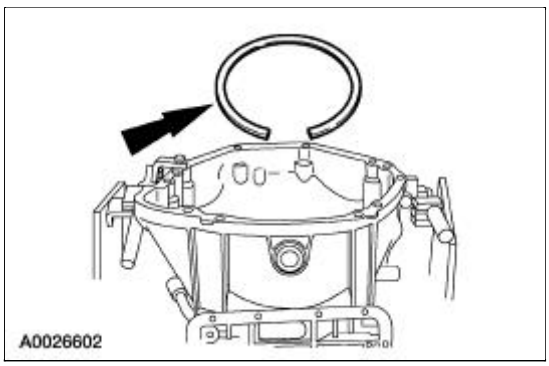
36. **CAUTION: Do not misalign the intermediate/overdrive cylinder assembly. This can damage the case bore.**

    Install the intermediate/overdrive cylinder assembly with the feed holes aligned with the holes in the case.

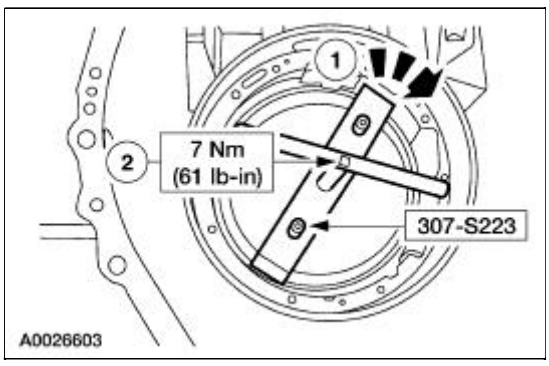


37. **NOTE:** Clock position is viewed looking into the converter housing with the top of the transmission in the 12 o'clock position.

    Install the intermediate/overdrive cylinder retaining ring over the intermediate/overdrive cylinder with the ring opening in the 6 o'clock position to allow for the correct fluid drainback.



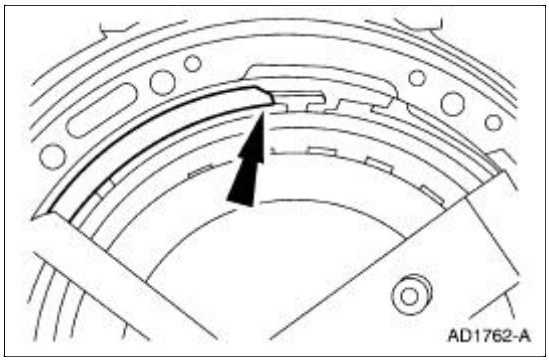
38. Install the special tool.
    1. Rotate the special tool clockwise to lock in place.
    2. Tighten the handle.



39. **CAUTION: Make sure the snap ring is fully seated into the case. Transmission failure could occur.**

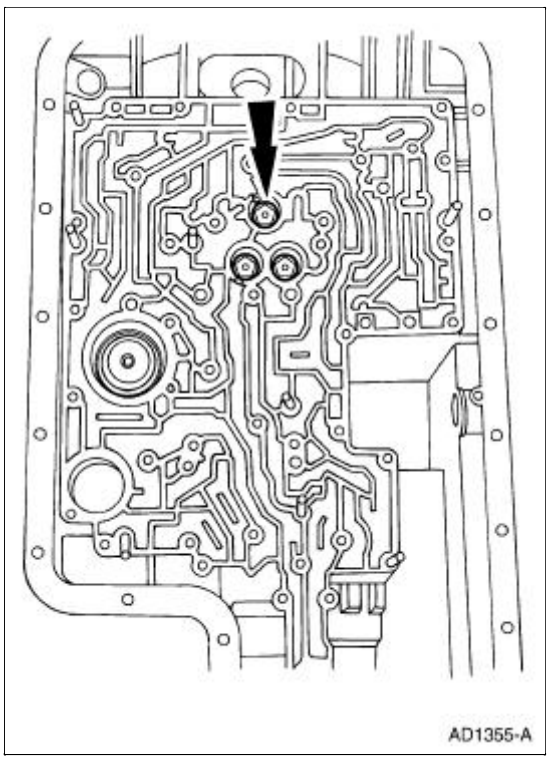
NOTE: Clock position is viewed looking into the converter housing with the top of the transmission in the 12 o'clock position.

Seat the intermediate/overdrive cylinder retaining ring into the case ring groove with the ring opening in the 6 o'clock position.

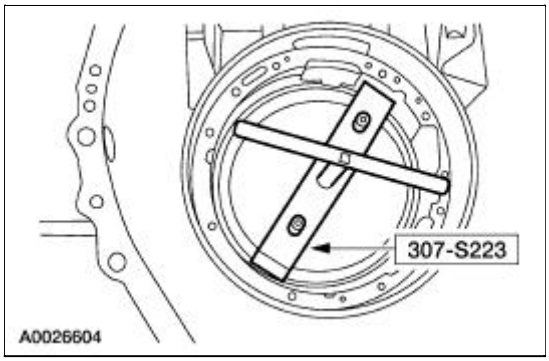


40. **CAUTION: Do not tighten the bolts at this time. Transmission failure could occur.**

Loosely install a new intermediate/overdrive cylinder feedbolt.



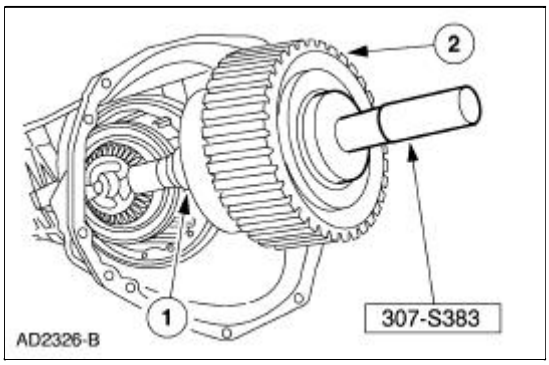
41. Loosen the center bolt and remove the special tool.



42. **NOTE:** The special tool must be used to install the coast clutch assembly or damage to the overdrive one-way clutch may occur.

    NOTE: Use petroleum jelly to hold the No. 5 thrust bearing on the center shaft during assembly.

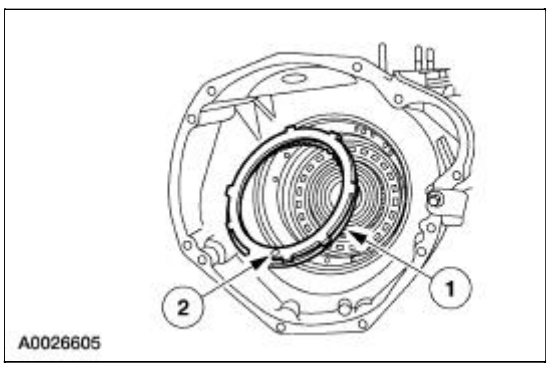
    Using the special tool, install the coast clutch and No. 5 thrust bearing assembly.
    1. Install the No. 5 thrust bearing.
    2. Install the coast clutch assembly.



43. **NOTE:** The number of plates in the clutch pack is vehicle-dependent.

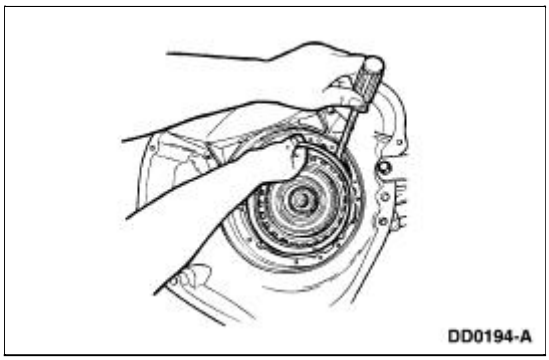
    NOTE: Clock position is viewed looking into the converter housing with the top of the transmission in the 12 o'clock position.

    Install the overdrive clutch pack.
    1. Install the overdrive clutch pack starting with a steel plate and alternating with friction plates.
    2. Install the overdrive clutch pressure plate with the dot facing outward and in the 12 o'clock position.

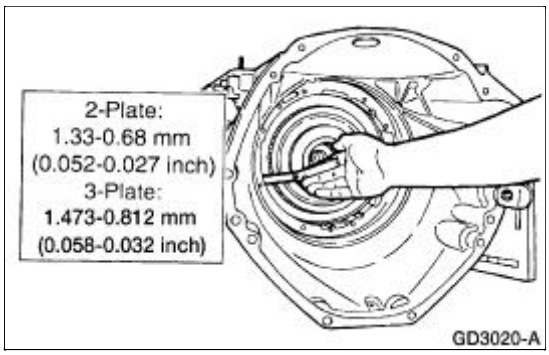


44. **NOTE:** Clock position is viewed looking into the converter housing with the top of the transmission in the 12 o'clock position.

Install the overdrive clutch pressure plate retainer snap ring with the ring opening in the 6 o'clock position.

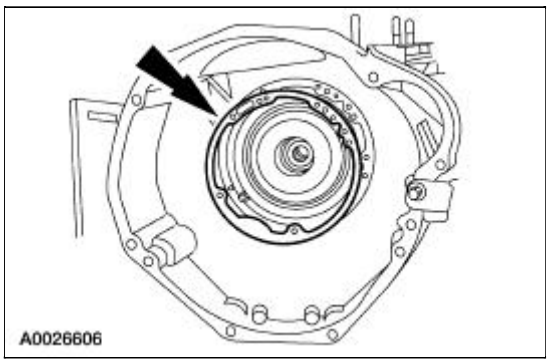


45. Check the stack-up clearance.
    - Using a feeler gauge, check the stack-up clearance in 3 places, 120 degrees apart.
    - If the clearance is not to specification, install the correct selective overdrive clutch pressure plate retainer snap ring and recheck the clearance. Refer to the Clutch Plate Usage and Clearance Specification Chart for selective snap ring thicknesses and part numbers.

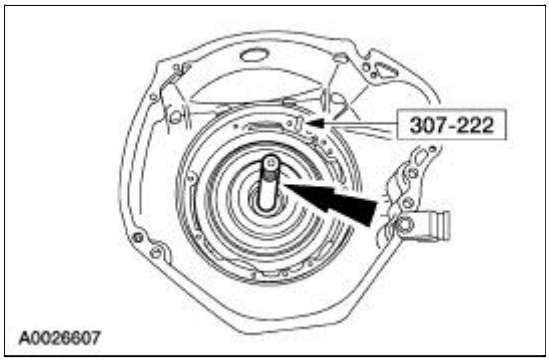


46. **NOTE:** Lightly lubricate the gasket with petroleum jelly to hold it in place during assembly.

    Install the new pump gasket. Aligning the holes in the gasket with the holes in the case.

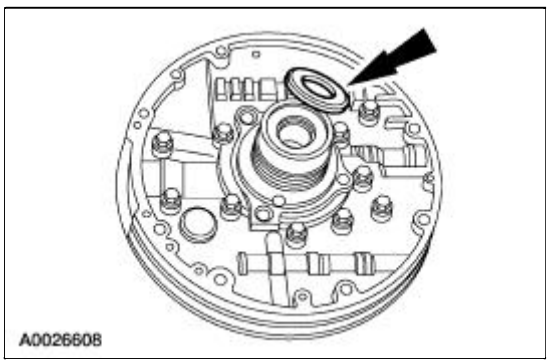


47. Install the input shaft with long splined end first and install the special tool.



48. **NOTE:** Lightly lubricate the thrust washer and bearing with petroleum jelly to hold it in place during assembly.

    Install the No. 1 pump thrust washer and the No. 2A overdrive sun gear thrust bearing.



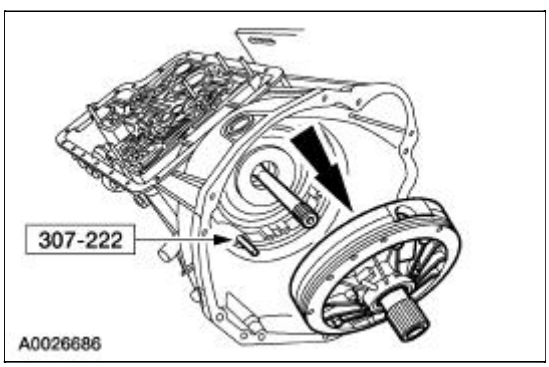
49. **CAUTION: Pump assemblies are vehicle-dependent. Using the wrong pump will cause transmission failure.**

    CAUTION: Fully seat the front pump assembly using hand pressure only. Do not use bolts to draw the front pump assembly into the case.

    CAUTION: Tighten the bolts alternately to avoid possible damage.

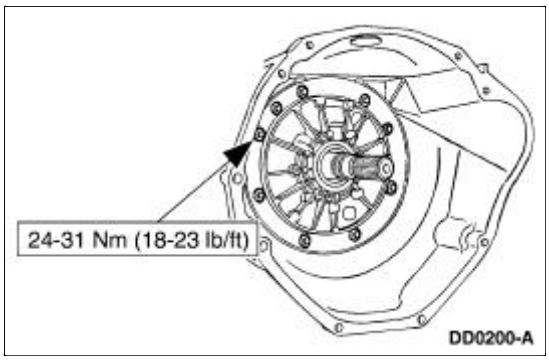
    NOTE: Clock position is viewed looking into the converter housing with the top of the transmission in the 12 o'clock position.

    Install the front pump assembly with the filter inlet tube bore in the 6 o'clock position. Fully seat the front pump assembly using hand pressure only. When the pump is fully seated, remove the special tool.



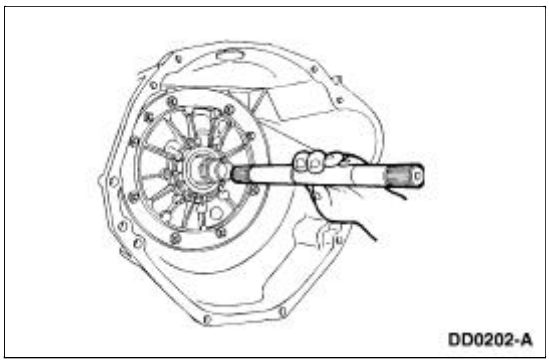
50. **CAUTION: Discard the old washers.**

Install the bolts with new rubber-coated washers. Tighten the bolts alternately in a crisscross pattern.

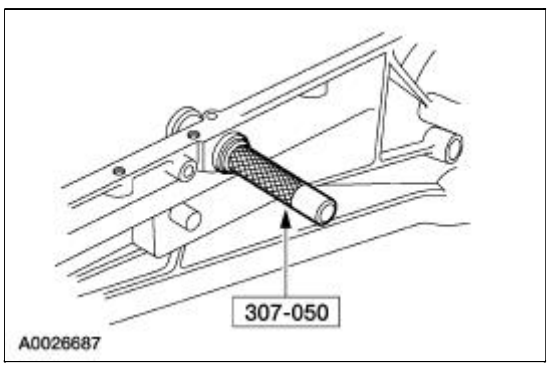


51. **CAUTION: Remove the input shaft prior to rotating the transmission.**

Remove the input shaft.



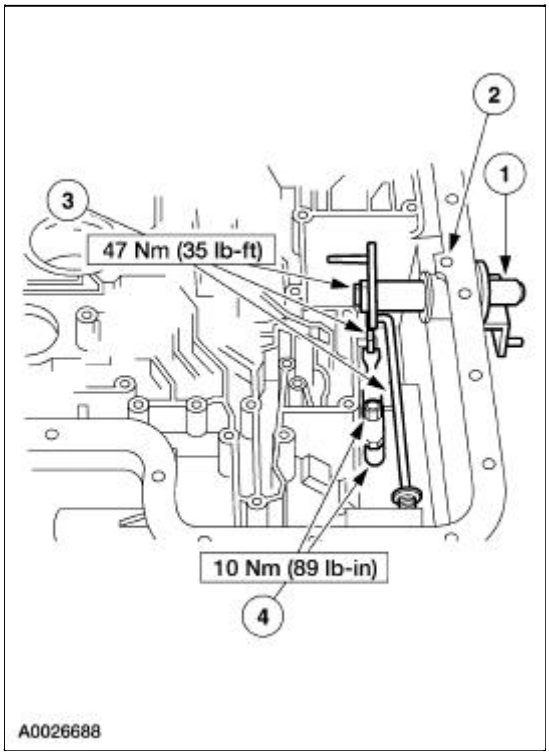
52. Using the special tool, install the manual control lever seal.



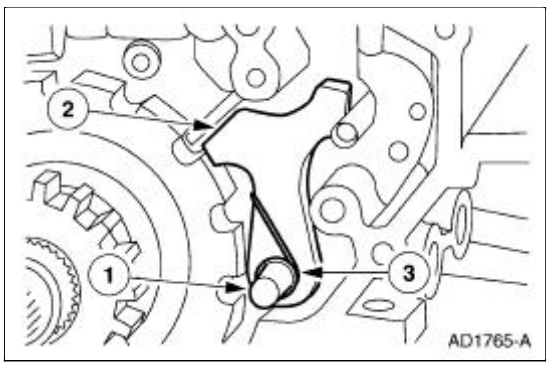
53. Install the manual control lever shaft assembly.
    1. Install the manual control lever shaft assembly.
    2. Install and seat the manual lever shaft retaining pin below the case surface.
    3. **NOTE:** Use a crescent wrench on the manual control lever or outer flats of the manual control lever shaft assembly when installing the inner manual valve detent lever nut.

       Install the parking pawl actuating rod, the inner manual valve detent lever and the nut onto the manual control lever shaft assembly.
    4. **NOTE:** The manual control valve detent lever spring must be on the inner manual valve detent lever and the detent lever pin must align with the manual shift valve.

Install the manual control valve detent lever spring and the bolt.

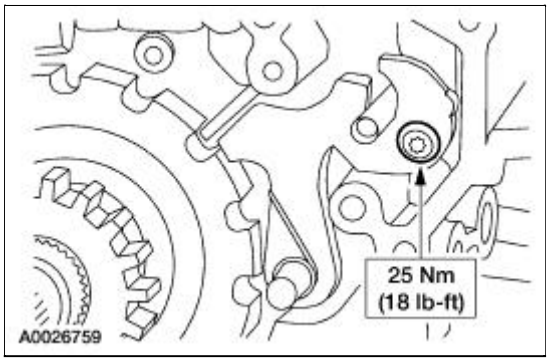


54. Install the park pawl.
    1. Install the parking pawl shaft.
    2. Install the parking pawl.
    3. Install the parking pawl return spring.



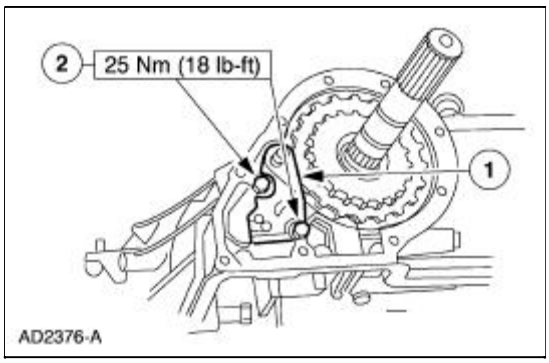
55. **CAUTION: The Torx® screw has a thread-locking compound. If the screw is removed, it must be discarded and a new one installed.**

    If removed, install the parking pawl abutment with a new Torx® screw.

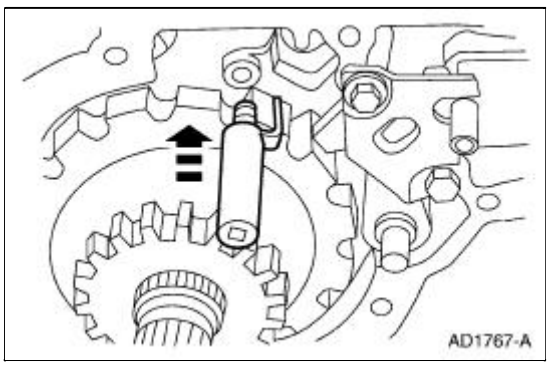


56. **NOTE:** Make sure the dimple on the parking guide support plate is facing inward and the parking pawl actuating rod is in the parking rod support plate slot.

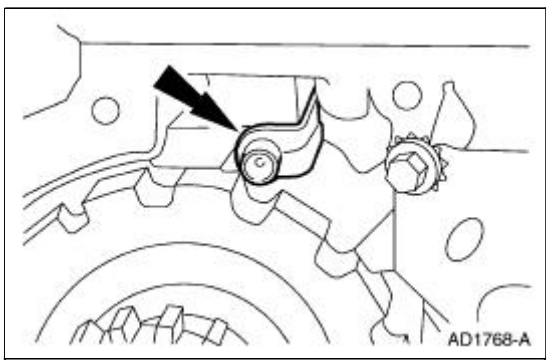
    Install the parking rod guide plate.
    1. Install the parking rod guide plate.
    2. Install the bolts.



57. Install a new orifice lube plug in the rear of the case. Using a 12 mm (0.48 in) socket, tap the orifice lube plug into the back of the transmission.

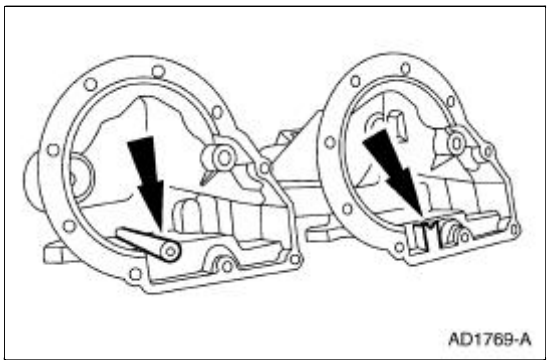


58. Check to make sure that the orifice lube plug is fully seated into the back of the transmission.



59. **CAUTION: The extension must have a shoulder or a boss cast in it to hold the orifice lube plug in the back of the case. If the wrong extension housing is used the plug will fall out and cause transmission failure.**

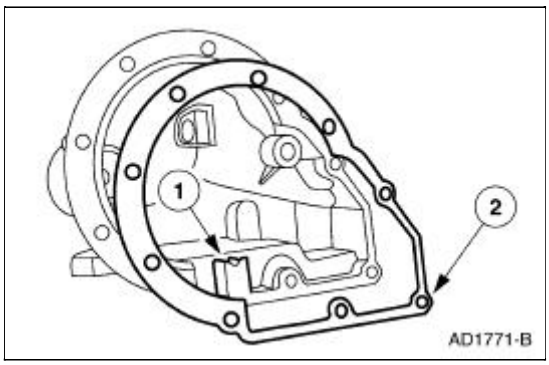
Inspect the extension housing for the correct application.



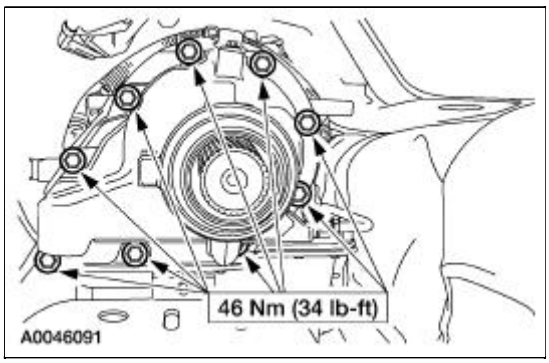
60. **CAUTION: The extension must have a shoulder or a boss cast in it to hold the orifice lube plug in the back of the case. If the wrong extension housing is used the plug may become loose and/or fall out and cause transmission damage.**

NOTE: Lightly lubricate the gasket with petroleum jelly to hold it in place during assembly.

Install the new extension housing gasket.
1. Verify that the extension has a shoulder cast in it.
2. Install the new extension housing gasket.



61. Install the extension housing, the eight bolts, and the stud.

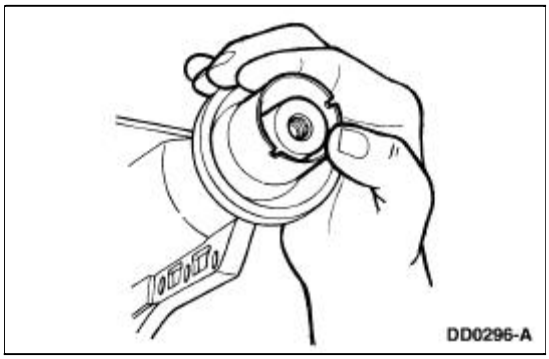


62. **CAUTION: Prior to installing the extension housing bushing, inspect the extension housing counter bore for burrs. If necessary, remove the burrs with an oil stone. Damage**

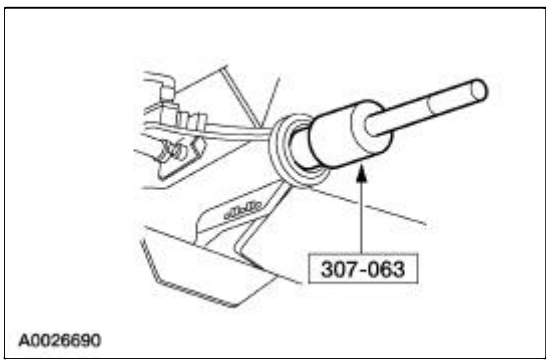
to the new bushing may occur.

NOTE: Extension housing bushing is vehicle-dependent. Refer to the parts catalog for correct part.

Align the extension housing bushing in the extension housing so that the slots are in the 2 o'clock and 7 o'clock position.

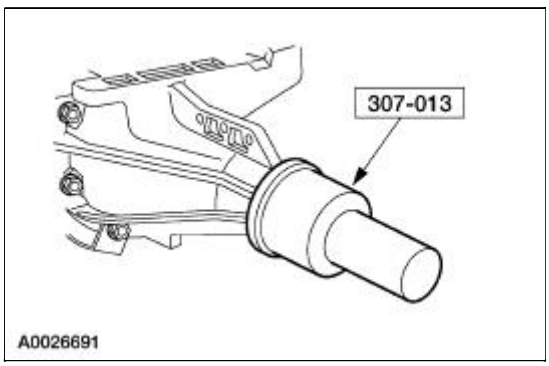


63. Using the special tool, install the extension housing bushing.

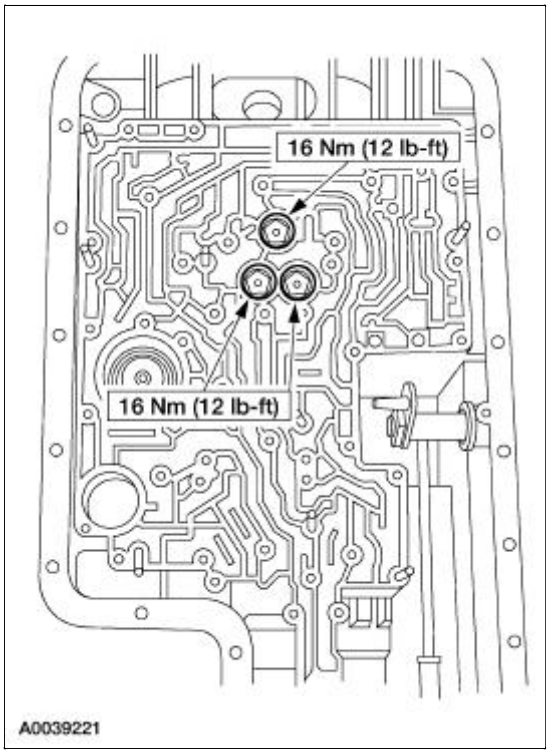


64. **NOTE:** Extension seal is vehicle-dependent. Refer to the parts catalog for correct part.

Using the special tool, install a new extension housing seal.

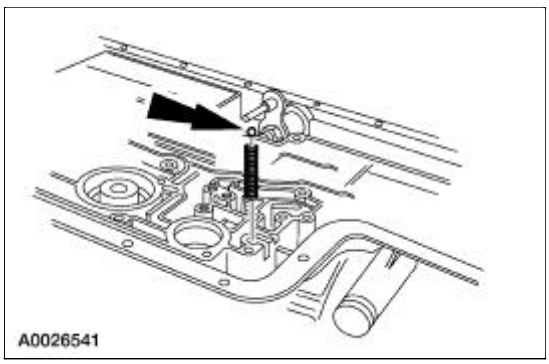


65. Tighten the center support assembly, and the intermediate/overdrive cylinder assembly feedbolts.



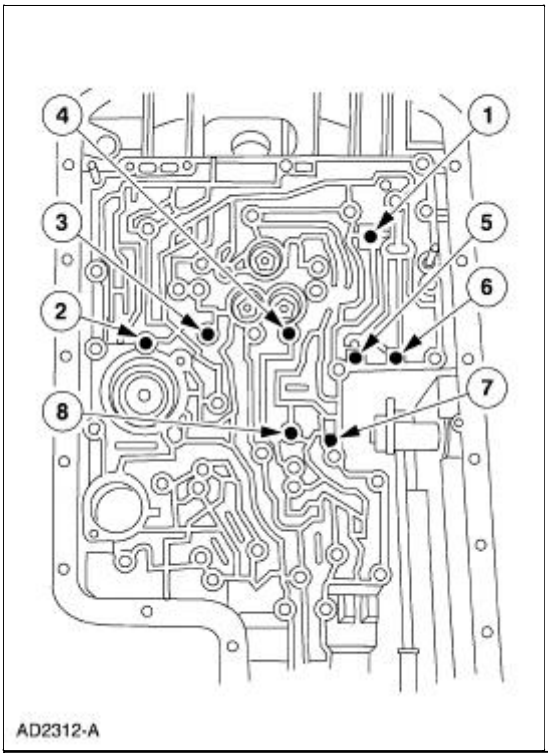
66. **NOTE:** The steel EPC check ball has a 6.35 mm (0.25 in) diameter and is smaller than the other check balls.

    Install the spring and the steel EPC check ball.



67. **CAUTION: Use care not to damage the rubber check balls.**

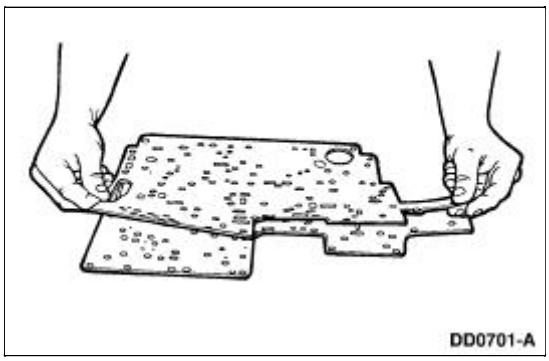
    Install the rubber check balls.



Item	Part Number	Description
1	CB7	Check ball
2	CB9	Check ball
3	CB14	Check ball
4	CB1	Check ball
5	BS3	Ball shuttle
6	CB8	Check ball
7	CB6	Check ball
8	BS1	Ball shuttle

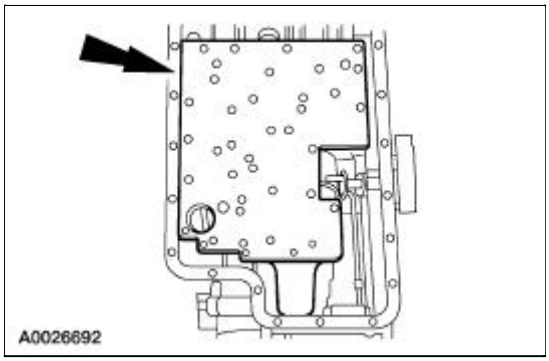
68. **CAUTION: Refer to the parts catalog for correct gasket. Using the incorrect gasket will cause damage to transmission.**

    Install a new separating plate-to-case gasket on the separating plate.

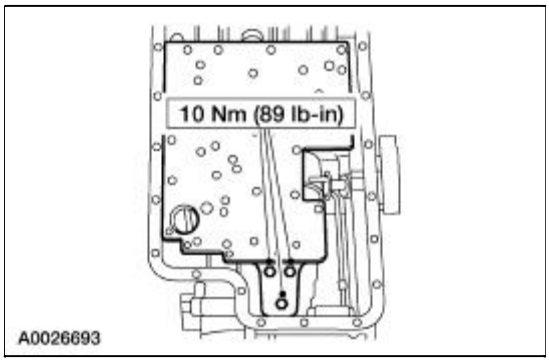


69. **NOTE:** Check the placement of the steel EPC check ball under separator plate.

    Install the valve body separator plate.

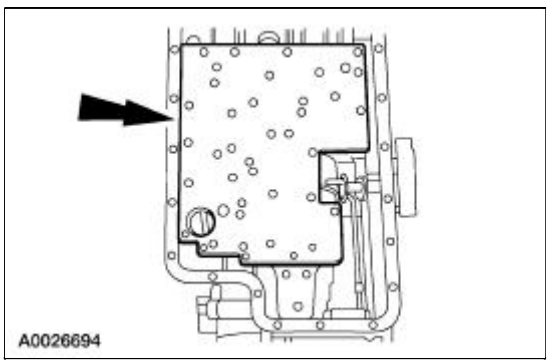


70. Install the separating plate reinforcing plate, with the stamped word UP visible, and install the bolts.

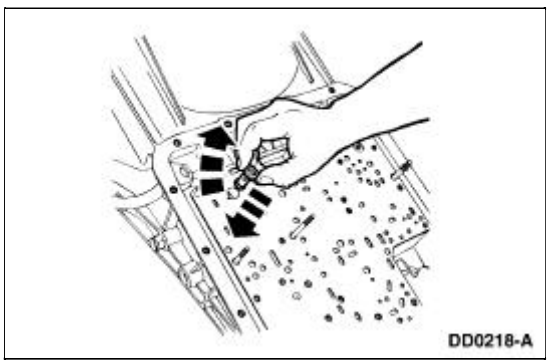


71. **CAUTION: Refer to the Parts Catalog for the correct gasket. Using the incorrect gasket will cause damage to the transmission.**

Install a new main control-to-separating plate gasket.

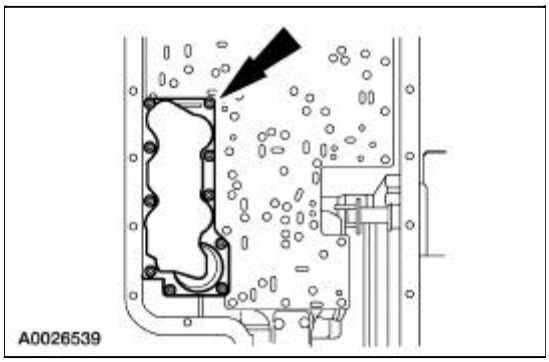


72. Install the solenoid screen assembly by pushing it in and rotating it to lock.

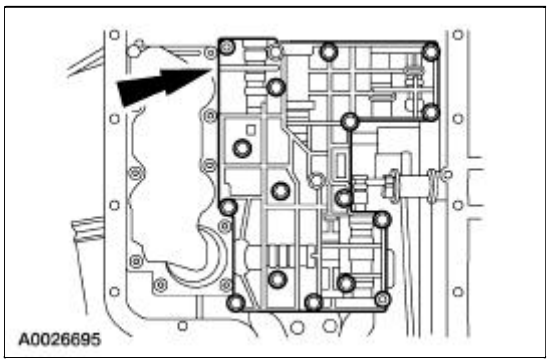


73. **NOTE:** Prior to installing the solenoid body assembly, coat the case connector bore with petroleum jelly or equivalent.

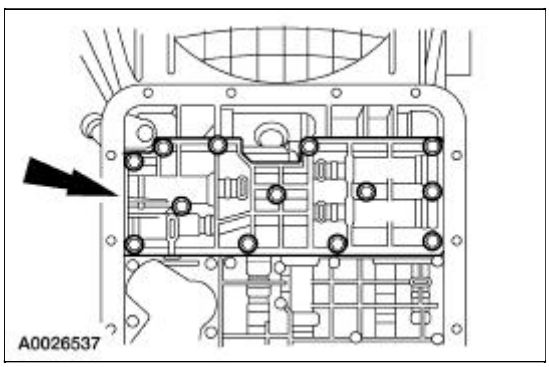
    Install the solenoid body assembly with the nut and the Torx® bolts finger-tight.



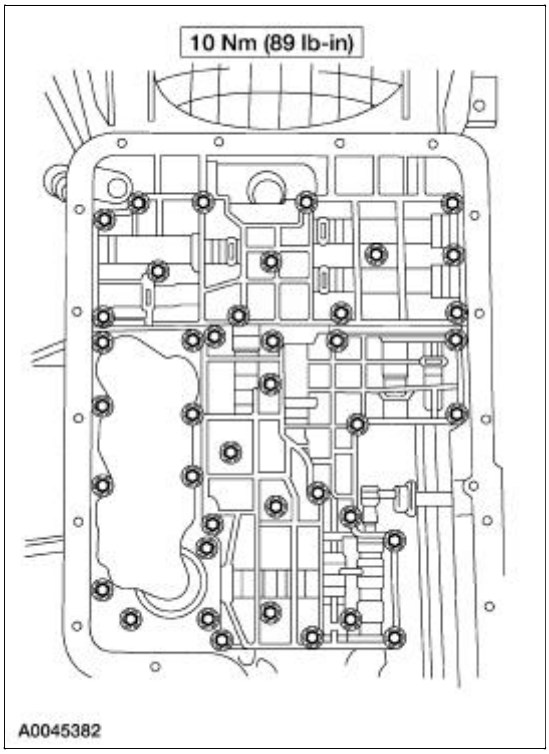
74. Install the main control valve body, aligning the manual shift valve with the inner manual valve detent lever. Install the nuts and the bolts finger-tight.



75. Install the accumulator body with the nuts and the bolts finger-tight.



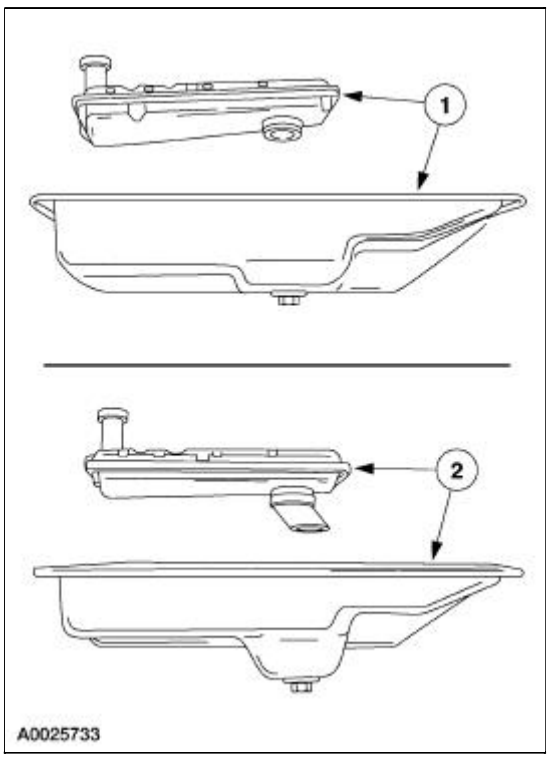
76. Tighten all accumulator body, upper and lower control body and solenoid body nuts and bolts.



77. **CAUTION: Mixing the 4x2-style and 4x4-style transmission fluid filters and transmission pan assembly components can cause transmission damage.**

Select the appropriate 4x2-style or 4x4-style filter assembly and transmission pan.

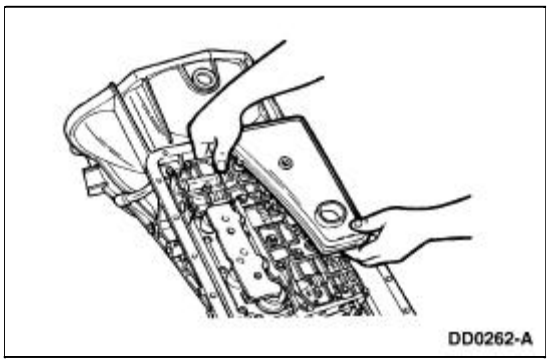
1. 4x2 filter and pan application.
2. 4x4 filter and pan application.



78. **CAUTION: Make sure the pump bore is clean and the oil filter seal has been removed. Damage to new filter and seal can occur.**

NOTE: Prior to installation, lightly lubricate the seal with clean automatic transmission fluid.

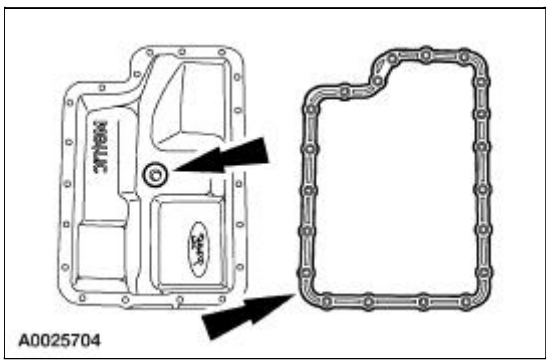
Install a new fluid filter and seal assembly into the pump bore until seated.



79. **NOTE:** Do not discard the gasket unless damaged. This is a reusable gasket.

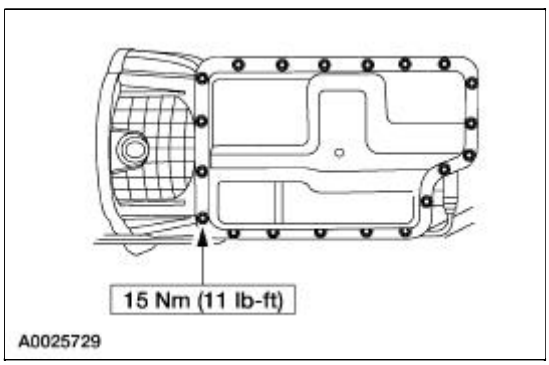
NOTE: Apply a light coat of petroleum jelly to hold the gasket to the fluid pan.

Position the gasket onto the clean fluid pan. Make sure the magnet is positioned over the dimple in the fluid pan.

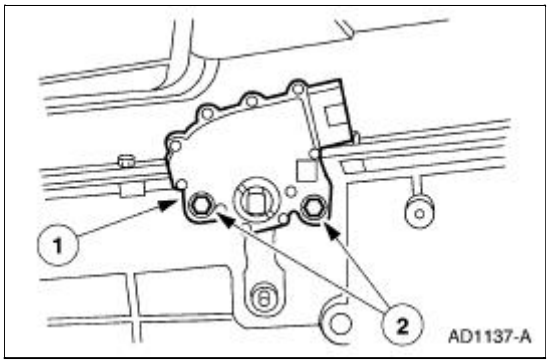


80. **CAUTION: Mixing the 4x2-style and 4x4-style transmission fluid filters and transmission pan assembly components can cause transmission damage.**

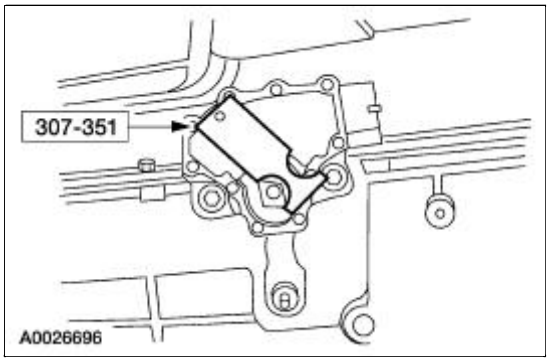
Install the correct pan with gasket for this application. Alternately tighten the bolts.



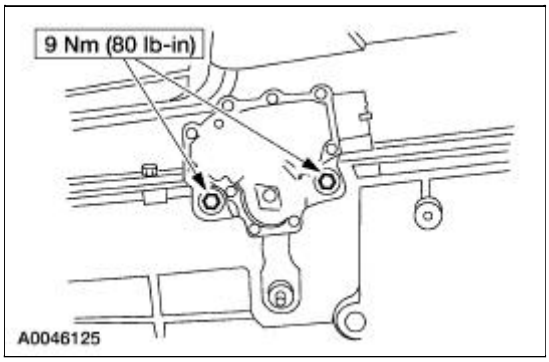
81. With the transmission in NEUTRAL, install and adjust the digital transmission range (TR) sensor.
    1. Install the digital TR sensor.
    2. Loosely install the bolts.



82. Using the special tool, align the TR sensor.



83. Tighten the bolts and remove the special tool.

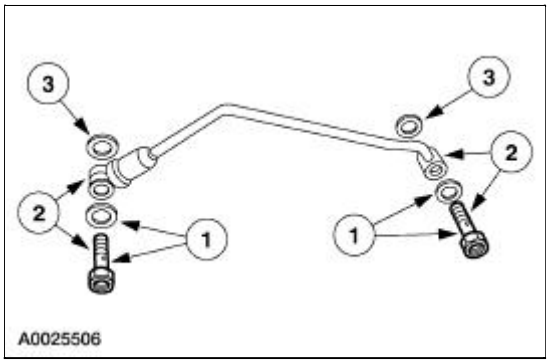


84. Make sure that the cooler bypass valve (CBV) has been cleaned and flushed. For additional information, refer to Cooler Bypass Valve Assembly in this section.

85. **CAUTION: Failure to correctly install the new rubber-coated sealing washers will result in transmission fluid leaks.**

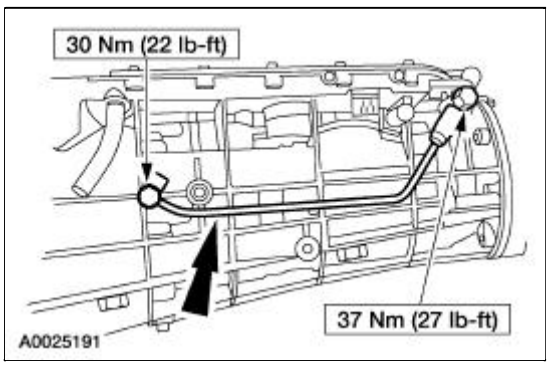
Install the new rubber-coated sealing washers and the new cooler line case fittings.

1. Install one rubber-coated sealing washers on each cooler line case fittings.
2. Install new cooler line case fittings into their respective ends of the CBV assembly.
3. Install one rubber-coated sealing washers on each cooler line case fittings.



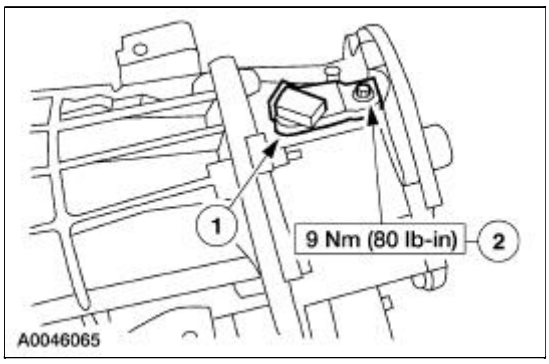
86. **CAUTION: Do not overtighten. Damage to the sealing washers can occur.**

Install the CBV with the front (inlet) and the rear (outlet) cooler line case fitting.



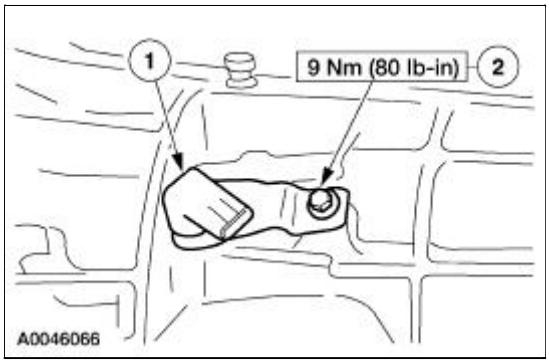
87. **CAUTION: Use care when installing the sensor, damage to the O-ring seal can result in a leak.**

Install the output shaft speed (OSS) sensor.
1. Lubricate O-ring seal and install the OSS.
2. Install the bolt.



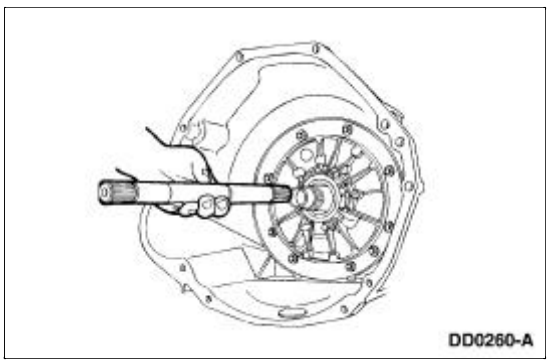
88. **CAUTION: Use care when installing the sensor, damage to the O-ring could result in a leak.**

If removed, install the turbine shaft speed (TSS) sensor.
1. Lubricate O-ring and install the TSS.
2. Install the bolt.



89. **NOTE:** The input shaft is vehicle-dependent. Refer to the parts catalog for correct part.

    With the fluid pan facing down, install the input shaft with the long splined end first.

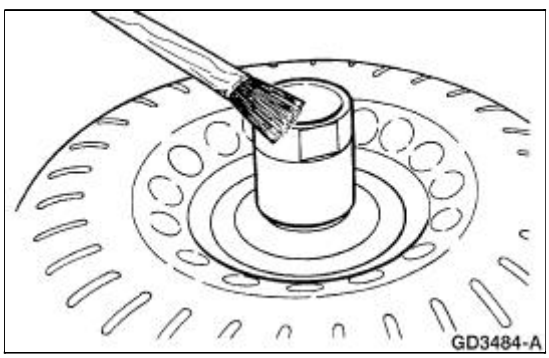


90. **CAUTION: Do not damage the fluid pump gear O-ring when installing torque converter.**

    CAUTION: Make sure the converter hub is fully engaged in the front pump support and gear and rotates freely. Do not damage the hub seal.

    CAUTION: If the torque converter slides out, the hub seal may be damaged.

    Lubricate the converter hub with clean automatic transmission fluid.



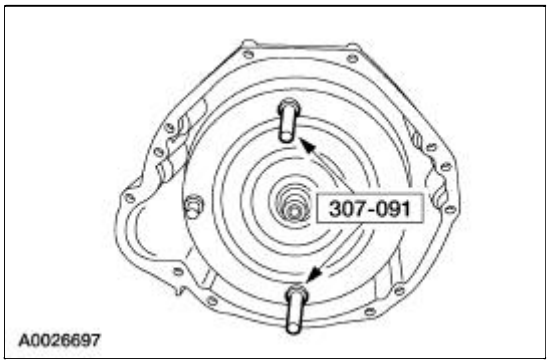
91. **CAUTION: Use care when installing the torque converter to avoid damage to the front pump stator support seal.**

    NOTE: Check the converter crankshaft pilot for nicks or damaged surfaces that can cause interference when installing the transmission to the engine. Check the converter impeller hub for

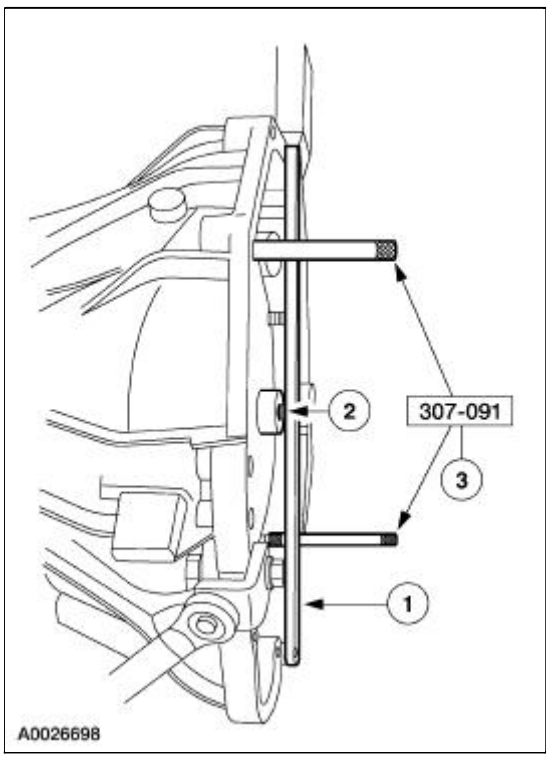
nicks or sharp edges that can damage the pump seal.

NOTE: Carry the torque converter with the Torque Converter Handles held in the 6 o'clock and 12 o'clock positions.

Using the special tools, install the torque converter. Push and rotate the converter onto the front pump assembly until it bottoms out.



92. Check the seating of the torque converter.
    1. Place the straightedge across the converter housing.
    2. Make sure there is a gap between the converter pilot face and the straightedge.
    3. Remove the special tools.



Transmission —4x4

Special Tool(s)

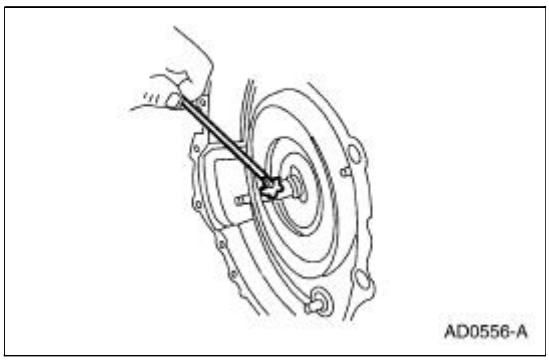
 ST1636-A	Retainer, Torque Converter 307-346 (T97T-7902-A)

Material

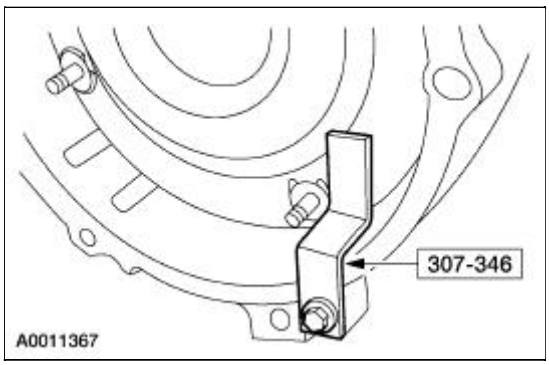
Item	Specification
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®
Multi-Purpose Grease XG-4	ESR-M1C159-A

Installation

1. Lubricate the torque convertor pilot hub with multi-purpose grease.



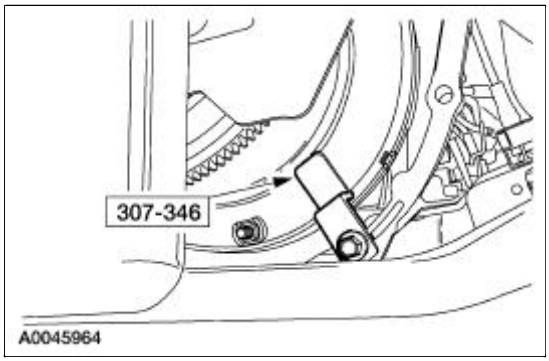
2. Install the special tool for installation of the transmission.



3. The transmission will need to be put in a nose-down position so the rear of the transmission will clear the exhaust. Partially raise the transmission up into the vehicle.

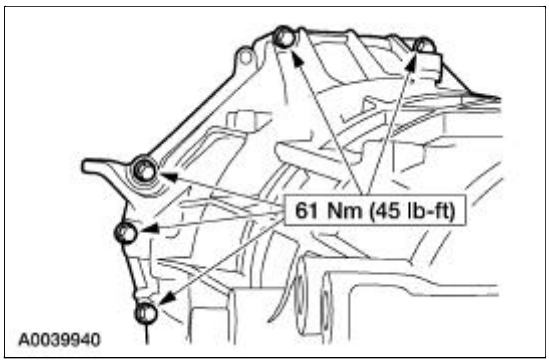
4. Connect the wire harness to the top of the transmission.

5. With the transmission in a horizontal position, remove the special tool.



6. Position the transmission to the back of the engine and install the bolts to the RH side of the transmission.

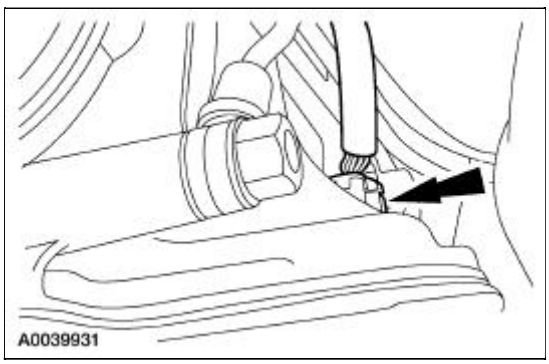
7. Install the bolts to the LH side of the transmission.



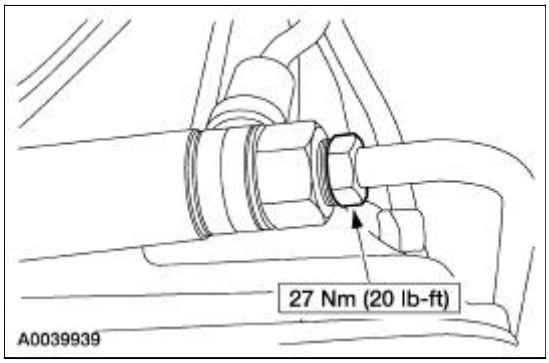
8. Install a jack stand under the bellhousing with a block of wood.

9. Remove the transmission jack.

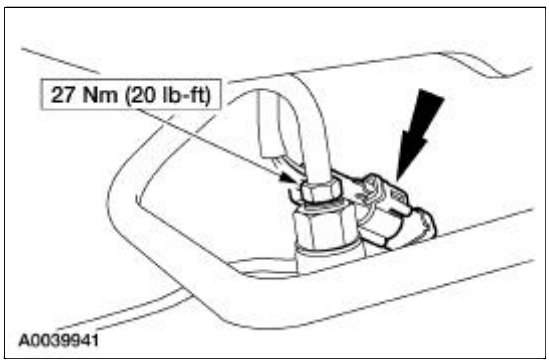
10. Connect the transmission harness connector.



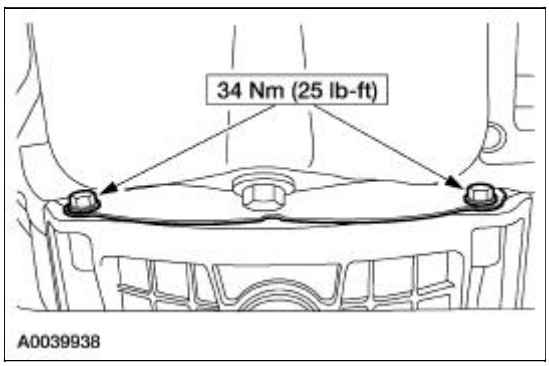
11. Connect the rear transmission cooler line.



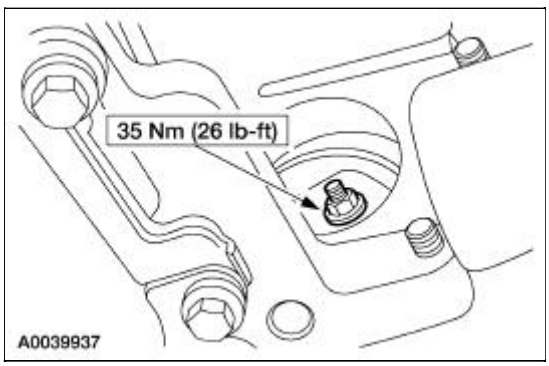
12. Connect the front transmission cooler line and the HO2S connector.



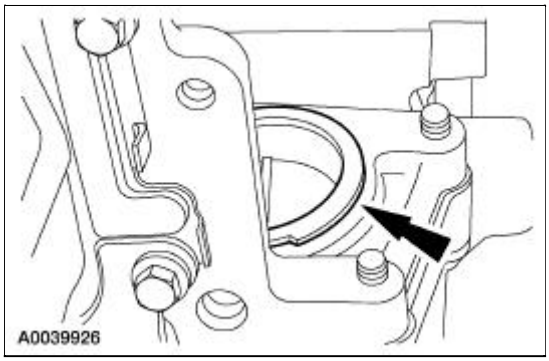
13. Install the shield and install the bolts.



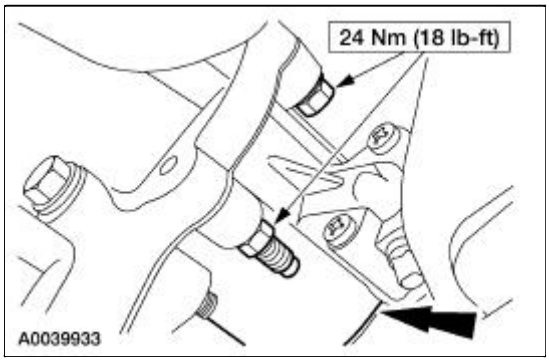
14. Install four new torque converter nuts.



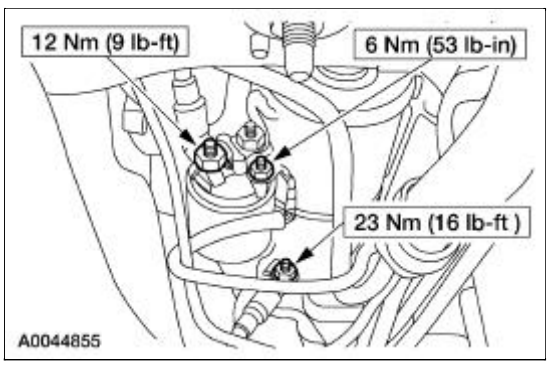
15. Install the torque converter access cover.



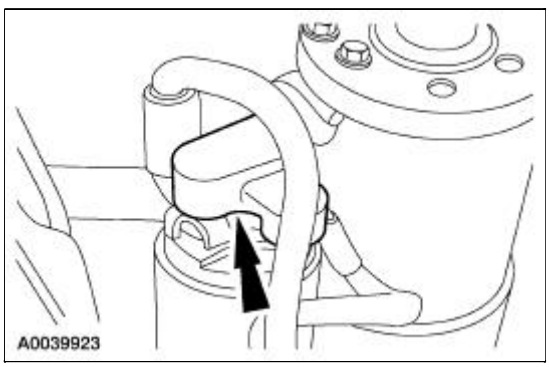
16. Install the starter motor and the three starter bolts.



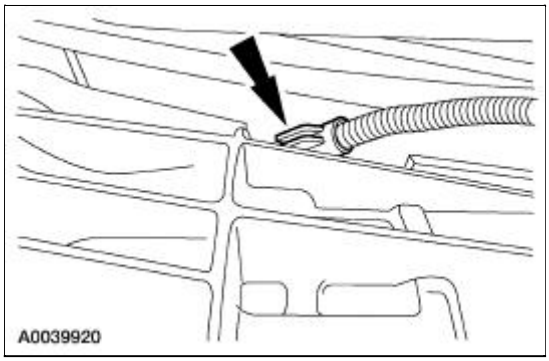
17. Install the battery cables to the starter motor and connect the ground cable.



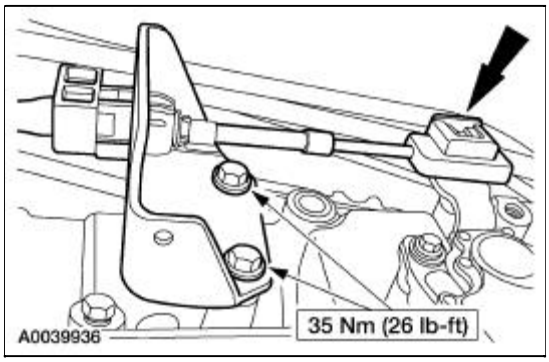
18. Install the plastic cover to the starter motor electrical connector.



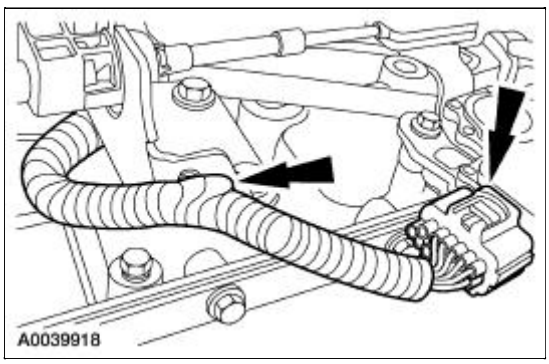
19. Connect the turbine shaft speed (TSS) sensor connector.



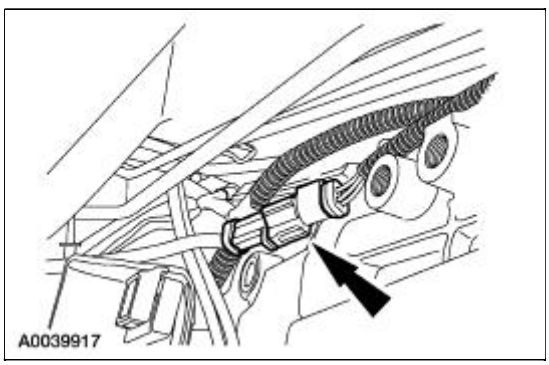
20. Install the shift cable and bracket to the transmission and connect the shift cable to the manual control lever.



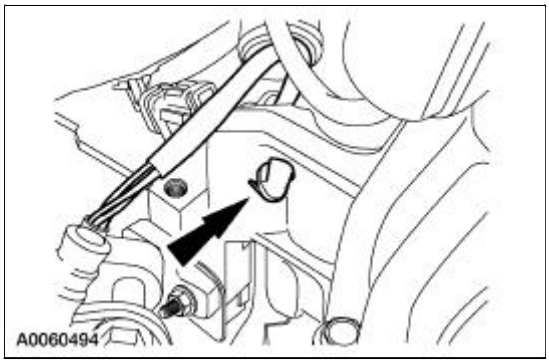
21. Connect the wire harness to the TR sensor bracket and connect the digital TR sensor connector.



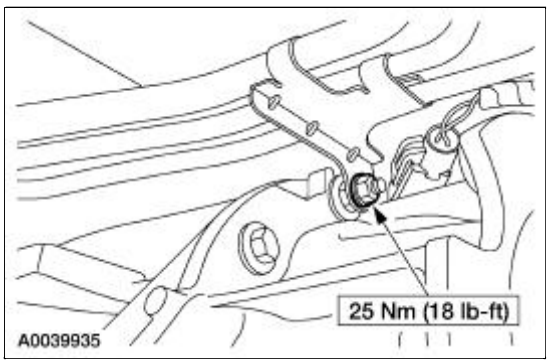
22. Connect the LH HO2S.



23. Connect the HO2S sensor clip from the transmission.

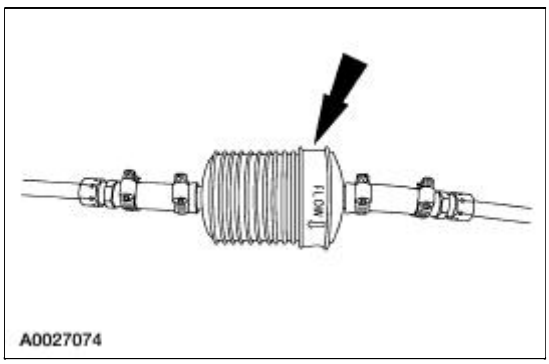


24. Install the fuel line bracket and connect the output shaft speed (OSS) sensor connector.



25. **NOTE:** Use the following guidelines for the in-line transmission fluid filter:
    - If the transmission was overhauled and the vehicle was equipped with an in-line fluid filter, install a new in-line fluid filter.
    - If the transmission was overhauled and the vehicle was not equipped with an in-line fluid filter, install a new in-line fluid filter kit.
    - If the transmission is being installed for a non-internal repair, do not install an in-line filter or filter kit.
    - If installing a Ford-authorized remanufactured transmission, install the in-line transmission fluid filter that is supplied.

    Install a new in-line transmission filter or a filter kit.



26. Install the transfer case. For additional information, refer to Section 308-07B .

27. **NOTE:** When the battery has been disconnected and reconnected, some abnormal drive symptoms can occur while the vehicle relearns its adaptive strategy. The customer needs to be notified that they may experience slightly different upshifts (either soft or firm) and this is a temporary condition that will eventually return to normal operating condition.

Connect the battery ground cable. For additional information, refer to Section 414-01 .

28. **CAUTION: The use of any other fluids can result in the transmission failing to operate in a normal manner or failure.**

    Fill the transmission.

    - Add 6.2 liters (6.5 qts) of clean automatic transmission fluid to the transmission through the fluid fuller tube.

29. Start the engine. Move the transmission range selector lever through all the gear ranges, checking for engagements.

30. With the engine running and the transmission at normal operating temperature 66-77°C (150-170°F), check and adjust the transmission fluid level and check for any leaks. If fluid is needed, add fluid in increments of 0.24-liter (0.5-pint) until the correct level is achieved (fluid should be in the cross-hatched area of the fluid level indicator.)

Transmission —4x2

Special Tool(s)

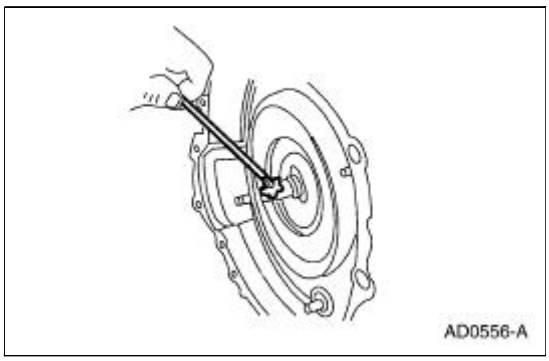
 ST1636-A	Retainer, Torque Converter 307-346 (T97T-7902-A)

Material

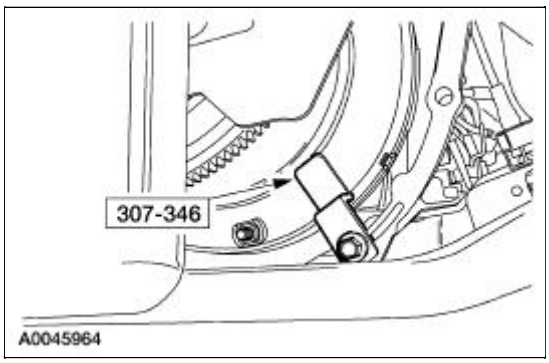
Item	Specification
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®
Multi-Purpose Grease XG-4	ESR-M1C159-A

Installation

1. Lubricate the torque converter pilot hub with multi-purpose grease.



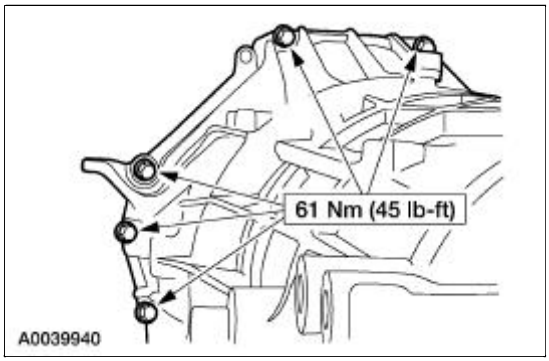
2. Install the special tool for installation of the transmission.



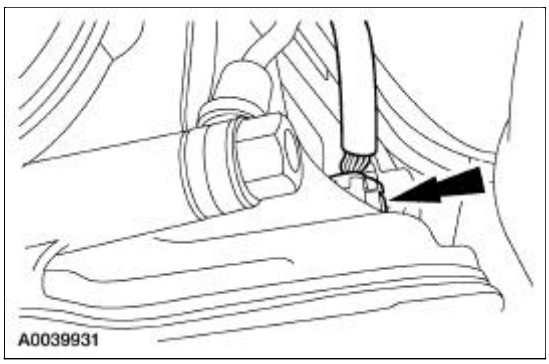
3. The transmission will need to be put in a nose down position so the rear of the transmission will clear the exhaust. Partially raise the transmission up into the vehicle.

4. Connect the wire harness to the top of the transmission.

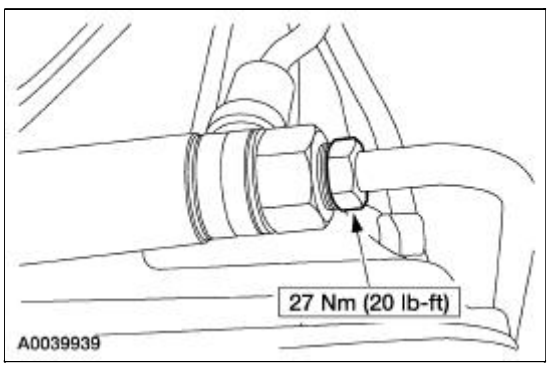
5. Position the transmission to the back of the engine and install the bolts.



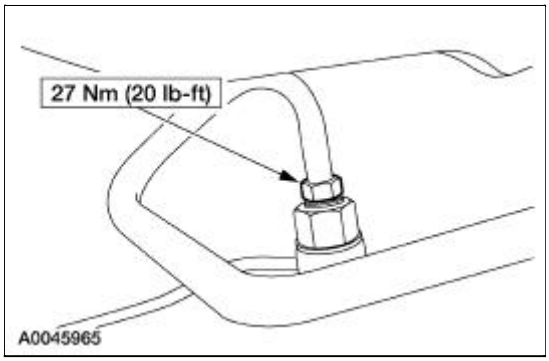
6. Connect the transmission harness connector.



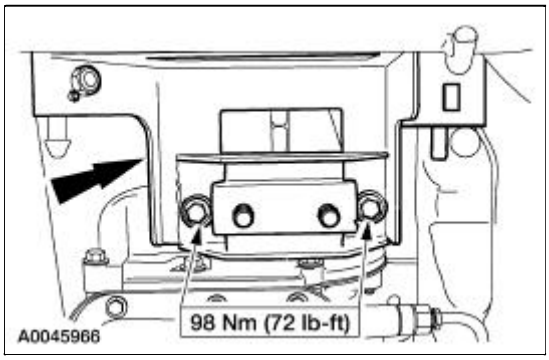
7. Connect the rear transmission cooler line.



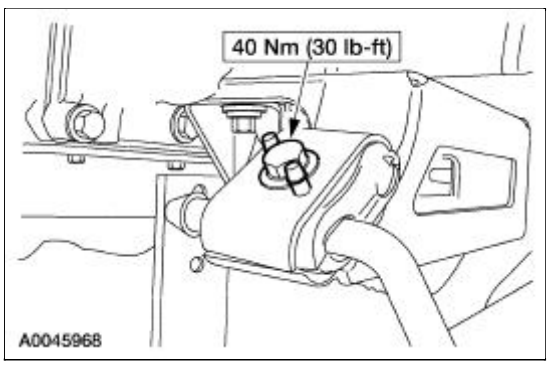
8. Connect the front transmission cooler line.



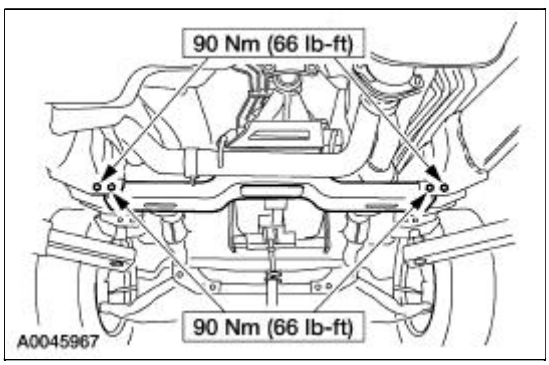
9. Install the rear exhaust hanger, transmission support and the bolts.



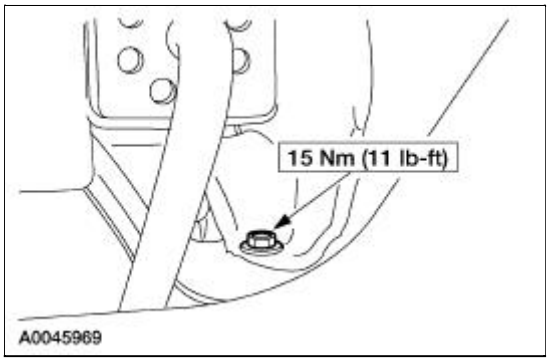
10. Install the exhaust hanger bolt.



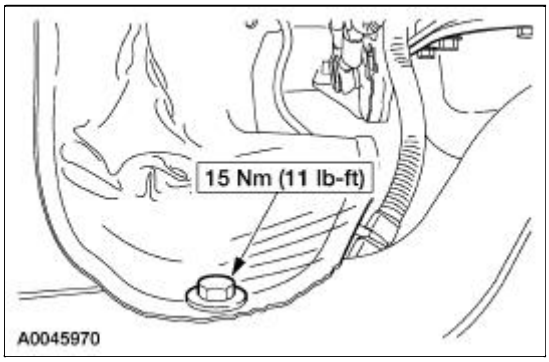
11. Install the crossmember and the bolts.



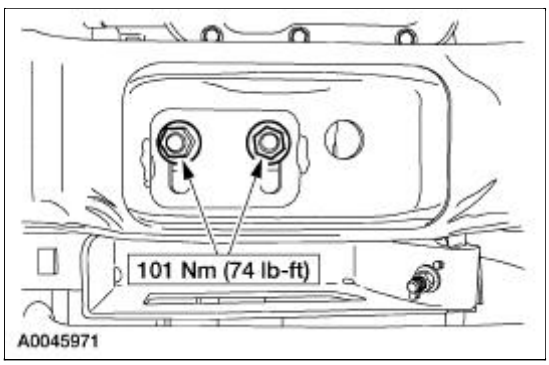
12. Install the RH heat shield bolt.



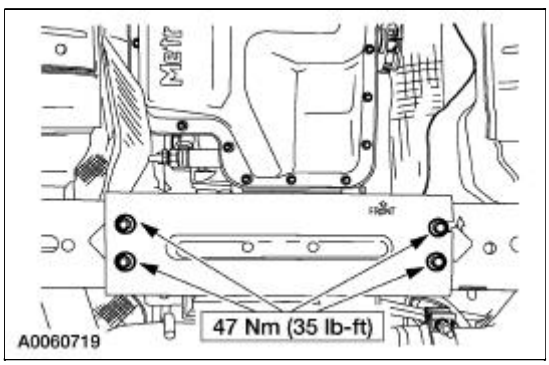
13. Install the LH heat shield bolt.



14. Install the rear transmission support nuts.

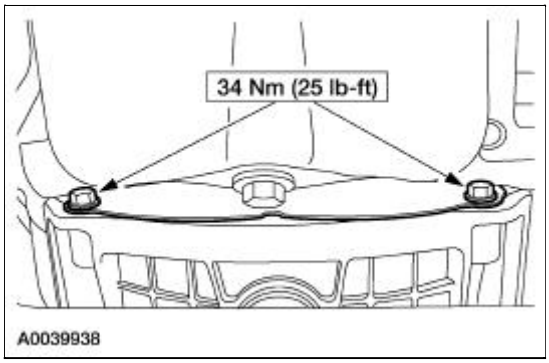


15. Install the dampener and install the bolts.

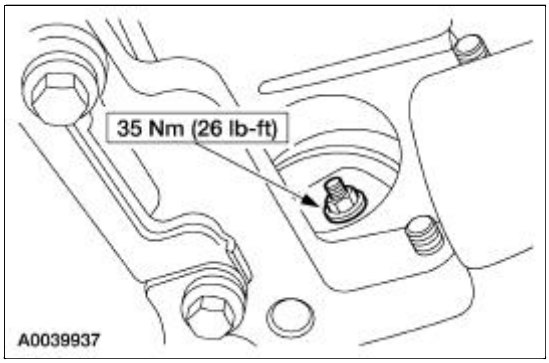


16. Remove the transmission jack.

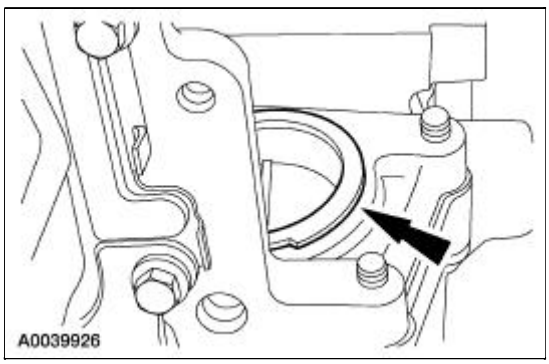
17. Install the shield and install the bolts.



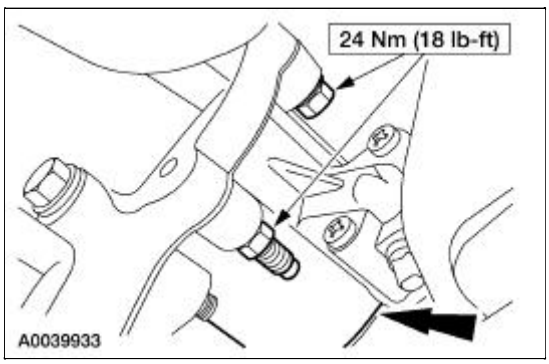
18. Install four new torque converter nuts.



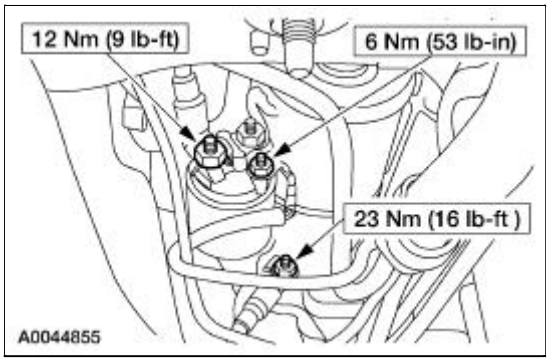
19. Install the torque converter access cover.



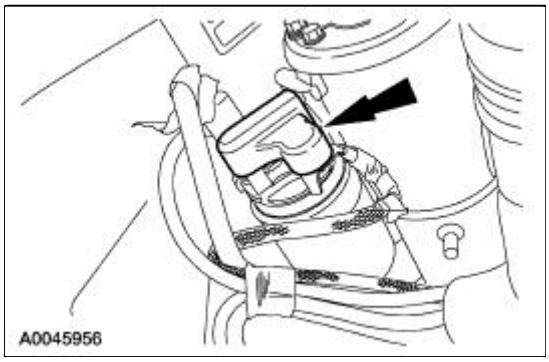
20. Install the starter motor and the three starter bolts.



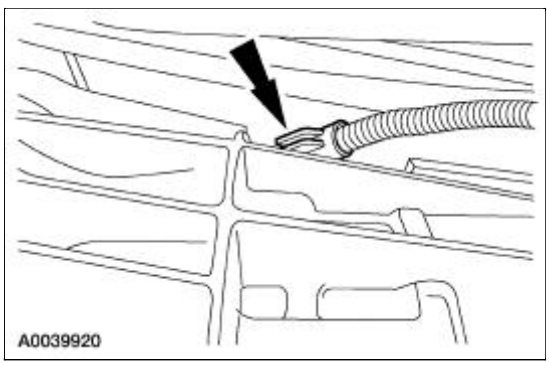
21. Install the battery cables to the starter motor and connect the ground cable.



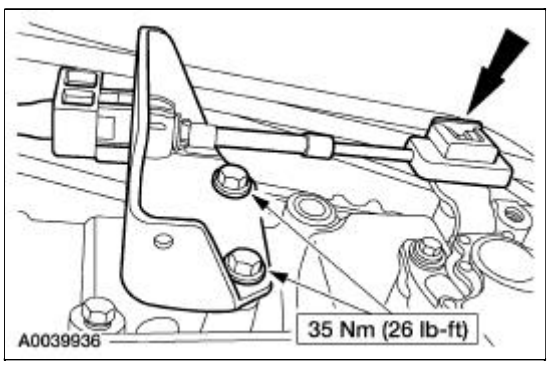
22. Install the plastic cover to the starter motor electrical connector.



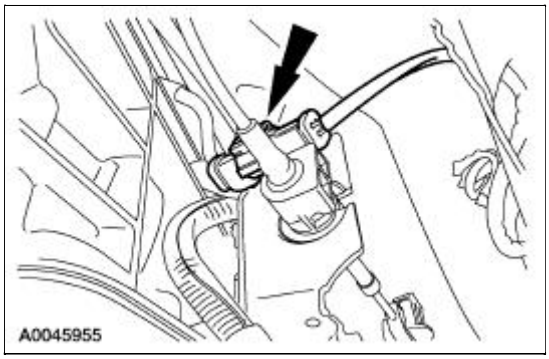
23. Connect the turbine shaft speed (TSS) sensor connector.



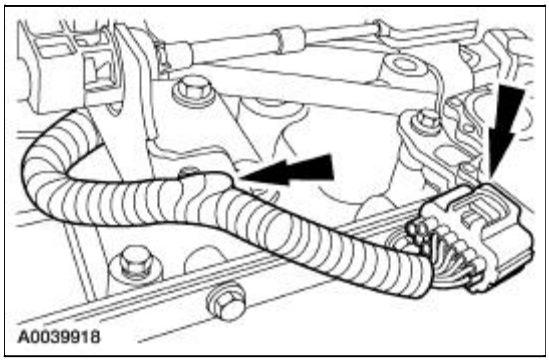
24. Install the shift cable and bracket to the transmission and connect the shift cable to the manual control lever.



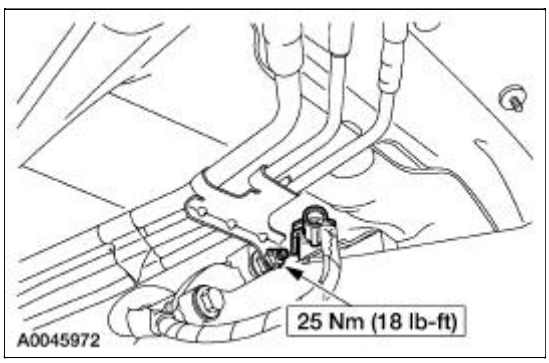
25. Connect the LH catalyst monitor sensor connector to the shift cable bracket.



26. Connect the wire harness to the TR sensor bracket and connect the digital TR sensor connector.



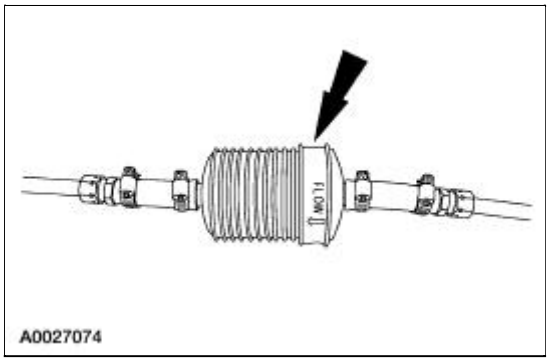
27. Install the fuel line bracket and connect the output shaft speed (OSS) sensor connector.



28. Install the rear drive shaft. For additional information, refer to Section 205-01 .

29. **NOTE:** Use the following guidelines for the in-line transmission fluid filter:
    - If the transmission was overhauled and the vehicle was equipped with an in-line fluid filter, install a new in-line fluid filter.
    - If the transmission was overhauled and the vehicle was not equipped with an in-line fluid filter, install a new in-line fluid filter kit.
    - If the transmission is being installed for a non-internal repair, do not install an in-line filter or filter kit.
    - If installing a Ford-authorized remanufactured transmission, install the in-line transmission fluid filter that is supplied.

    Install a new in-line transmission fluid filter or filter kit.



30. Lower the vehicle.

31. **NOTE:** When the battery has been disconnected and reconnected, some abnormal drive symptoms can occur while the vehicle relearns its adaptive strategy. The customer needs to be notified that they may experience slightly different upshifts (either soft or firm) and this is a temporary condition that will eventually return to normal operating condition.

    Connect the battery ground cable. For additional information, refer to Section 414-01 .

32. **CAUTION: The use of any other fluids can result in the transmission failing to operate in a normal manner or failure.**

    Fill the transmission.

    - Add 6.2 liters (6.5 qts) of clean automatic transmission fluid to the transmission through the fluid filler tube.

33. Start the engine. Move the transmission range selector lever through all the gear ranges, checking for engagements.

34. With the engine running and the transmission at normal operating temperature 66-77°C (150-170°F), check and adjust the transmission fluid level and check for any leaks. If fluid is needed, add fluid in increments of 0.24-liter (0.5-pint) until the correct level is achieved (fluid should be in the cross-hatched area of the fluid level indicator)

General Specifications

Item	Specification
Fluid [a]	
Motorcraft MERCON® V Automatic Transmission Fluid XT-5-QM	MERCON® V
Fluid Capacities	
All	13.2L (13.9 quarts)
Fluid Filter	
Inline Transmission Fluid Filter Kit XC3Z-7B155-AA	—
Inline Transmission Fluid Filter XC3Z-7B155-AB	
Lubricants	
Ford Multi-Purpose Grease D0AZ-19584-AA	ESB-M1C93-B
Torque Converter End Play	
New or rebuilt mm (inch)	0.355-1.04 (0.014-0.041)
Used mm (inch)	0.355-1.87 (0.014-0.074)

[a] MERCON® V is not interchangeable at this time with the current MERCON® service fluids. Check the transmission dipstick to determine the correct fluid and refer to the Workshop Information/Owner publication to determine the correct service interval for the specific vehicle.

Band/Clutch Application Chart A

Gear	Overdrive Band	Intermed- iate Clutch	Low/ Reverse Band	Reverse Clutch	Forward Clutch	Direct Clutch
REVERSE			A	A		
1st GEAR MANUAL LOW			A		A	
2nd GEAR MANUAL LOW	A	A			A	
1st GEAR (D) (Overdrive)					A	
2nd GEAR (D) (Overdrive)		A			A	
3rd GEAR (D) (Overdrive)		A			A	A
4th GEAR (D) (Overdrive)	A	A				A

A = Applied

Band/Clutch Application Chart B

Gear	Intermediate One-Way Clutch		Planetary One-Way Clutch		Solenoid States		
	Drive	Coast	Drive	Coast	SSA	SSB	TCC
PARK					ON	OFF	HD
REVERSE			NE		ON	OFF	HD
NEUTRAL					ON	OFF	HD
1st GEAR MANUAL LOW			H		ON	OFF	HD
2nd GEAR MANUAL LOW	H				OFF	OFF	EC
1st GEAR (D) (Overdrive)			H	OR	ON	OFF	HD
2nd GEAR (D) (Overdrive)	H	OR	OR		OFF	OFF	EC
3rd GEAR (D) (Overdrive)	OR	OR			OFF	ON	EC
4th GEAR (D) (Overdrive)	OR	OR	OR		ON	ON	EC

HD = Hydraulically Disabled

NE = No Effect

H = Hold

EC = Electronically Controlled

OR = Overrunning

Stall Speed

Engine	Min	Max
4.6L	2,121	2,459
5.4L (2V)	1,816	2,200

Sensor Resistance Reading

Component	Readings (ohm)
SSA	20-30 ohms
SSB	20-30 ohms
EPC	248-566 ohms
TCC	10-16 ohms
OSS	1,026-1,194 ohms

Selective Thrust Washer - No. 1

Item	Specifications
Green Thickness	1.217-1.371 mm (0.050-0.054 in)
Yellow Thickness	1.727-1.828 mm (0.068-0.072 in)
Natural Thickness	2.159-2.260 mm (0.085-0.089 in)
Red Thickness	2.590-2.692 mm (0.102-0.106 in)
Blue Thickness	3.022-3.124 mm (0.119-0.123 in)

Forward Clutch Pack

Item	Specifications
Clearance	1.17-1.72 mm (0.046-0.068 in)
Snap Ring Thickness	1.524-1.625 mm (0.060-0.064 in)
	1.880-1.981 mm (0.074-0.078 in)
	2.235-2.337 mm (0.088-0.092 in)
	2.591-2.692 mm (0.102-0.106 in)

Reverse Clutch Pack

Item	Specifications
Clearance	1.27-1.93 mm (0.050-0.076 in)
Snap Ring Thickness	1.524-1.625 mm (0.060-0.064 in)
	1.880-1.981 mm (0.074-0.078 in)
	2.235-2.337 mm (0.088-0.092 in)
	2.591-2.692 mm (0.102-0.106 in)

Direct Clutch Pack

Item	Specifications
Clearance	1.574-2.159 mm (0.062-0.085 in)
Selective Steel Plates	1.270-1.372 mm (0.050-0.054 in)
	1.625-1.727 mm (0.064-0.068 in)
	1.981-2.083 mm (0.078-0.082 in)
	2.337-2.438 mm (0.092-0.096 in)

Intermediate Clutch Pack

Item	Specifications

Clearance	42.5958-41.7322 mm (1.677-1.643 in)
Snap Ring Thickness	1.702-1.803 mm (0.067-0.071 in) 1.956-2.057 mm (0.077-0.081 in) 2.210-2.311 mm (0.087-0.091 in) 2.464-2.565 mm (0.097-0.101 in)

Torque Specifications

Description	Nm	lb-ft	lb-in
Rear transmission crossmember bolts	90	66	—
Transmission mount nuts	103	76	—
Transmission mount bolts	80	59	—
Extension housing bolts	25-30	18-22	—
Transmission fluid pan bolts	14	10	—
Front pump bolts	24-30	18-22	—
Front pump support bolts	20-26	15-19	—
Harness electrical connector bolt	4-5.6	—	36-50
Inspection cover bolts	34	25	—
Main control valve body bolts	9-11	—	80-98
Main control valve body cover plate bolts	9-11	—	80-98
Main control valve body separator plate bolts	9-11	—	80-98
Manual lever shaft inner nut	26-37	19-27	—
Manual lever shaft outer nut	30-35	22-26	—
Valve body reinforcement plates	9-11	—	80-98
Transmission fluid filler tube bolt	12	9	—
Fluid cooler line case fittings	20	15	—
Pressure tap plugs	8-16	6-12	—
Rear driveshaft bolts	103	76	—
Starter bolts	26	19	—
TCC solenoid bolt	9-11	—	80-100
Torque converter drain plug	10	—	89
Torque converter nuts	36	27	—
Transmission range (TR) sensor bolts	7-10	—	62-89
Transmission case bolts	48	35	—
Output shaft speed (OSS) sensor bolt	12	9	—
Starter B+ cable	12	9	—
Transmission vent tube	8-16	6-12	—
Manual control valve detent lever spring bolt	10	—	89
Cooler tube nut to case fitting	13-22	9.8-16	—
Heat shield bolts	15	11	—
Starter ground wire	23	16	—

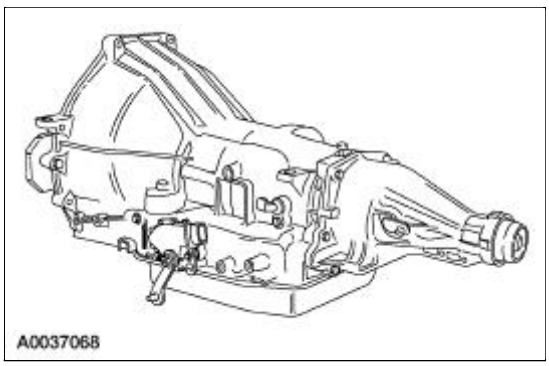
Transmission Description

The 4R70W has the following features:

- Wide ratio gears
- Four speeds
- Rear wheel drive
- Automatic
- Electronic shift
- Torque converter clutch control
- Line pressure controls

The transmission uses Ravigneaux-style double-pinion gearset with two bands, one one-way roller clutch, one mechanical diode and four friction clutches to produce four forward gears and Reverse.

4R70W Automatic Transmission

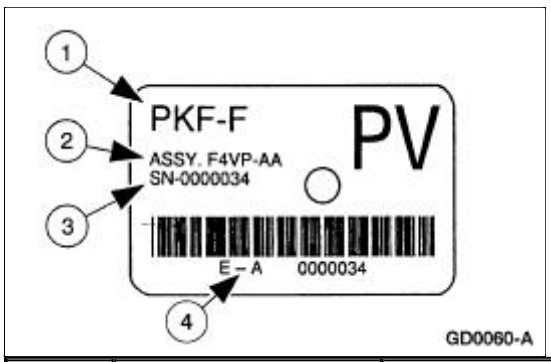


Identification Tags

All vehicles are equipped with a Vehicle Certification Label, located on the driver side door lock post. For correct transmission identification, refer to the code in the space marked TR.

For model, service ID level or build date information, refer to the transmission service ID tag located on the transmission case.

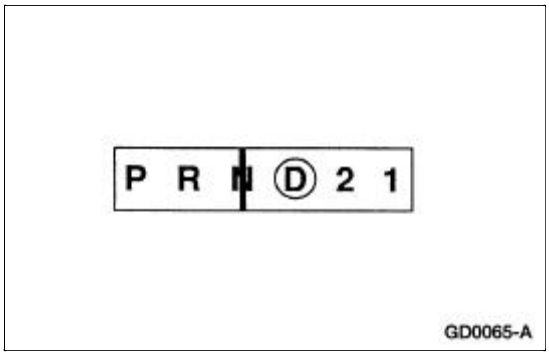
Identification Tag



Item	Part Number	Description
1	—	Model number
2	—	Assembly number
3	—	Serial number
4	—	Model and serial number

Range Selection

The transmission has six range positions: P, R, N, (D), 2 and 1.



Park

In the PARK position:

- there is no powerflow through the transmission.
- the parking pawl locks the output shaft to the case.
- the engine can be started.
- the ignition key can be removed.

Reverse

In the REVERSE position:

- the vehicle can be operated in a rearward direction, at a reduced gear ratio.
- engine braking will occur.

Neutral

In the NEUTRAL position:

- there is no powerflow through the transmission.
- the output shaft is not held and is free to turn.
- the engine can be started.

Overdrive

Overdrive is the normal position for most forward driving.

The OVERDRIVE position provides:

- Automatic shifts.

- Apply and release of the torque converter clutch.
- Maximum fuel economy during normal operation.

Second Position

This position provides:

- Second gear start and hold.
- The torque converter clutch can apply and release.
- Improved traction and engine braking on slippery roads.
- Engine braking for descending steep grades.

First Position

If this position is selected at normal road speeds, the transmission will shift into second gear, then into first when the vehicle reaches a speed below approximately 45 km/h (28 mph).

This position provides:

- First gear operation only.
- Engine braking for descending steep grades.

Shift Patterns

Upshifts

Transmission upshifting is controlled by the powertrain control module (PCM). The PCM receives inputs from various engine or vehicle sensors and driver demands to control shift scheduling, shift feel and torque converter clutch (TCC) operation.

Downshifts

Under certain conditions the transmission will downshift automatically to a lower gear range (without moving the gearshift lever). There are three categories of automatic downshifts; Coastdown, Torque Demand and Forced or Kickdown shifts.

Coastdown

The coastdown downshift occurs when the vehicle is coasting down to a stop.

Torque Demand

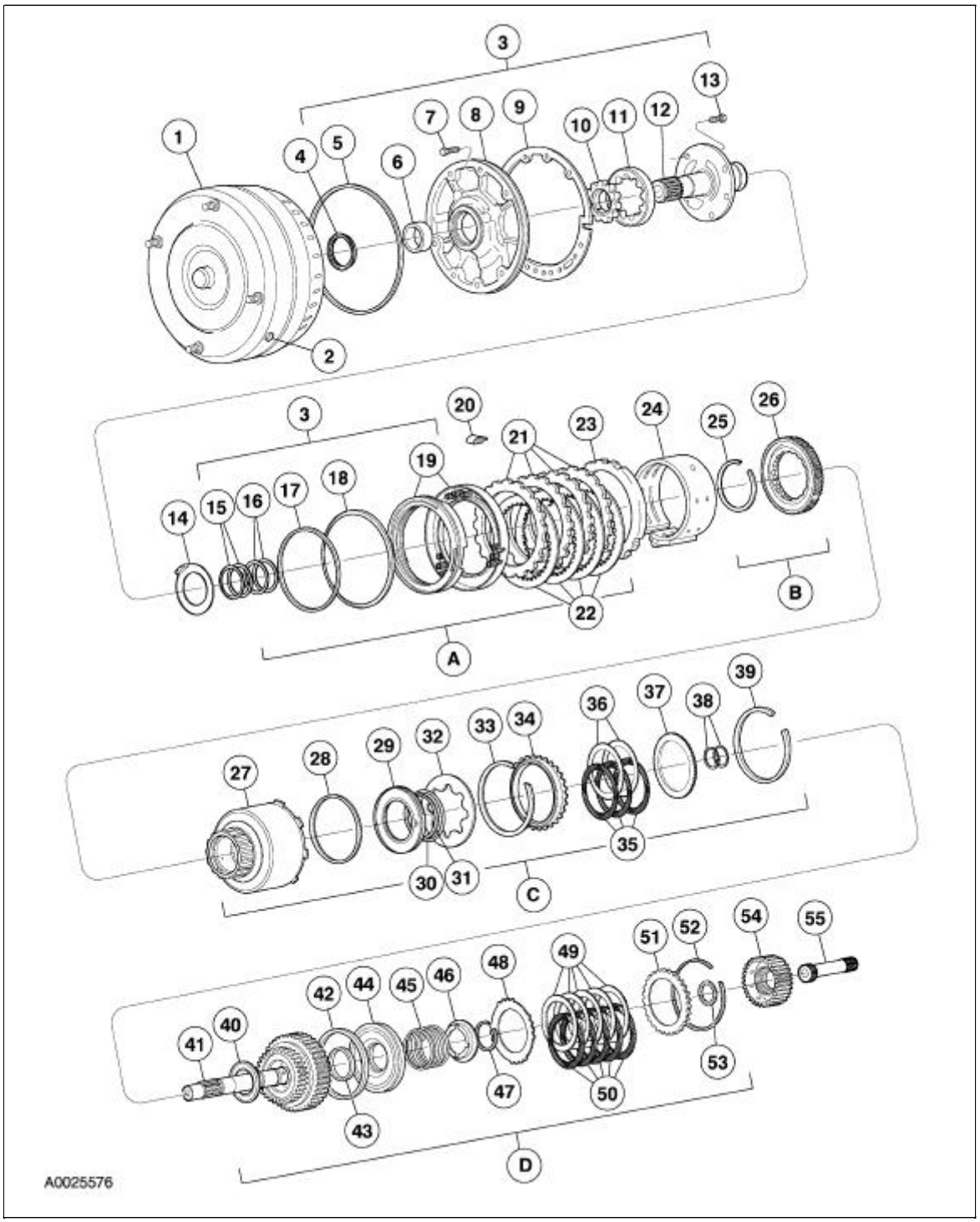
The torque demand downshift occurs (automatically) during part throttle acceleration when the demand for torque is greater than the engine can provide at that gear ratio. If applied, the transmission will disengage the TCC to provide added acceleration.

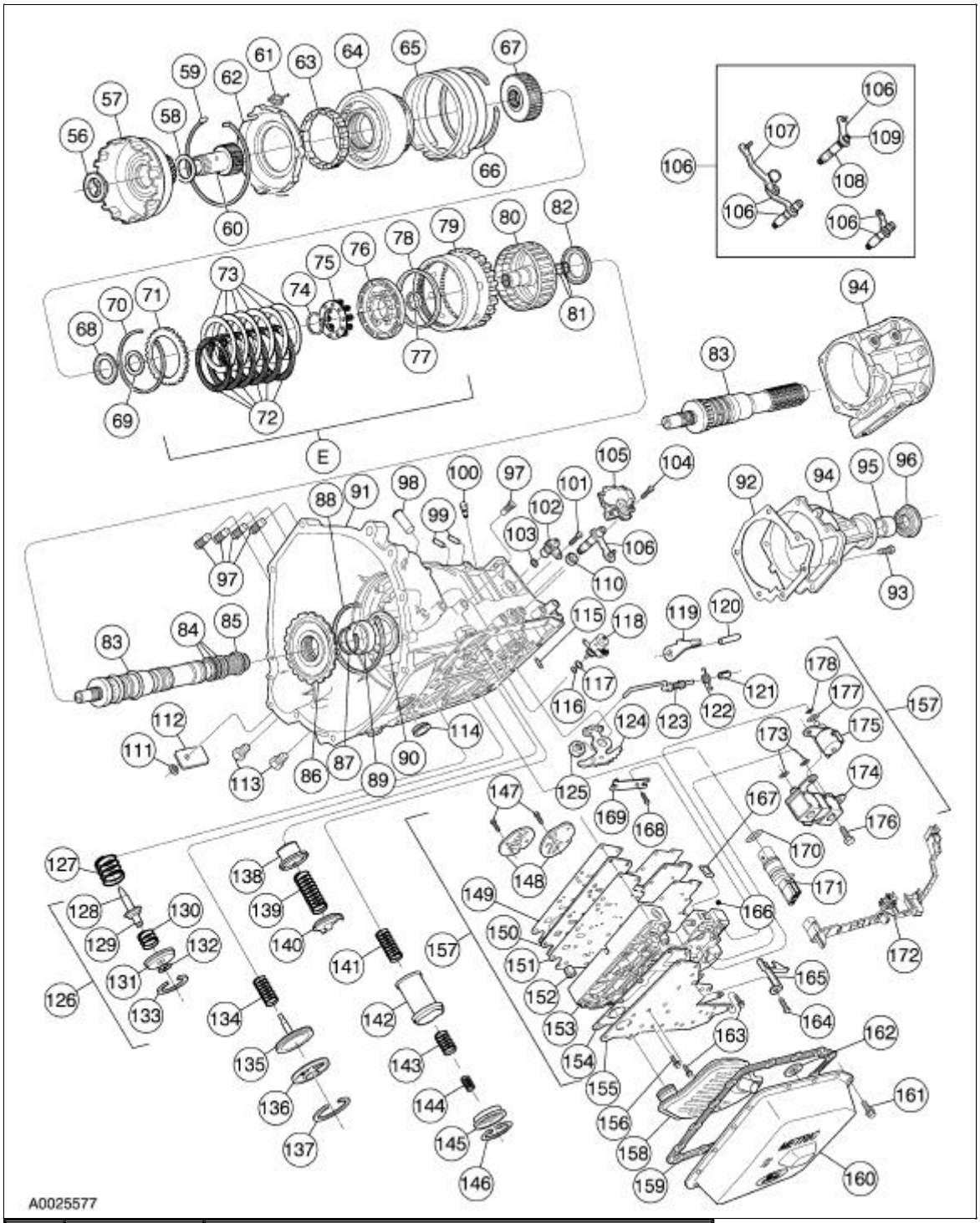
Kickdown

For maximum acceleration, the driver can force a downshift by pressing the accelerator pedal to the floor. A forced downshift into a lower gear is possible below calibrated speeds. Specifications for downshift speeds are subject to variations due to tire size, engine and transmission calibration requirements.

Disassembled Views

4R70W Automatic Transmission — Disassembled View





Item	Part Number	Description
1	7902	Converter assembly (model dependent)
2	391855-S100	Plug — converter drain — 1/8-27 Dryseal (model dependent)
3	7A103	Pump assembly — front
4	7A248	Seal assembly — front pump
5	7A248	Seal — front pump
6	7B258	Bushing — front pump
7	N605789-S101	Bolt — M8-1.25 x 35 hex head (7-attaches 7A103 to 7005)

8	7A106	Body assembly — front pump (part of 7A103)
9	7A136	Gasket — front pump
10	7H169	Gear — pump inner gerotor (part of 7A103)
11	7H169	Gear — pump outer gerotor (part of 7A103)
12	7A108	Support assembly — front pump
13	N605787-S	Bolt — M8-1.25 x 25 hex flange head (5-attaches 7A108 to 7A103)
14	7D014	Washer — front pump support thrust — select fit No. 1
15	7D020	Seals — reverse clutch cylinder (2 req'd)
16	7D019	Seals — forward clutch cylinder (2 req'd)
17	7F225	Seal — intermediate clutch piston inner
18	7F224	Seal — intermediate clutch piston outer
19	7E005	Piston kit — intermediate clutch
20	7A609	Anti rattle clip — intermediate clutch (model dependent)
21	7B442	Plate — intermediate clutch external spline (select fit) (steel)
22	7B164	Plate assembly — intermediate clutch internal spline (friction)
23	7B066	Plate — intermediate clutch pressure
24	7F196	Band assembly — overdrive
25	391267-S	Ring —3-21/64 retains type SU external (retains 7F262 to 7F215)
26	7F271	Clutch assembly —intermediate one-way clutch
27	7D044	Drum assembly — reverse clutch
28	7D403	Seal — reverse clutch piston outer
29	7D402	Piston assembly — reverse clutch
30	7D404	Seal reverse clutch piston inner
31	7D256	Ring — reverse clutch piston pressure
32	7B070	Spring — reverse clutch piston return
33	7A577	Spring — reverse clutch piston spring
34	7B066	Plate — reverse clutch front pressure
35	7B164	Plate — reverse clutch internal spline (friction)
36	7B442	Plate — reverse clutch external spline (steel)
37	7B066	Plate — reverse clutch rear pressure
38	7B497	Seals — input shaft (2 req'd)
39	7D483	Retainer — reverse clutch pressure plate — (select fit)
40	7A166	Bearing and race assembly — forward clutch No. 2
41	7F207	Cylinder and input shaft assembly — forward clutch
42	7A548	Seal — forward clutch piston outer

43	7C099	Seal — forward clutch piston inner
44	7A262	Piston — forward clutch
45	7A480	Spring — forward clutch piston return
46	7A527	Retainer return spring — forward clutch
47	388099-S	Snap ring — retaining — 1-59/64 (retains 7A529 in 7F207)
48	7E085	Spring — rear clutch pressure plate (model dependent)
49	7B442	Plate — forward clutch external spline (steel)
50	7B164	Plate — forward clutch internal spline (friction)
51	7B066	Plate — forward clutch pressure
52	7D483	Snap ring — retaining (select fit)
53	7F231	Bearing and race assembly — forward clutch front No. 3
54	7B067	Hub — forward clutch
55	7F351	Shaft — intermediate stub
56	7C096	Bearing and race assembly — forward clutch hub No. 4
57	7A019	Gear assembly — reverse sun
58	7F244	Bearing and race assembly — forward clutch sun gear No. 5
59	388501-S	Retaining ring — center support — 7-7/92
60	7A399	Gear assembly — forward clutch sun
61	7F277	Spring — case to planet support
62	7A130	Support assembly — planetary gear
63	7A089	OWC cage spring and roller assembly — planetary
64	7A398	Planetary assembly (model dependent)
65	7D095	Band assembly — reverse
66	377437-S	Retaining ring — 0.58 thick (locates reverse band during assembly)
67	7F236	Hub — direct clutch
68	7F243	Bearing and race assembly — direct clutch inner No. 7
69	7F237	Support — direct clutch inner bearing
70	7D483	Retaining ring — direct clutch pressure plate (select fit)
71	7B066	Plate — direct clutch pressure
72	7B164	Plate — direct clutch internal spline (friction)
73	7B442	Plate — direct clutch external spline (steel)
74	388104-S	Retainer ring — 1-19/32 (retains 7F235 to 7F283)
75	7F235	Retainer and spring assembly — direct clutch
76	7A262	Piston assembly — direct clutch
77	7C099	Seal — direct clutch piston inner

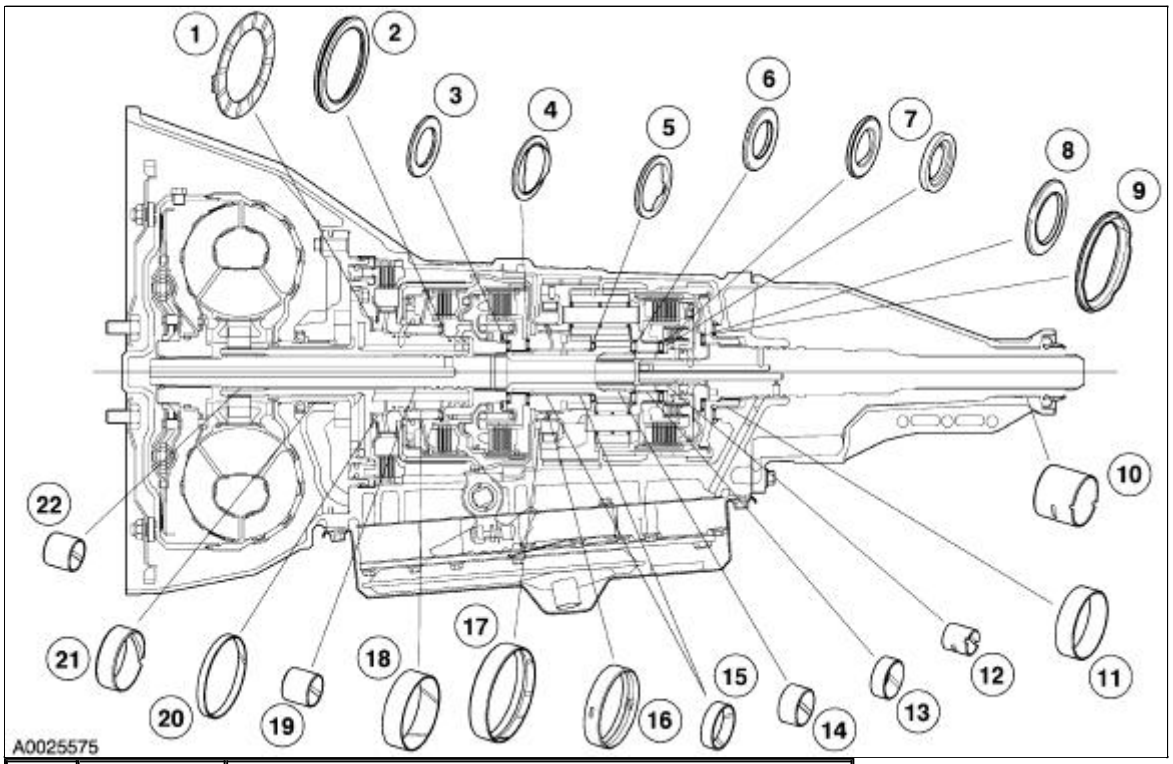
78	7A233	Seal — direct clutch piston outer
79	7A153	Gear — output shaft ring
80	7F283	Cylinder assembly — direct clutch
81	7F274	Seals — output shaft small — direct clutch (2 req'd)
82	7F240	Bearing and race assembly — direct clutch outer No. 8
83	7060	Shaft assembly — output (model dependent)
84	7F273	Seal — output to case shaft large (3 req'd)
85	87054-S94	Seal — O-ring (piloted output shaft only) (model dependent)
86	7D164	Hub — output shaft
87	97713-S	Snap ring — 1-13/16 retaining (retains 7D164 to 7060)
88	7C122	Snap ring — retaining (retains 7D164 to 7A153)
89	7025	Bushing — rear case
90	7F242	Bearing and race assembly — case rear No. 9
91	7005	Case assembly
92	7086	Gasket — extension (model dependent)
93	N803747-S1101	Bolt — M8-1.25 x 30 (6-attaches 7A039 to 7005) (model dependent)
94	7A039	Extension housing assembly (model dependent)
95	—	Bushing — extension housing (part of 7A039)
96	7052	Seal assembly — extension housing (model dependent)
97	390318-S100	Pipe plug — 1/8-27 Dryseal tapered (5 req'd)
98	7F295	Pin — overdrive band anchor
99	388142-S	Pin — reverse band anchor (part of 7005)
100	7034	Vent assembly — case
101	N605771-S427	Bolt — M6-1.0 x 14 hex head (attaches output shaft speed sensor to case)
102	7H103	Sensor assembly — transmission output shaft speed
103	N811757-S100	Seal — 14.0 x 1.78 O-ring (2 req'd)
104	N806933-S102	Bolt and washer assembly — M6-1.0 x 25 mm (1 in) (2-attaches 7F293 to 7005) (model dependent)
105	7F293	Sensor — transmission range
106	7A256	Lever assembly — manual control (model dependent)
107	7H296	Link assembly — manual control (model dependent)
108	7C493	Shaft — transmission manual control lever (model dependent)
109	N808737-	Nut — M10-1.5 (attaches 7A256 to 7C493)

	S427	
110	7B498	Seal assembly — manual control lever
111	373907-S2	Nut — 1/4 spring (retains identification tag to 7000)
112	7B148	Tag — identification (part of 7005)
113	7D273	Connector assembly — fluid tube (2 req'd)
114	7N171	Plug — converter housing access
115	7B210	Pin — manual lever shaft retainer
116	391131	Seal — 0.426 x 0.070 O-ring
117	N805862-S	Seal — 14.0 x 1.78 O-ring
118	7G383	Solenoid valve — transmission pressure control
119	7A441	Pawl — parking pawl
120	7D071	Shaft — parking pawl
121	7D419	Cup — park rod guide (part of 7A039)
122	7D070	Spring — parking pawl return
123	7A232	Rod assembly — park pawl actuating
124	7A115	Lever assembly — manual valve detent lever
125	N800287-S536	Nut — M14 x 1.5 hex intermediate detent lever (attaches 7A115 to 7A256)
126	7H188	Piston assembly — overdrive servo
127	7F201	Spring — overdrive servo piston
128	7F203	Rod — overdrive servo actuating (part of 7H188)
129	7H179	Washer — backup overdrive servo (part of 7H188)
130	7G277	Spring — overdrive cushion spring (part of 7H188)
131	7F200	Piston assembly — overdrive servo (part of 7H188)
132	97411-S	Ring — retaining (part of 7H188)
133	7384	Ring — 2.85 retaining type TVP "H" internal (retains 7H188 to 7005)
134	7D031	Spring — reverse band servo piston
135	7D189	Piston assembly — reverse band servo
136	7D036	Cover assembly — reverse band servo piston
137	388215-S100	Retaining ring internal — 3-13/16
138	7H292	Piston — 2-3 accumulator (bonded seals)
139	7F285	Spring — 2-3 shift accumulator piston (model dependent)
140	7B264	Retainer — 2-3 shift accumulator spring
141	7F284	Spring — 1-2 shift accumulator (model dependent)
142	7F251	Piston — 1-2 shift accumulator (bonded seals)
143	7F284	Spring — 1-2 shift accumulator

144	7G326	Nested spring — 1-2 (inner spring) (vehicle dependent)
145	7F247	Cover and seal assembly — 1-2 accumulator
146	7384	Ring — 2-1/16 retaining type HU internal (retains 7H300 to 7005)
147	N807178-S1000	Bolt — M6-1.0 x 18 hex head (12-attaches reinforcing plate to valve body)
148	7F282	Plate — valve body reinforcing (part of 7A100)
149	7C155	Gasket — valve body separator upper
150	7A008	Plate — control valve body separator (part of 7A100)
151	7D100	Gasket — valve body separator lower
152	7D174	Valve — converter drainback
153	7A091	Body assembly — main control
154	7H173	Gasket — valve body cover plate
155	7C034	Plate — valve body cover (part of 7A100)
156	N807178-S1000	Bolt — M6-1.0 x 18 hex head (11-attaches 7C034 to 7A100 (part of 7A100)
157	7A100	Control assembly — main (model dependent)
158	7A098	Filter and seal assembly — fluid
159	7A191	Gasket — transmission pan
160	7A194	Pan — transmission
161	N605785-S1036	Bolt — M8-1.25 x 18 hex flange head (14-attaches 7A194 to 7005)
162	7L027	Magnet — ceramic case (part of 7A194)
163	N808947-S1300	Bolt — M8-1.25 x 46 hex shoulder pilot (2-attaches 7C034 to 7A100)
164	N807179-S1000	Bolt — M6-1.0 x 52 hex flange head (12-attaches 7A100 to 7005)
165	7H111	Retainer — solenoid
166	7E195	Ball — 1/4 diameter coast booster valve shuttle (8 req'd)
167	7H187	Screen — solenoid pressure supply
168	N800670-S1000	Bolt — M6-1.0 x 40 hex flange head (13-attaches 7A100 to 7005)
169	7E332	Spring assembly — manual valve detent
170	7Z276	Seal — 0.864 x 0.070 O-ring (2 req'd)
171	7G276	Bulkhead assembly — wiring connector
172	7G276	Bulkhead assembly — connector (molded lead frame)
173	7Z484	Seal — 6.07 x 1.70 O-ring (2 req'd)
174	7G484	Solenoid valve — transmission shift
175	7G136	Solenoid valve — transmission torque converter clutch
176	N807178-S1000	Bolt — M6-1.0 x 16 hex head (retains 7D136 and 7G484 to 7A100)

177	7Z136	Seal — 0.489 x 0.070 O-ring
178	7Z484	Seal — 0.176 x 0.070 O-ring
A	—	Intermediate clutch assembly
B	—	Intermediate one-way clutch
C	—	Reverse clutch assembly
D	—	Forward clutch assembly
E	—	Direct clutch assembly

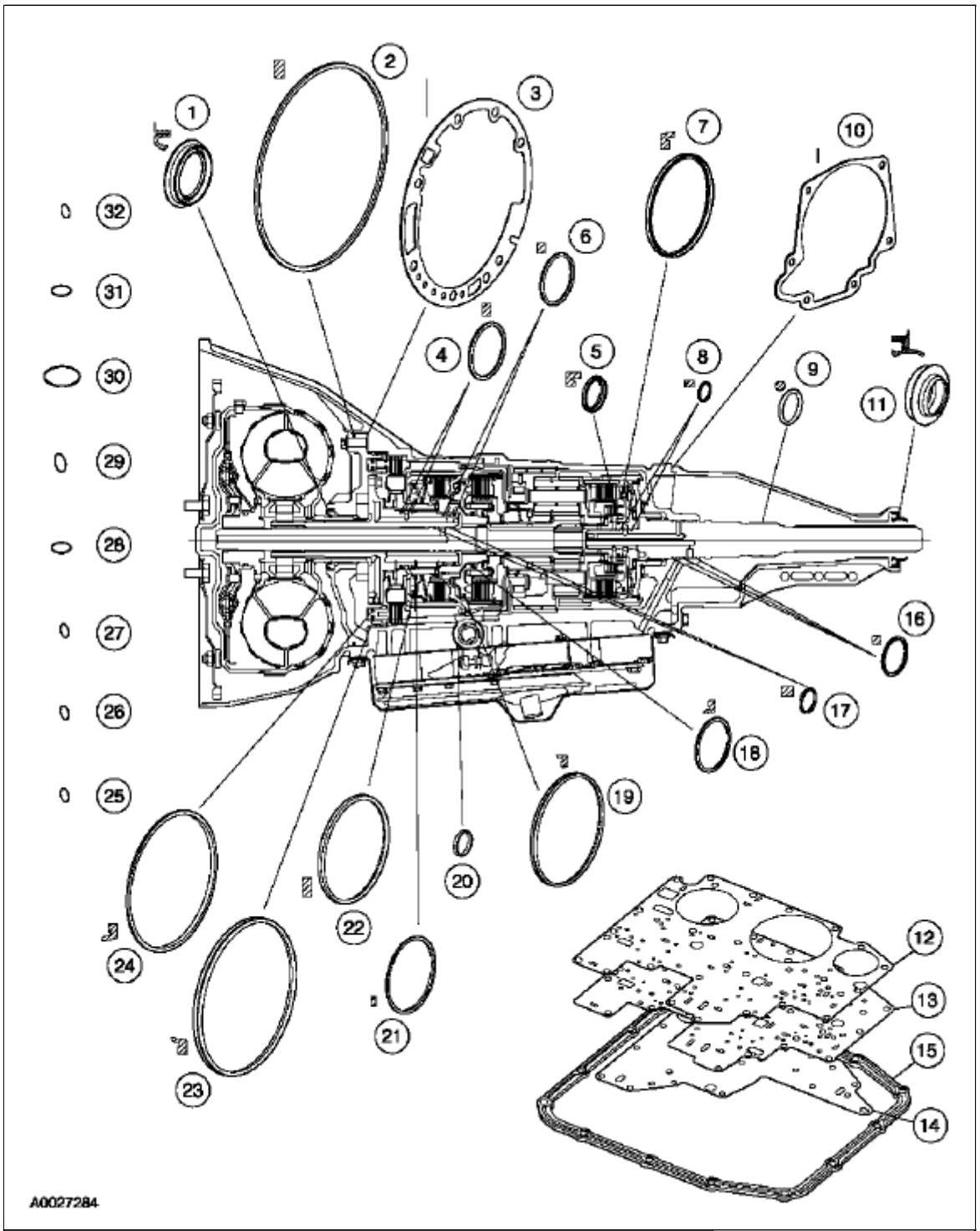
Bushings, Bearing and Thrust Washer Locator



Item	Part Number	Description
1	7D014	Pump No.1 thrust washer (select fit)
2	7A166	Forward clutch No. 2 bearing and race assembly
3	7F231	Forward clutch bearing and race assembly — front No. 3
4	7F244	Forward clutch hub bearing and race assembly No. 4
5	7F244	Forward clutch sun gear bearing and race assembly No. 5
6	7F241	Planet assembly bearing and race No. 6
7	7F243, 7F237	Direct clutch inner bearing, race assembly No. 7 and direct clutch inner bearing support No. 7
8	7F240	Direct clutch outer bearing and race assembly No. 8
9	7F242	Outer bearing and race assembly — rear No. 9
10	—	Extension bushing (part of 7A039)
11	7025	Case bushing
12	7B233	Output shaft bushing
13	7B375	Planet carrier bushing — rear
14	7F209	Forward clutch sun gear bushing
15	7N193	Reverse clutch sun gear bushing

16	7B374	Carrier bushing — front
17	7A132	Planetary support bushing
18	7F218	Reverse clutch drum bushing — rear
19	7B261	Front pump support bushing
20	7F217	Reverse clutch drum bushing — front
21	7B258	Front pump bushing
22	7B261	Front pump support bushing

Seals, Rings and Gasket Locator

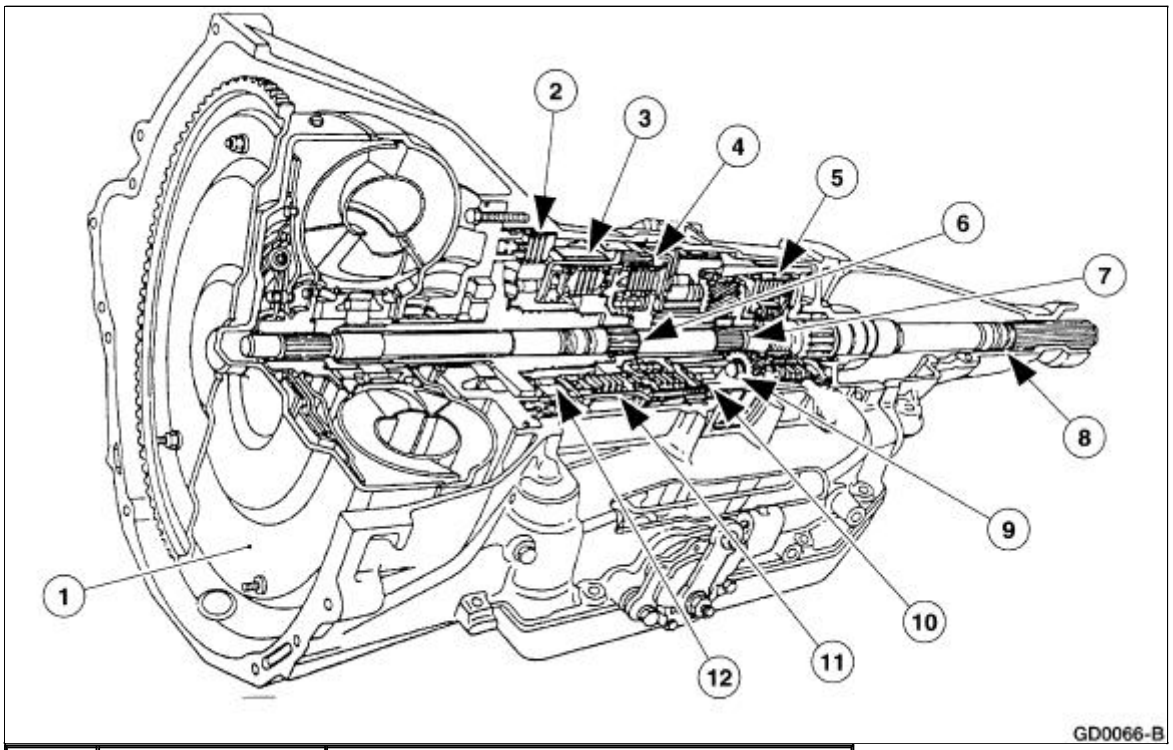


Item	Part Number	Description
1	7A248	Front pump seal assembly
2	7A248	Front pump seal
3	7A136	Front pump gasket

4	7D020	Reverse clutch cylinder seal (2 req'd)
5	7C099	Direct clutch piston inner seal
6	7D019	Forward clutch cylinder
7	7A548	Direct clutch piston outer seal
8	7F274	Output shaft to direct clutch cylinder seal (2 req'd)
9	87054-S94	O-ring seal (piloted) (model dependent)
10	7086	Extension gasket
11	7052	Extension housing seal assembly
12	7C155	Control valve body upper gasket
13	7D100	Valve body separator plate lower gasket
14	7H173	Valve body cover plate gasket
15	7A191	Transmission pan to case gasket
16	7F273	Output shaft to case seal (3 req'd)
17	7B497	Input shaft seal (2 req'd)
18	7C099	Forward clutch piston inner seal
19	7A548	Forward clutch piston outer seal
20	7B498	Manual control lever seal assembly
21	7D403	Reverse clutch piston outer seal
22	7D404	Reverse clutch piston inner seal
23	7F224	Intermediate clutch piston outer seal
24	7F225	Intermediate clutch piston inner seal
25	391308-S	Fill tube level indicator seal
26	7Z484	TCC solenoid seal (large)
27	7Z136	TCC solenoid seal (small)
28	7Z484	Shift solenoid seal (2 req'd)
29	N811757-S100	Output shaft speed sensor seal
30	7Z276	Bulkhead seal (1 req'd)
31	N805862-S	Pressure control solenoid seal (large)
32	391131	Pressure control solenoid seal (small)

Main Components and Functions

Transmission Main Components — Sectional View



Item	Part Number	Description
1	7902	Torque converter
2	7B164	Intermediate clutch (friction)
3	7B164	Reverse clutch (friction)
4	7B164	Forward clutch (friction)
5	7B164	Direct clutch (friction)
6	7F207	Forward clutch cylinder and shaft
7	7F351	Shaft — intermediate stub
8	7060	Output shaft
9	7A089	Planetary one-way clutch
10	7D095	Reverse clutch band
11	7F196	Overdrive band
12	7A089	Intermediate one-way clutch

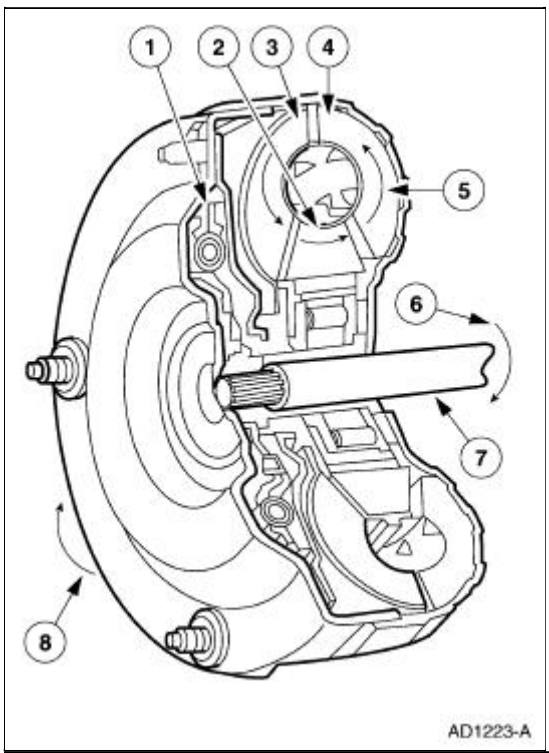
Torque Converter

The torque converter transmits and multiplies torque. The torque converter is a four-element device:

- impeller assembly
- turbine assembly
- reactor assembly
- clutch and damper assembly

The standard torque converter components operate as follows:

- Rotation of the converter housing and impeller set the fluid in motion.
- The turbine reacts to the fluid motion from the impeller, transferring rotation to the geartrain through the input shaft.
- The reactor redirects fluid going back into the impeller, allowing for torque multiplication.
- The clutch and damper assembly dampens powertrain torsional vibration and provides a direct mechanical connection for improved efficiency.
- Power is transmitted from the torque converter to the planetary gearsets and other components through the input shaft.



Item	Part Number	Description
1	—	Converter clutch and damper (part of 7902)
2	—	Reactor (part of 7902)
3	—	Turbine (part of 7902)

4	—	Impeller (part of 7902)
5	—	Fluid motion
6	—	Transmission input rotation
7	—	Input shaft
8	—	Engine rotation

Geartrain

Power is transmitted from the torque converter to the Ravigneaux geartrain components through the input shaft and forward clutch cylinder.

- The geartrain contains a Ravigneaux planetary set connected by dual pinion gears.
- By holding or driving certain components of the gearset, four forward ratios and one reverse ratio are obtained and transmitted to the output shaft. The ratios are as follows:

Gear Ratio	
1st	2.84 to 1
2nd	1.55 to 1
3rd	1.00 to 1
4th	0.70 to 1
Reverse	2.32 to 1

- Components of the geartrain can be held by bands or clutches and driven by clutches only.

The 4R70W uses:

- two bands.
- two one-way clutches (one roller, one mechanical diode).
- four friction clutches.

Planetary Gearset

The planetary gearset in the transmission is a Ravigneaux-type set consisting of the following components:

- forward clutch sun gear
- reverse clutch sun gear
- a pinion carrier
- long and short pinions
- output ring gear

Components are held or driven to produce forward and reverse gear ratios.

Input Shaft

The forward clutch cylinder and shaft transfers speed and torque from the converter turbine to the geartrain. This shaft is splined to the turbine on one end and to the forward clutch sun gear and stub shaft on the other end.

Stub Shaft

The stub shaft transfers power from the input shaft to the planet carrier (through the direct clutch) during third and fourth gear operation.

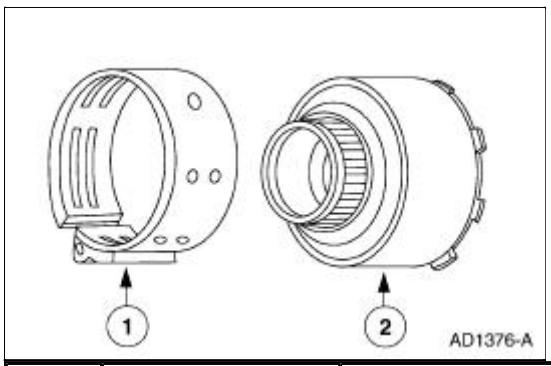
Output Shaft

The output shaft provides torque to the driveshaft and rear axle assembly. It is driven by the ring gear of the planetary gearset.

Apply Components

There are eight apply components used to drive or hold the planetary gearset components.

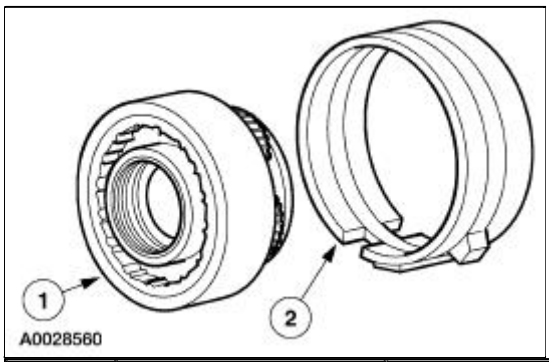
Band—Overdrive



Item	Part Number	Description
1	7F196	Overdrive band assembly
2	7D044	Reverse clutch drum assembly

The overdrive band holds the reverse clutch drum stationary in fourth gear and manual 2. This action causes the reverse sun gear to be held in these ranges.

Band—Low and Reverse

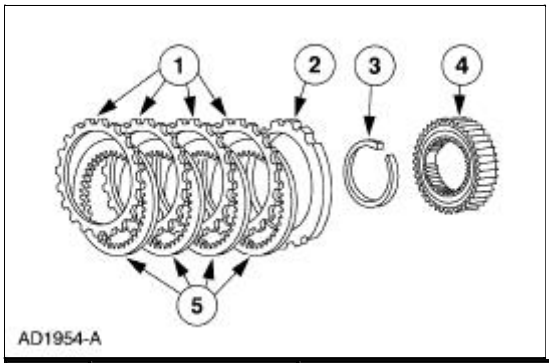


Item	Part Number	Description
1	7A398	Planetary assembly
2	7D095	Reverse band assembly

The low and reverse band holds the pinion carrier in reverse. The reverse band also applies in manual 1 position to provide engine braking.

Clutch—Intermediate

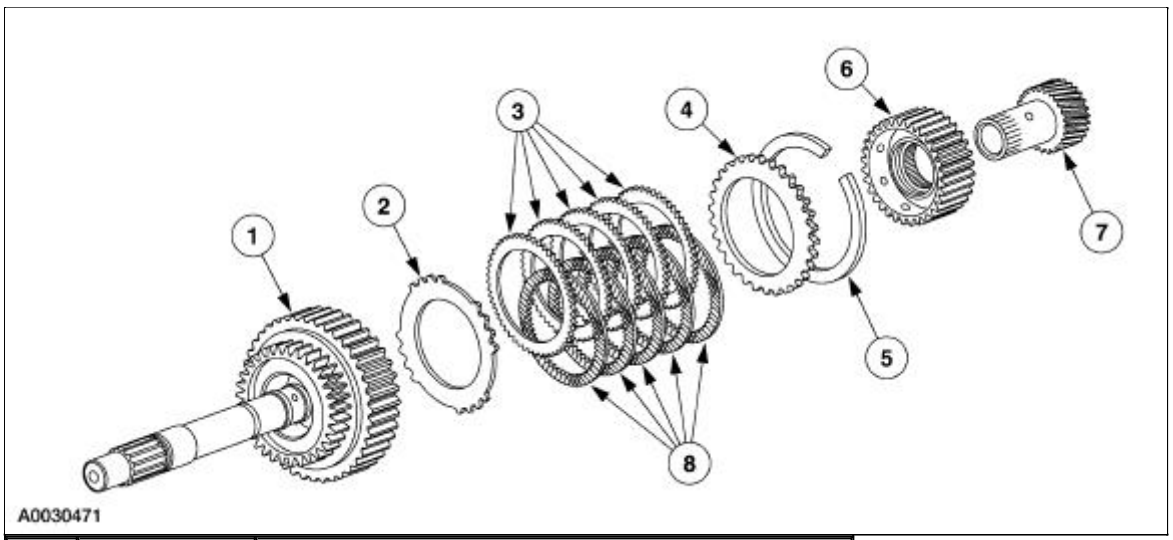
Intermediate Clutch Disassembled View



Item	Part Number	Description
1	7B442	Intermediate clutch plates (steel)
2	7B066	Intermediate clutch pressure plate
3	391267-S	Retaining ring
4	7A089	Intermediate one-way clutch assembly
5	7B164	Intermediate clutch plates (friction)

The intermediate clutch works with the intermediate one-way clutch to hold the reverse sun gear stationary in second gear. The intermediate clutch remains applied in third and fourth gears, but does not transmit power.

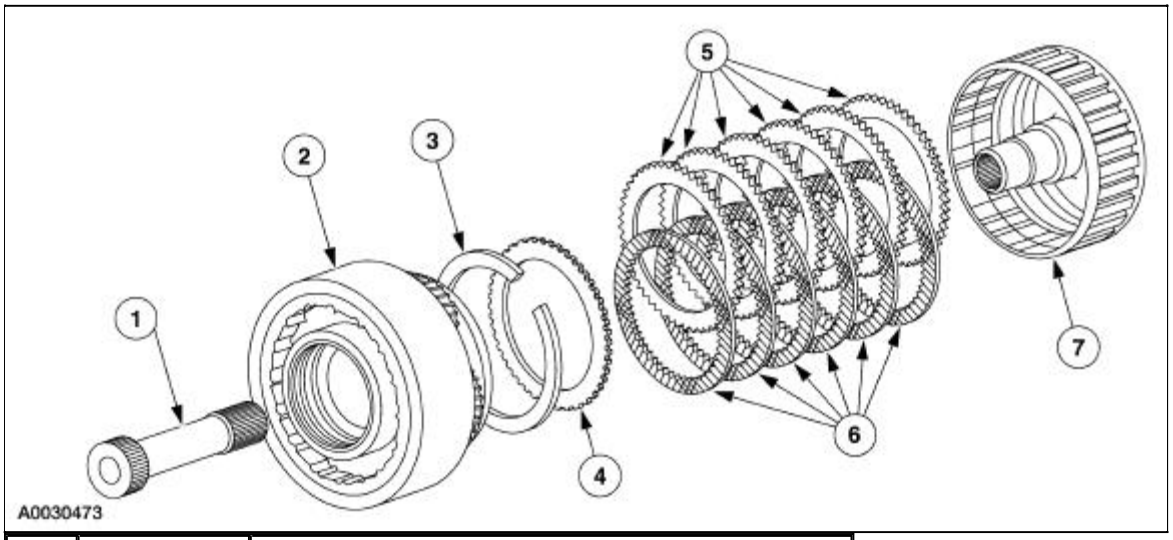
Clutch—Forward



Item	Part Number	Description
1	7F207	Forward clutch cylinder and input shaft assembly
2	7E085	Rear clutch pressure plate spring
3	7B442	Forward clutch plate external spline (steel)
4	7B066	Forward clutch pressure plate
5	7D483	Snap ring — retaining (select fit)
6	7B067	Forward clutch hub
7	7A399	Forward clutch sun gear assembly
8	7B164	Forward clutch plate internal spline (friction)

The forward clutch couples the forward clutch cylinder and input shaft to the forward sun gear in first, second, and third gears. The forward clutch is not applied in fourth gear.

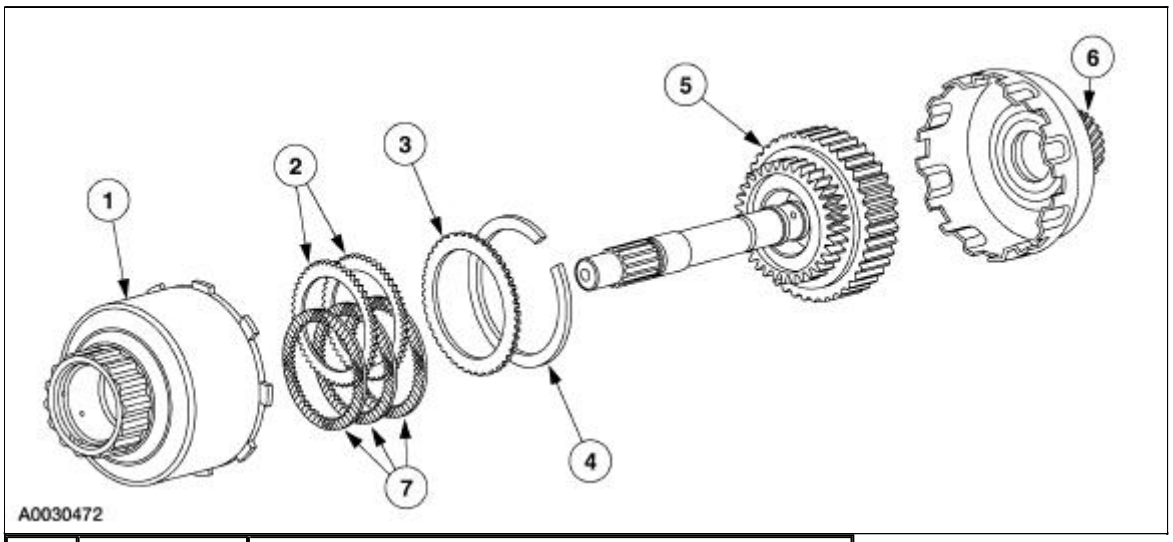
Clutch—Direct



Item	Part Number	Description
1	7F351	Intermediate stub shaft
2	7A398	Planetary assembly
3	7D483	Direct clutch pressure plate retaining ring (select fit)
4	7B066	Direct clutch pressure plate
5	7B442	Direct clutch plates external splined (steel)
6	7B164	Direct clutch plates internal splined (friction)
7	7F283	Direct clutch cylinder assembly

The direct clutch couples the input shaft to the planet carrier through the stub shaft in third and fourth gears.

Clutch—Reverse

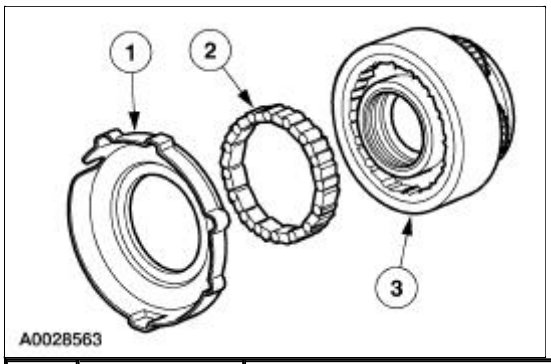


Item	Part Number	Description
1	7D044	Reverse clutch drum assembly

2	7B442	Reverse clutch plate external splined (steel)
3	7B066	Reverse clutch pressure plate (rear)
4	7D483	Reverse clutch pressure plate retaining ring (select fit)
5	7F207	Forward clutch cylinder and input shaft assembly
6	7A019	Reverse clutch sun gear assembly
7	7B164	Reverse clutch plate internal splined (friction)

The reverse clutch couples the input shaft to the reverse sun gear, applied in reverse range only.

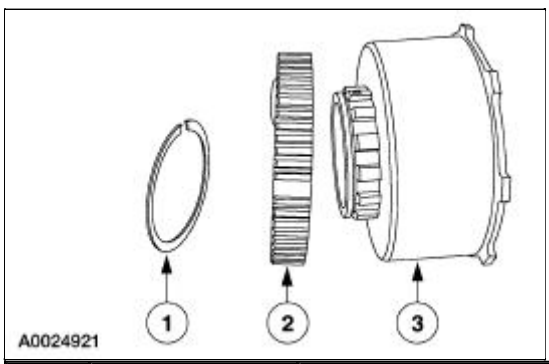
One-Way Clutch—Planetary (Low)



Item	Part Number	Description
1	7A130	Planetary gear support assembly
2	7A089	Planetary one-way clutch cage and spring roller assembly
3	7A398	Planetary assembly

The planetary (low) one-way clutch is a roller clutch that holds the planetary gearset in first gear, (D) and D ranges. During automatic coasting downshifts into first gear ((D) and D ranges), the planetary one-way clutch freewheels so there is no engine braking.

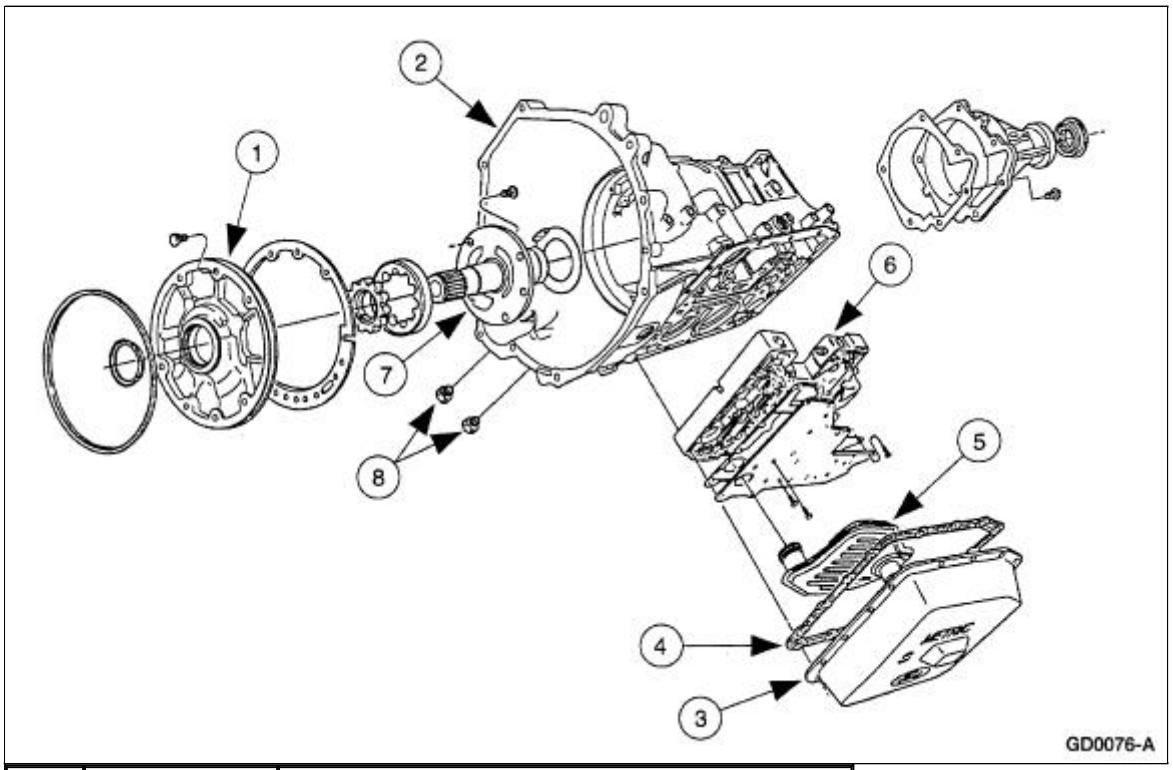
One-Way Clutch—Intermediate



Item	Part Number	Description
1	391267-S	Retaining ring
2	7A089	Intermediate one-way clutch assembly
3	7D044	Reverse clutch drum assembly

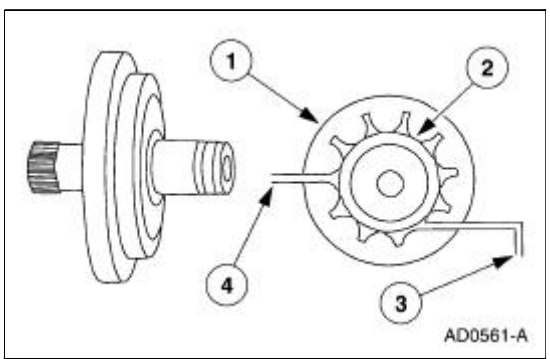
The intermediate one-way clutch works with the intermediate friction clutch to hold the reverse clutch drum and reverse sun gear stationary in second gear during acceleration. The intermediate one-way clutch freewheels in third gear and during coasting in second gear, (D) and D ranges.

Hydraulic System



Item	Part Number	Description
1	7A106	Front pump body assembly
2	7005	Case assembly
3	7A194	Transmission pan
4	7A191	Transmission pan gasket
5	7A098	Fluid filter and seal assembly
6	7A100	Main control assembly
7	7A108	Front pump support assembly
8	7D273	Fluid tube connector assembly (2 required)

Fluid Pump



Item	Part Number	Description

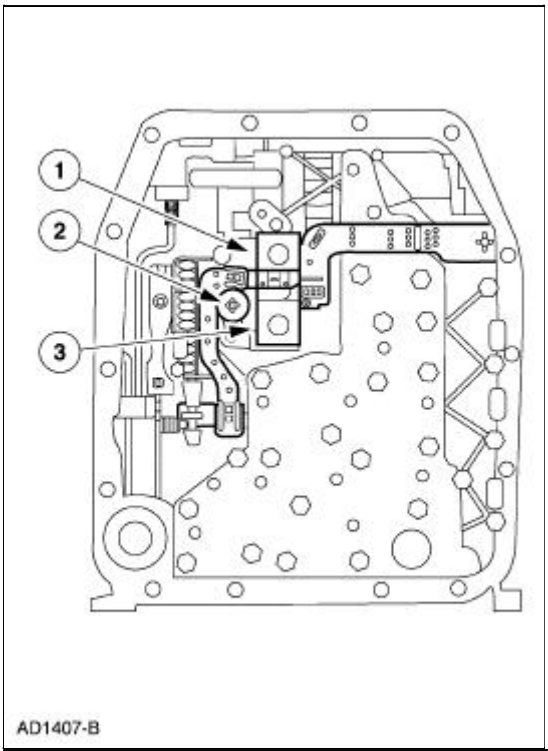
1	—	Outer rotor (part of 7A103)
2	—	Inner rotor (part of 7A103)
3	—	Outlet
4	—	Inlet

The transmission uses a gerotor-type design front pump support and gear. The pump provides the volume of fluid needed to charge the torque converter, main control assembly, cooling system and lube system. Pump pressure is regulated by the main regulator valve. The pump has an internal boost circuit which is more efficient at lower engine speeds.

Filter

All fluid drawn from the transmission pan by the pump passes through the filter. The filter and its accompanying seal are part of the fluid path from the sump (pan) to the fluid pump.

Main Control

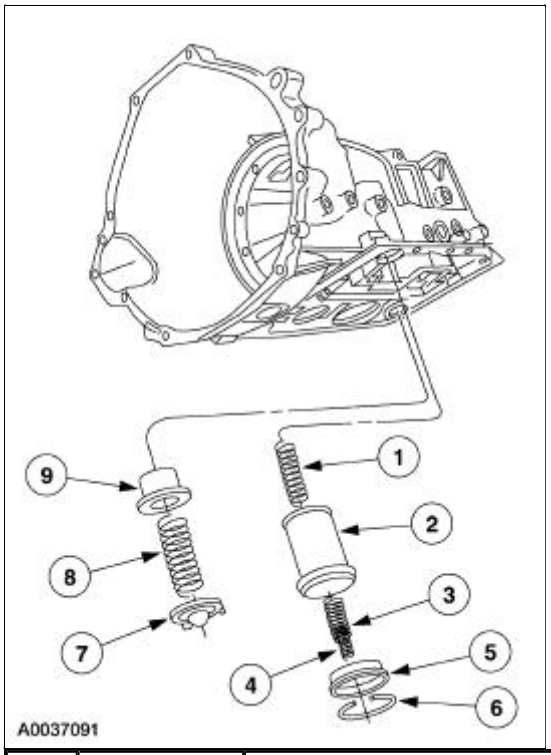


Item	Part Number	Description
1	—	Shift solenoid A (part of 7G484)
2	7G136	Torque converter clutch solenoid
3	—	Shift solenoid B (part of 7G484)

The main control valve body houses three electronic solenoids:

- two shift solenoids
- one torque converter clutch solenoid (TCC solenoid)

Accumulators



Item	Part Number	Description
1	7F284	Spring — 1-2 shift accumulator (model dependent)
2	7F251	Piston — 1-2 shift accumulator
3	7F284	Spring — outer 1-2 shift accumulator (model dependent)
4	7G326	Spring — inner 1-2 shift accumulator (model dependent)
5	7F247	Cover and seal assembly — 1-2 accumulator
6	7384	Ring — 2-1/16 retaining type HU internal
7	7B264	Retainer — 2-3 shift accumulator piston
8	7F285	Spring — 2-3 shift accumulator piston
9	7H292	Piston — 2-3 shift accumulator

The transmission uses two accumulators:

- 1-2 Accumulator — The 1-2 accumulator is used to soften the 1-2 shift by absorbing some of the pressure directed to the intermediate clutch. Constant line pressure is applied to the middle section of the 1-2 accumulator piston, opposing the intermediate clutch pressure, until the pressure is high enough to overcome line pressure. The top of the piston is exhausted to the sump.
- 2-3 Accumulator — The 2-3 accumulator is used to soften the 2-3 shift by absorbing some of the direct clutch pressure. Forward clutch pressure is applied to the top side of the 2-3 accumulator piston, holding the piston down until clutch pressure is high enough to overcome it. The middle section of the piston is exhausted to the sump.

Transmission Electronic Control System

Electronic System Description

The powertrain control module (PCM) and its input/output network control the following transmission operations:

- shift timing
- line pressure (shift feel)
- torque converter clutch

The transmission control is separate from the engine control strategy in the PCM, although some of the input signals are shared. When determining the best operating strategy for transmission operation, the PCM uses input information from certain engine-related and driver-demand related sensors and switches.

In addition, the PCM receives input signals from certain transmission-related sensors and switches. The PCM also uses these signals when determining transmission operating strategy.

Using all of these input signals, the PCM can determine when the time and conditions are right for a shift, or when to apply or release the torque converter clutch. It will also determine the best line pressure needed to optimize shift feel. To accomplish this the PCM uses hydraulic solenoids to control transmission operation.

The following provides a brief description of each of the sensors and actuators used to control transmission operation.

Mass Air Flow (MAF) Sensor

The mass air flow sensor (MAF) measures the mass of air flowing into the engine. The MAF sensor output signal is used by the powertrain control module (PCM) to calculate injector pulse width. For transmission strategies the MAF sensor is used to regulate electronic pressure control EPC, shift and torque converter clutch scheduling.

Powertrain Control Module (PCM)

The operation of the transmission is controlled by the powertrain control module (PCM). Many input sensors provide information to the PCM. The PCM then controls actuators which determine transmission operation.

Transmission Control Switch (TCS) and Transmission Control Indicator Lamp (TCIL)

The transmission control switch (TCS) is a momentary contact switch. When the switch is pressed, a signal is sent to the PCM to allow automatic shifts from first through fourth gears or first through third gears only. The PCM energizes the transmission control indicator lamp (TCIL) when the switch is off. The TCIL indicates overdrive cancel mode activated (lamp on) and electronic pressure control (EPC) circuit shorted (lamp flashing) or a monitored sensor failure.

Output Shaft Speed (OSS) Sensor

The output shaft speed (OSS) sensor is a magnetic pickup, located at the output shaft ring gear, that sends a signal to the powertrain control module to indicate transmission output shaft speed. The OSS is used for torque converter clutch control, shift scheduling and to determine electronic pressure

control.

Digital Transmission Range (TR) Sensor

The digital transmission range (TR) sensor is located on the outside of the transmission at the manual lever. The digital TR sensor completes the start circuit in PARK and NEUTRAL, the back-up lamp circuit in REVERSE and the neutral sense circuit (4x4 only) in NEUTRAL. The digital TR sensor also opens and closes a set of four switches that are monitored by the powertrain control module (PCM) to determine the position of the manual lever (P, R, N, D, 2, 1).

Transmission Fluid Temperature (TFT) Sensor

The transmission fluid temperature (TFT) sensor is located on the lead frame assembly near the shift solenoids on the main control valve body. It is a temperature sensitive device called a thermistor. It sends a voltage signal to the PCM. The voltage signal varies with transmission fluid temperature. The PCM uses this signal to determine whether a cold start shift schedule is necessary. The shift schedule is compensated when the transmission fluid temperature is cold. The PCM also inhibits (TCC) operation at low transmission fluid temperatures and corrects electronic pressure control.

Vehicle Speed Sensor (VSS)

The vehicle speed sensor (VSS) is model dependent. Possible sources of vehicle speed input are, anti-lock brake sensor (ABS), a gear-driven vehicle speed sensor (VSS), or the transmission output shaft speed (OSS) sensor. On 4x4 applications with a manual shift transfer case, the transfer case speed sensor is the source of vehicle speed. The VSS signal is either an AC signal whose frequency changes with vehicle speed, or an SCP data message depending on the source. Some vehicles have both. The vehicle speed signal is an input to various vehicle sub-systems such as the powertrain control module (PCM), instrument cluster (speedometer and odometer), speed control systems, etc. The vehicle speed source must be operational to enter output state control mode for diagnostics.

Electronic Pressure Control (EPC) Solenoid

The electronic pressure control (EPC) solenoid regulates transmission pressure. EPC valve pressure is used to control line pressure.

Shift Solenoid — SSA, SSB

Two on/off shift solenoids provide gear selection of first through fourth gears by controlling the pressure to the three shift valves. One unit containing the two shift solenoids is located in the main control valve body. The shift solenoids are two-way normally open style.

Solenoid Operation Chart

		Solenoids		
Gear Lever Position	**PCM Commanded Gear**	**SSA**	**SSB**	**TCC**
P/R/N	1	ON	OFF	HD
(D)	1	ON	OFF	HD
(D)	2	OFF	OFF	EC
(D)	3	OFF	ON	EC
(D)	4	ON	ON	EC
w/OD OFF				
1	1	ON	OFF	HD
2	2	OFF	OFF	EC

3	3	OFF	ON	EC
Manual 2	2	OFF	OFF	EC
Manual 1	1	ON	OFF	HD
1 [a]	2	OFF	OFF	EC

[a] When a manual pull-in occurs above a calibrated speed, the transmission will not downshift from the higher gear until the vehicle speed drops below this calibrated speed.

EC = Electronically Controlled.

HD = Hydraulically Disabled.

Torque Converter Clutch (TCC) Solenoid

The torque converter clutch (TCC) solenoid is used to control the apply and release of the TCC.

4x4 Low (4x4L) Switch

The 4x4 low (4x4L) range switch is located on the transfer case cover. It provides an indication of when the 4x4 transfer case gear system is in the low range. The PCM then modifies shift schedule for 4x4L operation.

Brake Pedal Position (BPP) Switch

The brake pedal position (BPP) switch tells the powertrain control module (PCM) when the brakes are applied. The torque converter clutch disengages when the brakes are applied. The BPP switch closes when the brakes are applied and opens when they are released.

Electronic Ignition (EI) System

The electronic ignition consists of a crankshaft position sensor, two four tower ignition coils and the powertrain control module (PCM). The ignition control module operates by sending crankshaft position information from the crankshaft position sensor to the ignition control module. The ignition control module generates a profile ignition pickup (PIP) signal (engine rpm) and sends it to the PCM. The PCM uses PIP signal in the transmission strategy, wide-open throttle (WOT) shift control, torque converter clutch control and EPC pressure.

Air Conditioning (A/C) Clutch

An electromagnetic clutch is energized when the clutch cycling pressure switch closes. The switch is located on the suction accumulator/drier. The closing of the switch completes the circuit to the clutch and draws it into engagement with the compressor driveshaft. When the A/C clutch is engaged, electronic pressure control (EPC) is adjusted by the PCM to compensate for additional load on the engine.

Intake Air Temperature (IAT) Sensor

The intake air temperature (IAT) sensor provides the sequential fuel injection (SFI) system mixture temperature information. The IAT sensor is used both as a density corrector for air flow calculation and to proportion cold enrichment fuel flow. The IAT sensor is installed in the air cleaner outlet tube. The IAT sensor is also used in determining electronic pressure control (EPC) pressures.

Engine Coolant Temperature (ECT) Sensor

The engine coolant temperature (ECT) sensor detects temperature of engine coolant and supplies the information to the powertrain control module (PCM). The ECT sensor is used to control torque converter clutch (TCC) operation. The ECT is installed in the heater outlet fitting or cooling passage on

the engine. For engine control applications, the ECT signal is used to modify ignition timing, EGR flow and air-to-fuel ratio as a function of engine coolant temperature.

Throttle Position (TP) Sensor

The throttle position (TP) sensor is a potentiometer mounted on the throttle body. The TP sensor detects the position of the throttle plate and sends this information to the powertrain control module (PCM). The TP sensor is used for shift scheduling, electronic pressure control and torque converter clutch (TCC) control.

Diagnostic Strategy

Troubleshooting an electronically controlled automatic transmission is simplified by using the proven method of diagnosis. One of the most important things to remember is that there is a definite procedure to follow.

NOTE: Do not take any short cuts or assume that critical checks or adjustments have already been made.

Follow the procedures as written to avoid missing critical components or steps.

To properly diagnose a concern have the following publications available:

- Transmission Reference Manual.
- Powertrain Control/Emissions Diagnosis (PC/ED) manual.
- TSBs and OASIS Messages.
- Wiring Diagram.

These publications provide the information required when diagnosing transmission concerns.

Use the Diagnostic Flow Chart as a guide and follow the steps as indicated.

Preliminary Inspection

- Know and understand the customer's concern.
- Verify the concern by operating the vehicle.
- Check the fluid levels and condition.
- Check for non-factory add-on items.
- Check shift linkages for proper adjustment.
- Check TSBs and OASIS messages regarding the concern.

Diagnostics

- Carry out on-board diagnostic procedures key on engine off (KOEO) and key on engine running (KOER).
- Record all diagnostic trouble codes (DTCs).
- Repair all non-transmission codes first.
- Repair all transmission codes second.
- Erase all continuous codes and attempt to repeat them.
- Repair all continuous codes.
- If only pass codes are obtained, refer to Diagnosis By Symptom for further information and diagnosis.

Follow the diagnostic sequence to diagnose and repair the concern the first time.

Diagnostic Flow Chart

Diagnostic Flow Chart		
• Know and understand the customer concerns • Check the fluid level and condition • Verify the concern by operating the vehicle • Check for non-factory-installed items and verify correct installation • Check the shift linkage adjustments • Check TSBs and OASIS messages for vehicle concerns • Carry out quick test both KOER and KOEO • Record all codes 1) Did you record any diagnostic trouble codes?	Yes	· REPAIR all hard diagnostic trouble codes. FOLLOW the pinpoint tests. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual first, then this Workshop Manual.
	No	· REFER to Diagnosis By Symptom in this section, then GO to Step 5.
2) Are any continuous test memory codes present?	Yes	· CLEAR codes and CARRY OUT drive cycle test.
	No	· GO to Step 4.
3) Did the continuous test memory codes reappear?	Yes	· REPAIR all continuous test memory codes. FOLLOW the pinpoint tests. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual then the transmission reference manual, then this workshop manual, then GO to Step 4.
	No	· GO to Step 4.
4) Is the concern repaired?	Yes	· CARRY OUT the final quick test to verify that no diagnostic trouble codes are present. CLEAR memory codes.
	No	· REFER to Diagnosis By Symptom in this section.
5) Are there any electrical concerns?	Yes	· INSTALL the scan tool and CARRY OUT the output state control test, then GO to Step 6.
	No	· REFER to the hydraulic and mechanical routine to diagnose and REPAIR the concern, then GO to Step 7.
6) Was the transmission concern corrected when the scan tool was installed?	Yes	· REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual, intermittent fault diagnosis section and use the scan tool to diagnose cause of concern in the processor, vehicle harness or external inputs (sensors or switches).

	No	・REFER to the hydraulic and mechanical routine to diagnose the concern, then GO to Step 7.
7) Is the concern repaired?	Yes	・CARRY OUT the final quick test to verify that no diagnostic trouble codes are present. CLEAR memory codes.
	No	・Get assistance from technical hotline.

Preliminary Inspection

The following items must be checked prior to beginning the diagnostic procedures:

Know and Understand the Concern

In order to correctly diagnose a concern, first understand the customer complaint or condition. Customer contact may be required in order to begin to verify the concern. Understand the conditions as to when the concern occurs, for example:

- Hot or cold vehicle temperature.
- Hot or cold ambient temperature.
- Vehicle driving conditions.
- Vehicle loaded/unloaded.

After understanding when and how the concern occurs, proceed to Verification of Condition.

Verification of Condition

This section provides information that must be used in both determining the actual cause of customer concerns and carrying out the appropriate procedures.

The following procedures must be used when verifying customer concerns for the transmission.

Determine Customer Concern

NOTE: Some transmission conditions can cause engine concerns. An electronic pressure control short circuit can cause engine misfiring. The torque converter clutch not disengaging will stall the engine.

Determine customer concerns relative to vehicle use and dependent driving conditions, paying attention to the following items:

- Hot or cold vehicle operating temperature.
- Hot or cold ambient temperatures.
- Type of terrain.
- Vehicle loaded/unloaded.
- City/highway driving.
- Upshift.
- Downshift.
- Coasting.
- Engagement.
- Noise/vibration — check for dependencies, either rpm dependent, vehicle speed dependent, shift dependent, gear dependent, range dependent, or temperature dependent.

Check Fluid Level and Condition

Fluid Level Check

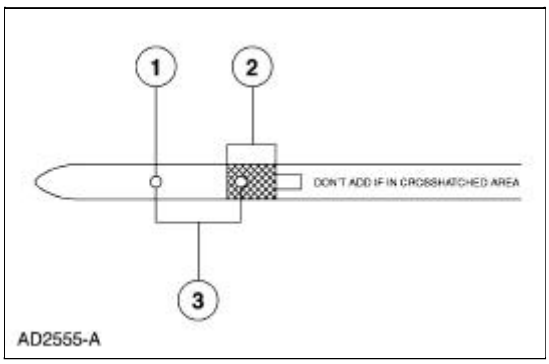
CAUTION: The vehicle should not be driven if the fluid level indicator shows the fluid below the DO NOT DRIVE mark or internal failure could result.

NOTE: If vehicle has been operated for an extended period of time at highway speeds, in city traffic, in hot weather, or when pulling a trailer, the fluid needs to cool down to obtain an accurate reading.

NOTE: The fluid level reading on the indicator will differ from operating and ambient temperatures. The correct reading should be within the normal operating temperature range.

Under normal circumstances, the fluid level should be checked during normal maintenance. If the transmission starts to slip, shifts slowly, or has signs of fluid leaking, the fluid level should be checked.

1. With the transmission in (P) PARK, the engine at idle, foot pressed on the brake, move the range selector lever through each gear and allow engagement of each gear. Place the range selector lever in the PARK position.
2. Wipe the fluid level indicator cap and remove the indicator.
3. Wipe the indicator with a clean cloth.
4. Install the indicator back in the filler tube until it is fully seated, then remove the indicator. The fluid level should be within the normal operating temperature range.



Item	Description
1	Do not drive if below mark
2	Fluid Level at Operating Temperature 66°C-77°C (150°F-170°F)
3	Fluid Level at Room Temperature 21°C-35°C (70°-95°F)

High Fluid Level

A fluid level that is too high may cause the fluid to become aerated due to the churning action of the rotating internal parts. This will cause erratic control pressure, foaming, loss of fluid from the vent tube and possible transmission malfunction and/or damage. If an overfill reading is indicated drain and refill the transmission.

Low Fluid Level

A low fluid level could result in poor transmission engagement, slipping, malfunction and/or damage. This could also indicate a leak in one of the transmission seals or gaskets.

Adding Fluid

CAUTION: The use of any type of transmission fluid other than specified could result in transmission malfunction and/or damage.

If fluid needs to be added, add fluid in 0.25L (1/2 pint) increments through the filler tube. Do not overfill the fluid. For fluid type, refer to the General Specifications chart.

Fluid Condition Check

1. Check the fluid level.
2. Observe the color and the odor. The color under normal circumstances should be dark reddish, not brown or black or have a burnt odor.
3. Hold the fluid level indicator over a white facial tissue and allow the fluid to drip onto the facial tissue and examine the stain.
4. If evidence of solid material is found, the transmission fluid pan should be removed for further inspection.
5. If the stain is a foamy pink color, this may indicate coolant in the transmission. The engine cooling system should also be inspected at this time.
6. If fluid contamination or transmission failure is confirmed by the sediment in the bottom of the fluid pan, the transmission must be disassembled and completely cleaned. This includes the torque converter, coolers, and cooler lines.
7. Carry out diagnostic checks and adjustments; refer to Diagnosis By Symptom in this section.

Road Testing Vehicle

NOTE: Always drive the vehicle in a safe manner according to the driving conditions and obey all traffic laws.

The shift point road test and torque converter operation tests provide diagnostic information on transmission shift controls and torque converter operation.

Shift Point Road Test

This test verifies that the shift control system is operating correctly.

1. Bring engine and transmission up to normal operating temperature.

2. Operate vehicle with transmission range selector lever in (D) position.

3. **NOTE:** Shift speed ranges are approximate for all applications. For specific applications (engine, axle ratio and application) refer to the Automatic Transmission Specification Issue, available from Ford Customer Service Division.

   Apply minimum throttle and observe speeds at which upshift occurs and torque converter engages; refer to the 4R70W Shift Speeds chart in this section.

4. With the transmission in Overdrive (fourth gear), press the transmission control switch. The transmission should downshift to third gear. Release the accelerator pedal; engine braking should occur.

5. Press accelerator pedal to floor, wide open throttle (WOT). Transmission should shift from third to second gear, or third to first, depending on vehicle speed. Torque converter clutch should disengage and then reapply.

6. With the transmission in (D) position and speed above 80 km/h (50 mph) and less than half throttle, move the transmission range selector lever from (D) position to manual 2 position and remove pressure from the accelerator pedal. Transmission should immediately downshift into second gear. With vehicle remaining in manual 2 position, move the transmission range selector lever into manual 1 position, and release accelerator pedal. Transmission should downshift into first gear at speeds approximately below 45-56 km/h (28-35 mph).

7. If transmission fails to upshift/downshift or torque converter clutch does not apply and release, refer to Diagnosis By Symptom in this section.

Shift Speeds 4.6L (3:27:1 Axle Ratio)

Throttle Position	Shift	MPH	Km/H
Light Throttle	1-2	10-17	16-27
TP Voltage	2-3	17-32	27-51
1.25 Volts	3-4	40-49	64-79
Closed Throttle	4-3	25-23	40-37
	3-2	17-14	27-22
	2-1	10-8	16-13
Wide Open Throttle	1-2	38-43	61-70
	2-3	69-72	111-116
	3-4	105	169
	4-3	96-72	154-116
	3-2	72-70	116-113
	2-1	34-24	55-39

Shift Speeds 5.4L (3:73:1 Axle Ratio)

Throttle Position	Shift	MPH	Km/H
Light Throttle	1-2	11-23	17-37
TP Voltage	2-3	19-34	31-55
1.25 Volts	3-4	22-47	35-76
Closed Throttle	4-3	20-18	32-29
	3-2	18-16	29-26
	2-1	9-7	14-11
Wide Open Throttle	1-2	38-40	61-64
	2-3	73-75	117-120
	4-3	90-96	145-154
	3-2	60-66	97-106
	2-1	25-32	40-51

Torque Converter Diagnosis

Prior to installing a new or remanufactured torque converter, all diagnostic procedures must be followed. This is to prevent the unnecessary installation of good torque converters. Only after a complete diagnostic evaluation can the decision be made to install a new torque converter.

Begin with the normal diagnostic procedures as follows:

1. Preliminary inspection.
2. Know and understand the customer's concern.
3. Verify the condition — carry out the torque converter operation test.
4. Carry out diagnostic procedures.

- Carry out on-board diagnostics; refer to Diagnostics.
  - Repair all non-transmission related DTCs first.
  - Repair all transmission DTCs.
  - Rerun on-board diagnostic to verify repair.
- Carry out Line Pressure Test. For additional information, refer to Special Testing Procedures in this section.
- Carry out Stall Speed Test. For additional information, refer to Special Testing Procedures in this section.
- Carry out Diagnostic Routines. For additional information, refer to Diagnosis By Symptom in this section.
  - Use the Diagnosis by Symptom Index to locate the appropriate routine that best describes the symptom(s). The routine will list all possible components that may cause or contribute to the symptom. Check each component listed; diagnose and repair as required before changing the torque converter.

Torque Converter Operation Test

This test verifies that the torque converter clutch control system and the torque converter are operating correctly.

5. Carry out Quick Test with scan tool. For additional information, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Check for DTCs.
6. Connect a tachometer to the engine.
7. Bring the engine to normal operating temperature by driving the vehicle at highway speeds for approximately 15 minutes in (D) position.
8. After normal operating temperature is reached, maintain a constant vehicle speed of about 80 km/h (50 mph) and tap brake pedal with the left foot.
9. Engine rpm should increase when brake pedal is tapped, and decrease about five seconds after pedal is released. If this does not occur, see torque converter operation concerns. For additional information, refer to Diagnosis By Symptom in this section.

10. If the vehicle stalls in (D) or manual 2 at idle with vehicle at a stop, move the transmission range selector lever to manual 1 position. If the vehicle stalls, see torque converter operation concerns. For additional information, refer to Diagnosis By Symptom in this section. If the vehicle does not stall in (D), refer to Diagnosis By Symptom in this section.

11. If the vehicle exhibits a vibration during the road test, complete the Road Test Evaluation Form. This form will aid the technician in determining the source of the vibration.

NOTE: The following is a list of common vehicle concerns that have been misdiagnosed as torque converter clutch shudder. For diagnosis of the following items refer to the appropriate sections of the workshop manual and the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

- Spark plugs — check for cracks, high resistance or broken insulators
- Plug wires
- Fuel injector — filter may be plugged
- Fuel contamination — engine runs poor
- EGR valve — valve may let in too much exhaust gas and cause engine to run lean
- Vacuum leak — engine will not get correct air/fuel mixture
- MAP/MAF sensor — improper air/fuel mixture
- HO2S sensor — too rich/lean air/fuel mixture
- Fuel pressure — may be too low
- Engine mounts — loose/damaged mounts can cause vibration concerns
- Axle joints — check for vibration

Torque Converter Road Evaluation Form		
1) Does the torque converter engage/disengage?	Yes	GO to Step 2.
	No	REFER to Diagnosis By Symptom — Torque Converter No Apply Routine 240/340 and Always Applied Routine 241/341 in this section for further diagnosis information. Repair as required, verify converter operation and then continue.
2) Does vibration occur during 3-4 or 4-3 shift at: light, medium, or heavy throttle?	Light	May be torque converter clutch shudder. GO to Step 3.
	Medium	May be torque converter clutch shudder. GO to Step 3.
	Heavy	Not torque converter clutch shudder — converter does not engage due to PCM strategy. REFER to Section 100-04 and Diagnosis By Symptom — Noise/Vibration Routine 254/354 in this section for further diagnosis.
3) Is the problem vehicle speed dependent (operating at steady speed, i.e. 64 km/h (40 mph)	Yes	Not torque converter clutch shudder — REFER to Section 100-04 and

regardless of transmission range. Verify by manually selecting 2nd, OD cancel, and OD.		Diagnosis By Symptom — Noise/Vibration Routine 254/354 in this section for further diagnosis.
	No	GO to Step 4.
4) Is the problem engine-rpm dependent? (Occurs at the same engine rpm independent of transmission gear. Verify by holding same rpm in each transmission gear.)	Yes	Not torque converter clutch shudder — REFER to Section 100-04 and Diagnosis By Symptom — Noise/Vibration Routine 254/354 in this section for further diagnosis.
	No	GO to Step 5.
5) Does the problem occur in coast, steady speed, or reverse range?	Yes	Not torque converter clutch shudder — REFER to Section 100-04 and Diagnosis By Symptom — Noise/Vibration Routine 254/354 in this section for further diagnosis.
	No	GO to Step 6.
6) Does vibration occur during extended light brake application?	Yes	Not torque converter clutch shudder — REFER to Section 100-04 , Section 206-00 and Diagnosis By Symptom — Noise/Vibration Routine 254/354 in this section for further diagnosis.
	No	GO to Step 7.
7) If one of the driving modes in Step 2 identifies a vibration which was not present in steps 3-6, then there is a strong possibility that the vibration is caused by the torque converter clutch function. Carry out the repair procedures as found under Disassembly/Assembly.		

Visual Inspection

This inspection will identify modifications or additions to the vehicle operating system that may affect diagnosis. Inspect the vehicle for non-Ford factory add-on devices such as:

- electronic add-on items:
  - air conditioning
  - generator (alternator)
  - engine turbo
  - cellular telephone
  - cruise control
  - CB radio
  - linear booster
  - backup alarm signal
  - computer
- Vehicle modification:

These items, if not installed correctly, will affect the powertrain control module (PCM), or transmission function. Pay particular attention to add-on wiring splices in the PCM harness or transmission wiring harness, abnormal tire size, or axle ratio changes.

- Leaks; refer to Leak Inspection.
- Correct linkage adjustments; refer to Section 307-05 .

Shift Linkage Check

Check for a misadjustment in shift linkage by matching the detents in the transmission range selector lever with those of the manual lever in the transmission. If they match, the misadjustment is in the indicator. Do not adjust the shift linkage.

Hydraulic leakage at the manual control valve can cause delay in engagements and/or slipping while operating if the linkage is not correctly adjusted. Refer to Section 307-05 for shift linkage adjustment.

Check TSBs and OASIS

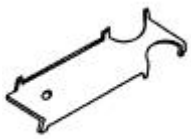
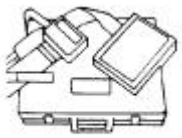
Refer to all technical service bulletins (TSB) and OASIS messages which pertain to the transmission concern and follow the procedure as described.

Carry Out On-Board Diagnostics (KOEO, KOER)

After a road test, with the vehicle warm and before disconnecting any connectors, carry out the Quick Test using the scan tool. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Diagnostics

Special Tool(s)

 ST1565-A	Transmission Fluid Pressure Gauge 307-004 (T57L-77820-A)
 ST1392-A	Air Test Plate, Transmission 307-246 (T92P-7006-A)
 ST1633-A	Alignment Gauge, TR Sensor 307-351 (T97L-70010-A)
 ST1391-A	Breakout Box, EEC-V Control System 418-049 (T94L-50-EEC-V) or equivalent
 ST1632-A	MLP-TR Cable 418-F107 (007-00111) or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052 or equivalent scan tool
 ST1389-A	Transmission Tester 307-F016 (007-00130) or equivalent
	Trans Tester TR/MLP Overlay

	and Manual 007-00131 or equivalent
 ST1137-A	73 III Automotive Meter 105-R0057 or equivalent
 ST1300-A	UV Leak Detector Kit 164-R0756 or equivalent

Diagnosing an electronically controlled automatic transmission is simplified by using the following procedures. One of the most important things to remember is that there is a definite procedure to follow. DO NOT TAKE SHORT CUTS OR ASSUME THAT CRITICAL CHECKS OR ADJUSTMENTS HAVE ALREADY BEEN MADE. Follow the procedures as written to avoid missing critical components or steps. By following the diagnostic sequence, the technician will be able to diagnose and repair the concern the first time.

On-Board Diagnostics With Diagnostic Tool

NOTE: For detailed instruction and other diagnostic methods using the scan tool, refer to the scan tool tester manual and the Powertrain Control/Emissions Diagnosis (PC/ED) manual. These quick tests should be used to diagnose the powertrain control module (PCM) and should be carried out in order.

- **Quick Test 1.0 - Visual Inspection**
- **Quick Test 2.0 - Set Up**
- **Quick Test 3.0 - Key On, Engine Off (KOEO)**
- **Quick Test 4.0 - Continuous Memory**
- **Quick Test 5.0 - Key On, Engine Running (KOER)**
  - Special Test Mode
  - Wiggle Test
  - Output Test Mode
  - PCM Reset Mode
  - Clearing DTCs
  - OBD II Drive Cycle
- **Other Scan Tool Features**

For further information on other diagnostic testing features using the scan tool, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Other diagnostic methods include the following:

- Parameter Identification (PID) Access Mode
- Freeze Frame Data Access Mode

- Oxygen Sensor Monitor Mode

Output State Control (OSC) Mode

Output State Control (OSC) allows the technician to take control of certain parameters to function the transmission. For example, OSC allows the technician to shift the transmission only when he/she commands a gear change. If the technician commands 1st gear in OSC, the transmission will remain in 1st gear until the technician commands the next gear. Another example, the technician can command a shift solenoid to turn on or off when carrying out an electrical circuit check. OSC has two modes of operation for transmission, the BENCH MODE and the DRIVE MODE. Each mode/parameter has a unique set of vehicle operating requirements that the technician is required to meet before being allowed to operate OSC.

NOTE: To operate OSC the digital transmission range (TR) sensor must be operational. No Diagnostic Trouble Codes (DTCs) related to the digital TR sensor can be present.

To operate OSC the vehicle speed source must be operational. No diagnostic codes (DTCs) related to this source can be present. The vehicle speed source can vary depending on vehicle configuration. Technicians should verify which input source is applicable for their vehicle application. The following are potential vehicle speed sources:

- anti-lock braking system (ABS)
- rear anti-lock braking system (RABS)
- output shaft speed (OSS) sensor

For manual 4x4 applications, the vehicle speed source is from the transfer case speed sensor.

- The vehicle requirements MUST BE MET when SENDING the OSC value. Refer to individual test modes for vehicle requirements.
- If the vehicle requirements are NOT MET when SENDING the OSC value, an ERROR MESSAGE will appear. When the ERROR MESSAGE is received, OSC is aborted and must be restarted.
- If AFTER SENDING an OSC value, and the vehicle requirements are no longer met, the PCM will cancel the OSC value and NO ERROR message will appear. Once the vehicle requirements are met again, the PCM will automatically SEND the previous OSC value without any additional actions required by the service technician.
- The OSC value XXX may be sent anytime to cancel OSC.

Output State Control (OSC) Procedures

- Carry out visual inspection and vehicle preparation as required.
- Select "Vehicle and Engine Selection" menu.
- Select appropriate vehicle and engine.
- Select "Diagnostic Data Link."
- Select "Powertrain Control Module."
- Select "Output Test Mode."
- Select "KOEO On-Demand Self Test and KOER On-Demand Self Tests."
- Carry out test and record DTCs.
- Repair all NON-Transmission DTCs.

- Repair all digital TR Sensor DTCs.
- Repair all vehicle speed DTCs.
- Ensure that the vehicle speed sensor and digital TR Sensors are functional.
- Select "Active Command Modes."
- Select "Trans - Bench Mode or Trans - Drive Mode."

OSC — Transmission Bench Modes

The following Transmission Bench Modes may be used or required during diagnostics.

SSA, SSB and TCC in BENCH MODE

The BENCH MODE allows the technician to carry out electrical circuit checks on the following components:

- SSA - Activates SSA OFF or ON.
- SSB - Activates SSB OFF or ON.
- Transmission Converter clutch (TCC) - Activates TCC OFF or ON.

OSC "SSA, SSB, TCC" BENCH MODE Operates ONLY when:

- digital TR sensor is operational and no digital TR sensor DTCs present.
- vehicle speed sensor is operational and no VSS sensor DTCs present.
- transmission range selector lever is in P.
- key is ON.
- engine is OFF.

OSC Command Values

- OFF - turns solenoid OFF.
- ON - turns solenoid ON.
- XXX - cancels OSC value sent.
- SEND - sends the values to PCM.

BENCH MODE Procedure for SSA, SSB and TCC

Follow operating instructions from the scan tool menu screen:

- Select "Output State Control."
- Select "Trans - Bench Mode."
- Select "PIDs" to be monitored.
- Monitor all selected PIDs during test.
- Select "Parameters - SSA, SSB or TCC."
- Select "ON" to turn solenoid ON.
- Press "SEND" to send command ON.
- Select "OFF" to turn solenoid OFF.

- Press "SEND" to send command OFF.
- Select "XXX" to cancel at any time.
- Press "SEND."

EPC in BENCH MODE

The BENCH MODE is also used to test the functionality of the transmission's electronic pressure control. During BENCH MODE, the electronic pressure control (EPC) solenoid can ramp in increments of 103 kPa (15 psi) from zero to 620 kPa (90 psi) and 620 kPa (90 psi) to zero psi.

The OSC functions for the parameter EPC allows the technician to choose the following options:

- EPC - Activates EPC to selected values.
- 00 - sets EPC pressure to 00 kPa (00 psi).
- 15 - sets EPC pressure to 103 kPa (15 psi).
- 30 - sets EPC pressure to 206 kPa (30 psi).
- 45 - sets EPC pressure to 310 kPa (45 psi).
- 60 - sets EPC pressure to 411 kPa (60 psi).
- 75 - sets EPC pressure to 517 kPa (75 psi).
- 90 - sets EPC pressure to 620 kPa (90 psi).

To carry out an EPC BENCH MODE pressure functionality test, install a pressure gauge in the EPC port. The following requirements are required to carry out this test:

- VSS and digital TR sensor operational.
- no VSS and digital TR sensor DTCs.
- transmission range selector lever in P.
- key ON.
- engine ON.
- engine speed at least 1,500 rpm for accurate EPC pressure measurement.

To carry out an EPC BENCH MODE solenoid circuit pinpoint test, the following requirements are required:

- VSS and digital TR sensor operational.
- no VSS and digital TR sensor DTCs.
- key ON.
- engine OFF.

OSC Command Values

- 00 - sets EPC pressure to 00 kPa (00 psi).
- 15 - sets EPC pressure to 103 kPa (15 psi).
- 30 - sets EPC pressure to 206 kPa (30 psi).
- 45 - sets EPC pressure to 310 kPa (45 psi).
- 60 - sets EPC pressure to 411 kPa (60 psi).

- 75 - sets EPC pressure to 517 kPa (75 psi).
- 90 - sets EPC pressure to 620 kPa (90 psi).
- XXX - cancels OSC value sent.
- SEND - sends the values to PCM.

BENCH MODE Procedure for EPC

Following operating instructions from the scan tool menu screen:

- Select "Output State Control."
- Select "Trans - Bench Mode."
- Select "PIDs" to be monitored.
- Monitor all selected PIDs during test.
- Select "Parameters - EPC."
- Select Value "0-620 kPa (0-90 psi)."
- Press "SEND" to send command.
- Select "XXX" to cancel at any time.
- Press "SEND."

OSC — Transmission DRIVE MODES

The DRIVE MODE allows control of three transmission parameters. Each mode/parameter has a unique set of vehicle operating requirements that the technician is required to meet before being allowed to operate OSC. The recommended procedure, when using the DRIVE MODE, is to control one parameter at a time.

The DRIVE MODE allows the technician to carry out the following functions on the transmission:

- GR_CM - allows upshifts or downshifts.
- TCC - engages or disengages the torque converter clutch.
- EPC - increases/decreases EPC pressure.

GR_CM in DRIVE MODE

This OSC function is used to test the transmission shift functions.

The OSC functions for the GR_CM parameter allows the technician to choose the following options:

- 1 - PCM selects 1st gear.
- 2 - PCM selects 2nd gear.
- 3 - PCM selects 3rd gear.
- 4 - PCM selects 4th gear.

OSC "GR_CM" Mode operates ONLY when:

- digital TR sensor is operational and no digital TR sensor DTCs present.
- vehicle speed sensor is operational and no VSS sensor DTCs present.

- engine is ON.
- TCC is OFF.
- transmission range selector lever is in O/D.
- vehicle speed is greater than 3.2 km/h (2 mph).

OSC Command Values

- 1 - PCM selects 1st gear.
- 2 - PCM selects 2nd gear.
- 3 - PCM selects 3rd gear.
- 4 - PCM selects 4th gear.
- XXX - cancels OSC value sent.
- SEND - sends the values to PCM.

DRIVE MODE Procedure for GR_CM

Follow operating instructions from the scan tool menu screen.

- Select "Output State Control."
- Select "Trans - DRIVE MODE."
- Select "PIDs" to be monitored.
- Monitor all selected PIDs during test.
- Select "Parameters - GR_CM."
- Select Value "1-4."
- Press "SEND" to send command.
- Re-Select Value "1-4."
- Press "SEND" to send command.
- Select "XXX" to cancel at any time.
- Press "SEND."

TCC in DRIVE MODE

This OSC function is used to test whether the torque converter clutch is engaging and disengaging correctly.

The OSC functions for the TCC parameter allows the technician to choose the following:

- TCC - activates TCC OFF and ON.
- ON - turns TCC solenoid ON.
- OFF - turns TCC solenoid OFF.

OSC "TCC OFF" DRIVE MODE operates ONLY when:

- digital TR sensor is operational and no digital TR sensor DTCs present.
- vehicle speed sensor is operational and no VSS sensor DTCs present.

- engine is ON.
- transmission range selector lever is in O/D.
- vehicle speed is greater than 3.2 km/h (2 mph).

OSC "TCC ON" DRIVE MODE operates ONLY when:

- digital TR sensor is operational and no digital TR sensor DTCs present.
- vehicle speed sensor is operational and no VSS sensor DTCs present.
- engine is ON.
- transmission range selector lever is in O/D.
- vehicle speed is greater than 3.2 km/h (2 mph).
- transmission is in 2nd gear or higher.
- TFT is between 15 and 135°C (60 and 275°F).
- brake is not applied "OFF" below 32 km/h (20 mph).
- Not an excessive load on engine (engine lugging).

OSC Command Values

- OFF - turns TCC OFF.
- ON - turns TCC ON.
- XXX - cancels OSC value sent.
- SEND - sends the values to PCM.

Drive Mode Procedures for TCC

Follow operating instructions from the scan tool menu screen.

- Select "Output State Control."
- Select "Trans - Drive Mode."
- Select "PIDs" to be monitored.
- Monitor all selected PIDs during test.
- Select "Parameters - TCC."
- Select "ON" to turn solenoid ON.
- Press "SEND" to send command ON.
- Select "OFF" to turn solenoid OFF.
- Press "SEND" to send command OFF.
- Select "XXX" to cancel at any time.
- Press "SEND."

EPC in DRIVE MODE

This OSC function is used to increase the EPC pressure while testing the transmission shift functions. This OSC function can only increase the EPC pressure greater than what the PCM normally commands. If an OSC value, such as (75) or (90) psi is sent, the upshifts and downshifts should exhibit a firmer shift. Firmer shifts would indicate that the EPC pressure control works at higher

pressures. The best test for the EPC is to use the BENCH MODE and a hydraulic pressure gauge. Using EPC in the BENCH MODE will confirm that the EPC works at both the higher and lower pressures.

The OSC functions for the parameter EPC allows the technician to choose the following options:

- EPC - Activates EPC to selected
  - 00 - sets EPC pressure to 00 kPa (00 psi).
  - 15 - sets EPC pressure to 103 kPa (15 psi).
  - 30 - sets EPC pressure to 206 kPa (30 psi).
  - 45 - sets EPC pressure to 310 kPa (45 psi).
  - 60 - sets EPC pressure to 411 kPa (60 psi).
  - 75 - sets EPC pressure to 517 kPa (75 psi).
  - 90 - sets EPC pressure to 620 kPa (90 psi).

OSC "EPC" DRIVE MODE operates ONLY when:

- digital TR sensor is operational and no digital TR sensor DTCs present.
- vehicle speed sensor is operational and no VSS sensor DTCs present.
- transmission range selector lever is in O/D.
- pressure gauge is installed.
- key is ON.
- engine is ON.
- vehicle speed is greater than 3.2 km/h (2 mph).
- OSC value for EPC must be greater than what the PCM commands (see EPC PID).

OSC Command Values

- 00 - sets EPC pressure to 00 kPa (00 psi).
- 15 - sets EPC pressure to 103 kPa (15 psi).
- 30 - sets EPC pressure to 206 kPa (30 psi).
- 45 - sets EPC pressure to 310 kPa (45 psi).
- 60 - sets EPC pressure to 411 kPa (60 psi).
- 75 - sets EPC pressure to 517 kPa (75 psi).
- 90 - sets EPC pressure to 620 kPa (90 psi).
- XXX - cancels OSC value sent.
- SEND - sends the values to PCM.

DRIVE MODE Procedure for EPC.

Follow operating instructions from the scan tool menu screen.

- Select "Output State Control."
- Select "Trans - Drive Mode."
- Select "PIDs" to be monitored.

- Monitor all selected PIDs during test.
- Select "Parameters - EPC."
- Select Value "0-620 kPa (0-90 psi)."
- Press "SEND" to send command.
- Re-Select Value "0-620 kPa (0-90 psi)."
- Press "SEND" to send command.
- Select "XXX" to cancel at any time.
- Press "SEND."

Using Output State Control and Accessing PIDs

To confirm that the OSC value was sent by the scan tool and the EEC has accepted the OSC substitution, a corresponding PID for each OSC parameter must be monitored. Additional PIDs should be monitored to help the technician adequately diagnose the transmission.

The following is a list of OSC parameters and their corresponding PID:

OSC PARAMETER CHART

OSC Parameter	PID	Additional PIDs
SSA	SSA	SS1F
SSB	SSB	SS2F
TCC	TCC	TCCF, TCCMACT (do not use PID TCCMCMD during OSC)
EPC	EPC	—
GR_CM	GEAR	TRANRAT

To confirm that the OSC substitution occurred, SEND the OSC value and monitor the corresponding PID value. If no ERROR MESSAGE was received and the value of the corresponding PID remains the same as the value sent from OSC, then the OSC substitution was successful.

Transmission Drive Cycle Test

NOTE: Always drive the vehicle in a safe manner according to driving conditions and obey all traffic laws.

NOTE: The Transmission Drive Cycle Test must be followed exactly. Malfunctions must occur four times consecutively for shift error DTC code to be set, and five times consecutively for continuous TCC code to set.

NOTE: When carrying out the Transmission Drive Cycle Test, refer to the Solenoid Application Chart for correct solenoid operation.

After carrying out the Quick Test, use the Transmission Drive Cycle Test for checking continuous codes.

1. Record and then erase Quick Test codes.
2. Warm engine to normal operating temperature.
3. Make sure transmission fluid level is correct.
4. With transmission in OVERDRIVE, moderately accelerate from stop to 80 km/h (50 mph). This allows the transmission to shift into fourth gear. Hold speed and throttle open steady for a minimum of 15 seconds.
5. With transmission in fourth gear and maintaining steady speed and throttle opening, lightly apply and release brake to operate stoplamps. Then hold speed and throttle steady for a minimum of five seconds.
6. Brake to a stop and remain stopped for a minimum of 20 seconds.
7. Repeat steps 4 through 6 at least five times.
8. Carry out Quick Test and record continuous DTCs.
    - If the DTCs are still present, refer to the Diagnostic Trouble Code Chart. Repair all non transmission DTCs first as they can directly affect the operation of the transmission. Repeat the Quick Test and the Road Test to verify the correction. Erase the DTCs, carry out the Drive Cycle Test and repeat the Quick Test after completing repair on the DTC.
    - If the continuous test passes and a concern is still present, refer to Diagnosis By Symptom in this section, OASIS messages, and TSBs for concerns.

After On-Board Diagnostic

NOTE: The vehicle wiring harness, PCM and non-transmission sensors may affect transmission operations. Repair these concerns first.

After the on-board diagnostic procedures are completed, repair all DTCs.

Begin with non-transmission related DTCs, then repair any transmission related DTCs. Use the diagnostic trouble code chart for information on condition and symptoms. This chart will be helpful in referring to the correct manual(s) and aids in diagnosing internal transmission concerns and external non-transmission inputs. The pinpoint tests are used in diagnosing transmission electrical concerns. Make sure that the vehicle wiring harness and the PCM are diagnosed as well. The Powertrain

Control/Emissions Diagnosis (PC/ED) manual will aid in diagnosing non-transmission electronic components.

Before Pinpoint Tests

NOTE: Prior to entering pinpoint tests, check the PCM wiring harness for tight connections, bent or broken pins, corrosion, loose wires, correct routing, correct seals and their condition. Check the PCM, sensors and actuators for damage. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

NOTE: If a concern still exists after electrical diagnosis has been carried out, refer to Diagnosis By Symptom in this section.

If DTCs appear while carrying out the on-board diagnostics, refer to the Diagnostic Trouble Code Charts for the appropriate repair procedure. Prior to entering pinpoint tests, refer to any TSBs and OASIS messages for transmission concerns.

Diagnostic Trouble Code Charts

Diagnostic Trouble Code Chart

Five Digit DTC	Component	Description	Condition	Symptom	Action
P0102 P0103 P1100 P1101	MAF	MAF concerns	MAF system has a malfunction which may cause a transmission concern.	High or low EPC pressure, incorrect shift schedule. Incorrect torque converter clutch engagement scheduling. Symptoms similar to a throttle position (TP) failure.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0112	IAT	IAT indicates 125°C (257°F) (grounded)	Voltage drop across IAT exceeds scale set for temperature 125°C (257°F).	Incorrect EPC pressure, either high or low, results in harsh or soft shifts.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0113	IAT	IAT indicates -40°C (-40°F) (open circuit)	Voltage drop across IAT exceeds scale set for temperature -40°C (-40°F).	Incorrect EPC pressure, either high or low, results in harsh or soft shifts.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0114	IAT	IAT out of on-board diagnostic range	IAT temperature higher or lower than expected during KOEO and KOER.	Rerun on-board diagnostic at normal operating temperature.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0117	ECT	ECT indicates 125°C (257°F)	Voltage drop across ECT exceeds scale set for temperature 125°C (257°F) (grounded).	Torque converter clutch will always be off, resulting in reduced fuel economy.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0118	ECT	ECT indicates -40°C (-40°F)	Voltage drop across ECT exceeds scale set for temperature -40°C (-40°F) (open circuit).	Torque converter clutch will always be off, resulting in reduced fuel economy.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0122 P0123 P1120	TP	TP concern	PCM has detected an error that may cause a transmission concern.	Harsh engagements, firm shift feel, abnormal shift schedule, torque converter clutch does not engage, torque converter clutch cycling.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0300-	Electronic	EI systems	EI system has a	Harsh	Refer to the

P0308 P0320 P0340 P1351- P1364	Ignition (EI)	concerns	malfunction which may cause a transmission concern.	engagements and shifts, late WOT shifts, no torque converter clutch engagement.	Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1702	Digital TR	Intermittent DTC codes P0705 or P0708	Refer to DTC codes P0705 or P0708 condition.	Refer to DTC codes P0705 or P0708 symptom.	Go To Pinpoint Test C .
P1704	Digital TR	Digital TR circuit reading in between gear position during KOEO/KOER	Digital TR sensor or shift cable incorrectly adjusted; or digital TR circuit failure.	Wrong commanded EPC pressure. Digital TR reading the wrong gear position.	Go To Pinpoint Test C .
P0705	Digital TR	Digital TR circuit failure	Digital TR circuits, indicating an invalid pattern in TR_D. Condition caused by a short to ground or an open in TR4, TR3A, TR2, and or TR1 circuits. This DTC cannot be set by an incorrectly adjusted digital TR sensor.	Increase in EPC pressure (harsh shifts). Defaults to (D) or D for all gear positions. In (D) position trans, stuck in D or manual 2.	Go To Pinpoint Test C .
P0708	Digital TR	Digital TR sensor circuit TR3A open	Digital TR sensor circuit TR3A reading 2.6v - 5.0v (open circuit). This DTC cannot be set by an incorrectly adjusted digital TR sensor.	Increase in EPC pressure. Defaults to (D)or D for all gear ranges.	Go To Pinpoint Test C .
P1705	Digital TR	Digital TR self test was not carried out in PARK or NEUTRAL	Vehicle not in PARK or NEUTRAL during on-board diagnostic.	Rerun on-board diagnostic in PARK or NEUTRAL.	Go To Pinpoint Test C .
P0720	OSS	Insufficient input from output shaft speed sensor	PCM detected a loss of OSS signal during operation.	Harsh shifts, abnormal shift schedule, no torque converter clutch activation.	Go To Pinpoint Test E .
P0721	OSS	OSS sensor signal noisy	PCM has detected an erratic OSS signal.	Harsh shifts, abnormal shift schedule, no torque converter clutch engagement.	Go To Pinpoint Test E .
P0722	OSS wiring	Insufficient input from OSS	PCM has detected a loss of OSS signal.	Harsh shifts, abnormal shift schedule, no torque converter clutch engagement.	Go To Pinpoint Test E .

P0741 **	TCC, internal components	TCC slippage detected	The PCM picked up an excessive amount of slippage during normal vehicle operation.	TCC slippage/erratic or no torque converter clutch operation. Flashing Transmission Control Indicator Lamp (TCIL).	Refer to Diagnosis By Symptom in this section.
P0743 *	TCC, wiring, PCM	TCC solenoid circuit failure during on-board diagnostic	TCC solenoid circuit fails to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostic.	Short circuit: engine stalls in second (OD, 2 range) at low idle speeds with brake applied. Open circuit: torque converter clutch never engages.	Go To Pinpoint Test A .
P0750 *	SSA, wiring, PCM	SSA solenoid circuit failure	SSA circuit failed to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostic.	Incorrect gear selection depending on condition mode and manual lever position. See Solenoid On/Off Chart.	Go To Pinpoint Test A .
P0751	SSA, wiring, PCM	Shift solenoid A functional failure	Mechanical or hydraulic failure of the shift solenoid.	Incorrect gear selection depending on failure mode manual lever position.	Refer to Solenoid Operation Chart, then Go To Pinpoint Test A .
P0753	SSA, wiring, PCM	SSA electrical failure	SSA circuit fails to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostic.	Incorrect gear depending on condition mode and manual lever position. See Solenoid On/Off Chart. May flash TCIL.	Go To Pinpoint Test A .
P0755 *	SSB, wiring, PCM	SSB solenoid circuit failure	SSB circuit fails to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostic.	Incorrect gear selection depending on condition mode and manual lever position. See Solenoid On/Off Chart.	Go To Pinpoint Test A .
P0758 *	SSB, wiring, PCM	SSB electrical circuit failure	SSB circuit fails to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostic.	Incorrect gear depending on condition mode and manual lever position. See Solenoid On/Off Chart. May flash TCIL.	Go To Pinpoint Test A .
P1714	SSA, internal components	SSA malfunction	Mechanical failure of the solenoid detected.	Incorrect gear selection depending on condition, mode and manual lever position. See	Go To Pinpoint Test F .

				Solenoid Operation Chart.	
P1715	SSB	SSB malfunction	Mechanical failure of the solenoid detected.	Incorrect gear selection depending on condition, mode and manual lever position. See Solenoid Operation Chart.	Go To Pinpoint Test F .
P0756	SSB	SSB functional failure	Mechanical or hydraulic failure of the shift solenoid.	Incorrect gear selection depending on failure mode and manual lever position.	Refer to Solenoid Operation Chart, then Go To Pinpoint Test A .
P0781 **	SSA or internal parts	1-2 shift error	Engine rpm drop not detected when 1-2 shift was commanded by PCM.	Incorrect gear selection depending on failure or mode and manual lever position. Shift errors may also be due to other internal transmission concerns (stuck valves, damaged friction material).	Refer to Solenoid Operation Chart, then Go To Pinpoint Test A .
P0782 **	SSA, SSB or internal parts	2-3 shift error	Engine rpm drop not detected when 2-3 shift was commanded by PCM.	Incorrect gear selection depending on failure or mode and manual lever position. Shift errors may also be due to other internal transmission concerns (stuck valves, damaged friction material).	Refer to Solenoid Operation Chart, then Go To Pinpoint Test A .
P0783 **	SSA, SSB or internal parts	3-4 shift error	Engine rpm drop not detected when 3-4 shift was commanded by PCM.	Incorrect gear selection depending on failure or mode and manual lever position. Shift errors may also be due to other internal transmission concerns (stuck valves, damaged friction material).	Refer to Solenoid Operation Chart, then Go To Pinpoint Test A .
—	TCIL	TCIL circuit failure	TCIL circuit open or shorted.	Failed on, OD cancel mode on. No flashing TCIL for EPC failure or sensor. Failed off, OD cancel mode never indicated. No flashing TCIL for EPC sensor failure.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1116	ECT	ECT out of on-board diagnostic	ECT temperature higher or lower than expected	Rerun on-board diagnostic at normal operating	Refer to the Powertrain Control/Emissions

		range	during KOEO and KOER.	temperature.	Diagnosis (PC/ED) manual.
P1124	TP	TP voltage high/low for on-board diagnostic	TP was not in the correct position for on-board diagnostic.	Rerun at appropriate throttle position per application.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1460	A/C	A/C clutch cycling pressure switch error	A/C or defrost on condition may result from A/C clutch being on during on-board diagnostic.	DTC set during on-board diagnostic, repeat with A/C off. Failed on, EPC pressure slightly low with A/C off.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1636	PCM	PCM detected internal error	—	—	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1703	BPP	BPP switch circuit failed	Brake ON/OFF circuit failure.	Failed on or not connected — torque converter clutch will not engage at less than 1/3 throttle. Failed off or not connected — torque converter clutch will not disengage when brake is applied.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1703	BPP	Brake not actuated during on-board diagnostic	Brake not cycled during KOER.	Failed off or not connected — torque converter clutch will not engage at less than 1/3 throttle. Failed off or not connected — torque converter clutch will not disengage when brake is applied.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0713	TFT, wiring, PCM	-40°C (-40°F) indicated TFT sensor circuit open	Voltage drop across TFT sensor exceeds scale set for temperature -40°C (-40°F).	Firm shift feel.	Go To Pinpoint Test B .
P1711	TFT	TFT out of on-board diagnostic range	Transmission not at operating temperature during on-board diagnostic.	Warm vehicle to normal operating temperature.	Go To Pinpoint Test B .
P0712	TFT, wiring, PCM	157°C (315°F) indicated TFT sensor circuit grounded	Voltage drop across TFT sensor exceeds scale set for temperature of 157°C (315°F).	Firm shift feel.	Go To Pinpoint Test B .
P1713	TFT wiring PCM	TFT continually reading cold	TFT sensor in range low failure.	Firm shift feel. Substitute ECT for TFT	Go To Pinpoint Test B .

P1783	TFT	Transmission over temperature condition indicated	Transmission fluid temperature exceeded 127°C (270°F).	Increase in EPC pressure.	Go To Pinpoint Test B .
P1718	TFT, wiring, PCM	TFT continually reading hot	TFT sensor in range high failure.	Firm shift feel. Substitute ECT for TFT.	Go To Pinpoint Test B .
P0740	TCC, wiring, PCM	TCC electrical failure	TCC circuit fails to provide voltage drop across solenoid. Circuit open, shorted or PCM driver failure during on-board diagnostics.	Short circuit, engine stalls in SECOND ((D), 2 range) at low speeds with brake applied. Open circuit, torque converter clutch never engages. May flash TCIL.	Go To Pinpoint Test A .
P1740	TCC	TCC malfunction	Mechanical failure of the solenoid detected.	Failed on — Engine stalls in 2nd (O/D, Manual 2 ranges) at low idle speeds with brake applied. Failed off — Torque Converter never applies.	Go To Pinpoint Test F .
P1741 **	TCC, internal components	Excessive torque converter clutch engagement error	Excessive variations in slip (engine speed surge) across the torque converter clutch.	Engine rpm oscillation is present in 3rd gear.	Go To Pinpoint Test A .
P1742	TCC, internal components	TCC solenoid failed on	TCC solenoid has failed on by electric, mechanical or hydraulic concern.	Harsh shifts.	Go To Pinpoint Test A .
P1743	TCC, internal components	TCC solenoid failed on	TCC solenoid has failed on by electric, mechanical or hydraulic concern.	Harsh shifts.	Go To Pinpoint Test A .
P1744	TCC	TCC	The PCM picked up an excessive amount of TCC slippage during normal vehicle operation.	TCC slippage/erratic or no torque converter clutch operation.	Refer to Diagnosis By Symptom in this section.
P1746 *	EPC, wiring, PCM	EPC solenoid open circuit	Voltage through EPC solenoid is checked. An error will be noted if tolerance is exceeded.	Open circuit causes maximum EPC pressure, harsh engagements and shifts.	Go To Pinpoint Test D .
P1747 *	EPC, wiring, PCM	EPC solenoid circuit failure, shorted circuit or output driver	Voltage through EPC solenoid is checked. An error will be noted if tolerance is	Short circuit causes minimum EPC pressure (minimum capacity) and limits engine torque	Go To Pinpoint Test D .

			exceeded.	(alternate firm).	
P1760	EPC, wiring, PCM	EPC solenoid circuit failure, shorted circuit or output driver	PCM detected a loss of EPC during operation.	Unexpected reduction in engine torque.	Go To Pinpoint Test D .
P1780	TCS	TCS not changing states	TCS not cycled during self-test. TCS circuit open or shorted.	Rerun on-board diagnostic and cycle switch. No OD cancel when switch is cycled.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1781 [1]	4x4 low switch	4x4 low switch closed	4x4 low switch closed or 4x4 low indicator lamp circuit open.	Failed on — early shift schedules in 4x2 and 4x4 HI range. Failed off — shifts delayed in 4x4 low. [1]	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1729	4x4L	4x4 low switch failure	4x4 low switch failure during normal vehicle operation.	Early shifts, harsh shifts, increase in electronic pressure control valve.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1728	Trans	Transmission slip error	The PCM has detected an excessive amount of slippage during normal operation.	Transmission slippage erratic or no torque converter clutch operation.	Refer to Diagnosis By Symptom in this section.

* Output circuit check, generated only by electrical symptoms.
** May also be generated by some other non-electric transmission hardware system.
[1] If the 4x4 low indicator light fuse is blown, the transmission will shift according to the 4x4 low shift scheduling regardless of the transfer case position.

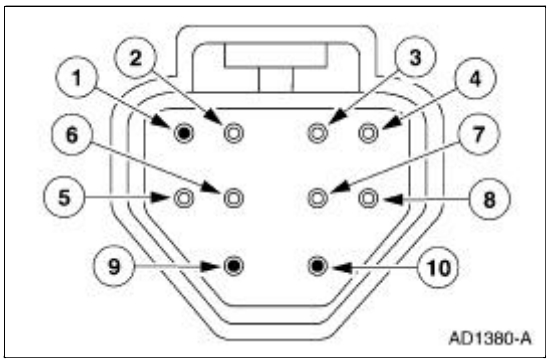
Rotunda Transmission Tester

The Rotunda Transmission Tester is used to diagnose the digital transmission range sensor and is used in conjunction with the pinpoint tests. The tests should be carried out in order. Installing the Rotunda Transmission Tester allows separation of the vehicle electronics from transmission electronics. For additional information, refer to the Rotunda Transmission Tester manual for these tests.

- Digital Transmission Range (TR) Sensor Testing
- Resistance/Continuity Test
- Voltage Test - PARK/NEUTRAL, REVERSE Lamp, and Optional Circuits

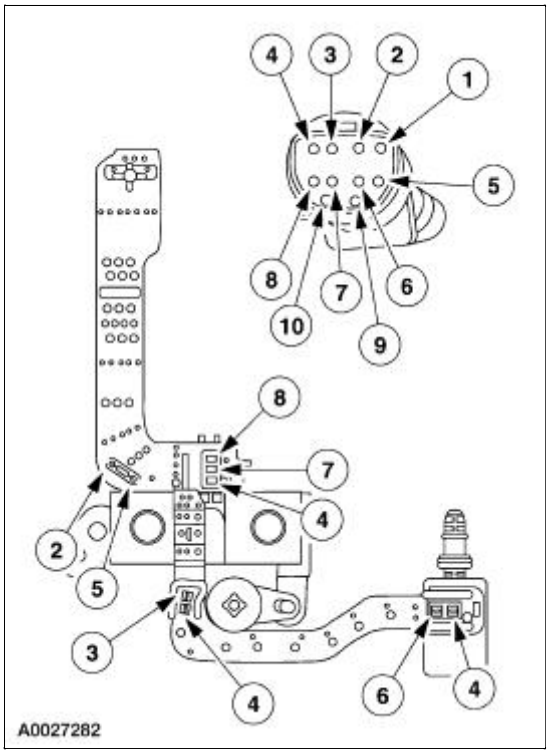
Transmission Connector Layouts

Transmission Vehicle Harness Connector



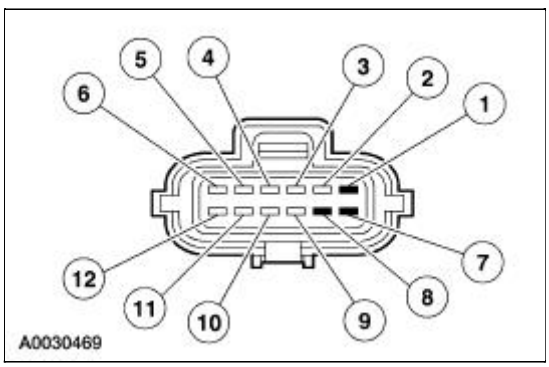
Pin Number	Circuit	Circuit Function
1	—	NOT USED
2	—	Signal Return
3	—	Torque Converter Clutch (TCC) Solenoid
4	—	Vehicle Power
5	—	Transmission Fluid Temperature (TFT) Input
6	—	Electronic Pressure Control (EPC) Solenoid
7	—	SSA
8	—	SSB
9	—	NOT USED
10	—	NOT USED

Transmission Internal Harness Connector



Pin Number	Circuit	Circuit Function
1	—	NOT USED
2	—	Signal Return Transmission Fluid Temperature (TFT)
3	—	Torque Converter Clutch (TCC)
4	—	Vehicle Power To Solenoid
5	—	Transmission Fluid Temperature (TFT)
6	—	Electronic Pressure Control
7	—	SSA
8	—	SSB
9	—	NOT USED
10	—	NOT USED

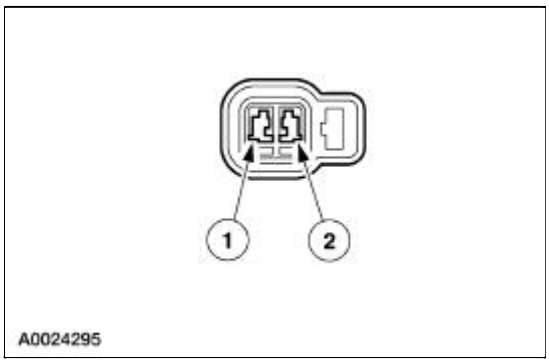
Digital Transmission Range (TR) Sensor Connector



Pin Number	Circuit	Circuit Function

1	—	NOT USED
2	—	Signal Return
3	—	TR3A
4	—	TR1
5	—	TR2
6	—	TR4
7	—	NOT USED
8	—	NOT USED
9	—	Fused Power Feed
10	—	Starter Control
11	—	Reverse
12	—	Starter to Starter Interrupt Relay

Output Shaft Speed (OSS) Sensor Harness Connector



Pin Number	Circuit	Circuit Function
1	—	Output Shaft Speed (OSS) Sensor
2	—	Signal Return

Digital Transmission Range (TR) Sensor Diagnosis Chart

Selector Position	PID: TR	PID: TR_D				PID: TR_V (volts)
		TR4	TR3A	TR2	TR1	TR3A (PCM Pin 64 to sigrtn)
PARK	P/N	0	0	0	0	0.0 Volts
In Between	REV	0	1	0	0	1.3 - 1.8 Volts
REVERSE	REV	1	1	0	0	1.3 - 1.8 Volts
In Between	REV	0	1	0	0	1.3 - 1.8 Volts
NEUTRAL	NTRL	0	1	1	0	1.3 - 1.8 Volts
In Between	O/D [a]	1	1	1	0	1.3 - 1.8 Volts
OVERDRIVE	O/D [a]	1	1	1	1	1.3 - 1.8 Volts
In Between	Man 2	1	0	1	1	0.0 Volts

Manual 2	Man 2	1	0	0	1	0.0 Volts
In Between	Man 2	1	0	1	1	0.0 Volts
Manual 1	Man 1	0	0	1	1	0.0 Volts

[a] Will read "Drive" if O/D is canceled.

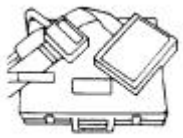
A. TR_V is the voltage at the PCM pin 64 (TR3A Circuit) to signal return.
B. "In Between" reading could be caused by a shift cable or digital TR sensor misaligned or a digital TR sensor circuit failure of TR1, TR2, TR3A, or TR4.
C. TR_D: 1= Open Digital TR switch, 0= Closed Digital TR switch.
D. EEC-V Control System Breakout Box Readings: Taken from PCM signal pins for TR1, TR2, TR3A, TR4 to signal return.
    - **Voltages for TR1, TR2, TR4:**
    - 0 = 0.0 volts.
    - 1 = 9.0 - 14.0 volts.
    - **Voltage for TR3A:**
    - 0 = 0.0 volts.
    - 1 = 1.3 - 1.8 volts.

Wiggle Test Information For Open/Shorts

- TR4, TR3A, TR2, and TR1 are all closed in PARK. PARK is a good position to check for intermittent open circuits (with scan tool monitoring TR_D).
- TR4, TR3A, TR2, and TR1 are all open in OVERDRIVE, so OVERDRIVE is a good position to check for shorts to ground. To determine the shorted components while observing TR_D, unplug the TR and see if the short goes away. If the short is still present, unplug the transmission harness and see if the short goes away. If the short is still present, then the short is in the PCM or vehicle harness. Remove the suspect circuit(s) wire from the PCM vehicle harness. If the short is still present, then the PCM has an internal failure. Otherwise the failure is in the vehicle harness.

Pinpoint Tests — OSC Equipped Vehicles

Special Tool(s)

 ST1391-A	Breakout Box, EEC-V Control System 418-049 (T94L-50 EEC-V) or equivalent
 ST1632-A	MLP TR Cable 418-F107 (007-00111) or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052 or equivalent scan tool
 ST1389-A	Transmission Tester 307-F016 (007-00130) or equivalent
	Trans Tester TR/MLP Overlay and Manual 007-00131 or equivalent
 ST1137-A	73 III Digital Multimeter 105-R0057 or equivalent
 ST2545-A	Gauge, Transmission Solenoid Connectors 307-426

Any time an electrical connector or solenoid body is disconnected, inspect the connector for pin condition, corrosion and contamination. Also inspect the connector seal for damage. Clean, repair or install a new connector as required.

Shift Solenoids Pre-Diagnosis

Use the following shift solenoid operation information when carrying out Pinpoint Test A.

Solenoid Operation Chart

Gear Lever Position	PCM Commanded Gear	Solenoids		
		SSA	SSB	TCC
P/R/N	1	ON	OFF	HD
(D)	1	ON	OFF	HD
(D)	2	OFF	OFF	EC
(D)	3	OFF	ON	EC
(D)	4	ON	ON	EC
(D)				
w/OD OFF				
1	1	ON	OFF	HD
2	2	OFF	OFF	EC
3	3	OFF	ON	EC
Manual 2	2	OFF	OFF	EC
Manual 1	1	ON	OFF	HD
[a] 1	2	OFF	OFF	EC

[a] When a manual pull-in occurs above a calibrated speed the transmission will downshift from the higher gear until the vehicle speed drops below this calibrated speed.

EC = Electronically controlled.

HD = Hydraulically disabled.

Shift Solenoid Failure Mode Chart "Always Off"

Failed off due to powertrain control module (PCM) and or vehicle wiring concerns, shift solenoid electrically or hydraulically stuck off.

SSA ALWAYS OFF	Gear Lever Position		
	(D)	2	1
PCM Gear Commanded	Actual Gear Obtained		
1	2	2	2
2	2	2	2
3	3	2*	2*
4	3	2*	2*

*No engine braking.

SSB ALWAYS OFF	Gear Lever Position		
	(D)	2	1
PCM Gear Commanded	Actual Gear Obtained		
1	1	1	1
2	2	2	2
3	2	2	2
4	1	1	1

Shift Solenoid Failure Mode Chart "Always On"

Failed on due to powertrain control module (PCM) and or vehicle wiring concerns, shift solenoid electrically or hydraulically stuck on.

SSA ALWAYS ON	Gear Lever Position		
	(D)	2	1
PCM Gear Commanded	Actual Gear Obtained		
1	1	1	1
2	1	1	1
3	4	2*	2*
4	4	2*	2*

*No engine braking.

SSB ALWAYS ON	Gear Lever Position		
	(D)	2	1
PCM Gear Commanded	Actual Gear Obtained		
1	4	2*	2*
2	3	2*	2*
3	3	2*	2*
4	4	2*	2*

*No engine braking.

Pinpoint Tests

PINPOINT TEST A: SHIFT AND TORQUE CONVERTER CLUTCH

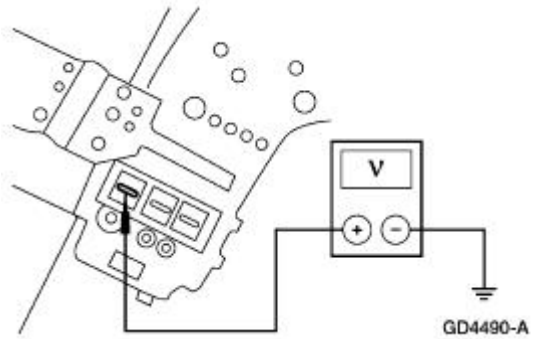
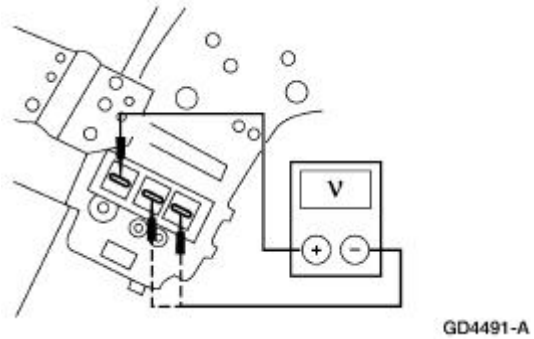
SOLENOIDS

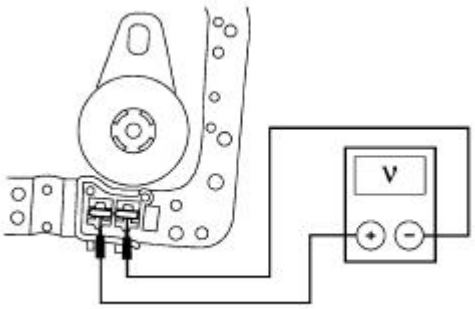
<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td colspan="2">NOTE: Read and record all DTCs. All Digital TR Sensor and VSS DTCs must be repaired before entering Output State Control (OSC).</td></tr>
<tr><td colspan="2">NOTE: Refer to the Transmission Internal Harness illustration preceding these pinpoint tests.</td></tr>
<tr><td colspan="2">NOTE: Refer to the Transmission Vehicle Harness Connector illustration preceding these pinpoint tests.</td></tr>
<tr><td>A1 ELECTRONIC DIAGNOSTICS
● Select PARK.
● Key in OFF position.
● Check to make sure the transmission harness connector is fully seated, pins are fully engaged in connector and in good condition before proceeding.
● Install Scan Tool
● Key in ON position.
● Enter the following diagnostic mode on the diagnostic tool: Diagnostic Data Link.
● Enter the following diagnostic mode on the diagnostic tool: PCM.
● Enter the following diagnostic mode on the diagnostic tool: Active Command Modes.
● Enter the following diagnostic mode on the diagnostic tool: Output State Control (OSC).
● Enter the following diagnostic mode on the diagnostic tool: Trans-Bench Mode.
● Does vehicle enter Trans-Bench Mode?</td><td>Yes
GO to A2 .

No
REPEAT procedure to enter Trans-Bench Mode. If vehicle did not enter Trans-Bench Mode, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of PCM.</td></tr>
<tr><td>A2 WIGGLE TEST
● Select PIDs to be monitored.
<table><tr><th>PID Command</th><th>PID Actual</th></tr><tr><td>SSA</td><td>SS1F</td></tr><tr><td>SSB</td><td>SS2F</td></tr><tr><td>TCC</td><td>TCCF</td></tr></table>● Select "ON" to turn suspect solenoid on.
● Press "SEND".
● Wiggle all wiring and connectors to the transmission. Monitor the Solenoid State for changes.
● Select "OFF" to turn solenoid off.
● Press "SEND".
● Does the suspect solenoid(s) fault state change?</td><td>Yes
REPAIR open or short in the vehicle harness or connector.

No
GO to A3 .</td></tr>
<tr><td>A3 SOLENOID FUNCTIONAL CHECK
● Monitor each solenoid state.
● Turn each solenoid ON and OFF.
● Does the solenoid turn ON and OFF when commanded and can solenoid activation be heard?</td><td>Yes
GO to A4 .

No
GO to A5 .</td></tr>
<tr><td>A4 OSC TRANS-DRIVE MODE (GR_CM OR TCC)
● Carry out OSC Trans-Drive Mode.
● Select GR_CM for Shift Solenoids or follow procedures for GR_CM as listed.
● Select TCC for Torque Converter Clutch Solenoid. Follow procedures of TCC in Drive Mode as listed.</td><td>Yes
CLEAR all DTCs. ROAD TEST to verify if concern is still present. If concern is still present, REFER to Diagnosis</td></tr>
</table>

• **Does the transmission upshift and downshift or torque converter engage/disengage when commanded?**	By Symptom in this section to diagnose shift or torque converter concern. **No** GO to A5 .
A5 CHECK FOR BATTERY VOLTAGE	
• Remove transmission fluid pan. • Visually inspect the lead frame and connectors for damage. • Key in ON position. • Measure the voltage with the positive lead to VPWR solenoid pin and negative lead to a good ground.  • **Is the voltage greater than 10 volts?**	**Yes** GO to A6 . **No** CHECK for open or short circuit in harness, or solenoid.
A6 ELECTRICAL SIGNAL CHECK	
• Measure the voltage with the positive lead connected to VPWR solenoid pin and the negative lead to the signal pin of the appropriate solenoid.  • Select Parameter SSA, SSB or TCC. • Select "ON". • Press "SEND". • Turn the solenoids ON and OFF, while monitoring the voltage, solenoid state on the scan tool (ON and OFF), and listen for the solenoid to activate (click). • Measure the voltage with the positive lead to VPWR pin and the negative lead to the TCC pin.	**Yes** GO to A7 . **No** CHECK for open or short circuit in harness, solenoid or a PCM concern.

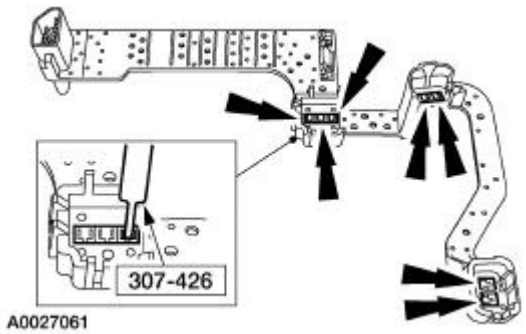


GD4492-A

- Select Parameter TCC.
- Select "ON".
- Press "SEND".
- Turn the solenoid ON and OFF, while monitoring the voltage, solenoid state on the scan tool (ON and OFF), and listen for the solenoid to activate (click).
- Select "OFF", press "SEND".
- **Does the voltage and solenoid state change?**

A7 CHECK LEAD FRAME SOLENOID CONNECTIONS

- Key in OFF position.
- Disconnect the lead frame.
- Inspect the lead frame for damage.
- Using the special tool, check all lead frame solenoid connections.



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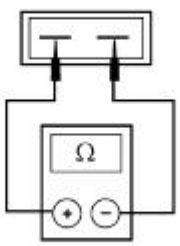
- **Does the special tool go through any of the lead frame solenoid connector pins?**

Yes
INSTALL a new lead frame and GO to A8 .

No
GO to A8 .

A8 CHECK SOLENOID RESISTANCE AT SOLENOID

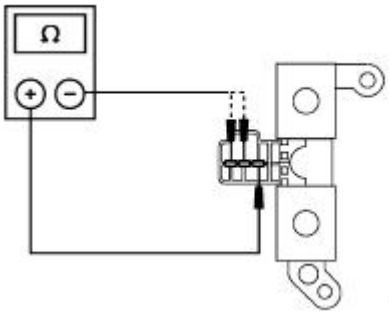
- Measure the solenoid resistance between the pins of the solenoid.



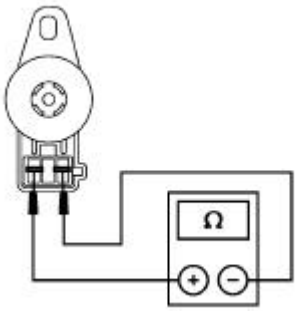
GD3386-A

Yes
GO to A9 .

No
INSTALL a new solenoid.



AD1391-A



AD1392-A

- Measure the resistance for each solenoid (SSA, SSB or TCC) as follows:

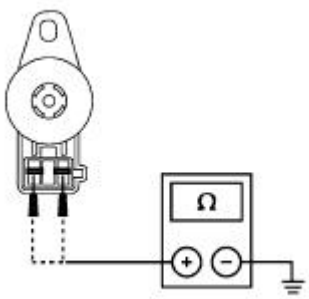
Solenoid	Resistance (ohms)
SSA	20-30
SSB	20-30
TCC	10-16

- **Are the resistances correct?**

A9 CHECK SOLENOID FOR SHORT TO GROUND

- Check for continuity between engine ground and appropriate solenoid pin with ohmmeter or other low current tester. Connection should show infinite resistance (no continuity).

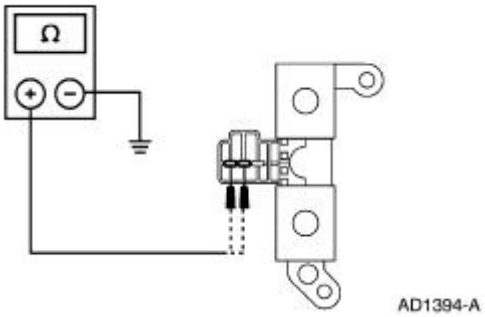
Solenoid	Terminal
SSA	+/-
SSB	+/-
TCC	+/-



AD1393-A

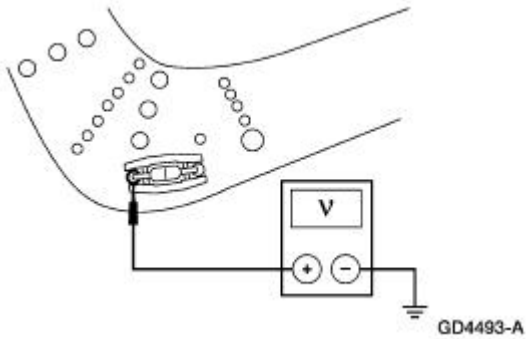
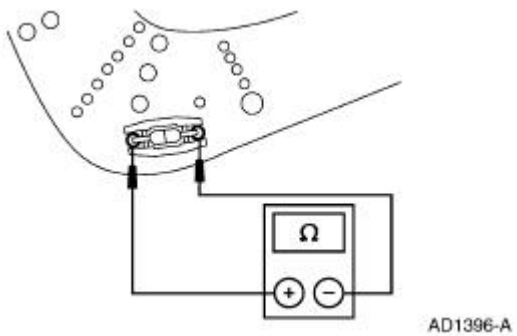
Yes
INSTALL a new solenoid.

No
REFER to Diagnosis By Symptom for diagnosis of shift or torque converter concerns.

 ● **Is there continuity?**	

PINPOINT TEST B: TRANSMISSION FLUID TEMPERATURE (TFT) SENSOR

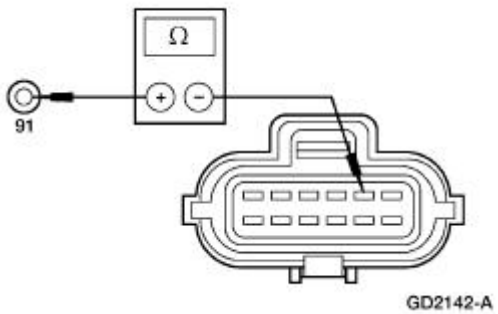
Test Step	Result / Action to Take
NOTE: Refer to the Transmission Connector layouts preceding these pinpoint tests.	
B1 ELECTRONIC DIAGNOSTICS	
● Check to make sure the transmission harness connector is fully seated, pins are fully engaged in connector and in good condition before proceeding. ● Install Scan Tool ● Key in ON position. ● Select Diagnostic Data Link. ● Select PCM. ● Select PID/Data Monitor and Record. ● Enter the following diagnostic mode on the diagnostic tool: PIDs; TFT, TFTV. ● **Does the vehicle enter PID/Data Monitor and Record?**	**Yes** GO to B2 . **No** REPEAT procedure to enter PID. If vehicle did not enter PID, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of PCM.
B2 WARM-UP/COOL-DOWN CYCLE	
● While monitoring the TFT PIDs, carry out the following test: If transmission is cold, run transmission to warm it up. If transmission is warm, allow transmission to cool down. ● **Do the TFT PIDs increase as the transmission is warmed up or decrease as the transmission is cooled or does the TFT or TFTV drop in and out of range?**	**Yes** If the TFT PIDs increase as the transmission is warmed or decrease as the transmission is cooled, CLEAR all DTCs. ROAD TEST to verify if concern is still present. If concern is still present, REFER to Diagnosis By Symptom in this section to diagnose transmission overheating. If the TFT or TFTV drop in and out of range, INSPECT for intermittent concern in the internal/external harness, sensor or connector. **No** GO to B3 .
B3 ELECTRICAL SIGNAL CHECK	
● Key in ON position. ● Remove transmission fluid pan. ● Visually inspect the lead frame and connectors for damage.	**Yes** GO to B4 . **No** CHECK for open or short circuit in

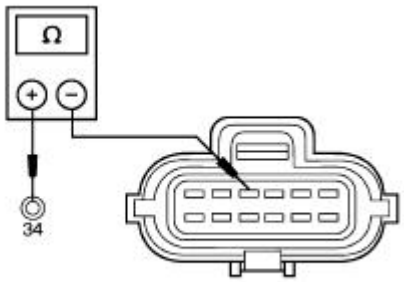
• Measure the voltage with the positive lead to positive TFT at sensor pin and negative lead to a good ground.  • **Is the voltage present?**	vehicle harness, internal harness or a PCM concern.
B4 CHECK RESISTANCE OF TFT SENSOR • Disconnect: Transmission Harness. • Measure the resistance between the positive TFT and negative TFT pins at transmission connector, using the following: **Transmission Fluid Temperature** **°C** / **°F** / **Resistance (Ohms)** -40 to -20 / -40 to -4 / 967K - 284K -19 to -1 / -3 - 31 / 284K - 100K 0 - 20 / 32 - 68 / 100K - 37K 21 - 40 / 69 - 104 / 37K - 16K 41 - 70 / 105 - 158 / 16K - 5K 71 - 90 / 159 - 194 / 5K - 2.7K 91 - 110 / 195 - 230 / 2.7K - 1.5K 111 - 130 / 231 - 266 / 1.5K - 0.8K 131 - 150 / 267 - 302 / 0.8K - 0.54K  • **Is the resistance correct?**	**Yes** REFER to Diagnosis By Symptom in this section to diagnose an overheating concern. **No** INSTALL a new internal harness (sensor is part of harness).

PINPOINT TEST C: DIGITAL TRANSMISSION RANGE (TR) SENSOR

Test Step	Result / Action to Take
NOTE: Refer to the Digital Transmission Range (TR) Sensor Connector illustration preceding	

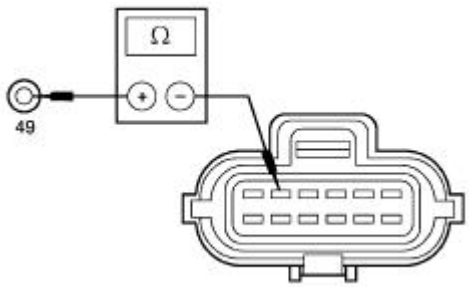
these pinpoint tests.	
NOTE: Refer to the Digital Transmission Range (TR) Sensor Diagnosis Chart preceding these pinpoint tests.	
C1 VERIFY DIAGNOSTIC TROUBLE CODES ● Select PARK. ● Key in OFF position. ● **NOTE:** DTC codes P0705 and P0708 cannot be set by an incorrectly adjusted digital TR sensor. ● Carry out on board diagnostic test. ● **Are only DTC codes P0705, P0708 present?**	**Yes** GO to C4 . **No** GO to C2 .
C2 VERIFY DIGITAL TRANSMISSION RANGE SENSOR ALIGNMENT ● Check to make sure the digital TR sensor harness connector is fully seated, pins are fully engaged in connector and in good condition before proceeding. ● Apply the parking brake. ● Select NEUTRAL. ● Disconnect the shift cable/linkage from the manual lever. ● Verify that the digital TR Sensor Alignment Tool fits in the appropriate slots. ● **Is the digital TR sensor adjustment OK?**	**Yes** GO to C3 . **No** ADJUST the digital TR sensor. PLACE transmission range selector lever in P and CLEAR DTCs. REPEAT OBD Tests. GO to C3 .
C3 VERIFY SHIFT CABLE/LINKAGE ADJUSTMENT ● Place the manual lever in the overdrive position. ● Reconnect the shift cable/linkage. ● Verify that the shift cable/linkage is adjusted OK. REFER to Section 307-05 . ● **Is the shift cable/linkage adjusted OK?**	**Yes** GO to C4 . **No** ADJUST the shift cable/linkage. REFER to Section 307-05 .
C4 CHECK ELECTRICAL SIGNAL OPERATION ● Select PARK. ● Disconnect: Digital TR Sensor. ● **CAUTION: Do not pry on connector. This will damage the connector and result in a transmission concern.** ● Press the button and pull out on the digital TR harness connector. ● Inspect both ends of the connector for damage or pushed-out pins, corrosion, loose wires and missing or damaged seals. ● **Are the connector, pins and harness damaged?**	**Yes** REPAIR as required. CLEAR DTCs and REPEAT OBD Tests. **No** If diagnosing a DTC, GO to C5 . If diagnosing a starting concern or a reversing lamp concern, GO to C10 .
C5 CHECK ELECTRICAL SYSTEM OPERATION (DIGITAL TR AND PCM) ● Key in OFF position. ● Install Scan Tool ● Connect: Digital TR Sensor. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: TR PIDS TR, TR_D, TR_V. ● Move transmission range selector lever into each gear and stop. ● Observe any of the following PIDs, TR and TR_D, TR_V (vehicle dependent) while wiggling harness, tapping on sensor, or driving the vehicle. Use PIDs TR, and TR_D for DTCs P0705, P1704, and P1705. Use PIDs TR, and TR_V for DTC P0708. ● Compare the PIDs to the Digital Transmission Range	**Yes** The problem is not in the digital TR sensor system. REFER to Diagnosis By Symptom in this section for further diagnosis. **No** If TR_D changes when wiggling harness, tapping on the sensor, or driving the vehicle, the problem may be intermittent. GO to C6 .

(TR) Sensor Diagnosis Chart. ● **Do the PIDs TR, TR_D and TR_V match the Digital Transmission Range (TR) Sensor Diagnosis chart, and does the TR_D PID remain steady when the harness is wiggled, the sensor is tapped, or the vehicle driven?**	
C6 CHECK DIGITAL TRANSMISSION RANGE SENSOR OPERATION	
● Disconnect: Digital TR Sensor. ● **CAUTION: Do not pry on connector. This will damage the connector and result in a transmission concern.** ● Connect: TR-E Cable to Transmission Tester. ● Connect: TR-E Cable to Digital TR Sensor. ● Place the Digital TR Overlay onto Transmission Tester. ● Carry out Sensor Test as instructed on the Digital TR Overlay. ● **Does the status lamp on the tester TRS-E cable match the selected gear positions?**	**Yes** Concern is not in the digital TR sensor, GO to C7 . **No** INSTALL a new digital TR sensor. CLEAR DTCs and REPEAT OBD Tests.
C7 CHECK PCM HARNESS CIRCUITS FOR OPENS	
● Key in OFF position. ● Disconnect: Powertrain Control Module (PCM). ● Inspect for damaged or pushed-out pins, corrosion or loose wires. ● Disconnect: Digital TR Sensor. ● **CAUTION: Do not pry the connector. This will damage the connector and result in a transmission concern.** ● Disconnect the digital TR sensor connector. ● Install the EEC-V Control System Breakout Box. ● Measure the resistance between the PCM Test Pin 91 at the EEC-V Control System Breakout Box and signal return circuit Pin 2 at digital TR sensor connector harness side.  ● Measure the resistance between the PCM Test Pin 34 at the EEC-V Control System Breakout Box and TR1 circuit Pin 4 at digital TR sensor connector harness side.	**Yes** GO to C8 . **No** REPAIR open circuit(s). RECONNECT all components. CLEAR DTCs. REPEAT OBD Tests.



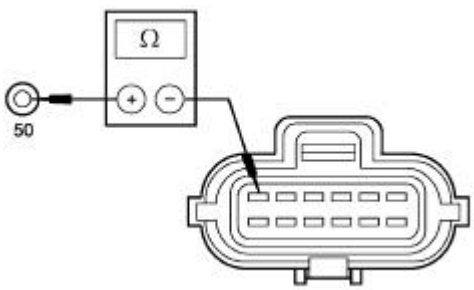
AD1665-A

- Measure the resistance between the PCM Test Pin 49 at the EEC-V Control System Breakout Box and TR2 circuit Pin 5 at digital TR sensor connector harness side.



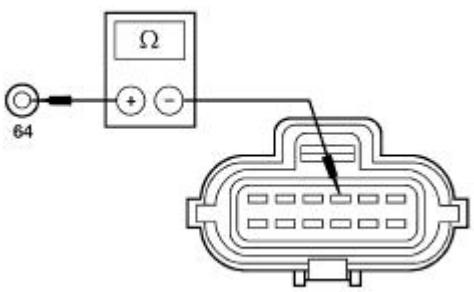
GD2144-A

- Measure the resistance between the PCM Test Pin 50 at the EEC-V Control System Breakout Box and TR4 circuit Pin 6 at digital TR sensor connector harness side.



GD2145-A

- Measure the resistance between the PCM Test Pin 64 at the EEC-V Control System Breakout Box and TR3A circuit Pin 3 at digital TR sensor connector harness side.

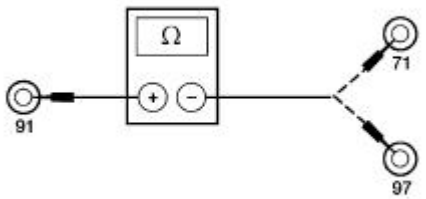


GD2146-A

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

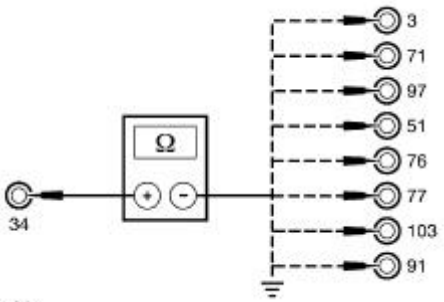
C8 CHECK PCM HARNESS CIRCUITS FOR SHORT TO GROUND OR POWER	
• Measure the resistance between PCM Test Pin 91 and Test Pins 71 and 97 at the EEC-V Control System	**Yes** GO to C9 .

Breakout Box.



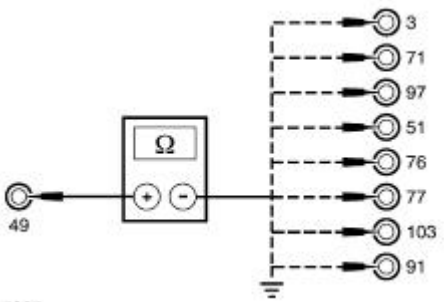
GD2254-A

- Measure the resistance between PCM Test Pin 34 and Test Pins 3, 71, 97, 51, 76, 77, 103, and 91 at the EEC-V Control System Breakout Box and chassis ground.



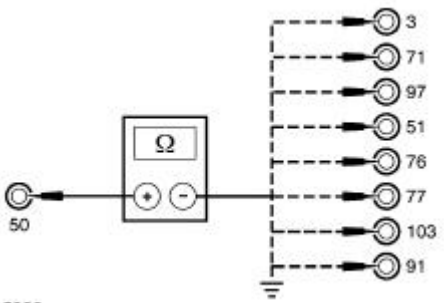
A0015064

- Measure the resistance between PCM Test Pin 49 and Test Pins 3, 71, 97, 51, 76, 77, 103, and 91 at the EEC-V Control System Breakout Box and chassis ground.



A0015065

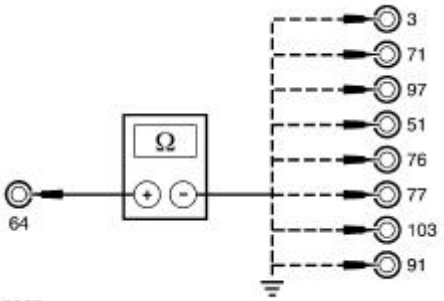
- Measure the resistance between PCM Test Pin 50 and Test Pins 3, 71, 97, 51, 76, 77, 103, and 91 at the EEC-V Control System Breakout Box and chassis ground.



A0015066

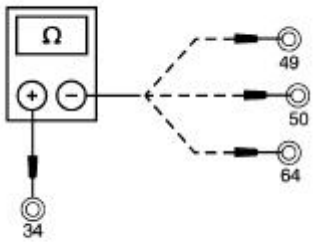
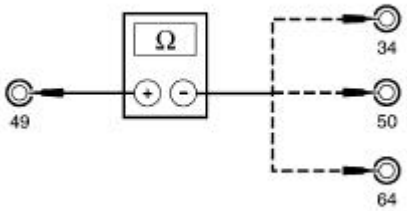
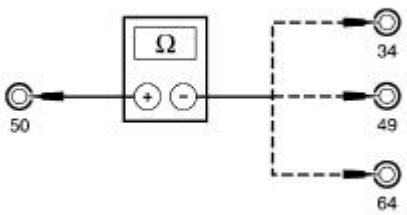
- Measure the resistance between PCM Test Pin 64 and Test Pins 3, 71, 97, 51, 76, 77, 103, and 91 at the EEC-V Control System Breakout Box and chassis ground.

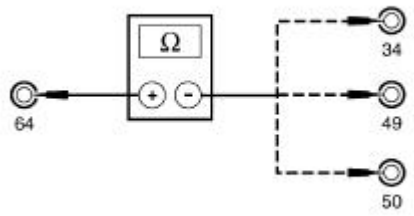
No
REPAIR short circuit(s). RECONNECT all components. CLEAR DTCs. REPEAT OBD Tests.



A0015067

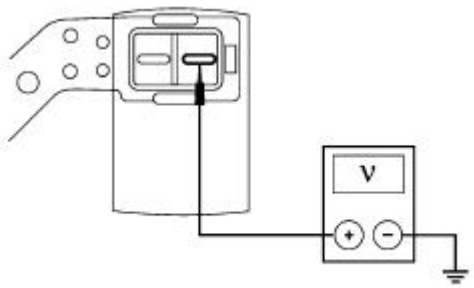
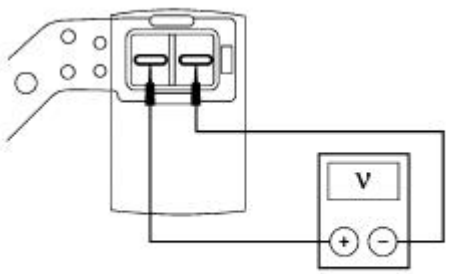
- **Are all resistances greater than 10,000 ohms?**

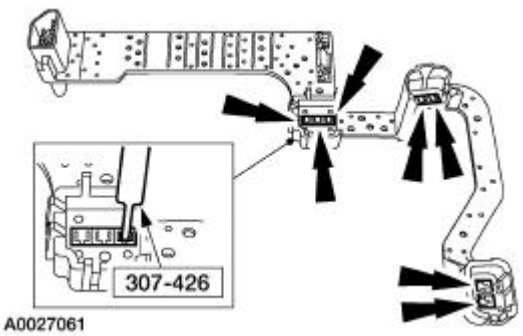
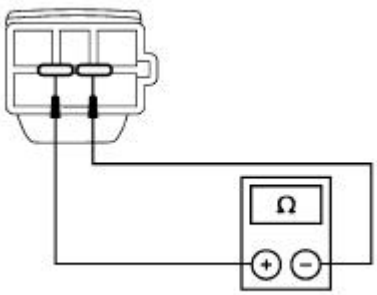
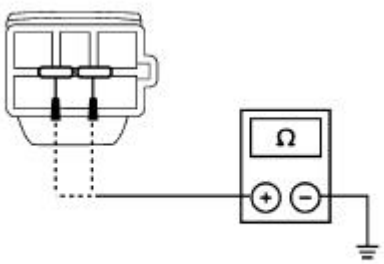
C9 CHECK FOR SHORT BETWEEN TR/PCM INPUT SIGNAL CIRCUITS	
• Measure the resistance between Test Pin 34 and Pins 49, 50, and 64 at the EEC-V Control System Breakout Box.  AD1666-A • Measure the resistance between Test Pin 49 and Pins 34, 50, and 64 at the EEC-V Control System Breakout Box.  A0008659 • Measure the resistance between Test Pin 50 and Pins 34, 49, and 64 at the EEC-V Control System Breakout Box.  A0008657 • Measure the resistance between Test Pin 64 and Pins 34, 49, and 50 at the EEC-V Control System Breakout	**Yes** INSTALL a new PCM. REFER to Section 303-14 . RECONNECT all components. CLEAR DTCs. REPEAT OBD Tests. **No** REPAIR shorts on circuits having less than 10,000 ohms between other TR/PCM input signal circuits. RECONNECT all components. CLEAR DTCs. REPEAT OBD Tests.

Box.  A0008658 ● **Are all the resistances greater than 10,000 ohms?**	
C10 CHECK THE NON-PCM INTERNAL CIRCUITS OF SENSOR	
● Connect: TRS-E Cable to Transmission Tester. ● Connect: TRS-E Cable to Digital TR Sensor. ● Place the Digital TR Overlay onto Transmission Tester. ● Carry out Switch Test as instructed on the Digital TR Overlay. ● **Does the status lamp on the tester indicate RED for the correct gear position?**	**Yes** Concern is not in the digital TR sensor. For starting system concerns, REFER to Section 303-06 . For reversing lamp concerns, REFER to Section 417-01 . For optional circuits, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. **No** INSTALL a new digital TR sensor. Clear DTCs. REPEAT OBD Tests.

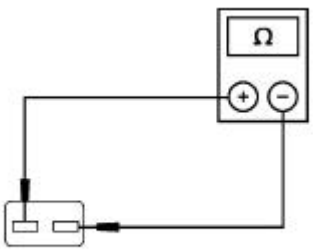
PINPOINT TEST D: ELECTRICAL PRESSURE CONTROL (EPC) SOLENOID

Test Step	Result / Action to Take
NOTE: Refer to the Transmission Internal Harness illustration preceding these pinpoint tests.	
NOTE: Read and record all DTCs. All Digital TR Sensor and VSS DTCs must be repaired before entering Output State Control (OSC).	
D1 ELECTRONIC DIAGNOSTICS	
● Key in OFF position. ● Select PARK. ● Check to make sure the transmission harness connector is fully seated, pins are fully engaged in the connector and in good condition before proceeding. ● Install Scan Tool ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Diagnostic Data Link. ● Enter the following diagnostic mode on the diagnostic tool: PCM. ● Enter the following diagnostic mode on the diagnostic tool: Active Command Modes. ● Enter the following diagnostic mode on the diagnostic tool: Output State Control (OSC). ● Enter the following diagnostic mode on the diagnostic tool: Trans-Bench Mode.	**Yes** GO to D2 . **No** REPEAT procedure to ENTER Trans-Bench Mode. If vehicle did not enter OSC, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of PCM.

• **Does the vehicle enter the Trans-Bench Mode?**	
D2 SOLENOID FUNCTIONAL TEST	
• Install 2,060 kPa (300 psi) pressure gauge into EPC tap. • Monitor pressure gauge. • Enter the following diagnostic mode on the diagnostic tool: Parameter; EPC. • Select value - 15, 30, 45, 60, 70 or 90 psi. • Press "SEND". • Select another value "0-90 psi". • Press "SEND". • Enter the following diagnostic mode on the diagnostic tool: XXX. • Press "SEND". • **Does the pressure reading match the commanded pressure?**	**Yes** CLEAR DTCs. REPEAT OBD Tests. **No** GO to D3 .
D3 CHECK FOR BATTERY VOLTAGE	
• Remove transmission fluid pan. • Visually inspect the lead frame connectors for damage. • Key in ON position. • Measure the voltage with positive lead to VPWR solenoid pin and negative lead to a good ground.  GD4494-A • **Is voltage greater than 10 volts?**	**Yes** GO to D4 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the OBD Tests.
D4 ELECTRICAL SIGNAL CHECK	
• Measure the voltage with positive lead connected to VPWR solenoid pin and connect negative lead to the signal pin of the EPC solenoid.  GD4495-A • Turn the solenoids ON and OFF, while monitoring the voltage reading, solenoid state on the scan tool (ON and OFF), listen for the solenoid to activate (click). • Enter the following diagnostic mode on the diagnostic tool: Trans-Bench Mode. • Enter the following diagnostic mode on the diagnostic tool: Parameter EPC. • Select a value "0-90 psi". • Press "SEND". • Select another value "0-90 psi".	**Yes** GO to D5 . **No** CHECK for open or short circuit in harness or PCM.

• Press "SEND". • Enter the following diagnostic mode on the diagnostic tool: XXX. • Press "SEND". • **Does the voltage and solenoid state change?**	
D5 CHECK LEAD FRAME SOLENOID CONNECTIONS	**Yes** INSTALL a new lead frame and GO to D6 . **No** GO to D6 .
• Key in OFF position. • Disconnect the lead frame. • Inspect lead frame for damage. • Using the special tool, check all the lead frame solenoid connections.  A0027061 • **Does the special tool go through any of the lead frame solenoid connector pins?**	
D6 CHECK SOLENOID RESISTANCE AT SOLENOID	**Yes** GO to D7 . **No** INSTALL a new solenoid. CLEAR the DTCs. REPEAT the OBD Tests.
• Measure the resistance of the EPC solenoid.  AD1399-A • **Is the resistance between 2.48 and 5.66 ohms?**	
D7 CHECK SOLENOID FOR SHORT TO GROUND	**Yes** INSTALL a new solenoid. CLEAR the DTCs. REPEAT the OBD Tests. **No** REFER to Diagnosis By Symptom in this section for diagnosis of pressure concerns.
• Check for continuity between engine GROUND and the EPC solenoid terminals with ohmmeter or other low current tester (less than 200 milliamps). Connection should show infinite resistance (no continuity).  AD1400-A • **Is there continuity?**	

PINPOINT TEST E: OUTPUT SHAFT SPEED (OSS) SENSORS

Test Step	Result / Action to Take
NOTE: Refer to the Output Shaft Speed (OSS) Sensor Harness Connector illustration preceding these pinpoint tests.	
E1 ELECTRONIC DIAGNOSTICS ● Check to make sure the transmission harness connector is fully seated, pins are fully engaged in connector and in good condition before proceeding. ● Install Scan Tool ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Diagnostic Data Link. ● Enter the following diagnostic mode on the diagnostic tool: PCM. ● Select PID/Data Monitor and Record. ● Select the PID OSS. ● **Does vehicle enter PID/Data Monitor and Record?**	**Yes** GO to E2 . **No** REPEAT procedure to ENTER PID. If vehicle did not enter PID, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of PCM.
E2 DRIVE CYCLE TEST ● While monitoring the OSS Speed PID, drive the vehicle so that the transmission upshifts and downshifts through all gears. ● **Does the OSS Speed PID increase and decrease with engine and vehicle speed?**	**Yes** CLEAR all DTCs. ROAD TEST to verify if concern is still present. If concern is still present, REFER to Diagnosis By Symptom in this section. **No** If the OSS Speed PID does not increase and decrease with engine and vehicle speed, INSPECT for open or short in vehicle harness, sensor, a PCM concern, or internal hardware concern. If the sensor signal is erratic, INSPECT for intermittent concern in the internal/external harness, sensor, or connector. If the sensor signal is steady, GO to E3 .
E3 CHECK RESISTANCE OF OSS SENSOR ● Disconnect the vehicle harness connector from the OSS sensor. ● Measure the resistance between the OSS sensor pins.  AD1084-B	**Yes** REFER to Diagnosis by Symptom Index for concern diagnosis. **No** INSTALL a new OSS sensor.

- Record the resistance.

Sensor	Resistance (ohms)	Temperature
OSS	791 to 1,795	-40°C to 160°C (-40°F to 320°F)

- **Is the resistance within specification?**

PINPOINT TEST F: SOLENOID MECHANICAL FAILURE

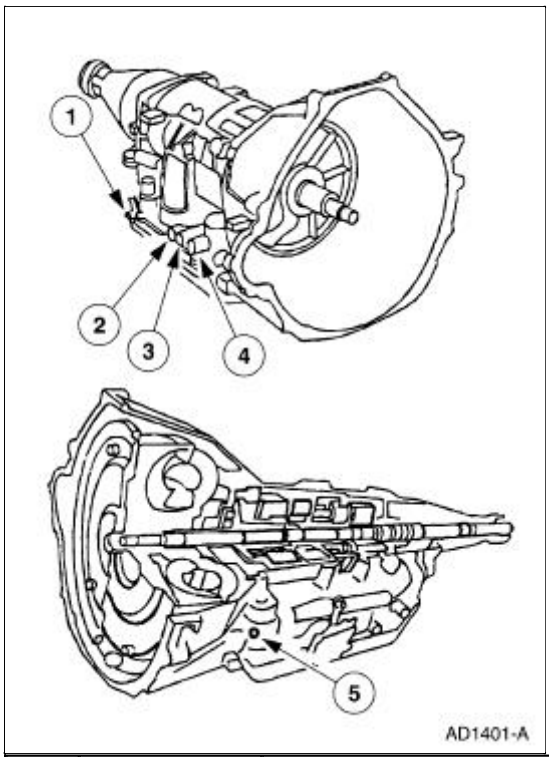
Test Step	Result / Action to Take
NOTE: Repair all other DTCs before repairing the following DTCs: P1714, P1715, P1740.	
F1 ELECTRONIC DIAGNOSIS - Install Scan Tool - Carry out KOEO test. - **Are only DTCs P1714, P1715, P1740 present?**	**Yes** REPAIR the other DTCs first. CLEAR DTCs and CARRY OUT Transmission Drive Cycle Test. REPEAT Quick Test. **No** INSTALL a new solenoid and or body. REFER to the Diagnostic Trouble Code Charts in this section for code description. GO to F2 .
F2 TRANSMISSION DRIVE CYCLE TEST - Carry out transmission drive cycle test. - Carry out On-Board Diagnostic Test. - **Does the vehicle upshift and downshift OK?**	**Yes** GO to F3 . **No** REFER to Diagnosis By Symptom in this section to diagnose shift concerns.
F3 RETRIEVE DTCS - Install Scan Tool - Carry out KOEO test until continuous DTCs have been displayed. - **Are DTCs P1714, P1715, P1740 still present?**	**Yes** INSTALL a new PCM. REFER to Section 303-14 . ROAD TEST and REPEAT Quick Test. **No** Testing completed. If a concern still exists, REFER to Diagnosis By Symptom in this section for concern diagnosis.

Special Testing Procedures

The special tests are designed to aid the technician in diagnosing the hydraulic and mechanical portion of the transmission.

Engine Idle Speed Check

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the engine idle speed.



Item	Part Number	Description
1	—	Direct clutch pressure tap
2	—	Forward clutch pressure tap
3	—	Electronic pressure control (EPC) pressure tap
4	—	Intermediate clutch pressure tap
5	—	Line pressure tap

Line Pressure Test

CAUTION: Carry out the line pressure test prior to carrying out the stall speed test. If the line pressure is low at stall, do not carry out stall speed test or further transmission damage will occur. Do not maintain WOT in any transmission range for more than five seconds.

This test verifies that the line pressure is within specification.

1. Connect pressure gauge to line pressure tap.

2. Start engine and check line pressures. Refer to the Line Pressure Chart to determine if line pressure is within specification.

Line Pressure Chart

Application	Range	Idle		WOT Stall	
		EPC	Line Pressure	EPC	Line Pressure
4.6L	P, N, OD, 2, 1	207-276 kPa (30-40 psi)	552-689 kPa (80-100 psi)	689-758 kPa (100-110 psi)	1,310-1,448 kPa (190-210 psi)
4.6L	R	138-207 kPa (20-30 psi)	552-689 kPa (80-100 psi)	586-655 kPa (85-95 psi)	1,723-2,068 kPa (250-300 psi)
5.4L	P, N, OD, 2, 1	207-276 kPa (30-40 psi)	552-689 kPa (80-100 psi)	689-793 kPa (100-115 psi)	1,172-1,861 kPa (170-270 psi)
5.4L	R	138-207 kPa (20-30 psi)	552-689 kPa (80-100 psi)	586-655 kPa (85-95 psi)	1,723-2,068 kPa (250-300 psi)

Clutch Pressure Chart

Transmission Pressures with TP at 1.5 Volts and Vehicle Speed Above 8 Km/h (5 MPH)					
Gear	EPC Tap [1]	Line Pressure Tap	Forward Clutch Tap	Intermediate Clutch Tap	Direct Clutch Tap
M1	172-241 kPa (25-35 psi)	517-655 kPa (75-95 psi)	448-586 kPa (65-85 psi)	0-34 kPa (0-5 psi)	0-34 kPa (0-5 psi)
M2	276-345 kPa (40-50 psi)	689-814 kPa (100-118 psi)	620-745 kPa (90-108 psi)	648-779 kPa (94-113 psi)	0-34 kPa (0-5 psi)
1	172-241 kPa (25-35 psi)	517-655 kPa (75-95 psi)	448-586 kPa (65-85 psi)	0-34 kPa (0-5 psi)	0-34 kPa (0-5 psi)
2	276-345 kPa (40-50 psi)	689-814 kPa (100-118 psi)	620-745 kPa (90-108 psi)	641-779 kPa (93-113 psi)	0-34 kPa (0-5 psi)
3	310-345 kPa (45-50 psi)	731-869 kPa (106-126 psi)	662-800 kPa (96-116 psi)	689-827 kPa (100-120 psi)	655-800 kPa (95-116 psi)
4	241-310 kPa (35-45 psi)	620-758 kPa (90-110 psi)	0-34 kPa (0-5 psi)	586-724 kPa (85-105 psi)	551-689 kPa (80-100 psi)

[1] EPC readings will vary due to EEC strategy. These values are approximate pressures. Actual clutch pressures should be within 69-103 kPa (10-15 psi) of line pressure. For additional information on testing, refer to the Clutch Pressure Test in this section.

3. Place the ignition switch in the OFF position. If line pressure is not within specification, check EPC pressure.

4. Connect pressure gauge to EPC pressure tap.

5. Start engine and check EPC pressure. Use the line pressure chart for specifications.

6. If EPC pressure is not within specification, carry out Pinpoint Test E to diagnose EPC operation. If EPC operation is OK, see the line pressure diagnosis chart for line pressure concern causes.

Line Pressure Diagnosis Chart

Test Results	Possible Source
High At Idle — In All Positions	Wiring Harnesses
	Run Quick Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	EPC Solenoid Main Regulator Valve
Low At Idle — In All Positions	Low Fluid Level
	Control Bodies
	Leakage in Pump
	Damaged Gaskets on Separator Valve
	Damaged Separator Plate
	Restricted Inlet Filter
	Case Bolts
	Loose Main Control Valve Body
	VSS O-Ring
	VSS Bracket
	Case
	Sticking Main Regulator Valve Damaged Inlet Tube Seal on Inlet Filter
Low In Park Only	Valve Body Low/Reverse Servo
Low In Reverse Only	Separator Plate
	Low/Reverse Servo or Valve Bodies Reverse Clutch
Low In Neutral Only	Valve Body
Low In Overdrive Only	Forward Clutch Valve Body
Low In 1st Position Only	Forward Clutch
	Valve Body Low/Reverse Servo
Low In 2nd Only	Intermediate Clutch
	Valve Bodies Forward Clutch

Stall Speed Test

WARNING: Apply the parking brake firmly while carrying out each stall test.

CAUTION: Carry out line pressure test prior to carrying out stall test. If the line pressure is low at stall, do not carry out stall test or further transmission damage will occur.

The stall speed test checks:

- torque converter clutch operation and installation.
- holding ability of the forward clutch.
- reverse clutch (the low-reverse bands).
- planetary one-way clutch.
- engine driveability.

Conduct this test with the engine coolant and transmission fluid at correct levels and at normal operating temperature.

Apply the parking brake firmly for each stall speed test.

1. Find the specified stall rpm for the vehicle; see the stall speed diagnosis chart. Use a grease pencil to mark the rpm on the dial of a tachometer.

Stall Speed Chart

Engine	Stall Speed RPM
4.6L	2,121-2,459
5.4L (2V)	1,816-2,200

2. Connect a tachometer to the engine.

3. **NOTE:** If the rpm recorded by the tachometer exceeds the maximum limits, release the accelerator pedal immediately because clutch or band slippage is indicated.

   In each of the following ranges (D), 2, 1, R, press the accelerator pedal to the floor and hold it just long enough to let the engine get to wide open throttle (WOT). While making this test, do not hold the throttle open for more than 5 seconds at a time.

4. Note the results in each range.

5. After each range, move the shift control selector lever to Neutral and run the engine at 1,000 rpm for about 15 seconds to cool the torque converter before making the next test.

6. Refer to the stall speed diagnosis chart for corrective actions.

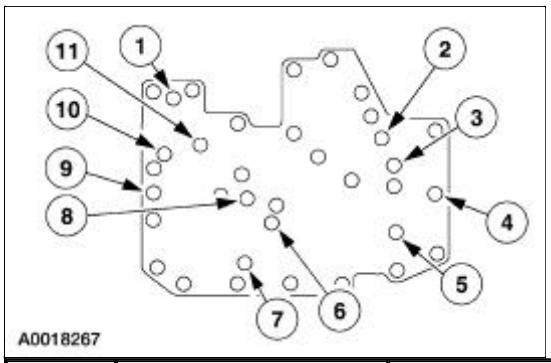
Stall Speed Diagnosis Chart

Selector Position	Stall Speeds High	Stall Speeds Low
(D)	Planetary One-Way Clutch	
(D), 2 and 1	Forward Clutch or Intermediate	

	Clutch	
(D), 2, 1 and R	Carry Out Pressure Test	Torque Converter Stator One-Way Clutch or Engine Driveability Concerns
R	Reverse Clutch or Low Reverse Band or Servo	

Air Pressure Tests

Transmission Air Test Plate



Item	Part Number	Description
1	—	Converter bypass
2	—	Direct clutch
3	—	Forward clutch
4	—	2-3 accumulator top
5	—	2-3 accumulator bottom
6	—	Reverse servo
7	—	Overdrive servo apply
8	—	Overdrive servo release
9	—	Intermediate clutch
10	—	Reverse clutch
11	—	1-2 accumulator apply

A no-drive condition can exist even with correct transmission fluid pressure because of inoperative clutches or bands. An erratic shift can be located through a series of checks by substituting air pressure for fluid pressure to determine the location of the malfunction.

Follow the procedure to determine the location of the inoperative clutch or band by introducing air pressure into the various test plate passages.

NOTE: Use only dry, regulated 276 kPa (40 psi) maximum air pressure.

Apply air to the appropriate passage(s). A dull thud should be felt or heard or movement could be observed when the clutch component applies. There should be no hissing sound when the component is applied.

Cover the vent hole in the test plate with a clean, lint-free shop towel to prevent spray when the air is applied. Plugging the vent hole during testing will result in inaccurate results.

1. Drain transmission fluid and remove the transmission fluid pan.

2. Remove the main control valve body.

3. Install transmission test plate and gasket. Tighten bolts to 10 Nm (89 lb-in).

4. **NOTE:** Do not apply air to the test plate vent hole.

   Apply air to the appropriate clutch port (refer to the Transmission Air Test Plate illustration). A dull thud may be heard or movement felt when the component is applied or released. If clutch seals or check balls are leaking a hissing sound may be heard.

If the servos do not operate, disassemble, clean and inspect them to locate the source of the concern.

If air pressure applied to the clutch passages fails to operate a clutch, or operates clutches simultaneously, inspect the fluid passages in the case.

If air pressure applied to the accumulator fails to operate an accumulator, remove and inspect case passages and piston.

Clutch Pressure Test

The Clutch Pressure Test will diagnose a low-pressure condition or leakage in a clutch circuit. A difference of 103 kPa (15 psi) or more between the clutch pressure and line pressure will prevent a normal shift.

1. **CAUTION: Pressure gauges affect the shift quality of the transmission. Care must be taken not to accelerate or decelerate rapidly. Possible transmission failure can result.**

   Attach 0-2,068 kPa (0-300 psi) pressure gauges to the line pressure tap and the appropriate clutch pressure tap according to Band/Clutch Application Chart. Gauges must be accurate enough to distinguish a 103 kPa (15 psi) difference. (If this test is done in conjunction with a control pressure test, pressure gauges will be attached to all pressure taps.) Have sufficient flexible hose available to read the gauges in the vehicle.

2. Drive the vehicle. When pressure is applied to the clutch, note the difference between the line pressure gauge and the corresponding clutch pressure gauge.

3. If the difference in pressures is less than 103 kPa (15 psi), the corresponding clutch circuit does not have a pressure loss. The gauges on the line pressure tap and appropriate clutch pressure tap can be switched to confirm that gauge calibration differences are not the cause.

4. If the difference is greater than 103 kPa (15 psi), there is a leak in the corresponding clutch pressure circuit. The gauges on the line pressure tap and clutch pressure tap can be switched to confirm that gauge calibration differences are not the cause. Carry out the appropriate procedure to correct the clutch leak problem.

Leakage Inspection

CAUTION: Do not try to stop the fluid leak by increasing the torque beyond specifications. This may cause damage to the case threads.

Check the fluid filler tube connection at the transmission case. If leakage is found here, install a new grommet.

Check the VSS plug or VSS sensor O-ring (model dependent). If leakage is found install a new O-ring.

Check fluid lines and fittings between the transmission and the cooler in the radiator tank for looseness, wear, or damage. If leakage cannot be stopped by tightening a fluid tube nut, install new parts. When fluid is found leaking between the case and cooler line fitting, check for missing or damaged O-ring, then tighten the fitting to maximum specification.

If the leak continues, install a new cooler line fitting and tighten to specification. The same procedure should be followed for fluid leaks between the radiator cooler and the cooler line fittings in this section; refer to Section 307-02 .

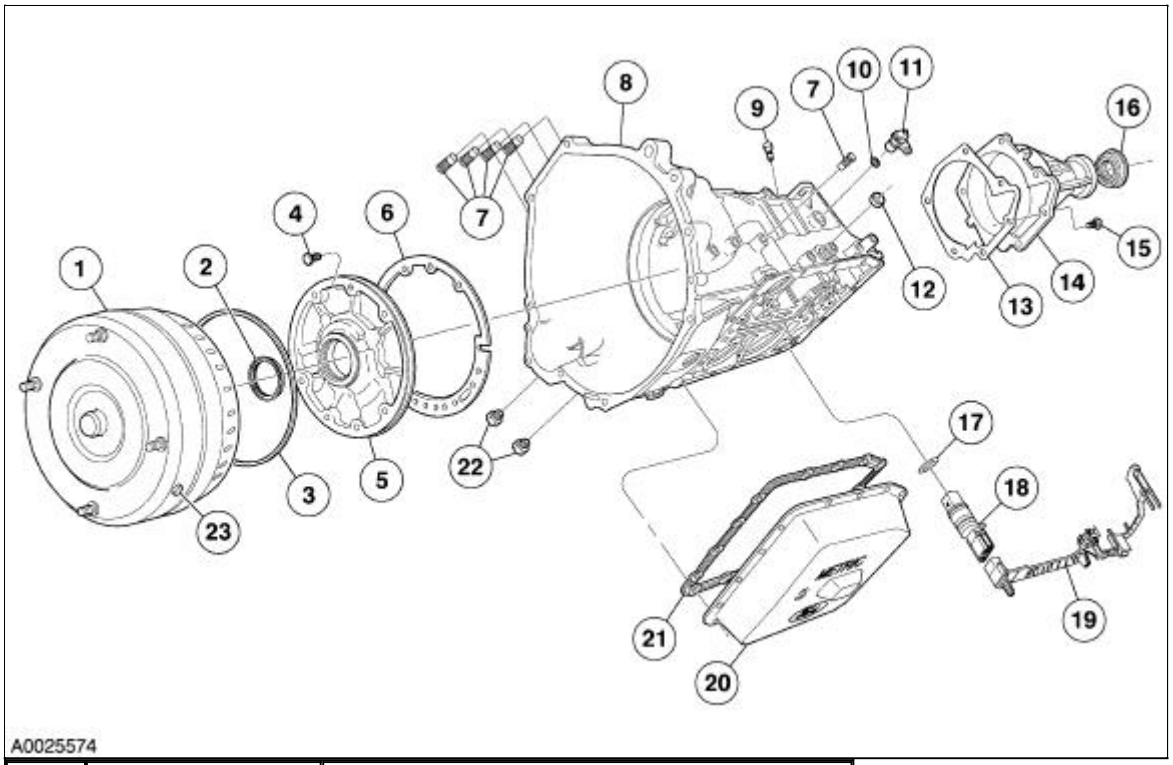
Check the engine coolant in the radiator. If transmission fluid is present in the coolant, the cooler in the radiator is probably leaking.

The cooler can be further checked for leaks by disconnecting the lines for the cooler fittings and applying no more than 345 kPa (50 psi) air pressure to the fittings. Remove the radiator cap to relieve the pressure buildup at the exterior of the oil cooler tank. If the cooler is leaking and or will not hold pressure, install a new cooler.

If leakage is found at the transmission range selector lever, install a new seal.

If leakage is found at the transmission internal harness connector, install a new O-ring.

4R70W External Sealing

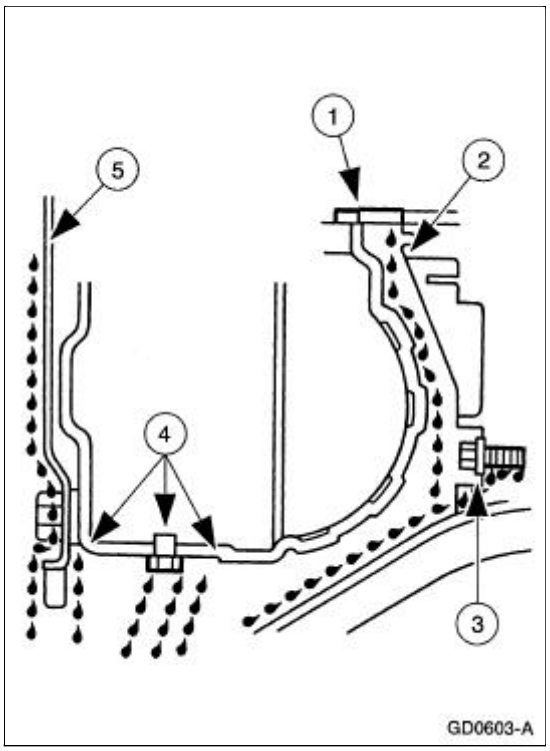


Item	Part Number	Description
1	7902	Torque converter
2	7A248	Front pump seal
3	7A248	Front pump seal
4	N605789-S101	Bolt
5	7A106	Front pump body assembly
6	7A136	Pump gasket
7	390318-S2	Pipe plug — 1/8 — 27 Dryseal tapered
8	7005	Case
9	7034	Vent
10	N811757-S100	Speed sensor seal
11	7H103	Output shaft speed (OSS) sensor
12	7B498	Manual control lever seal assembly
13	7086	Extension housing gasket
14	7A039	Extension housing
15	N803737-S1101	Bolt — M8-1.25 x 30
15	N606047-S101	Bolt — M8-1.25 x 70
15	N803521-S1101	Bolt — M8-1.25 x 1.25 x 0.54
15	N811524-S101	Bolt — M8-1.25 x 42
16	7052	Oil seal
17	7Z276	Seal — bulkhead assembly
18	7G276	Bulkhead assembly wiring connector
19	7G276	Molded lead frame
20	7A194	Transmission fluid pan
21	7A191	Gasket

22	7D273	Fluid tube connector
23	87650-S2	Converter drain plug

Fluid Leakage in Torque Converter Area

In diagnosing and correcting fluid leaks in the front pump support and gear and torque converter area, use the following procedures to locate the exact cause of the leakage. Leakage at the front of transmission, as evidenced by fluid around the torque converter housing, may have several sources. By careful observation it is possible, in many instances, to pinpoint the source of leak before removing the transmission from the vehicle. The paths which the fluid takes to reach the bottom of the torque converter housing are shown in the illustration. The five steps following correspond with the numbers in the illustration.



1. Fluid leaking by the front pump seal lip will tend to move along the impeller hub and onto the back of the impeller housing. Except in the case of a total seal failure, fluid leakage by the lip of the seal will be deposited on the inside of the torque converter housing only, near the outside diameter of the housing.

2. Fluid leakage by the outside diameter of the front pump seal and front pump body will follow the same path that leaks by the inside diameter of the front pump seal follow.

3. Fluid that leaks by a front pump to case bolt or pump gasket will be deposited on the inside of the torque converter housing only. Fluid will not be deposited on the back of the torque converter.

4. Fluid leakage from the converter drain plug, (model dependent) converter seal weld or converter to flexplate stud weld will appear at the outside diameter of the torque converter on the back face of the flexplate and in the converter housing only near the flexplate. Fluid leaks from the torque converter will leave a ring of fluid around the inside of the torque converter housing.

5. **NOTE:** White facial tissue paper may aid in determining the color (red is transmission fluid) and source of the leaking fluid.

   Engine oil leaks are sometimes incorrectly diagnosed as transmission pump gasket leaks. The

following areas of possible leakage should also be checked to determine if engine oil leakage is causing the concern.

a. Leakage at the engine valve cover gasket may allow oil to flow over the torque converter housing or seep down between the torque converter housing and cylinder block causing oil to be present in or at the bottom of the torque converter housing.
b. Oil galley plug leaks will allow oil to flow down the rear face of the cylinder block to the bottom of the torque converter housing.
c. Leakage at the crankshaft rear oil seal will work back to the flexplate, and then into the torque converter housing.
d. Leakage at engine oil pressure sensor.

Leak Check Test

1. Remove the fluid level indicator and note the color of the fluid. Original factory fill fluid is dyed red to aid in determining if leakage is from the engine or transmission. Unless a considerable amount of makeup fluid has been added or the fluid has been changed, the red color should assist in pinpointing the leak.

2. Remove the torque converter housing cover. Clean off any fluid from the top and bottom of the torque converter housing, front of the case and rear face of the engine and oil pan. Clean the torque converter area by washing with a suitable nonflammable solvent and blow dry with compressed air.

3. Wash out the torque converter housing, the front of the flexplate and the converter drain plugs. The torque converter housing may be washed out using cleaning solvent and a squirt-type oil can. Blow all washed areas dry with compressed air.

4. Start and run the engine until the transmission reaches its normal operating temperature. Observe the back of the cylinder block and top of the torque converter housing for evidence of fluid leakage. Raise the vehicle on a hoist; refer to Section 100-02 and run the engine at fast idle, then at engine idle, occasionally shifting to the Overdrive and Reverse ranges to increase pressure within the transmission. Observe the front of the flexplate, back of the cylinder block (in as far as possible), and inside the torque converter housing and front of the case. Run the engine until fluid leakage is evident and the probable source of leakage can be determined.

Leak Check Test With Black Light Used With 12 Volt Master UV Diagnostic Inspection Kit

Oil soluble aniline or fluorescent dyes premixed at the rate of 2.5ml (1/2 teaspoon) of dye powder to 0.235L (1/2 pint) of transmission fluid have proved helpful in locating the source of fluid leakage. Such dyes may be used to determine whether an engine oil or transmission fluid leak is present, or if the fluid in the fluid cooler leaks into the engine cooling system. A black light must be used with the fluorescent dye solution.

Transmission Fluid Cooler

CAUTION: Whenever a transmission has been disassembled to install new parts, the cooler bypass valve (CBV), all transmission fluid coolers (in tank and auxiliary) and transmission fluid cooler lines must be cleaned and backflushed. Use a suitable the torque converter/fluid cooler cleaner.

NOTE: Cleaning and backflushing the transmission fluid cooling system along with following all the normal cleaning and inspection procedures in this section during disassembly and reassembly will keep contamination from reentering the transmission and causing a repeat repair.

When internal wear or damage has occurred in the transmission, metal particles, clutch plate material, or band material may have been carried into the torque converter and transmission fluid cooler. These contaminants are a major cause of recurring transmission troubles and must be removed from the system before the transmission is put back into use.

Transmission Fluid Cooler Flow Test

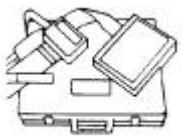
NOTE: The transmission linkage/cable adjustment, fluid level and line pressure must be within specification before carrying out this test. Refer to Section 307-05 for adjustments.

1. Remove fluid level indicator from fluid filler tube.
2. Place funnel in fluid filler tube.
3. Position the vehicle on a hoist. For additional information, refer to Section 100-02 .
4. Remove the cooler return line (top fitting) from the fitting on the transmission case.
5. Connect one end of a hose to the cooler return line and route other end of the hose up to a point where it can be inserted into the funnel at the fluid filler tube.
6. Remove the safety stands and lower the vehicle. Insert end of hose into the funnel.
7. Start the engine and run it at idle with the transmission in NEUTRAL.
8. When fluid flows from the hose in a steady stream, a liberal amount of fluid should be observed. "Liberal" is about 1 liter (1 quart) delivered in 15 seconds. If a liberal flow is observed, the test is complete.
9. If the flow is not liberal, stop the engine. Disconnect the hose from the cooler return line and connect it to the converter outlet fitting (bottom fitting) on the transmission case.
10. Repeat steps 6 and 7. If flow is now approximately 1 liter (1 quart) in 15 seconds, refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section. If the flow is still not approximately 1 liter (1 quart) in 15 seconds, repair or install pump and or converter.

For the installation of new transmission fluid cooler or tubes, refer to Section 307-02 .

Diagnosis By Symptom

Special Tool(s)

 ST1565-A	Transmission Fluid Pressure Gauge 307-004 (T57L-77820-A)
 ST1392-A	Air Test Plate, Transmission 307-246 (T92P-7006-A)
 ST1391-A	Breakout Box, EEC-V Control System 418-049 (T94L-50-EEC-V) or equivalent
 ST1632-A	MLP-TR Cable 418-F107 (007-00111) or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052 or equivalent scan tool
 ST1389-A	Transmission Tester 307-F016 (007-00130) or equivalent
	Trans Tester TR/MLP Overlay and Manual 007-00131 or equivalent
	73 III Automotive Meter

 ST1137-A	105-R0057 or equivalent
 ST1300-A	UV Leak Detector Kit 164-R0756 or equivalent

The Diagnosis by Symptom charts give the technician diagnostic information, direction, and suggest possible components, using a symptom as a starting point.

The Diagnosis by Symptom charts are divided into two categories: Electrical Routines, indicated by 200 series numbers, and Hydraulic/Mechanical Routines, indicated by 300 series numbers. The Electrical Routines list the possible electrical components that could cause or contribute to the symptom described. The Hydraulic/Mechanical Routines list the possible hydraulic or mechanical components that could cause or contribute to the symptom described.

Diagnosis by Symptom Chart Directions

1. Using the Diagnosis by Symptom Index, select the Concern/Symptom that best describes the condition.

2. Refer to the routine indicated in the Diagnosis by Symptom Index.

3. Always begin diagnosis of a symptom with:

a. preliminary inspections.
b. verifications of condition.
c. checking the fluid levels.
d. carrying out other test procedures as directed.

4. **NOTE:** Not all concerns and conditions with electrical components will set a diagnostic trouble code (DTC). Be aware that the components listed may still be the cause. Verify correct function of these components prior to proceeding to the Hydraulic/Mechanical Routine listed.

   Begin with the Electrical Routine, if indicated. Follow the reference or action required statements. Always carry out the on-board diagnostic tests as required. Never skip steps. Repair as required. If the concern is still present after electrical diagnosis, then proceed to the Hydraulic/Mechanical Routine listed.

5. The Hydraulic/Mechanical Routines list possible hydraulic or mechanical components that could cause the concern. These components are listed in the removal sequence and by most probable cause. All components listed must be inspected to ensure correct repair.

Diagnosis by Symptom Index

Title	Routines	
	Electrical [a]	Hydraulic/ Mechanical

Engagement Concerns		
No Forward	201	301
No REVERSE	202	302
Harsh REVERSE	203	303
Harsh Forward	204	304
Delayed/Soft Reverse	205	305
Delayed/Soft Forward	206	306
Shift Concerns		
Some/All Shifts Missing	210	310
Timing Concerns		
—Early/Late	211	311
—Erratic/Hunting	212	312
Feel		
—Soft/Slipping	213	313
—Harsh	214	314
No 1st Gear, Engages in Higher Gear	215	315
No Manual 1st Gear	216	316
No Manual 2nd Gear	217	317
Torque Converter Operation Concerns		
No Apply	240	340
Always Applied/Stalls Vehicle	241	341
Cycling/Shudder/Chatter	242	342
Other Concerns		
No Engine Braking in 2nd Gear, Manual 2nd or Manual 1st Position	250	350
Gearshift Lever Efforts High	251	351
External Leaks	252	352
Vehicle Driveability Concerns	253	353
Noise/Vibration in Forward or Reverse	254	354
Engine Will Not Crank	255	355
No PARK (P) Range	256	356
Overheating	257	357

[a] Carry out electrical routine first.

Diagnostic Routines

Engagement Concern: No Forward

Possible Component	Reference/Action
201 — ELECTRICAL ROUTINE	
· No Electrical Concerns	
301 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect as under Fluid Condition Check; refer to Verification of

	Condition.
Shift Linkage	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify the digital transmission range (TR) sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· Low forward clutch pressure, low line pressure	· Check pressure at line and forward clutch tap. Refer to Line Pressure Chart for specification. If pressures are low, check the following components: oil filter and seal assembly, main controls, pump assembly, forward clutch assembly.
Fluid Filter and Seal Assembly	
· Plugged, damaged	· Install a new filter and seal assembly.
· Filter seal damaged	
Main Controls	
· 3-4 shift valve, main regulator valve, manual valve — stuck, damaged	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Gaskets damaged	· Inspect gaskets for damage and install a new gasket.
· 2-3 accumulator and seals damaged	· Inspect piston, seals and bore for damage. Repair as required.
· Pressure regulator valve	· Inspect the diameter for wear.
Pump Assembly	
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Porosity/cross leaks/ball missing or leaking, plugged hole	· Inspect for porosity and leaks. Repair as required.
· No. 3 and No. 4 seal rings damaged	· Inspect seals for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Forward Clutch Assembly	
· Seals, piston damaged	· Inspect seals for damage. Repair as required.
· Check balls damaged, missing, mislocated, not seating correctly	· Inspect for mislocation, poor seating, damage. Install a new cylinder as required.
· Friction elements damaged or worn	· Check for abnormal wear, damage. Repair as required.
One-Way Clutch Assembly (Planetary)	
· Worn, damaged or assembled incorrectly	· Inspect for damage. Repair as required.
Output Shaft	

· Damaged	· Inspect for damage. Install new components as required.

Engagement Concern: No Reverse

Possible Component	Reference/Action
202 — ELECTRICAL ROUTINE	
· No Electrical Concerns	
302 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Shift Linkage	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· Low reverse clutch pressure, low reverse band pressure, low line pressure	· Check pressure at line pressure tap; refer to Line Pressure Chart for specifications. If pressures are low, check the following components: oil filter and seal assembly, main controls, reverse servo, pump assembly, reverse clutch assembly.
Fluid Filter and Seal Assembly	
· Plugged, damaged	· Install a new filter and seal assembly.
Main Controls	
· No. 6 shuttle ball, manual valve, main regulator valve, 1-2 accumulator seals stuck or damaged	· Inspect for damage. Repair as required.
· Loose bolts	· Tighten bolts to specifications.
· Gasket damaged	· Inspect for damage and install a new gasket.
Low/Reverse Servo	
· Seals (piston and cover) damaged	· Inspect for damage. Repair as required.
· Servo cover retaining ring damaged	
· Anchor pins (case) damaged	
Pump Assembly	
· Loose bolts	· Tighten bolts to specifications.
· Porosity/cross leaks/ball missing or leaking, plugged hole	· Inspect pump assembly. Install new as required.
· Gasket damaged	· Inspect for damage and install a new gasket.
· No. 1 and 2 seal rings damaged	· Inspect for damage. Repair as required.
Reverse Clutch Assembly	

· Seals, piston damaged	· Inspect for damage. Repair as required.
· Check ball missing or damaged	
· Friction elements damaged or worn	
Low/Reverse Band	· Inspect for damage. Repair as required.
· Band, servo, anchor pins damaged or worn	

Engagement Concern: Harsh Reverse

Possible Component	Reference/Action
203 — ELECTRICAL ROUTINE	
Powertrain Control System	· Carry out Self-Test; refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Carry out engagement test, EPC test and Go To Pinpoint Test B or Go To Pinpoint Test D . Check idle speed. Repair as required. Clear DTCs, road test and repeat Self-Test.
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, TFT sensor, EPC solenoid	
303 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Engine Driveline	· Repair as required.
· Looseness in the driveshaft, U-joints or the engine mounts	
Shift Linkage	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
· Damaged or incorrectly adjusted	
Incorrect Pressures	· Check pressure at line and EPC pressure taps; refer to Line Pressure Chart for specifications. If high, check the following components: main controls, oil filter and seal assembly.
· High line pressure, high EPC pressure	
Fluid Filter and Seal Assembly	
· Plugged or damaged	· Install a new filter and seal assembly.
· Filter seal damaged	
Main Controls	
· No. 6 shuttle ball, No. 5 check ball, manual valve, main regulator valve stuck, damaged or missing	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.

· Gasket damaged	· Inspect for damage and install a new gasket.
· EPC solenoid stuck or damaged	· Inspect for damage, contamination. Carry out EPC test in Routine No. 203. Repair as required.
Low Reverse Servo	
· Seals (piston and cover) damaged	· Inspect for damage. Repair as required.
· Servo cover retaining ring assembled incorrectly	
· Anchor pins (case) damaged	
Pump Assembly	
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Porosity/cross leaks	· Inspect pump assembly. Install new as required.
· Gasket damaged	· Inspect for damage and install a new gasket.
· No. 1 and No. 2 seal rings damaged	· Inspect for damage. Repair as required.
Reverse Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as required.
· Check ball missing or damaged	
· Friction elements damaged, worn	
· Return spring piston damaged, worn	
Low Reverse Band	
· Band, servo, anchor pin damaged or worn	· Inspect for damage. Repair as required.

Engagement Concern: Harsh Forward

Possible Component	Reference/Action
204 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, TFT sensor, EPC solenoid	· Carry out Self-Test; refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Carry out engagement test and EPC test. Go To Pinpoint Test B or Go To Pinpoint Test D . Check idle speed. Repair as required. Clear DTCs, road test and repeat Self-Test.
304 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Engine Driveline	
· Looseness in the driveshaft, U-joints or	· Repair as required.

the engine mounts	
Incorrect Pressures	
· High forward clutch pressure, high line pressure, high EPC pressure	· Check pressure at line, EPC and forward pressure taps. Refer to Line Pressure Chart for specifications. If pressures are high, check the following possible components: main controls, pump assembly.
Main Controls	
· Main regulator valve stuck, damaged	· Inspect and repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Gaskets damaged	· Inspect for damage and install a new gasket.
· EPC solenoid stuck or damaged	· Inspect for damage or contamination. Carry out EPC test in Routine 204. Repair as required.
Case	
· 2-3 accumulator seal/retainer stuck, damaged	· Inspect for damage. Repair as required.
Pump Assembly	
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Porosity/cross leaks	· Inspect for porosity/leaks. Install a new pump as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Forward Clutch Assembly	
· Check balls missing or damaged	· Inspect for mislocation, poor seating, damage. Install a new forward clutch cylinder.
· Friction element damaged or worn	· Inspect for damage. Repair as required.
· Forward clutch wave spring damaged	· Inspect for damage. Repair as required.
· Forward clutch return spring damaged	· Inspect for damage. Repair as required.

Engagement Concern: Delayed/Soft Reverse

Possible Component	Reference/Action
205 — ELECTRICAL ROUTINE	
	· No Electrical Concerns
305 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Shift Linkage	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor

	as necessary.
Incorrect Pressures	
· Low reverse clutch pressure, low reverse band pressure, low line pressure	· Check pressure at line tap; refer to Line Pressure Chart for specifications. If pressures are low, check the following components: main controls, pump assembly, reverse clutch assembly, reverse servo.
Fluid Filter and Seal Assembly	
· Plugged, damaged	· Install a new filter and seal assembly.
	· Filter seal damaged
Main Controls	
· No. 6 shuttle ball, manual valve, main regulator valve stuck or damaged	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Case	
· 1-2 accumulator seals stuck or damaged	· Inspect for damage. Repair as required.
Low Reverse Servo	
· Seals (piston and cover) damaged	· Inspect for damage. Repair as required.
· Servo cover retaining ring assembled incorrectly	
Pump Assembly	
· Bolts not tightened to specification	· Tighten bolts to specification.
· Porosity/cross leaks/ball missing or leaking	· Inspect pump assembly. Install new as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
· No. 1 and No. 2 seal rings damaged	· Inspect for damage. Repair as required.
Reverse Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Install new components as required.
· Check ball missing or damaged	
· Friction elements damaged, worn	
· Return spring and piston damaged, worn	
Low Reverse Band	
· Damaged, worn	· Inspect for damage. Repair as required.

Engagement Concern: Delayed/Soft Forward

Possible Component	Reference/Action
206 — ELECTRICAL ROUTINE	
	· No Electrical Concerns
306 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Shift Linkage	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· Low forward clutch pressure, low line pressure, low EPC pressure	· Check pressure at line, forward clutch and EPC taps; refer to Line Pressure Chart for specifications. If pressures are low, check the following components: oil filter and seal assembly, main controls and pump assembly.
Fluid Filter and Seal Assembly	
· Plugged, damaged	· Install a new filter and seal assembly.
· Filter seal damaged	
Main Controls	
· 3-4 shift valve, main regulator valve stuck or damaged	· Inspect and repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Gaskets damaged	· Inspect for damage and repair as required.
Case	
· 2-3 or 1-2 accumulator, bore damaged or stuck	· Inspect for damage. Repair as required.
Pump Assembly	
· Bolts not tightened to specification	· Tighten bolts to specifications.
· Porosity/cross leaks	· Inspect pump assembly. Repair as required.
· Gaskets damaged	· Inspect for damage. Repair as required.
· No. 3 and No. 4 seal rings damaged	· Inspect for damage. Repair as required.
Forward Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as required.
· Check balls missing, damaged	· Inspect for mislocation, poor seating, damage. Install a new cylinder as required.
· Friction elements damaged, worn	· Check for damage. Repair as required.

Shift Concerns: Some/All Shifts Missing

Possible Component	Reference/Action
210 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, output shaft speed (OSS) sensor, digital TR sensor	· Carry out Self-Test; refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A , Go To Pinpoint Test C or Go To Pinpoint Test E . Repair as required. Clear DTCs, road test and repeat Self-Test.
310 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Shift Linkage, Digital TR Sensor	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
	· Refer to the following shift routine(s) for further diagnosis: ■ Shift 1-2, Routine 220/320 ■ Shift 2-3, Routine 221/321 ■ Shift 3-4, Routine 222/322 ■ Shift 4-3, Routine 223/323 ■ Shift 3-2, Routine 224/324 ■ Shift 2-1, Routine 225/325

Shift Concerns: Timing Concerns — Early/Late

Possible Component	Reference/Action
211 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, EPC solenoid, TFT sensor, OSS	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A , Go To Pinpoint Test C or Go To Pinpoint Test E . Repair as required. Clear DTCs, road test and repeat Self-Test.
311 — HYDRAULIC/MECHANICAL ROUTINE	
Other	
· Tire size change, axle ratio change	· Verify vehicle has original equipment. Refer to Certification Label and Safety Standard Certification Label. Changes in tire size or axle ratio will affect shift timing.
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Powertrain Control System	
· Engine driveability concerns	· Refer to Routine 253.

Incorrect Pressures	
· Line pressure, EPC pressure	· Check pressure at line and EPC taps; refer to Line Pressure Chart for specifications. If not OK, check the main controls. If OK, refer to the shift routine(s) for further diagnosis: ■ Shift 1-2, Routine 320 ■ Shift 2-3, Routine 321 ■ Shift 3-4, Routine 322 ■ Shift 4-3, Routine 323 ■ Shift 3-2, Routine 324 ■ Shift 2-1, Routine 325
Main Controls	
· EPC solenoid, stuck or damaged hydraulically or mechanically	· Inspect for damage, contamination. Carry out EPC tests in Routine No. 211. Repair as required.
· Valves, accumulators, seals stuck or damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
· Solenoid screen blocked or damaged	· Clean or install a new screen.

Shift Concerns: Timing Concerns — Erratic/Hunting

Possible Component	Reference/Action
212 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, torque converter clutch (TCC) solenoid, digital TR sensor, output shaft speed (OSS)	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Go To Pinpoint Test A , Go To Pinpoint Test C or Go To Pinpoint Test E . Repair as required. Clear DTCs, road test and repeat Self-Test.
· Poor engine performance	· Refer to Routine 253.
312 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Main Controls	
· Valves, accumulators, seals, assembled wrong, stuck or damaged	· Inspect for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
· Solenoid screen blocked or damaged	· Clean or install a new screen.
Torque Converter Clutch	
· Torque converter	· Refer to Torque Converter Operation Concerns: Cycling/Shudder/Chatter Hydraulic/Mechanical Routine 342.
Specific Shifts	
	· Refer to the following shift routine(s) for further diagnosis:

	■ Shift 1-2, Routine 320 ■ Shift 2-3, Routine 321 ■ Shift 3-4, Routine 322 ■ Shift 4-3, Routine 323 ■ Shift 3-2, Routine 324 ■ Shift 2-1, Routine 325

Shift Concerns: Feel — Soft/Slipping

Possible Component	Reference/Action
213 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, EPC solenoid, OSS	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test D or Go To Pinpoint Test E . Repair as required. Clear DTCs, road test and repeat Self-Test.
· Engine driveability concerns	· Refer to Routine 253.
313 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Incorrect Pressures	
· Low line pressure, low EPC pressure	· Check pressures at line and EPC taps; refer to Line Pressure Chart for specifications. If pressures are low or all shifts are soft/slipping, go to main controls. If pressures are OK and a specific shift is soft/slipping, refer to the following routine(s) for further diagnosis: ■ Shift 1-2, Routine 320 ■ Shift 2-3, Routine 321 ■ Shift 3-4, Routine 322 ■ Shift 4-3, Routine 323 ■ Shift 3-2, Routine 324 ■ Shift 2-1, Routine 325
Main Controls	
· Main regulator valve, overdrive servo regulator valve stuck, damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· EPC solenoid stuck or damaged	· Inspect for damage and contamination. Carry out EPC tests in Routine 213. Repair as required.
Case	
· 1-2 accumulator stuck or damaged	· Inspect for damage. Repair as required.
Filter and Seal Assembly	
· Filter plugged, damaged	· Inspect for damage. Install a new filter as required.
· Seal damaged or cut	· Inspect for damage. Replace as required.

Shift Concerns: Feel — Harsh

Possible Component	Reference/Action
214 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, EPC solenoid, OSS	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test D or Go To Pinpoint Test E . Repair as required. Clear DTCs, road test and repeat Self-Test.
· Engine driveability concerns	· Refer to Routine 253.
314 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Incorrect Pressures	
· High line pressure, high EPC pressure	· Check pressures at line and EPC taps. See the to Line Pressure Chart for specifications. If pressures are high or all shifts are harsh, go to Main Controls. If pressures are OK and a specific shift is harsh, refer to the following shift routine(s) for further diagnosis: ■ Shift 1-2, Routine 320 ■ Shift 2-3, Routine 321 ■ Shift 3-4, Routine 322 ■ Shift 4-3, Routine 323 ■ Shift 3-2, Routine 324 ■ Shift 2-1, Routine 325
Main Controls	
· Main regulator valve, overdrive servo regulator valve stuck, damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· EPC solenoid stuck or damaged	· Inspect for damage or contamination. Carry out EPC tests in Routine 214. Repair as required.

Shift Concerns: No 1st Gear, Engages In Higher Gear

Possible Component	Reference/Action
215 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, digital transmission range TR sensor	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A or Go To Pinpoint Test C . Repair as required. Clear DTCs, road test and repeat Self-Test.
315 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Digital TR Sensor	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment. Refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted.

	Adjust the digital TR sensor as necessary.
Incorrect Pressures	
・Low reverse clutch pressure, low reverse band pressure, low line pressure ● Forward Off, Intermediate Off, Direct X ● Forward Off, Intermediate X, Direct Off ● Forward Off, Intermediate X, Direct X ● Forward X, Intermediate Off, Direct X ● Forward X, Intermediate X, Direct Off ● Forward X, Intermediate X, Direct X ● Forward X, Intermediate Off, Direct Off	・Check for which pressures are on and refer to Band/Clutch Application Chart 601 and corresponding routines. ■ 324, 301 ■ 325, 301 ■ 323, 324, 325, 301 ■ 324 ■ 325 ■ 323, 324, 325 ■ Refer to appropriate mechanical diagnosis.
Mechanical	
・Bands, clutches or seals damaged or worn	・Refer to Transmission Disassembly and Assembly.

X = pressure applied

Shift Concerns: No Manual 1st Gear

Possible Component	Reference/Action
216 — ELECTRICAL ROUTINE	
Powertrain Control System	
・Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, digital TR sensor	・Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A or Go To Pinpoint Test C . Repair as required. Clear DTCs, road test and repeat Self-Test.
316 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Cable, Digital TR Sensor	
・Damaged or incorrectly adjusted	・Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
・Low reverse clutch pressure, low reverse band pressure, low line pressure, low EPC pressure	・Check pressure at line and EPC pressure taps; refer to Line Pressure Chart for specifications. If pressures are low, check the following components: oil filter and seal assembly, main controls, reverse clutch assembly and reverse servo assembly.
Fluid Filter and Seal Assembly	
・Plugged or damaged	・Install a new filter and seal assembly.

Main Controls	
· No. 6 shuttle ball, manual valve, main regulator valve, low servo modulator valve stuck, damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Low Reverse Servo	
· Seals (piston and cover) damaged	· Inspect for damage. Repair as required.
	· Servo cover retaining ring assembled incorrectly.
	· Anchor pins (case) damaged.

Shift Concerns: No Manual 2nd Gear

Possible Component	Reference/Action
217 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, digital TR sensor	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A or Go To Pinpoint Test C . Repair as required. Clear DTCs, road test and repeat Self-Test.
317 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Cable, Digital TR Sensor	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Main Controls	
· 3-4 shift valve, 1-2 and 2-3 shift valve, 3-4 capacity modulator valve stuck, damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Gaskets damaged	· Inspect for damage and install a new gasket.

Shift Concerns: 1-2 Shift (Automatic)

Possible Component	Reference/Action
220 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs,	· Carry out Self-Test. Refer to the Powertrain Control/Emissions

vehicle wiring harnesses, PCM, shift solenoids, OSS	Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A or Go To Pinpoint Test E . Repair as required. Clear DTCs, road test and repeat Self-Test.
· Poor engine performance	· Refer to Routine 253.
320 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Digital TR Sensor	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· Intermediate clutch pressure, line pressure	· Check pressure at line and intermediate clutch taps; see the line pressure chart for specifications. If not OK, check the main controls.
Main Controls	
· 1-2 shift valve, stuck or damaged	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specification.
· Shift solenoid SSA malfunction	· Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as required.
· Gasket damaged	· Inspect for damage and install a new gasket.
· No. 8 ball not seating	· Inspect for damage. Repair as required.
Case	
· 1-2 accumulator stuck or damaged	· Inspect for damage. Repair as required.
Pump	
· Porosity/cross leaks, balls missing, damaged or leaking	· Inspect for porosity/leaks, balls missing. Install a new pump as required.
· Gasket damaged	· Inspect for damage and install a new gasket.
Intermediate Clutch Assembly	
· Seals damaged	· Inspect for damage. Repair as required.
· Piston damaged	· Inspect for damage. Repair as required.
· Friction elements damaged or worn	· Inspect for damage. Repair as required.
Intermediate One-Way Clutch Assembly	
· Not holding or damaged	· Inspect for damage. Repair as required.
Planetary One-Way Clutch Assembly	
· Not overrunning or damaged	· Inspect for damage. Repair as required.
1-2 Accumulator	
· Damaged accumulator	· Inspect for damage. Repair as required.

piston	
· Springs damaged or broken	· Inspect for damage. Repair as required.
· Case bore scored	· Inspect for damage. Repair as required.

Shift Concerns: 2-3 Shift (Automatic)

Possible Component	Reference/Action
221 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, OSS	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A or Go To Pinpoint Test E . Repair as required. Clear DTCs, road test and repeat Self-Test.
· Engine driveability concerns	· Refer to Routine 253.
321 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment. Refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· Direct clutch pressure	· Check pressure at direct clutch tap; refer to Line Pressure Chart for specifications. If not OK, check the main controls.
Main Controls	
· 2-3 shift valve, check ball No. 9 or No. 3, solenoid pressure regulator valve, damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Shift solenoid SSB malfunction	· Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
· Output shaft seals damaged or cup plug leaking or missing	· Inspect for damage and repair as required.
· 2-3 accumulator damaged or stuck	· Inspect piston seal and bore for damage. Repair as required.
· Solenoid screen (in main control) blocked or damaged	· Clean or install a new screen.
Intermediate One-Way Clutch Assembly	
· Not overrunning or damaged	· Inspect for damage. Repair as required.
Output Shaft	
· Seal rings damaged	· Inspect for damage. Repair as required.
· Cup plug damaged or missing	

Direct Clutch Assembly	
· Seals or piston damaged	· Inspect for damage. Repair as required.
· Friction elements worn or damaged	· Inspect for damage. Repair as required.
· Check ball not seating	· Inspect for damage. Repair as required.
· Return spring assembly damaged	· Inspect for damage. Repair as required.
Case	
· Output shaft rear seals leaking or damaged	· Inspect for damage. Repair as required. Inspect case for damaged seal area. If damaged, install a new case.
2-3 Accumulator	
· Damaged accumulator piston	· Inspect for damage. Repair as required.
· Springs damaged or broken	· Inspect for damage. Repair as required.
· Case bore scored	· Inspect for damage. Repair as required.

Shift Concerns: 3-4 Shift (Automatic)

Possible Component	Reference/Action
222 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, OSS, transmission control switch (TCS)	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A or Go To Pinpoint Test E . Repair as required. Clear DTCs, road test and repeat Self-Test.
· Engine driveability concerns	· Refer to Routine 253.
322 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Digital TR Sensor	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· Forward clutch pressure, direct clutch pressure, line pressure	· Check line, direct and forward clutch pressures at appropriate taps; refer to Line Pressure Chart for specifications. If pressures are out of specification, check main controls.
Main Controls	
· 3-4 shift valve, solenoid pressure regulator valve, OD servo regulator, 3-4 capacity modulator valve, 1-2 and 2-3 shift valves stuck, damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· SSA or SSB malfunction	· Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as

	required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
· OD servo rod and piston cushion spring or seals damaged	· Inspect for damage. Repair as required.
· Worn or damaged OD servo anchor pins	· Inspect for damage. Repair as required.
· No. 2, No. 4, No. 7 and No. 9 check balls damaged or missing	· Inspect for damage. Repair as required.
· Solenoid screen blocked or damaged	· Clean or install a new screen.
Pump	
· Porosity/cross leaks, balls missing, damaged or leaking	· Inspect for porosity/leaks, balls missing. Install a new pump as required.
· Gaskets damaged	· Inspect for damage. Install new gaskets as required.
OD Band	
· OD band and reverse clutch drum assembly damaged, worn or assembled incorrectly	· Inspect for damage. Repair as required.
· Intermediate one-way clutch assembly damaged	· Inspect for damage. Repair as required.
Forward Clutch Assembly	
· Seals or piston damaged	· Inspect for damage. Repair as required.
· Friction elements worn or damaged	· Inspect for damage. Repair as required.
· Check ball stuck, damaged or not seating correctly	· Inspect for damage. Repair as required.
Input Shaft	
· Seals damaged	· Inspect for damage. Repair as required.

Shift Concerns: 4-3 Shift (Automatic)

Possible Component	Reference/Action
223 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, transmission control switch (TCS)	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A . Repair as required. Clear DTCs, road test and repeat Self-Test.
323 — HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· Forward clutch pressure, line pressure	· Check line and forward clutch at pressure taps; refer to Line Pressure Chart for specifications. If out of specification, check the main controls.
Main Controls	
· 3-4 shift valve, solenoid pressure regulator valve, OD servo regulator, 3-4 capacity modulator, 1-2 and 2-3 shift valves stuck, damaged or assembled	· Inspect for damage. Repair as required.

incorrectly	
· Check balls No. 2, No. 7, No. 9 damaged, missing or not seating correctly	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specification.
· SSA malfunction	· Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
· OD servo, seal, rod damaged	· Inspect for damage. Repair as required.
· Solenoid screen blocked or damaged	· Clean or install a new screen.
Pump	
· Porosity/cross leaks, balls missing, damaged or leaking	· Inspect for porosity/leaks, balls missing. Install a new pump as required.
· Seal rings damaged	· Inspect for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Overdrive Band	
· OD band and reverse clutch assembly damaged, worn or assembled incorrectly	· Inspect for damage. Repair as required.
· Intermediate one-way clutch assembly damaged	· Inspect for damage. Repair as required.
Forward Clutch Assembly	
· Seals or piston damaged	· Inspect for damage. Repair as required.
· Friction elements damaged, worn	· Inspect for damage. Repair as required.
· Check ball stuck, damaged or not seating correctly	· Inspect for damage. Repair as required.
· Forward clutch piston and return spring damaged	· Inspect for damage. Repair as required.
Input Shaft	
· Seals damaged	· Inspect for damage. Repair as required.

Shift Concerns: 3-2 Shift (Automatic)

Possible Component	Reference/Action
224 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A . Repair as required. Clear DTCs, road test and repeat Self-Test.
324 — HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· Direct clutch	· Check pressure at direct clutch tap; refer to Line Pressure Chart for specifications. If not within specification, check the main controls.
Main Controls	

· 2-3 shift valve stuck or damaged	· Inspect for damage. Repair as required.
· Check balls damaged or missing	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· SSB malfunction	· Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Intermediate One-Way Clutch	
· Not holding or damaged	· Inspect for damage. Repair as required.
· Intermediate one-way retaining clutch snap ring not seated	· Inspect for damage. Repair as required.
Direct Clutch Assembly	
· Seals or piston damaged	· Inspect for damage. Repair as required.
· Friction element damaged, worn	· Inspect for damage. Repair as required.
· Check ball stuck, damaged or not seating correctly	· Inspect for damage. Repair as required.

Shift Concerns: 2-1 Shift (Automatic)

Possible Component	Reference/Action
225 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A . Repair as required. Clear DTCs, road test and repeat Self-Test.
325 — HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· Intermediate clutch	· Check pressure at intermediate clutch tap; refer to Line Pressure Chart for specifications. If not within specifications, check main controls and pump.
Main Controls	
· 1-2 shift valve, 1-2 accumulator solenoid pressure regulator valve stuck, damaged or assembled wrong	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· SSA malfunction	· Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage; repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.

Pump	
· Gaskets damaged	· Inspect for damage and install a new gasket.
· Porosity/cross leaks	· Inspect for leak/porosity. Install a new pump as required.
Intermediate Clutch Assembly	
· Piston damaged	· Inspect for damage. Repair as required.
· Friction elements damaged, worn	· Inspect for damage. Repair as required.
· End clearance incorrect	· Inspect and correct; refer to Transmission Assembly.
Intermediate One-Way Clutch	
· Damaged	· Inspect for damage. Repair as required.
· Intermediate one-way clutch retaining snap ring not seated	· Inspect for damage. Repair as required.
Planetary One-Way Clutch	
· Not holding or damaged	· Inspect for damage. Repair as required.

Torque Converter Clutch Operation Concerns: No Apply

Possible Component	Reference/Action
240 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, torque converter clutch (TCC) solenoid, TFT sensor, OSS	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test B or Go To Pinpoint Test E . Repair as required. Clear codes, road test and repeat Self-Test.
340 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· Low line pressure, low EPC pressure	· Check pressure at line and EPC taps; refer to Line Pressure Chart for specifications. If pressure is low, check EPC and main regulator valve. If within specifications, check the main controls.
Main Controls	
· Solenoid pressure regulator valve, manual valve, bypass clutch control valve and plunger, converter pressure limit valve, drain back valve stuck, damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Solenoid screen blocked or damaged	· Clean or install a new screen.
· TCC solenoid malfunction	· Activate solenoid using scan tool. If solenoid operation

	cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Pump Assembly	
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Porosity/cross leaks, balls leaking	· Inspect for porosity/leaks, ball missing. Install a new pump as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Input Shaft	
· Seals damaged	· Inspect for damage. Repair as necessary.
Torque Converter Assembly	
· Leakage, friction material damaged, internal seals damaged	· Inspect torque converter. Repair or install a new or remanufactured torque converter as required.

Torque Converter Clutch Operation Concerns: Always Applied/Stalls Vehicle

Possible Component	Reference/Action
241 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, torque converter clutch (TCC) solenoid, TFT sensor	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test B or Go To Pinpoint Test A . Repair as required. Clear DTCs, road test and repeat Self-Test.
341 — HYDRAULIC/MECHANICAL ROUTINE	
Main Control	
· Drain back valve, torque converter clutch (TCC) and plunger stuck, damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· TCC solenoid malfunction	· Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as required.
· No. 7 ball incorrect seating	· Inspect for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Pump Assembly	
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Ball missing, leaking, porosity/cross leaks	· Inspect for porosity/leaks, balls missing. Install a new pump as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Input Shaft	
· Seals damaged	· Inspect for damage. Repair as required.
Torque Converter Assembly	

· No end clearance	· Inspect converter and install a new or remanufactured torque converter as required.
· Piston plate damaged or stuck to cover	· If cover is heat-stained, install a new converter and determine the cause of the overheat condition.

Torque Converter Clutch Operation Concerns: Cycling/Shudder/Chatter

Possible Component	Reference/Action
242 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, torque converter clutch (TCC) solenoid, OSS	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test E . Repair as required. Clear DTCs, road test and repeat Self-Test.
· Speed control equipped vehicles	· Evaluate with speed control off.
342 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Condition	· Inspect fluid condition. If burnt, drain fluid and converter. Install a new fluid and filter assembly. Bring vehicle to normal operating temperature. Carry out Transmission Drive Cycle Test. Carry out Transmission Self-Test. If condition still exists, continue diagnostics.
Main Controls	
· Solenoid pressure regulator valve, No. 7 check ball, bypass clutch control valve and plunger, converter pressure limit valve stuck, damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Solenoid screen blocked or damaged	· Clean or install a new screen.
· TCC solenoid malfunction	· Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Pump Assembly	
· Bolts not tightened to specification	· Tighten bolts to specification.
· Porosity/cross leaks, missing balls or leaking	· Inspect for porosity/leaks or missing balls. Install a new pump as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Input Shaft	
· Seals damaged	· Inspect for damage. Repair as required.
Torque Converter	
· Excessive end clearance	· Inspect converter. Install a new or re-manufactured torque converter as required.

Other Concerns: No Engine Braking In Manual 2nd Or Manual 1st Position

Possible Component	Reference/Action
250 — ELECTRICAL ROUTINE	
	· No Electrical Concerns
350 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Main Controls	
· 3-4 shift valve, 1-2 and 2-3 shift valve, gaskets, 3-4 capacity modulator valve, stuck or damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· OD servo assembly damaged or stuck in manual 2nd only.	· Inspect cover, piston and seal for damage. Repair as required.
· Low/Reverse servo assembly damaged or stuck in manual 1st only	· Inspect cover, piston and seal for damage. Repair as required.
Overdrive	
· Reverse band, manual 1st (only) damaged	· Inspect for damage. Repair as required.
· OD band, reverse clutch drum assembly worn or damaged (manual 2nd only)	· Inspect for damage. Repair as required.
Reverse Band (Manual 1st Only)	
· Damaged or incorrectly adjusted	· Inspect for damage. Repair as required.

Other Concerns: Shift Lever Efforts High

Possible Component	Reference/Action
251 — ELECTRICAL ROUTINE	
	· No Electrical Concerns
351 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Digital TR Sensor	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
· Brake shift interlock system, solenoid damaged	· Refer to the appropriate brake section in the workshop manual.
Manual Lever	
· Retaining pin damaged, nut loose, detent spring bent or damaged or Park	· Inspect for damage. Repair as required.

mechanism damaged	
Main Controls	
· Manual valve stuck or damaged	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.

Other Concerns: External Leaks

Possible Component	Reference/Action
252 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, sensor seals leaking (digital TR, OSS, vehicle speed sensor VSS, if equipped, or transmission connector)	· Inspect for leakage and repair as required.
352 — HYDRAULIC/MECHANICAL ROUTINE	
Case	
· Case vent, case porosity, case cracked	· Check the vent for free breathing. Check the fluid level. Check the transmission for overheat conditions. Repair as required.
Seals/Gaskets	
· Leakage at gaskets, seals, etc. (refer to external sealing illustration for potential leak locations)	· Remove all traces of lubricant on exposed surfaces of the transmission. Check the vent for free breathing. Operate the transmission at normal temperatures and perform fluid leakage check. Repair as required.
Other	
· Cooler fitting, cooler lines pressure tap, converter drain plug, band anchor pins	· Locate the source of the leak. Repair as required.

Other Concerns: Poor Vehicle Performance

Possible Component	Reference/Action
253 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, shift solenoids, digital TR sensor, torque converter clutch (TCC) solenoid, transmission fluid temperature (TFT) sensor	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A , Go To Pinpoint Test B or Go To Pinpoint Test C . Repair as required. Clear codes, road test and repeat Self-Test. Also refer to Routines 241/341 Torque Converter Operation Concern: Always Applied.
· Engine driveability concerns	· Inspect air intake/air filter system. Check the fuel system and fuel pressure. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Inspect the exhaust system for restriction. Refer to Section 309-00 .
353 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Digital TR Sensor	

· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Verify Correct Shift Scheduling and Engagements	
· See Reference/Action	· Go to the appropriate diagnostic routines.
Torque Converter Clutch Always Applied	
· See Reference/Action	· Go to Hydraulic/Mechanical Routine 241/341.
Torque Converter Clutch	
· Damaged	· Inspect torque converter. Install a new converter as outlined.

Other Concerns: Noise/Vibration — Forward Or Reverse

Possible Component	Reference/Action
254 — ELECTRICAL ROUTINE	
	· No Electrical Concerns
354 — HYDRAULIC/MECHANICAL ROUTINE	
For Noises/Vibrations That Change With Engine Speed	
· Converter components/balance weight	· Locate source of disturbance. Repair as required.
· Fluid level (low) pump cavitation	
· Pump assembly	
· Engine drive accessories	
· Cooler lines grounding out	
· Flexplate	
For Noises/Vibrations That Change With Vehicle Speed	
· Engine mounts loose or damaged	· Locate source of disturbance and repair as required.
· Driveline concerns: ■ U-joints ■ Rear axle ■ Suspension ■ Modifications 1st Gear: ■ Low one-way clutch ■ Gearset ■ Friction elements	· Refer to the following shift routine(s) for further diagnosis: ■ Shift 1-2, Routine 320 ■ Shift 2-3, Routine 321 ■ Shift 3-4, Routine 322 ■ Shift 4-3, Routine 323 ■ Shift 3-2, Routine 324 ■ Shift 2-1, Routine 325 ■ Torque Converter Cycling 242/342
· 2nd Gear: ■ Intermediate one-way clutch ■ Intermediate clutch piston bleed hole out of	

12 o'clock position ■ Friction elements	
· 3rd Gear: ■ Torque converter ■ Case to planet support spring ■ Friction elements	
· 4th Gear: ■ Gear set ■ Friction elements ■ Torque converter	
· Reverse: ■ Gear set ■ Friction elements	
· Output shaft splines worn or damaged	
Other Noises/Vibrations	
· Main controls, valve resonance	· Locate source of disturbance and repair as required.
· Shift cable: ■ Vibration ■ Grounding ■ Cooler lines ■ Grounding	

Other Concerns: Engine Will Not Crank

Possible Component	Reference/Action
255 — ELECTRICAL ROUTINE	
Powertrain Control System	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test C . Repair and adjust as required.
· Electrical inputs/outputs, vehicle wiring harnesses, engine starting system hardware, digital TR sensor	
355 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Digital TR Sensor	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
· Damaged or incorrectly adjusted	

Other Concerns: No Park (P) Range

Possible Component	Reference/Action
256 — ELECTRICAL ROUTINE	
· No Electrical Concerns	
356 — HYDRAULIC/MECHANICAL ROUTINE	

Shift Linkage, Digital TR Sensor	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Park Mechanism	
· Output shaft ring, parking brake pawl, parking pawl return spring, park rod guide cup, parking pawl shaft, parking pawl actuating rod, manual lever detent spring damaged or assembled incorrectly	· Inspect for damage or incorrect assembly and repair as required.

Other Concerns: Overheating

Possible Component	Reference/Action
257 — ELECTRICAL ROUTINE	
Refer to Routine 240/340, Torque Converter Operation Concern: No Apply	
357 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Other	
· Damaged, blocked or reversed cooler lines or restriction in the transmission oil cooler	· Inspect for damage and correct installation. Repair as required.
Vehicle Concerns Causing Engine Overheating	
	· Refer to the appropriate engine cooling section.
Main Controls	
· Drain back valve, torque clutch control valve, converter limit valve stuck, damaged or assembled incorrectly	· Inspect for damage and repair as required.
Torque Converter Clutch	
· No apply	· Refer to Routine 240/340.

Transmission Fluid Cooler — Backflushing and Cleaning

1. **CAUTION: Do not use any supplemental transmission fluid additives or cleaning agents. The use of these products could cause internal transmission components to fail; this will effect the operation of the transmission.**

   Conduct backflushing with a suitable torque converter/fluid cooler cleaner. Test your equipment to make sure that a vigorous fluid flow is present before proceeding. Install a new filter in the flush equipment if flow is weak or contaminated.

2. To aid in attaching the cleaner to the transmission steel cooler lines, connect two additional rubber hoses to the transmission end of the steel transmission cooler lines as described below.
   - Connect the cleaner tank pressure line to the steel transmission cooler return line (longest line).
   - Connect a tank return hose to the steel transmission cooler pressure line (shorter line). Place the outlet end of this hose in the solvent tank reservoir.

3. Turn on solvent pump and allow the solvent to circulate a minimum of 5 minutes (cycling switch on and off will help dislodge contaminants in cooler system).

4. Switch off the solvent pump and disconnect the solvent pressure hose from the transmission cooler return line.

5. Use compressed air to blow out the cooler(s) and lines (blow air into the transmission cooler return line) until all solvent is removed.

6. Remove the rubber return hose from the remaining steel cooler line.

Transmission Fluid Drain and Refill

Special Tool(s)

 ST2654-A	Automatic Transmission Flush and Fill Machine 211-00018 Automatic Transmission Flush and Fill Machine 199-00010 or equivalent

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM	MERCON®V

Draining

CAUTION: Always refer to the instructions supplied with the flush and fill machine.

NOTE: Draining fluid from the transmission by removing only the fluid pan is acceptable for vehicles that do not have a torque converter drain plug, for normal or severe duty fluid maintenance.

NOTE: A new procedure for draining and adding transmission fluid using a suitable transmission flush and fill machine has been added. The following procedure has different methods for draining and refilling the listed vehicles:

- All vehicles using a suitable flush and fill machine.
- Vehicles equipped with a torque converter drain plug.
- Vehicles without a torque converter drain plug.

Use the method that is applicable to your vehicle.

All vehicles using a suitable flush and fill machine

1. With the vehicle in NEUTRAL, position on a hoist. For additional information, refer to Section 100-02 .
2. Use a suitable flush and fill machine to change the fluid.
3. When connecting the flush and fill machine, connect the machine to the fluid cooler tube after the fluid cooler on the cooler return line. This will help remove any foreign material trapped in the fluid coolers.

Refill

4. Use only clean automatic transmission fluid.

5. Once the fluid exchange has been completed, disconnect the flush and fill machine. Reconnect any disconnected fluid cooler tubes.

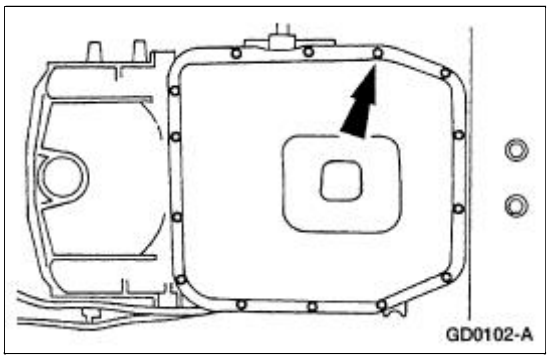
6. With the engine running and the transmission at normal operating temperature 66-77°C (150-170°F), check and adjust the transmission fluid level, and check for any leaks. If fluid is needed, add fluid in increments of 0.24-liter (0.5-pint) until the correct level is achieved (fluid should be in the cross-hatched area of the fluid level indicator).

Draining

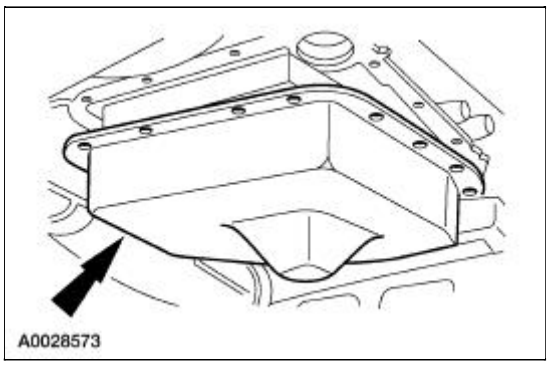
Vehicles equipped with a torque converter drain plug

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

2. Loosen the transmission fluid pan bolts and allow the fluid to drain.

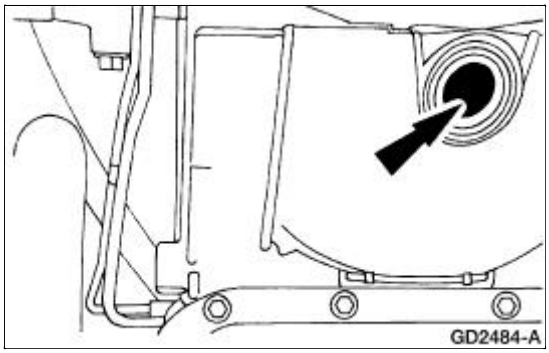


3. After the fluid has drained, remove the transmission fluid pan.

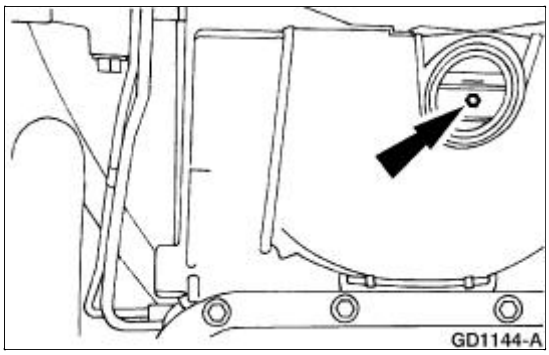


4. Do not remove the fluid filter. It is not necessary to change the fluid filter during a normal maintenance fluid change.

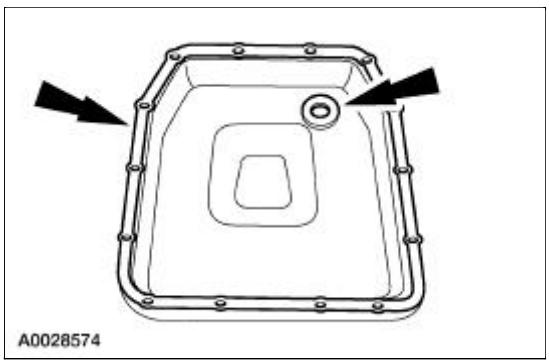
5. Remove the torque converter drain plug cover.



6. Remove the torque converter drain plug and discard.



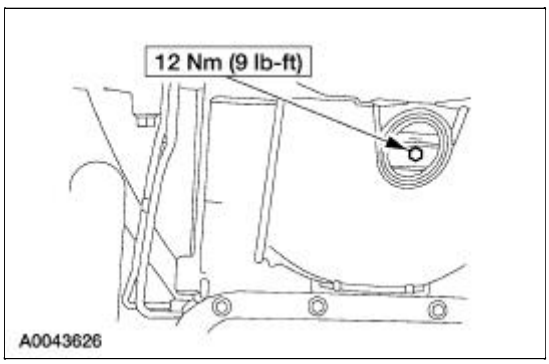
7. Clean and inspect the transmission fluid pan, transmission fluid pan gasket and magnet.



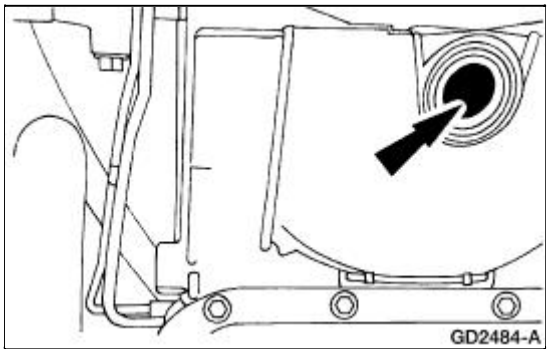
8. Thoroughly flush the cooler tubes. For additional information, refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section.

Refill

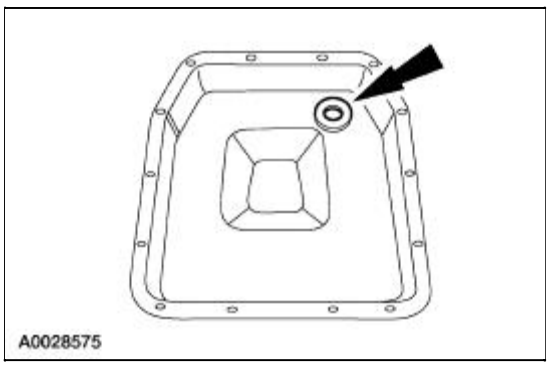
9. After the torque converter has drained, install a new drain plug.



10. Install the torque converter drain plug cover.

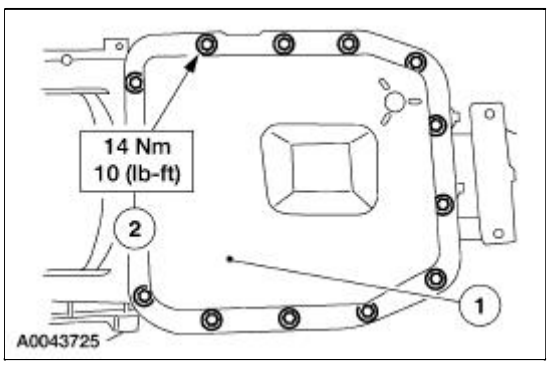


11. Position the magnet into the transmission fluid pan.



12. **NOTE:** The fluid pan gasket is reusable, clean and inspect for damage. If not damaged, the gasket should be reused.

    Install the fluid pan and gasket.
    1. Position the fluid pan with the gasket in place.
    2. Install the bolts.



13. **CAUTION: The use of any other transmission fluid than specified can result in the transmission failing to operate in a normal manner or transmission failure.**

    Fill the transmission.
    - Add 4.7 liters (5 qts) of clean automatic transmission fluid to the transmission through the fluid filler tube.

14. Start the engine. Move the transmission range selector lever through all the gear ranges, checking for engagements.

15. With the engine running and the transmission at normal operating temperature 66-77°C (150-

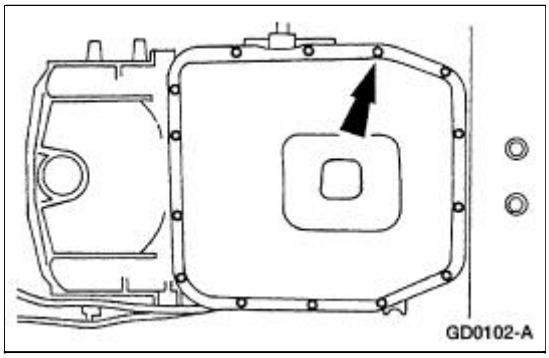
170°F), check and adjust the transmission fluid level, and check for any leaks. If fluid is needed, add fluid in increments of 0.24-liter (0.5-pint) until the correct level is achieved (fluid should be in the cross-hatched area of the fluid level indicator).

Draining

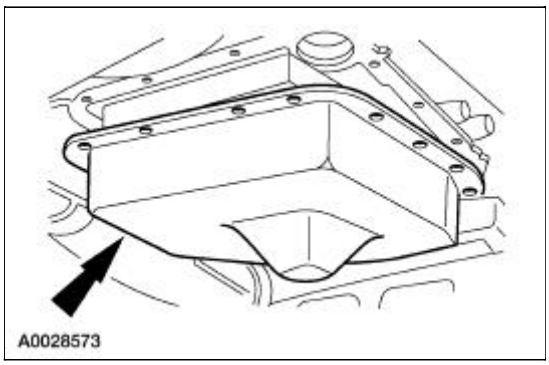
Vehicles without a torque converter drain plug

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

2. Loosen the transmission fluid pan bolts and allow the fluid to drain.

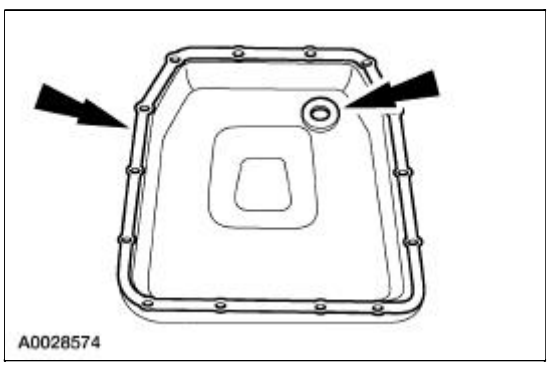


3. After the fluid has drained, remove the transmission fluid pan.



4. Do not remove the fluid filter. It is not necessary to change the fluid filter during a normal maintenance fluid change.

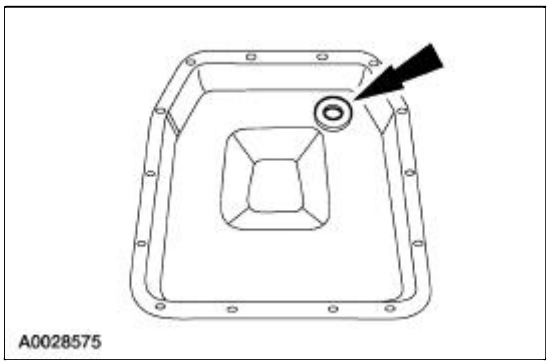
5. Clean and inspect the transmission fluid pan, transmission fluid pan gasket and magnet.



6. Thoroughly flush the cooler tubes. For additional information, refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section.

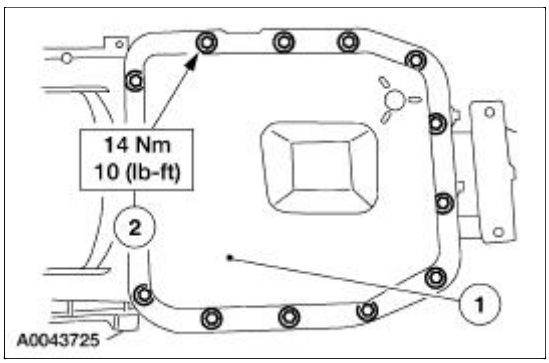
Refill

7. Position the magnet into the transmission fluid pan.



8. **NOTE:** The fluid pan gasket is reusable, clean and inspect for damage. If not damaged, the gasket should be reused.

   Install the fluid pan and gasket.
   1. Position the fluid pan with the gasket in place.
   2. Install the bolts.



9. **CAUTION: The use of any other transmission fluid than specified can result in the transmission failing to operate in a normal manner or transmission failure.**

   Fill the transmission.
   - Add 4.7 liters (5 qts) of clean automatic transmission fluid to the transmission through the fluid filler tube.

10. Start the engine. Move the transmission range selector lever through all the gear ranges, checking for engagements.

11. With the engine running and the transmission at normal operating temperature 66-77°C (150-170°F), check and adjust the transmission fluid level, and check for any leaks. If fluid is needed, add fluid in increments of 0.24-liter (0.5-pint) until the correct level is achieved (fluid should be in the cross-hatched area of the fluid level indicator).

Transmission Range (TR) Sensor Adjustment

Special Tool(s)

 ST1633-A	Alignment Gauge, TR Sensor 307-351 (T97L-70010-A)

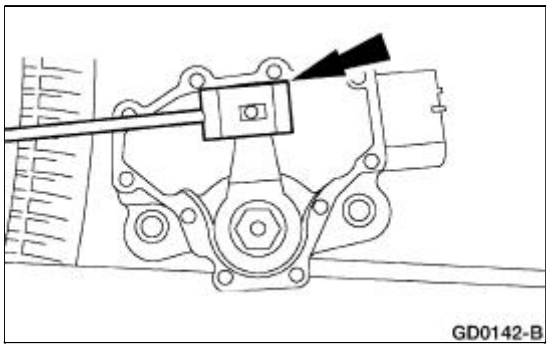
Material

Item	Specification
Threadlock 262 E2FZ-19554-B	WSK-M2G351-A6

1. Position the vehicle on a hoist. Place in NEUTRAL. For additional information, refer to Section 100-02 .

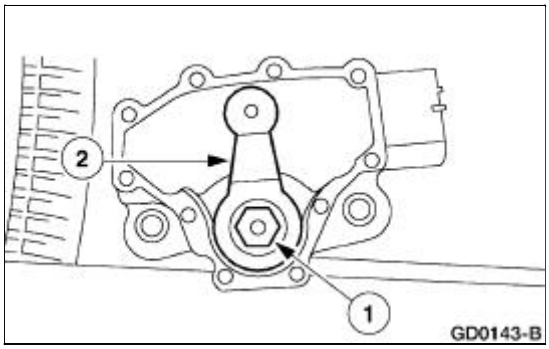
2. **CAUTION: Do not pry on the swivel tube to disconnect the transmission shift linkage.**

   Disconnect the manual lever shift control cable.

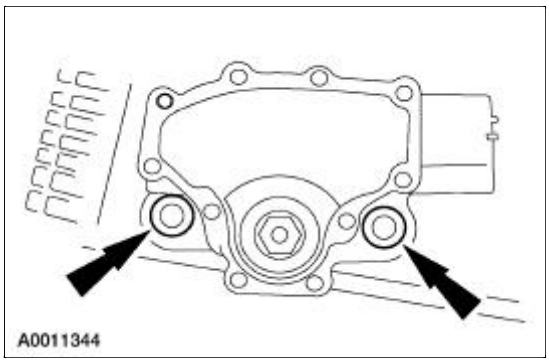
   
   GD0142-B

3. **CAUTION: Discard the outer manual control lever shaft nut. Do not reuse. The old nut will not retain the torque specification.**

   Remove the manual control lever.
   1. Remove the nut.
   2. Remove the lever.

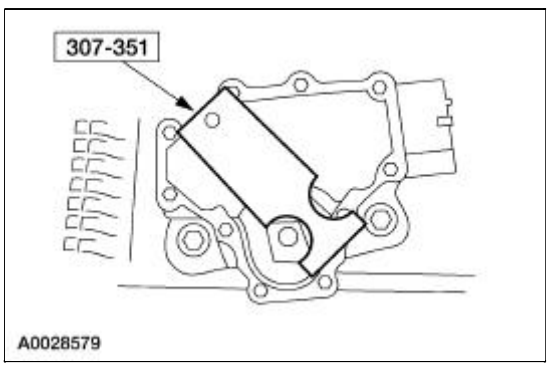


4. Loosen the digital TR sensor bolts.

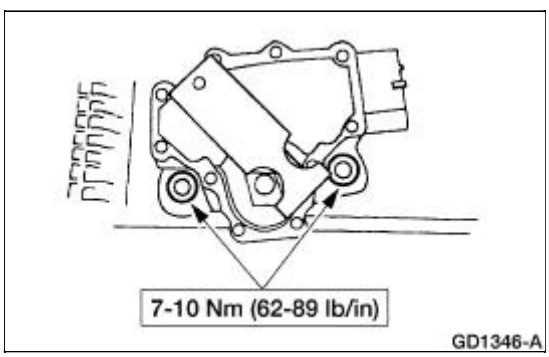


5. **NOTE:** The manual lever must be in the NEUTRAL position.

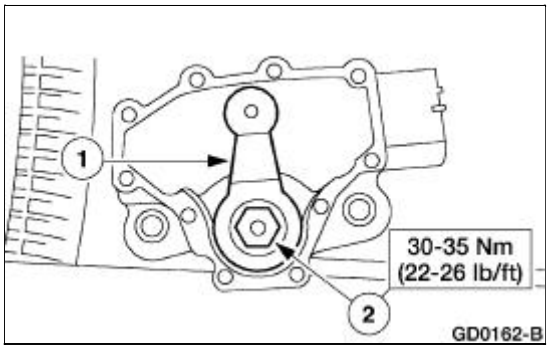
   Using the special tool, align the digital TR sensor slots. The tool is designed to fit snug.



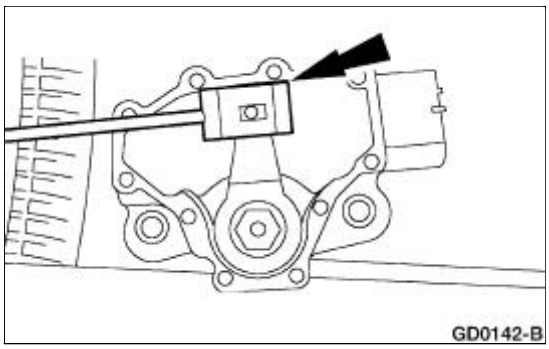
6. Tighten the digital TR sensor bolts.



7. Install the manual control lever.
   1. Position the manual control lever.
   2. Install a new manual control lever outer nut.



8. With the manual lever in overdrive connect the shift lever control cable.



9. Lower the vehicle.

Fluid Pan, Gasket and Filter

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

1. Normal maintenance requires periodic automatic transmission fluid changes. If a major repair, such as a clutch, band, bearing, etc., is required, the automatic transmission will also have to be removed for repair. At this time, the torque converter, transmission cooler and tubes must be thoroughly flushed to remove any dirt. The transmission fluid needs to be changed if evidence of fluid contamination is found. When used under continuous or severe conditions, the transmission and torque converter should be drained and refilled with fluid as specified.

2. **CAUTION: Do not use any supplemental transmission fluid additives or cleaning agents. The use of these products could cause internal transmission components to fail; this will effect the operation of the transmission.**

   CAUTION: Use of a fluid other than specified could result in transmission failure.

   Refer to the vehicle certification label affixed to the LH front door lock face panel or door pillar for the transmission code.

3. When filling a dry transmission and torque converter, refer to General Specifications chart in this section for capacity. Check the fluid level.

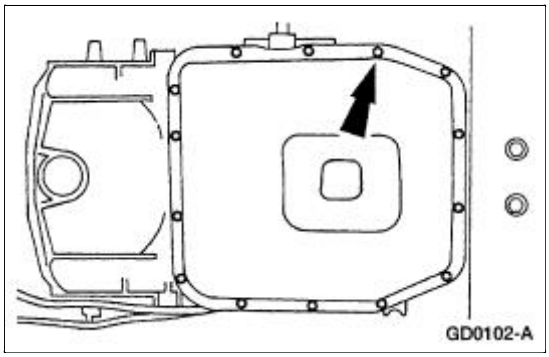
Removal

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

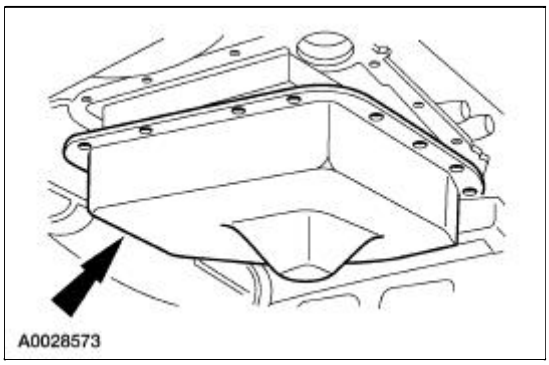
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .

3. Place a drain pan under the transmission fluid pan.

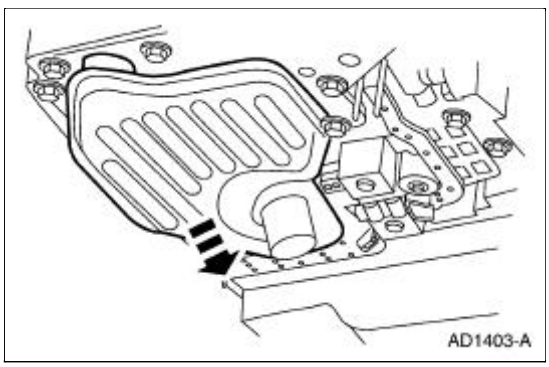
4. Drain transmission fluid.
   - Loosen the transmission fluid pan bolts and allow fluid to drain. After fluid is drained remove the bolts.



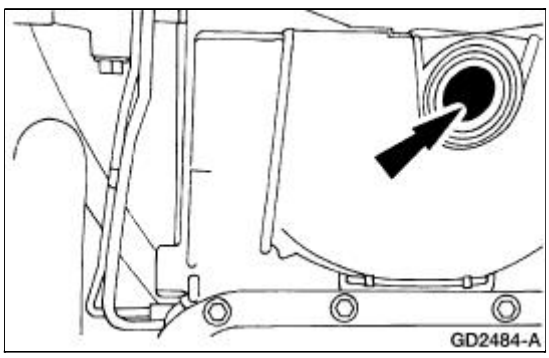
5. Remove the transmission fluid pan and transmission fluid pan gasket.



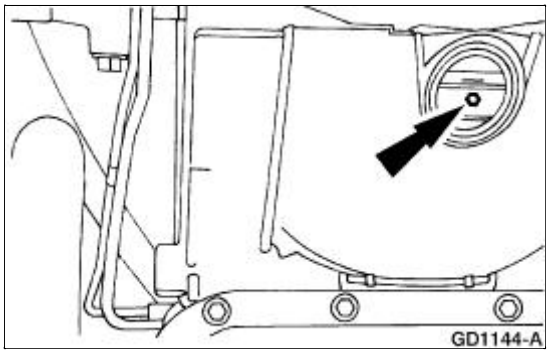
6. Pull down evenly and remove the transmission fluid filter and seal.



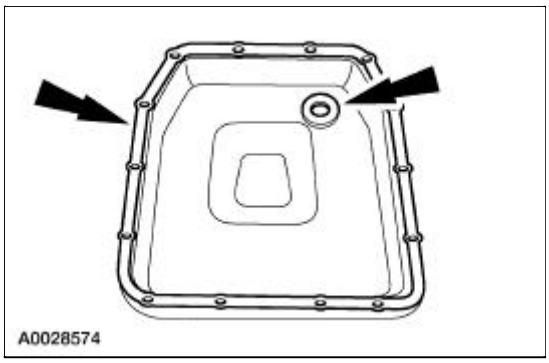
7. Remove torque converter housing plug.



8. Remove the torque converter drain plug and drain the torque converter.
    - Rotate the crankshaft to access the drain plug.



9. Clean and inspect the transmission fluid pan, gasket and magnet.

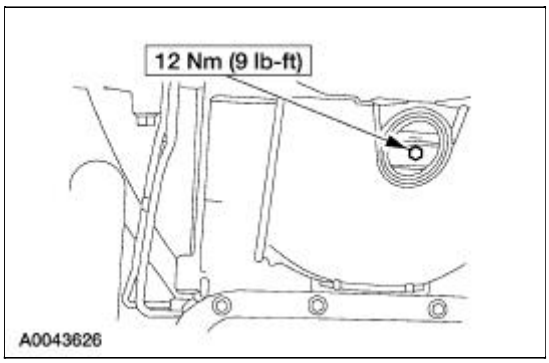


10. Flush the fluid cooler tubes. For additional information, refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section.

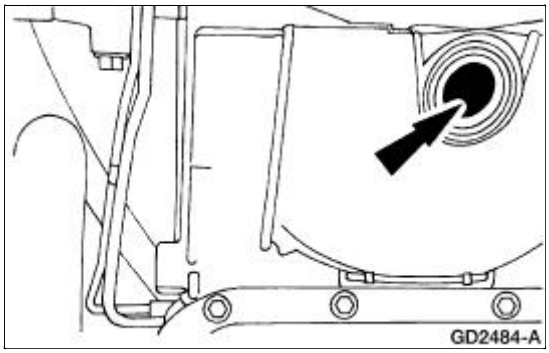
Installation

1. **NOTE:** A new torque converter drain plug must be used.

   Install the torque converter drain plug.



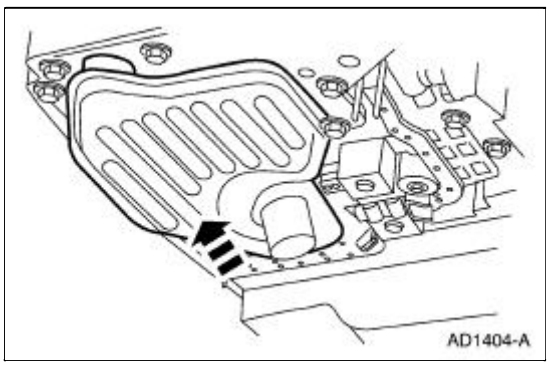
2. Install the torque converter housing plug.



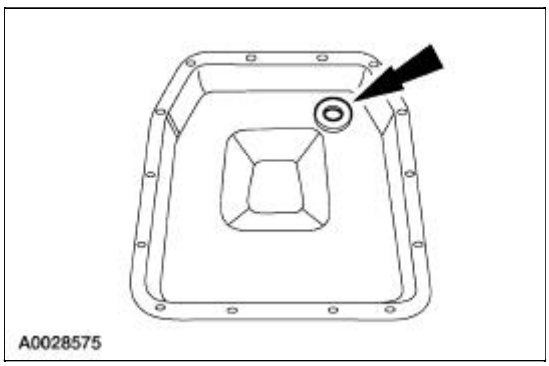
3. **CAUTION: If installing a new filter, and the seal remains in the main control bore, carefully use a small screwdriver to remove the seal. Use care not to damage the main control bore.**

   NOTE: If transmission is being repaired for a contamination-related failure, use a new filter and seal. The filter may be reused if no excessive contamination is present.

   Install a new fluid filter and seal as required.

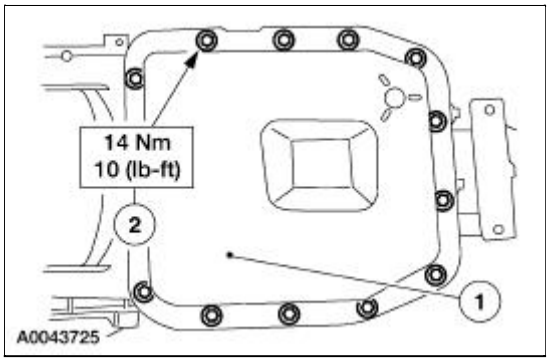


4. Position the pan magnet into the transmission fluid pan.



5. **NOTE:** The transmission fluid pan gasket is reusable. Clean and inspect for damage; if not damaged, the gasket should be reused.

   Install the transmission fluid pan and gasket.
   1. Position the transmission fluid pan and gasket.
   2. Install the transmission fluid pan bolts.



6. Lower the vehicle.

7. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn the strategy.

   Connect the battery ground cable. For additional information, refer to Section 414-01 .

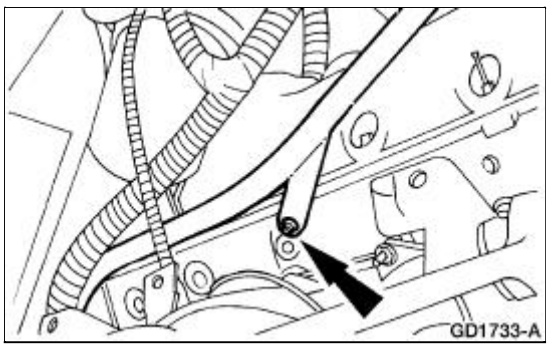
8. **NOTE:** When filling a dry transmission and converter, start with a minimum of 4.7 liters (5 quarts).

   Fill the transmission to the correct level with clean automatic transmission fluid.

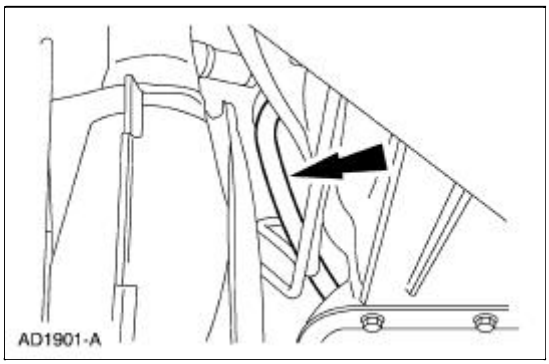
Transmission Filler Tube

Removal and Installation

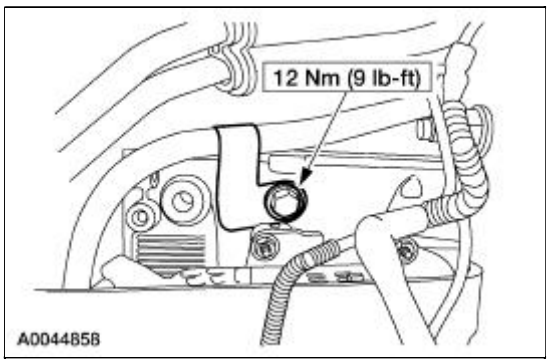
1. Remove the transmission fluid filler tube bolt from the side of the RH cylinder head.



2. Remove the fluid filler tube.



3. To install, reverse the removal procedure.



Main Control Valve Body

Special Tool(s)

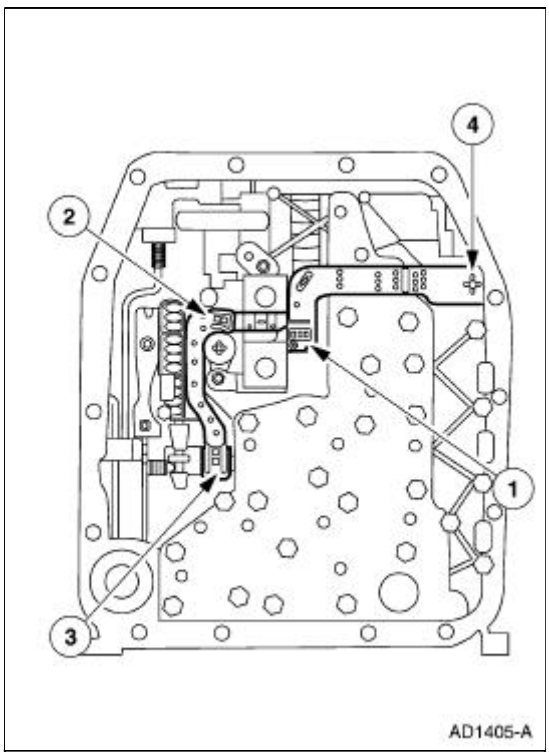
 ST2545-A	Gauge, Transmission Solenoid Connectors 307-426

Removal

1. Drain transmission fluid and remove the transmission fluid pan and filter. For additional information, refer to Fluid Pan, Gasket and Filter .

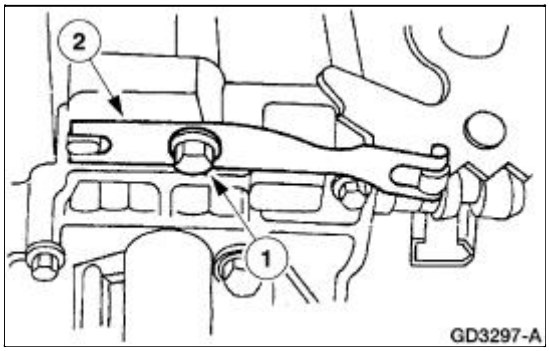
2. **CAUTION: Do not pull on the molded lead frame. This may cause damage to the connector ends. Carefully pry up on the locking tabs to disconnect the solenoids. Disconnect the molded lead frame from the solenoids.**

   Disconnect the molded lead frame from the solenoids.
   1. Disconnect the shift solenoid SSA and SSB.
   2. Disconnect the torque converter clutch (TCC).
   3. Disconnect the electronic pressure control (EPC) solenoid.
   4. Disconnect the bulkhead inter-connector.

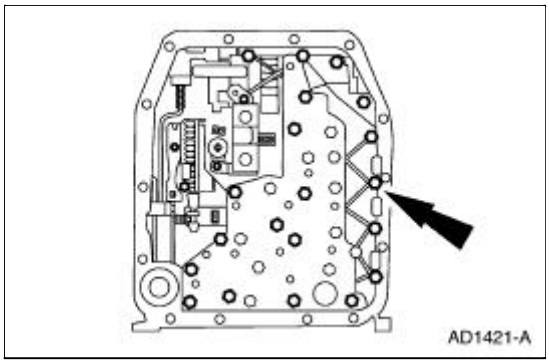


3. Remove the manual control valve detent lever spring.
   1. Remove the bolt.

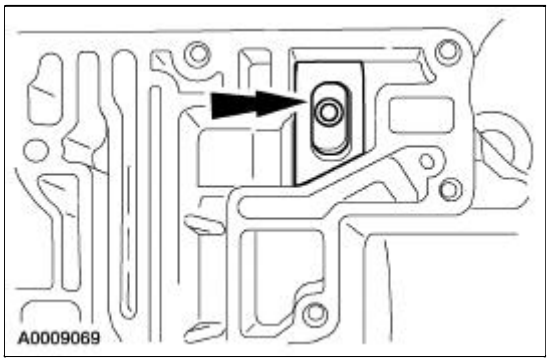
2. Remove the manual control valve detent lever spring.



4. Remove the 24 valve body-to-case bolts.



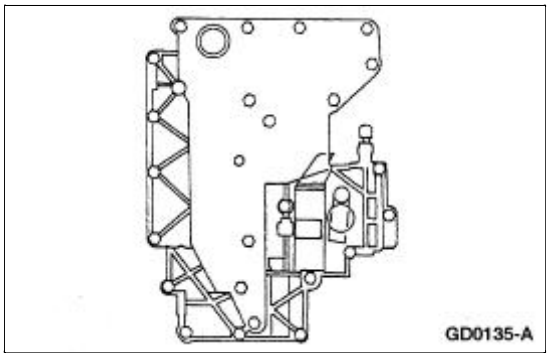
5. Remove the main control valve body and discard the pump outlet screen.



Installation

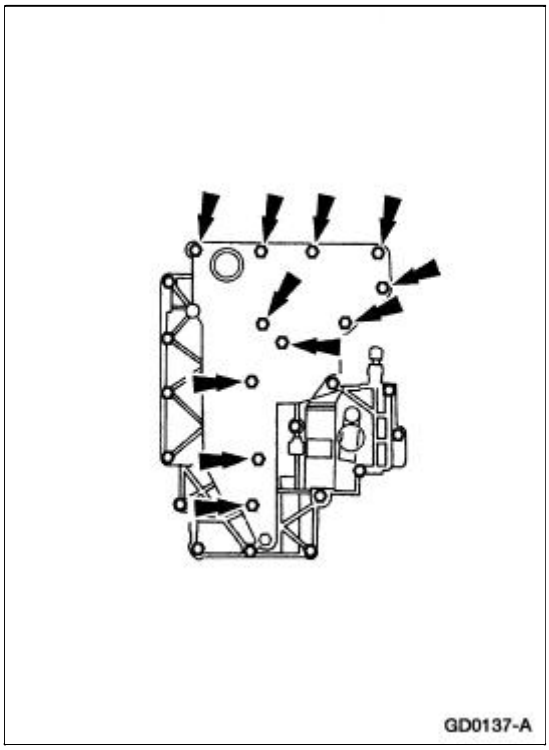
1. **NOTE:** Make sure that the drive pin of the manual valve detent lever assembly engages the manual valve in the correct location prior to installing the bolts.

   Position the main control valve body gasket and main control valve body using the two alignment bolts as a guide.



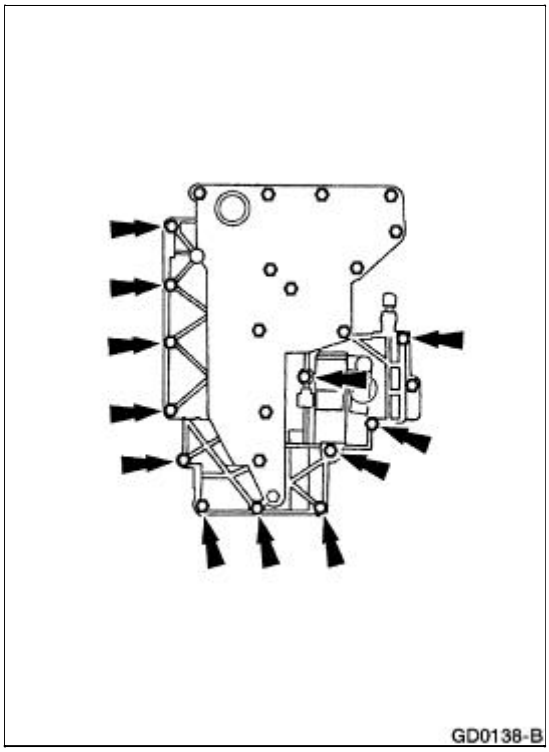
2. **NOTE:** The main control valve body bolts will be tightened in later steps.

   Loosely install the bolts.

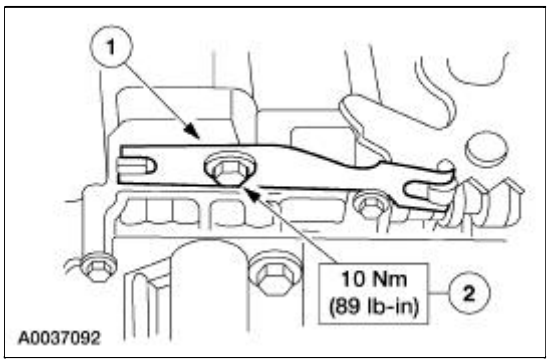


3. **NOTE:** The main control valve body bolts will be tightened in later steps.

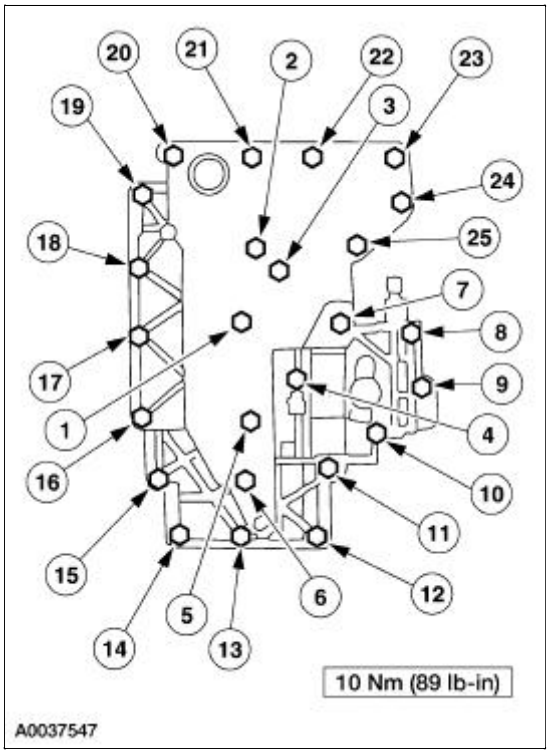
   Loosely install the bolts.



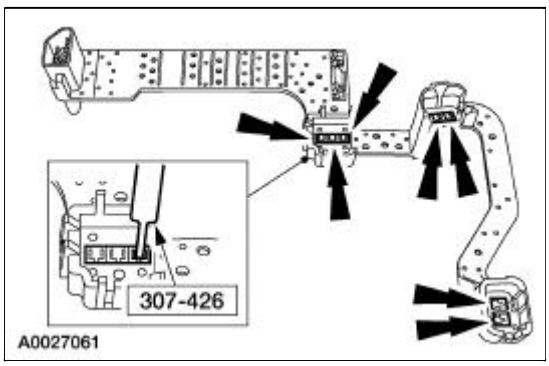
4. Install the manual control valve detent lever spring.
    1. Position the manual control valve detent lever spring.
    2. Install the bolt.



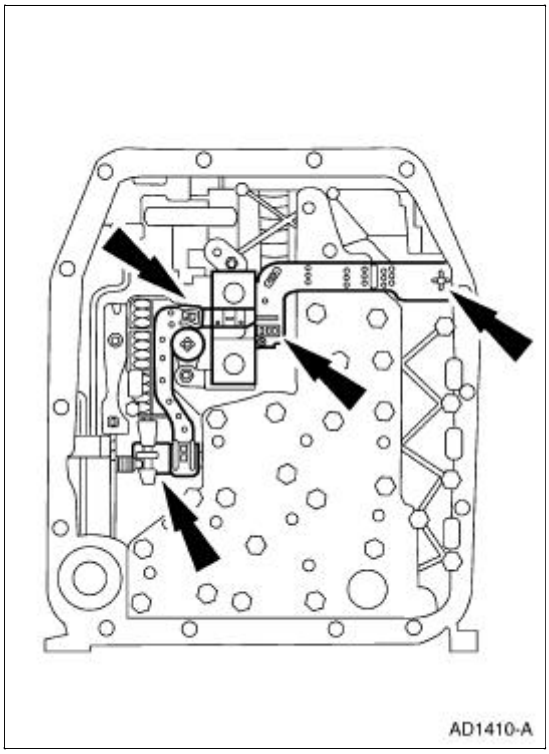
5. Tighten the main control valve body bolts in the sequence shown.



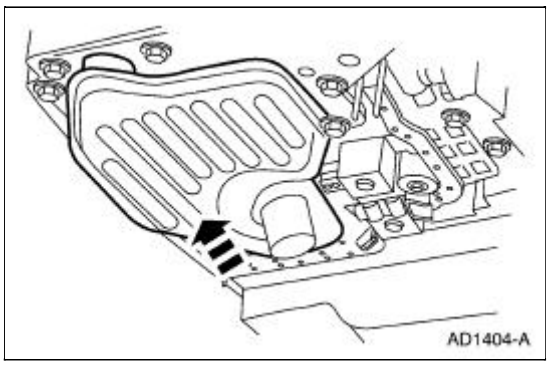
6. Inspect the lead frame for damage.
    - Using the special tool, check all lead frame solenoid connections. The gauge should fit tightly and not fall out after being inserted.
    - If the special tool passes through any lead frame connector pins or does not feel like it makes a good contact, install a new lead frame.



7. Connect the molded lead frame to the solenoids.
    - Connect the bulkhead inter-connector by pressing it in place by hand and fully seating the connector in place.
    - Connect the EPC solenoid by pressing it in place by hand and fully seating the connector in place. Make sure that the terminals pass fully through the connector slots.
    - Connect the TCC by pressing it in place by hand and fully seating the connector in place. Make sure that the terminals pass fully through the connector slots.
    - Connect the shift solenoid SSA and SSB by pressing it in place by hand and fully seating the connector in place. Make sure that the terminals pass fully through the connector slots.



8. Install the transmission filter and pan. For additional information, refer to Fluid Pan, Gasket and Filter in this section.



Extension Housing Oil Seal and Gasket

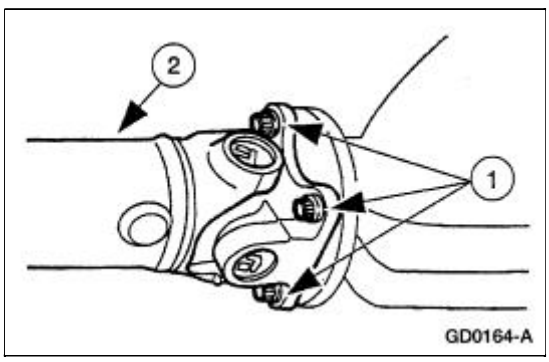
Special Tool(s)

 ST1188-A	Installer, Transmission Extension Housing Fluid Seal 308-002 (T61L-7657-A)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
 ST1192-A	Remover, Transmission Fluid Seal 307-048 (T74P-77248-A)

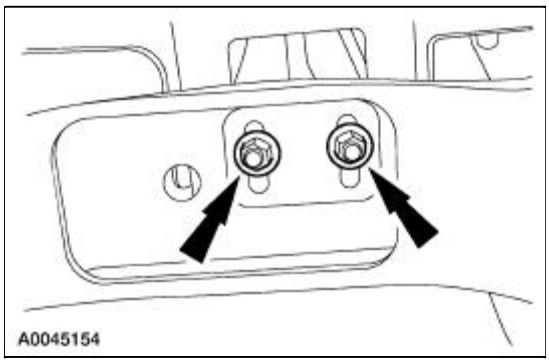
Removal

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. Drain the transmission fluid. For additional information, refer to Fluid Pan, Gasket and Filter in this section.
4. **NOTE:** To maintain initial driveshaft balance, mark the rear driveshaft yoke and axle flange so they can be installed in their original positions.

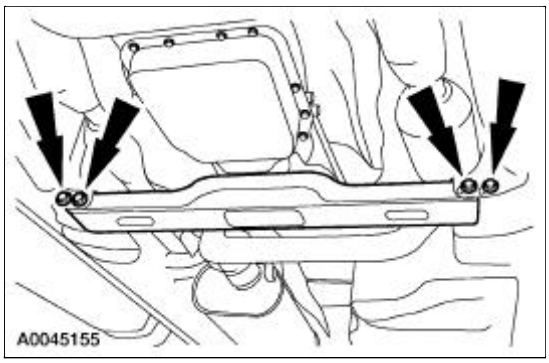
   Remove the rear driveshaft.
   1. Remove the four bolts.
   2. Remove the rear driveshaft.



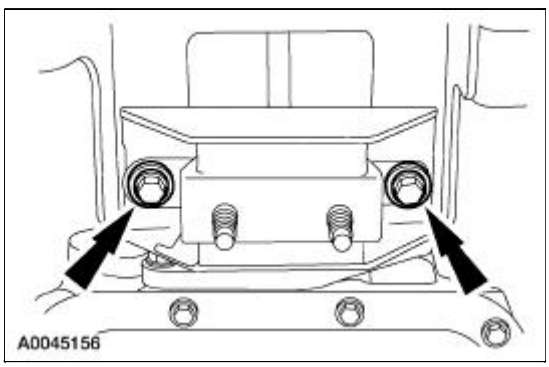
5. Use a high-lift jack to support the transmission.
6. Remove the rear crossmember bolts.



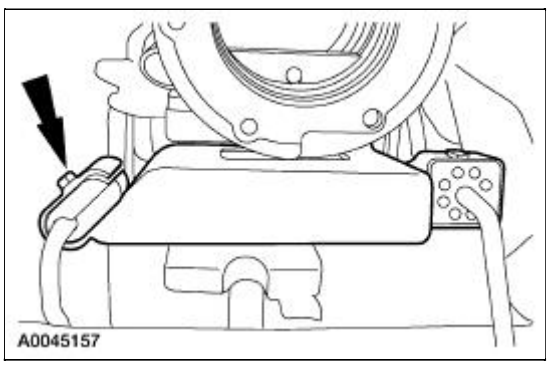
7. Remove the rear transmission retainer nuts and remove the crossmember.



8. Remove the rear transmission support.

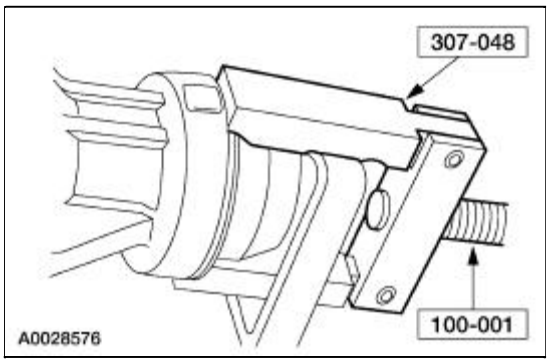


9. Remove the exhaust hanger.

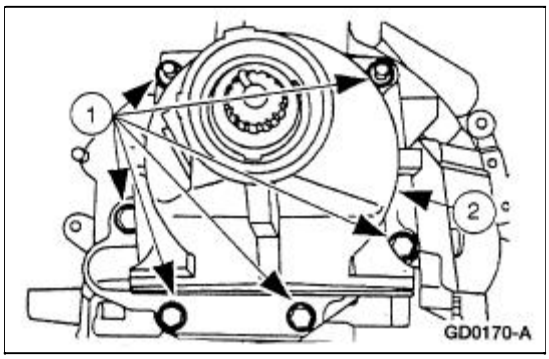


10. Lower the transmission to access the extension housing bolts.

11. Using the special tool, remove the extension housing seal.

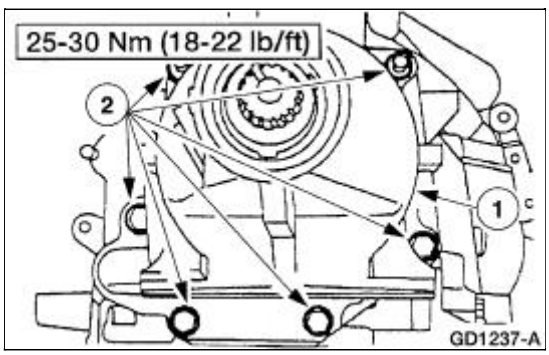


12. Remove the extension housing and gasket.
    1. Remove the bolts and nuts.
    2. Remove the extension housing and gasket.

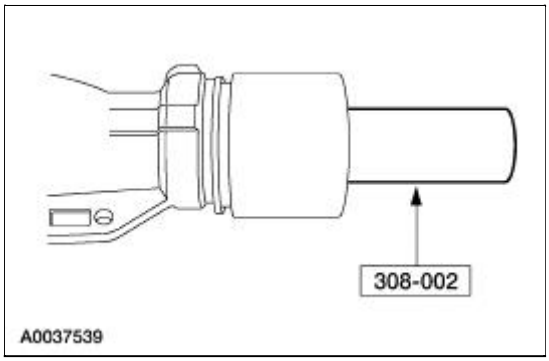


Installation

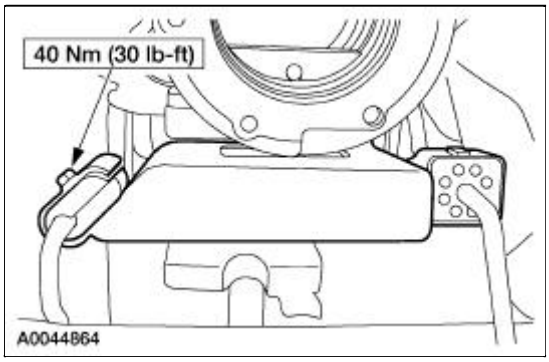
1. Install the extension housing and gasket.
    1. Position the extension housing gasket and the extension housing.
    2. Install the bolts and nuts.



2. Using the special tool, install the new extension housing seal.

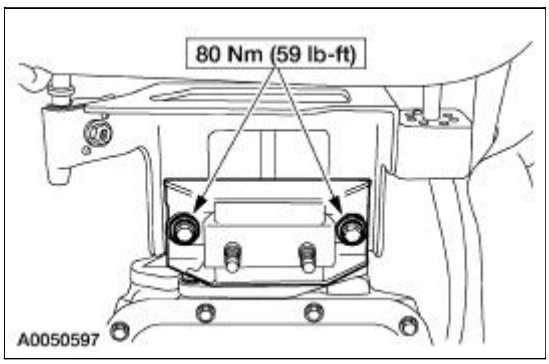


3. Install the exhaust hanger.

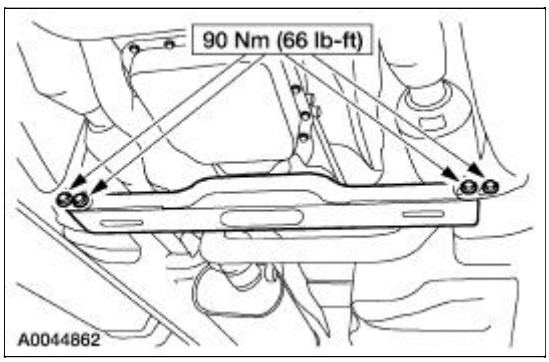


4. Raise and position the transmission.

5. Install the rear transmission support.

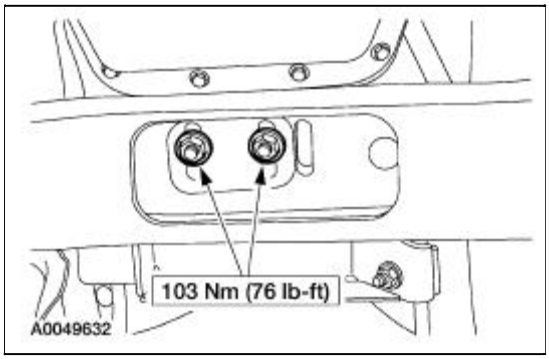


6. Install the transmission crossmember and the bolts.



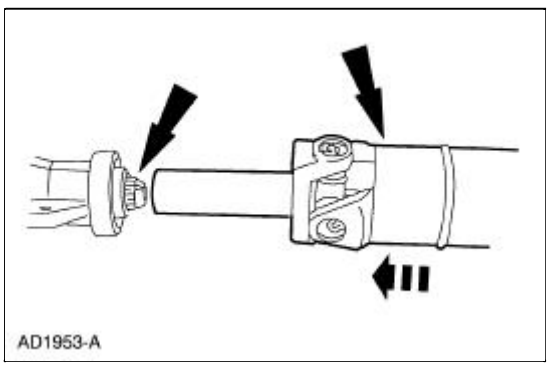
7. Remove the high-lift transmission jack.

8. Install the rear transmission support nuts.



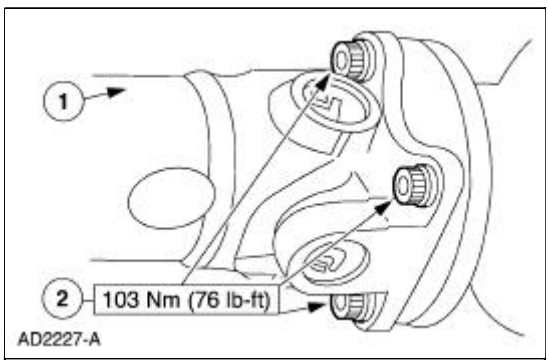
9. **NOTE:** The output shaft and the driveshaft are a balanced assembly.

   Install the driveshaft.
   - Align the yellow dots and position the driveshaft on the transmission.
   - Position the driveshaft to the rear differential.



10. **NOTE:** To maintain initial driveshaft balance, align the index marks made during removal.

    Install the rear driveshaft.
    1. Position the driveshaft.
    2. Install the four bolts.



11. Lower the vehicle.

12. Connect the battery ground cable.

13. Fill the transmission with clean automatic transmission fluid and inspect for correct operation. For additional information, refer to Fluid Pan, Gasket and Filter in this section.

Electronic Pressure Control (EPC) Solenoid

Special Tool(s)

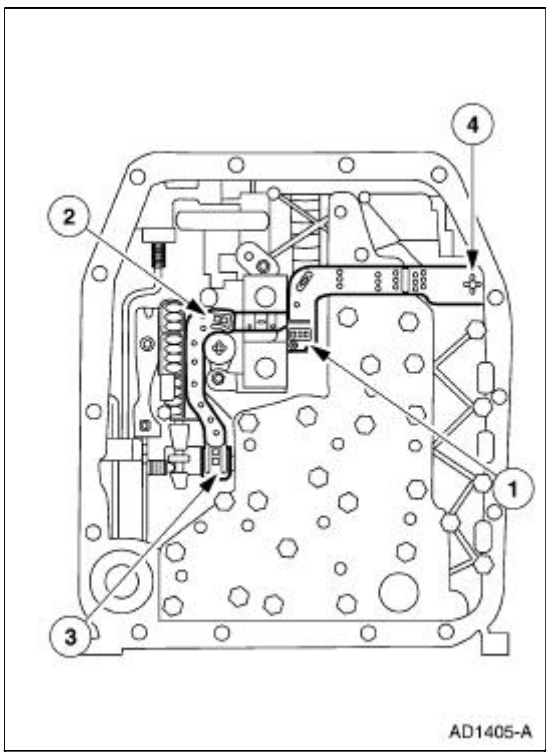
 ST2545-A	Gauge, Transmission Solenoid Connectors 307-426

Removal

1. Remove the manual control lever. For additional information, refer to Manual Control Lever Shaft and Seal in this section.

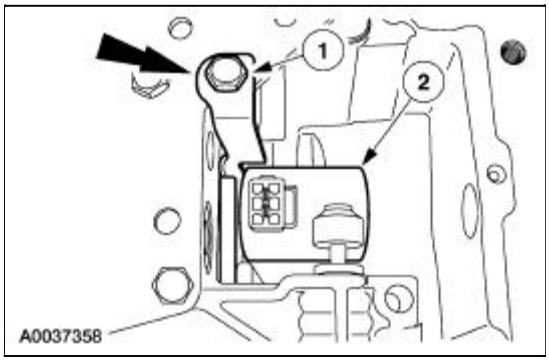
2. **CAUTION: Do not pull on the molded lead frame. This may cause damage to the connector ends. Carefully pry up on the locking tabs to disconnect the solenoids. Disconnect the molded lead frame from the solenoids.**

   Disconnect the molded lead frame from the solenoids.
   1. Disconnect the shift solenoid SSA and SSB.
   2. Disconnect the torque converter clutch (TCC).
   3. Disconnect the electronic pressure control (EPC) solenoid.
   4. Disconnect the bulkhead inter-connector.



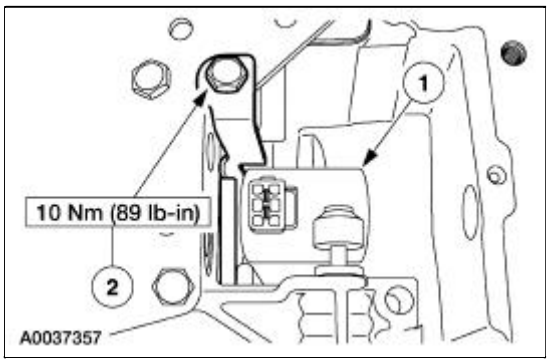
3. Remove the EPC solenoid.
   1. Remove the bolt and EPC solenoid bracket.

2. Remove the EPC solenoid.

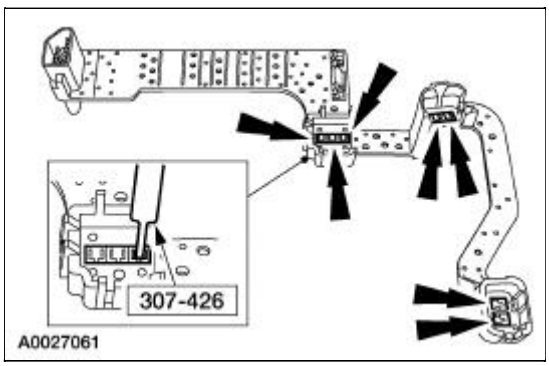


Installation

1. Install the EPC solenoid.
    1. Install the EPC solenoid.
    2. Install the EPC solenoid bracket and bolt.



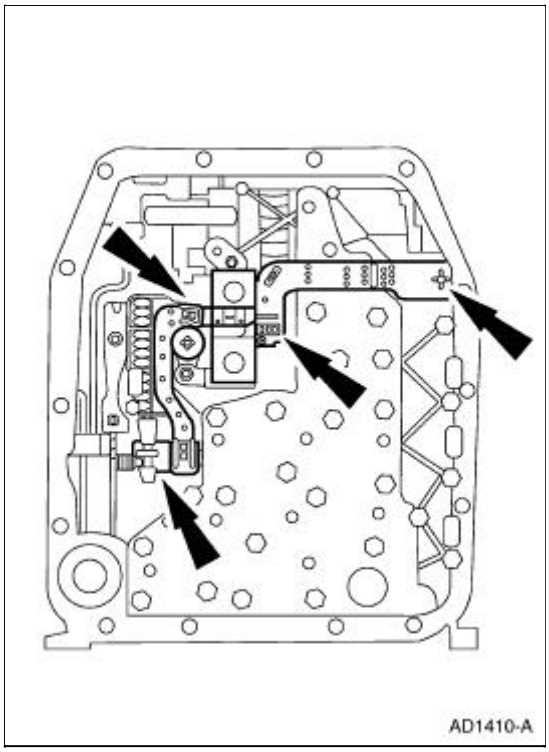
2. Inspect the lead frame for damage.
    - Using the special tool, check all lead frame solenoid connections. The gauge should fit tightly and not fall out after being inserted.
    - If the special tool passes through any lead frame connector pins or does not feel like it makes a good contact, install a new lead frame.



3. Connect the molded lead frame to the solenoids.
    - Connect the bulkhead inter-connector by pressing it in place by hand and fully seating the connector in place.
    - Connect the EPC solenoid by pressing it in place by hand and fully seating the connector in place. Make sure that the terminals pass fully through the connector slots.
    - Connect the TCC by pressing it in place by hand and fully seating the connector in place.

Make sure that the terminals pass fully through the connector slots.

- Connect the shift solenoid SSA and SSB by pressing it in place by hand and fully seating the connector in place. Make sure that the terminals pass fully through the connector slots.



4. Install the manual control lever. For additional information, refer to Manual Control Lever Shaft and Seal in this section.

Manual Control Lever Shaft and Seal

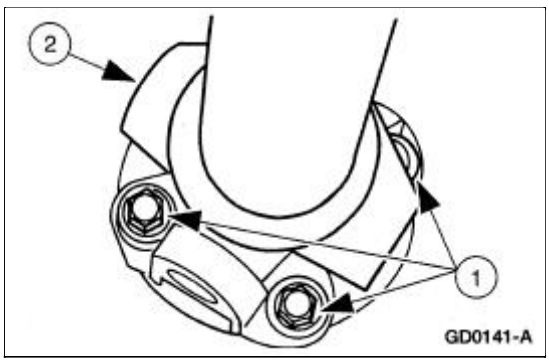
Special Tool(s)

 ST1633-A	Alignment Gauge, TR Sensor 307-351 (T97L-70010-A)
 ST1199-A	Installer, Shift Shaft Fluid Seal 307-050 (T74P-77498-A)

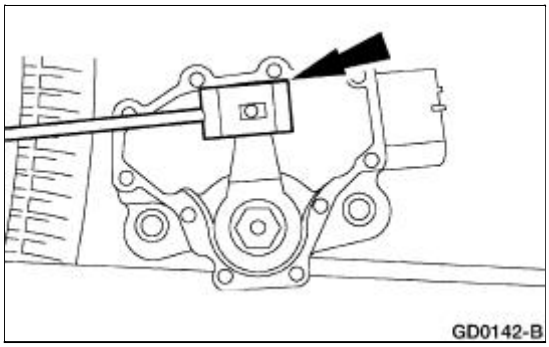
Removal

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. **NOTE:** Mark the driveshaft flange and rear axle pinion flange for correct alignment during installation.

   On 4x4 vehicles, remove the front driveshaft.
   1. Remove the eight front driveshaft bolts (four each end).
   2. Remove the front driveshaft.

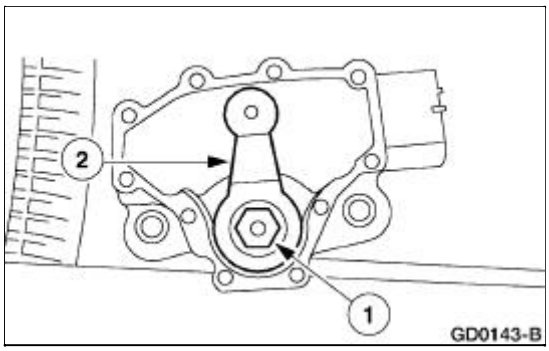


4. Drain the transmission fluid and remove the fluid pan and filter. For additional information, refer to Fluid Pan, Gasket and Filter in this section.
5. Disconnect digital TR sensor electrical connector.
6. Disconnect the transmission shift linkage.

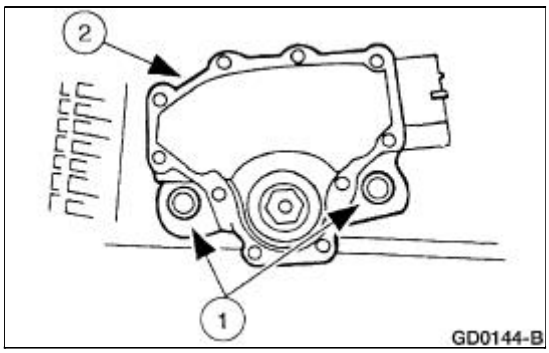


7. **CAUTION: Discard outer manual control lever shaft nut. Do not reuse. The old nut will not retain torque specification.**

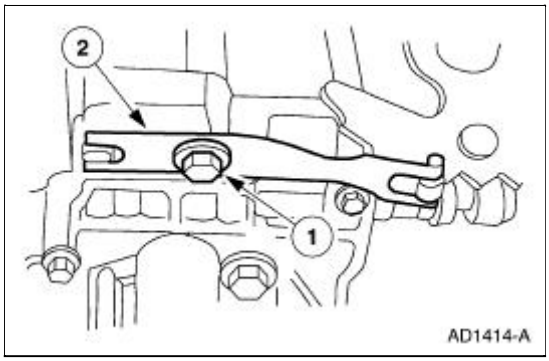
   Remove the manual control lever.
   1. Remove the outer manual control lever shaft nut.
   2. Remove the manual control lever.



8. Remove the digital transmission range TR sensor.
   1. Remove the two bolts.
   2. Remove the digital TR sensor.

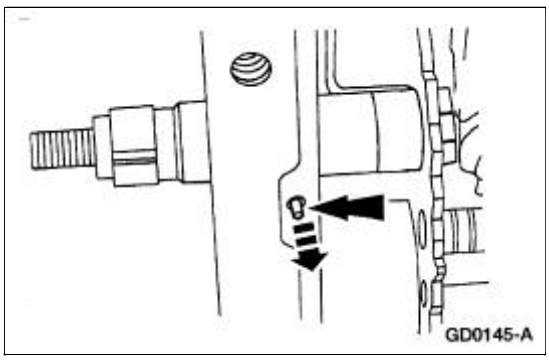


9. Remove the manual control valve detent lever spring.
   1. Remove the bolt.
   2. Remove the manual control valve detent lever spring.

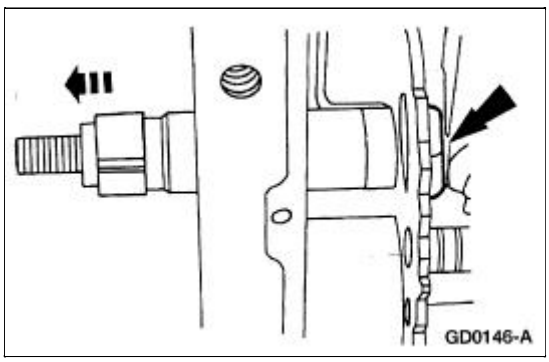


10. **NOTE:** Use a shop cloth to protect the transmission case surface.

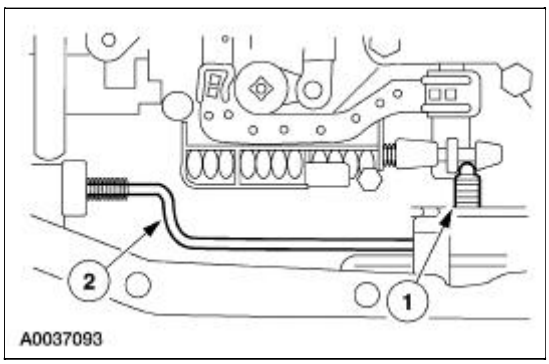
    Remove the manual lever shaft retaining pin.



11. Remove the inner manual control lever shaft nut and slide the manual control lever shaft out of the case.

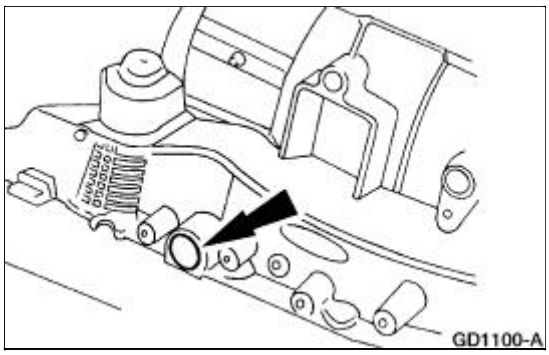


12. Remove the parking lever actuating rod.
    1. Remove the manual valve detent lever.
    2. Remove the parking lever actuating rod.



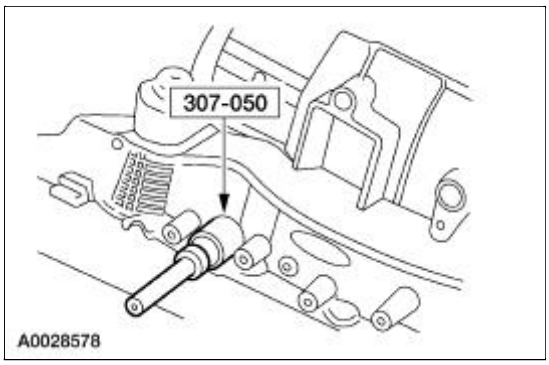
13. **CAUTION: Use care not to damage the manual control lever shaft bore. The new seal can leak.**

    Remove the manual control lever shaft seal.

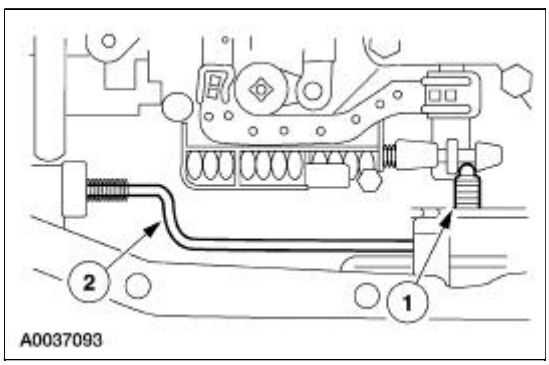


Installation

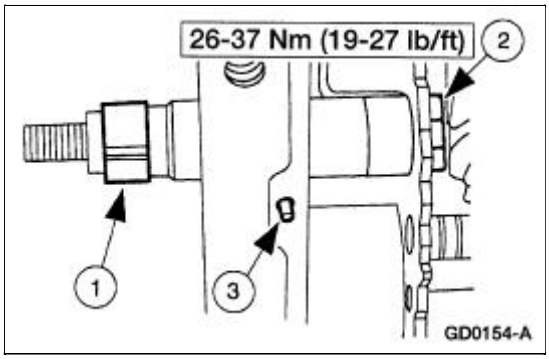
1. Using the special tool, install the manual control lever seal.



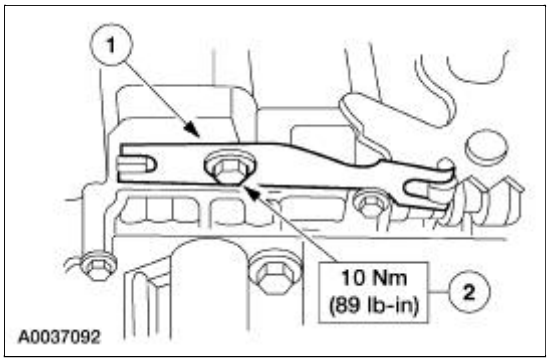
2. Install the parking lever actuating rod.
    1. Install the manual valve detent lever.
    2. Install the parking lever actuating rod.



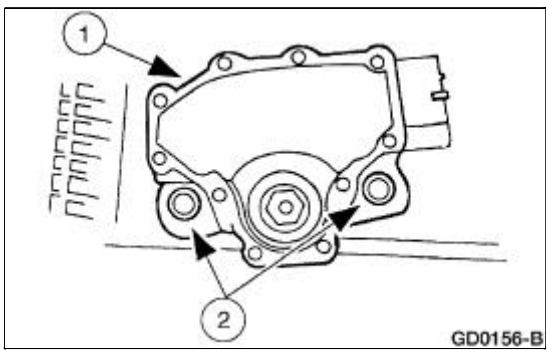
3. Install the manual control lever shaft.
    1. Install the manual control lever shaft.
    2. Install the inner manual control lever shaft nut.
    3. Install the manual lever shaft retaining pin.



4. Install the manual valve detent lever spring.
    1. Position the manual valve detent lever spring.
    2. Install the manual valve detent lever spring bolt.

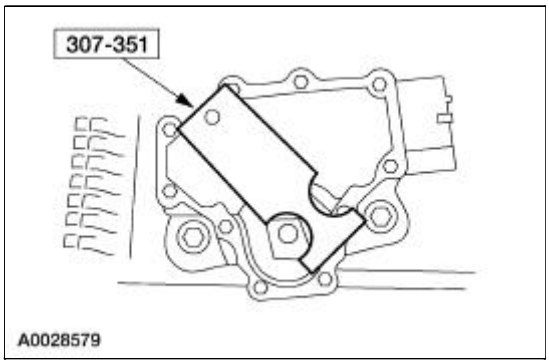


5. Install the digital TR sensor.
    1. Install the digital TR sensor.
    2. Loosely install the bolts.

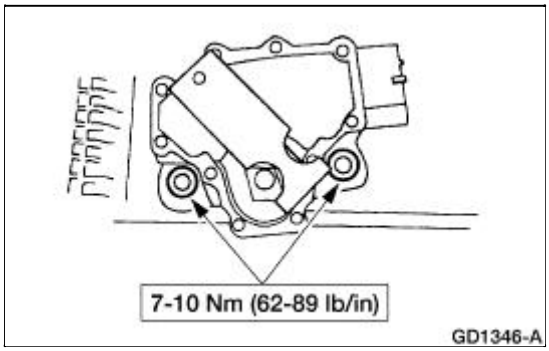


6. **NOTE:** Manual shift lever must be in the neutral position.

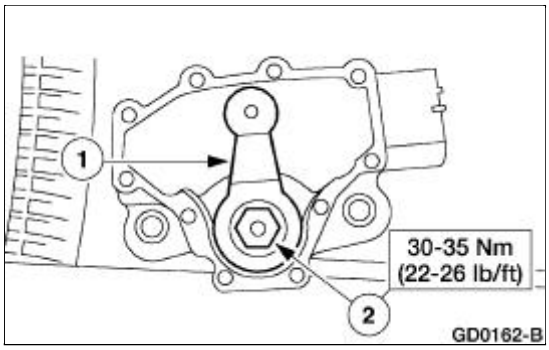
    Using the special tool, align the digital TR sensor slots. The tool is designed to fit snug.



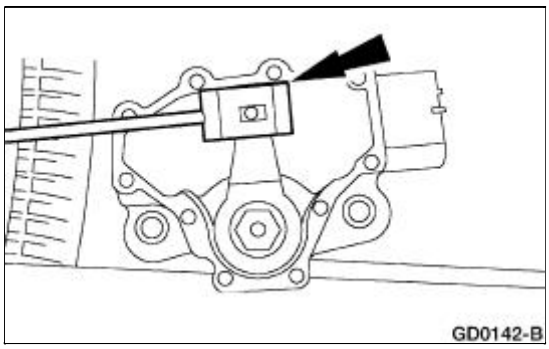
7. Tighten the bolts.



8. Install the manual control lever.
    1. Position the manual control lever.
    2. Install a new manual lever shaft outer nut.



9. With manual lever in overdrive, connect the shift control cable.

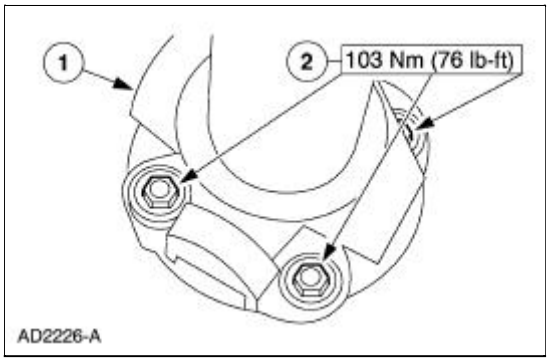


10. Install digital TR sensor electrical connector.

11. Install the filter and transmission fluid pan.

12. **NOTE:** To maintain initial driveshaft balance, align the index marks made during removal.

    On 4x4 vehicles, install the front driveshaft.
    1. Position the front driveshaft.
    2. Install the eight front driveshaft bolts (four each end).



13. Lower the vehicle.

14. Connect the battery ground cable.

15. Fill the transmission with clean automatic transmission fluid and inspect for correct operation. For additional information, refer to Fluid Pan, Gasket and Filter in this section.

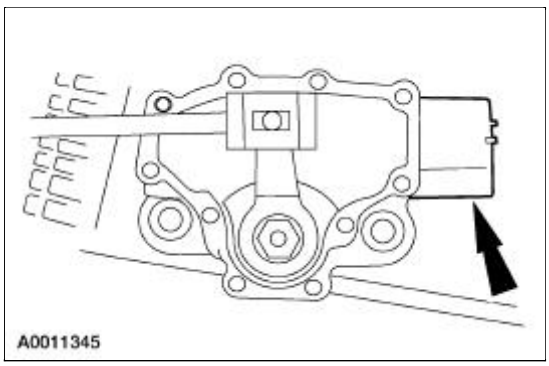
Digital Transmission Range (TR) Sensor

Special Tool(s)

 ST1633-A	Alignment Gauge, TR Sensor 307-351 (T97L-70010-A)

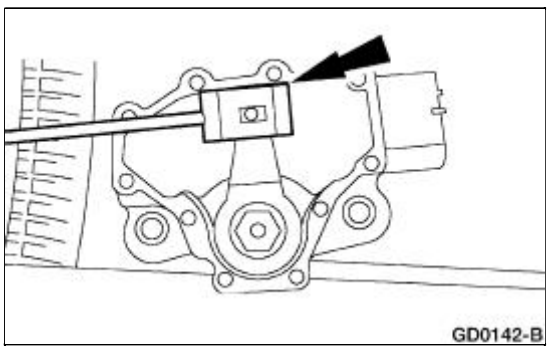
Removal

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. Disconnect the digital TR electrical connector.



4. **CAUTION: Do not pry on the swivel tube to disconnect the transmission shift linkage.**

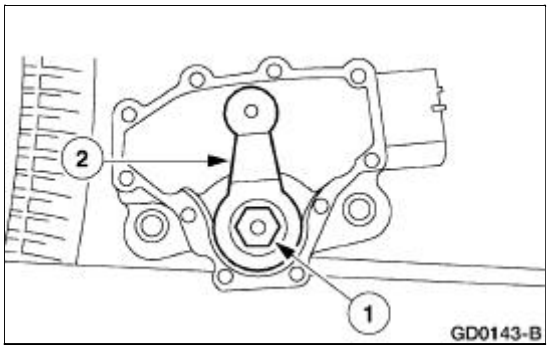
   Disconnect the manual lever shift control cable.



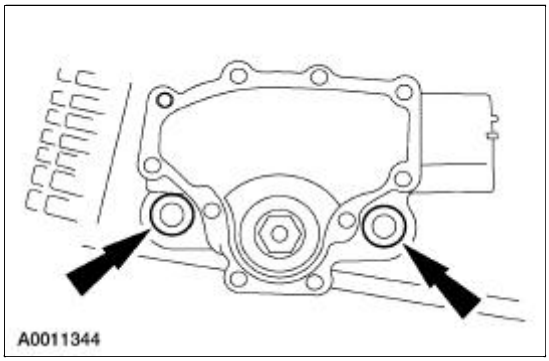
5. **CAUTION: Discard outer manual control lever shaft nut. Do not reuse. The old nut will not retain torque specification.**

Remove the manual control lever.

1. Remove the nut.
2. Remove the lever.

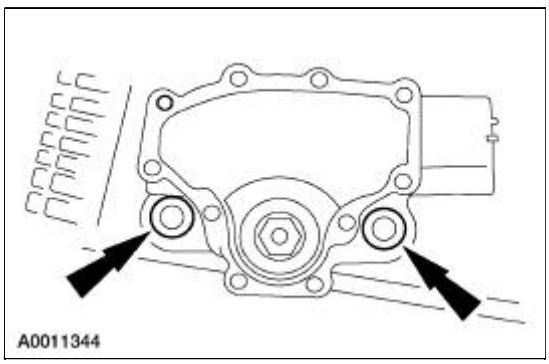


6. Remove the digital TR sensor bolts and the TR sensor.



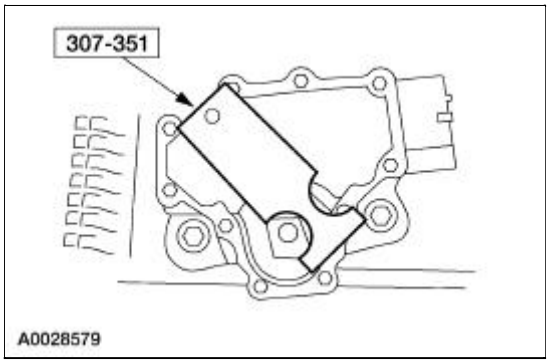
Installation

1. Install the digital TR sensor and loosely install the bolts.

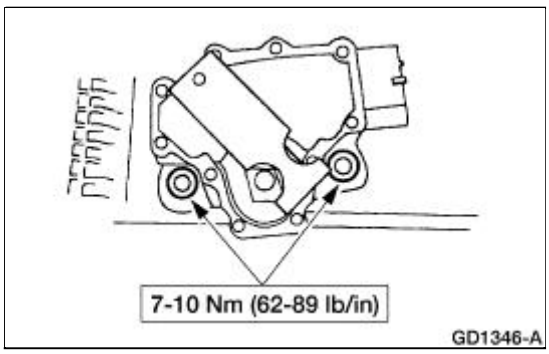


2. **NOTE:** Manual shift lever must be in the neutral position.

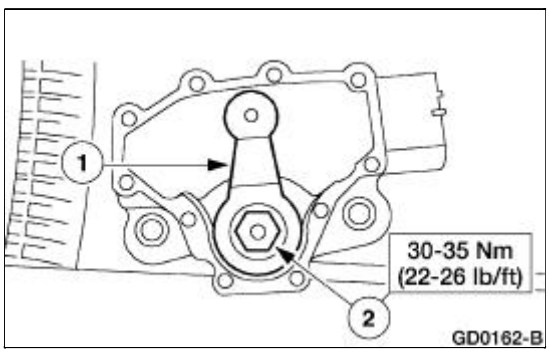
   Using the special tool, align the digital TR sensor slots. The tool is designed to fit snug.



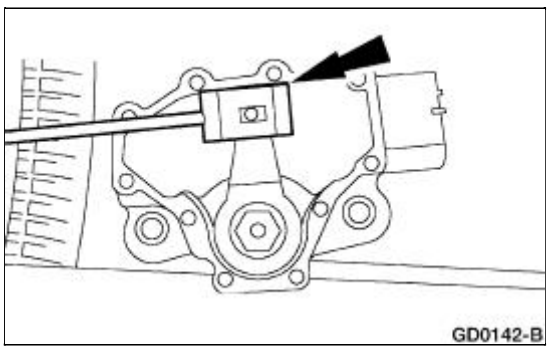
3. Tighten the bolts.



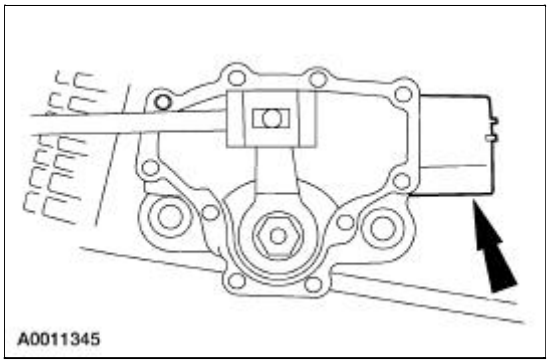
4. Install the manual control lever.
    1. Position the manual control lever.
    2. Install a new manual lever shaft outer nut.



5. With the manual lever in overdrive connect the shift lever control cable.



6. Install the digital TR sensor electrical connector.



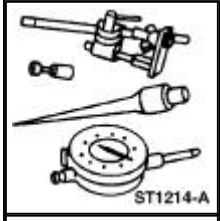
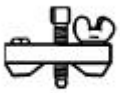
7. Lower the vehicle.

8. **NOTE:** When the battery is disconnect and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn the strategy.

   Connect the battery ground cable. For additional information, refer to Section 414-01 .

Reverse Servo Assembly

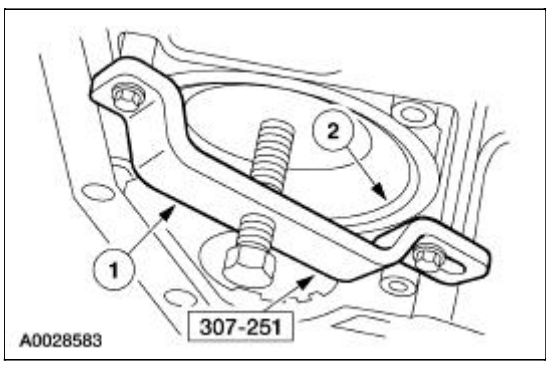
Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)
 ST1210-A	Remover/Installer, Servo Piston 307-251 (T92P-70023-A)
 ST1202-A	Installer, Servo Piston 307-073 (T80L-77030-A)

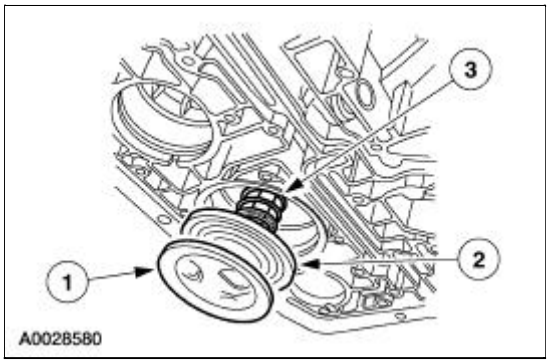
Removal

1. Remove the main control valve body. For additional information, refer to Main Control Valve Body in this section.

2. Using the special tool, remove the reverse band servo retaining ring.
   1. Compress the servo spring.
   2. Remove the reverse band servo retaining ring.



3. Remove the reverse servo assembly.
   1. Remove the reverse band servo cover.
   2. Remove the reverse band servo piston and rod.
   3. Remove the reverse band servo spring.

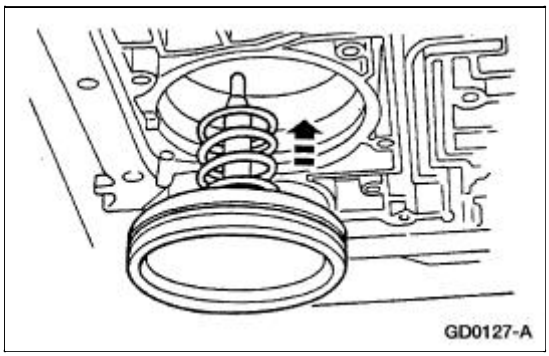


Installation

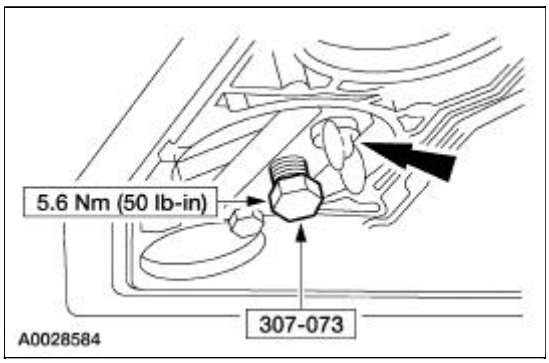
NOTE: This is not an ordinary installation procedure and does not compensate for band wear.

1. **NOTE:** Lubricate the reverse piston seal to facilitate assembly and prevent damage to the seal.

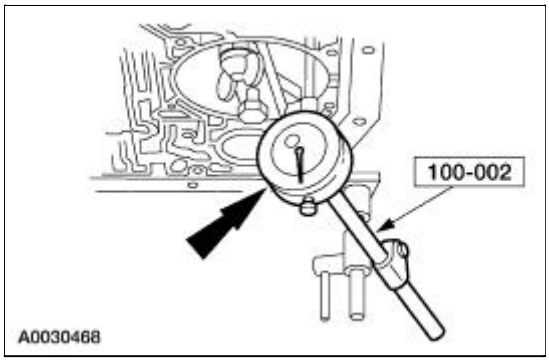
   Install the reverse servo return spring and piston.
   - Do not install the piston cover.



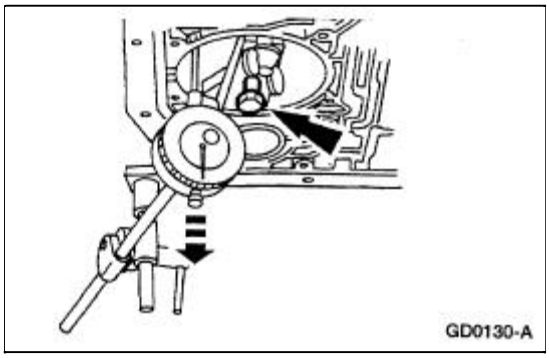
2. Install the special tool and tighten the band apply bolt.



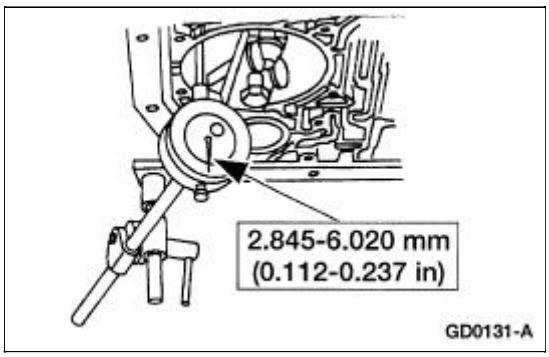
3. Attach the special tool to the transmission.
   - Position the indicator stem on the flat portion of the reverse servo piston and zero the dial indicator.



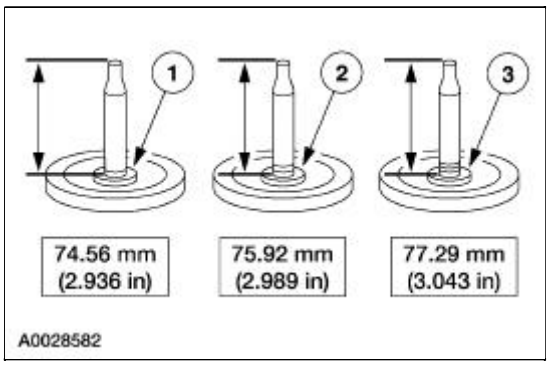
4. Loosen the bolt until the piston stops against the tool.



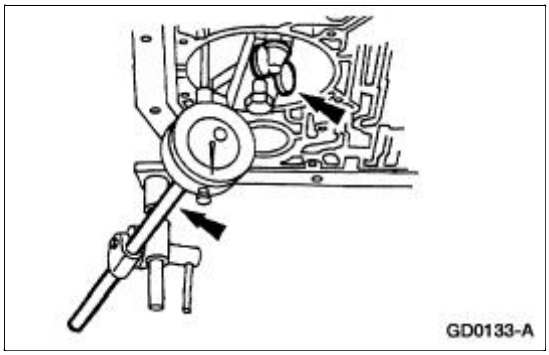
5. Verify that the amount of piston travel on the dial indicator is within specification.



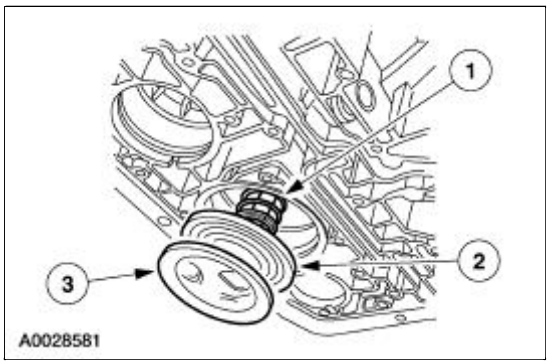
6. If piston travel is not within specification, select and install the correct servo piston assembly to bring the servo piston travel within specification.
    1. One groove
    2. Two groove
    3. Three groove



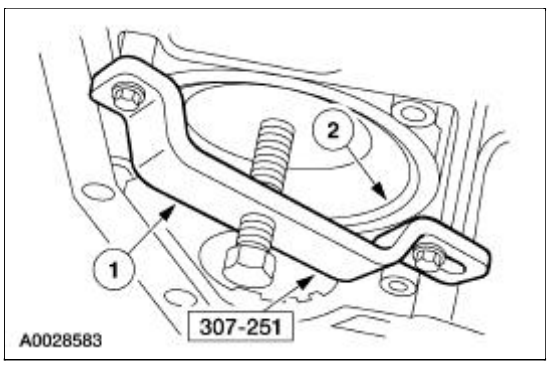
7. Remove the dial indicator and servo selection tool.



8. Install the correct reverse servo assembly.
    1. Install the reverse band servo spring.
    2. Install the reverse band servo piston and rod.
    3. Install the reverse band servo cover.



9. Using the special tool, install the reverse servo retaining ring.
    1. Compress the servo spring.
    2. Install the reverse band servo retaining ring.



10. Install the main control valve body. For additional information, refer to Main Control Valve Body in this section.

Overdrive Servo

Special Tool(s)

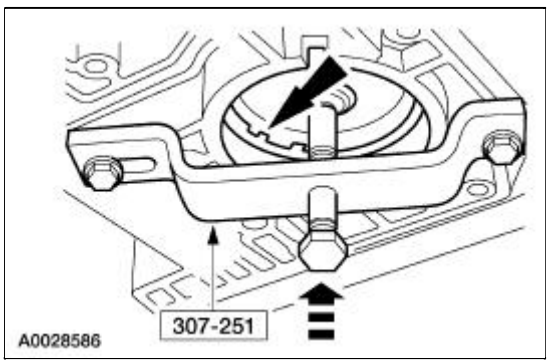
 ST1210-A	Remover/Installer, Servo Piston 307-251 (T92P-70023-A)

Removal

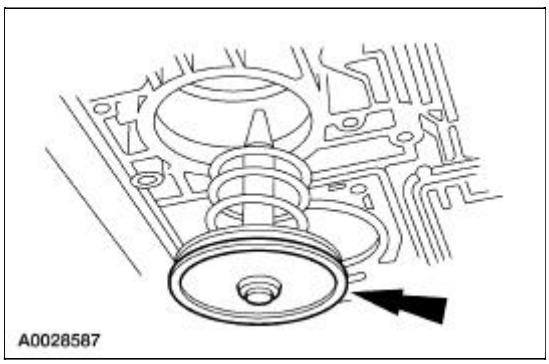
1. Remove the main control valve body. For additional information, refer to Main Control Valve Body in this section.

2. **NOTE:** If the tool is not available, extreme care must be taken. Spring pressure will force overdrive servo piston assembly out of case. Case bore damage may result from trying to pry on overdrive servo internal retaining ring.

   Using the special tool, compress the servo spring to remove the overdrive servo retaining ring.



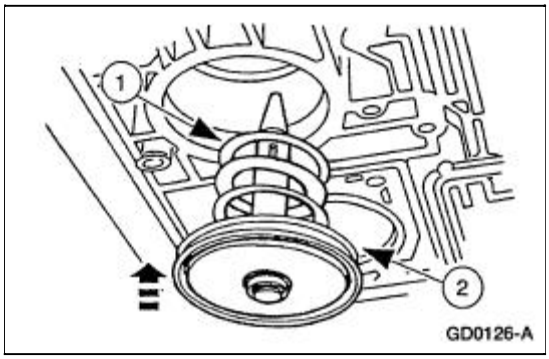
3. Remove the overdrive servo piston and return spring.



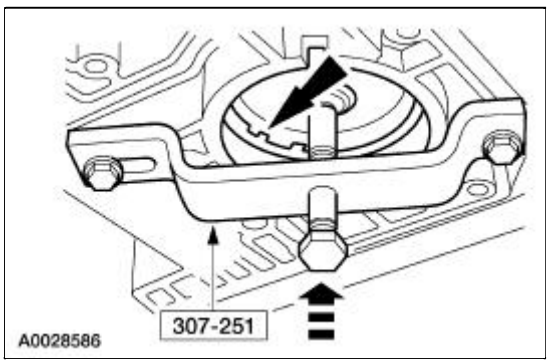
Installation

1. Install the overdrive servo piston assembly.
   1. Install the overdrive servo piston return spring.

2. Install the overdrive servo piston assembly.



2. Use the special tool to install the overdrive servo piston retaining ring.

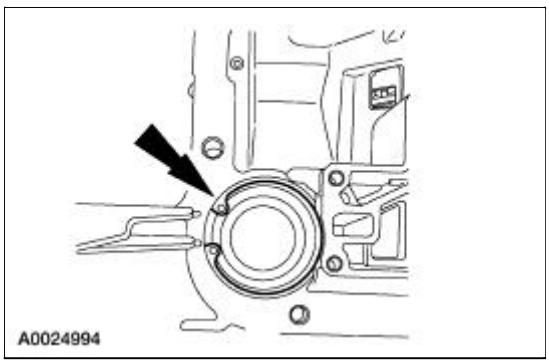


3. Install the main control valve body. For additional information, refer to Main Control Valve Body in this section.

1-2 Accumulator

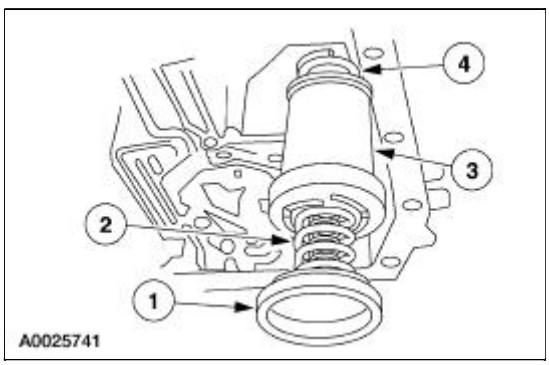
Removal

1. Compress the 1-2 accumulator cover and remove the accumulator piston retaining ring.



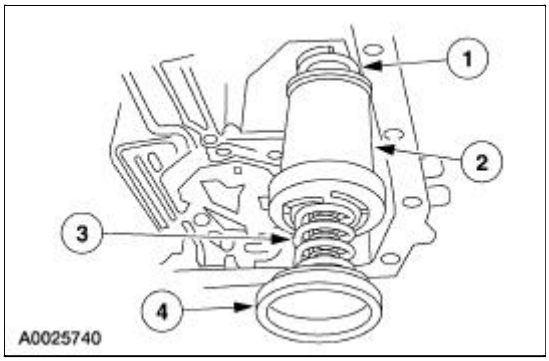
2. **NOTE:** Note the location of the 1-2 accumulator springs for reference during assembly.

   Remove the 1-2 accumulator.
   1. Remove the 1-2 accumulator cover.
   2. Remove the inner and outer 1-2 accumulator springs.
   3. Remove the accumulator piston.
   4. Remove the upper 1-2 accumulator spring.

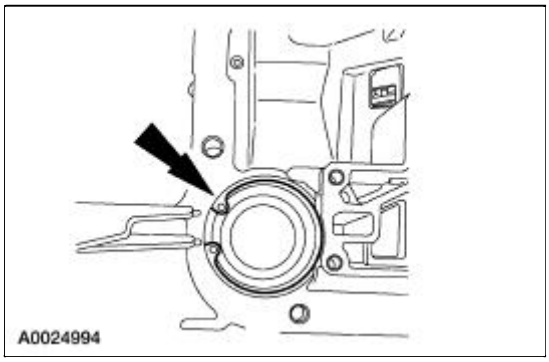


Installation

1. Install the 1-2 accumulator.
   1. Install the 1-2 accumulator upper spring.
   2. Install the accumulator piston.
   3. Install the inner and outer 1-2 accumulator springs.
   4. Install the cover and seal assembly.



2. Compress the 1-2 accumulator springs and install the accumulator piston retaining ring.

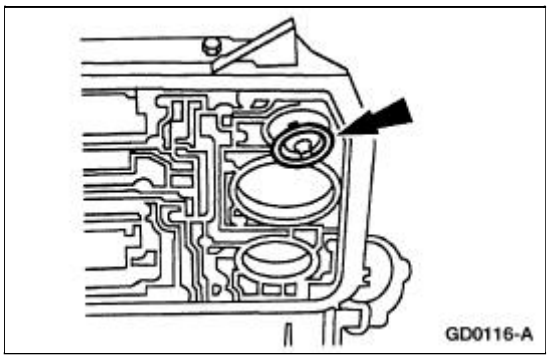


2-3 Accumulator

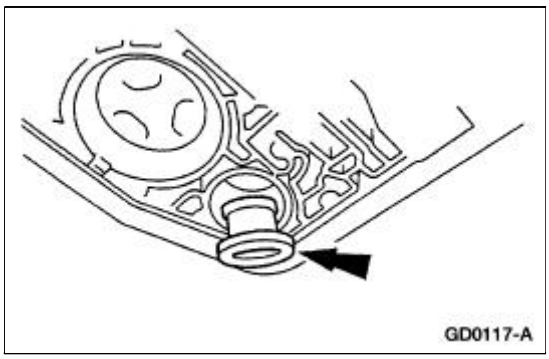
Removal

1. Remove the main control valve body. For additional information, refer to Main Control Valve Body in this section.

2. Remove the 2-3 accumulator piston retainer.

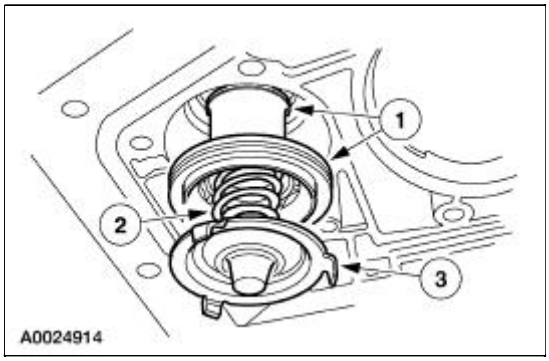


3. Remove the accumulator piston and spring.



Installation

1. Install the 2-3 accumulator assembly.
    1. Install the accumulator piston.
    2. Install the accumulator piston spring.
    3. Install the accumulator spring retainer.



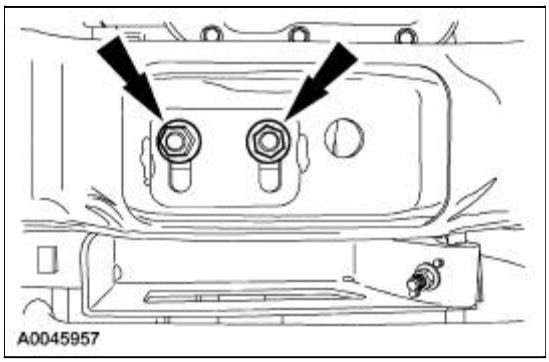
2. Install the main control valve body. For additional information, refer to Main Control Valve Body in this section.

Transmission Insulator and Retainer

Removal

1. Position the vehicle on a hoist. Place in NEUTRAL. For additional information, refer to Section 100-02 .

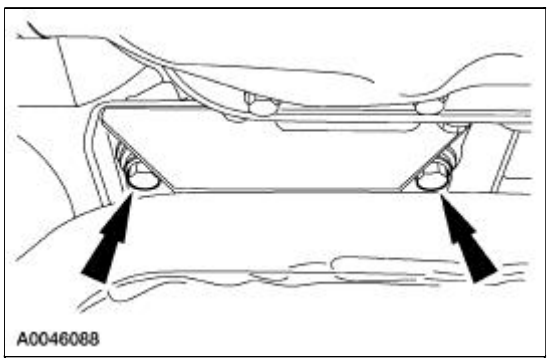
2. Remove the rear transmission support nuts.



3. Install a suitable transmission jack.

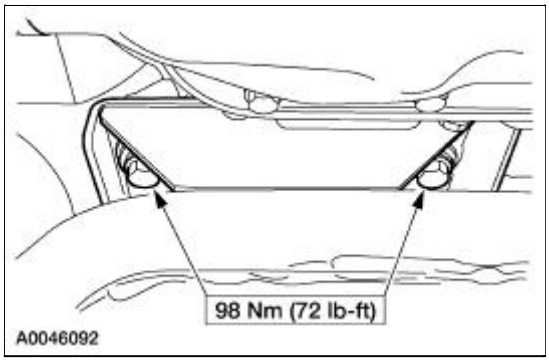
4. **CAUTION: Be sure not to raise the back of the transmission too high, if it makes contact with the underbody, damage to the TSS and OSS sensors will occur.**

   Slightly raise the rear of the transmission and remove the bolts. Remove the rear transmission mount.

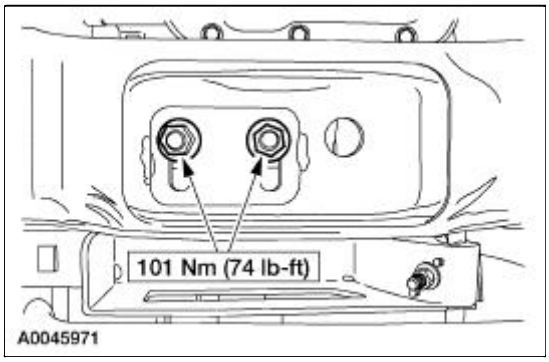


Installation

1. Install the rear transmission mount and the bolts.



2. Lower the transmission onto the crossmember and install the nuts.



3. Remove the high lift transmission jack.
4. Lower the vehicle.
5. Connect the battery ground cable.

Transmission —4x2

Special Tool(s)

 ST1636-A	Retainer, Torque Converter 307-346 (T97T-7902-A)

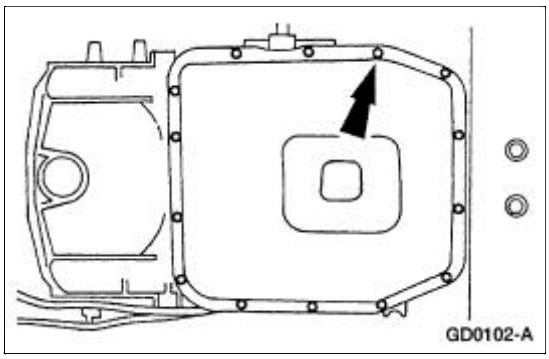
Removal

1. Position the vehicle on a hoist. Place in NEUTRAL. For additional information, refer to Section 100-02 .

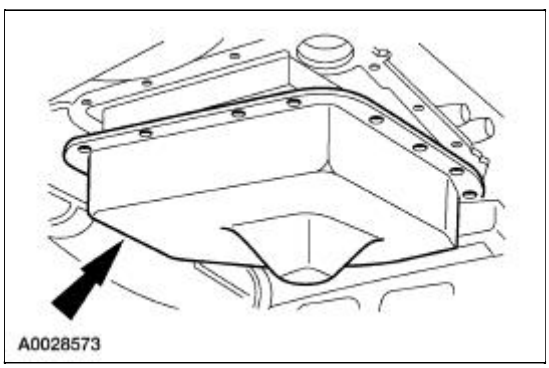
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

3. **NOTE:** If transmission disassembly is required, drain the transmission fluid.

   Loosen the transmission fluid pan bolts and allow the fluid to drain.

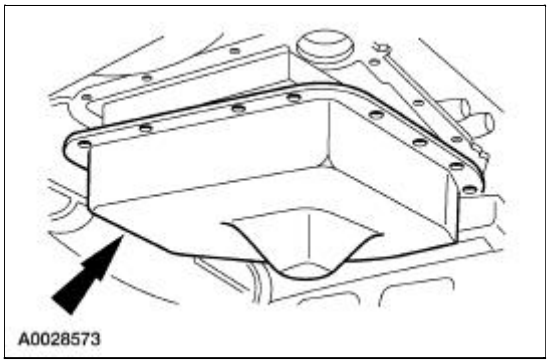
   
   GD0102-A

4. After the fluid has drained, remove the transmission fluid pan and drain the remaining fluid from the pan.

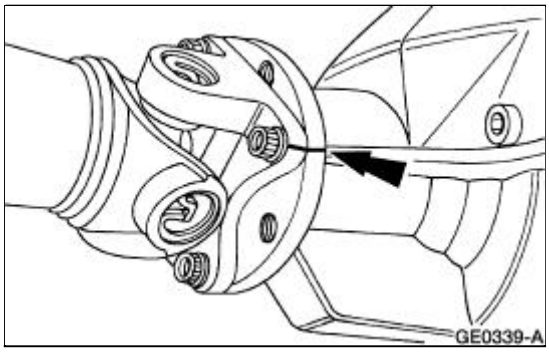
   
   A0028573

5. **NOTE:** It is not necessary to torque the transmission fluid pan bolts in this step.

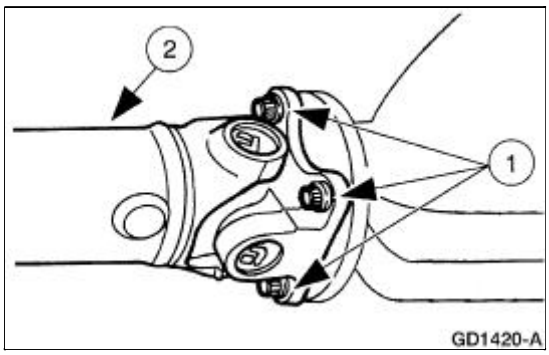
   Install the transmission fluid pan.



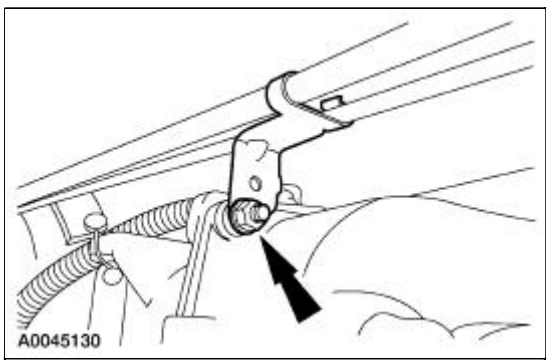
6. Mark the driveshaft flange and rear axle pinion flange for correct alignment during installation.



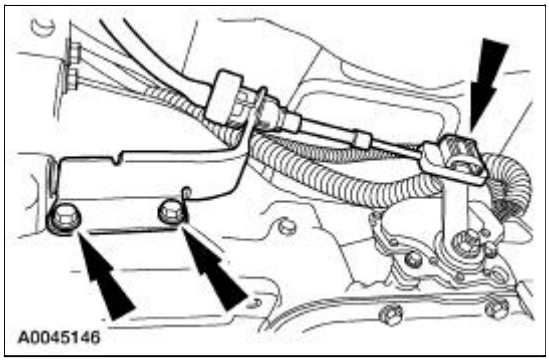
7. Remove the rear driveshaft.
    1. Remove the four bolts.
    2. Remove the driveshaft.



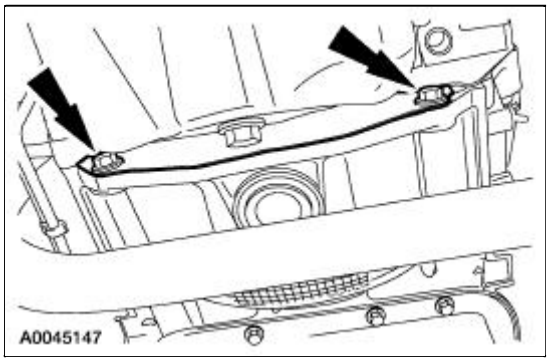
8. Remove the fuel line bracket from the extension bolt.



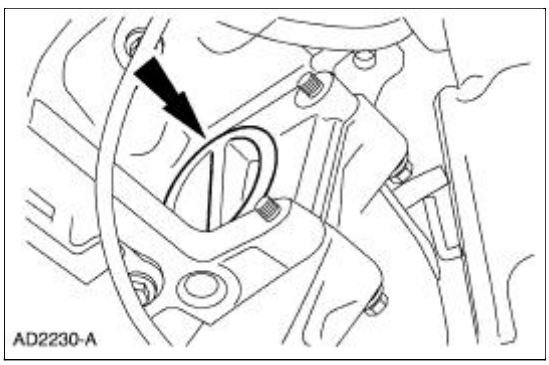
9. Disconnect the shift cable end and remove the shift cable bracket.



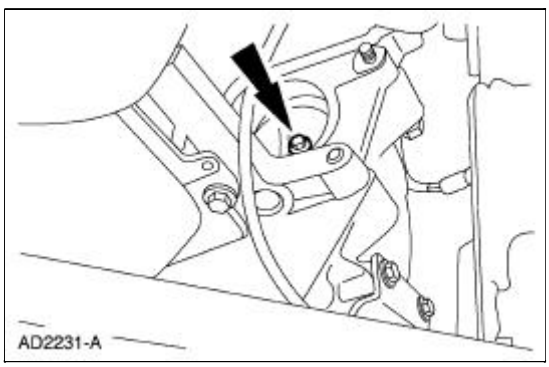
10. Remove the flexplate inspection cover.



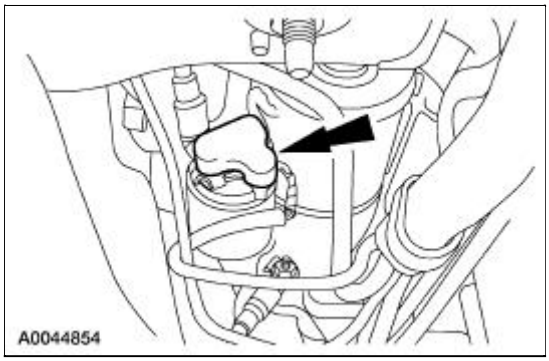
11. Remove the rubber access plug.



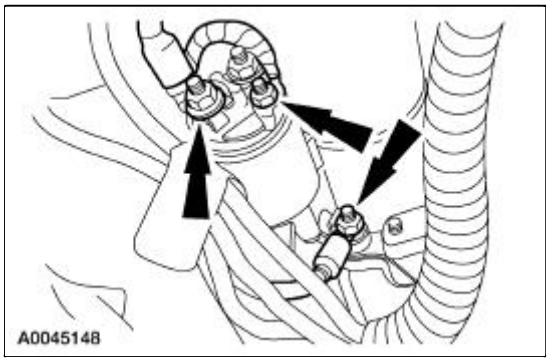
12. Remove and discard the four flexplate-to-torque converter nuts.



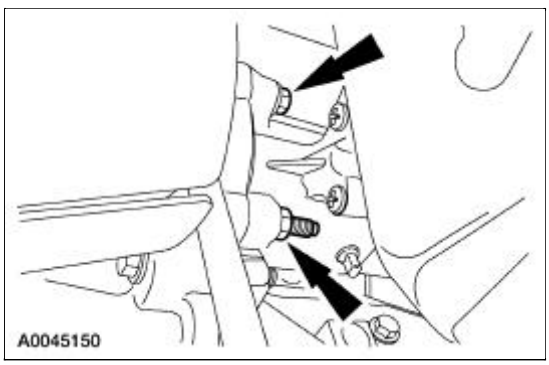
13. Remove the plastic starter motor electrical connector cap.



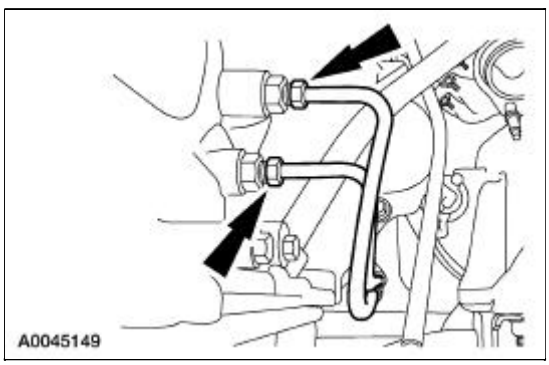
14. Remove the starter motor electrical connectors and the ground wire.



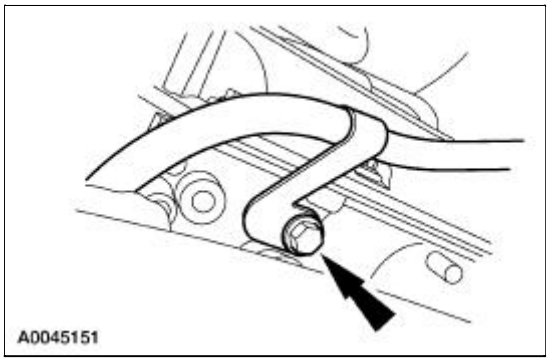
15. Remove the three bolts and the starter motor.



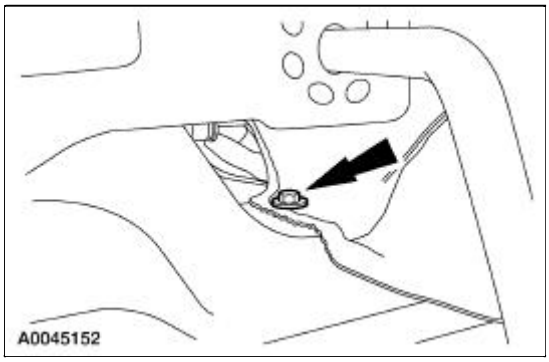
16. Disconnect the transmission cooler lines and position them aside.



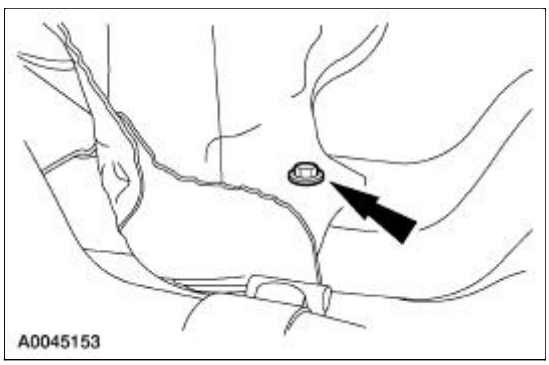
17. Remove the bolt from the RH cylinder head for the transmission filler tube and position the filler tube aside.



18. Remove the RH exhaust shield bolt.



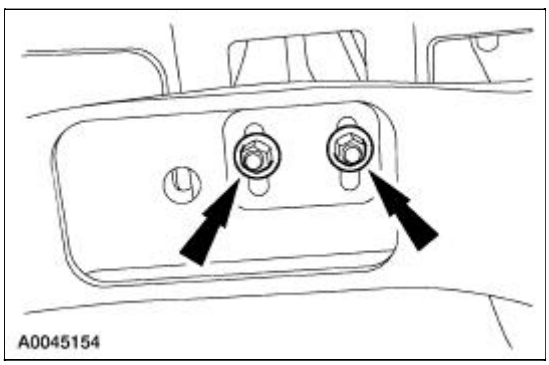
19. Remove the LH exhaust shield bolt.



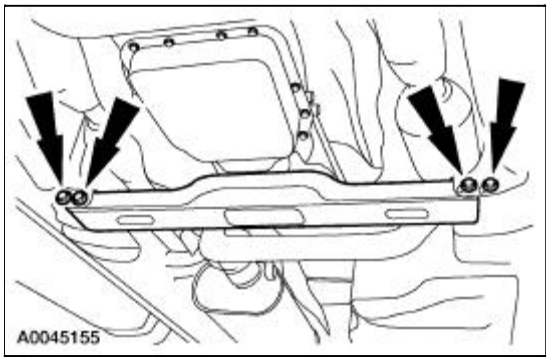
20. **NOTE:** Make sure that the transmission is securely fastened to the transmission jack.

    Position a suitable high-lift transmission jack under the transmission.

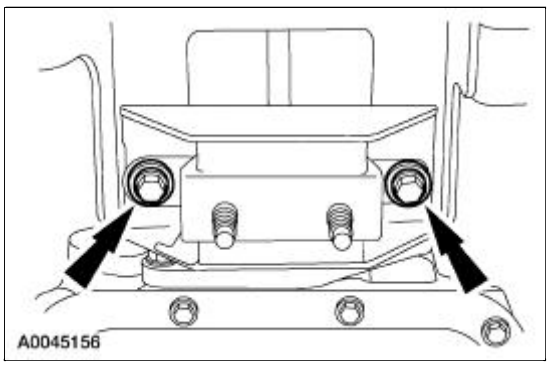
21. Remove the rear crossmember bolts.



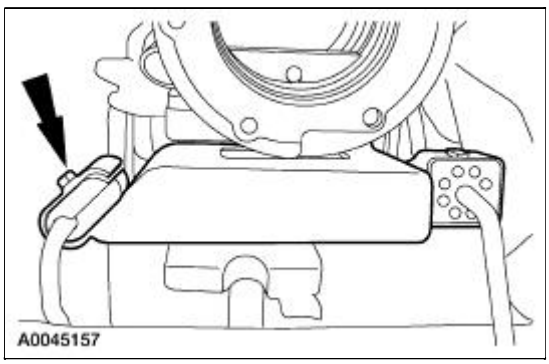
22. Remove the rear transmission retainer nuts and remove the crossmember.



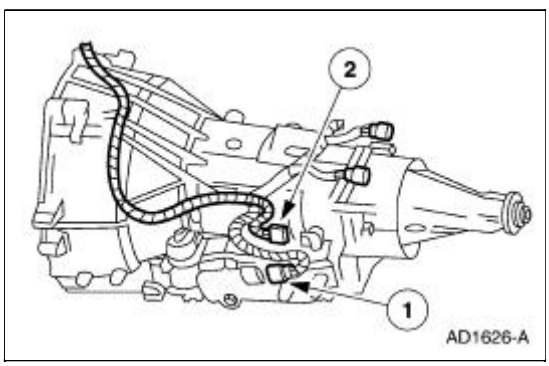
23. Remove the rear transmission support.



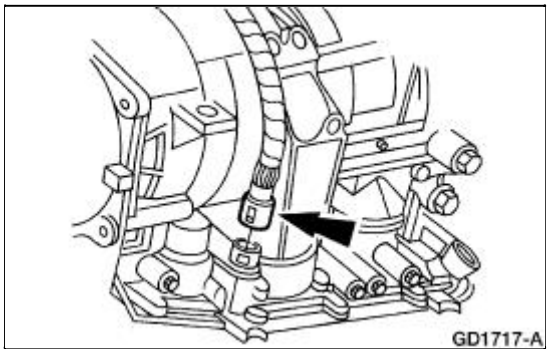
24. Remove the exhaust hanger.



25. Disconnect the transmission electrical connectors.
    1. Disconnect the digital transmission range (TR) sensor.
    2. Disconnect the output shaft speed (OSS) sensor.



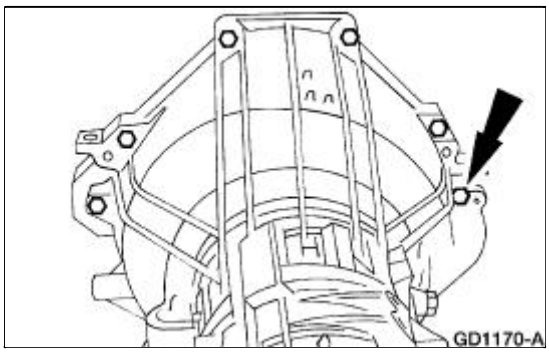
26. Disconnect the solenoid body assembly electrical connector.



27. **NOTE:** If the transmission fluid has not been drained, position a drain pan and install a suitable plug into the transmission.

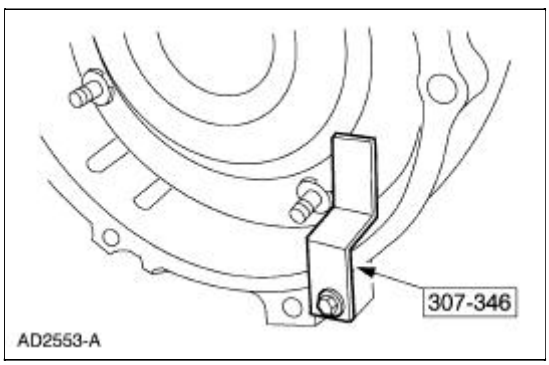
    NOTE: Note the length and the location of the bolts during removal.

    Remove the seven transmission-to-engine bolts.



28. **WARNING: The torque converter is heavy and can result in injury if it falls out of the transmission. Secure the torque converter in the transmission.**

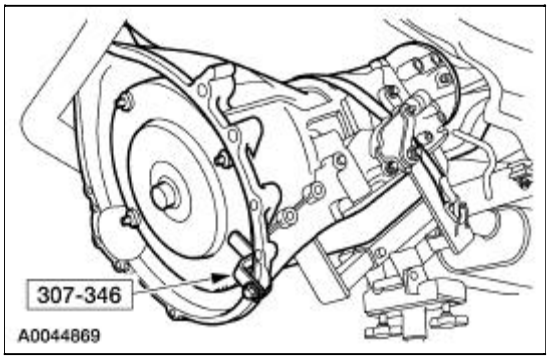
    Leaving the transmission in a horizontal position, slide it back far enough to install the special tool. Install the special tool.



29. **CAUTION: To remove the transmission from the vehicle, it will be necessary to put the transmission into a nose-down position to clear the flexplate and the exhaust system.**

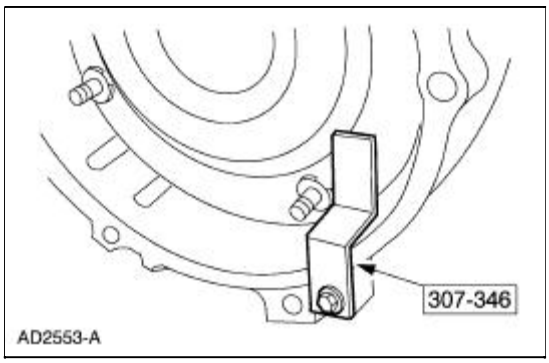
    NOTE: Make sure that the special tool is in place and the transmission is securely fastened to the transmission jack before tilting the transmission.

Lower the transmission from the vehicle.



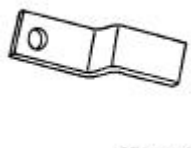
30. If the transmission is to be overhauled or if installing a new transmission, carry out transmission backflushing and cleaning. Carry out transmission fluid cooler backflushing and cleaning. For additional information, refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section.

31. Remove the special tool.



Transmission —4x4

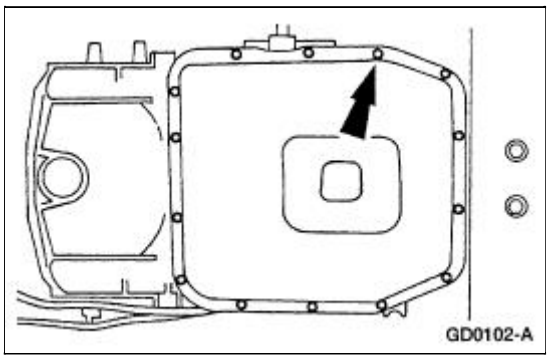
Special Tool(s)

 ST1636-A	Retainer, Torque Converter 307-346 (T97T-7902-A)

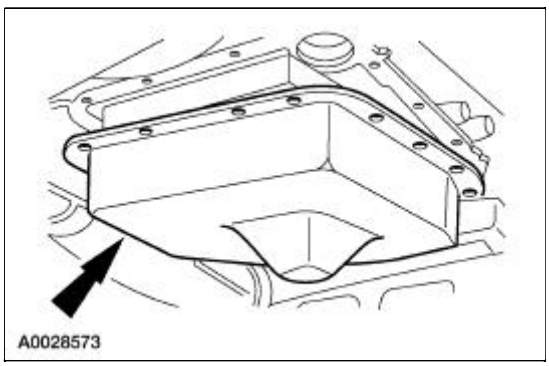
Removal

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the transfer case. For additional information, refer to Section 308-07B .
3. **NOTE:** If transmission disassembly is required, drain the transmission fluid.

   Loosen the transmission fluid pan bolts and allow the fluid to drain.

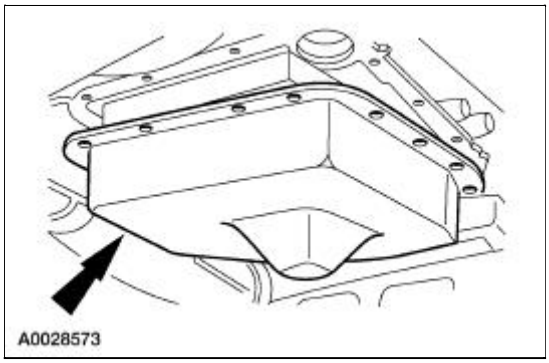


4. After the fluid has drained, remove the transmission fluid pan and drain the remaining fluid from the pan.

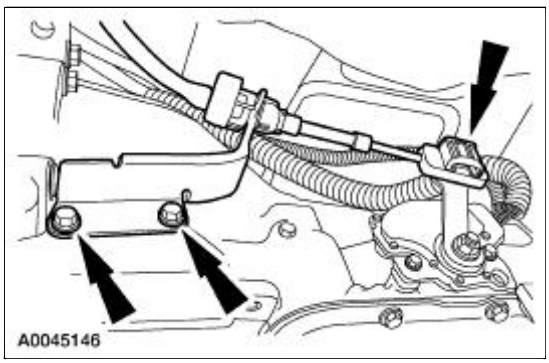


5. **NOTE:** It is not necessary to torque the transmission fluid pan bolts in this step.

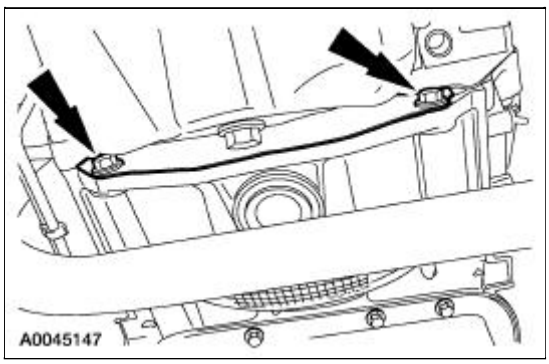
   Install the transmission fluid pan.



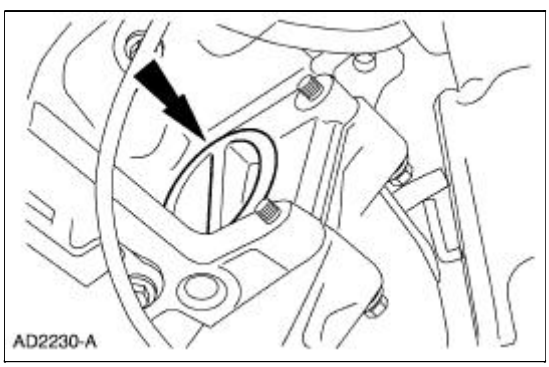
6. Disconnect the shift cable end and remove the shift cable bracket.



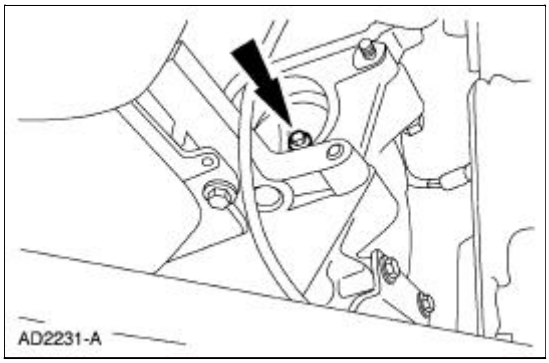
7. Remove the flexplate inspection cover.



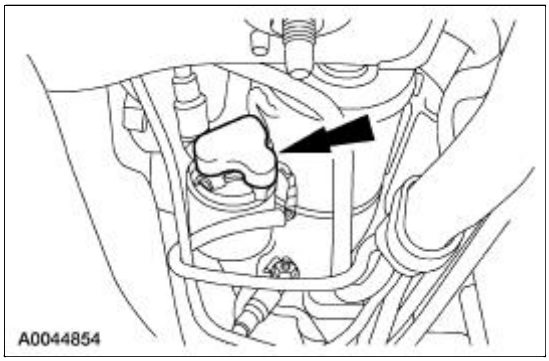
8. Remove the rubber access plug.



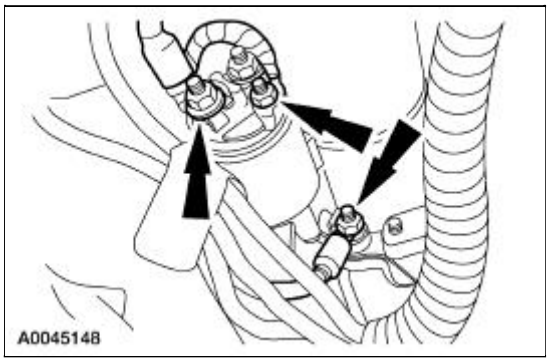
9. Remove and discard the four flexplate-to-torque converter nuts.



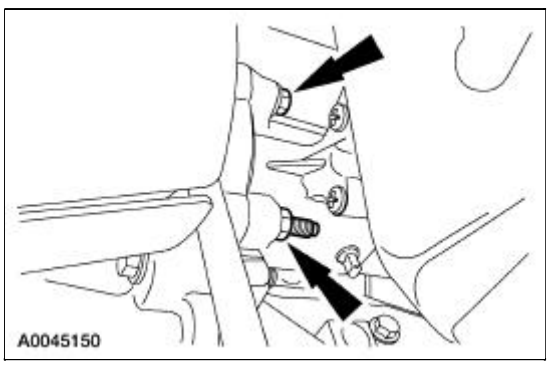
10. Remove the plastic starter motor electrical connector cap.



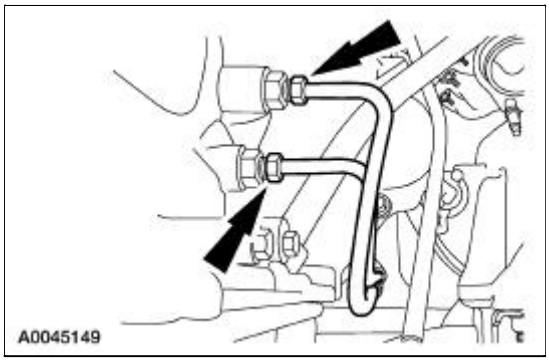
11. Remove the starter motor electrical connectors and the ground wire.



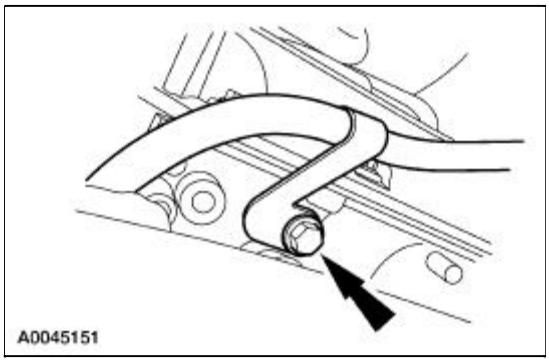
12. Remove the three bolts and the starter motor.



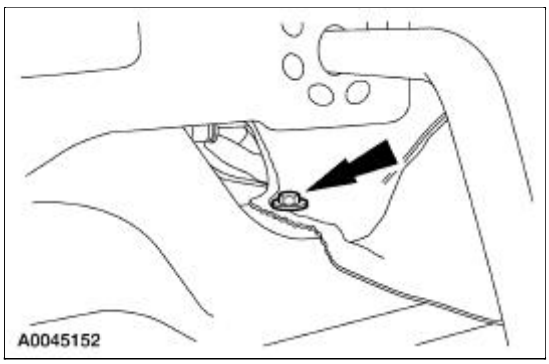
13. Disconnect the transmission cooler lines and position them aside.



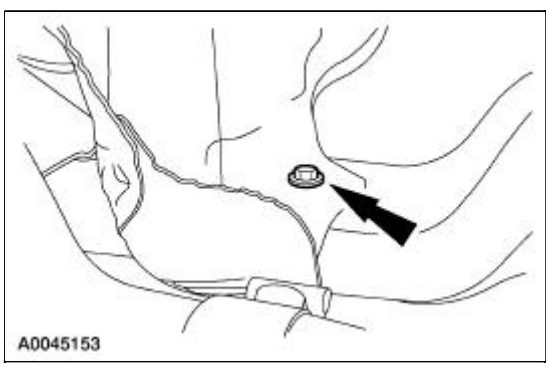
14. Remove the bolt from the RH cylinder head for the transmission filler tube and position the filler tube aside.



15. Remove the RH exhaust shield bolt.



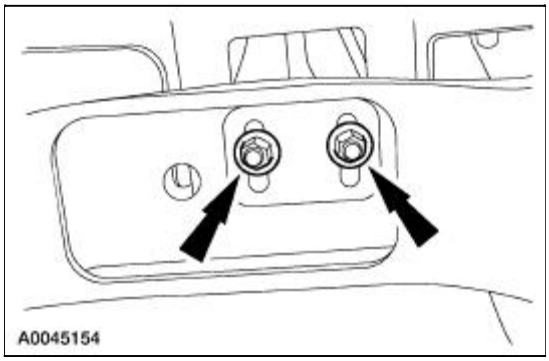
16. Remove the LH exhaust shield bolt.



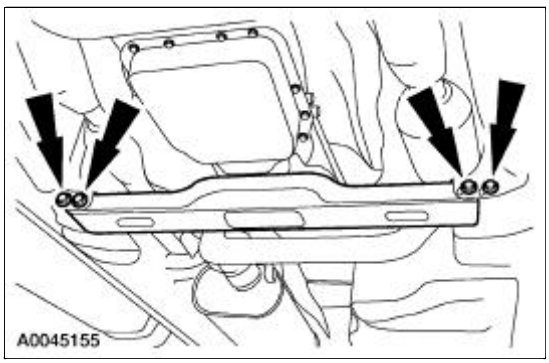
17. **NOTE:** Ensure that the transmission is securely fastened to the transmission jack.

    Position a suitable high-lift transmission jack under the transmission.

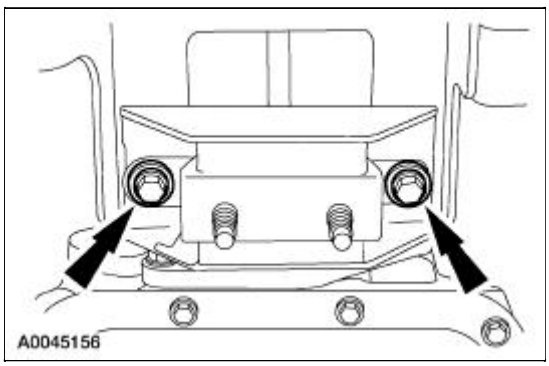
18. Remove the rear crossmember bolts.



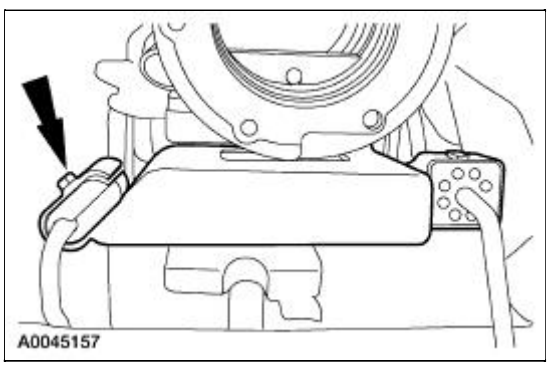
19. Remove the rear transmission retainer nuts and remove the crossmember.



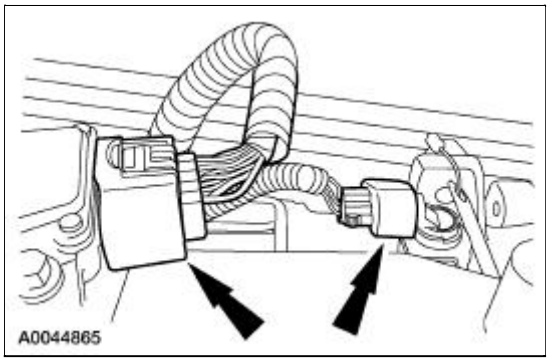
20. Remove the rear transmission support.



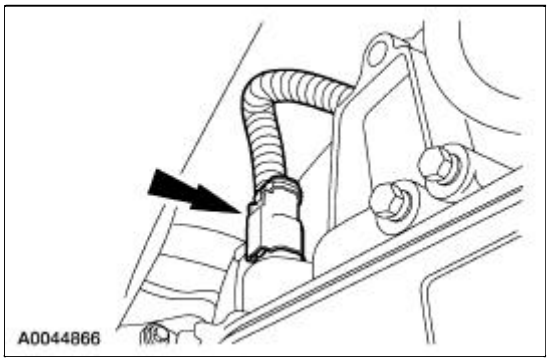
21. Remove the exhaust hanger.



22. Disconnect the digital transmission range (TR) sensor and the output shaft speed (OSS) sensor.

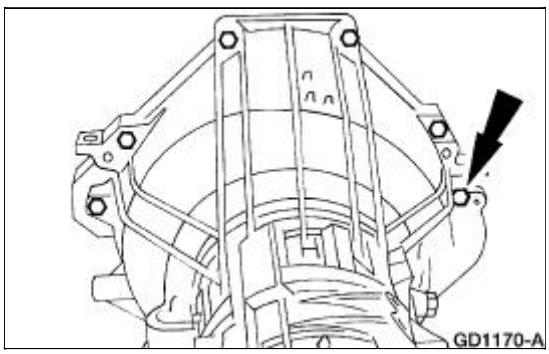


23. Disconnect the solenoid body assembly electrical connector.



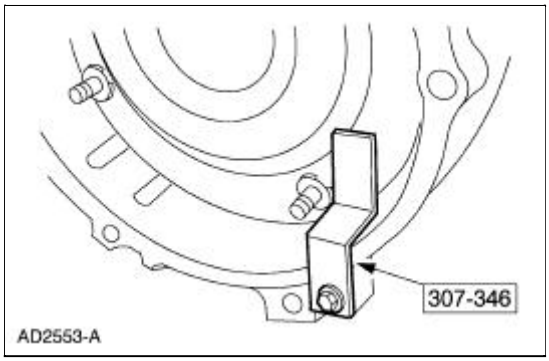
24. **NOTE:** Note the length and the location of the bolts during removal.

    Remove the seven transmission-to-engine bolts.



25. **WARNING: The torque converter is heavy and can result in injury if it falls out of the transmission. Secure the torque converter in the transmission.**

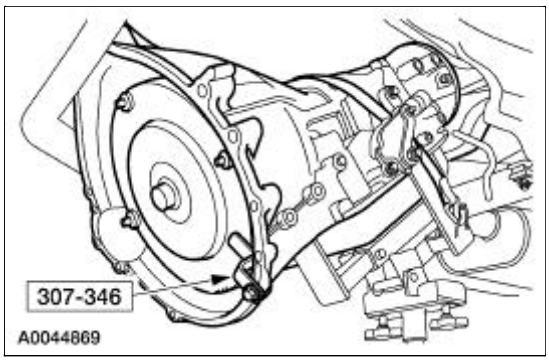
    Leaving the transmission in a horizontal position, slide it back far enough to install the special tool. Install the special tool.



26. **CAUTION: To remove the transmission from the vehicle, it will be necessary to put the transmission into a nose-down position to clear the flexplate and the exhaust system.**

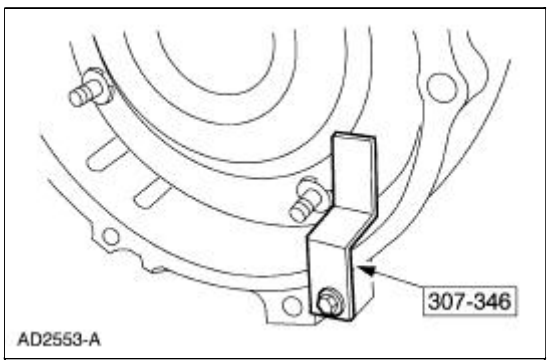
    NOTE: Make sure that the special tool is in place and the transmission is securely fastened to the transmission jack before tilting the transmission.

    Lower the transmission from the vehicle.

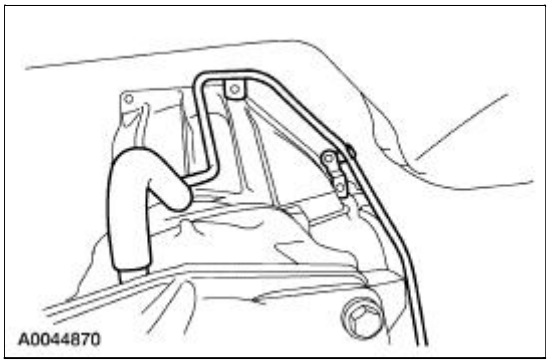


27. Once the transmission is clear of the vehicle the transmission fluid cooler and cooler tubes should be cleaned. Carry out transmission fluid cooler backflushing and cleaning. For additional information, refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section.

28. Remove the special tool.



29. Remove the vent tube.


A0044870

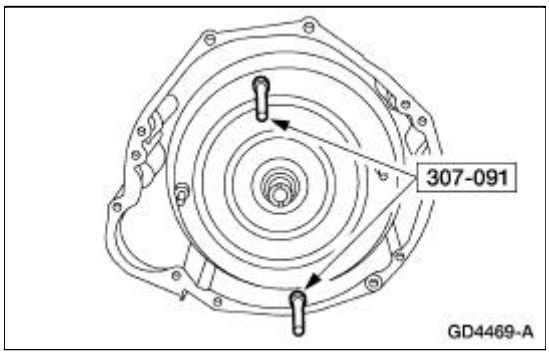
Transmission

Special Tool(s)

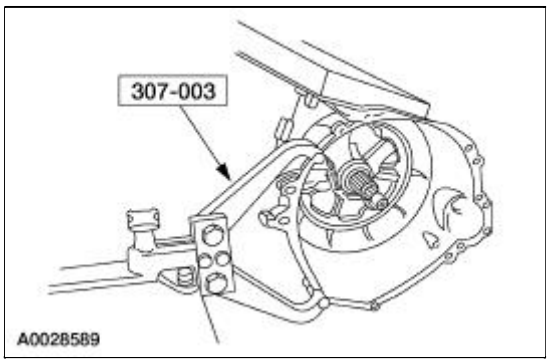
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
 ST1186-A	Holding Fixture, Transmission 307-003 (T57L-500-B)
 ST1187-A	Slide Hammer 307-005 (T59L-100-B)
 ST1192-A	Remover, Transmission Fluid Seal 307-048 (T74P-77248-A)
 ST1631-A	Handle, Torque Converter 307-091 (T81P-7902-C)
 ST1208-A	Remover, Transmission Fluid Pump 307-221 (T89T-70010-A)
 ST1210-A	Remover/Installer, Servo Piston 307-251 (T92P-70023-A)
	Remover, Torque Converter Fluid Seal

 ST1192-A	307-309 (T94P-77001-BH)
 ST1200-A	Remover, Bearing Cup 308-047 (T77F-1102-A)

1. Using the special tools, remove torque converter.

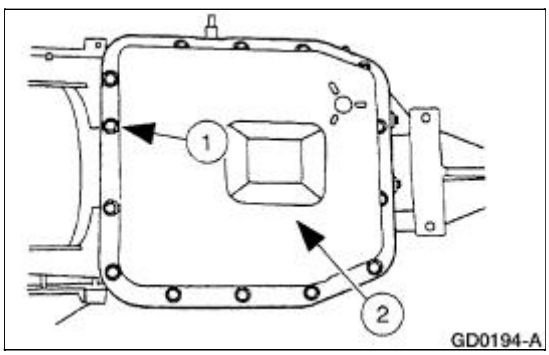


2. Using the special tool, mount the transmission to the bench.

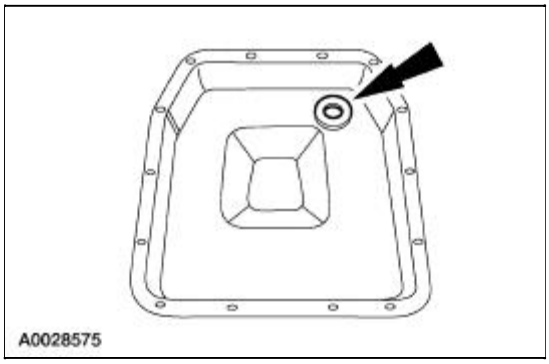


3. **NOTE:** If the transmission fluid pan gasket is not damaged, it may be reused.

   Remove the transmission fluid pan and transmission fluid pan gasket.
   1. Remove the bolts.
   2. Remove the transmission fluid pan and transmission fluid pan to case gasket.



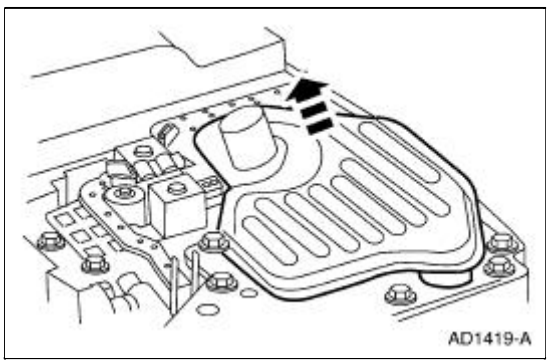
4. Clean the transmission fluid pan and pan magnet.



5. **CAUTION: If installing a new filter, and grommet remains in the main control bore, carefully use a small screwdriver to remove the grommet. Use care not to damage the main control bore.**

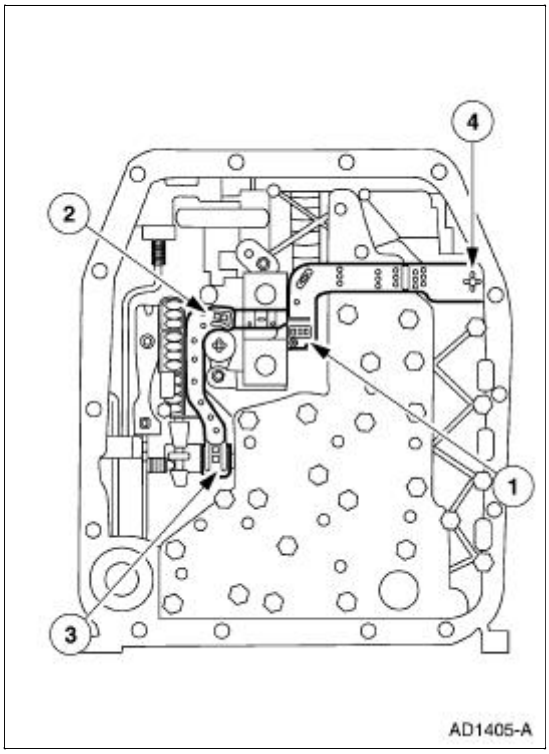
   NOTE: If transmission is being repaired for a contamination-related failure, use a new filter and seal. The filter may be reused if no excessive contamination is present.

   Remove the fluid filter and grommet.

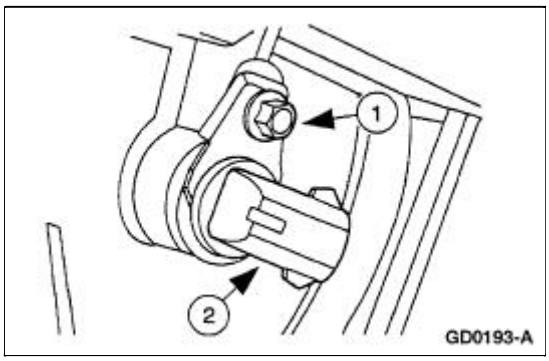


6. **CAUTION: Do not pull on the plastic lead frame. This may cause damage to the connector ends. Carefully pry up on the locking tabs to disconnect the solenoids. Disconnect the molded lead frame from the solenoids.**

   Disconnect the molded lead frame from the solenoids.
   1. Disconnect the shift solenoid SSA and SSB.
   2. Disconnect the torque converter clutch (TCC).
   3. Disconnect the electronic pressure control (EPC) solenoid.
   4. Disconnect the bulkhead inter-connector.

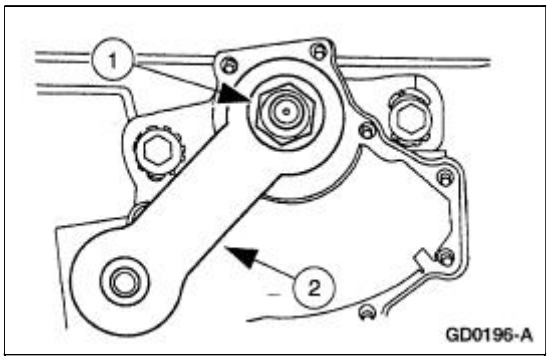


7. Remove the output shaft speed (OSS) sensor.
    1. Remove the bolt.
    2. Remove the OSS sensor.

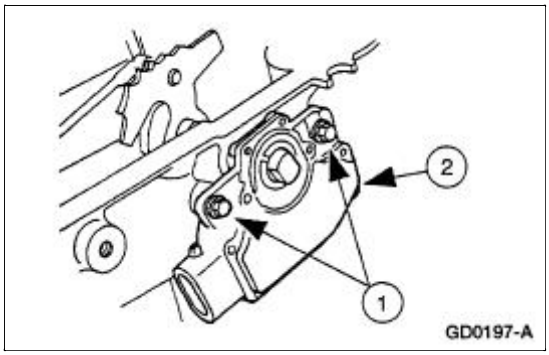


8. **CAUTION: Discard the manual lever shaft outer nut. Do not reuse.**

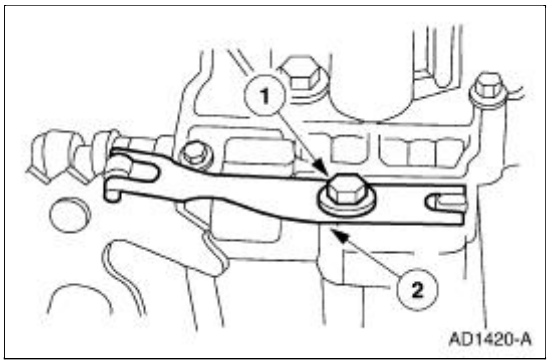
Remove the outer manual control lever.
1. Remove the manual lever shaft outer nut.
2. Remove the outer manual control lever.



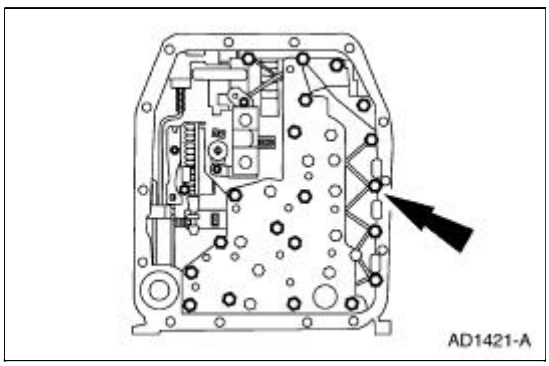
9. Remove the digital transmission range (TR) sensor.
    1. Remove the bolts.
    2. Remove the digital TR sensor.



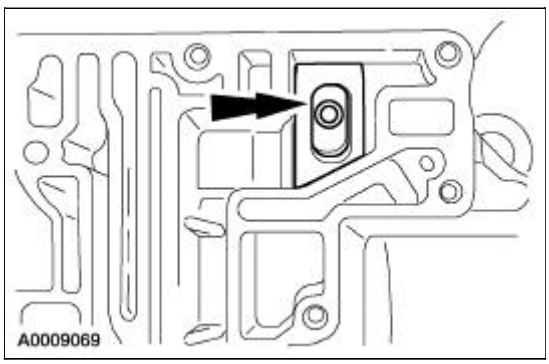
10. Remove the manual control valve detent lever spring.
    1. Remove the bolt.
    2. Remove the manual control valve detent lever spring.



11. Remove the 24 main control valve body bolts and the main control valve body.

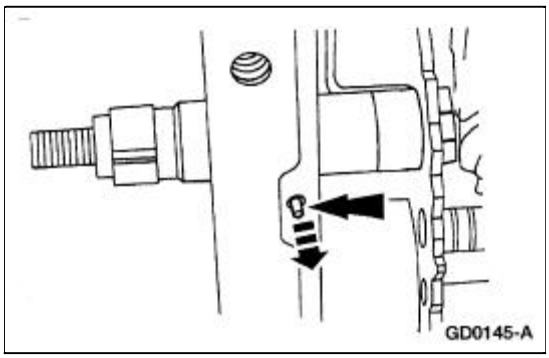


12. Remove and discard the pump outlet screen.

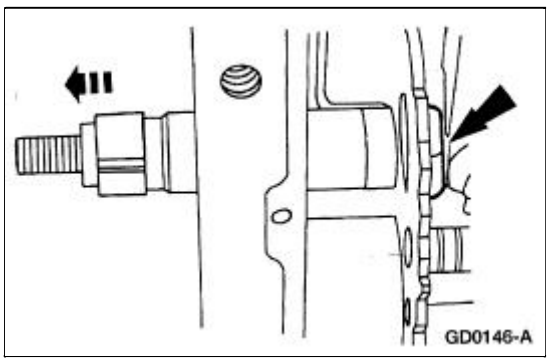


13. **NOTE:** Use a shop cloth to protect the transmission case surface.

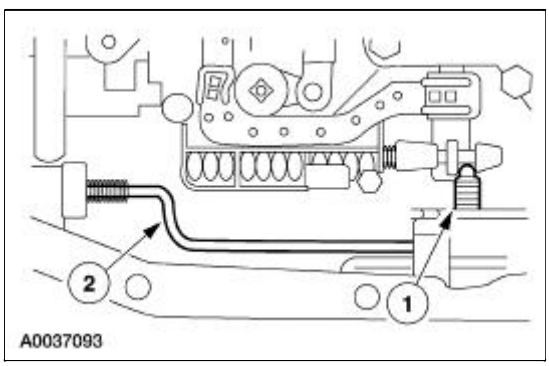
    Remove the manual lever shaft retaining pin.



14. Remove the manual lever shaft inner nut.
    - Slide the manual control lever shaft out of the case while removing the inner nut.

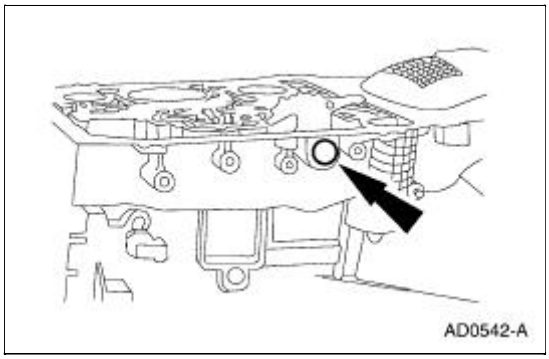


15. Remove the parking lever actuating rod.
    1. Remove the manual valve detent.
    2. Remove the parking lever actuating rod.

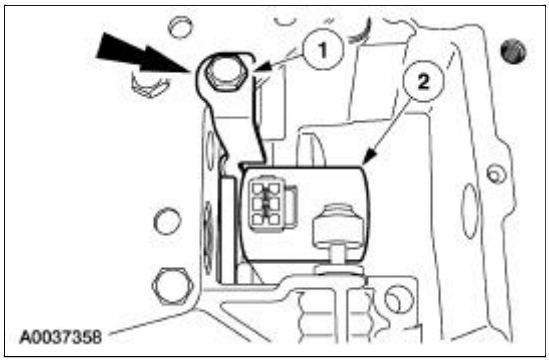


16. **CAUTION: Use care not to damage the manual control lever shaft bore. If the bore is damaged the new seal may leak.**

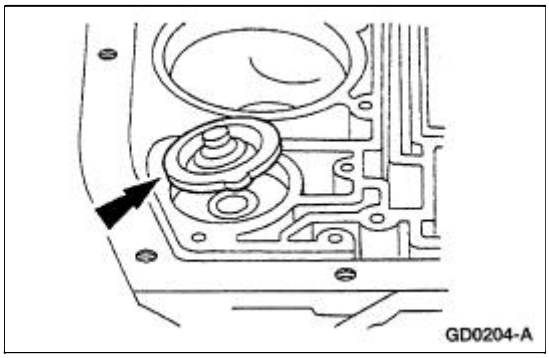
    Remove the manual control lever shaft seal.



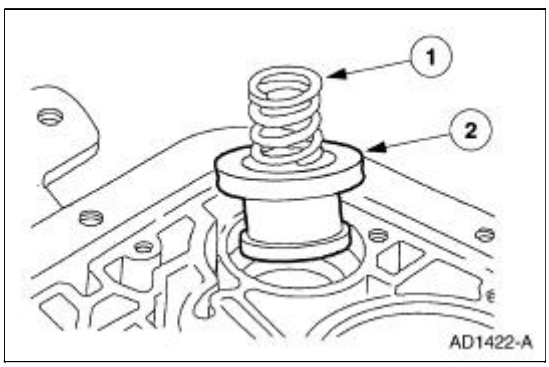
17. Remove the EPC solenoid.
    1. Remove the bolt and EPC solenoid bracket.
    2. Remove the EPC solenoid.



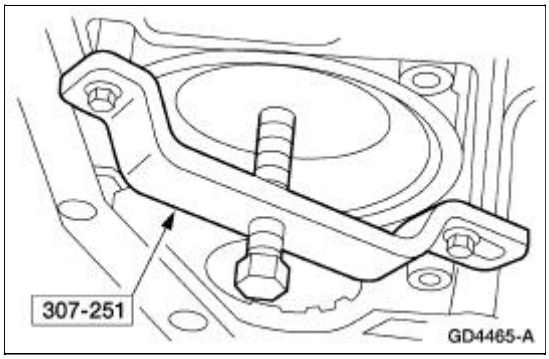
18. Remove the 2-3 accumulator spring retainer.



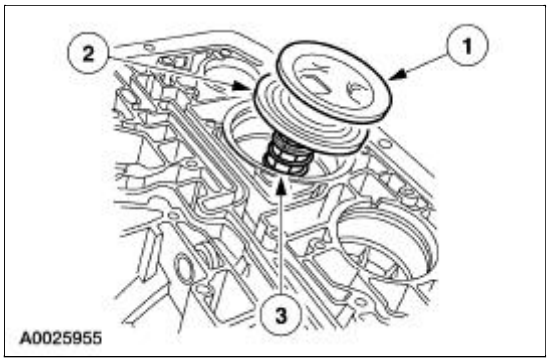
19. Remove the 2-3 accumulator piston.
    1. Remove the 2-3 accumulator spring.
    2. Remove the 2-3 accumulator piston.



20. Using the special tool, remove the reverse band servo retaining ring.

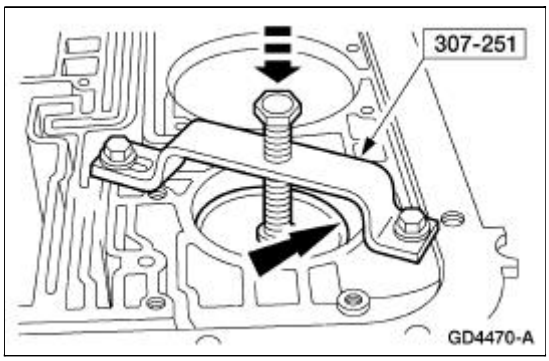


21. Remove the reverse band servo.
    1. Remove the reverse band servo cover.
    2. Remove the reverse band servo piston and rod assembly.
    3. Remove the reverse band servo spring.

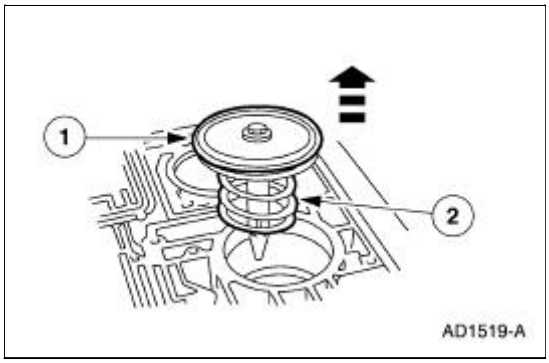


22. **NOTE:** If tool is not available, extreme care must be taken. Spring pressure will force overdrive servo piston assembly out of case. Case bore damage may result from trying to pry on internal retaining ring.

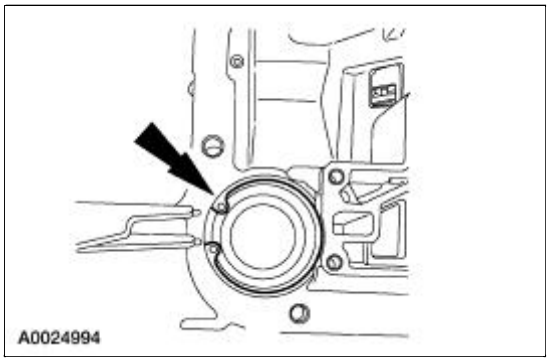
    Using the special tool, compress the piston spring, then remove the overdrive servo piston retainer.



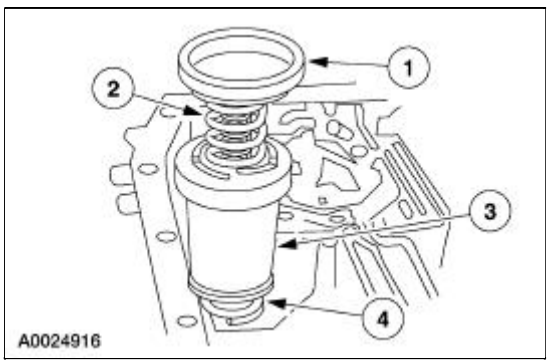
23. Remove the overdrive servo piston.
    1. Remove the overdrive servo piston.
    2. Remove the overdrive servo piston return spring.



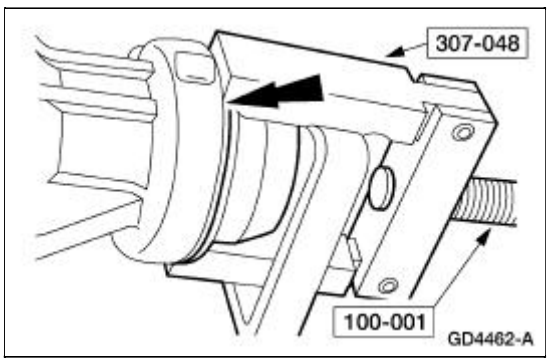
24. Compress the 1-2 accumulator cover and remove the 1-2 accumulator piston retaining ring.



25. Remove the 1-2 accumulator upper spring.
    1. Remove the 1-2 accumulator spring cover.
    2. Remove the inner and outer 1-2 accumulator springs.
    3. Remove the 1-2 accumulator.
    4. Remove the 1-2 accumulator upper spring.



26. Using the special tools, remove the extension housing seal.

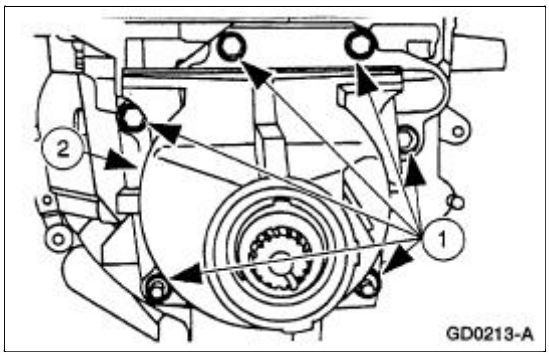


27. **NOTE:** These bolts have been coated with a sealant. High break torque may be required to

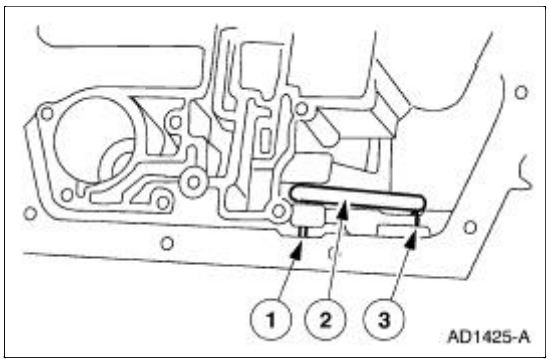
remove these bolts.

Remove the extension housing.

1. Remove the four bolts and two nuts.
2. Remove the extension housing and the extension housing gasket.



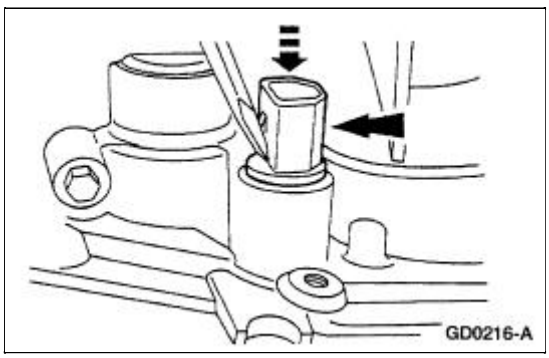
28. Remove the parking pawl.
    1. Remove the parking pawl shaft.
    2. Remove the parking pawl return spring.
    3. Remove the parking pawl.



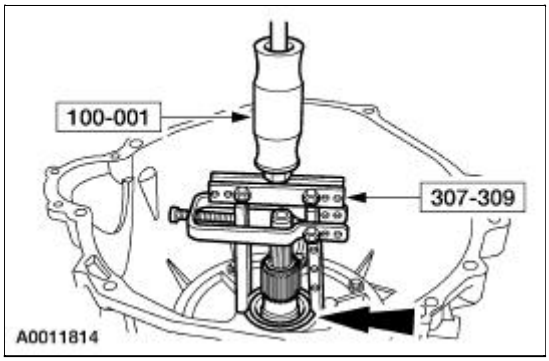
29. Rotate the transmission to the vertical position with the output shaft towards the floor.

30. **CAUTION: Extreme care must be taken during transmission connector removal. Do not pull on wires, or use a hammer on the connector body.**

    Place a screwdriver on the flat portion of the connector and push the connector out through the bottom of the case.

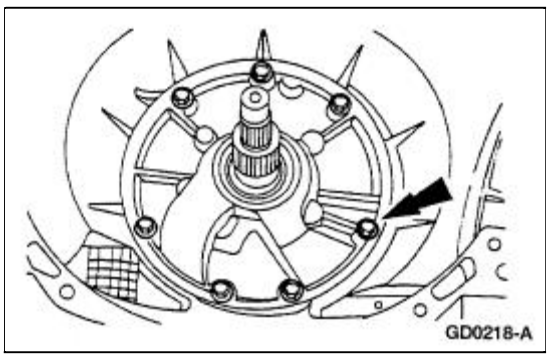


31. Using the special tools remove the front pump seal.

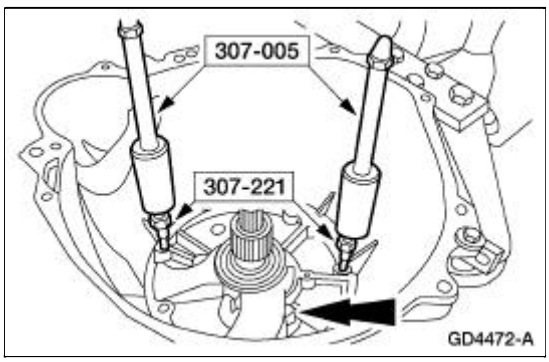


32. **NOTE:** These bolts have been coated with sealant. High break torque may be required to remove the bolts.

    Remove the front bolts.

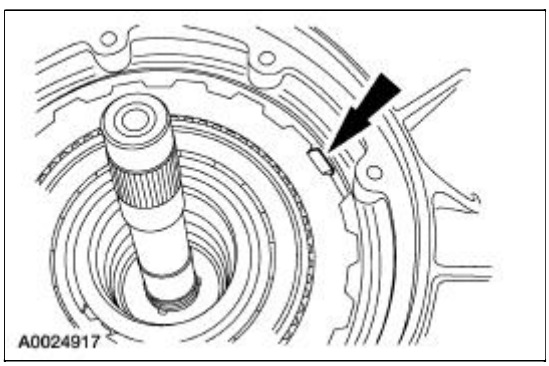


33. Using the special tools, remove the front pump support.



34. Remove and discard the pump gasket.

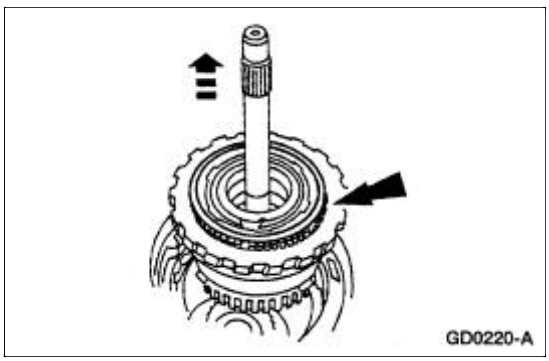
35. If equipped, remove the intermediate clutch anti-ratle clip.



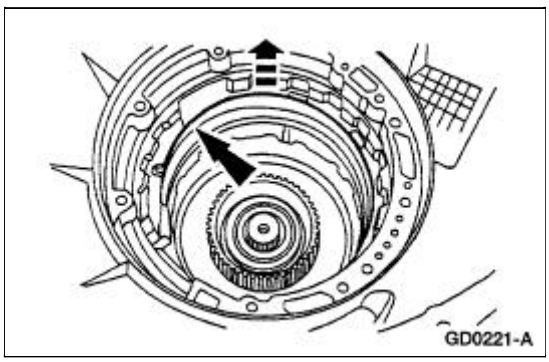
36. **CAUTION: Remove the assembly carefully to prevent damage to the overdrive band friction material by the reverse clutch drive lugs.**

Remove the following components as an assembly:

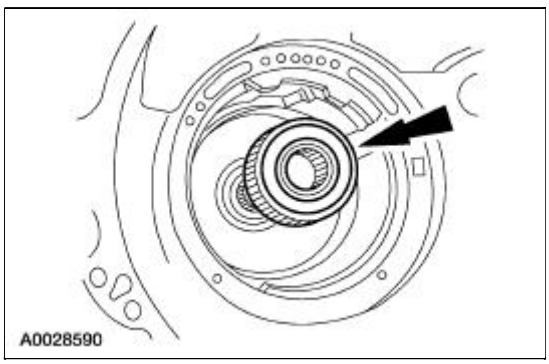
- intermediate clutch pack.
- intermediate one-way clutch.
- reverse clutch.
- forward clutch assembly.



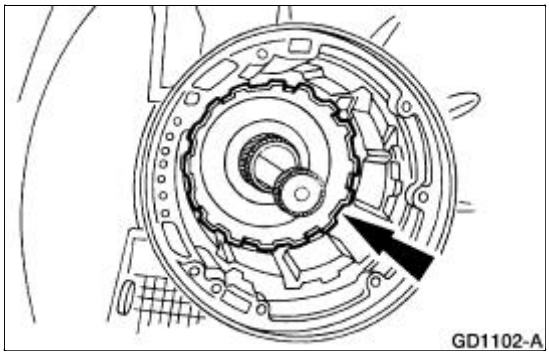
37. Disengage and remove the overdrive band.



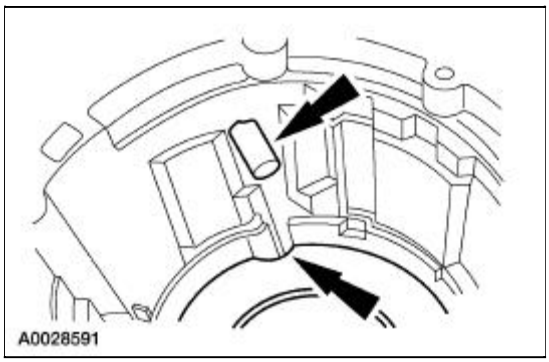
38. Remove the forward clutch hub and the No. 3 forward clutch hub front bearing.



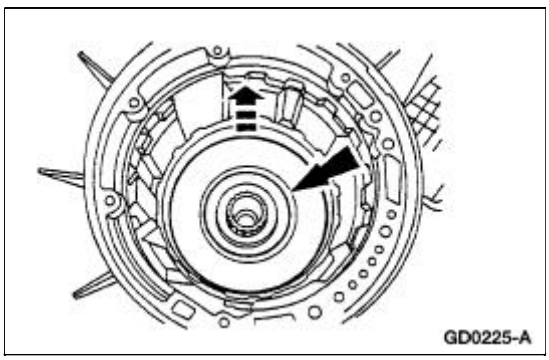
39. Remove the intermediate stub shaft.



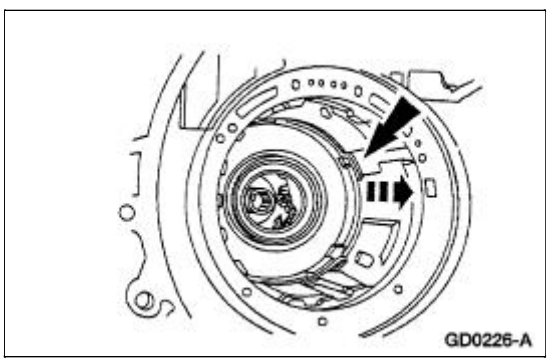
40. Align the reverse sun shell with the overdrive band anchor pin for removal.



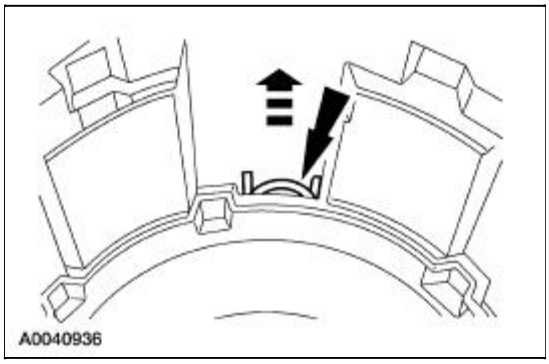
41. Remove the following components as an assembly:
    - Forward clutch sun gear.
    - No. 5 forward clutch sun gear bearing.
    - Reverse clutch sun gear.
    - No. 4 forward clutch hub bearing.



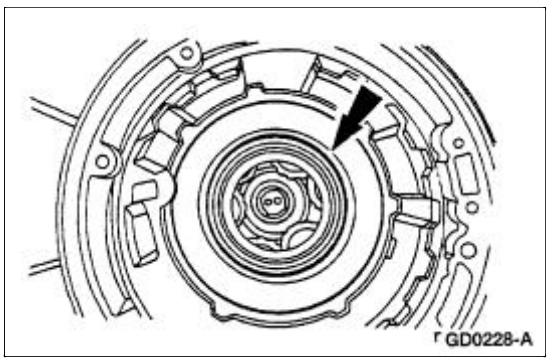
42. Remove the center support retaining ring and note location for assembly.



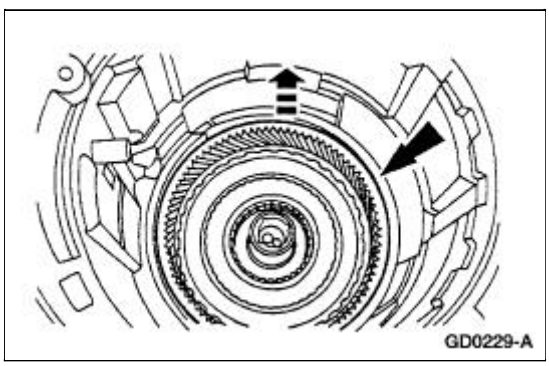
43. Remove the case to planet support spring.



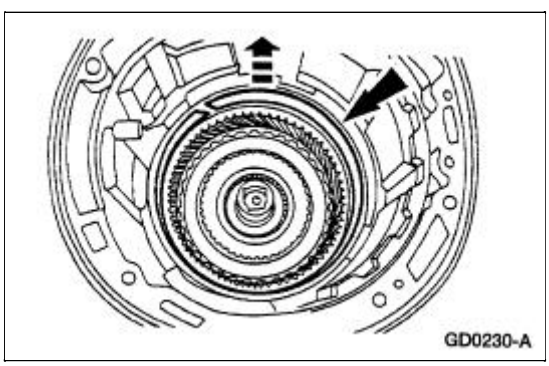
44. Remove the planetary gear support and planetary as an assembly.



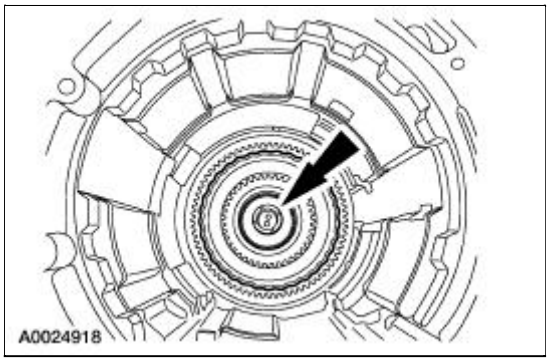
45. Remove the reverse clutch band.



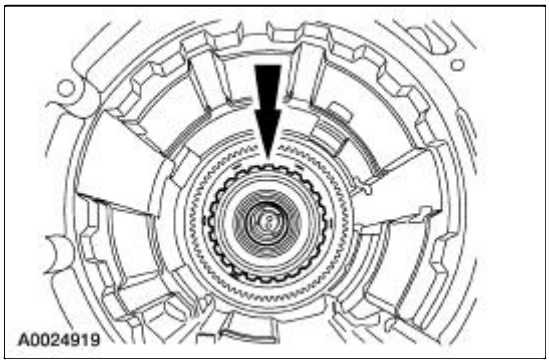
46. Remove the retaining ring.



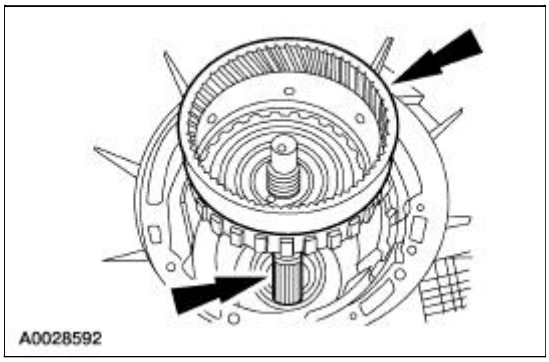
47. Remove the direct clutch pack.



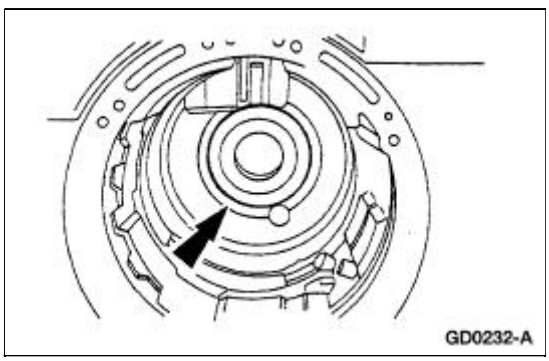
48. Remove the No. 8 bearing.



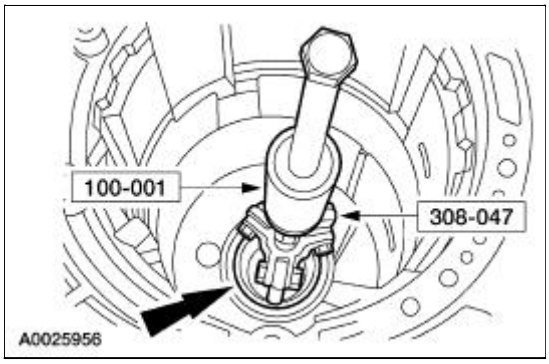
49. Remove the output shaft, output shaft ring gear assembly and direct clutch.



50. Remove the No. 9 case rear bearing.



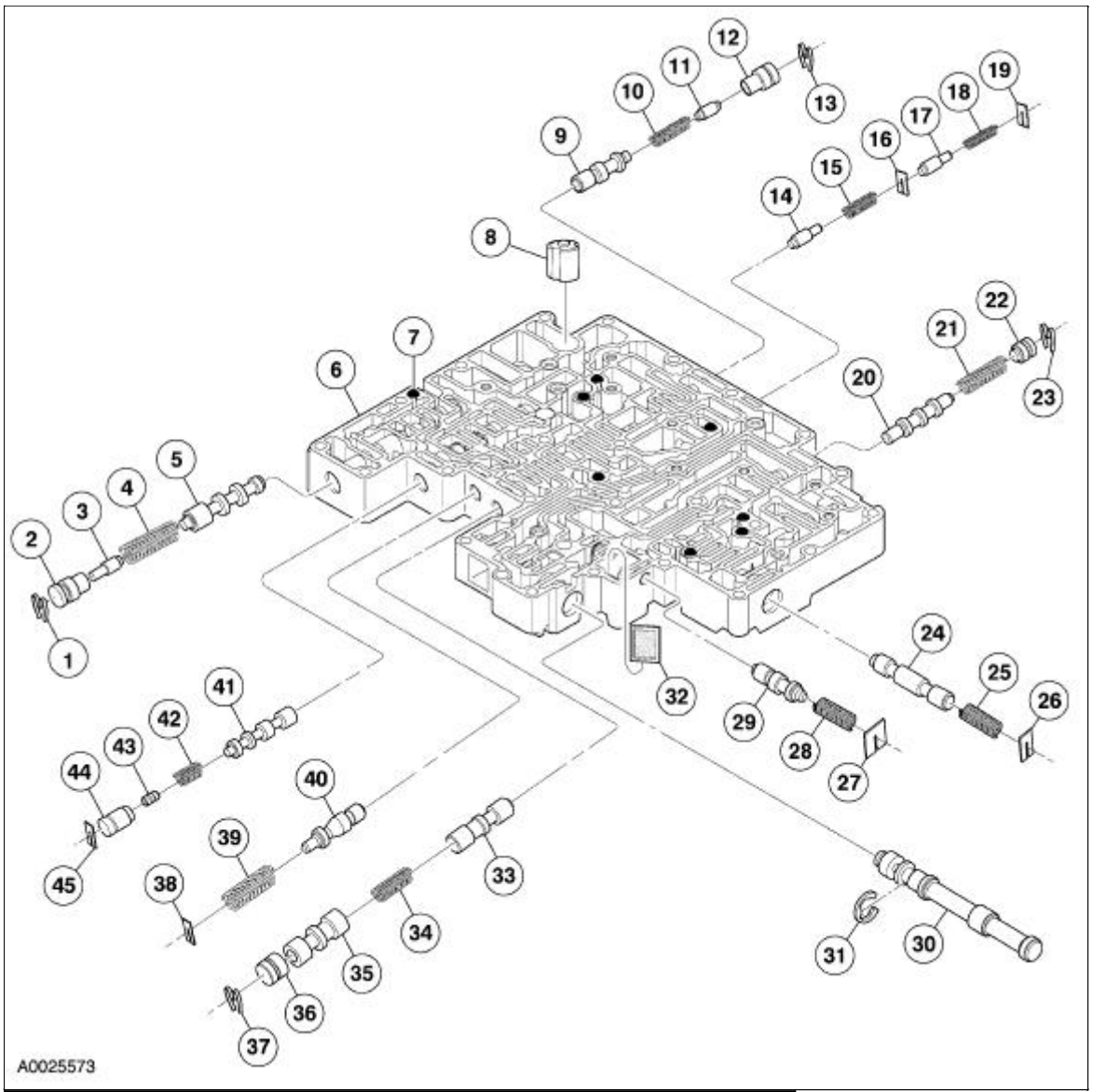
51. Inspect and if necessary, using the special tools, remove the rear case bushing.


100-001
308-047
A0025956

Main Control Valve Body

Disassembly

Main Control Valve Body — Disassembled View

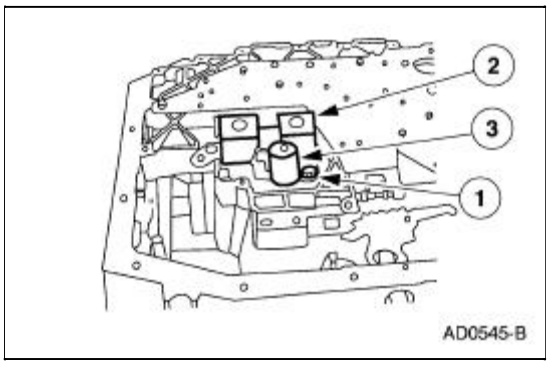


Item	Part Number	Description
1	—	Valve plug retainer (part of 7A100)
2	—	Main pressure booster valve sleeve (part of 7A100)
3	—	Main pressure booster valve (part of 7A100)
4	—	Main pressure regulator valve spring (part of 7A100)
5	—	Main regulator valve (part of 7A100)

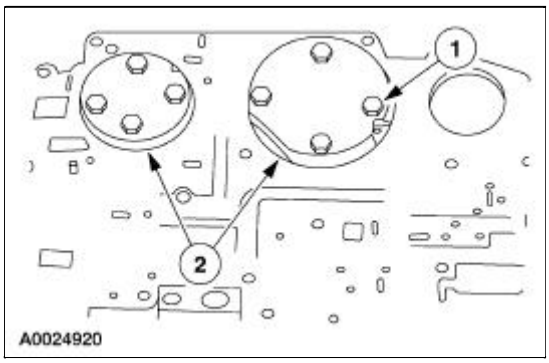
6	7A100	Main control valve body assembly
7	7E195	Check ball (8 req'd)
8	7H171	Converter drain back valve
9	—	Pressure regulator valve (part of 7A100)
10	—	Pressure regulator valve spring (part of 7A100)
11	—	Regulator boost plunger (part of 7A100)
12	—	Regulator boost sleeve (part of 7A100)
13	—	Valve retainer (part of 7A100)
14	—	Capacity modulator valve (part of 7A100)
15	—	Capacity modulator valve spring (part of 7A100)
16	—	Spring retaining plate (part of 7A100)
17	—	Capacity modulator valve (part of 7A100)
18	—	Capacity modulator valve spring (part of 7A100)
19	—	Spring retaining plate (part of 7A100)
20	—	3-4 shift valve (part of 7A100)
21	—	3-4 shift valve spring (part of 7A100)
22	—	Valve retainer plug (part of 7A100)
23	—	Valve plug retainer (part of 7A100)
24	—	2-3 backout valve (part of 7A100)
25	—	2-3 backout valve spring (part of 7A100)
26	—	Spring retaining plate (part of 7A100)
27	—	Spring retaining plate (part of 7A100)
28	—	Pressure regulator valve spring (part of 7A100)
29	—	Pressure regulator valve (part of 7A100)
30	—	Control manual valve (part of 7A100)
31	—	Retaining ring (part of 7A100)
32	—	Solenoid screen
33	—	1-2 shift valve (part of 7A100)
34	—	2-3 shift valve spring (part of 7A100)
35	—	2-3 valve (part of 7A100)
36	—	Valve retaining plug (part of 7A100)
37	—	Valve plug retainer (part of 7A100)
38	—	Spring retaining plate (part of 7A100)
39	—	Pressure regulator valve spring (part of 7A100)
40	—	Pressure regulator valve (part of 7A100)
41	—	Bypass clutch control valve (part of 7A100)
42	—	Bypass clutch control valve spring (part of 7A100)
43	—	Bypass clutch control valve plunger (part of 7A100)
44	—	Bypass clutch control plunger sleeve (part of 7A100)

45	—	Control valve plate (part of 7A100)

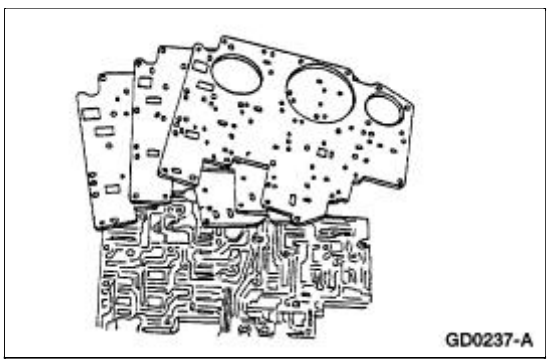
1. Remove the torque converter clutch (TCC) solenoid and the shift solenoid.
    1. Remove the bolt.
    2. Remove the shift solenoid.
    3. Remove the TCC solenoid.



2. Remove the two reinforcement plates.
    1. Remove the bolts.
    2. Remove the plates.

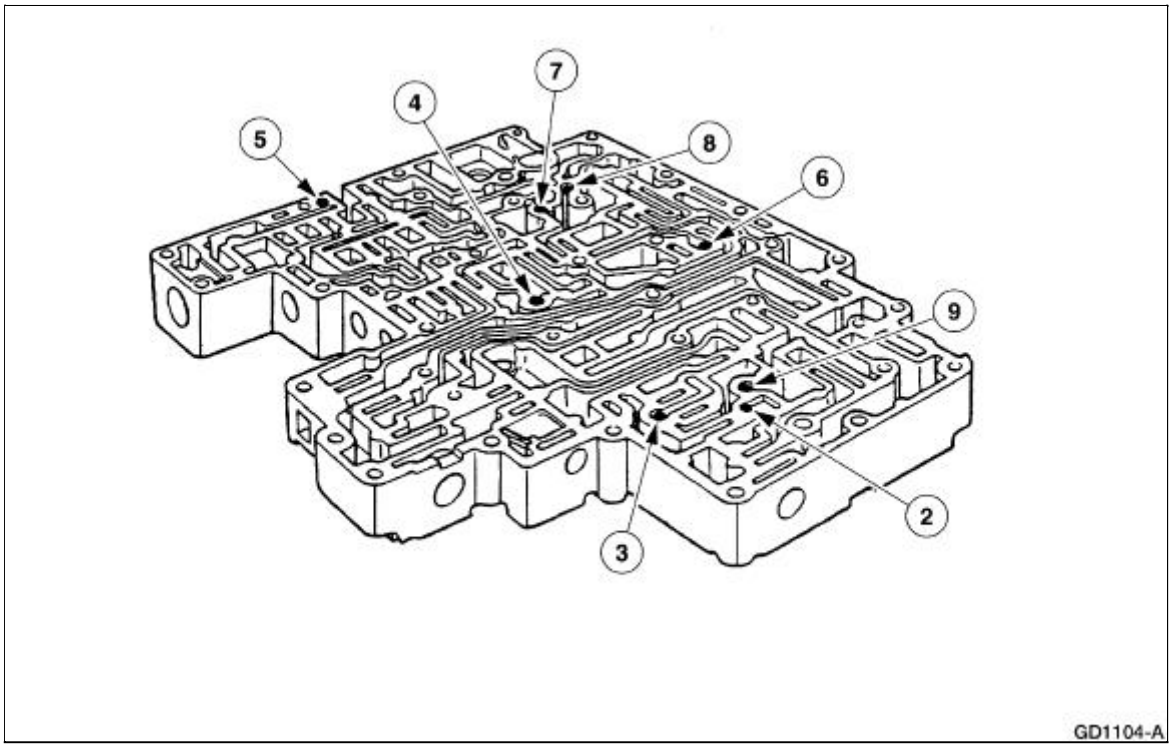


3. Remove the separator plate and discard the gaskets.

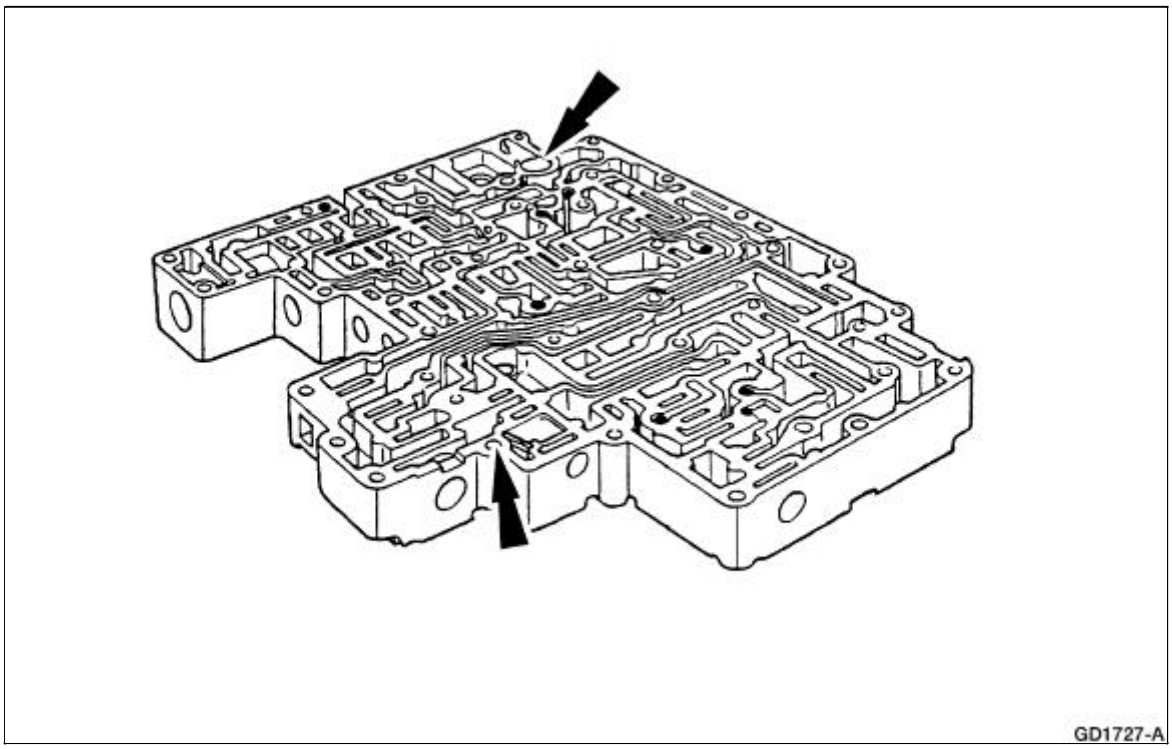


4. **NOTE:** Note the location of the eight coasting booster valve shuttle balls for assembly.

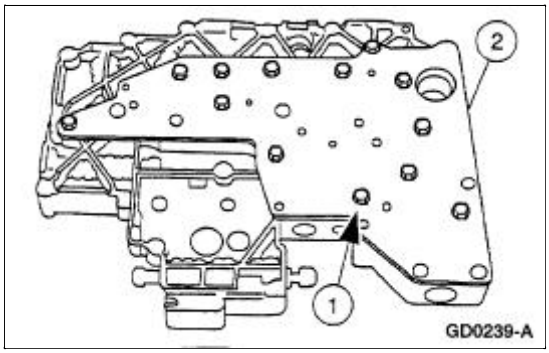
   Remove the eight coasting booster valve shuttle balls.



5. Remove the converter drain back valve and solenoid pressure supply screen.



6. Remove the main control valve body cover plate.
    1. Remove the 13 bolts.
    2. Remove the valve body cover plate and gasket.



Assembly

1. **CAUTION: Before beginning assembly, carry out and inspect the following:**

   When building up subassemblies and assembling the transmission, ALWAYS use new gaskets and seals.

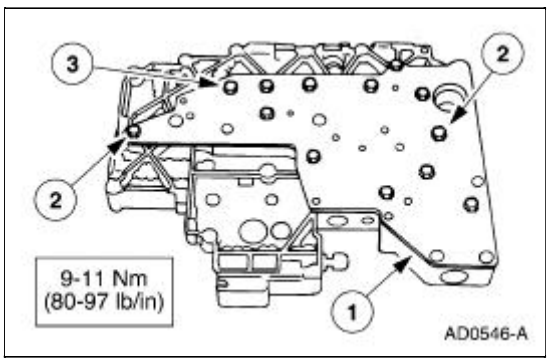
   All fasteners must be tightened to the torque specification indicated. In addition to appearing in the section, the necessary torques can be found in the General Specifications Chart.

   When building up subassemblies, each component part should be lubricated with clean transmission fluid. It is also good practice to lubricate the subassemblies as they are installed in the case.

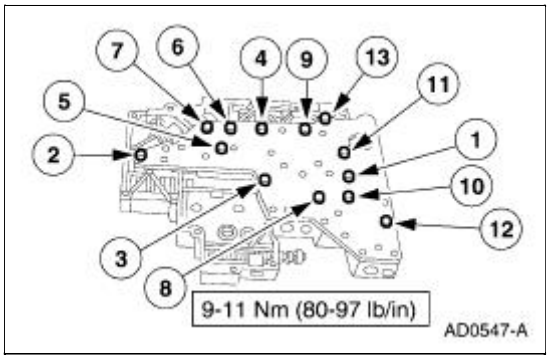
   Needle bearings, thrust washers and seals should be lightly coated with petroleum jelly during subassembly buildup or transmission assembly.

   Many components and surfaces in the transmission are precision machined. Careful handling during disassembly, cleaning, inspection and assembly can prevent unnecessary damage to machined surfaces.

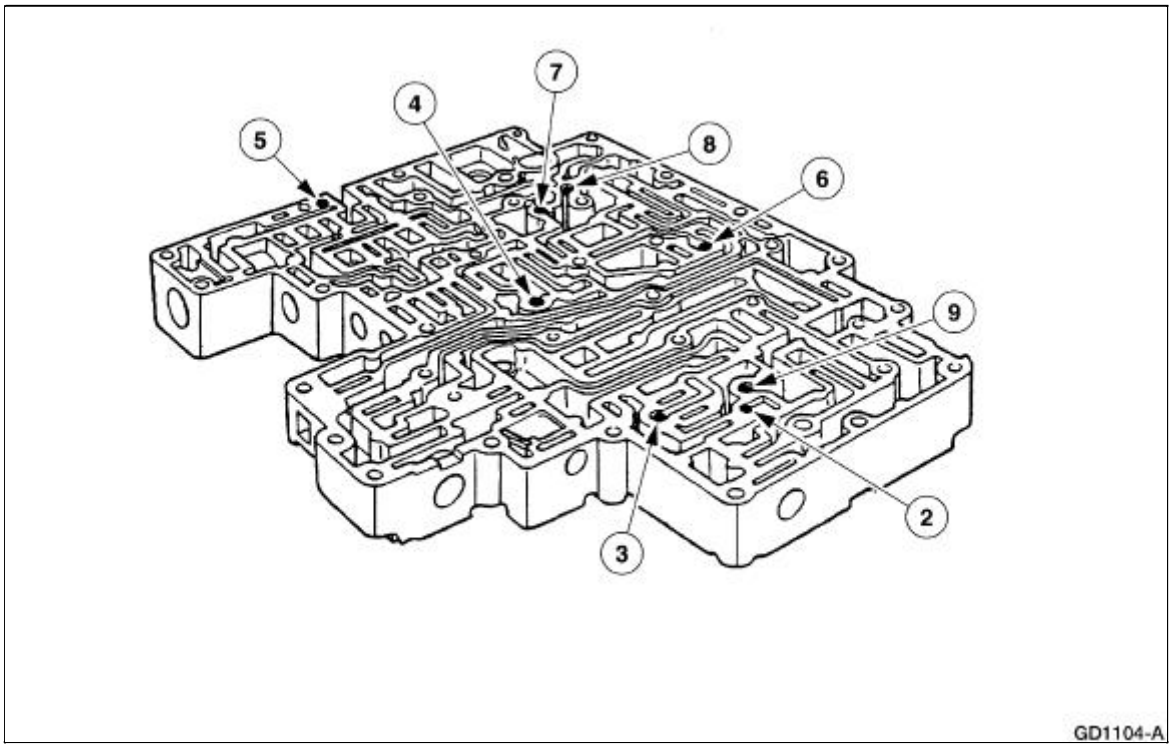
   Install the valve body cover plate.
   1. Position the valve body cover plate gasket and cover plate.
   2. Install the two guide pin bolts.
   3. Install the bolts.



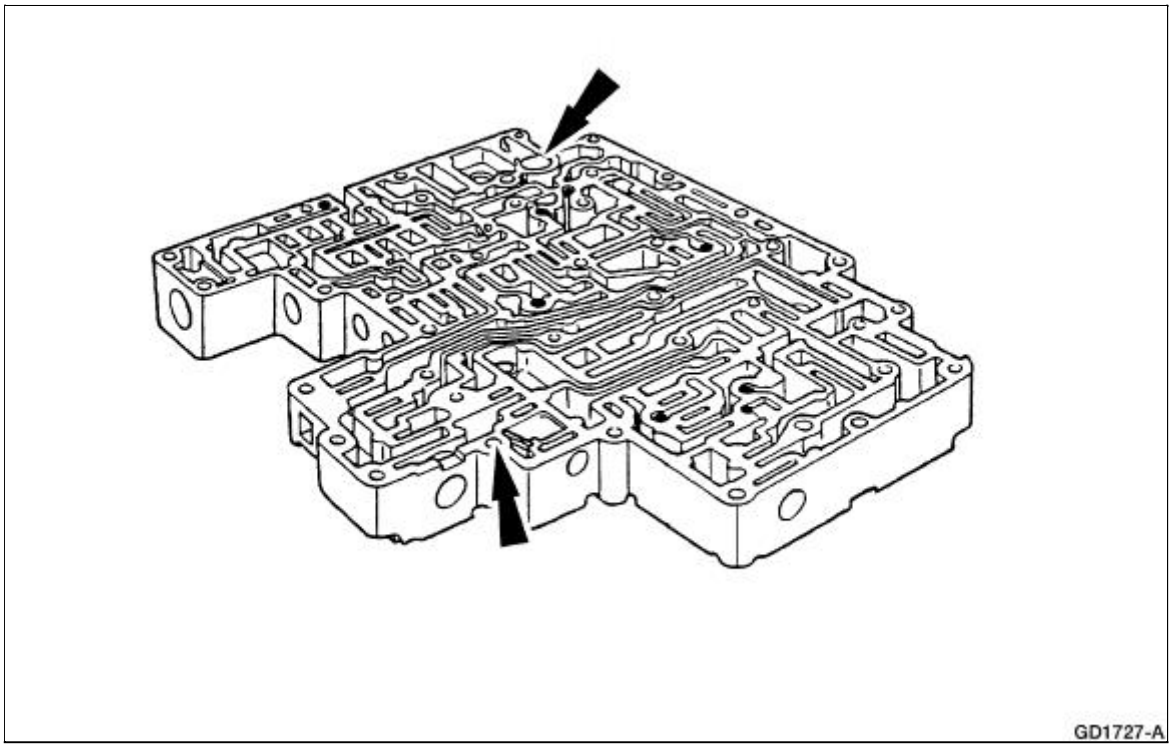
2. Tighten the bolts in the sequence shown.



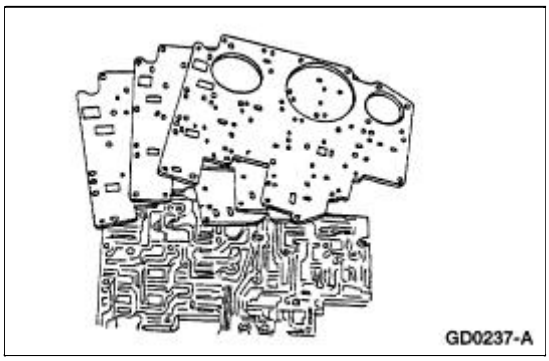
3. Install the eight coasting booster valve shuttle balls.



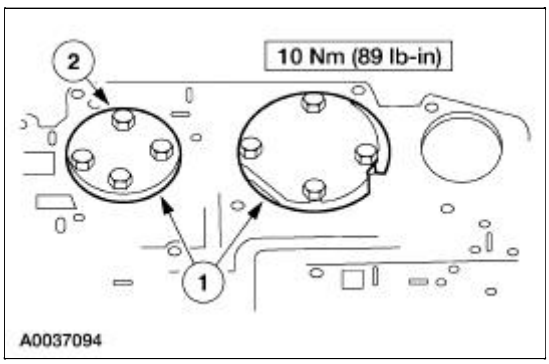
4. Install the converter drain back valve and solenoid pressure supply screen.



5. Install the separator plate and gaskets.



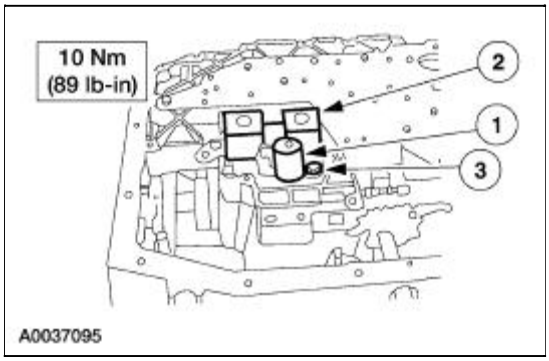
6. Install the two reinforcement plates.
    1. Position the plates.
    2. Install the bolts.



7. **NOTE:** Inspect the shift solenoid O-rings and TCC solenoid O-rings for damage.

    Install the shift solenoid.
    1. Position the TCC solenoid.
    2. Position the shift solenoid.

3. Install the bolt.

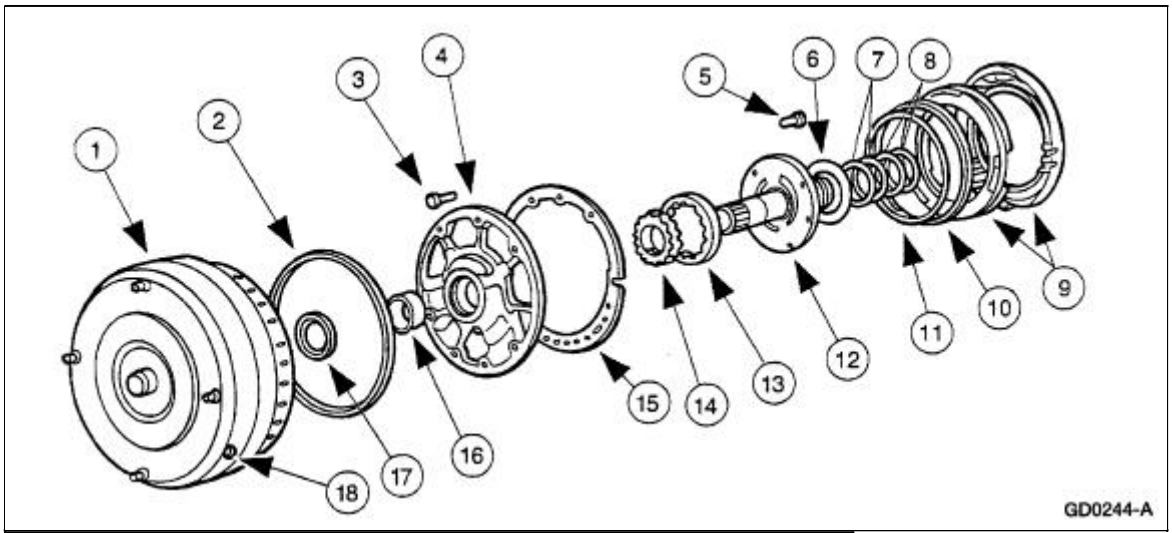


Pump and Intermediate Clutch Piston

Special Tool(s)

 ST1189-A	Installer, Front Pump Fluid Seal 307-014 (T63L-77837-A)
 ST1914-A	Protector, Piston Seal 307-339 (T95L-77005-A)

Pump and Intermediate Clutch Piston — Disassembled View

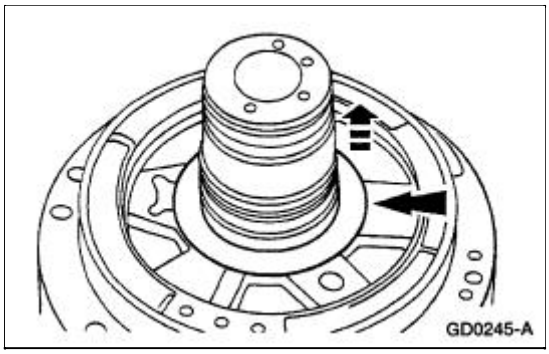


Item	Part Number	Description
1	7902	Torque converter
2	7A248	Front pump O-ring
3	N605789-S101	Bolt
4	—	Pump body assembly
5	N605787-S1000	Front pump support bolt
6	7D014	No. 1 pump support thrust washer
7	7D020	Reverse clutch cylinder seal
8	7D019	Forward clutch cylinder seal
9	7E005	Intermediate clutch piston
10	7F224	Intermediate clutch piston outer seal

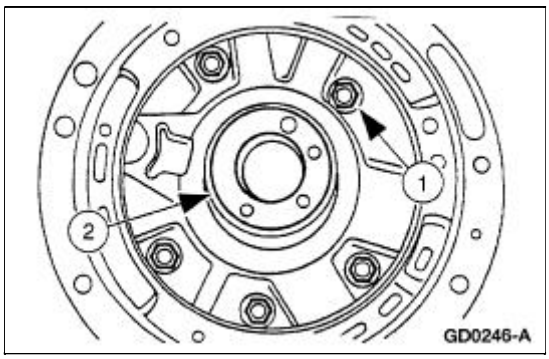
11	7F225	Intermediate clutch piston inner seal
12	7A108	Pump support
13	—	Pump outer gerotor gear
14	—	Pump inner gerotor gear
15	7A136	Pump gasket
16	—	Pump bushing
17	7A248	Pump inner seal
18	391855-S100	Converter drain plug

Disassembly

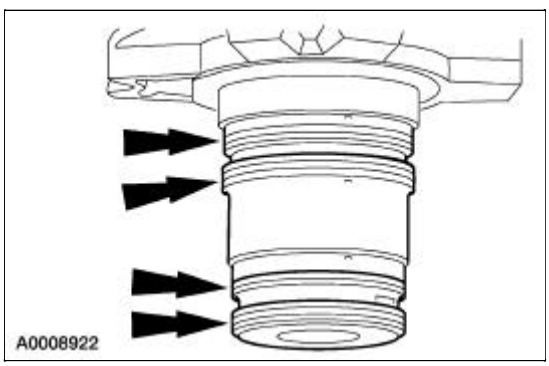
1. Remove the No. 1 selective pump support thrust washer.



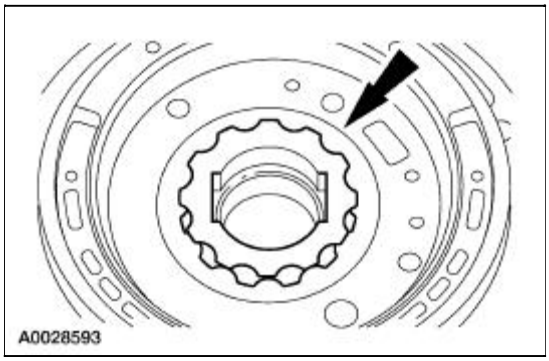
2. Remove the front pump support.
    1. Remove the bolts.
    2. Remove the front pump support.



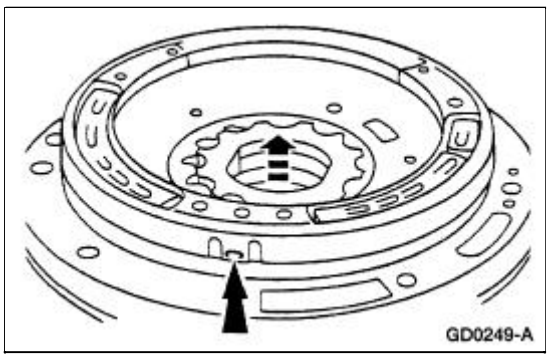
3. Remove the seal rings.



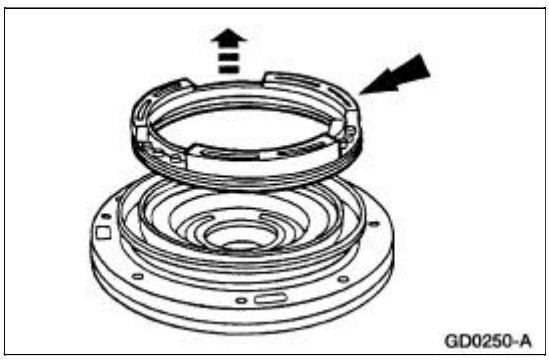
4. Remove the inner and outer pump gerotor gears.



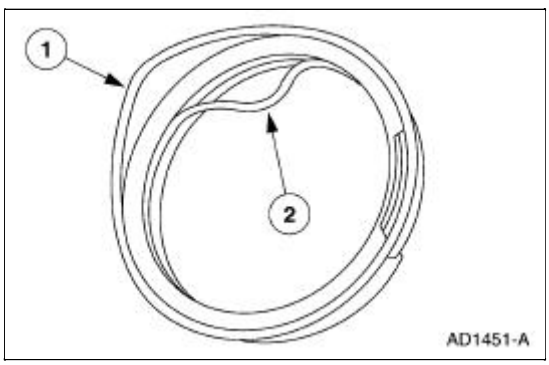
5. Carefully pry spring retainer tabs and remove the spring retainer assembly.



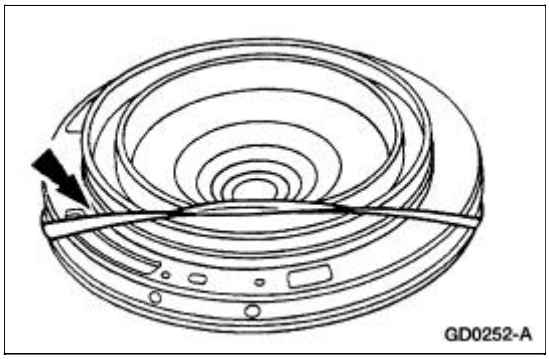
6. Remove the intermediate clutch piston.



7. Remove the clutch piston seals.
    1. Remove the intermediate clutch piston outer seal.
    2. Remove the intermediate clutch piston inner seal.

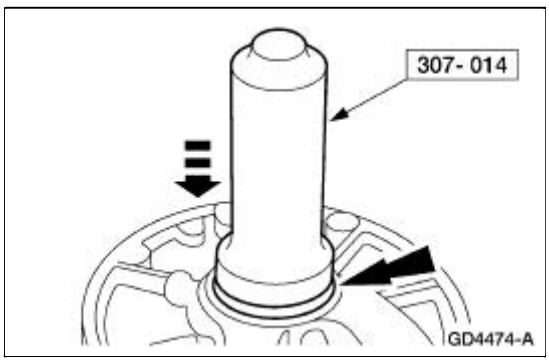


8. Remove and discard the front pump seal.

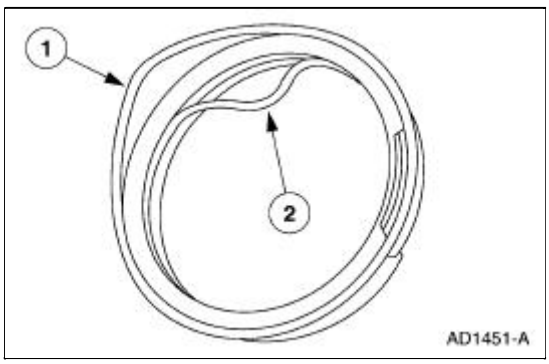


Assembly

1. Using the special tool, install the front pump seal assembly.

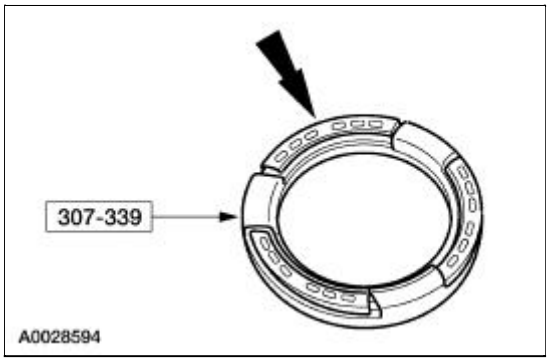


2. Install the clutch piston seals.
    1. Install the intermediate clutch piston outer seal.
    2. Install the intermediate clutch piston inner seal.

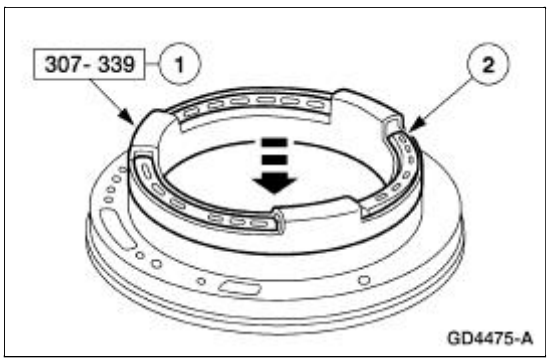


3. **NOTE:** Coat the intermediate clutch piston outer seal, inner seal and pump body with petroleum jelly.

   Install the intermediate clutch piston into the special tool.



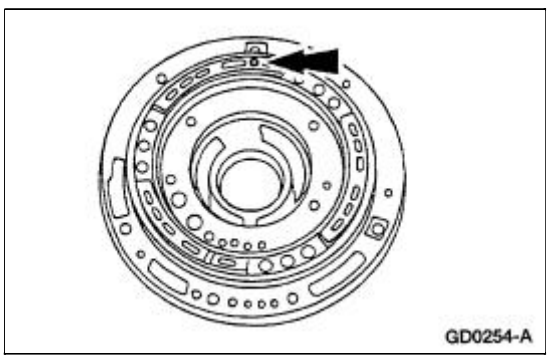
4. Using the special tool, install the intermediate clutch piston.
    1. Position the intermediate clutch piston and the special tool onto the pump body.
    2. Push the intermediate clutch piston to the bottom of the pump body bore, exerting even pressure and remove the special tool.



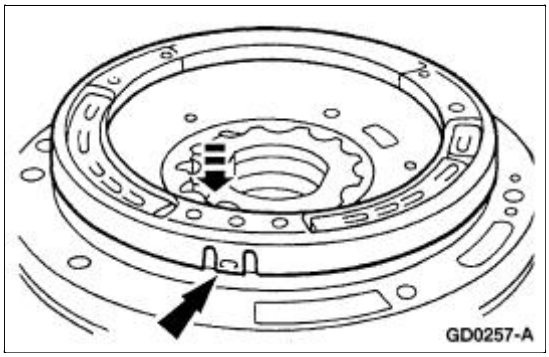
5. **CAUTION: The piston bleed hole must be located at 12 o'clock position (towards the top of the transmission). Shift problems may occur if installed incorrectly.**

    NOTE: The piston bleed hole is the only round hole in the pump body.

    Locate the piston bleed hole.

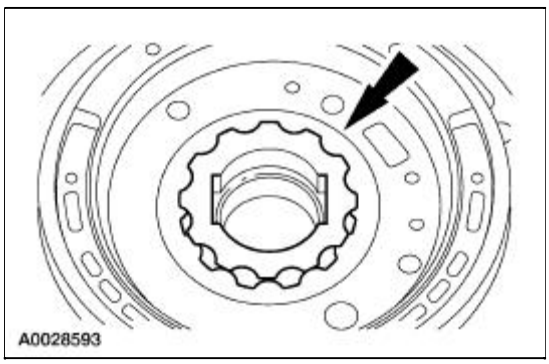


6. Install by snapping the spring retainer assembly on pump body.



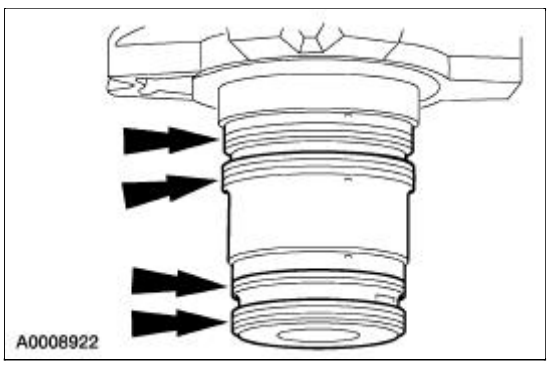
7. **NOTE:** The flats on the inner fluid pump gear have steps that must face the pump body or damage will result.

   Install the inner and outer fluid pump gerotor gears.

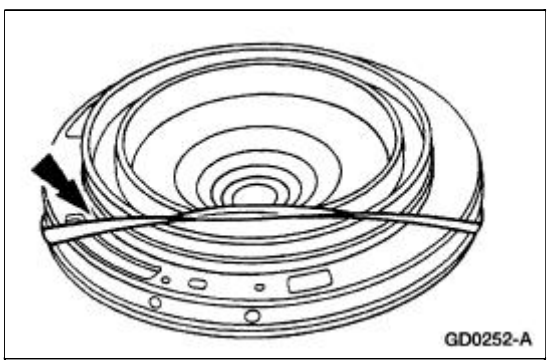


8. **NOTE:** The reverse clutch cylinder seal rings are larger than the forward clutch cylinder seals.

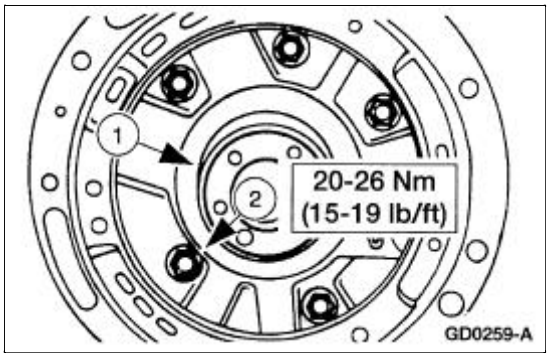
   Install the seal rings.



9. Install a new front pump seal.

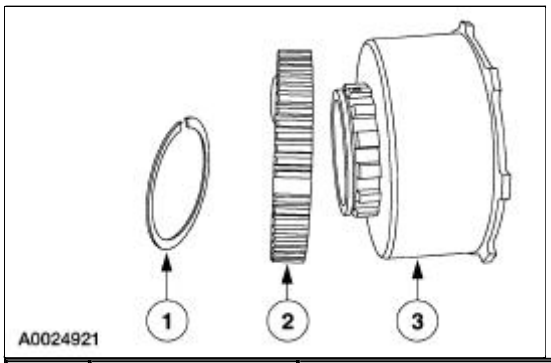


10. Assemble the front pump.
    1. Position the pump support to the pump body assembly.
    2. Install the bolts.



Intermediate One-Way Clutch

Intermediate Clutch Cylinder Disassembled View

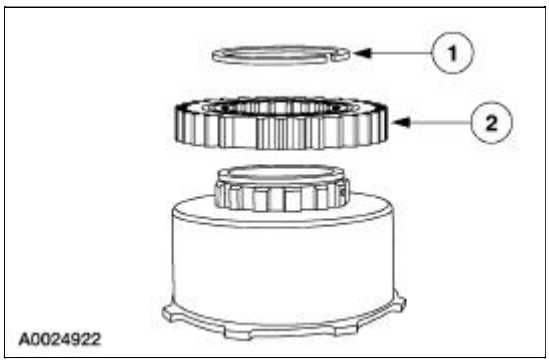


Item	Part Number	Description
1	391267-S	Retaining ring
2	7A089	Intermediate one-way clutch assembly
3	7D044	Reverse clutch drum

Disassembly

1. **NOTE:** One tab that locks the reverse clutch drum into the reverse sun shell may be removed. This is done for balancing purposes.

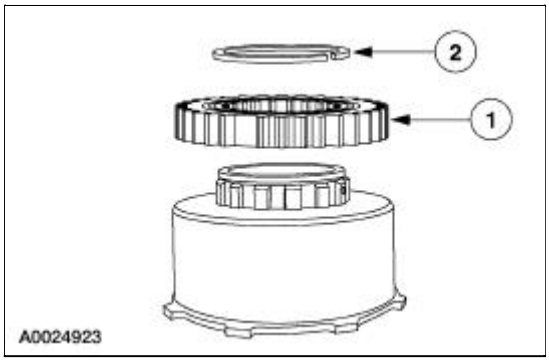
   Remove the intermediate one-way clutch.
   1. Remove the snap ring.
   2. Remove the intermediate one-way clutch.



Assembly

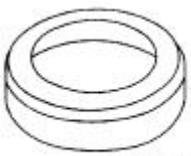
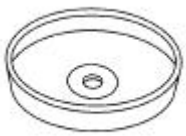
1. **NOTE:** The intermediate one-way clutch must rotate counterclockwise when installed on the reverse clutch drum and will make a ratchet sound.

   Install the intermediate one-way clutch.
   1. Install the intermediate one-way clutch.
   2. Install the snap ring.


2
1
A0024923

Reverse Clutch

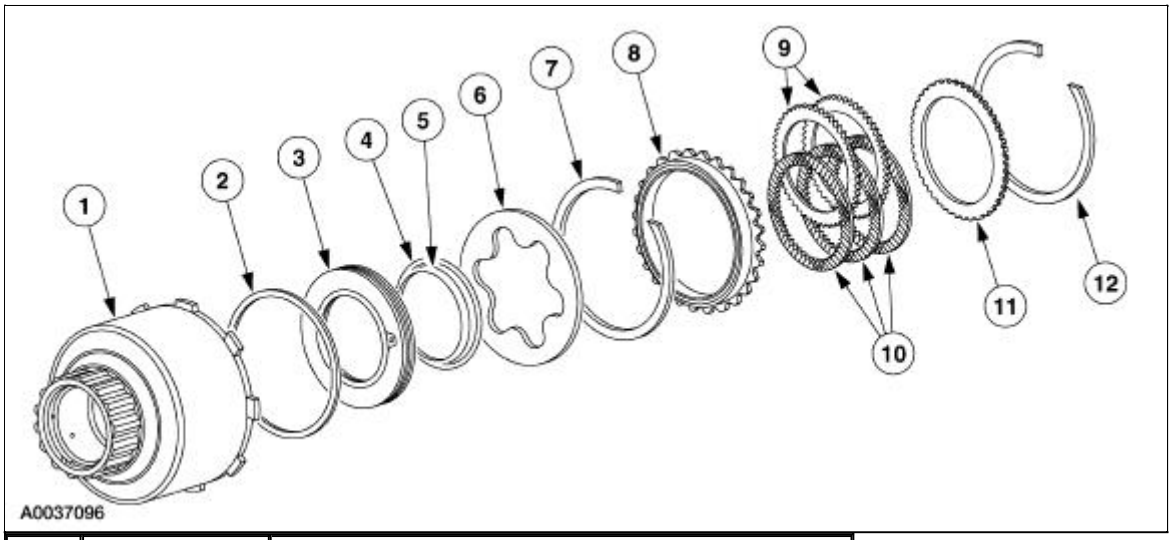
Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)
 ST1190-A	Compressor, Clutch Spring 307-015 (T65L-77515-A)
 ST1206-A	Protector, Transmission Reverse Clutch Outer Fluid Seal 307-424
 ST1207-A	Protector, Transmission Reverse Clutch Inner Fluid Seal 307-425
 ST1198-B	Compressor, Clutch Spring 307-086 (T80L-77405-A)

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

Reverse Clutch Disassembled View



Item	Part Number	Description
1	7D044	Reverse clutch drum
2	7D403	Reverse clutch piston outer seal
3	7D402	Reverse clutch piston
4	7D404	Reverse clutch piston inner seal
5	7D256	Reverse clutch piston spring pressure ring
6	7B070	Reverse clutch piston spring
7	7A577	Reverse clutch piston spring ring
8	7B066	Reverse clutch front pressure plate
9	7B442	Reverse clutch external spline plates (steel)
10	7B164	Reverse clutch internal spline plates (friction)
11	7B066	Reverse clutch rear pressure plate
12	7D483	Reverse clutch retaining ring (select fit)

Disassembly

1. Inspect the clutch cylinder thrust surfaces, piston bore and clutch plate serrations for scores or burrs. Minor scores or burrs may be removed with a crocus cloth. Install a new clutch cylinder if badly scored or damaged.

2. Check fluid passage in the clutch cylinder for obstructions. Clean out all fluid passages. Inspect the clutch piston for scores and install new if necessary. Inspect check balls for freedom of movement and correct seating.

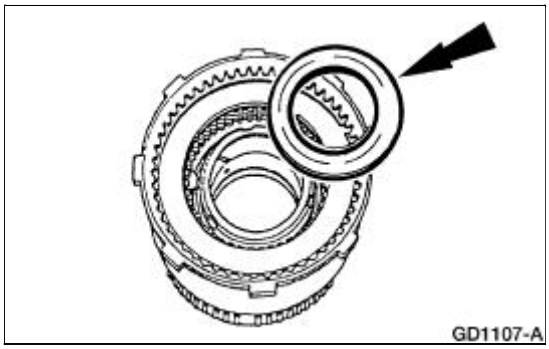
3. Check clutch release spring for distortion and cracks. Install a new spring (including the wave spring) if distorted or cracked.

4. Inspect the composition clutch plates, steel clutch plates and clutch pressure plate for worn or scored bearing surfaces. Install new parts if they are deeply scored or burred.

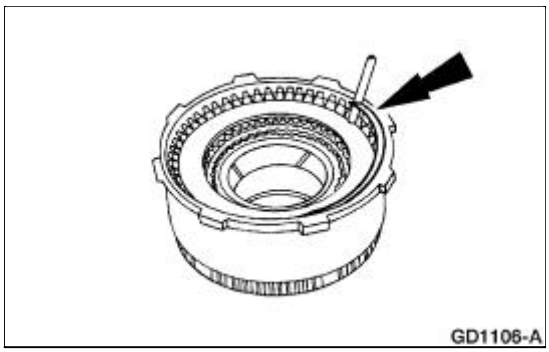
5. Check the clutch plates for flatness and fit on clutch hub serrations. Discard any plate that does not slide freely on serrations or that is not flat.

6. Check clutch hub thrust surfaces for scores and clutch hub splines for wear.

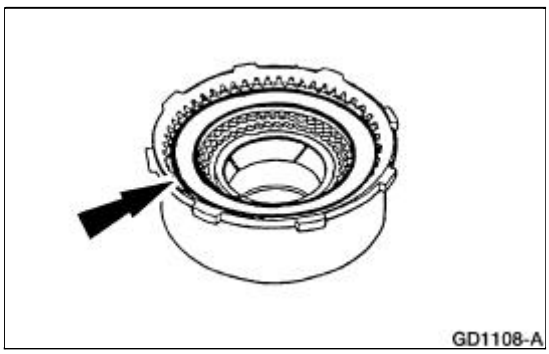
7. Remove the No. 2 forward clutch bearing.



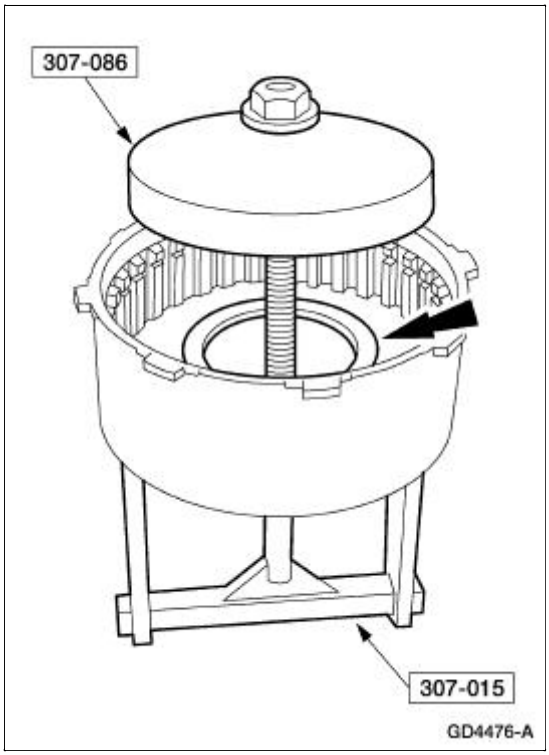
8. Remove the reverse clutch selective retaining ring.



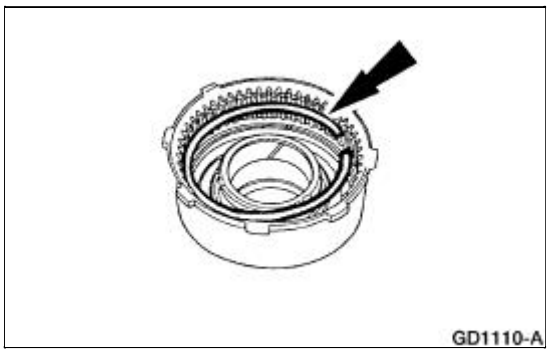
9. Remove the reverse clutch pack.



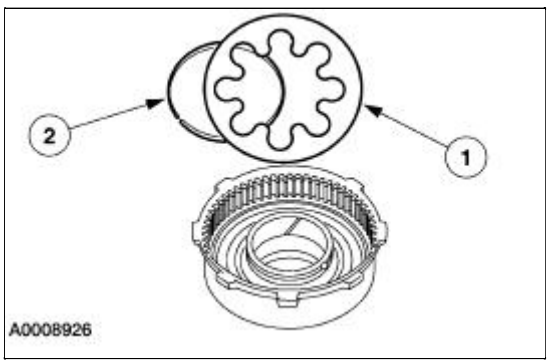
10. Using the special tools, compress the reverse clutch piston spring.



11. Remove the reverse clutch piston spring retaining ring.

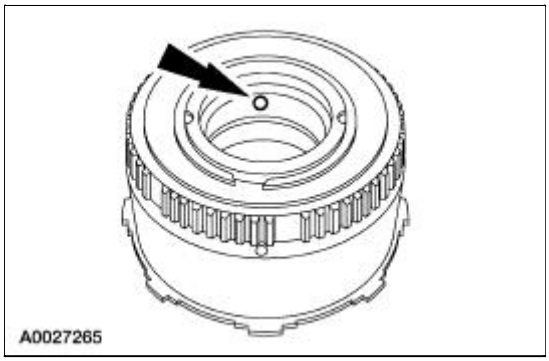


12. Remove the reverse clutch piston spring pressure ring.
    1. Remove the reverse clutch piston spring.
    2. Remove the reverse clutch piston spring pressure ring.

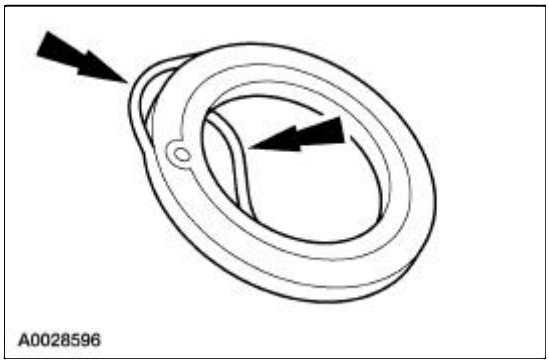


13. **NOTE:** To ease reverse clutch piston removal, it may be necessary to apply air pressure to the reverse clutch drum. Block the opposite hole.

    Remove the reverse clutch piston.



14. Remove the reverse clutch piston inner and outer seals.



Assembly

1. **NOTE:** One tab that locks the reverse clutch drum into the reverse sun shell may be removed. This is done for balancing purposes.

   Inspect the clutch cylinder thrust surfaces, piston bore and clutch plate serrations for scores or burrs. Minor scores or burrs may be removed with crocus cloth. Install a new clutch cylinder if badly scored or damaged.

2. Check the fluid passage in the clutch cylinder for obstructions. Clean out all fluid passages. Inspect clutch piston for scores and install new if necessary. Inspect the check balls for freedom of movement and correct seating.

3. Check the clutch release spring for distortion and cracks. Install a new spring (including wave spring) if distorted or cracked.

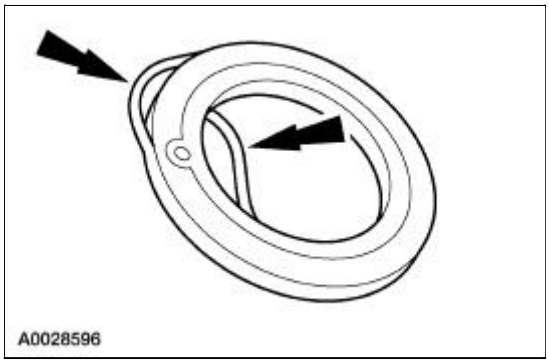
4. Inspect the composition clutch plates, steel clutch plates and clutch pressure plate for worn or scored bearing surfaces. Install new parts if they are deeply scored or burred.

5. Check the clutch plates for flatness and fit on the clutch hub serrations. Discard any plate that does not slide freely on serrations or that is not flat.

6. Check the clutch hub thrust surfaces for scores and clutch hub splines for wear.

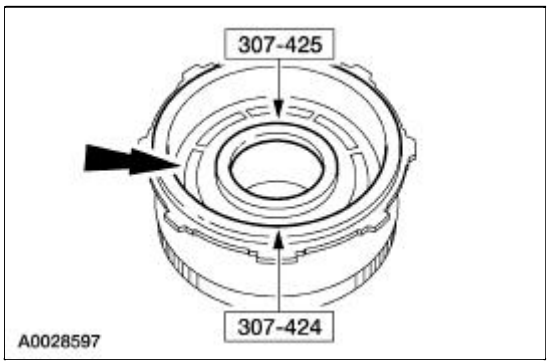
7. **NOTE:** The piston check ball must be present and moving freely.

   Install a new reverse clutch piston inner and outer seals.



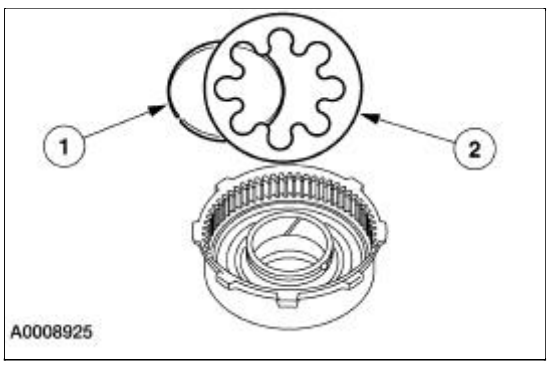
8. **NOTE:** Coat the reverse clutch piston inner seal, outer seal, drum sealing area and special tools with petroleum jelly.

   Using the special tools, install the reverse clutch piston using even pressure to push it to the bottom of the reverse clutch drum.

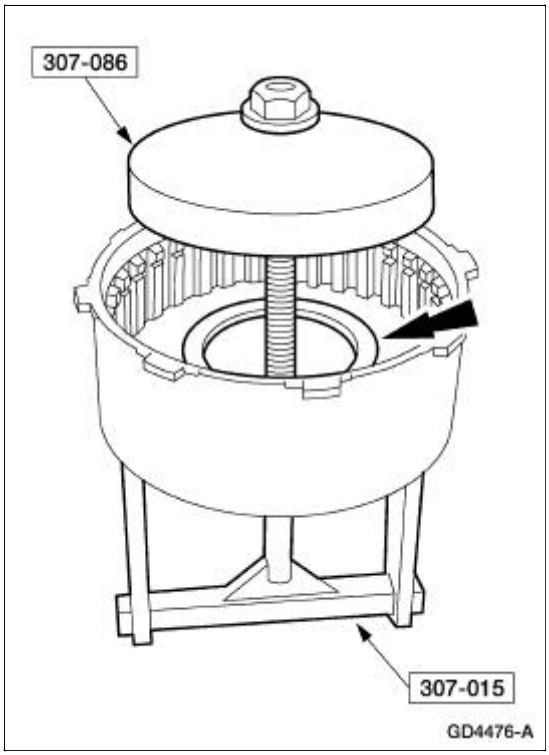


9. **NOTE:** The dished side of the reverse clutch piston spring must face the reverse clutch piston.

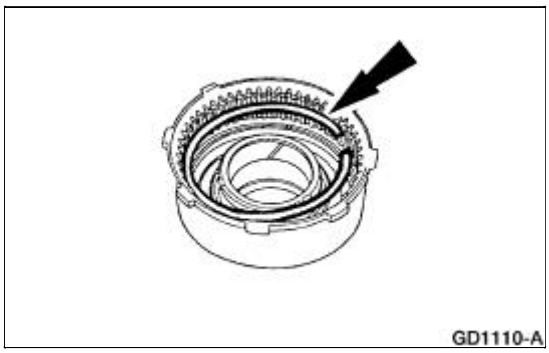
   Install the reverse clutch piston spring.
   1. Install the reverse clutch piston spring pressure ring.
   2. Install the reverse clutch piston spring.



10. Using the special tools, compress the reverse clutch piston spring.



11. Install the reverse clutch piston spring retaining ring.

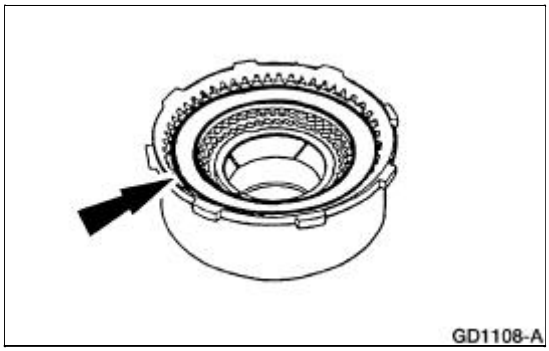


12. Remove the special tool.

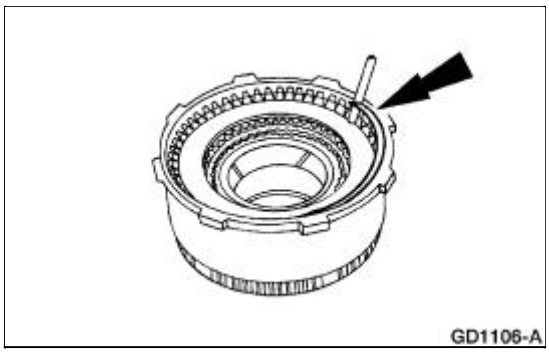
13. **CAUTION: Install the pressure plates with the flat sides facing the clutch pack.**

    NOTE: Before assembly, soak the new clutch discs in clean automatic transmission fluid for 15 minutes.

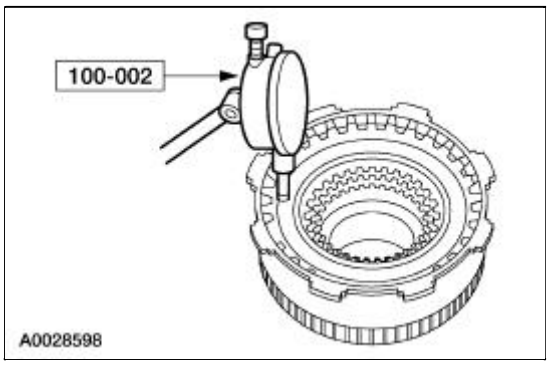
    Install the reverse clutch front pressure plate, clutch pack and reverse clutch rear pressure plate.



14. Install the reverse clutch pressure plate retainer snap ring.



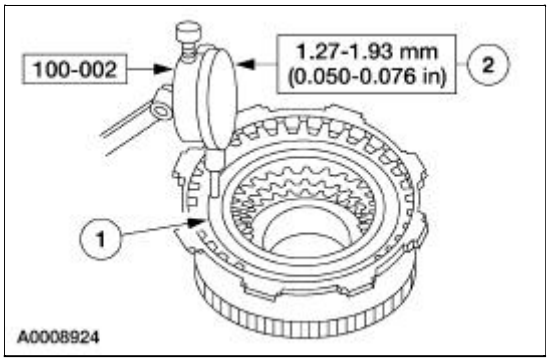
15. Install the special tool on the reverse clutch pack.
    - Push downward on the clutch pack.
    - Release pressure and zero the dial indicator.



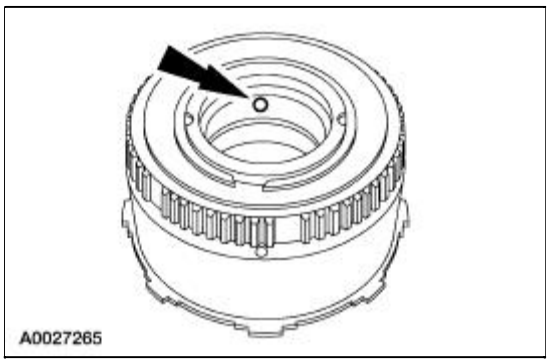
16. Using the special tool check the reverse clutch pack clearance.
    1. Lift up on the clutch pack until it fully seats against the reverse clutch pressure plate retainer.
    2. Read the dial indicator.
        - If clearance is not within specifications, install the correct size retaining ring.

Selective Retaining Rings

Specification
1.52-1.62 mm (0.060-0.064 inch)
1.87-1.98 mm (0.074-0.078 inch)
2.23-2.33 mm (0.088-0.092 inch)
2.59-2.69 mm (0.102-0.106 inch)

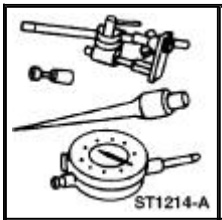


17. Check the clutch for correct operation.
    - Apply air pressure to the reverse clutch drum. The clutch should be heard and felt to work without leakage.



Forward Clutch Cylinder

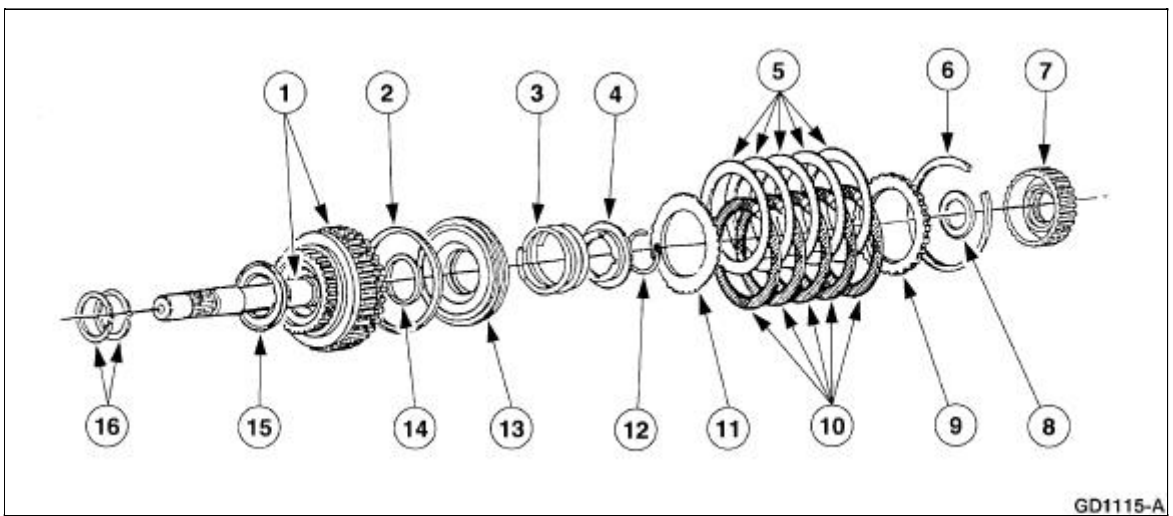
Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent
 ST1209-A	Compressor, Clutch Spring 307-096 (T81P-70235-A)
 ST2693-A	Protector, Transmission Forward Clutch Outer Fluid Seal 307-423

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

Forward Clutch — Disassembled View



Item	Part Number	Description

1	7F207	Forward clutch cylinder and shaft
2	7A548	Forward clutch piston outer seal
3	7A480	Forward clutch piston return spring
4	7A527	Forward clutch retainer return spring
5	7B442	Forward clutch external spline plate (steel)
6	7D483	Retaining snap ring
7	7B067	Forward clutch hub
8	7F231	No. 3 forward clutch hub front bearing
9	7B066	Forward clutch pressure plate
10	7B164	Forward clutch internal spline plates (friction)
11	7E085	Forward clutch pressure spring
12	388099-S	Retaining snap ring
13	7A262	Forward clutch piston
14	7C099	Forward clutch piston inner seal
15	7A166	No. 2 forward clutch bearing
16	7B497	Input shaft seal

Disassembly

1. Inspect the clutch cylinder thrust surfaces, piston bore and clutch plate serrations for scores or burrs. Minor scores or burrs may be removed with crocus cloth. Install a new clutch cylinder if it is badly scored or damaged.

2. Check the fluid passage in the clutch cylinder for obstructions. Clean out all the fluid passages. Inspect the clutch piston for scores and install a new piston if necessary. Inspect check balls for freedom of movement and correct seating.

3. Check the clutch release spring for distortion and cracks. Install a new spring (including wave spring) if distorted or cracked.

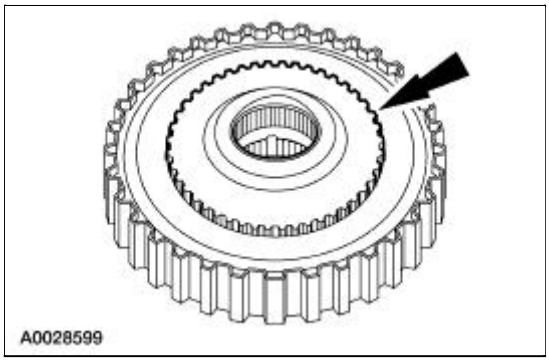
4. Inspect the composition clutch plates, steel clutch plates and clutch pressure plate for worn or scored bearing surfaces. Install new parts if they are deeply scored or burred.

5. Check the clutch plates for flatness and fit on clutch hub serrations. Discard any plate that does not slide freely on serrations or that is not flat.

6. Check the clutch hub thrust surfaces for scores and clutch hub splines for wear.

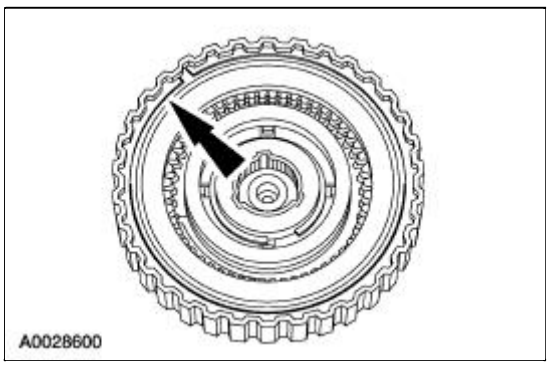
7. **NOTE:** The forward clutch hub may remain in the shell during disassembly.

   Remove the forward clutch hub and the No. 3 forward clutch hub front bearing.

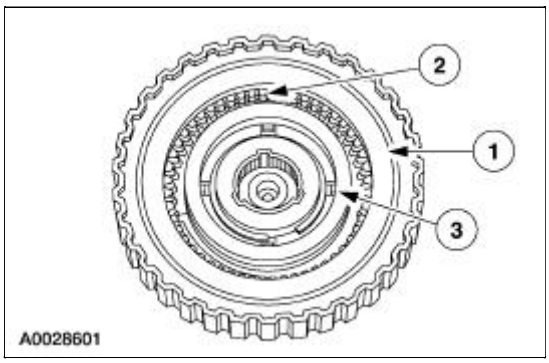


8. **NOTE:** To aid handling, the forward clutch assembly may be set in the extension housing or a hole in the work bench.

   Remove the forward clutch pack selective retaining ring.

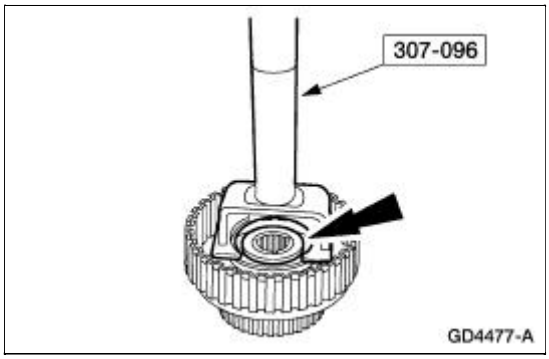


9. Remove the following components.
   1. Remove the pressure plate.
   2. Remove the clutch pack.
   3. Remove the pressure spring.



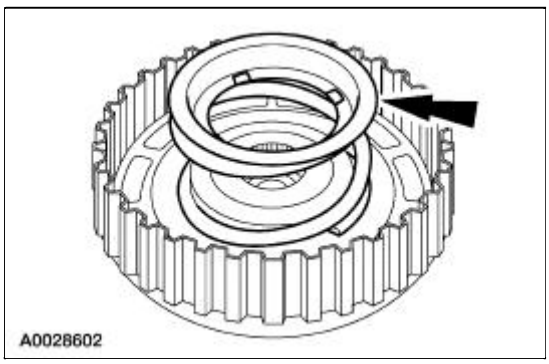
10. **CAUTION: Apply only enough pressure to release pressure on the retaining ring. If too much pressure is applied, the spring may break.**

    Using the special tool, remove the forward clutch retaining ring.



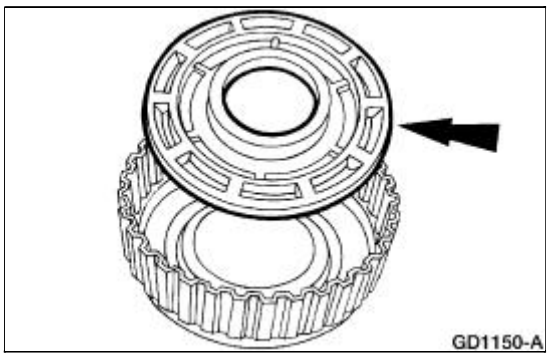
11. Slowly release the press and remove the forward clutch from the press.

12. Remove the forward clutch retainer and the return spring.

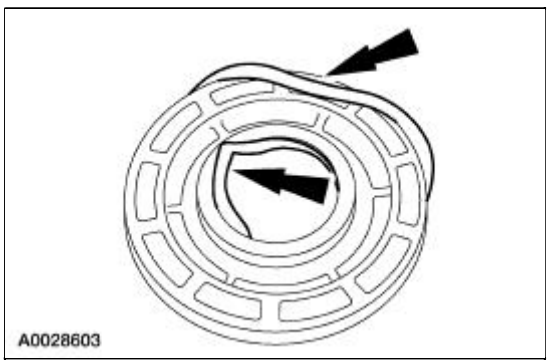


13. **NOTE:** Air pressure may be required to remove the forward clutch piston.

    Remove the forward clutch piston.

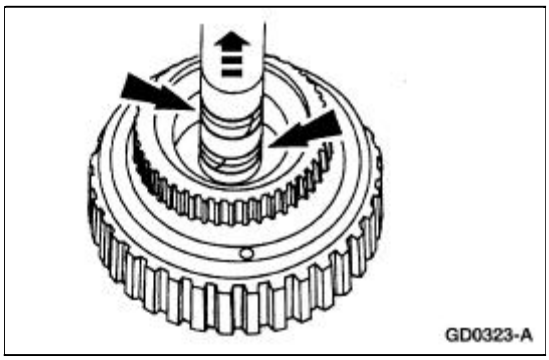


14. Remove the inner and outer forward clutch piston seals.

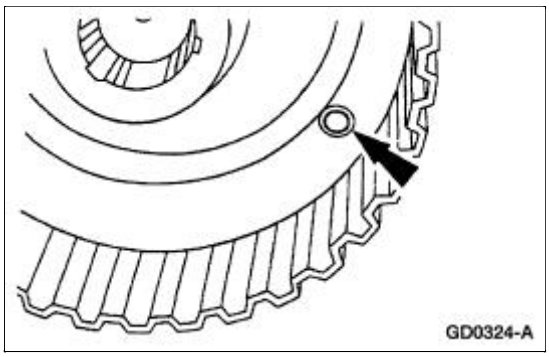


15. **NOTE:** The seals are solid seals, however, when installing new seals use scarf-cut seals.

    Remove the forward clutch input shaft seals.



16. Make sure the check ball in the clutch cylinder is free and clean. Check for correct seating.



Assembly

1. Inspect the clutch cylinder thrust surfaces, piston bore and clutch plate serrations for scores or burrs. Minor scores or burrs may be removed with crocus cloth. Install a new clutch cylinder if badly scored or damaged.

2. Check the fluid passage in the clutch cylinder for obstructions. Clean out all fluid passages. Inspect the clutch piston for scores and install a new piston if necessary. Inspect check balls for freedom of movement and correct seating.

3. Check the clutch release spring for distortion and cracks. Install a new spring (including the wave spring) if distorted or cracked.

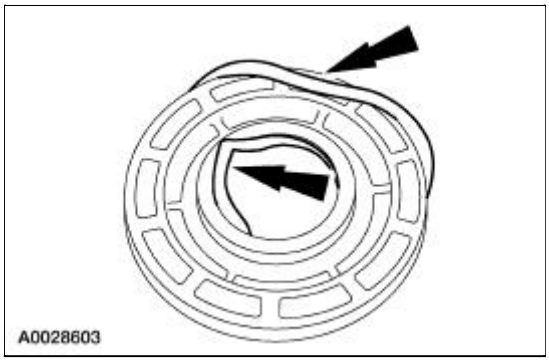
4. Inspect composition clutch plates, steel clutch plates and clutch pressure plate for worn or scored bearing surfaces. Install new parts if they are deeply scored or burred.

5. Check the clutch plates for flatness and fit on the clutch hub serrations. Discard any plate that does not slide freely on serrations or that is not flat.

6. Check the clutch hub thrust surfaces for scores and the clutch hub splines for wear.

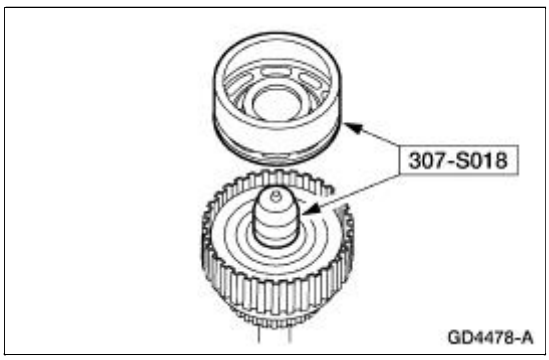
7. **NOTE:** To aid handling, the forward clutch assembly may be set in the extension housing or a hole in the work bench.

   Install the inner and outer forward clutch piston seals. Note the direction of the sealing rings before installation.

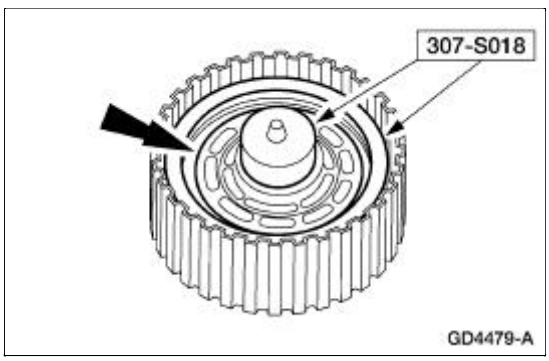


8. **NOTE:** Coat the piston seals and clutch drum sealing area with petroleum jelly.

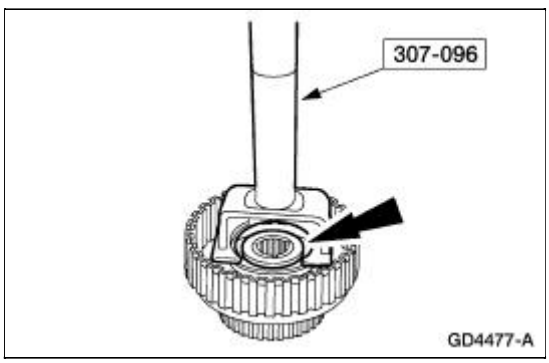
   Position the special tools on the clutch piston.



9. Using the special tools, install the forward clutch piston into the clutch drum.
   - Push the piston to the bottom of the drum using even pressure.



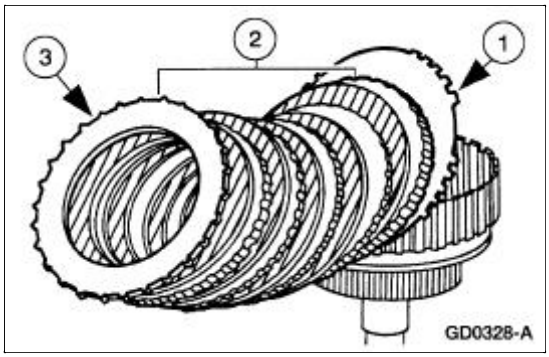
10. Using the special tool, compress the piston return spring and install the retaining ring.



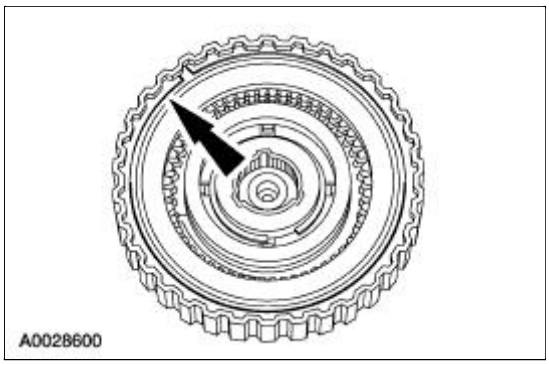
11. Slowly release the press pressure and remove the forward clutch.

12. **NOTE:** Before assembly, soak the new clutch discs in clean automatic transmission fluid for 15 minutes.

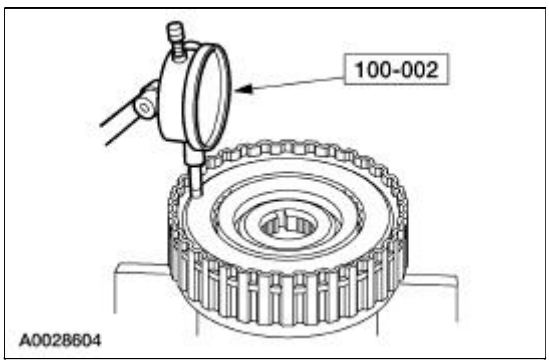
    Install the clutch pack assembly.
    1. Install the pressure ring.
    2. Install the clutch pack.
    3. Install the pressure plate.



13. Install the clutch pack retaining ring.



14. Install the special tool on the forward clutch pack.
    - Push downward on the clutch pack.
    - Release pressure and zero the dial indicator.

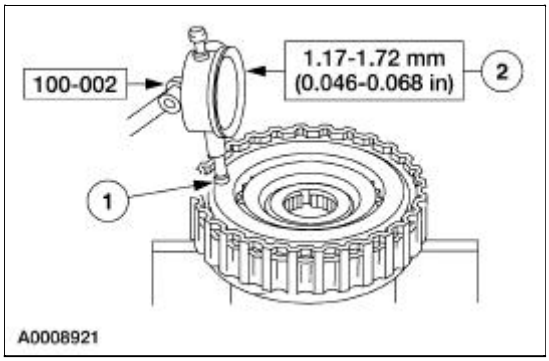


15. Using the special tool, check the clutch pack clearance.
    1. Lift up on the clutch pack until it fully seats against the clutch pressure plate retainer.
    2. Read the dial indicator.
        - If the clearance is not within specifications, install the correct size retaining ring.

Selective Retaining Ring

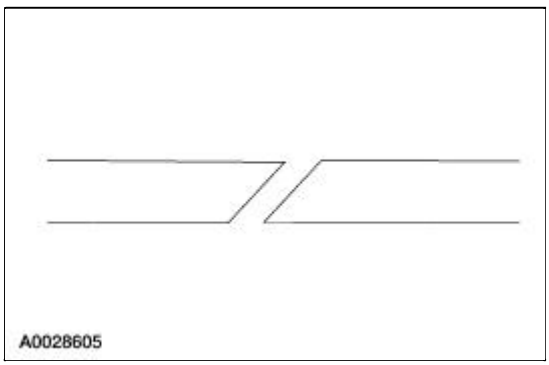
Specification

1.52-1.62 mm (0.060-0.064 inch)
1.87-1.98 mm (0.074-0.078 inch)
2.24-2.34 mm (0.088-0.092 inch)
2.59-2.69 mm (0.102-0.106 inch)

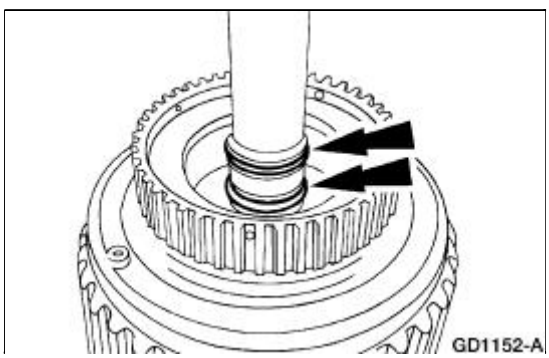


16. **NOTE:** Make sure the scarf-cut seals are mated correctly.

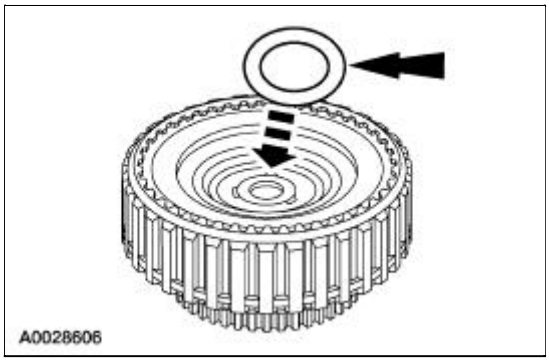
    Slide the two scarf-cut seals on the input shaft.



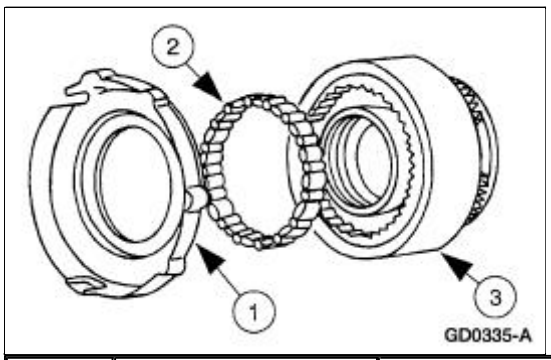
17. Install the two scarf-cut seals on the input shaft.



18. Install the No. 3 forward clutch hub front bearing and the forward clutch hub.


A0028606

Planetary Gear Support Assembly and Planetary One-Way Clutch

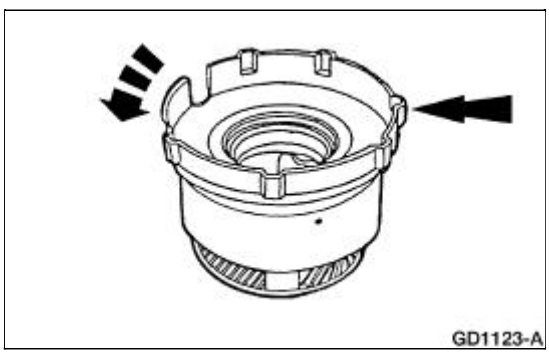


Item	Part Number	Description
1	7A130	Planetary gear support
2	7A089	Planetary one-way clutch
3	7A398	Planetary assembly

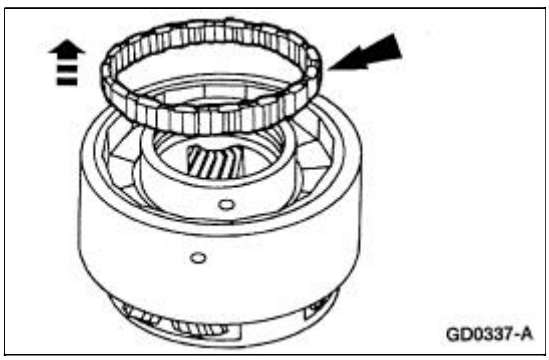
Disassembly and Assembly

1. **NOTE:** Inspect the outer and inner races for scores or damaged surface areas where rollers contact the races. Inspect the rollers and springs for excessive wear or damage. Inspect the spring and cage for bent or damaged spring retainers.

   Rotate the center support counterclockwise and lift to remove the planetary gear support.



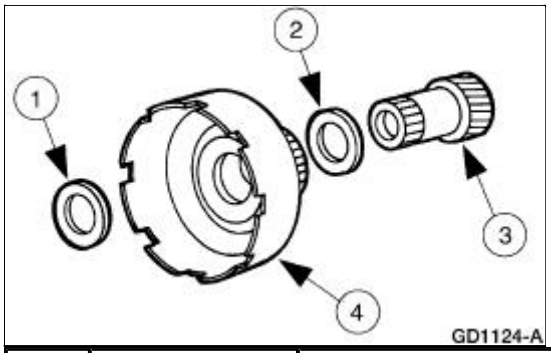
2. Remove the planetary one-way clutch.



3. To assemble, reverse the disassembly procedure.

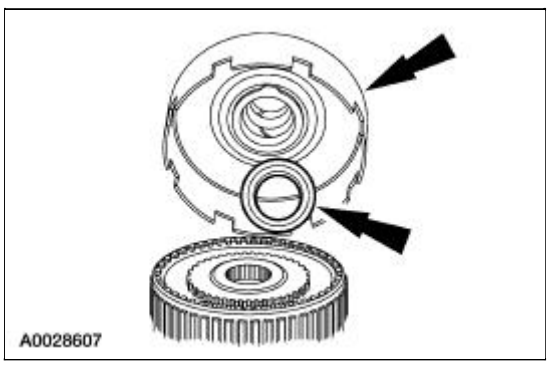
Reverse Sun Gear

Disassembly

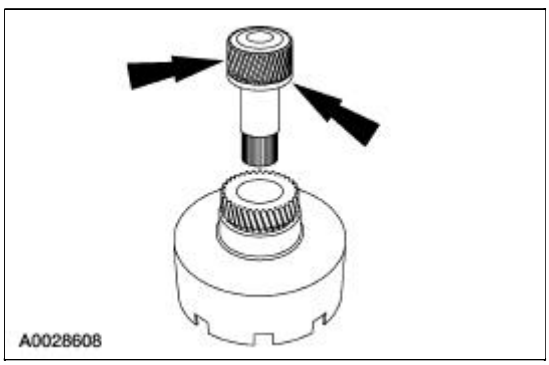


Item	Part Number	Description
1	7C096	Forward clutch hub bearing No. 4
2	7F244	Forward clutch sun gear bearing No. 5
3	7A399	Forward clutch sun gear
4	7A019	Reverse sun gear assembly

1. Remove the reverse clutch sun gear assembly and the No. 4 forward clutch hub bearing and race.



2. Remove the forward clutch sun gear assembly and the No. 5 forward clutch sun gear bearing and race.

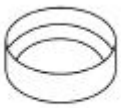


Assembly

1. The forward clutch sun gear and reverse sun gear assembly are assembled as part of the transmission assembly procedure.

Output Shaft and Direct Clutch Cylinder

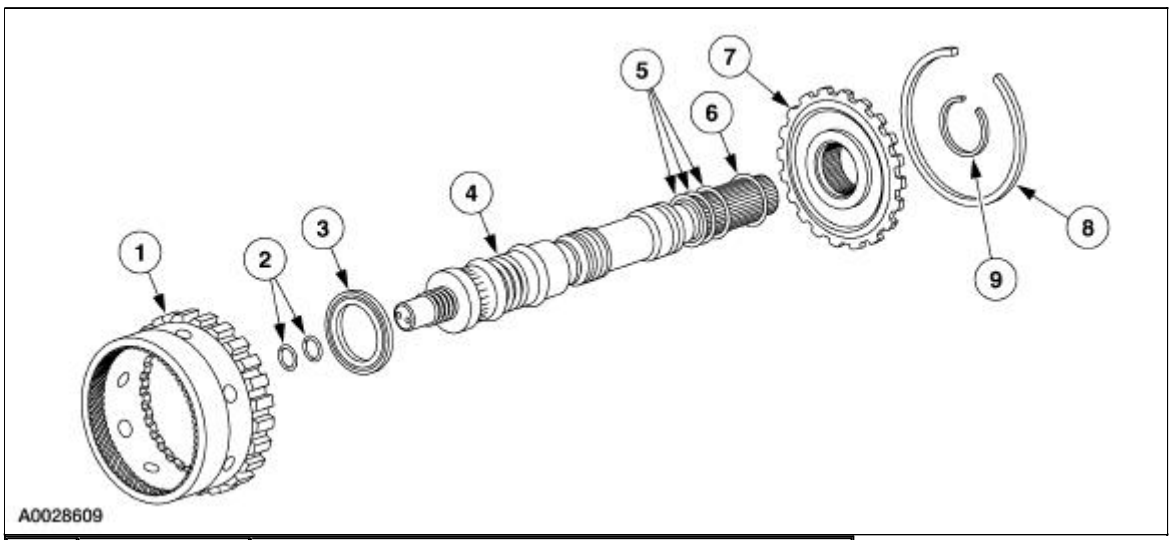
Special Tool(s)

 ST1190-A	Compressor, Clutch Spring 307-015 (T65L-77515-A)
 ST1204-A	Protector, Piston Seal 307-080 (T80L-77234-A)
 ST1901-A	Protector, Transmission Direct Clutch Outer Fluid Seal 307-422

Material

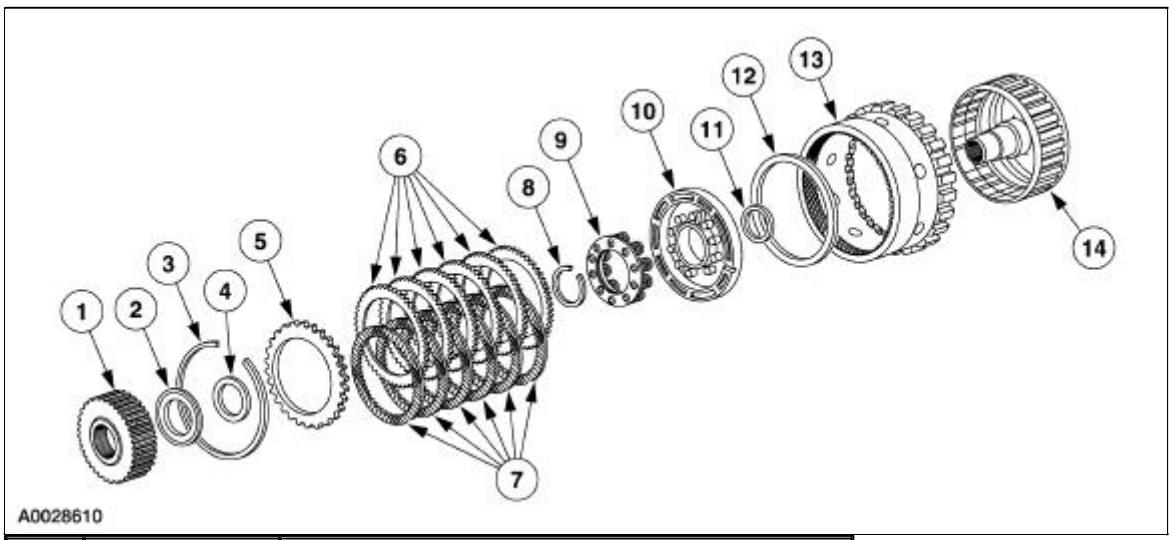
Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

Output Shaft, Direct Clutch Cylinder and Ring Gear Disassembled View



Item	Part Number	Description
1	7A233	Output shaft ring gear assembly
2	7F274	Output shaft to direct clutch cylinder seal (2 req'd)
3	7F240	Direct clutch outer bearing and race assembly No. 8
4	7060	Output shaft
5	7F273	Output shaft to case seal (3 req'd)
6	87054-S94	O-ring seal
7	7D164	Output shaft hub
8	97713-S	Retaining snap ring
9	7C122	Snap ring

Direct Clutch Disassembled View

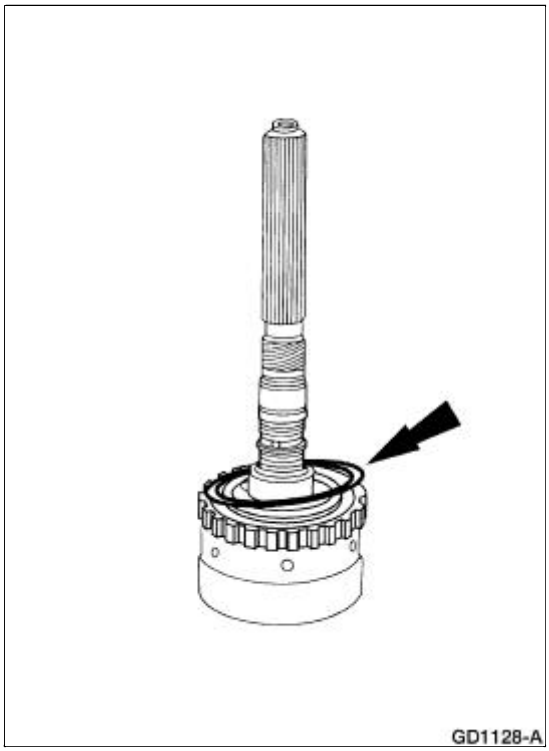


Item	Part Number	Description
1	7F236	Direct clutch hub
2	7F243	No. 7 direct clutch bearing
3	7D483	Direct clutch pressure plate retaining ring
4	7F237	Direct clutch inner bearing support
5	7B066	Direct clutch pressure plate
6	7B442	Direct clutch external spline plates (steel)
7	7B164	Direct clutch internal spline plates (friction)
8	388104-S2	Retaining ring
9	7F235	Direct clutch retainer and spring assembly
10	7A262	Direct clutch piston
11	7C099	Direct clutch piston inner seal
12	7A548	Direct clutch piston outer seal
13	7A233	Output shaft ring gear
14	7F283	Direct clutch cylinder

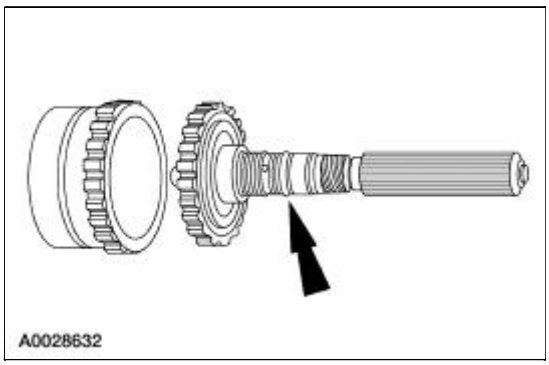
Disassembly

1. **NOTE:** The index mark on the output shaft must be aligned with the index mark on the output shaft ring gear during the assembly procedure.

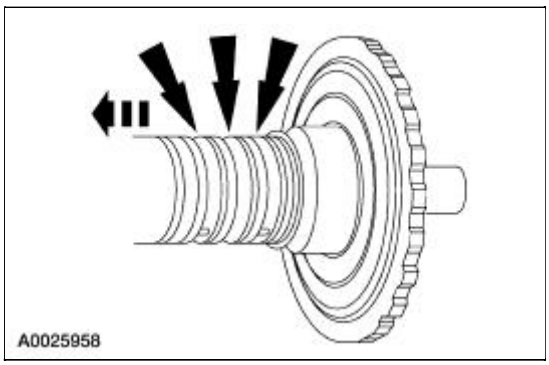
   Remove the ring gear snap ring.



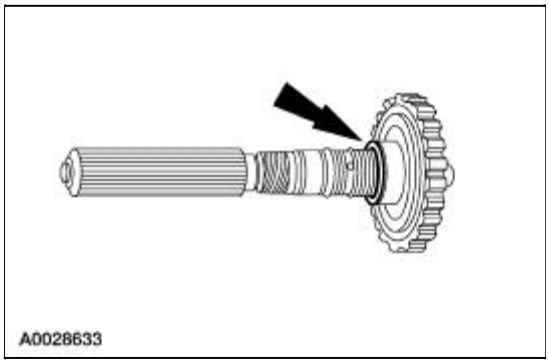
2. Separate the ring gear and output shaft.



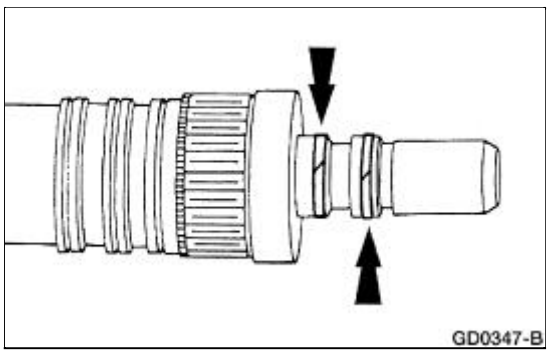
3. Remove the three output shaft seal rings.



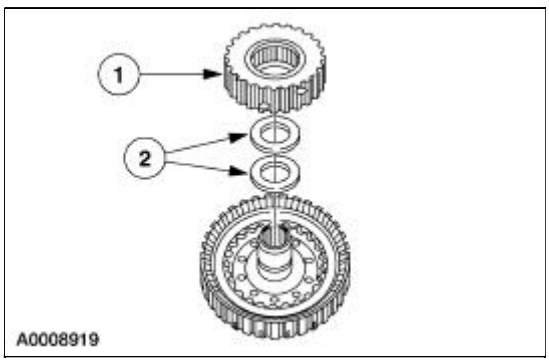
4. Remove the output shaft hub snap ring and the output shaft hub.



5. Remove the two direct clutch seal rings.



6. Remove the No. 7 direct clutch inner bearing support.
    1. Remove the direct clutch hub.
    2. Remove the No. 7 direct clutch inner bearing support.



7. Inspect the clutch cylinder thrust surfaces, piston bore and clutch plate serrations for scores or burrs. Minor scores or burrs may be removed with a crocus cloth. Install a new clutch cylinder if badly scored or damaged.

8. Check the fluid passage in the clutch cylinder for obstructions. Clean out all fluid passages. Inspect the clutch piston for scores and install new if necessary. Inspect the check balls for freedom of movement and correct seating.

9. Check clutch release spring for distortion and cracks. Install a new spring (including wave spring) if distorted or cracked.

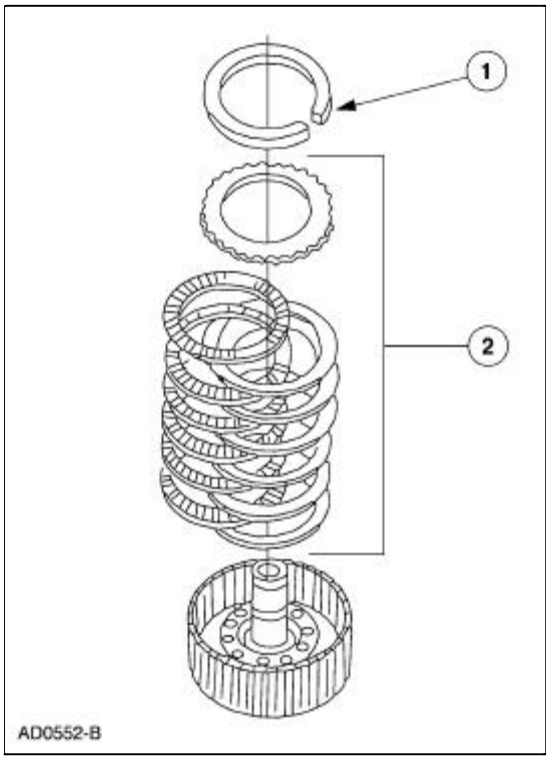
10. Inspect composition clutch plates, steel clutch plates and clutch pressure plate for worn or scored bearing surfaces. Install new parts if they are deeply scored or burred.

11. Check the clutch plates for flatness and fit on the clutch hub serrations. Discard any plate that

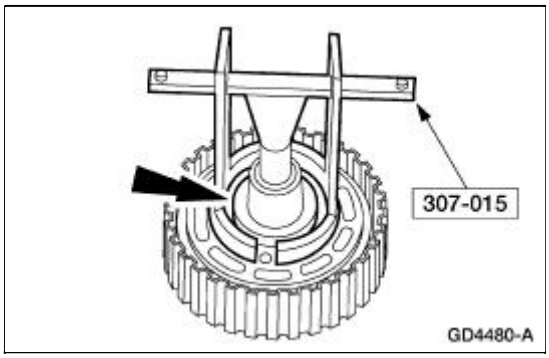
does not slide freely on the serrations or that is not flat.

12. Check the clutch hub thrust surfaces for scores and clutch hub splines for wear.

13. Remove the direct clutch pack.
    1. Remove the selective retaining ring.
    2. Remove the direct clutch pack.



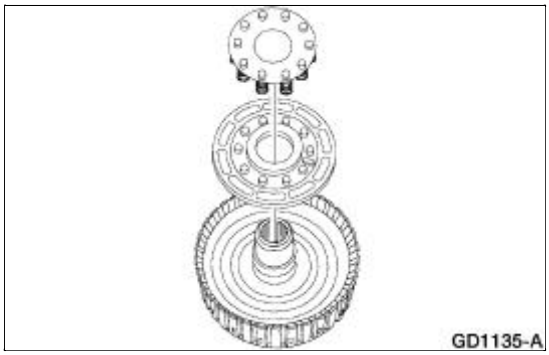
14. Using the special tool, compress the piston return spring and remove the snap ring.



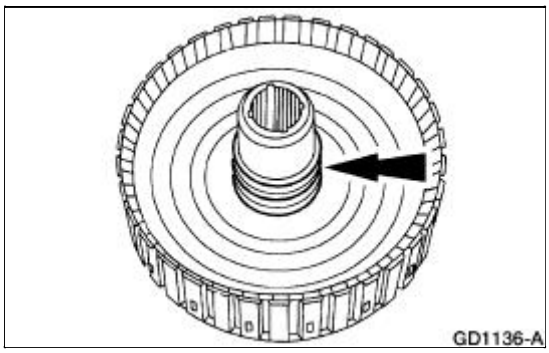
15. **WARNING: Wear safety glasses when using compressed air.**

    NOTE: If necessary, use regulated compressed air 207 kPa (30 psi) max pressure to remove the clutch piston.

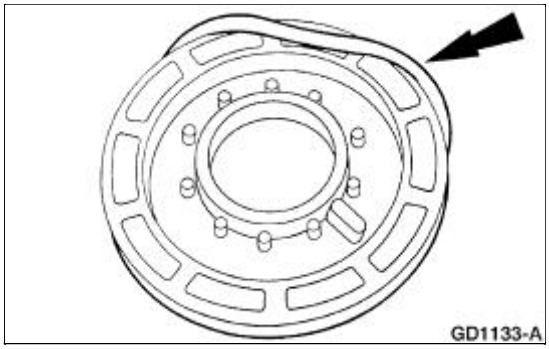
    Remove the support and spring assembly and piston.



16. Remove the inner piston seal.



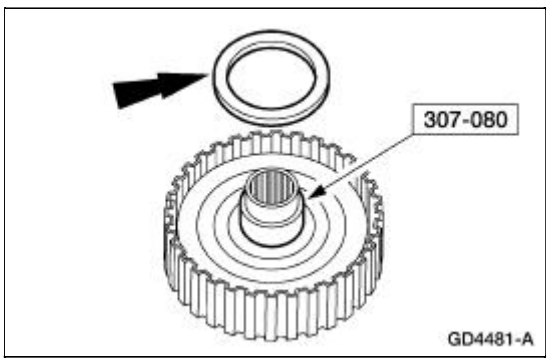
17. Remove the outer piston seal.



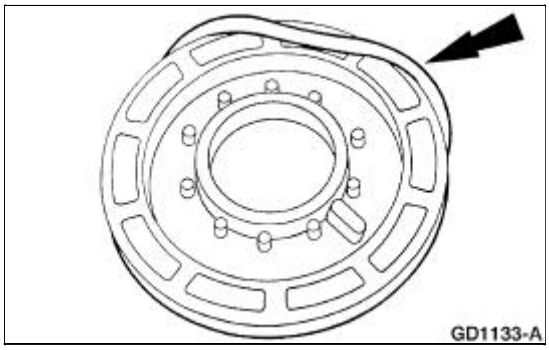
Assembly

1. **NOTE:** Lubricate direct clutch piston inner seal and seal protector with petroleum jelly.

   Using the special tool, install the inner piston seal.
   - Install the seal with sealing lip facing down.

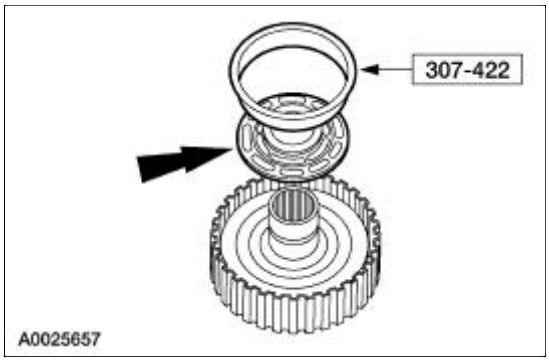


2. Install the clutch piston outer seal so that when the piston is installed the sealing lip points toward the bottom of the cylinder.



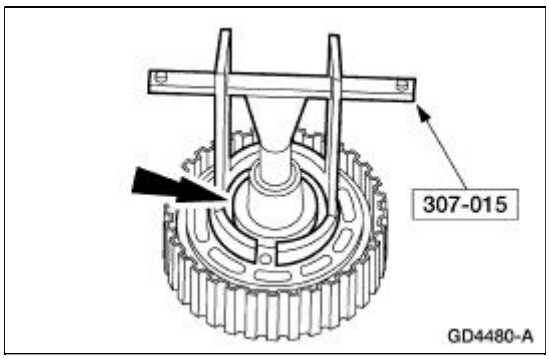
3. **NOTE:** Coat the inner and outer direct clutch piston seals, clutch cylinder sealing area and piston inner sealing area with petroleum jelly.

   Using the special tool, install the direct clutch piston.



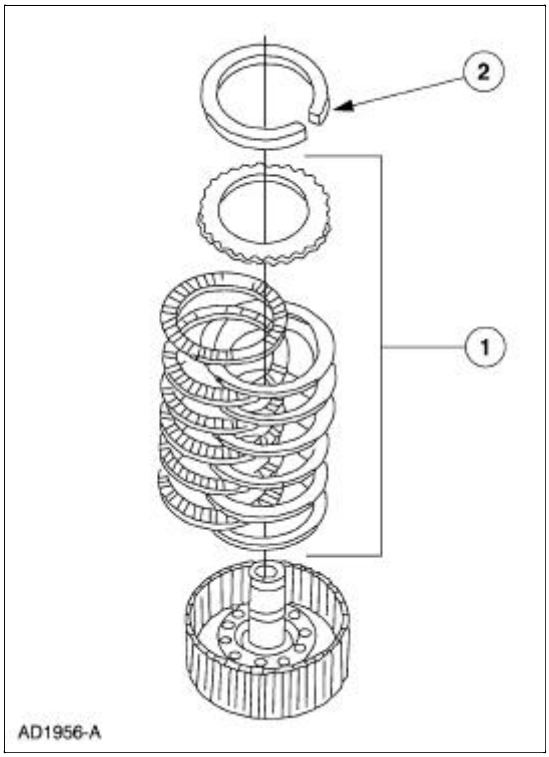
4. Install the piston return spring and retainer assembly.

5. Using the special tool, compress the piston return spring and install the retaining ring.



6. **NOTE:** Before assembly, soak new clutch discs in clean automatic transmission fluid for 15 minutes.

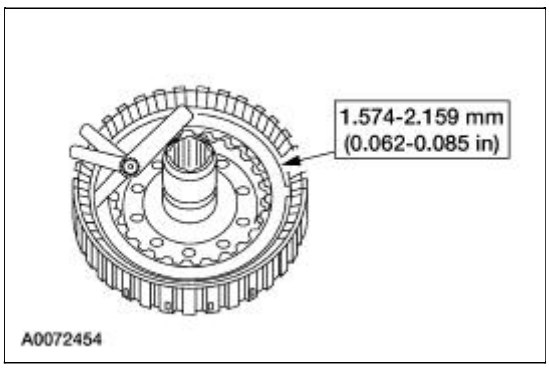
   Install the clutch pack retaining ring.
   1. Alternate external spline (steel) plates and internal spline (friction) plates, starting with a steel plate and ending with the friction plate.
   2. Install the clutch pack retaining ring.



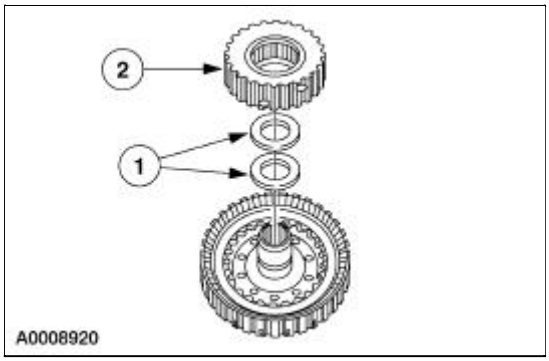
7. Use a feeler gauge to check the clearance between the clutch pack selective retaining ring and the pressure plate.
    - If the clearance is not within specifications, install the correct size retaining ring and recheck the clearance.

Selective Retaining Ring

Specification
1.52-1.62 mm (0.060-0.064 inch)
1.87-1.98 mm (0.074-0.078 inch)
2.24-2.34 mm (0.088-0.092 in)
2.59-2.69 mm (0.102-0.106 inch)



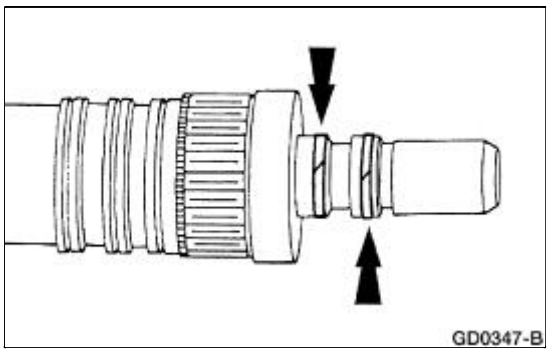
8. Install the direct clutch hub.
    1. Install the No.7 direct clutch inner bearing support.
    2. Install the direct clutch hub.



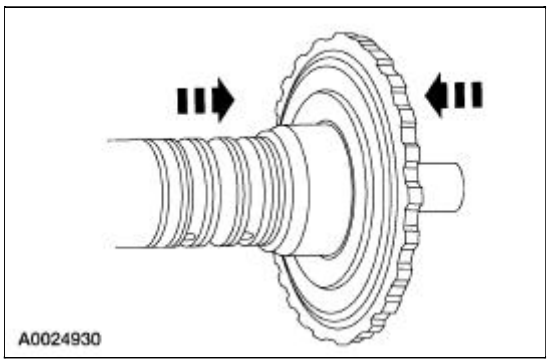
NOTE: Inspect the output shaft bearing surfaces for scores. Inspect the output shaft splines for wear. Inspect all bushings.

9. **CAUTION: Make sure the seals are lapped correctly. Internal damage may occur.**

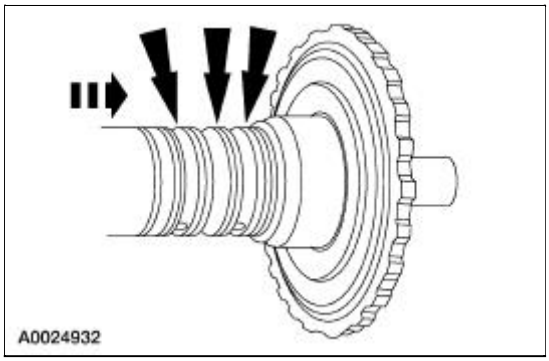
   Install the two direct clutch seal rings.



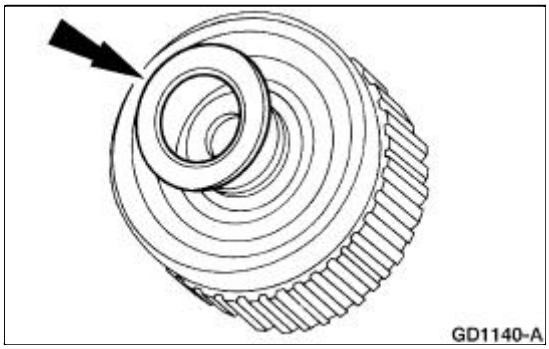
10. Install the output shaft hub.
    - Position the output shaft hub.
    - Install the retaining ring.



11. Install the three output shaft seal rings.

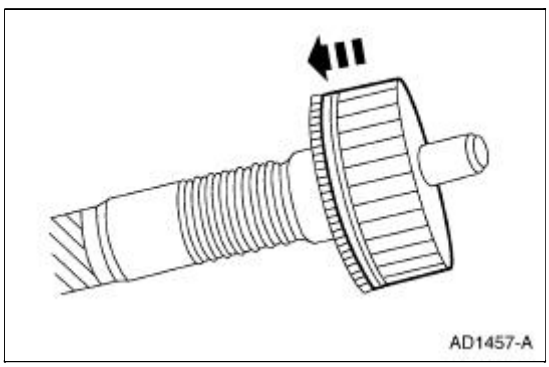


12. Install the No. 8 needle bearing on the direct clutch cylinder.



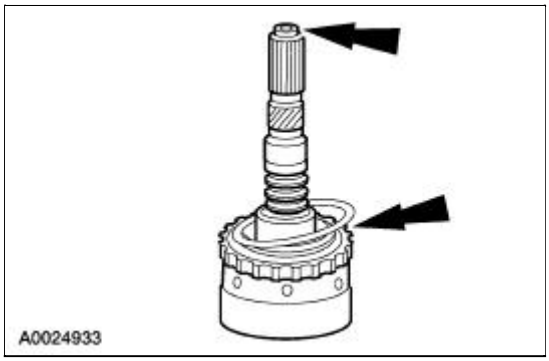
13. **NOTE:** Direct clutch cylinder may be installed after the output shaft ring gear is installed to the output shaft hub.

    Assemble the direct clutch on the output shaft.



14. **CAUTION: The index mark on the output shaft must be aligned with the index mark on the output shaft ring gear.**

    Align the index marks on output shaft and the output shaft ring gear and install the ring gear on the output shaft.


A0024933

Torque Converter

1. A new or remanufactured torque converter must be installed if one or more of the following statements is true:
    - A torque converter malfunction has been determined based on complete diagnostic procedures.
    - Converter stud or studs, impeller hub or bushing are damaged.
    - Discoloration (due to overheating).
    - The torque converter is found to be out of specification when carrying out one of the following torque converter checks:
        - One-Way Clutch Check
        - End Play Check
        - Stator to Turbine Interference Check
        - Stator to Impeller Interference Check
        - Torque Converter Leak Check
    - Evidence of transmission assembly or fluid contamination due to the following transmission or converter failure modes:
        - Major metallic failure.
        - Multiple clutches or clutch plate failures.
        - Sufficient component wear which results in metallic contamination.

Torque Converter Cleaning And Inspection

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

1. If a new torque converter is being installed, continue with Substep 2 of Step 2.

2. If a new torque converter is not being installed, the following procedures must be performed:
    1. The torque converter must be thoroughly cleaned.
        - Torque converters with drain plugs can be cleaned by using a suitable torque converter/fluid cooler cleaner.
        - Torque converters without drain plugs can be cleaned by hand. Partially fill the torque converter using only recommended transmission fluid for the applicable transmission. Hand agitate the torque converter and then thoroughly drain the fluid. Refill the torque converter with clean automatic transmission fluid specified for transmission, and reinstall.
    2. All in-tank and auxiliary coolers must be thoroughly cleaned by forward and backward flushing. For additional information, refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section.
    3. All cooler lines must be thoroughly cleaned by backward and forward flushing. For additional information, refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section.
    4. All Cooler Bypass Valves (CBV), if equipped, must be thoroughly cleaned.
    5. Carry out the Transmission Fluid Cooler Flow Test. For additional information, refer to Transmission Fluid Cooler — Backflushing and Cleaning in this section.
    6. If the transmission cooling system fails the Transmission Fluid Cooler Flow Test, a new fluid cooler, cooler bypass valve, and/or cooler lines must be installed. For additional information, refer to Section 307-02 .
    7. If new coolers are to be installed, use only factory approved service parts.

Torque Converter Flushing

Material

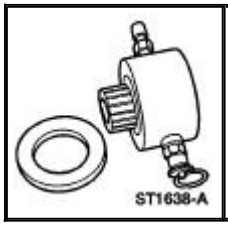
Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

NOTE: When the transmission has been repaired for internal damage the torque converter must be cleaned using a mechanically agitated cleaner.

1. Using a suitable torque converter/fluid cooler cleaner, clean and flush the torque converter.
2. After flushing, drain the remainder of the solvent.
3. Add 1.9 liter (2 qt.) of clean transmission fluid to the converter and agitate by hand.
4. Thoroughly drain the solution.

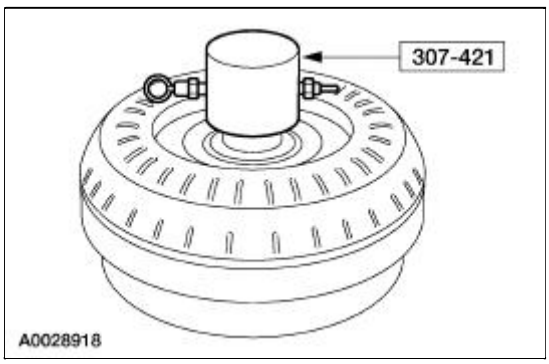
Torque Converter Leak Check

Special Tool(s)

	Leak Tester, Torque Converter 307-421

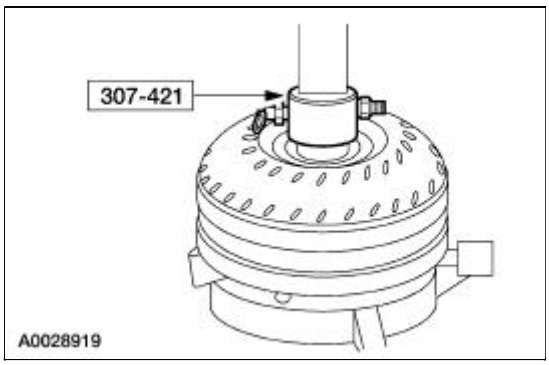
1. Clean the outside surface of the torque converter.

2. Install the special tool into the converter hub.



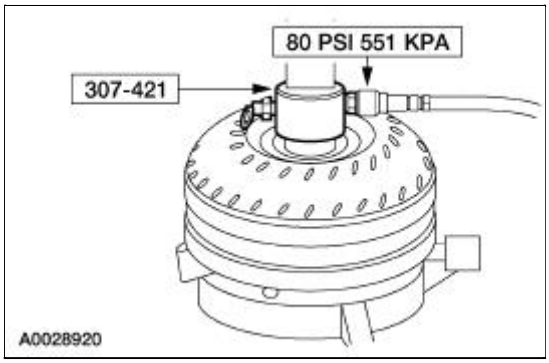
3. **WARNING: Always follow correct safety procedures while using press. Failure to follow these instructions may result in personal injury.**

   Install the torque converter with the installed special tool into the arbor press.
   Secure the press, apply enough force to seal the tool into the torque converter.

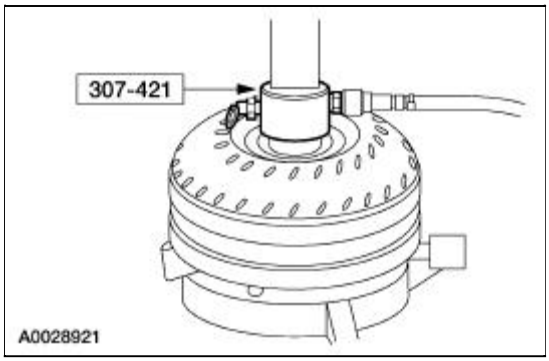


4. **NOTE:** Use clean dry shop air.

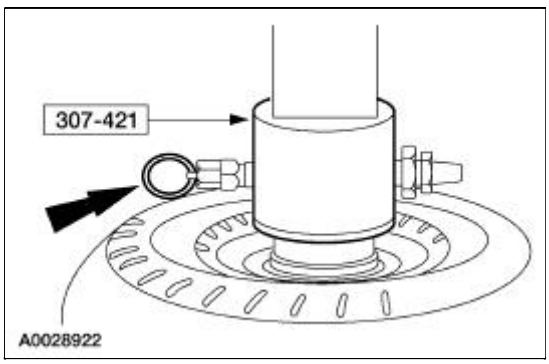
   Apply air pressure to the valve on the special tool.



5. With air pressure applied to the valve, inspect for leaks at the converter hub, seams, drain plug and studs. A soap bubble solution may be applied around these areas to aid in diagnosis. If a leak is found around the drain plug, install a new drain plug and recheck the torque converter. If any other leaks are present, install a new or remanufactured torque converter.



6. Remove the air hose. Release pressure and then slowly release the press. Remove the torque converter. Remove the special tool.

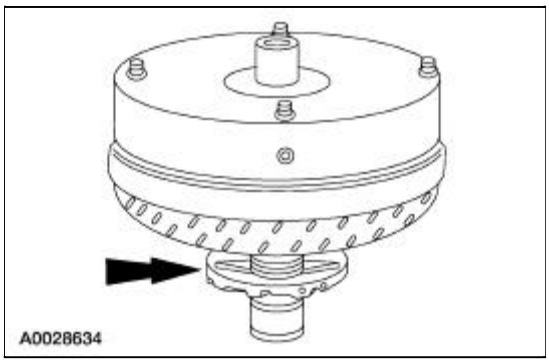


Torque Converter Impeller to Pump Stator Interference Check

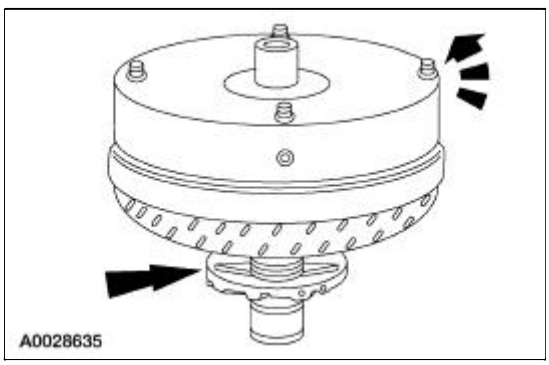
1. **NOTE:** Front pump support may remain in front pump support and gear during this test.

   Position the front pump support with the splines up.

2. Mount the torque converter on the front pump support with the splines on the one-way clutch inner race, engaging the mating splines of the front pump support.

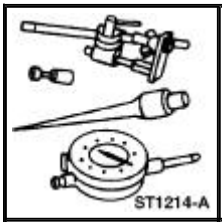


3. Hold the front pump support stationary and rotate the torque converter counterclockwise.
   - The torque converter should rotate freely with no signs of scraping.
   - If there are signs of scraping, install a new or remanufactured torque converter.

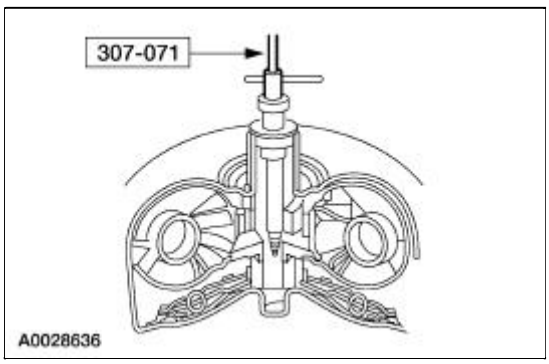


Torque Converter End Play Check

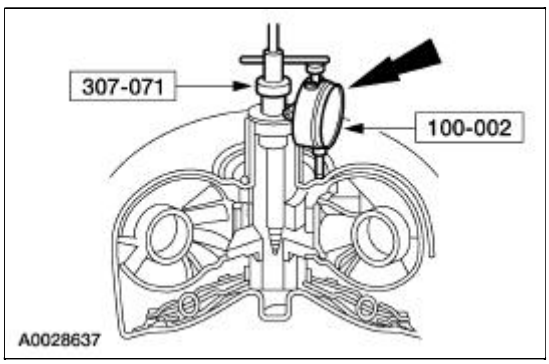
Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent
 ST1196-A	End Play Gauge, Torque Converter 307-071 (T80L-7902-A) or equivalent

1. Install the special tool into the torque converter pump drive.
   - Tighten the inner post until the tool is securely locked.



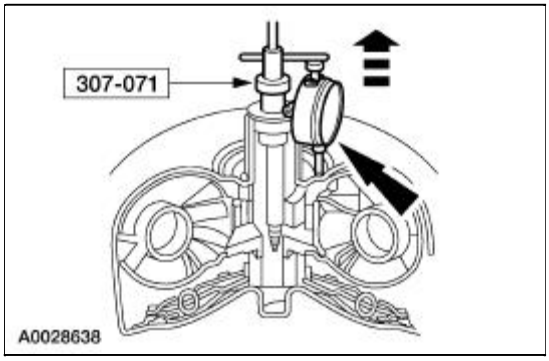
2. Install the special tool on the converter pump drive hub and zero the dial indicator.



3. Lift up on the special tool and note the dial indicator reading.
   - If the reading exceeds end play limits, install a new or remanufactured torque converter.

Torque Converter End Play

New or Rebuilt Torque Converter	Used Torque Converter
0.355-1.04 mm (0.014-0.041 inch) Max.	0.355-1.87 mm (0.014-0.074 inch) Max.



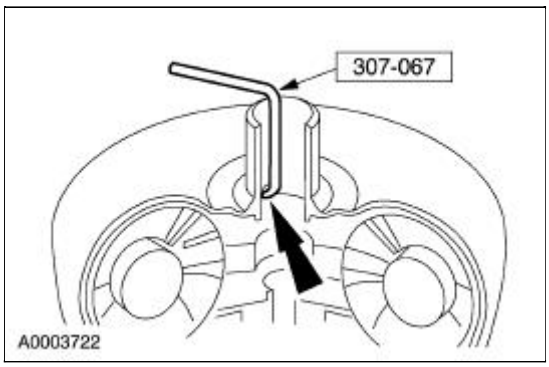
4. Remove the special tools.

Torque Converter One-Way Clutch Check

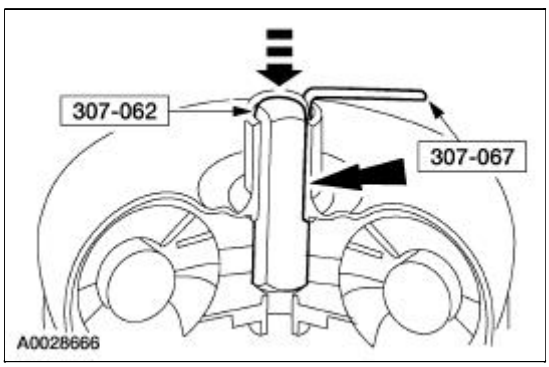
Special Tool(s)

 ST1193-A	Holding Tool, One-Way Clutch 307-062 (T76L-7902-C) or equivalent
 ST1195-A	Holding Tool, Torque Converter Clutch 307-067 (T77L-7902-R) or equivalent

1. Install the special tool in one of the grooves in the stator thrust washer.

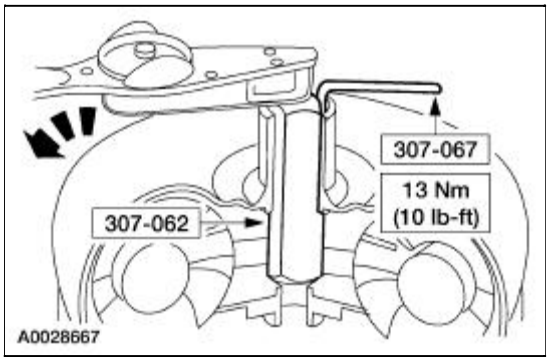


2. Install the special tool in the converter pump drive.



3. Use a torque wrench to turn the special tool counterclockwise while holding the special tool stationary.
   - The converter should lock up and hold torque.
   - The torque converter one-way clutch should rotate freely in the clockwise direction.
   - Try the clutch for lockup and hold in at least five positions.

- If the torque converter fails the lockup test torque, install a new or remanufactured torque converter.

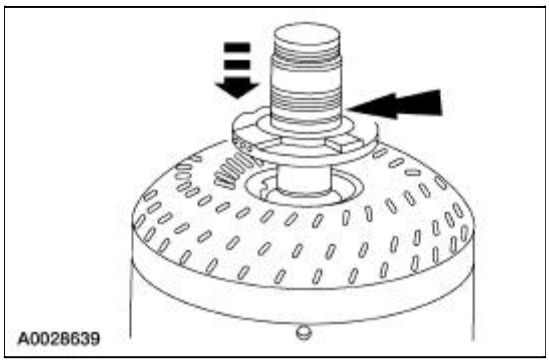


Torque Converter Turbine to Pump Stator Interference Check

1. **NOTE:** Front pump support may remain in front pump support and gear during this test.

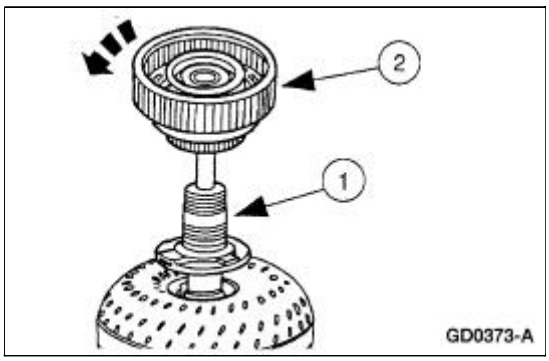
   Position the torque converter with the pump drive up.

2. Install the front pump support to engage the mating splines of the front pump support shaft on the torque converter.



3. Install the forward clutch cylinder and shaft, engaging the splines with the rear clutch hub.

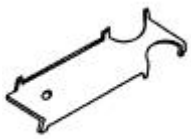
4. Check for stator to turbine interference.
   1. Hold the front pump support stationary.
   2. Attempt to rotate the forward clutch cylinder and shaft.
      - The turbine and torque converter clutch assemblies should rotate in both directions, not exceeding maximum torque of 9.5 Nm (7 lb-ft), without any signs of metallic interference or scraping noise.

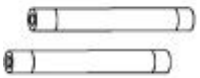


5. If interference exists, the stator front thrust washer may be worn, allowing the stator to hit the turbine. In such cases, a new or remanufactured torque converter must be installed.
   - The converter crankshaft pilot should be checked for nicks or damaged surfaces that could cause interference when installing the torque converter into the crankshaft. Check the converter front impeller hub for nicks or sharp edges that would damage the pump seal.

Transmission

Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)
 ST2467-A	Rubber Tip Air Nozzle 100-D009 (D93L-7000-A)
 ST1633-A	Alignment Gauge, TR Sensor 307-351 (T97L-70010-A)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
 ST1199-A	Installer, Shift Shaft Fluid Seal 307-050 (T74P-77498-A)
 ST1197-A	Shim Selection Gauge 307-072 (T80L-77003-A)
 ST1202-A	Installer, Servo Piston 307-073 (T80L-77030-A)
	Remover/Installer, Transmission Extension Housing

 ST1216-A	307-077 (T80L-77110-A)
 ST1631-A	Handle, Torque Converter 307-091 (T81P-7902-C)
 ST1940-A	Test Plate Screw Set, Transmission 307-126 (T82P-7006-C)
 ST1392-A	Air Test Plate, Transmission 307-246 (T92P-7006-A)
 ST1210-A	Remover/Installer, Servo Piston 307-251 (T92P-70023-A)
 ST1636-A	Retainer, Torque Converter 307-346 (T97T-7902-A)
 ST1188-A	Installer, Transmission Extension Housing Oil Seal 308-002 (T61L-7657-A)
 ST2545-A	Gauge, Transmission Solenoid Connectors 307-426

Material

Item	Specification
MERCON® V Automatic	

Transmission Fluid XT-5-QM	MERCON® V
Multi-Purpose Grease D0AZ-19584-AA	ESB-M1C93-B

CAUTION: Before beginning assembly, carry out and inspect the following:

When building up subassemblies and assembling the transmission, ALWAYS use new gaskets and seals.

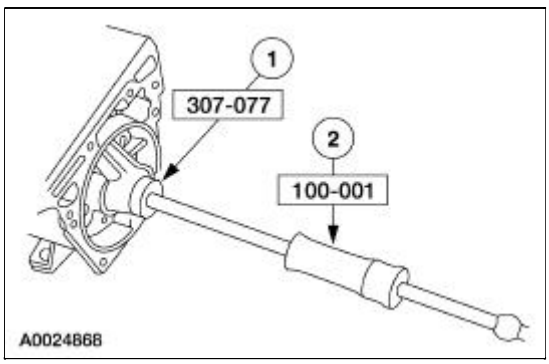
All fasteners must be tightened to the torque specification indicated. In addition to appearing in the section, the necessary torques can be found in the General Specifications Chart.

When building up subassemblies, each component part should be lubricated with clean transmission fluid. It is also good practice to lubricate the subassemblies as they are installed in the case.

Needle bearings, thrust washers and seals should be lightly coated with petroleum jelly during subassembly buildup or transmission assembly.

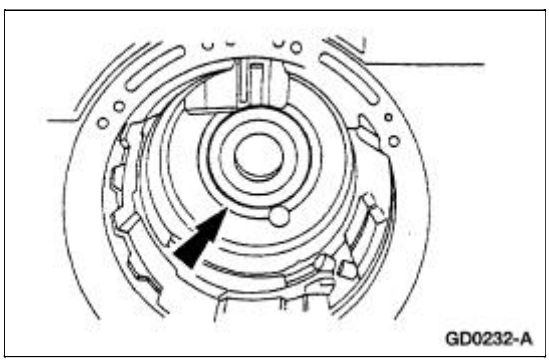
Many components and surfaces in the transmission are precision machined. Careful handling during disassembly, cleaning, inspection and assembly can prevent unnecessary damage to machined surfaces.

1. Use the special tools to install the rear case bushing if removed.
    1. Position the rear case bushing and the special tool inside the case.
    2. Assemble the special tools through the back of the case.



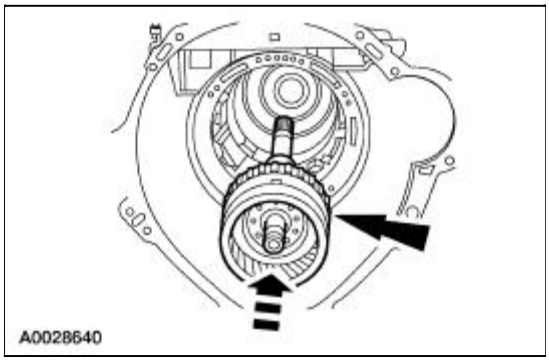
2. Place the transmission in the vertical position.

3. Coat the No. 9 case rear bearing with petroleum jelly and install on the case boss.

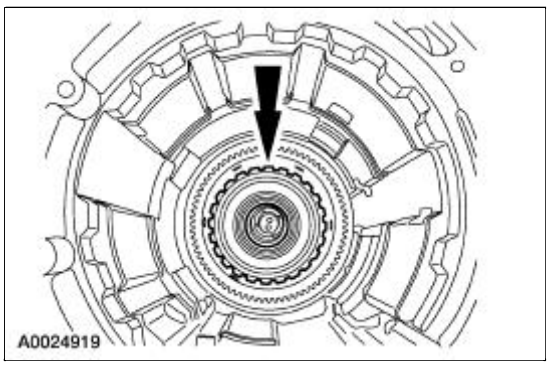


4. **CAUTION: Be sure the No. 7 needle bearing and direct clutch hub are installed as shown in the Subassembly section. Internal damage and shift problems may occur.**

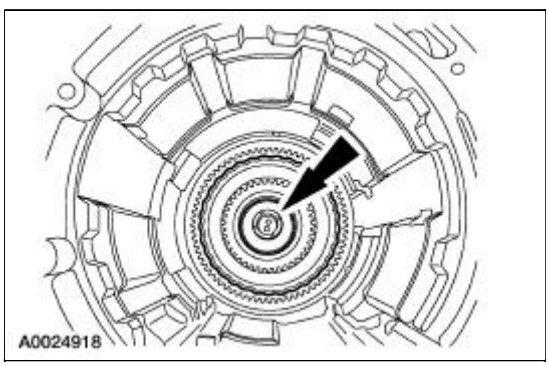
Install the output shaft and output shaft ring gear.



5. Install the No. 8 bearing.

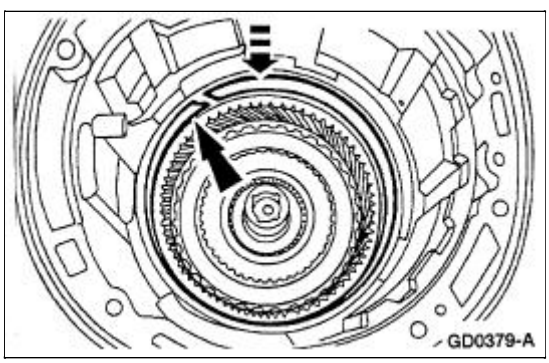


6. Install the direct clutch.



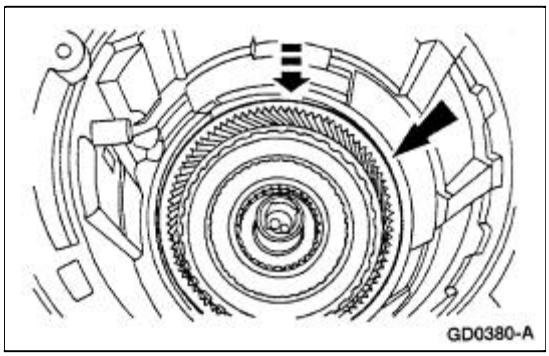
7. **NOTE:** The reverse band support retaining ring is used for assembly purposes during production. The reverse band support retaining ring is not required during assembly, it will not affect the operation of the transmission.

   Install the reverse band support retaining ring.



8. **NOTE:** Make sure the band is seated on the anchor pins.

   Install the reverse band.

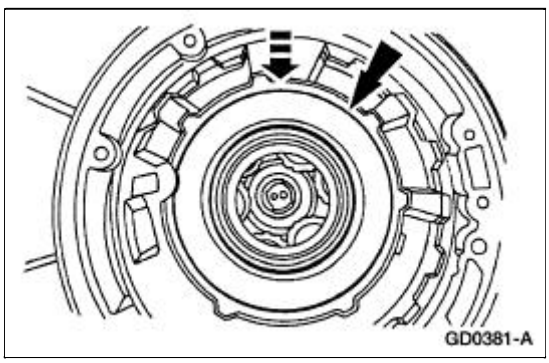


9. **NOTE:** The planetary assembly and planetary gear support cannot be installed unless the notch cut in the planetary gear support is aligned with the overdrive band anchor pin.

   NOTE: The top of the planetary gear support must be below the snap ring groove.

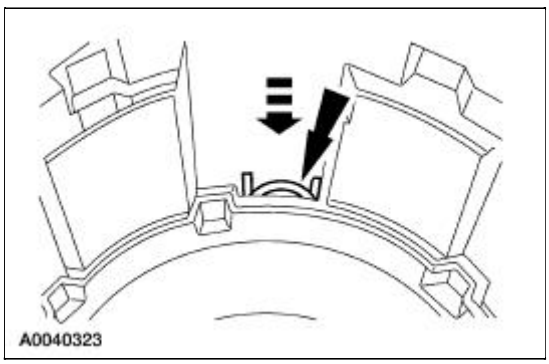
   Install the planetary assembly and planetary gear support as a unit.

   - Rotate the output shaft to fully seat the planetary assembly.



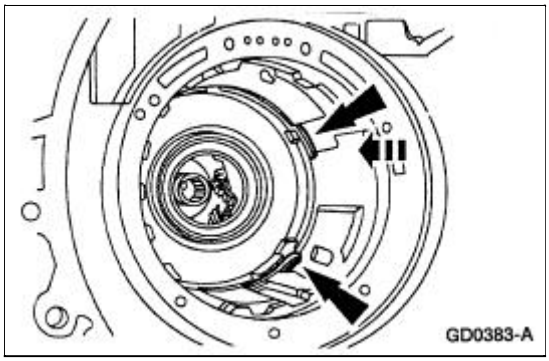
10. **NOTE:** The planet support spring must be compressed and installed below the snap ring groove. When the planet support spring is installed correctly both ends of the spring will be visible.

    Install the case to planet support spring located at the 1 o'clock position.

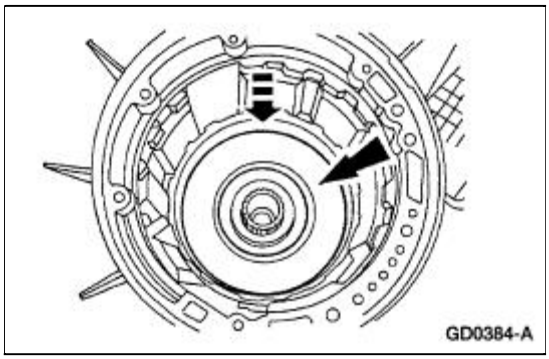


11. Install the center support retaining ring.

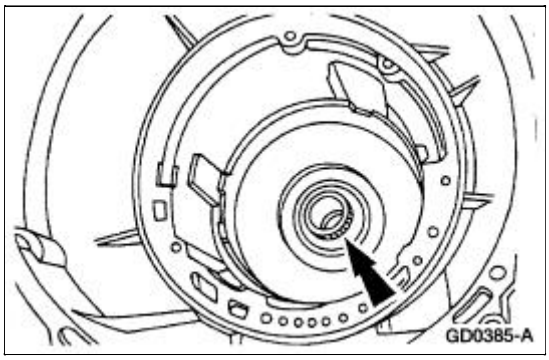
    - Reference the retaining ring tabs to the band anchor pin location.



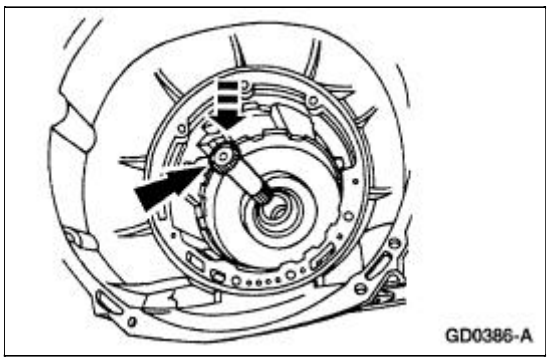
12. Install the forward clutch sun gear, No. 5 forward clutch sun gear bearing and the reverse sun gear.



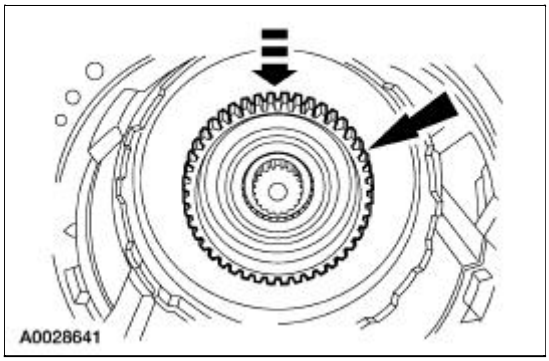
13. Install the No. 4 forward clutch hub bearing.



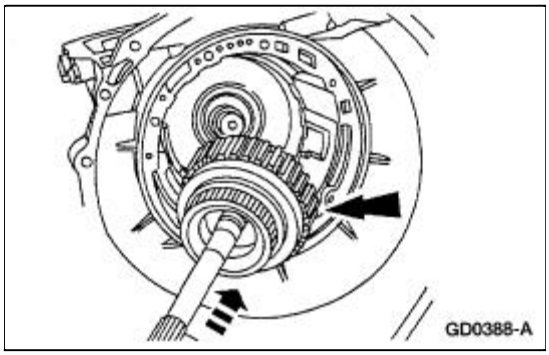
14. Install the intermediate stub shaft.



15. Install the forward clutch hub and the No. 3 forward clutch hub front bearing.

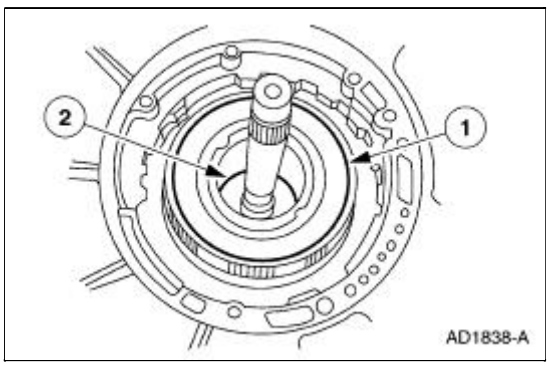


16. Install the forward clutch assembly.

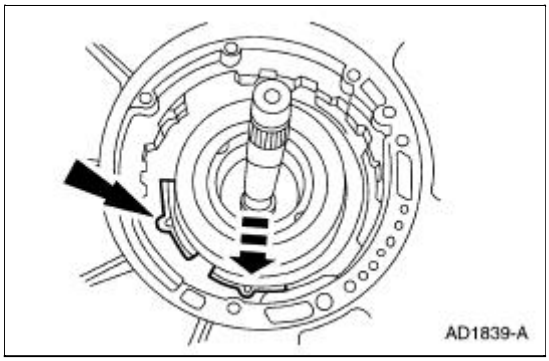


17. **NOTE:** Make sure the reverse clutch cylinder lugs are completely seated in the notches of the reverse sun gear.

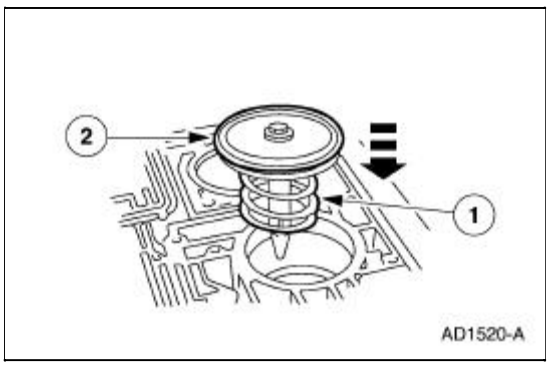
    Install the reverse clutch cylinder assembly.
    1. Install the reverse clutch cylinder assembly.
    2. Install the No. 2 forward clutch bearing.



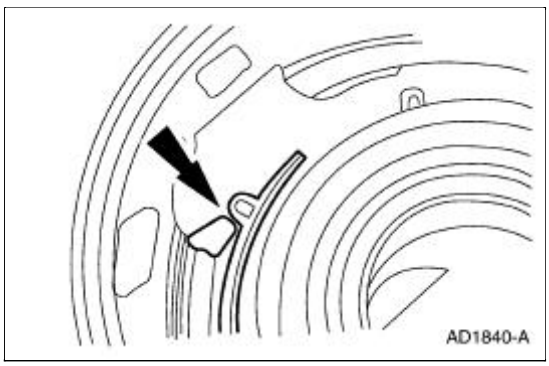
18. Install the overdrive band.
    - Position the overdrive band pocket onto the anchor pin.



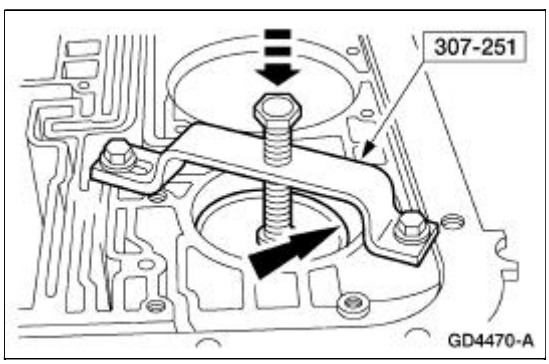
19. Install the overdrive servo spring.
    1. Install the overdrive servo piston return spring.
    2. Install the overdrive servo piston.



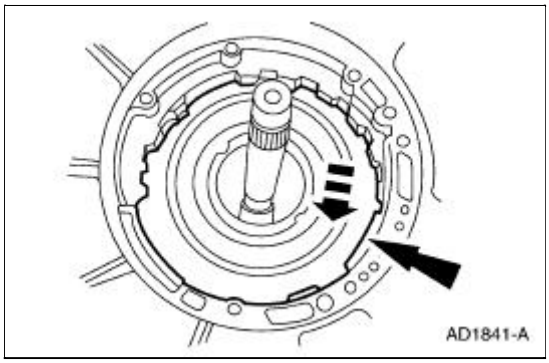
20. Verify the tip of the piston assembly engages the pocket of the overdrive band.



21. Using the special tool, compress the overdrive servo assembly and install the overdrive servo retaining ring.

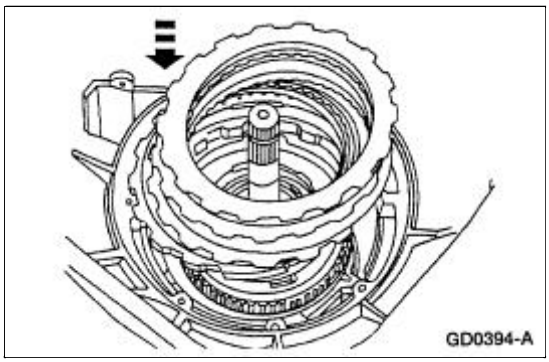


22. Install the intermediate clutch pressure plate.



23. **NOTE:** Before assembly, soak the new clutch discs in clean automatic transmission fluid for 15 minutes.

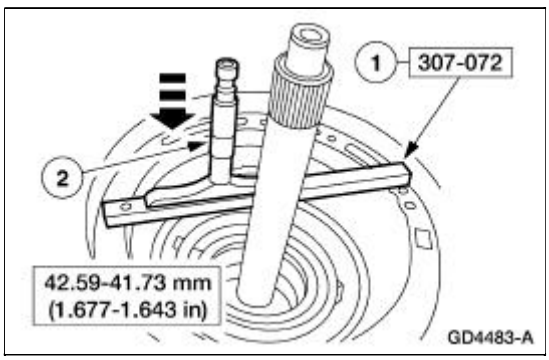
    Install the intermediate clutch pack and selective steel plate.



24. Using the special tool, check the intermediate clutch clearance.
    1. Position the special tool on the pump case mounting surface.
    2. Maintaining downward pressure, use a depth micrometer to measure and verify intermediate clutch clearance is within specification.
       If the intermediate clutch is not within specification, install a correct selective plate.

Selective Steel Plates

Specification
1.80-1.7 mm (0.071-0.067 inch)
2.05-1.95 mm (0.081-0.077 inch)
2.31-2.20 mm (0.091-0.087 inch)
2.56-2.46 mm (0.101-0.097 inch)

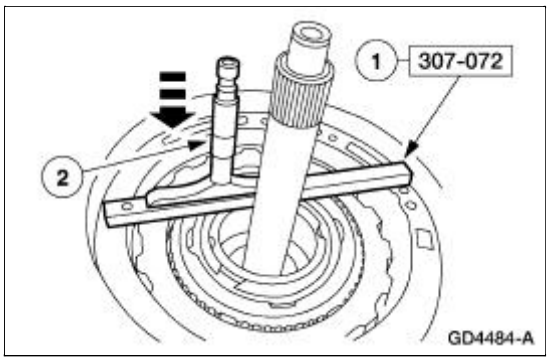


25. Using the special tool, measure end clearance for the No. 1 front pump thrust washer.
    1. Position the special tool on the pump case mounting surface.
    2. Maintaining downward pressure, use a depth micrometer to measure end play clearance.

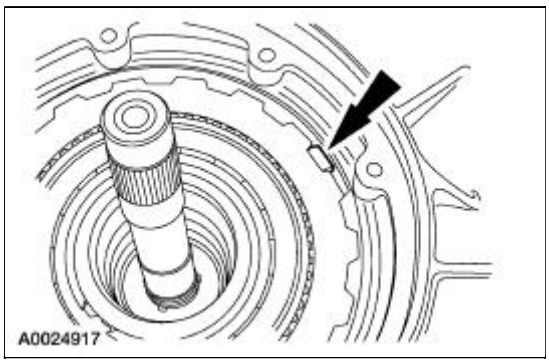
Use the No. 1 thrust washer chart to select the correct washer.

No.1 Thrust Washer Chart

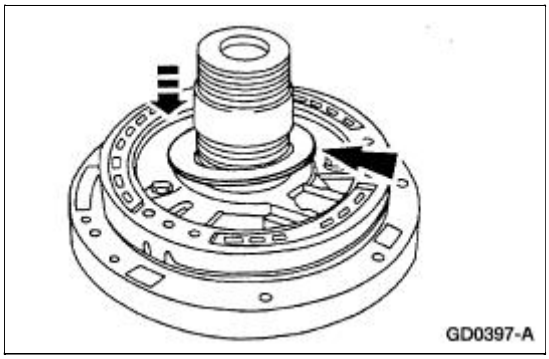
Depth	Thickness	Color Code
37.706-38.184 mm (1.485-1.503 inch)	1.270-1.372 mm (0.050-0.054 inch)	Green
38.185-38.641 mm (1.504-1.521 inch)	1.727-1.829 mm (0.068-0.072 inch)	Yellow
38.642-39.073 mm (1.522-1.538 inch)	2.159-2.261 mm (0.085-0.089 inch)	Natural
39.074-39.505 mm (1.539-1.555 inch)	2.591-2.692 mm (0.102-0.106 inch)	Red
39.506-40.165 mm (1.556-1.581 inch)	3.023-3.124 mm (0.119-0.123 inch)	Blue



26. If equipped, install the intermediate clutch anti-rattle clip.

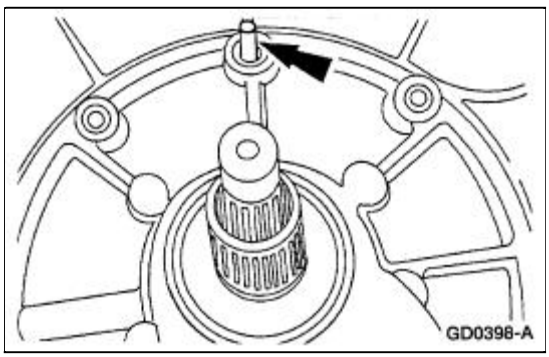


27. Install the No. 1 front pump support thrust washer.
    - Use petroleum jelly to hold the washer in place.



28. **NOTE:** The alignment pin is a fabricated M8 x 1.25 mm (0.05 in) bolt with the head removed.

    Install an alignment pin at the top of the case.

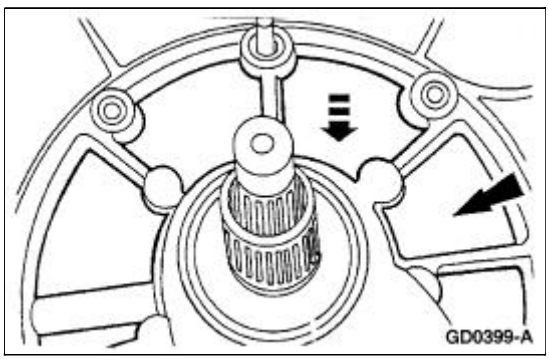


29. **NOTE:** Make sure the gasket is positioned correctly and the case passages are not covered.

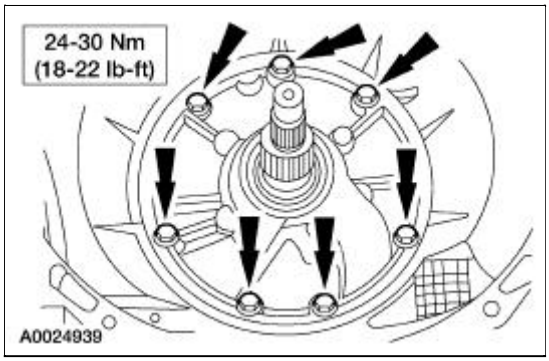
    Install the pump gasket.

30. **NOTE:** To aid assembly, shake the input shaft while pushing down on the pump.

    Install the pump assembly.

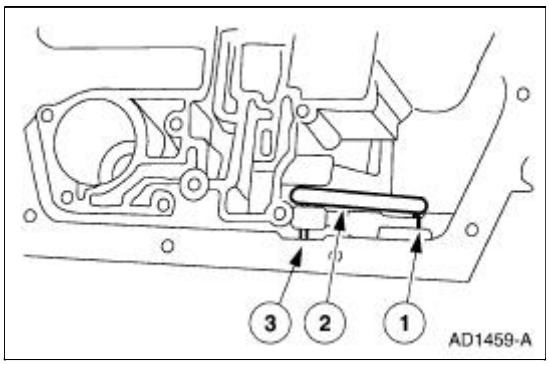


31. Remove the alignment pin and install the front pump bolts.
    - Alternate bolt tightening to set the pump.

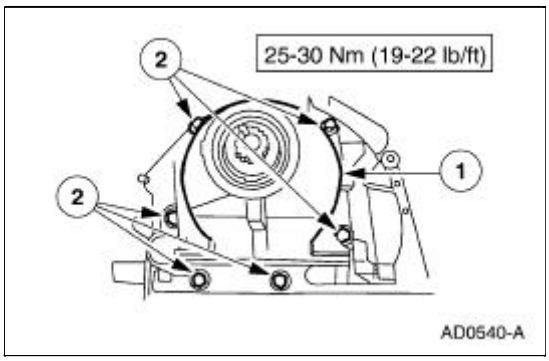


32. Rotate the transmission to the horizontal position.

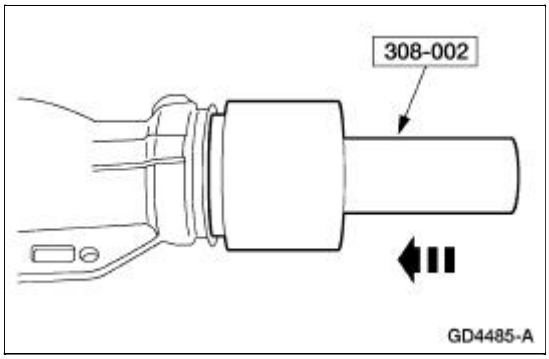
33. Install the parking pawl.
    1. Position the parking pawl return spring.
    2. Position the parking pawl.
    3. Install the parking pawl shaft.



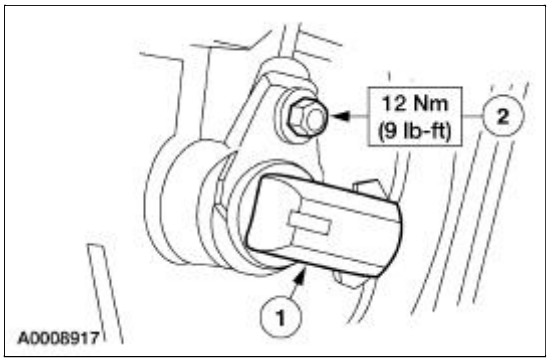
34. Install a new extension housing gasket and the extension housing.
    1. Position the extension housing.
    2. Install the four bolts and two nuts.



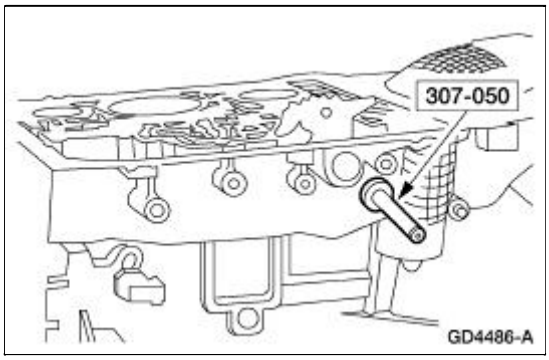
35. Using the special tool, install a new extension housing seal.



36. Install the output shaft speed (OSS) sensor.
    1. Position the OSS sensor.
    2. Install the bolt.

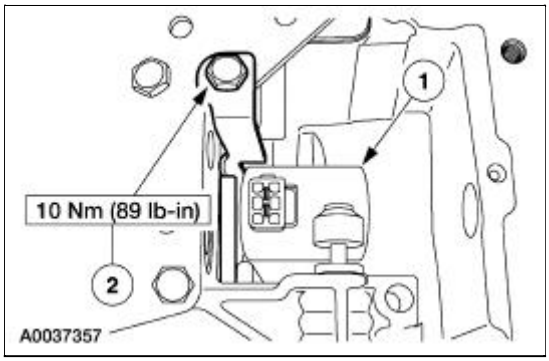


37. Using the special tool, install the manual control lever seal.

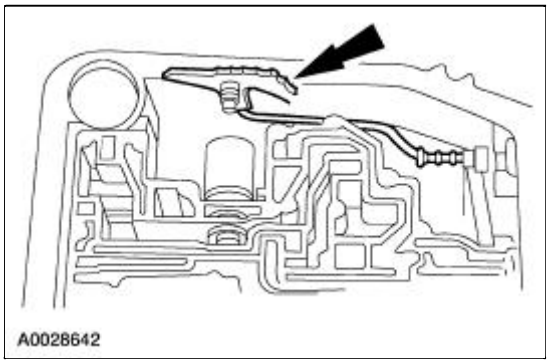


38. **NOTE:** Lubricate the electronic pressure control (EPC) solenoid O-rings with clean automatic transmission fluid.

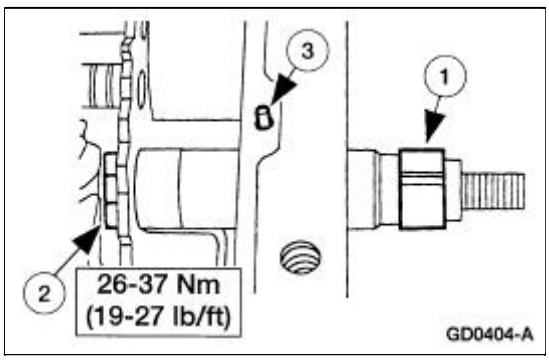
    Install the EPC solenoid.
    1. Install the EPC solenoid.
    2. Install the EPC solenoid bracket and bolt.



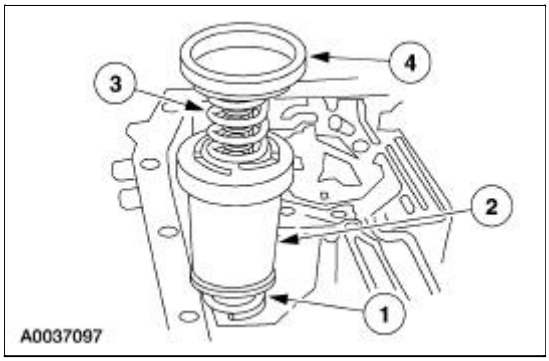
39. Install the manual valve detent lever and parking lever actuating rod.



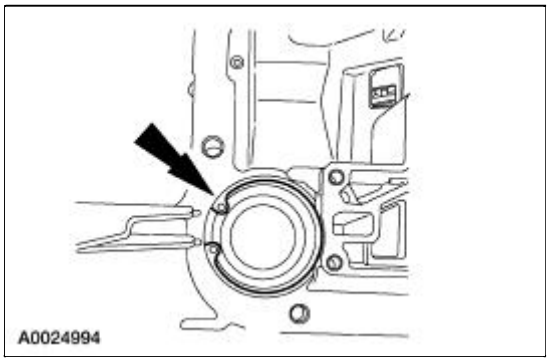
40. Install the manual control lever shaft.
    1. Slide the manual control shaft into the case.
    2. Install the manual lever shaft inner nut.
    3. Install the manual lever shaft retaining pin.



41. Install the 1-2 accumulator piston assembly.
    1. Install the 1-2 accumulator spring.
    2. Install the 1-2 accumulator.
    3. Install the inner and outer 1-2 accumulator springs.
    4. Install the 1-2 accumulator cover and seal.



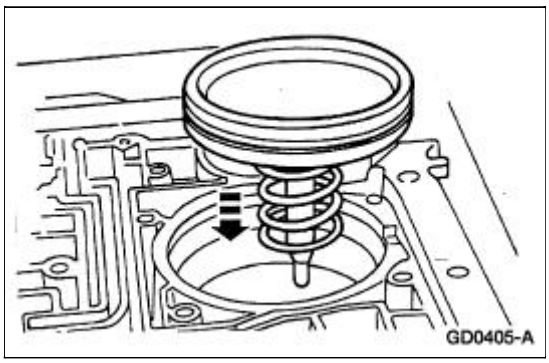
42. Install the 1-2 accumulator springs and install the accumulator piston retaining ring.



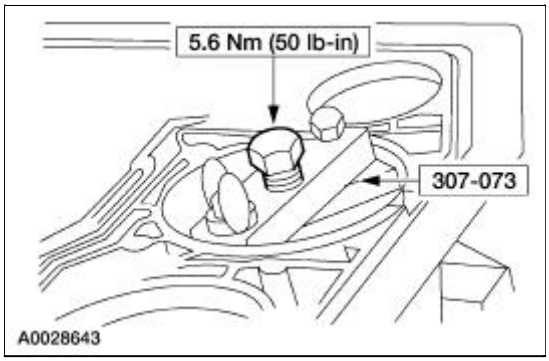
43. **NOTE:** This is not an ordinary installation procedure and does not compensate for band wear. When a new piston and rod assembly becomes necessary, or when a new reverse band has been installed, the reverse piston and rod length must be adjusted.

    NOTE: Lubricate the reverse piston seal to facilitate assembly and prevent damage to the seal.

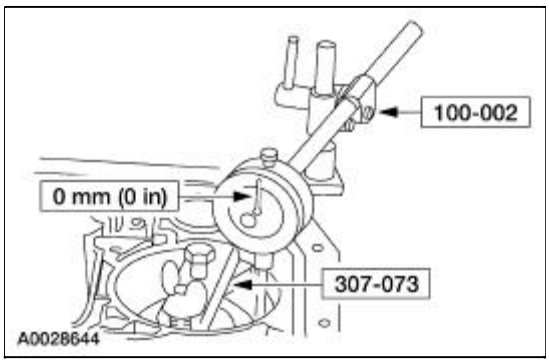
    Install the reverse servo piston and return spring.



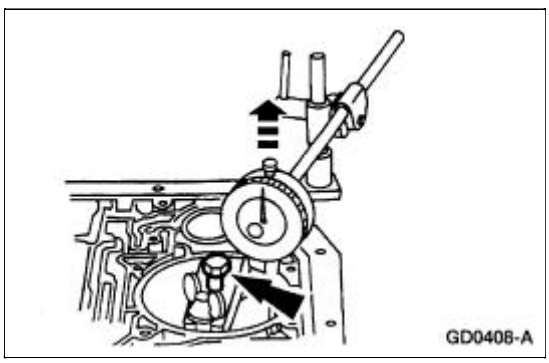
44. Install the special tool.
    - Tighten the bolt.



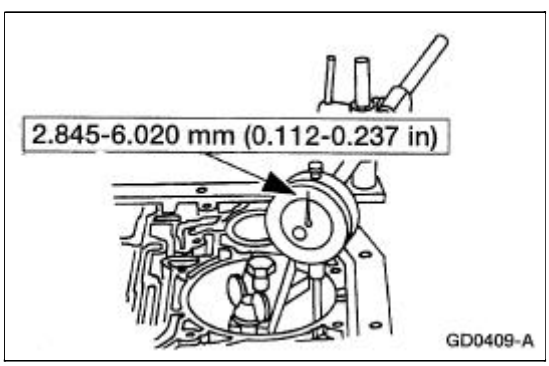
45. Install the special tool.
    - Position the indicator stem on the flat portion of the reverse servo piston and zero the dial indicator.



46. Loosen the bolt until the piston stops against the tool.

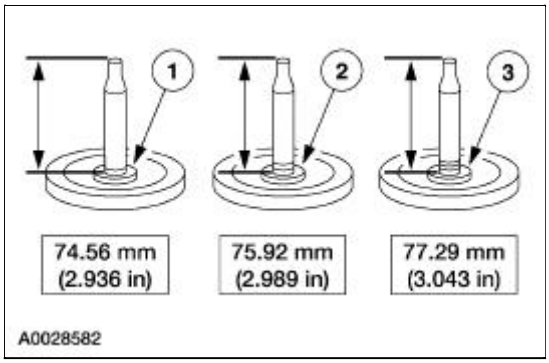


47. Verify the amount of piston travel on the dial indicator is within specification.

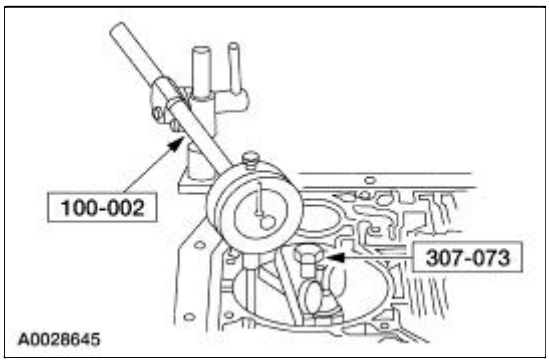


48. If piston travel is not within specification, select and install the correct servo assembly to bring the servo piston travel within specification.

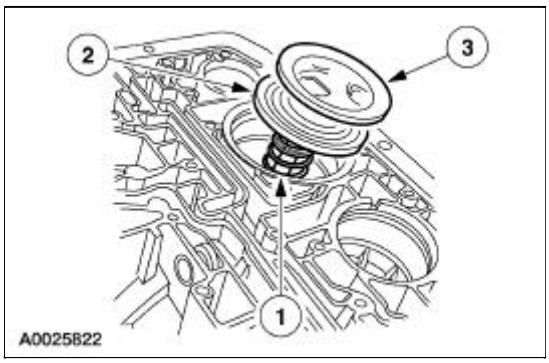
1. One groove
2. Two grooves
3. Three grooves



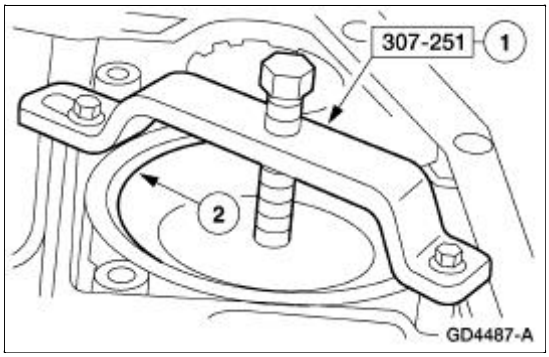
49. Remove the special tools.



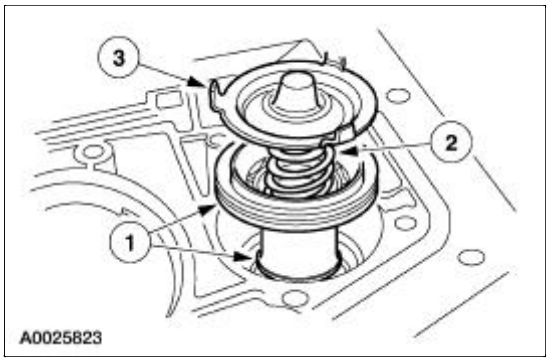
50. Install the reverse servo assembly.
    1. Install the rod.
    2. Install the piston assembly.
    3. Install the reverse servo piston cover and seal.



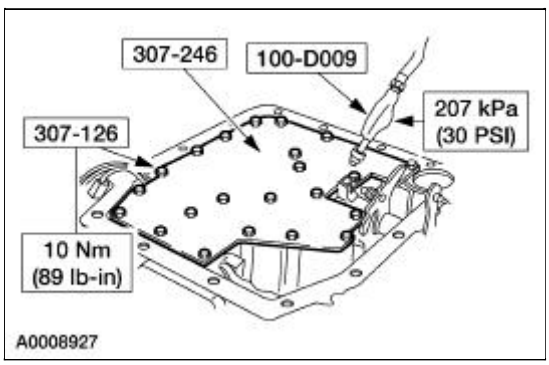
51. Using the special tool, install the reverse servo retaining ring.
    1. Compress the reverse band servo.
    2. Install the reverse band servo retaining ring.



52. Install the 2-3 accumulator assembly.
    1. Install the accumulator piston.
    2. Install the accumulator piston spring.
    3. Install the accumulator spring retainer.

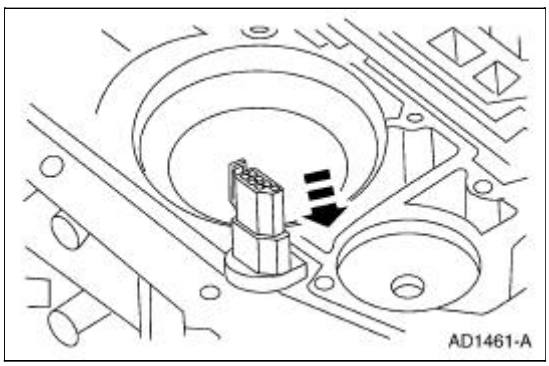


53. Using the special tools apply regulated air pressure to the test ports. Verify that the components are applied and released.



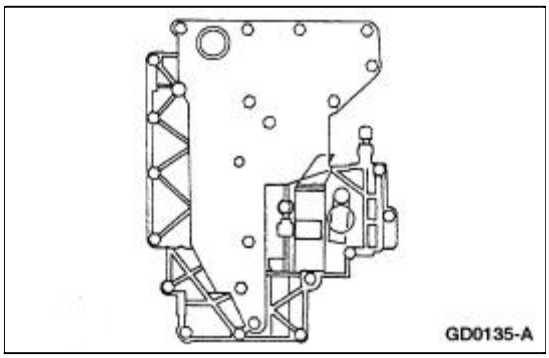
54. **NOTE:** The tab on the electrical connector is secured by main control valve body.

    Install the electrical connector into case.



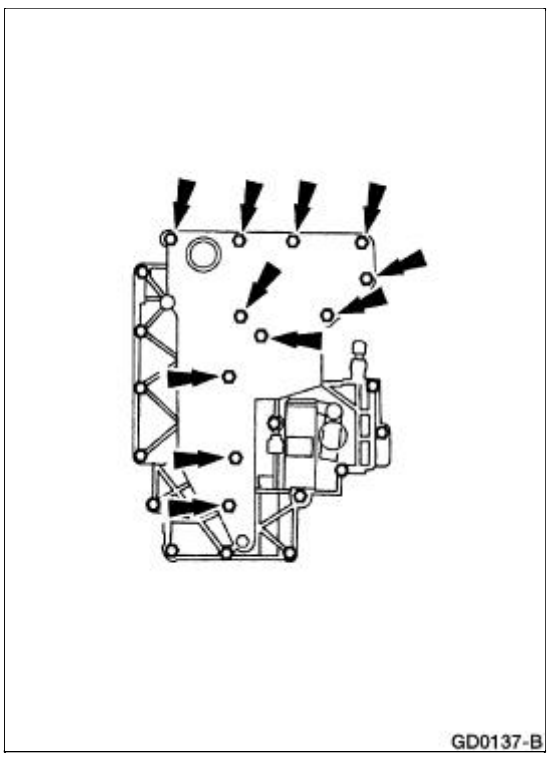
55. **NOTE:** The alignment bolts are valve body assembly bolts and are in the valve body.

    Align the main control valve body alignment bolts and position the main control valve body.



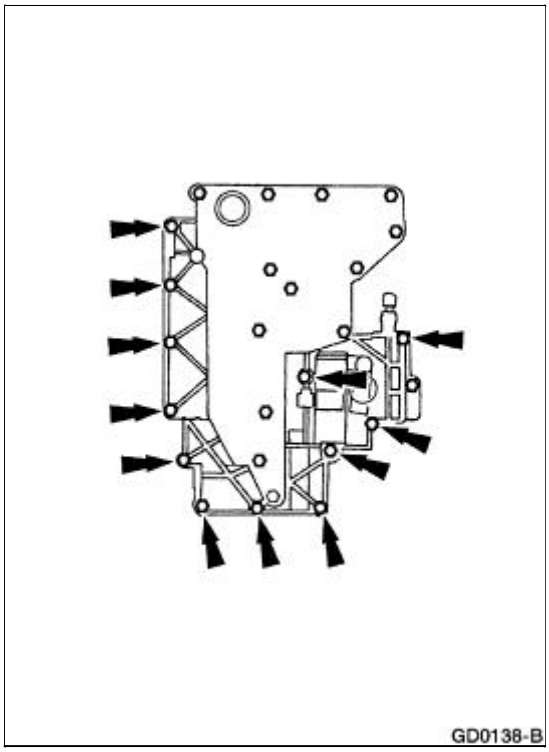
56. **NOTE:** The main control valve body bolts will be tightened in later steps.

    Loosely install the 11 long main control valve body bolts.

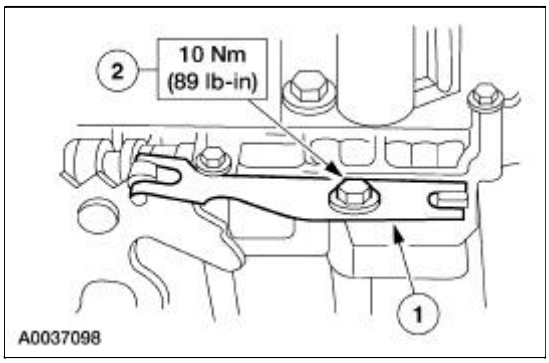


57. **NOTE:** The main control valve body bolts will be tightened in later steps.

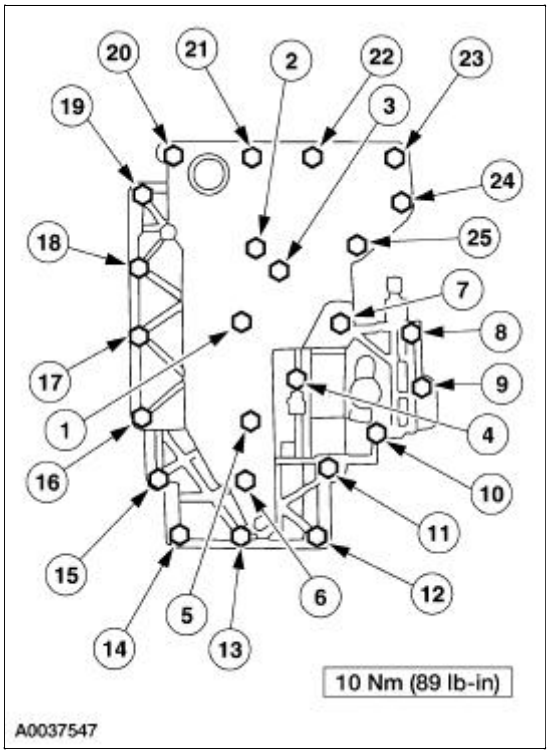
    Loosely install the 12 short main control valve body bolts.



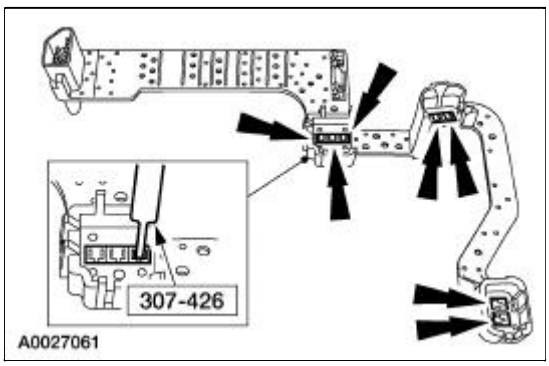
58. Install the manual control valve detent lever spring.
    1. Position the manual control valve detent lever spring.
    2. Install the bolt.



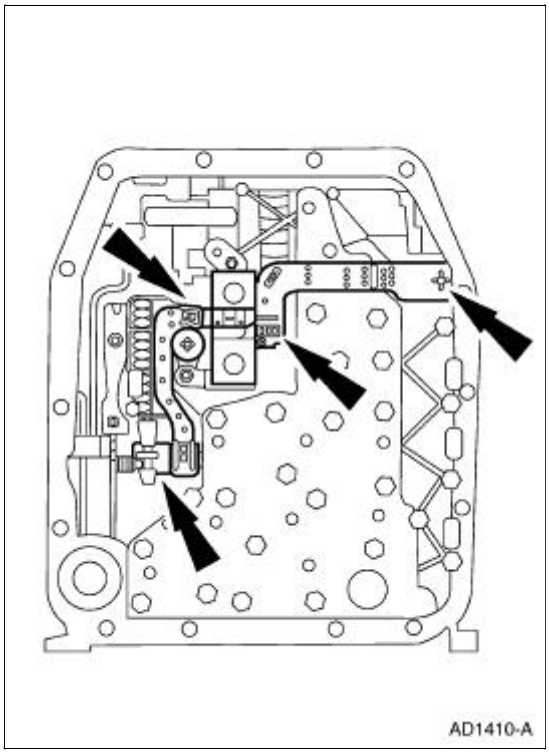
59. Tighten the bolts in the sequence shown.



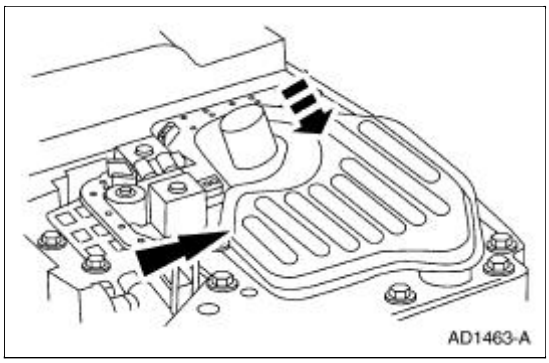
60. Inspect the lead frame for damage.
    - Using the special tool, check all lead frame solenoid connections. The gauge should fit tightly and not fall out after being inserted.
    - If the special tool passes through any lead frame connector pins or does not feel like it makes a good contact, install a new lead frame.



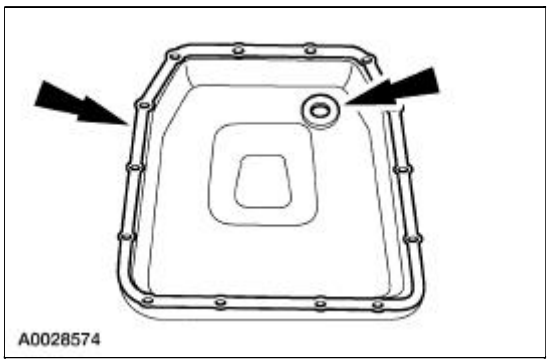
61. Connect the molded lead frame to the solenoids.
    - Connect the bulkhead inter-connector by pressing it in place by hand and fully seating the connector in place.
    - Connect the EPC solenoid by pressing it in place by hand and fully seating the connector in place. Make sure that the terminals pass fully through the connector slots.
    - Connect the TCC by pressing it in place by hand and fully seating the connector in place. Make sure that the terminals pass fully through the connector slots.
    - Connect the shift solenoid SSA and SSB by pressing it in place by hand and fully seating the connector in place. Make sure that the terminals pass fully through the connector slots.



62. Install the fluid filter and seal assembly.

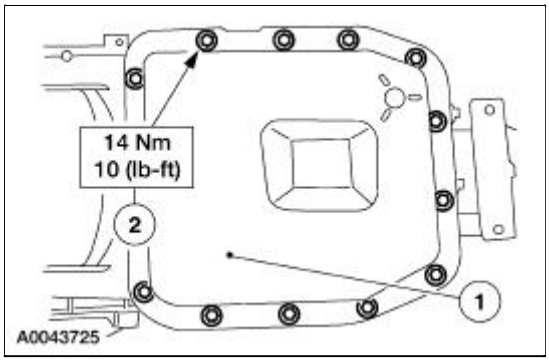


63. Position the pan magnet onto the fluid pan.

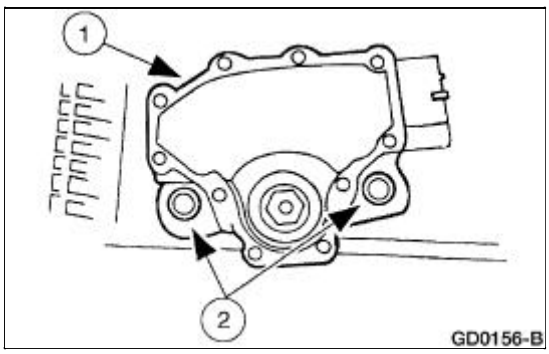


64. **NOTE:** The pan gasket is reusable; clean and inspect for damage. If not damaged, the gasket should be reused.

    Install the fluid pan and gasket.
    1. Position the transmission fluid pan with the gasket in place.
    2. Install the bolts.



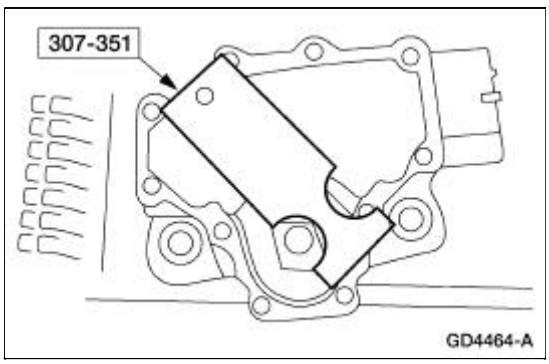
65. Install the digital transmission range (TR) sensor.
    1. Install the digital TR sensor.
    2. Loosely install the digital TR bolts.



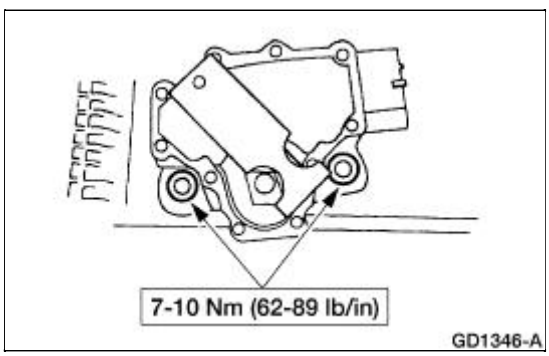
66. **NOTE:** The tool is designed to fit snug.

    NOTE: Manual shift lever must be in the neutral position.

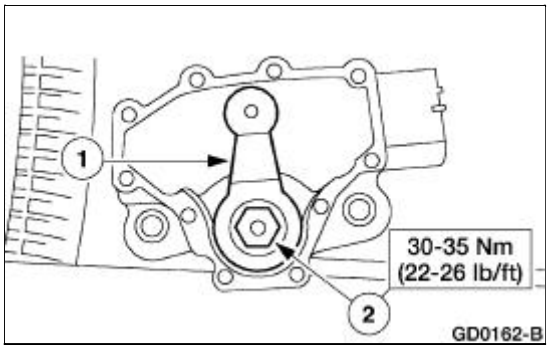
    Using the special tool, align the digital TR sensor slots.



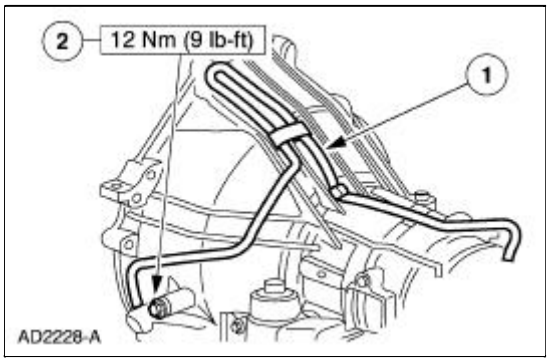
67. Tighten the bolts.



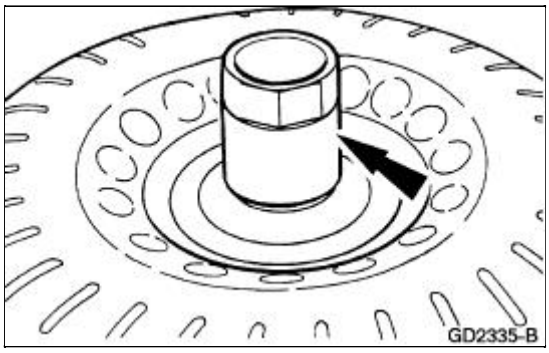
68. Install the manual control lever.
    1. Install the manual control lever.
    2. Install the nut.



69. Install the transmission vent tube, if equipped.
    1. Install the transmission vent tube.
    2. Install the bolt.



70. Lightly lubricate the converter hub with clean automatic transmission fluid.

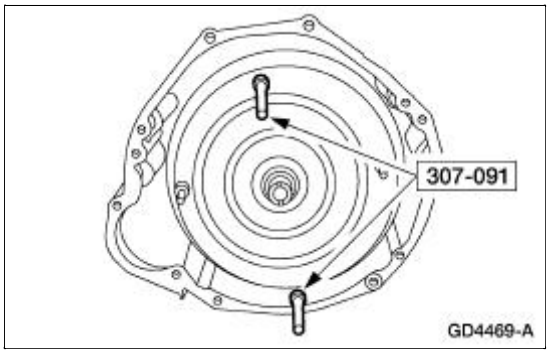


71. **WARNING: The torque converter can fall out if the transmission is tipped.**

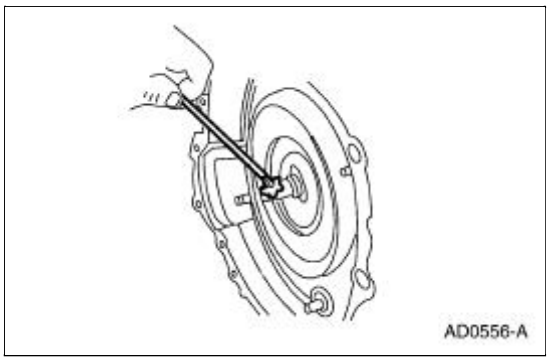
CAUTION: Make sure the converter hub is fully engaged in the front pump support and gear and rotates freely. Do not damage the hub seal.

CAUTION: If the torque converter slides out, the hub seal may be damaged.

Using special tools, install the torque converter.



72. Lubricate the torque converter pilot hub with multi-purpose grease.



Transmission —4x2

Special Tool(s)

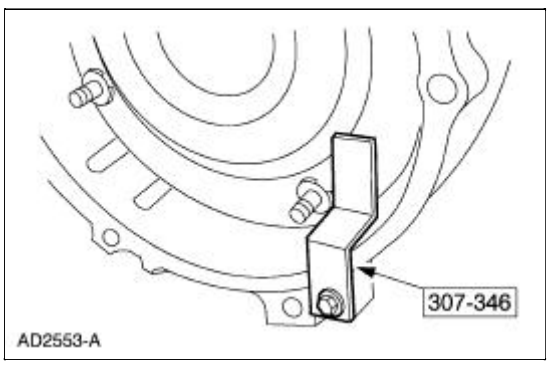
 ST1636-A	Retainer, Torque Converter 307-346 (T97T-7902-A)

Material

Item	Specification
MERCON®V Automatic Transmission Fluid XT-5-QM	MERCON®V

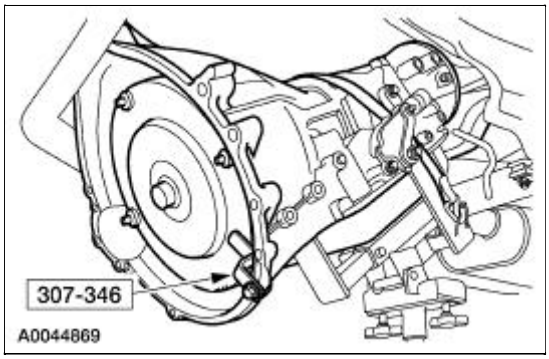
Installation

1. Install the special tool if not done in the assembly procedure.



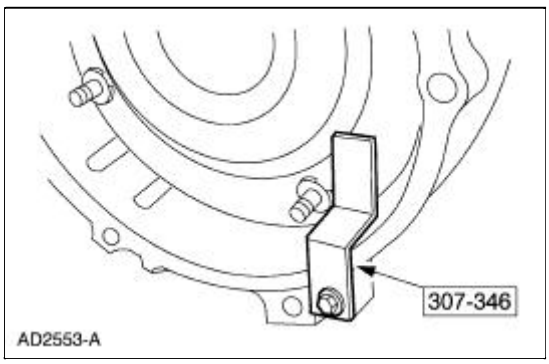
2. **CAUTION: To position the transmission in the vehicle, put the transmission into a nose-down position on the transmission jack. This allows the tail shaft to go over the exhaust system. The converter housing is piloted into position by dowels in the rear of the engine block. The torque converter must rest squarely against the flexplate. This indicates that the converter pilot is not binding in the engine crankshaft.**

   Position and secure the transmission on the high-lift transmission jack. Raise and position the transmission into the vehicle. Once the transmission is in position, place the transmission in a horizontal position.



3. **NOTE:** Do not remove the special tool until the transmission is in a horizontal position.

   Remove the special tool.

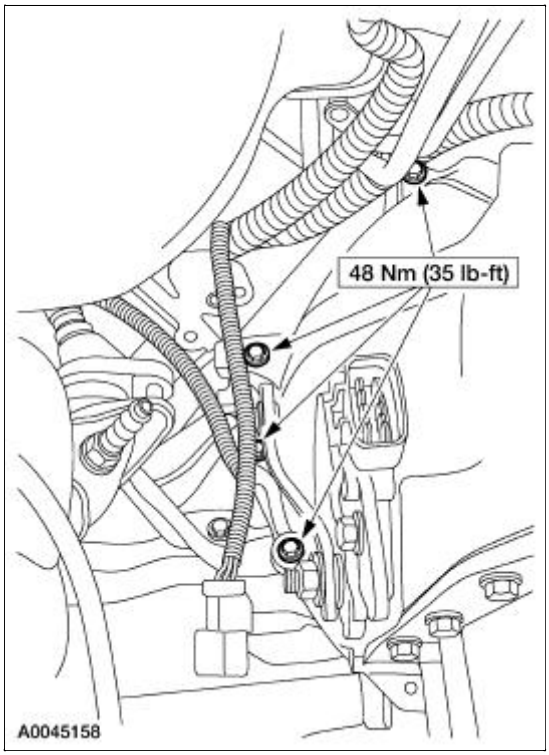


4. **NOTE:** Make sure the torque converter is fully seated in the transmission before aligning the transmission to the engine.

   With the transmission in a horizontal position move it toward the engine. Align the orange balancing marks between the torque converter studs and the flexplate bolt holes.

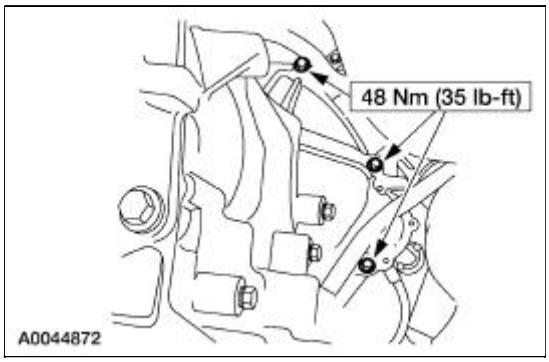
5. **NOTE:** Install the transmission retaining bolts in their correct locations made during removal.

   Install the LH transmission retaining bolts.

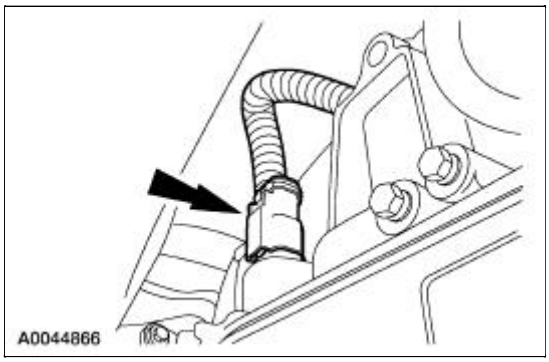


6. **NOTE:** Install the transmission retaining bolts in their correct locations made during removal.

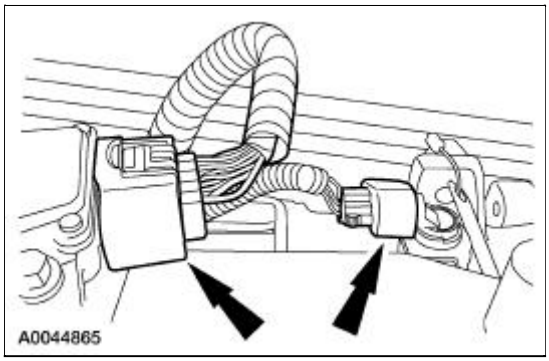
   Install the RH transmission retaining bolts.



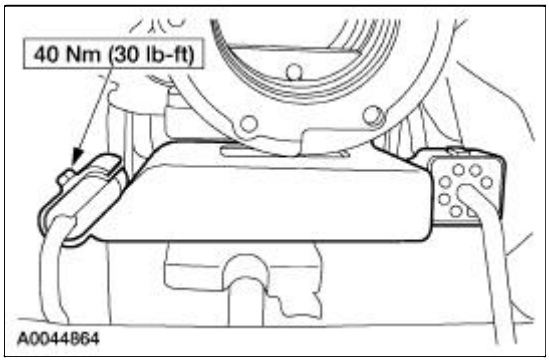
7. Connect the solenoid body connector and connect the harness retainer to the transmission.



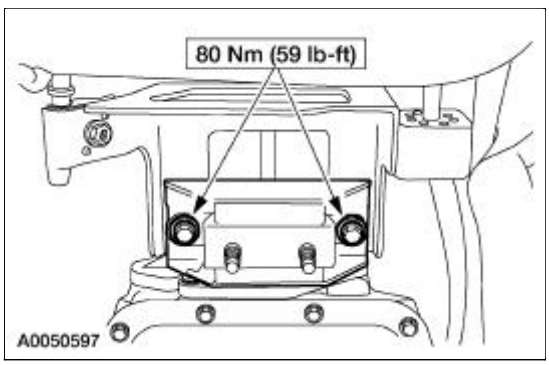
8. Connect the output shaft speed (OSS) sensor, the digital TR sensor connectors and connect the harness retainer to the transmission.



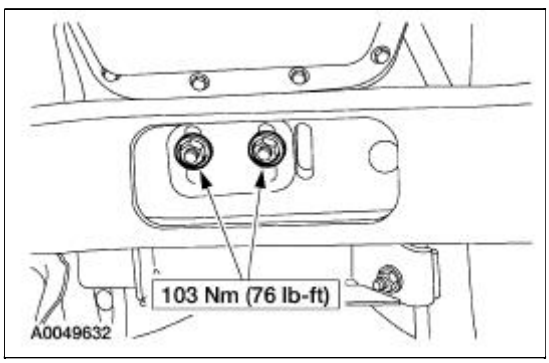
9. Install the exhaust hanger.



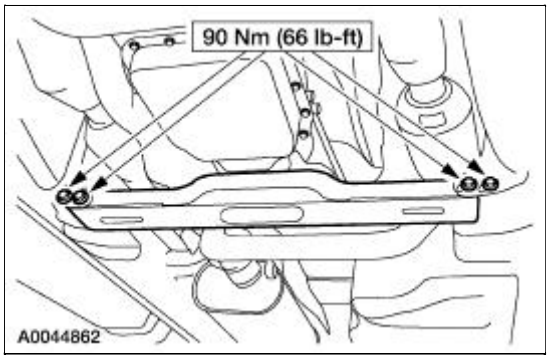
10. Install the rear transmission support.



11. Position the rear crossmember in place and install the rear transmission support nuts.

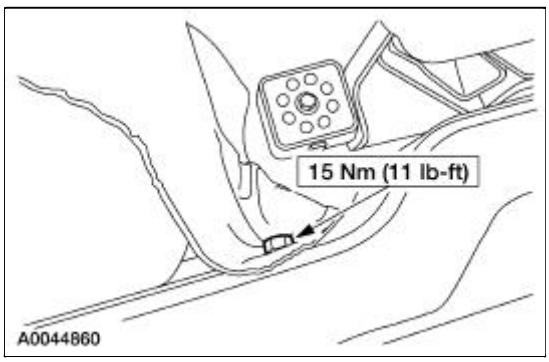


12. Position the rear crossmember in place and install the bolts.

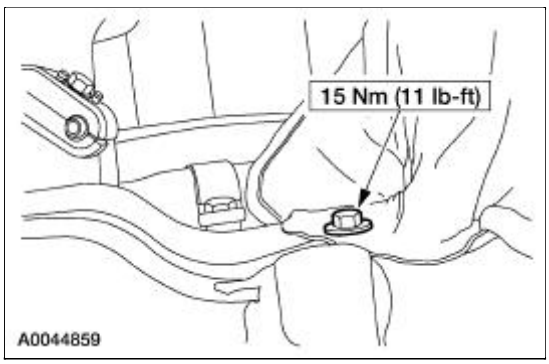


13. Remove the transmission jack.

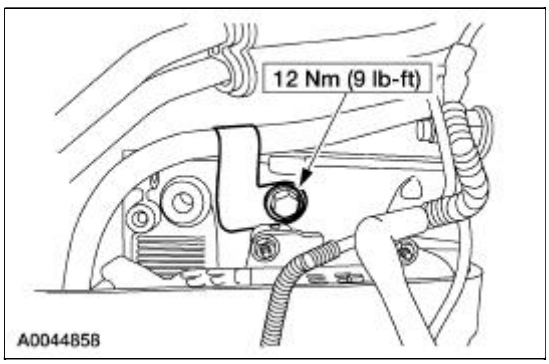
14. Install the RH exhaust shield bolt.



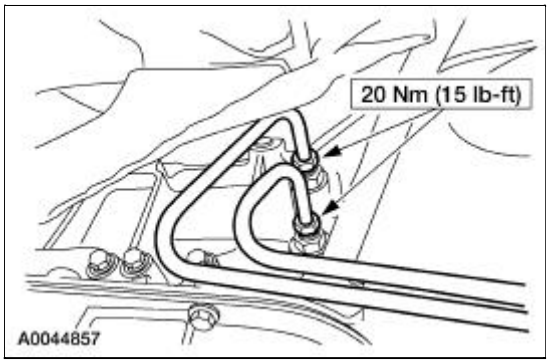
15. Install the LH exhaust shield bolt.



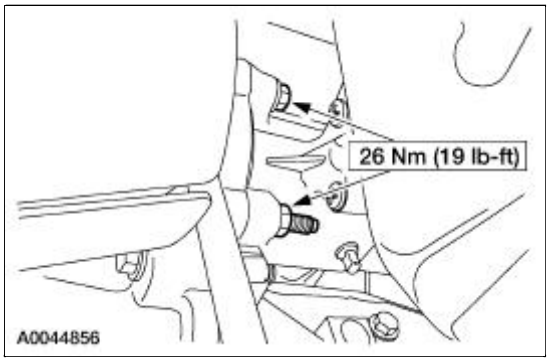
16. Position the transmission fluid fill tube into the transmission and install the retaining bolt on the RH cylinder head.



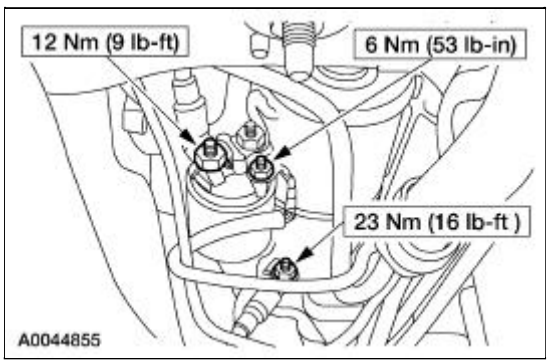
17. Connect the transmission fluid cooler tubes.



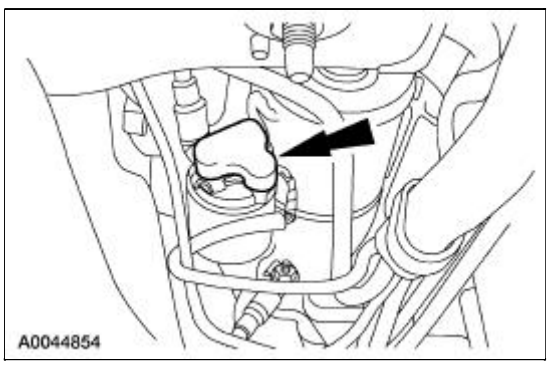
18. Install the starter motor and install three bolts.



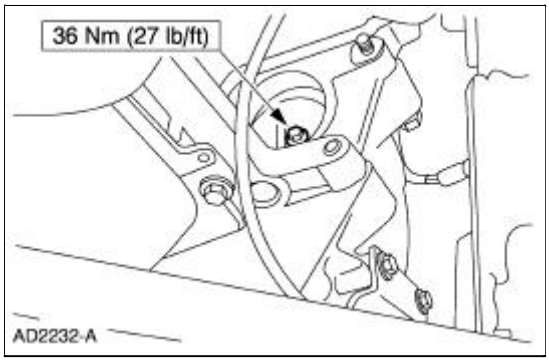
19. Install the starter motor electrical connectors and the ground wire.



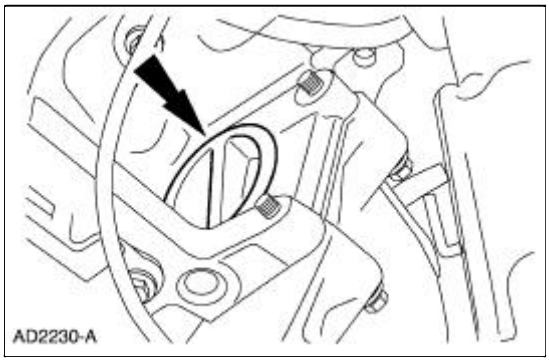
20. Install the plastic starter motor electrical connector cap.



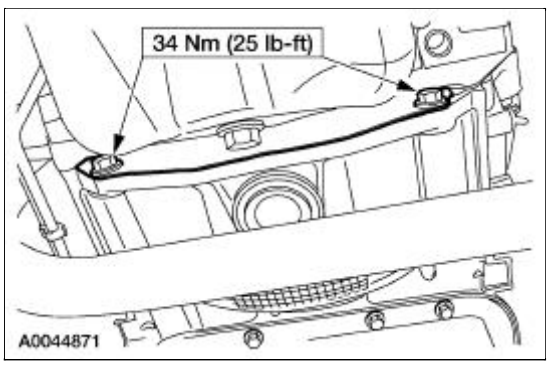
21. Install the four torque converter nuts.
    - Rotate the crankshaft to access all the torque converter nuts.



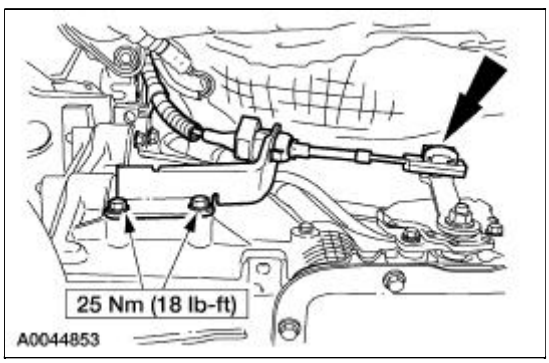
22. Install the rubber access plug.



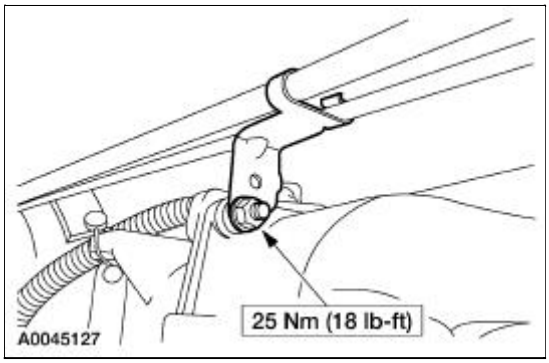
23. Install the flexplate inspection cover



24. Install the shift cable end and the bracket.

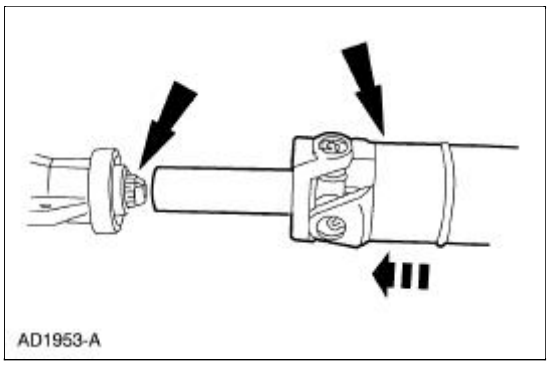


25. Install the fuel line bracket.



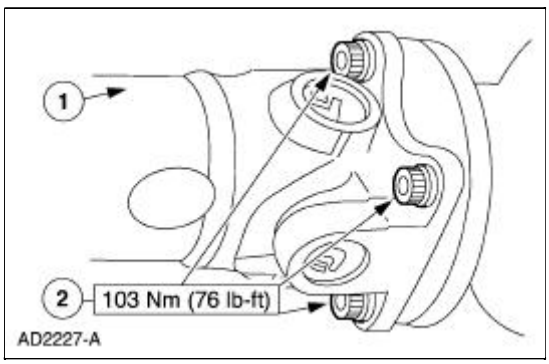
26. **NOTE:** The output shaft and the driveshaft are a balanced assembly.

    Install the driveshaft.
    - Align the yellow dots and position the driveshaft on the transmission.
    - Position the driveshaft to the rear differential.



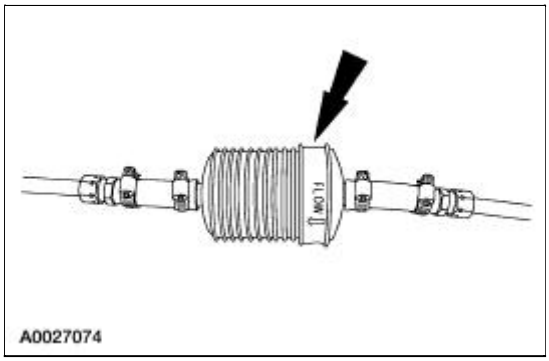
27. **NOTE:** To maintain initial driveshaft balance, align the index marks made during removal.

    Install the rear driveshaft.
    1. Position the driveshaft.
    2. Install the four bolts.



28. Use the following guidelines for the in-line transmission fluid filter:
    - If the transmission was overhauled and the vehicle was equipped with an in-line fluid filter, install a new in-line fluid filter.
    - If the transmission was overhauled and the vehicle was not equipped with an in-line fluid filter, install a new in-line fluid filter kit.
    - If the transmission is being installed for a non-internal repair, do not install an in-line filter or filter kit.
    - If installing a Ford authorized remanufactured transmission, install the in-line

transmission fluid filter that is supplied
Prior to lowering the vehicle, install a new in-line transmission filter or a filter kit.



29. Connect the battery ground cable.

30. Fill the transmission with clean automatic transmission fluid and inspect for correct operation.

Transmission —4x4

Special Tool(s)

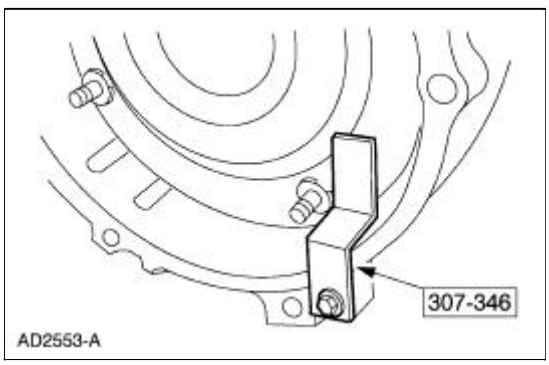
 ST1636-A	Retainer, Torque Converter 307-346 (T97T-7902-A)

Material

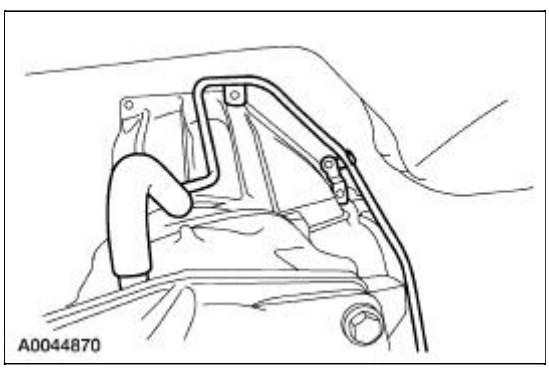
Item	Specification
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®

Installation

1. Install the special tool if not done during the assembly process.



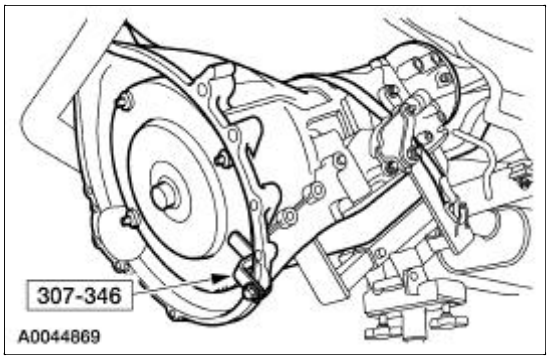
2. Position the vent tube on the top of the transmission.



3. **CAUTION: To position the transmission in the vehicle, put the transmission into a nose-down position to get the tail shaft over the exhaust system. The converter housing**

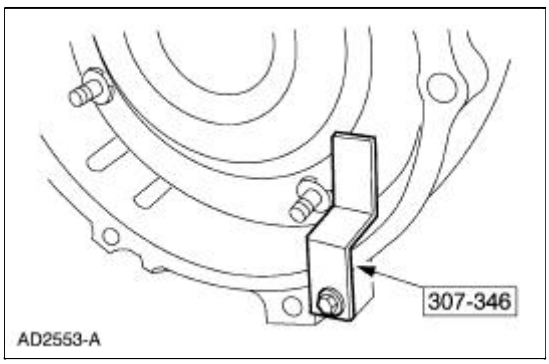
is piloted into position by dowels in the rear of the engine block. The torque converter must rest squarely against the flexplate. This indicates that the converter pilot is not binding in the engine crankshaft.

Position and secure the transmission on the high-lift transmission jack. Raise and position the transmission into the vehicle. Once the transmission is in position, place the transmission in a horizontal position.



4. **NOTE:** Do not remove the special tool until the transmission is in a horizontal position.

   Remove the special tool.

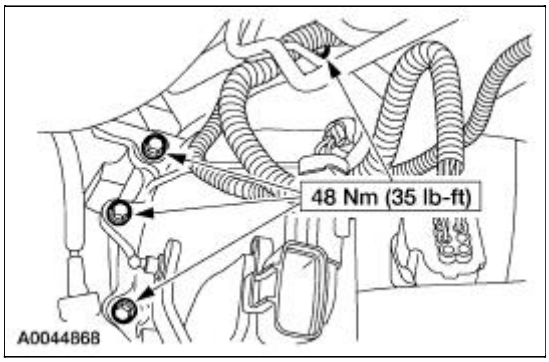


5. **NOTE:** Make sure that the torque converter is fully seated in the transmission before aligning the transmission to the engine.

   With the transmission in a horizontal position move it toward the engine. Align the orange balancing marks between the torque converter and the flexplate bolt holes.

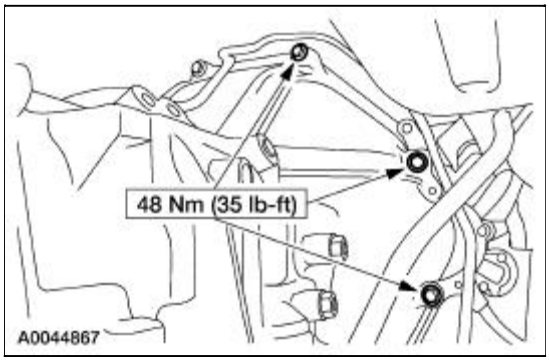
6. **NOTE:** Install the transmission retaining bolts in their correct locations made during removal.

   Install the shift cable bracket and the LH transmission retaining bolts.



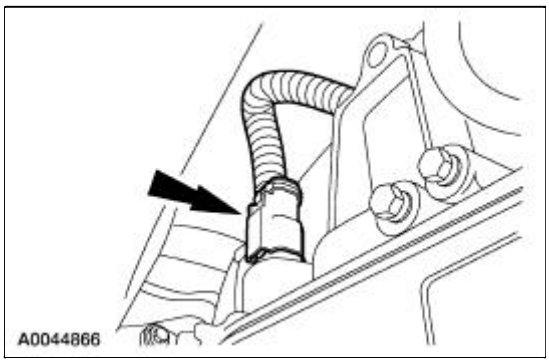
7. **NOTE:** Install the transmission retaining bolts in their correct locations made during removal.

Position the vent tube in its correct location and install the RH transmission retaining bolts.

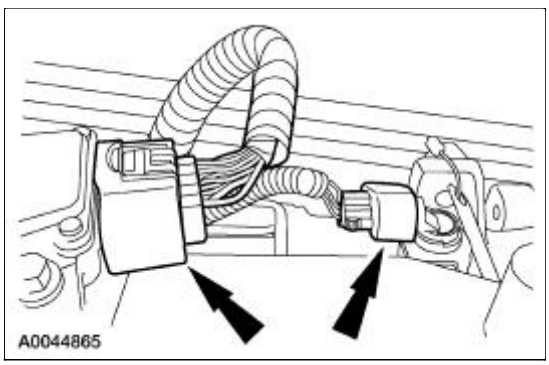


8. **NOTE:** It may be necessary to disconnect the rubber vent hose in order to route the wire harness under the vent hose.

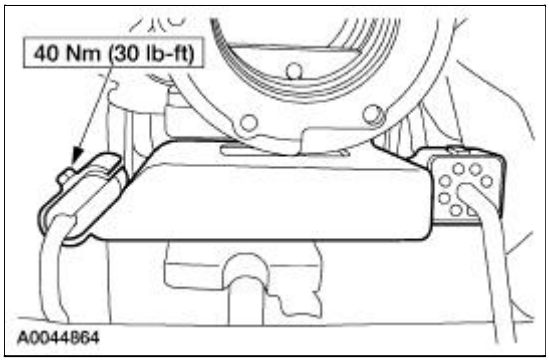
   Route the harness under the vent hose, connect the solenoid body connector and connect the harness retainer to the transmission.



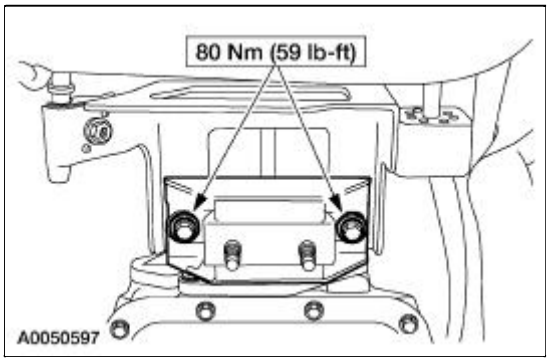
9. Connect the output shaft speed (OSS) sensor, the digital TR sensor connectors and connect the harness retainer.



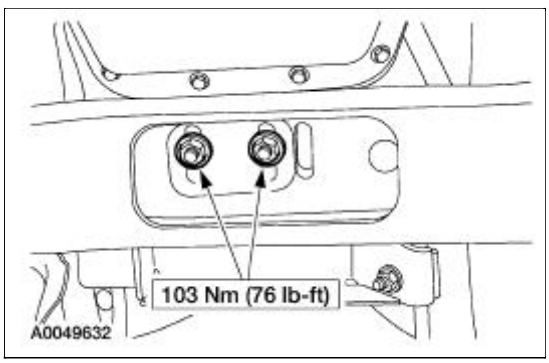
10. Install the exhaust hanger.



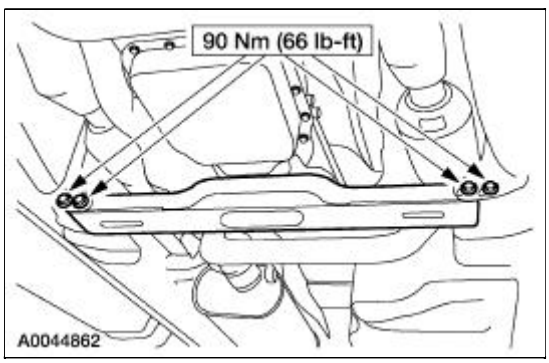
11. Install the rear transmission support.



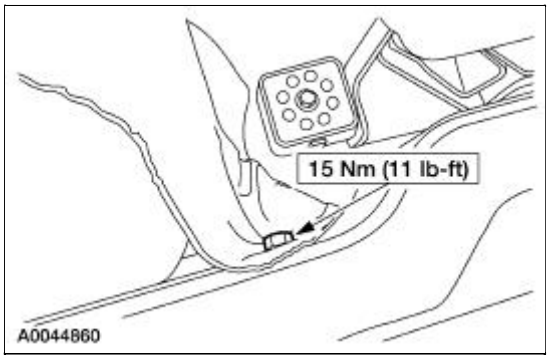
12. Position the rear crossmember in place and install the nuts.



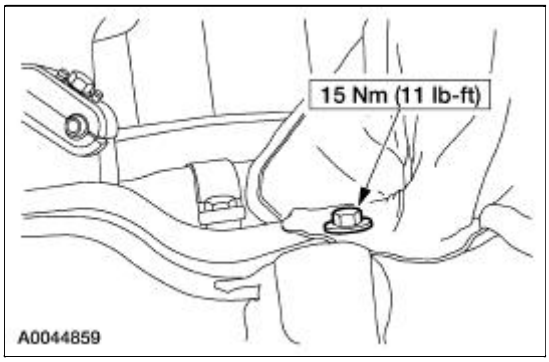
13. Position the rear crossmember in place and install the bolts and nuts.



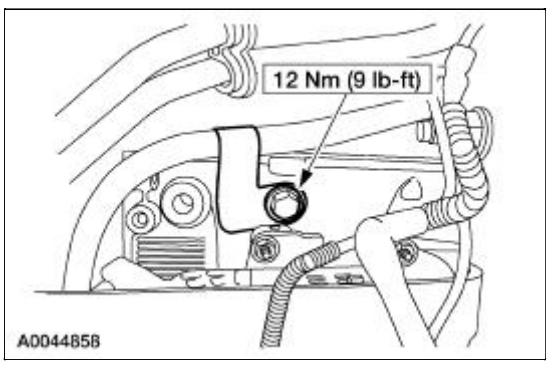
14. Install the RH exhaust bolts.



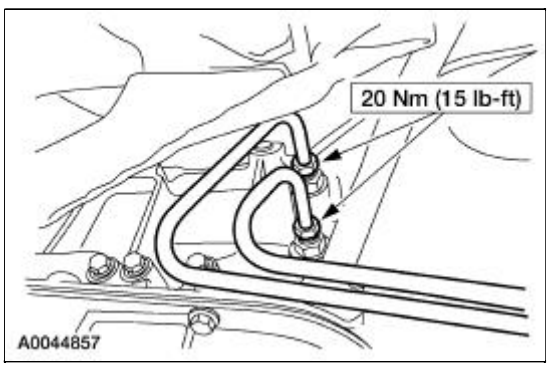
15. Install the LH exhaust bolts.



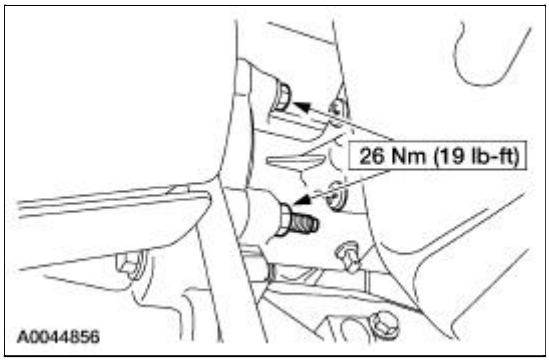
16. Position the transmission fluid fill tube into the transmission and install the retaining bolt on the RH cylinder head.



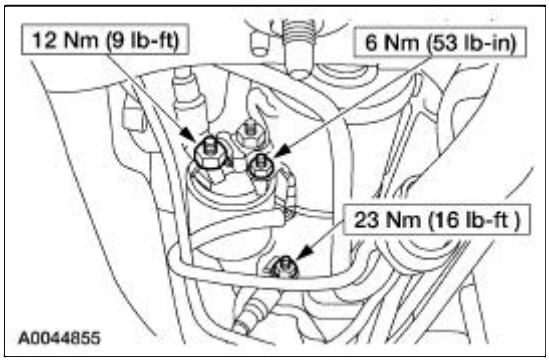
17. Connect the transmission fluid cooler tubes.



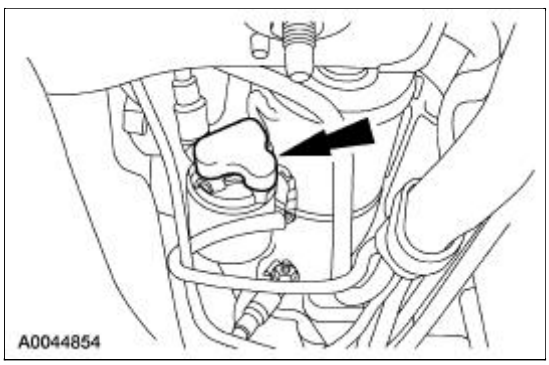
18. Install the starter motor and three bolts.



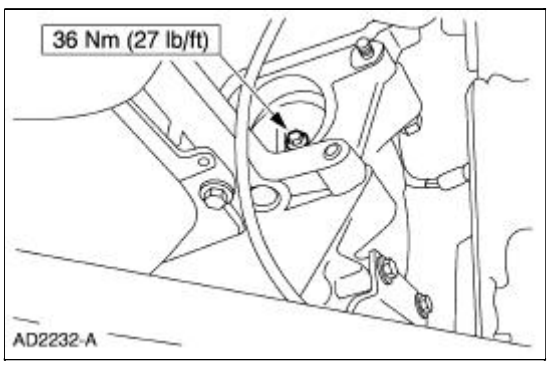
19. Install the starter motor electrical connectors and the ground wire.



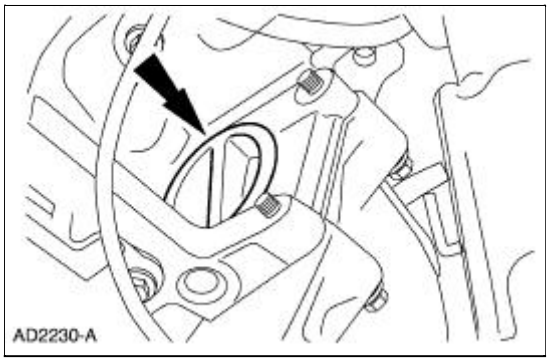
20. Install the plastic starter motor electrical connector cap.



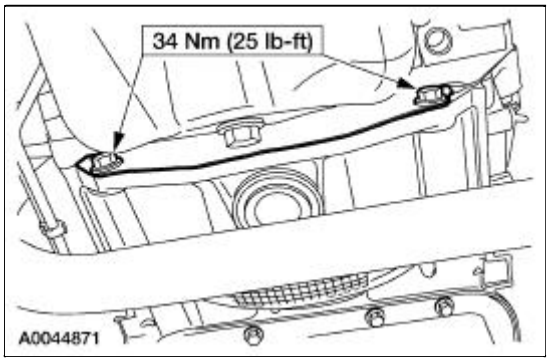
21. Install the four torque converter nuts.



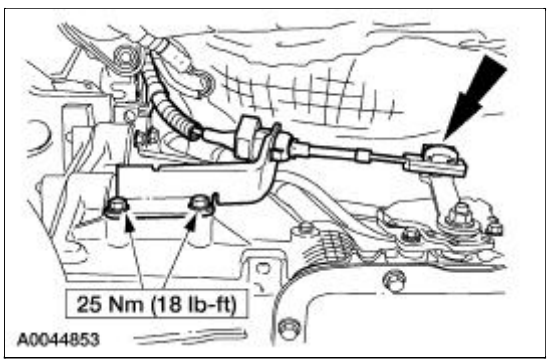
22. Install the rubber access plug.



23. Install the flexplate inspection cover.

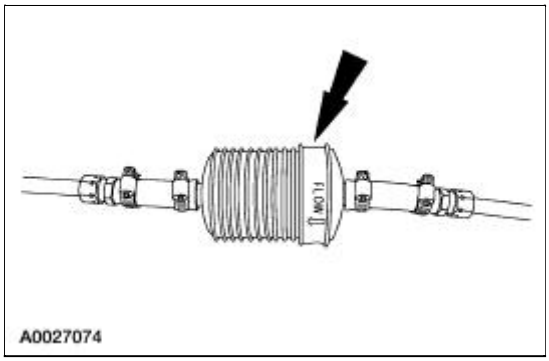


24. Install the shift cable end and the bracket.



25. Install the transfer case. For additional information, refer to Section 308-07B .

26. Use the following guidelines for the in-line transmission fluid filter:
    - If the transmission was overhauled and the vehicle was equipped with an in-line fluid filter, install a new in-line fluid filter.
    - If the transmission was overhauled and the vehicle was not equipped with an in-line fluid filter, install a new in-line fluid filter kit.
    - If the transmission is being installed for a non-internal repair, do not install an in-line filter or filter kit.
    - If installing a Ford-authorized remanufactured transmission, install the in-line transmission fluid filter that is supplied.
      Prior to lowering the vehicle, install a new in-line transmission filter or a filter kit.



27. Fill to correct level with clean automatic transmission fluid.

General Specifications

Item	Specification
Fluid	
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX (4R100 Transmission)	MERCON®
MERCON® V Automatic Transmission Fluid XT-5-QM (4R70W Transmission)	MERCON® V

Torque Specifications

Description	Nm	lb-ft
Bolts retaining the skid plate to the frame (4x4 only)	15	11
Fluid cooler tube-to-transmission fluid tube connector assembly (4R70W)	32	24
Fluid cooler tube-to-cooler line case fitting (4R100)	27	20
Front cooler line case fitting-to-transmission case (4R100)	30	22
Rear cooler line case fitting-to-transmission case (4R100)	37	27

Transmission Cooling

The transmission fluid cooling system, without an auxiliary transmission fluid cooler, consists of:

- an intank fluid cooler inlet tube
- a non-repairable intank transmission fluid cooler
- an intank fluid cooler return tube

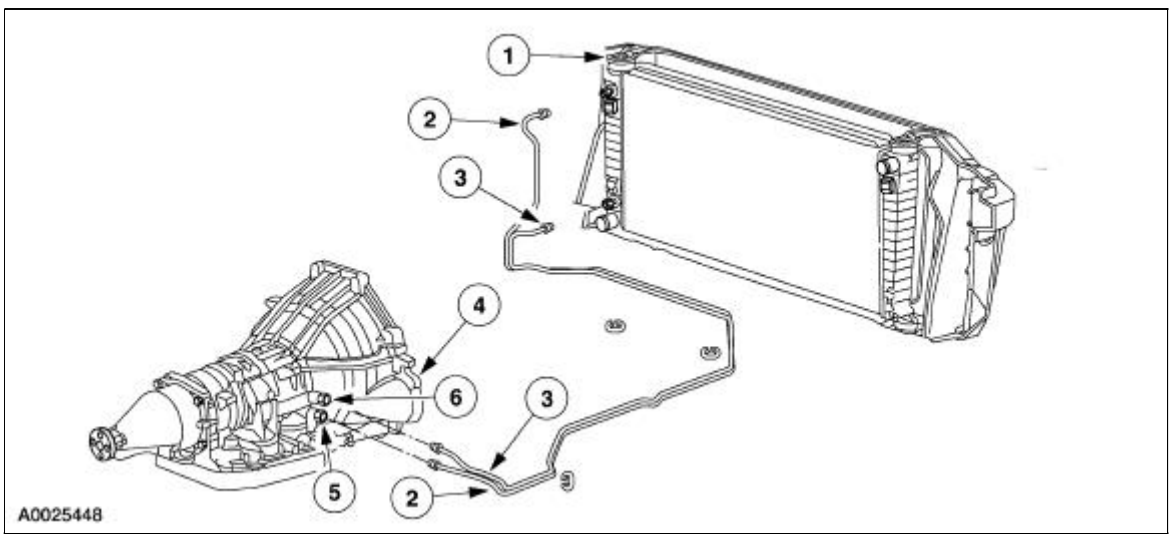
The transmission fluid cooling system, with an auxiliary transmission fluid cooler, consists of:

- an intank fluid cooler inlet tube
- a non-repairable intank transmission fluid cooler
- an auxiliary fluid cooler inlet tube
- an auxiliary transmission fluid cooler
- an auxiliary fluid cooler return tube

The transmission fluid flows from the transmission (front fitting for 4R100) (bottom fitting for 4R70W), to the intank transmission fluid cooler, to the auxiliary transmission fluid cooler, if so equipped, and returns to the transmission (rear fitting for 4R100) (top fitting for 4R70W).

For fluid cooler flow testing, and backflushing and cleaning procedures, refer to Section 307-01A (4R100) or Section 307-01B (4R70W).

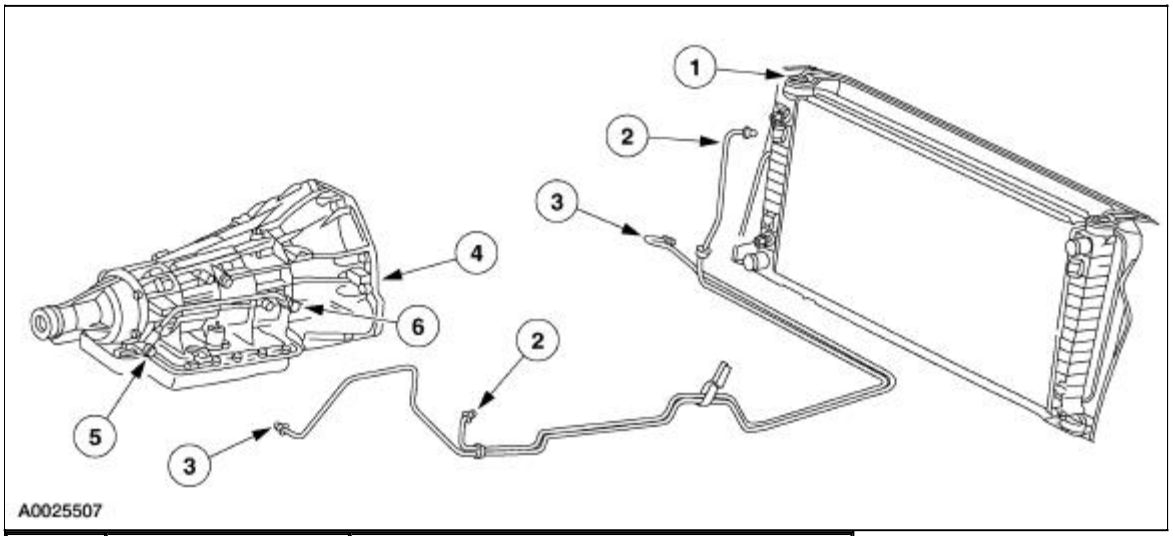
4R70W Transmission Without Auxiliary Transmission Fluid Cooler



Item	Part Number	Description
1	8005	Radiator
2	7A030	Intank fluid cooler inlet tube
3	7A031	Intank fluid cooler return tube
4	—	4R70W transmission

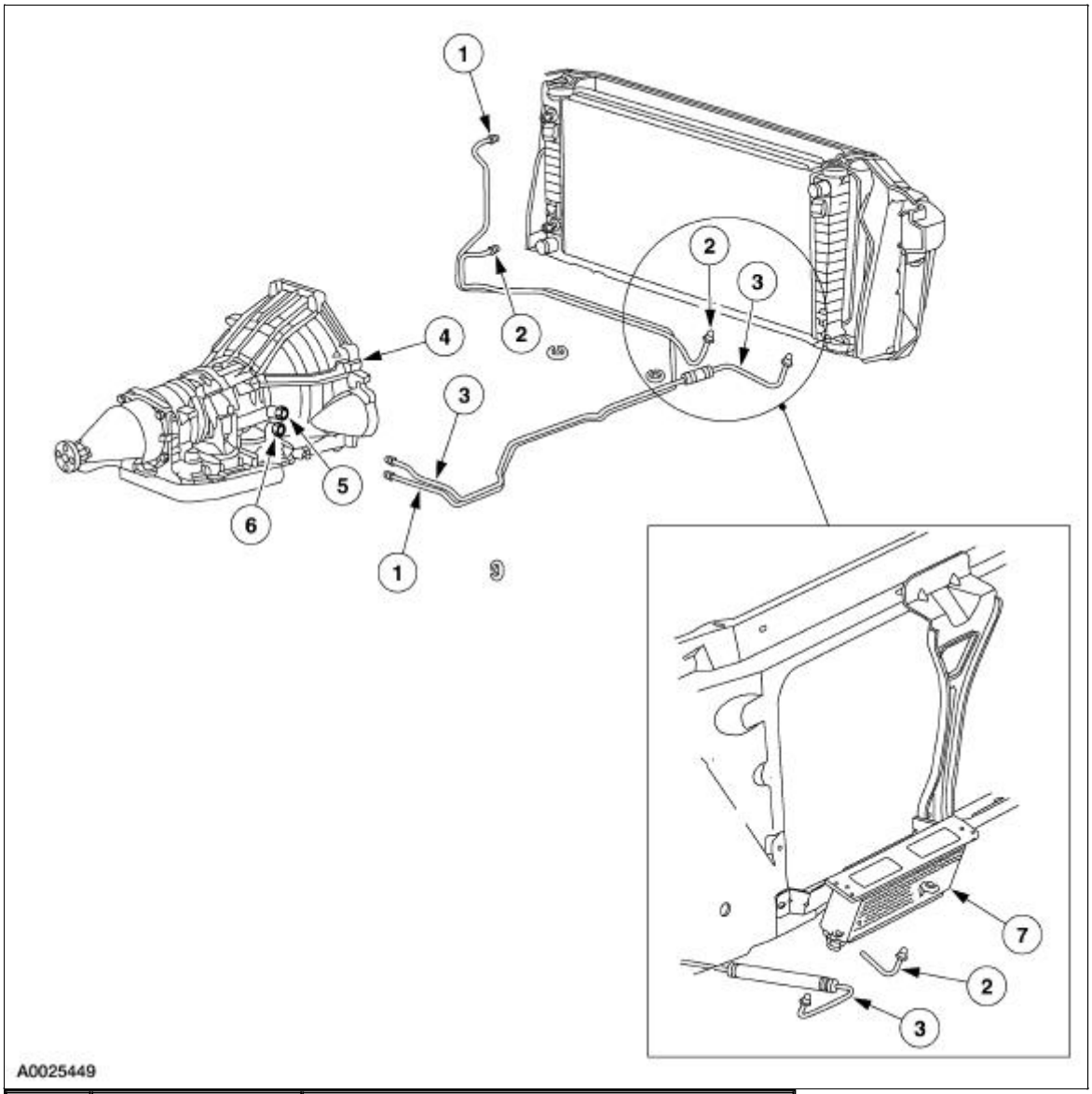
5	—	Fluid outlet
6	—	Fluid inlet

4R100 Transmission Without Auxiliary Transmission Fluid Cooler



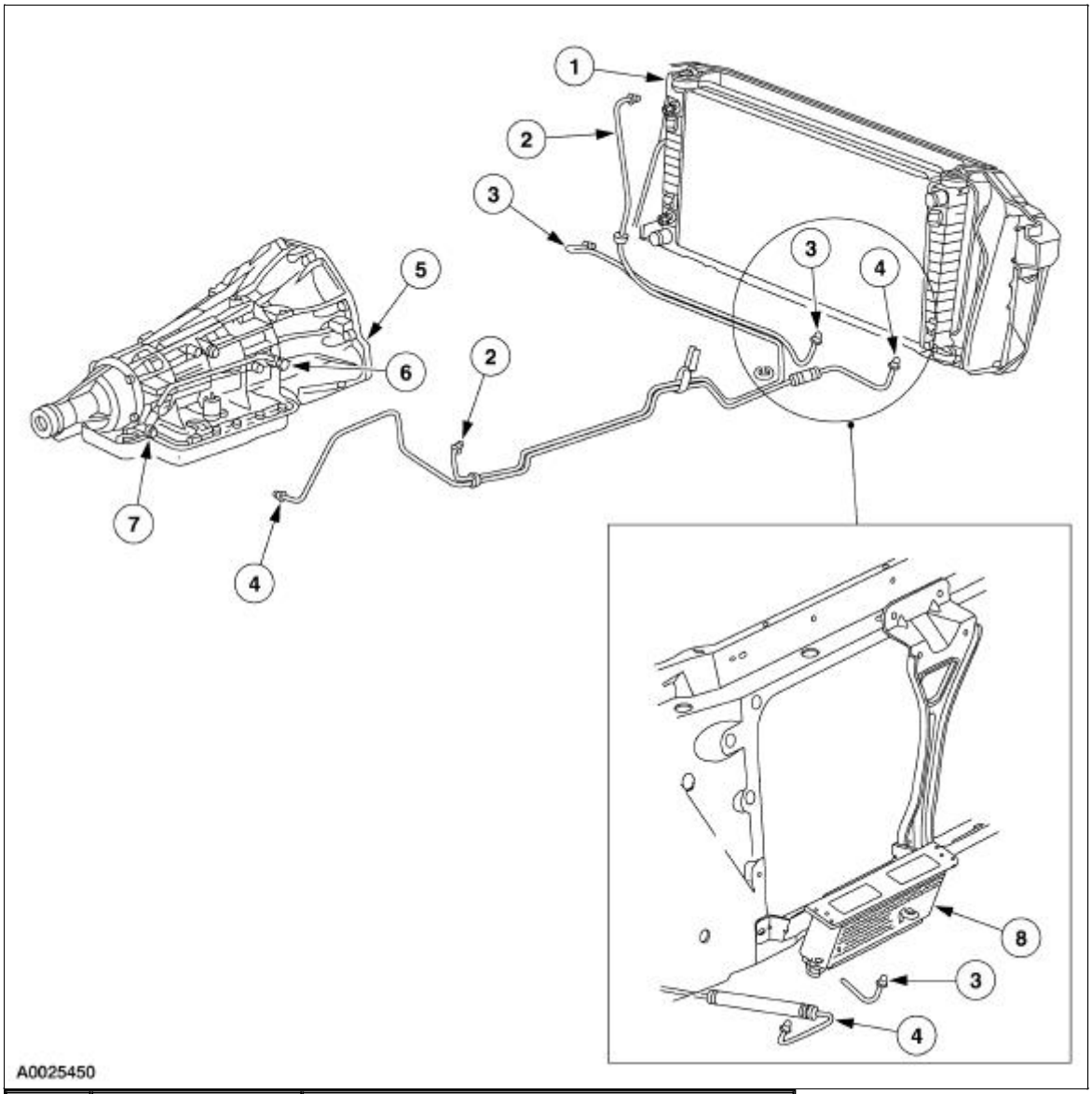
Item	Part Number	Description
1	8005	Radiator
2	7A030	Intank fluid cooler inlet tube
3	7A031	Intank fluid cooler return tube
4	7005	4R100 transmission
5	—	Fluid inlet
6	—	Fluid outlet

4R70W Transmission With Auxiliary Transmission Fluid Cooler



Item	Part Number	Description
1	7A030	Intank fluid cooler inlet tube
2	7F113	Auxiliary fluid cooler inlet tube
3	7A031	Auxiliary fluid cooler return tube
4	—	4R70W transmission
5	—	Fluid inlet
6	—	Fluid outlet
7	7A095	Auxiliary transmission fluid cooler

4R100 Transmission With Auxiliary Transmission Fluid Cooler



Item	Part Number	Description
1	8005	Radiator
2	7A030	Intank fluid cooler inlet tube
3	7F113	Auxiliary fluid cooler inlet tube
4	7A031	Auxiliary fluid cooler return tube
5	7005	4R100 transmission
6	—	Fluid outlet
7	—	Fluid inlet
8	7A095	Auxiliary transmission fluid cooler

Transmission Cooling

Inspection and Verification

CAUTION: When internal wear or damage occurs in the transmission, metal particles, clutch plate material and band material can travel into the torque converter, the fluid cooler tubes, the intank transmission fluid cooler and the auxiliary transmission fluid cooler, if so equipped. These contaminants are a major cause of recurring transmission concerns. To prevent future concerns, remove these contaminants from the cooling system before placing the transmission back into use. Refer to Section 307-01A (4R100) or Section 307-01B (4R70W) for fluid cooler flow testing, backflushing and cleaning, torque converter cleaning and inspection, and flushing. Refer to Section 307-01A (4R100 only) for cooler bypass valve (CBV) assembly cleaning and flushing.

1. Visually inspect for obvious signs of mechanical damage, incorrect component installation and system leaks. Repair as necessary.
   - Install a new or remanufactured radiator when fluid is found leaking from the intank transmission fluid cooler. For additional information, refer to Section 303-03 .
   - Install a new auxiliary transmission fluid cooler if there is leakage from the fluid cooler. For additional information, refer to Auxiliary Transmission Fluid Cooler in this section.
2. If the fault is not visually evident, GO to the Symptom Chart

Symptom Chart

SYMPTOM CHART

Condition	Possible Sources	Action
• Transmission overheating	• Excessive vehicle or towing loads, severe vehicle use.	• REFER to the vehicle specification manual for load and GVW/GCW information. REFER to the Owner's Guide.
	• Incorrect fluid level.	• CHECK and, if necessary, ADJUST the fluid to the correct level. REFER to Section 307-01A (4R100) or Section 307-01B (4R70W).
	• Fluid condition.	• CHECK fluid condition. REFER to Section 307-01A (4R100) or Section 307-01B (4R70W).
	• Incorrect fluid type.	• REFER to Specifications in this section.
	• Transmission cooling system damaged, blocked, restricted or installed incorrectly.	• CARRY OUT the transmission fluid cooler flow test. REFER to Section 307-01A (4R100) or Section 307-01B (4R70W).

	• Cooler bypass valve (CBV) assembly (4R100 only) damaged, blocked, restricted or installed incorrectly.	• INSPECT for damage and restrictions. If necessary, REFER to Cooler Bypass Valve—4R100 Transmission in this section for removal and installation. REFER to Section 307-01A for flushing and cleaning procedure.
	• System leaks.	• REFER to Section 307-01A (4R100) or Section 307-01B (4R70W) for leakage inspection procedures.
	• Engine overheating.	• REFER to Section 303-03 .
	• Powertrain control system electrical inputs/outputs, vehicle wiring harnesses, powertrain control module (PCM), torque converter clutch (TCC) solenoid.	• CARRY OUT on-board diagnostics. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual, and Section 307-01A (4R100) or Section 307-01B (4R70W).
	• Internal transmission concerns.	• REFER to Section 307-01A (4R100) or Section 307-01B (4R70W).

Auxiliary Transmission Fluid Cooler

Special Tool(s)

 ST2591-A	Disconnect Tool, Transmission Cooler Line 307-441

Material

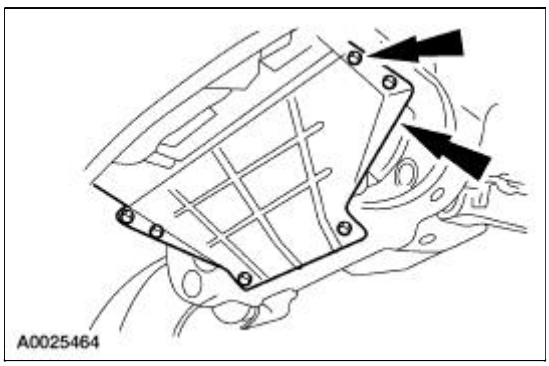
Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V
MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®

Removal

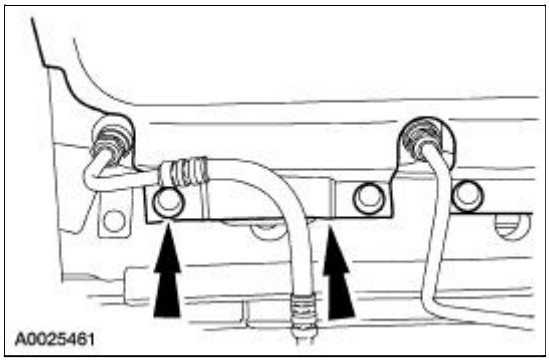
1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch in the RH kick panel area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

   Put the vehicle in NEUTRAL and position on a hoist. For additional information, refer to Section 100-02 .

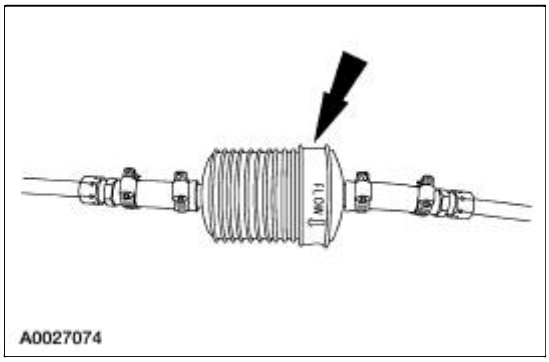
2. Remove the bolts and the skid plate (4x4 vehicles).



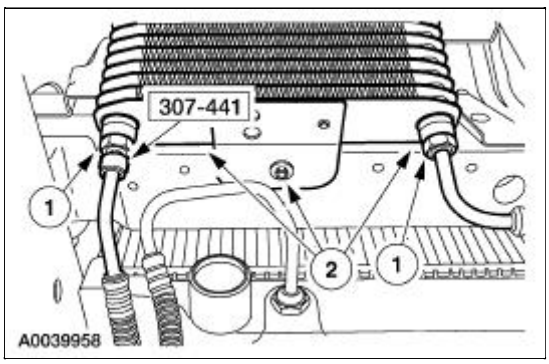
3. Remove three fasteners and position the air deflector aside.



4. If equipped, remove and discard the in-line transmission fluid filter.



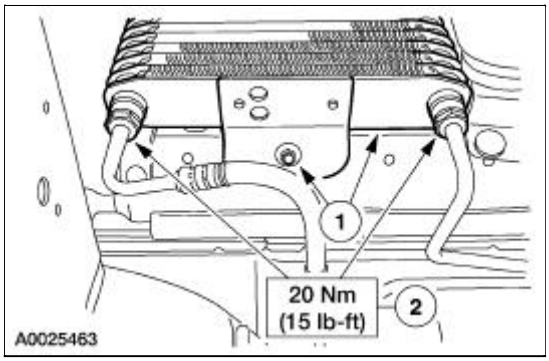
5. Remove the auxiliary transmission fluid cooler.
    1. Using the special tool, disconnect the fluid cooler tube fittings from the fluid cooler.
    2. Remove the three bolts and the fluid cooler.



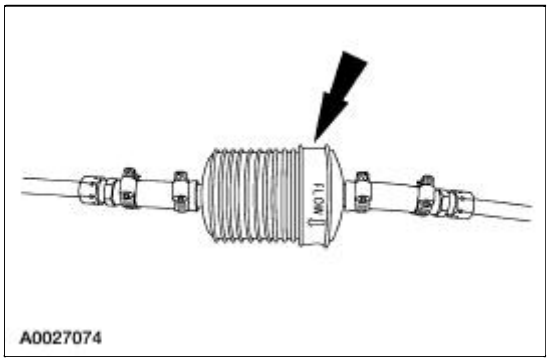
Installation

All vehicles

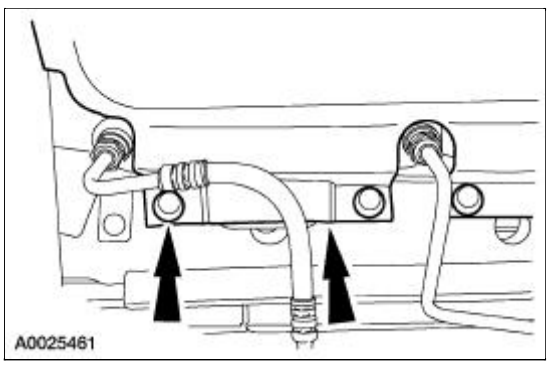
1. Install the auxiliary transmission fluid cooler.
    1. Position the fluid cooler and install the three bolts.
    2. Connect the fluid cooler tube fittings to the fluid cooler.



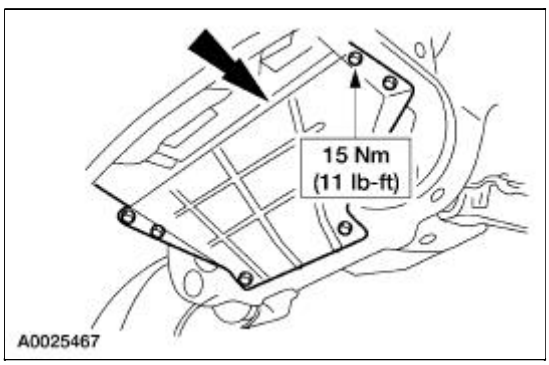
2. If equipped, install a new in-line transmission fluid filter.



3. Position the air deflector and install the fasteners.



4. Position the skid plate and install the bolts (4x4 vehicles).



5. Lower the vehicle.

Vehicles with 4R100 transmission

6.  **CAUTION: Do not use any fluid approved for MERCON® V application. Using a fluid rated for MERCON® V can cause internal damage in MERCON® only applications.**

   Fill the transmission with the specified type and quantity of transmission fluid. For additional information, refer to Section 307-01A .

Vehicles with 4R70W transmission

7. Fill the transmission with the specified type and quantity of transmission fluid. For additional information, refer to Section 307-01B .

All vehicles

8. Check for leaks.

9. If equipped with air suspension, reactivate the system by turning on the air suspension switch.

Transmission Fluid Cooler Tubes

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V
MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®

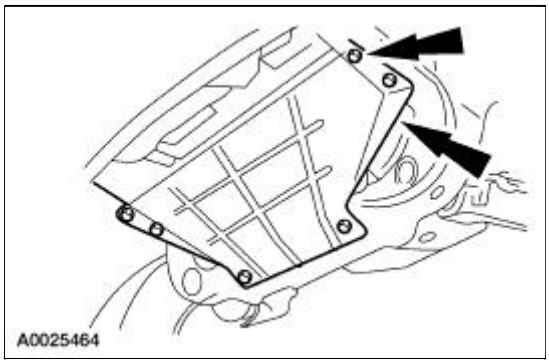
Removal

All vehicles

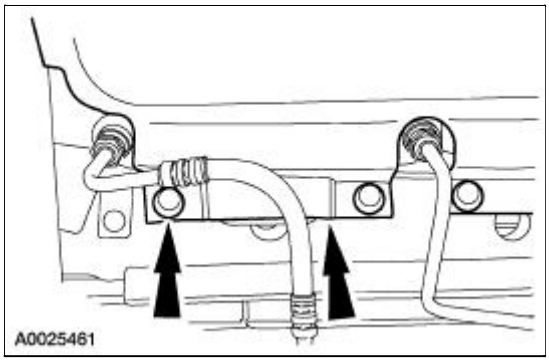
1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch in the RH kick panel area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

   Put the vehicle in NEUTRAL and position on a hoist. For additional information, refer to Section 100-02 .

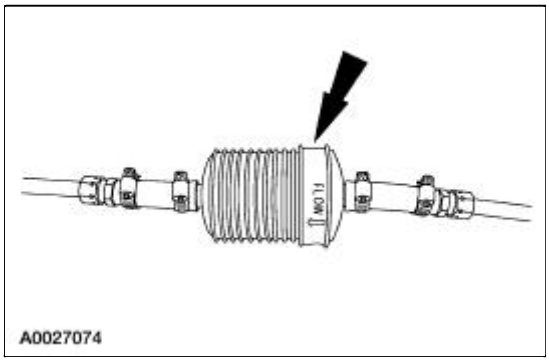
2. Remove the bolts and the skid plate (4x4 vehicles).



3. Remove three fasteners and position the air deflector aside.



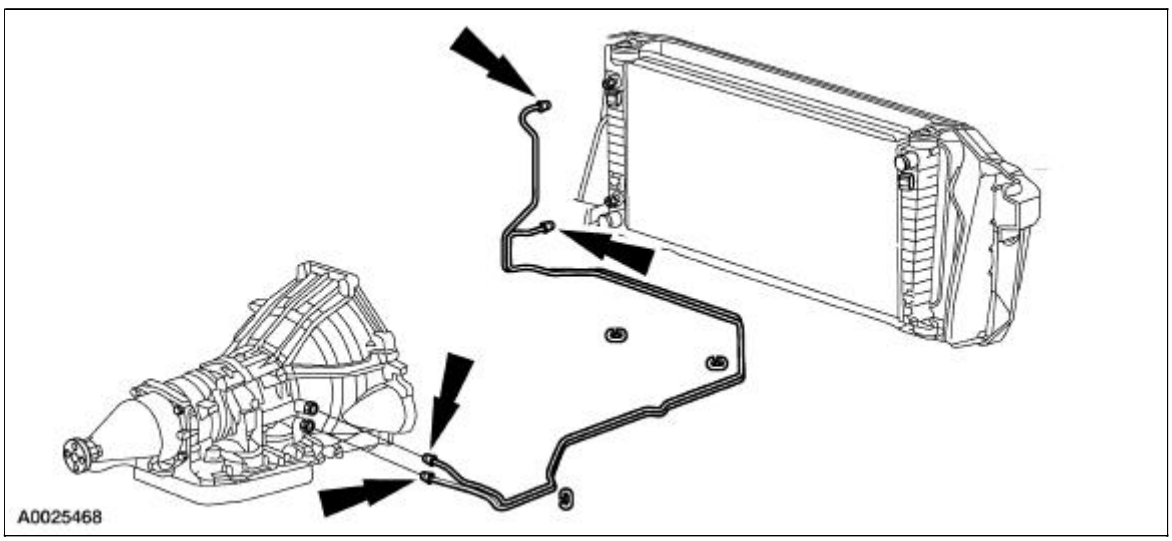
4. If equipped, remove and discard the in-line transmission fluid filter.



5. If not done previously, carry out the transmission fluid cooler flow test procedure. For additional information, refer to Section 307-01A .

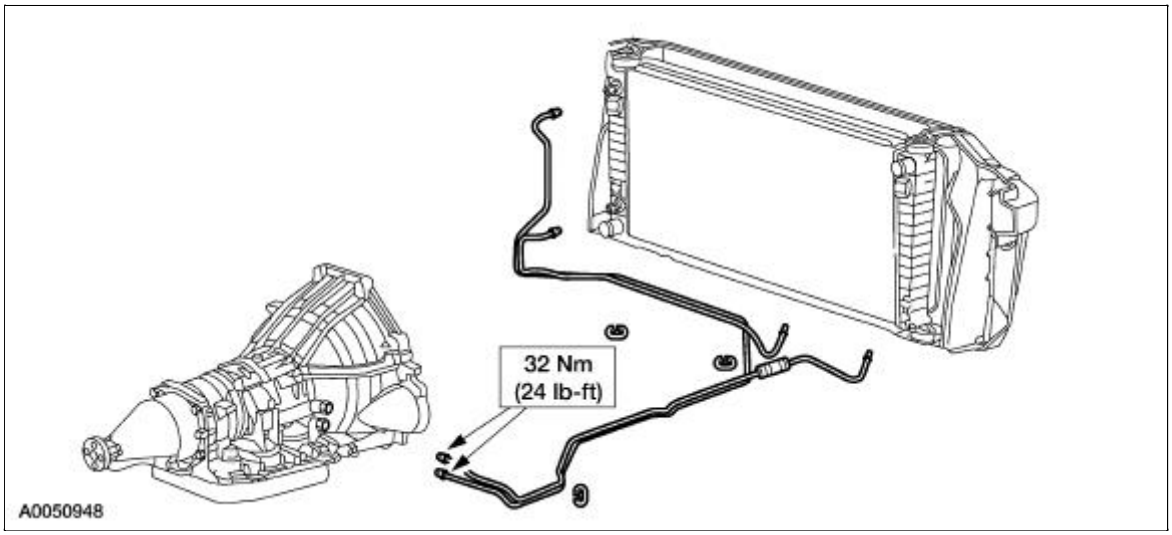
4R70W without auxiliary fluid cooler

6. Remove the fluid cooler tubes, as necessary.



4R70W with auxiliary fluid cooler

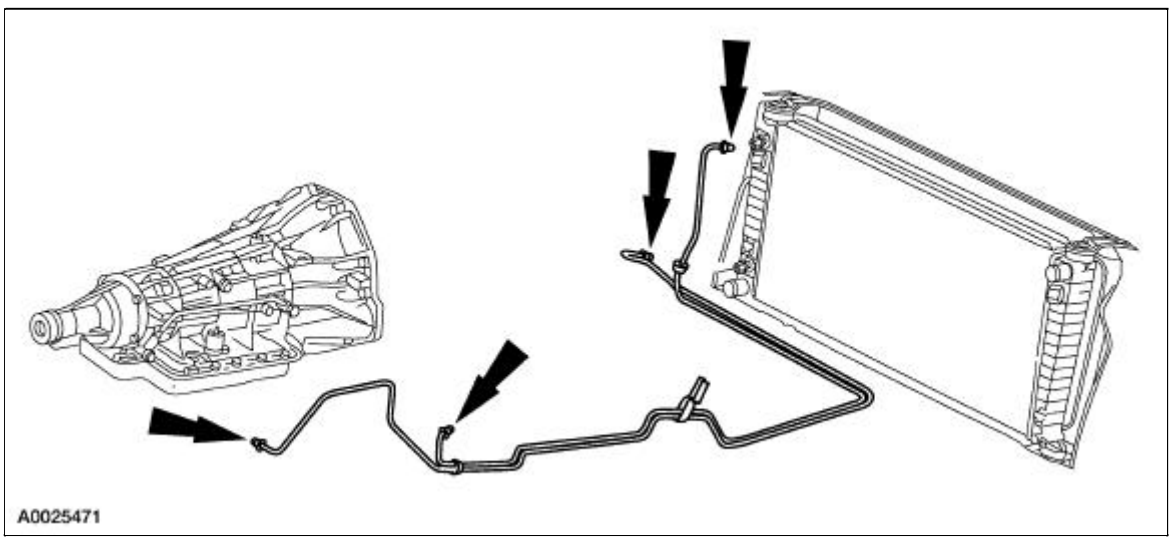
7. Remove the fluid cooler tubes, as necessary.



4R100 without auxiliary fluid cooler

8. **NOTE:** If cooler bypass valve (CBV) assembly removal is necessary, refer to Cooler Bypass Valve—4R100 Transmission in this section.

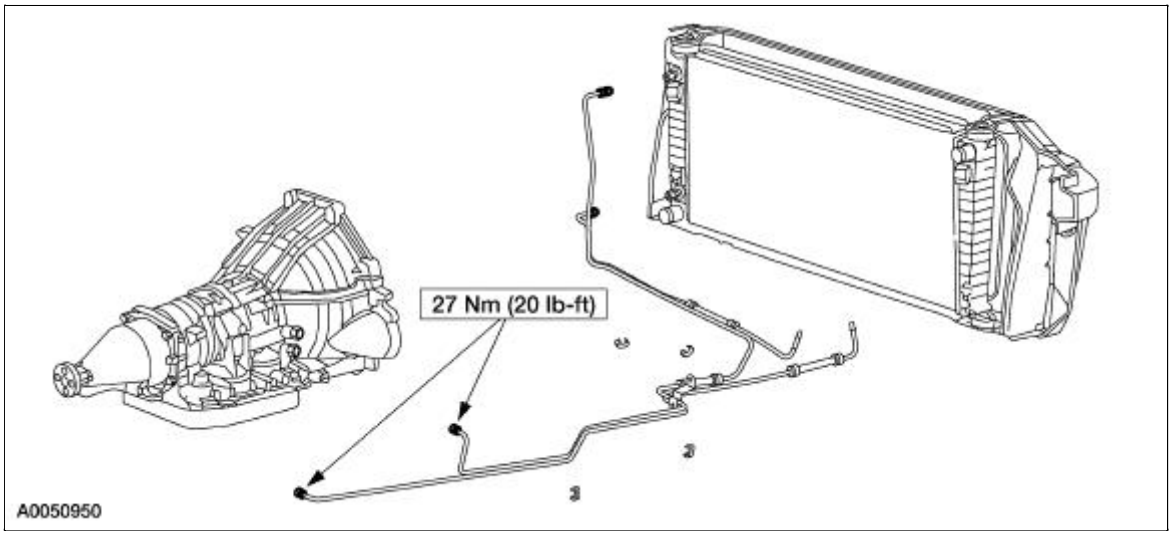
   Remove the fluid cooler tubes, as necessary.



4R100 with auxiliary fluid cooler

9. **NOTE:** If CBV assembly removal is necessary, refer to Cooler Bypass Valve—4R100 Transmission in this section.

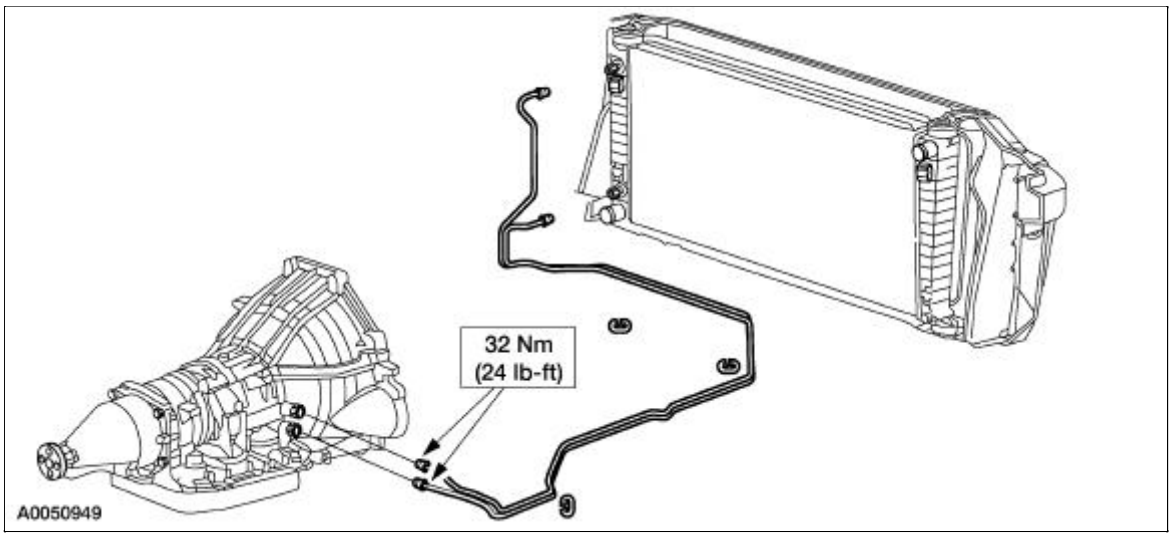
   Remove the fluid cooler tubes, as necessary.



Installation

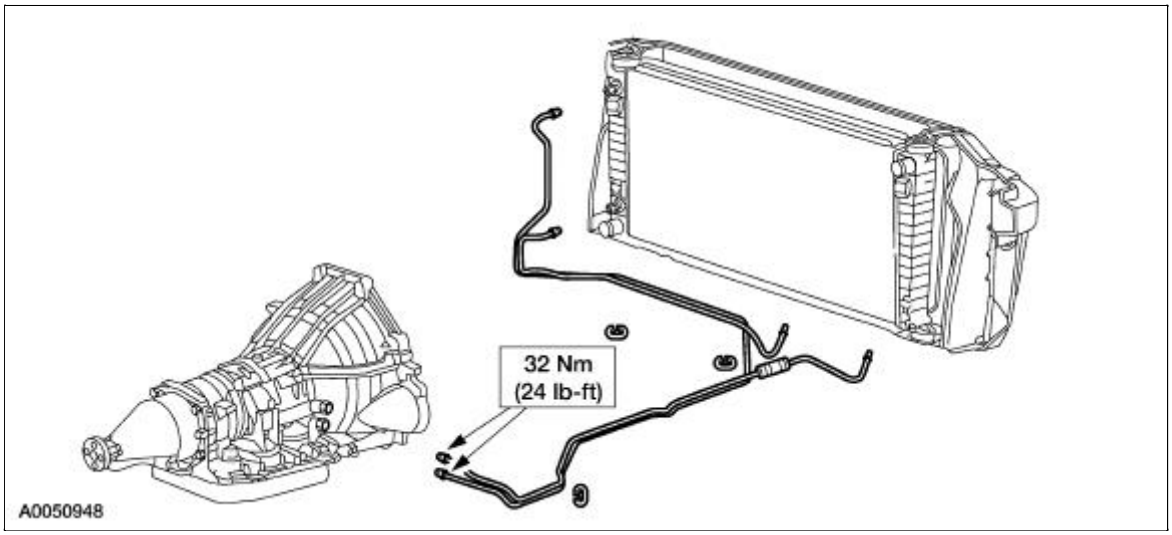
4R70W without auxiliary fluid cooler

1. Install the fluid cooler tube(s).



4R70W with auxiliary fluid cooler

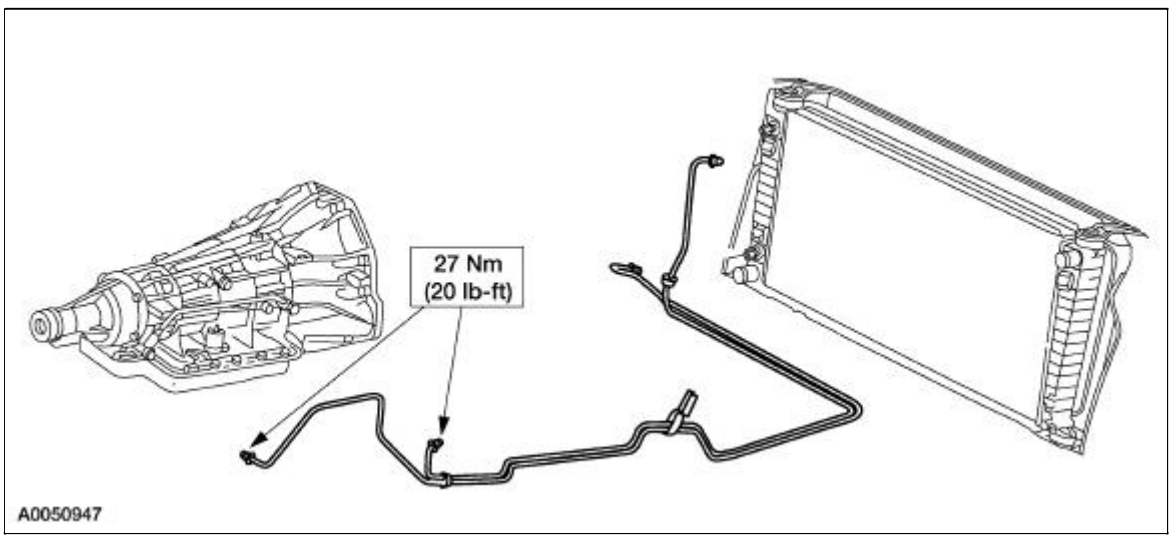
2. Install the fluid cooler tube(s).



4R100 without auxiliary fluid cooler

3. **NOTE:** If the CBV assembly was removed, refer to Cooler Bypass Valve—4R100 Transmission in this section for the installation procedure.

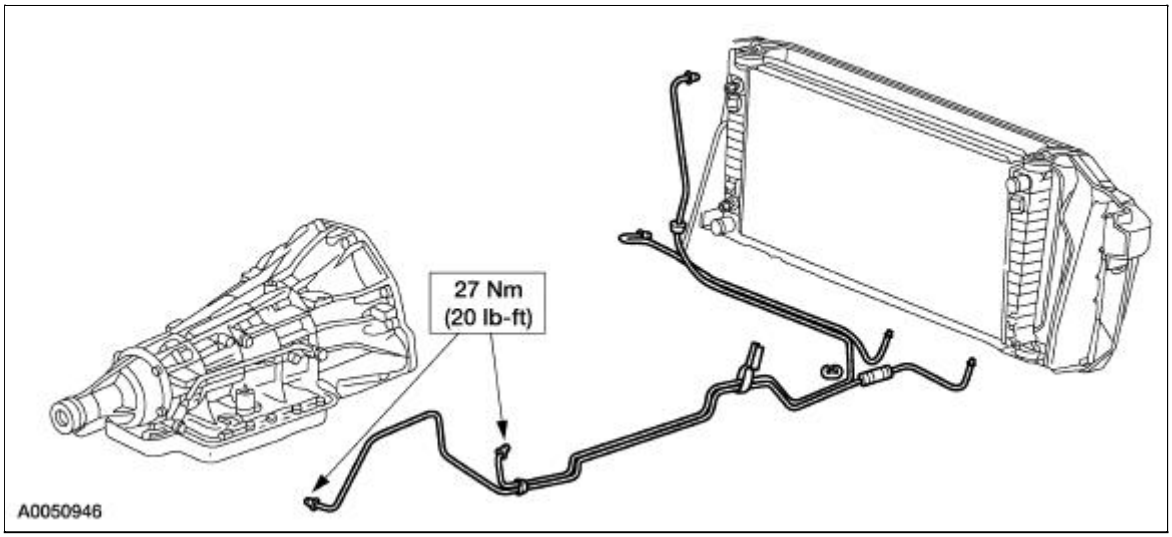
   Install the fluid cooler tube(s).



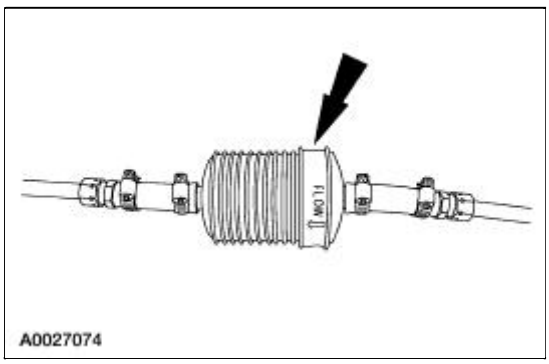
4R100 with auxiliary fluid cooler

4. **NOTE:** If the CBV assembly was removed, refer to Cooler Bypass Valve—4R100 Transmission in this section for the installation procedure.

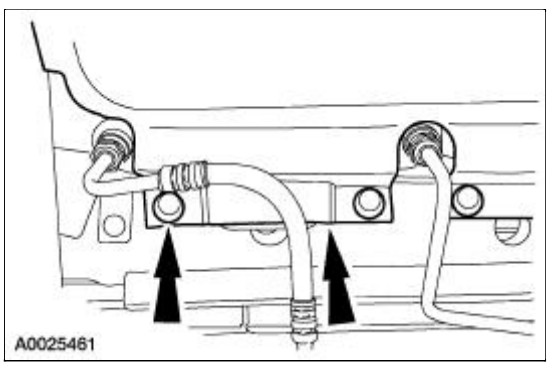
   Install the fluid cooler tube(s).



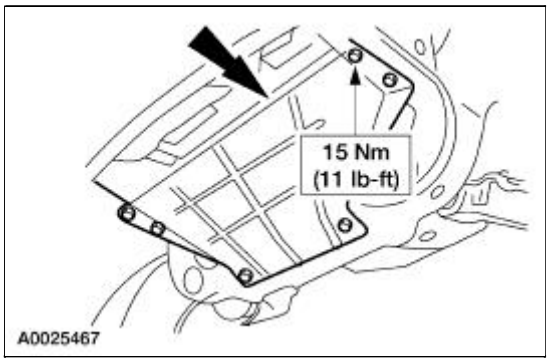
5. If equipped, install a new in-line transmission fluid filter.



6. Position the air deflector and install the fasteners.



7. Position the skid plate and install the bolts (4x4 vehicles).



8. Lower the vehicle.

Vehicles with 4R100 transmission

9.  **CAUTION: Do not use any fluid approved for MERCON® V application. Using a fluid rated for MERCON® V can cause internal damage in MERCON® only applications.**

   Fill the transmission with the specified type and quantity of transmission fluid. For additional information, refer to Section 307-01A .

Vehicles with 4R70W transmission

10. Fill the transmission with the specified type and quantity of transmission fluid. For additional information, refer to Section 307-01B .

All vehicles

11. Check for leaks.

12. If equipped with air suspension, reactivate the system by turning on the air suspension switch.

Cooler Bypass Valve —4R100 Transmission

Material

Item	Specification
MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®

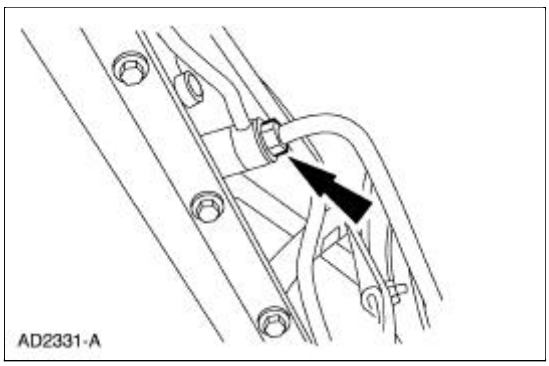
Removal

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch in the RH kick panel area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

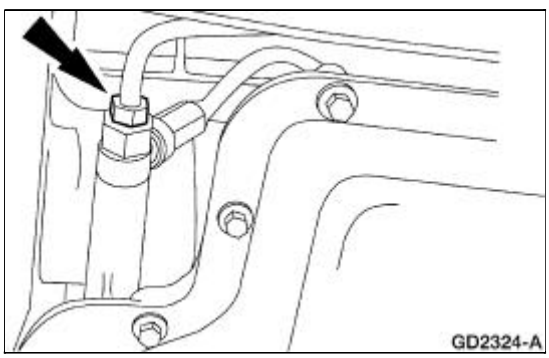
   Put the vehicle in NEUTRAL and position on a hoist. For additional information, refer to Section 100-02 .

2. If not done previously, carry out the transmission fluid cooler flow test procedure. For additional information, refer to Section 307-01A .

3. Remove the fluid cooler tube from the front cooler line case fitting.



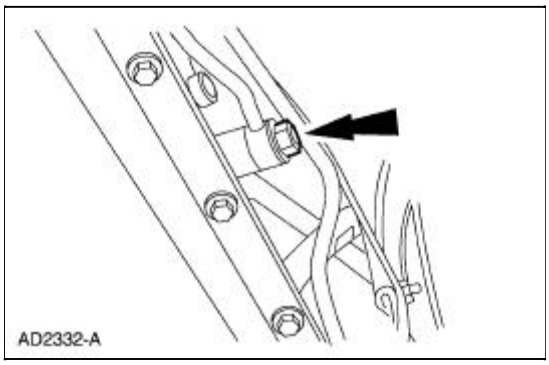
4. Remove the fluid cooler tube from the rear cooler line case fitting.



5. **NOTE:** The two rubber-coated sealing washers can fall out when removing the cooler line case

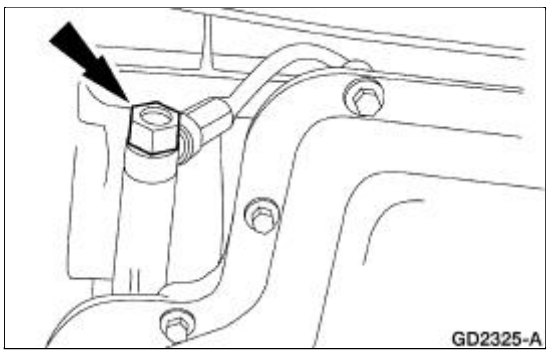
fitting.

Remove and discard the front cooler line case fitting, and the two rubber-coated sealing washers.



6. **NOTE:** The two rubber-coated sealing washers can fall out when removing the cooler line case fitting.

   Remove and discard the rear cooler line case fitting, and the two rubber-coated sealing washers.

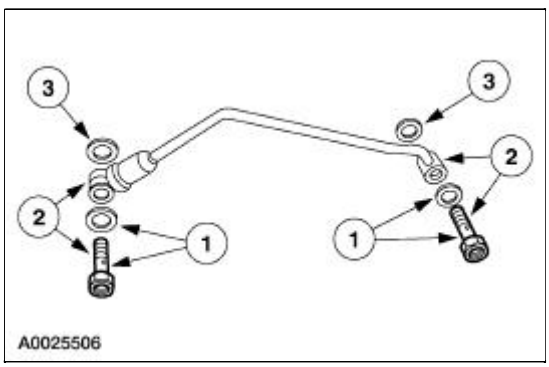


7. Remove the cooler bypass valve (CBV) assembly from the transmission.

Installation

1. **CAUTION: Failure to correctly install the new rubber-coated sealing washers will result in transmission fluid leaks.**

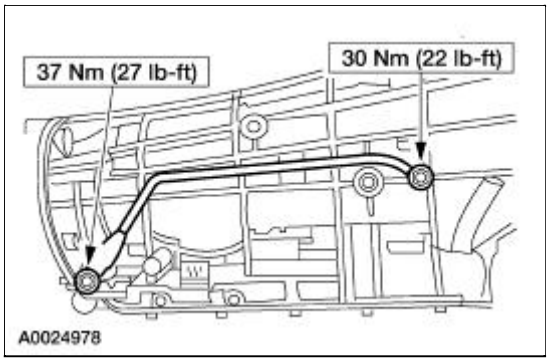
   Install the new rubber-coated sealing washers and the new cooler line case fittings.
   1. Install one rubber-coated sealing washer on each cooler line case fitting.
   2. Install both cooler line case fittings into the CBV assembly fittings.
   3. Install one rubber-coated sealing washer on each cooler line case fitting.



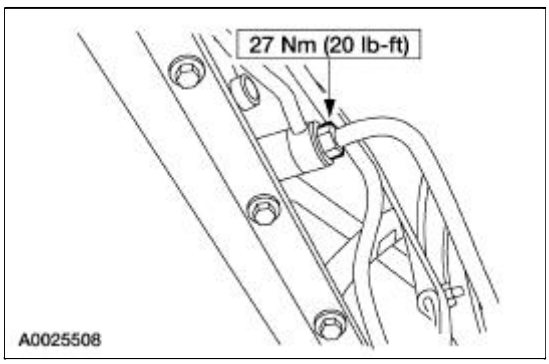
2. **CAUTION: Damage will occur to the rubber-coated sealing washers and transmission fluid will leak if the cooler line case fittings are over-tightened.**

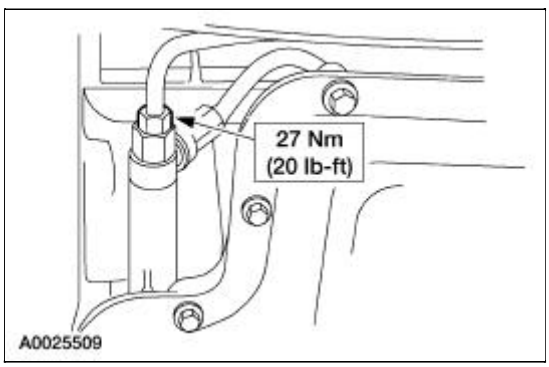
   NOTE: Align the rubber-coated sealing washers while installing CBV assembly on the transmission case.

   Install the CBV assembly.



3. Install the fluid cooler tubes in the front and rear cooler line case fittings.





4. Lower the vehicle.

5. **CAUTION: Do not use any fluid approved for MERCON® V application. Using a fluid rated for MERCON® V can cause internal damage in MERCON® only applications.**

   Fill the transmission with the specified type and quantity of transmission fluid. For additional information, refer to Section 307-01A .

6. Check for leaks.

7. If equipped with air suspension, reactivate the system by turning on the air suspension switch.

Torque Specifications

Description	Nm	lb-ft	lb-in
Shift cable bracket bolts (4R70W)	28	21	—
Shift lock actuator bolts (column shift)	5	—	44
Shift lock actuator screws (floor shift)	5	—	44
Floor shift mechanism to floor	15	11	—
Column shift insert plate bolts	15	11	—
Shift cable bracket bolts (4R100)	34	25	—

External Controls

The transmission shift cable transfers the transmission operating mode from the gearshift lever to the automatic transmission. The indicated position of the transmission control selector lever is transferred to the transmission through the steering column shift selector on the 4R70W transmission, or the floor shifter mechanism on the 4R100 transmission, then to the cable and down to the manual control lever on the transmission.

Shift Interlock System

The shift interlock system prevents the shifting from PARK unless the brake pedal is depressed. The shift interlock system consists of a shift lock actuator mounted at the base of the steering column or on the floor shifter mechanism. If the ignition switch is in the RUN position, the shift lock actuator is on unless the brake pedal is depressed.

Transmission Control Switch (TCS)

The transmission control switch (TCS) is a momentary contact switch that is located on the end of the column transmission control selector lever or on the floor shifter knob. Pushing the TCS will either disengage or engage the overdrive function of the automatic transmission. If the OVERDRIVE is disengaged, the word OFF will illuminate on the instrument panel.

External Controls —Column Shift

Refer to Wiring Diagrams Cell 37 , Shift Lock for schematic and connector information.

Special Tool(s)

 ST1137-A	73 Digital Multimeter 105-R0051 or equivalent

Inspection and Verification

1. Verify the customer concern by operating the transmission external control.
2. Visually inspect for obvious signs of mechanical and electrical damage; refer to the following chart:

Visual Inspection Chart

Mechanical	Electrical
● Damaged shift lock actuator ● Damaged transmission control switch	● Failed fuse(s) ● Damaged wiring harness ● Loose or corroded connections

3. If the fault is not visually evident, determine the symptom. GO to Symptom Chart .

Symptom Chart

Symptom Chart

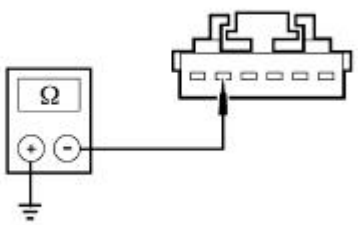
Condition	Possible Sources	Action
● The shift interlock system does not release/lock correctly	● Circuitry. ● Fuse(s). ● Shift lock actuator. ● Brake pedal position switch.	● Go To Pinpoint Test A .
● The shift control is out of correct gear relationship	● Transmission shift cable and bracket. ● Selector lever indicator. ● Shift control linkage.	● Go To Pinpoint Test B .

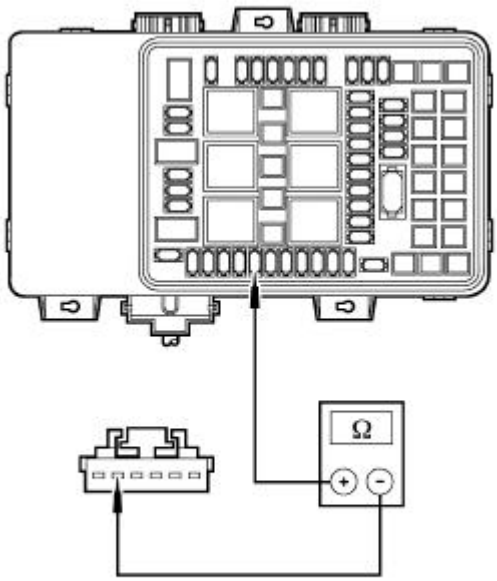
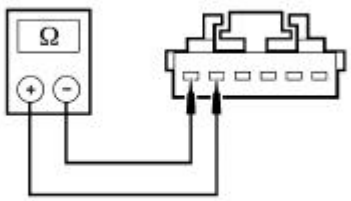
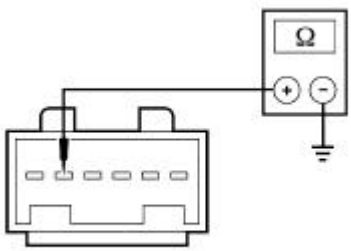
• Transmission range indicator does not correspond to the gear	• Transmission shift cable bracket.	• TIGHTEN bolts holding the transmission shift cable bracket.
	• Transmission control indicator linkage.	• ADJUST PRNDL at steering housing. REFER to Adjustments in this section.
	• Transmission shift cable loose from the transmission retainer bracket.	• VERIFY cable is fully seated in the transmission bracket.
	• Shift linkage.	• VERIFY transmission shift cable adjustment. REFER to Adjustments in this section. ADJUST transmission shift cable if necessary. VERIFY digital transmission range (TR) sensor or transmission range (TR) sensor for correct adjustment. REFER to Section 307-01A or Section 307-01B .
	• Clip securing the transmission shift cable to the steering column bracket.	• INSTALL clip correctly.
• Transmission range indicator lamp does not illuminate	• Bulb. • Circuitry.	• REFER to Section 413-00 .
• The transmission control switch (TCS) is inoperative	• Fuse. • TCS. • TCS not cycled during self-test. • Powertrain Control Module. • Circuitry.	• Go To Pinpoint Test C .
• The transmission control indicator lamp (TCIL) is not operating correctly	• Bulb. • Circuitry. • Powertrain Control Module.	• Go To Pinpoint Test D .
• Rattle, noise, buzz, or other noise	• Selector lever knob.	• INSTALL a new selector lever knob.
	• Shift control selector lever.	• TIGHTEN housing bolts.
	• Shift interlock spring.	• ATTACH shift interlock spring correctly.
• Water enters inside the vehicle	• Cable assembly grommet.	• SECURE grommet to floor panel.
	• Torn cable assembly grommet.	• INSTALL a new transmission shift cable.
• Excessive shift	• Transmission	• INSTALL a new transmission

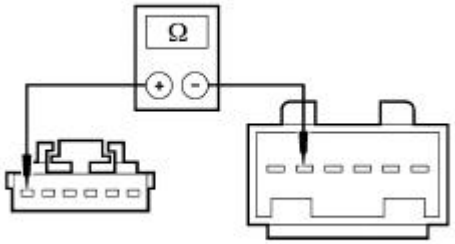
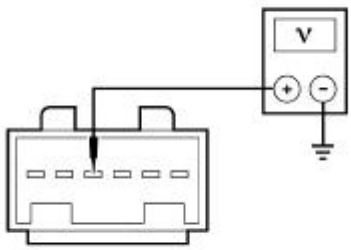
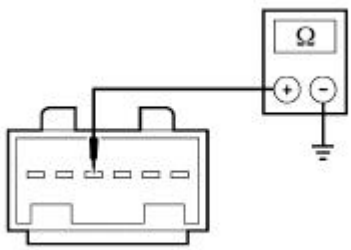
effort	shift cable. • Cable bracket.	shift cable. • ADJUST cable. TIGHTEN cable bracket screws.
• Transmission range selector lever will not shift	• Transmission shift cable. • Column bracket clip. • Broken transmission shift cable.	• REINSTALL transmission shift cable. • INSTALL a new bracket clip. • INSTALL a new transmission shift cable.

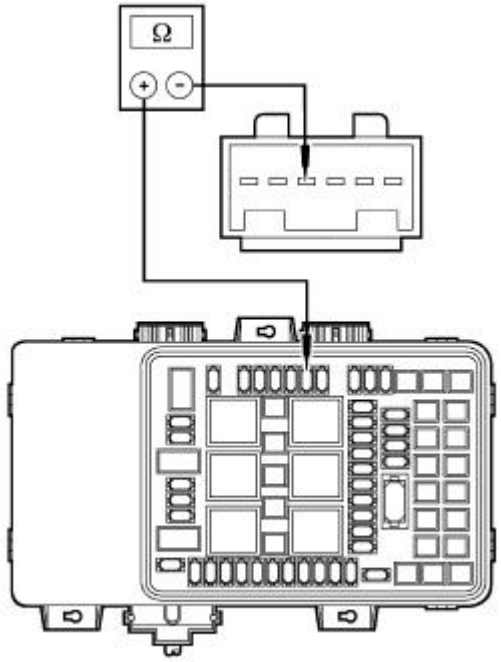
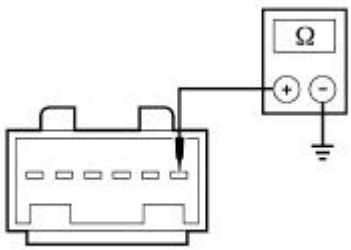
Pinpoint Tests

PINPOINT TEST A: THE SHIFT INTERLOCK SYSTEM DOES NOT RELEASE/LOCK CORRECTLY

Test Step	Result / Action to Take
A1 TEST BRAKE LIGHTS	
• Apply brake pedal and view brake lights. • **Do brake lights illuminate?**	**Yes** GO to A7 . **No** GO to A2 .
A2 TEST FUSE 5 (7.5A)	
• Check fuse: Fuse 5 (7.5A). • Measure the resistance of fuse 5. • **Is the resistance 5 ohms or less?**	**Yes** GO to A4 . **No** GO to A3 .
A3 TEST CIRCUIT 729 (RD/WH) FOR SHORT TO GROUND	
• Disconnect: Brake Pedal Position Switch C278. • Measure resistance of circuit 729 (RD/WH) at C278-5.  A0050540 • **Is the resistance 10 K ohms or less?**	**Yes** SERVICE circuit 729 (RD/WH) for short to ground. TEST the system for normal operation. **No** GO to A4 .
A4 TEST CIRCUIT 729 (RD/WH) FOR OPEN	
• Measure resistance between output side of fuse 5 (7.5A) and Brake Pedal Position Switch Connector C278-5, circuit 729 (RD/WH).	**Yes** GO to A5 . **No** SERVICE circuit 729

 A0050532 ● **Is the resistance 5 ohms or less?**	(RD/WH) for open. RETEST the system.
A5 TEST BRAKE PEDAL POSITION SWITCH	
● Measure resistance of brake pedal position switch while open (OFF) and closed (ON).  A0050529 ● **Is the resistance of switch greater than 10 K ohms while OFF and 5 ohms or less while ON?**	**Yes** GO to A6 . **No** INSTALL a new brake pedal position switch. TEST the system for normal operation.
A6 CHECK CIRCUIT 810 (RD/LG) FOR SHORT TO GROUND	
● Disconnect: Shift Lock Actuator C2008. ● Measure resistance of circuit 810 (RD/LG), pin C2008-2.  A0051045 ● **Is the resistance 10 K ohms or less?**	**Yes** SERVICE circuit 810 (RD/LG) for short to ground. TEST the system for normal operation. **No** GO to A7 .
A7 CHECK CIRCUIT 810 (RD/LG) FOR OPEN	

• Measure the resistance of circuit 810 (RD/LG) between shift lock actuator pin C2008-2 and brake pedal position switch connector C278-6.  A0051043 • **Is the resistance 5 ohms or less?**	**Yes** GO to A8 . **No** SERVICE circuit 810 (RD/LG) for open. TEST the system for normal operation.
A8 TEST FOR B+ ON CIRCUIT 1003 (GY/YE)	
• Measure voltage at shift lock actuator pin C2008-3, circuit 1003 (GY/YE).  A0051044 • **Is B+ present?**	**Yes** GO to A12 . **No** GO to A9 .
A9 TEST FUSE 27 (5A)	
• Check fuse: Fuse 27 (5A). • **Is the resistance 5 ohms or less?**	**Yes** GO to A11 . **No** GO to A10 .
A10 TEST CIRCUIT 1003 (GY/YE) FOR SHORT TO GROUND	
• Measure resistance at pin C2008-2, circuit 1003 (GY/YE).  A0051042 • **Is the resistance 10 K ohms or less?**	**Yes** SERVICE circuit 1003 (GY/YE) for short to ground. TEST the system for normal operation. **No** GO to A11 .
A11 TEST CIRCUIT 1003 (GY/YE) FOR OPEN	
• Measure resistance of circuit 1003 (GY/YE) between output side of fuse 27 (5A) and shift lock actuator pin C2008-2.	**Yes** GO to A12 . **No** SERVICE circuit 1003

 A0051041 ● **Is the resistance 5 ohms or less?**	(GY/YE) for open. TEST the system for normal operation.
A12 TEST CIRCUIT 57 (BK) FOR OPEN	
● Measure the resistance of shift lock actuator C2008-6, circuit 57 (BK).  A0051040 ● **Is the resistance 5 ohms or less?**	**Yes** INSTALL a new shift lock actuator. TEST the system for normal operation. **No** SERVICE circuit 57 (BK) for open. TEST the system for normal operation.

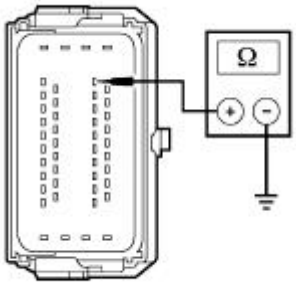
PINPOINT TEST B: THE SHIFT CONTROL IS OUT OF CORRECT GEAR RELATIONSHIP

Test Step	Result / Action to Take
B1 CHECK SHIFT CONTROL LINKAGE	
● Apply the brake pedal. ● Gain access to the column shift control linkage. ● Actuate the transmission range selector lever in all ranges. ● Observe all linkages	**Yes** INSTALL new column shift control linkage. TEST the system for normal operation. **No** GO to B2 .

during operation. ● **Is the linkage damaged?**	
B2 CHECK TRANSMISSION SHIFT CABLE	
● Check transmission shift cable and bracket installation and tightness. ● **Is the transmission shift cable correctly installed and adjusted?**	**Yes** VERIFY the transmission shift cable adjustment. REFER to Cable and Bracket Adjustment—Column Shift in this section. ADJUST the transmission shift cable if necessary. VERIFY the digital transmission range (TR) sensor for proper adjustment. REFER to Section 307-01A (4R70W). Adjust digital TR or TR sensor if necessary. GO to B3 . **No** REPAIR as necessary. TEST the system for normal operation.
B3 CHECK LINKAGE/CABLE FOR CORRECT GEAR RELATIONSHIP	
● Apply the brake pedal. ● Actuate the transmission range selector lever in all ranges. ● **Does the indicator match the gear selection?**	**Yes** System OK. TEST the system for normal operation. **No** REFER to Selector Lever Indicator Adjustment in this section. TEST the system for normal operation.

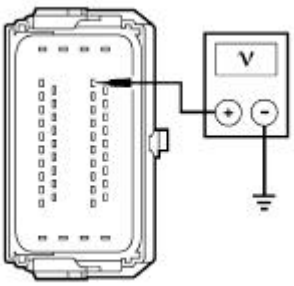
PINPOINT TEST C: THE TRANSMISSION CONTROL SWITCH (TCS) IS INOPERATIVE

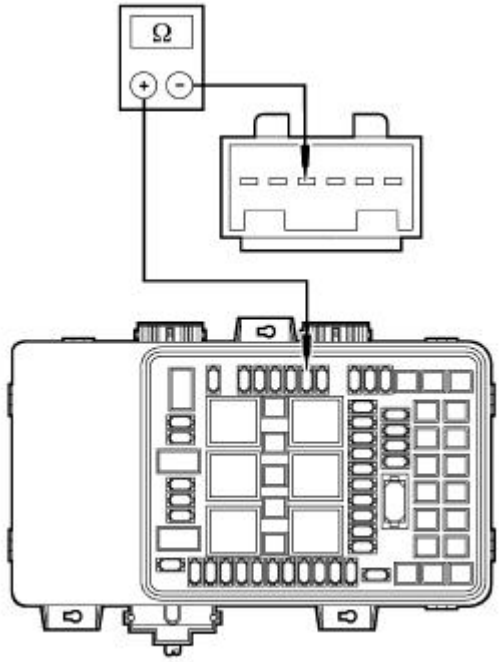
Test Step	Result / Action to Take
C1 CHECK FUSE 29	
● Check fuse: Fuse Junction Panel Fuse 27 (5A). ● **Is the resistance less than 5 ohms?**	**Yes** GO to C3 . **No** INSTALL a new fuse. TEST the system for normal operation. If the fuse fails again, GO to C2 .
C2 CHECK CIRCUIT 224 (TN/WH) FOR SHORT TO GROUND	
● Disconnect: Powertrain Control Module C175b. ● Inspect for damaged or pushed-out pins, corrosion, loose wires, etc. Repair as necessary. ● Measure the resistance between circuit 224 (TN/WH), pin C175b-22 and ground.	**Yes** GO to C3 . **No** REPAIR circuit 224 (TN/WH). TEST the system for normal operation.



A0050536

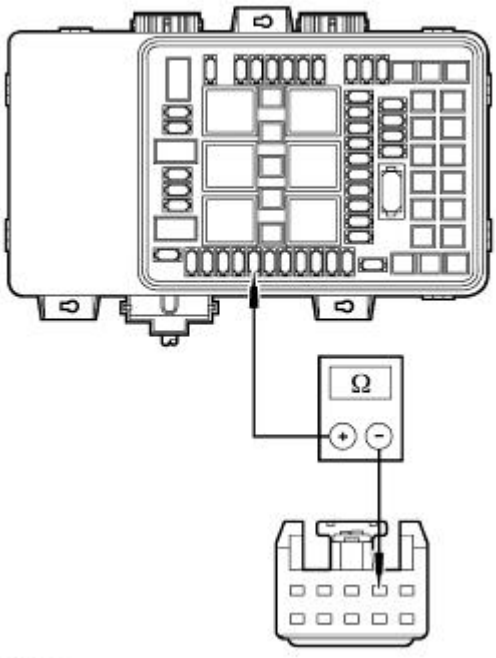
- **Is the resistance greater than 10 K ohms?**

C3 CHECK TRANSMISSION CONTROL SWITCH (TCS) CIRCUIT FOR VOLTAGE	
• Disconnect: Powertrain Control Module C175b. • Inspect for damaged or pushed-out pins, corrosion, loose wires, etc. Repair as necessary. • Leave PCM disconnected. • Measure the voltage at C175b-22, circuit 224 (TN/WH) and ground while cycling the TCS several times.  A0050537 • **Does the voltage cycle?**	**Yes** INSTALL a new PCM. TEST the system for normal operation. **No** GO to C4 .
C4 CHECK CIRCUIT 1003 (GY/YE) FOR OPEN	
• Disconnect: Power Distribution Junction Box. • Disconnect: Transmission Control Switch (TCS) C2135. • Inspect both ends for damaged or pushed-out pins, moisture, corrosion, loose wires, etc. Repair as necessary. • Measure the resistance between the PDJB fuse 27 (5A) and the power side of the TCS vehicle harness C2135-2, circuit 1003 (GY/YE).	**Yes** GO to C5 . **No** REPAIR open circuit. RECONNECT all components. TEST the system for normal operation.



A0051041

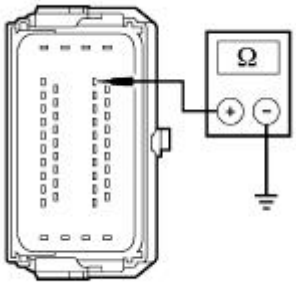
- Measure the resistance between C2135-1, circuit 224 (TN/WH) and signal side of the transmission control switch vehicle harness C175b-22, circuit 224 (TN/WH).



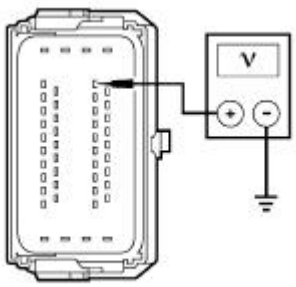
A0051038

- **Is the resistance less than 5 ohms for both circuits?**

C5 CHECK CIRCUIT 224 (TN/WH) FOR SHORT TO POWER	
• Measure the resistance between C175b-22, circuit 224 (TN/WH) and C175b-34.	**Yes** INSTALL a new transmission control switch. RECONNECT all components. TEST the system for normal operation.

 A0050536 ● **Is the resistance greater than 10 K ohms?**	**No** REPAIR circuit 224 (TN/WH). RECONNECT all components. TEST the system for normal operation.

PINPOINT TEST D: TRANSMISSION CONTROL INDICATOR LAMP (TCIL) IS NOT OPERATING CORRECTLY

Test Step	Result / Action to Take
D1 CHECK TRANSMISSION CONTROL INDICATOR LAMP (TCIL) CIRCUIT FOR VOLTAGE	**Yes** GO to D2 . **No** CHECK the indicator bulb and the fuse. If OK, REPAIR the wiring between ignition switch and the PCM harness connector. REPAIR as necessary. TEST the system for normal operation.
● Disconnect: Powertrain Control Module (PCM) C175b. ● Inspect for damaged or pushed-out pins, corrosion, loose wires, etc. Repair as necessary. ● Measure the voltage at C175b-22, circuit 224 (TN/WH).  A0050537 ● **Is the voltage reading greater than 2 volts?**	
D2 CYCLE TRANSMISSION CONTROL SWITCH (TCS)	**Yes** OK at this time. Concern may be intermittent. **No** GO to D3 .
● Cycle the transmission control switch (TCS). ● **Does the transmission control indicator lamp (TCIL) illuminate and then go off?**	
D3 CHECK CIRCUIT 911 (W/LG) FOR SHORT TO GROUND	**Yes** REPAIR circuit 911 (W/LG). RECONNECT all components. TEST the system for normal operation. **No** INSTALL a new PCM. TEST the system for normal operation.
● Disconnect: Powertrain Control Module (PCM) C175b. ● Inspect both ends for damage or pushed-out pins, moisture, corrosion, loose wires, etc. Repair as necessary. ● **Does the TCIL remain on?**	

External Controls —Floor Shift

Refer to Wiring Diagrams Cell 37 , Shift Lock for schematic and connector information.

Special Tool(s)

 ST1137-A	73 Digital Multimeter 105-R0051 or equivalent

Inspection and Verification

1. Verify the customer concern by operating the transmission external control.
2. Visually inspect for obvious signs of mechanical and electrical damage; refer to the following chart:

Visual Inspection Chart

Mechanical	Electrical
● Damaged shift lock actuator ● Damaged transmission control switch	● Failed fuse(s) ● Damaged wiring harness ● Loose or corroded connections

3. If the fault is not visually evident, determine the symptom. GO to the Symptom Chart.

Symptom Chart

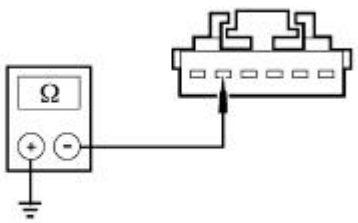
Symptom Chart

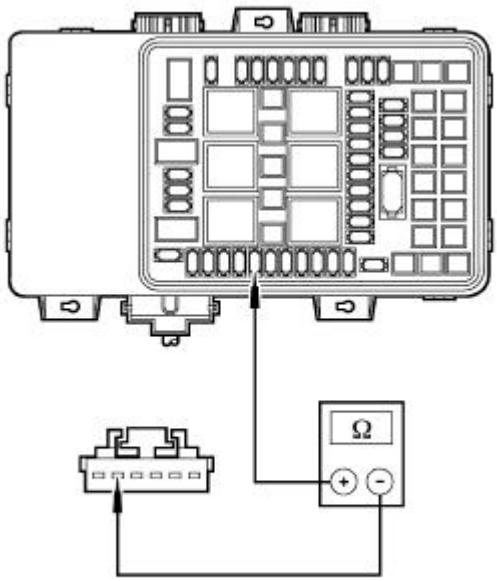
Condition	Possible Sources	Action
● The shift interlock system does not release/lock correctly	● Circuitry. ● Fuse(s). ● Shift lock actuator. ● Brake pedal position switch.	● Go To Pinpoint Test E .
● The shift control is out of correct gear relationship	● Transmission shift cable and bracket. ● Retainer bracket. ● Shift control linkage.	● Go To Pinpoint Test F .
● Transmission	● Transmission	● TIGHTEN bolts holding

range indicator does not correspond to the gear	shift cable bracket. ● Transmission shift cable loose from the transmission retainer bracket. ● Shift linkage.	transmission shift cable bracket. ● TIGHTEN transmission shift cable bolts. ● VERIFY transmission shift cable adjustment. REFER to Adjustments in this section. ADJUST transmission shift cable if necessary. VERIFY digital transmission range (TR) sensor or transmission range (TR) sensor for correct adjustment. REFER to Section 307-01A or Section 307-01B .
● Transmission range indicator LED's do not illuminate	● Bulb. ● Circuitry.	● REFER to Section 413-00 .
● The transmission control switch (TCS) is inoperative	● Fuse. ● TCS. ● TCS not cycled during self-test. ● Powertrain Control Module. ● Circuitry.	● Go To Pinpoint Test G .
● The transmission control indicator lamp (TCIL) is not operating correctly	● Bulb. ● Circuitry. ● Powertrain Control Module.	● Go To Pinpoint Test H .
● Rattle, noise, buzz, or other noise	● Selector lever knob. ● Shift control selector lever.	● INSTALL a new selector lever knob. ● TIGHTEN housing bolts.
● Water enters inside the vehicle	● Cable assembly grommet. ● Torn cable assembly grommet.	● SECURE grommet to floor panel. ● INSTALL a new transmission shift cable.
● Excessive shift effort	● Transmission shift cable. ● Cable bracket.	● INSTALL a new transmission shift cable. ● ADJUST cable. TIGHTEN cable bracket screws.
● Transmission range selector lever will not shift	● Transmission shift cable. ● Shifter knob. ● Broken transmission floor shifter.	● REINSTALL transmission shift cable. ● INSTALL a new shifter knob. ● INSTALL a new transmission floor shifter.

Pinpoint Tests

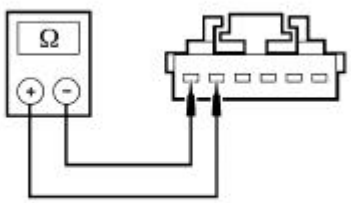
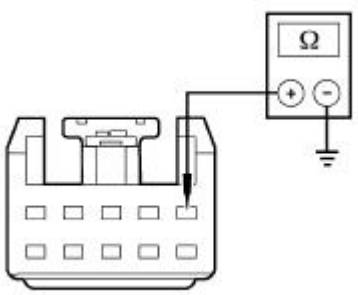
PINPOINT TEST E: THE SHIFT INTERLOCK SYSTEM DOES NOT RELEASE/LOCK CORRECTLY

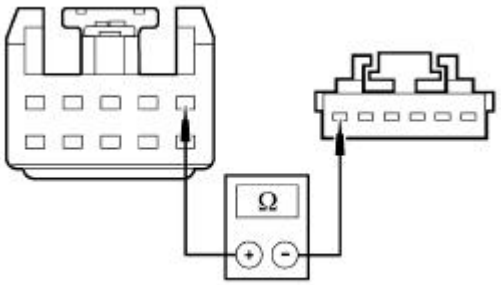
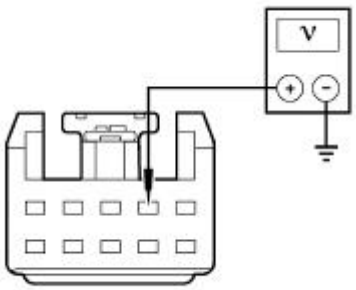
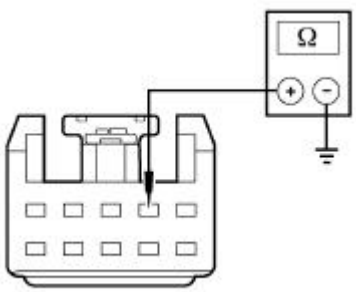
Test Step	Result / Action to Take
E1 TEST BRAKE LIGHTS	
• Apply brake pedal and view brake lights. • **Do the brake lights illuminate?**	**Yes** GO to E7 . **No** GO to E2 .
E2 TEST FUSE 5 (7.5A)	
• Check fuse: Fuse 5 (7.5A). • Measure the resistance of fuse 5. • **Is the resistance 5 ohms or less?**	**Yes** GO to E4 . **No** GO to E3 .
E3 TEST CIRCUIT 729 (RD/WH) FOR SHORT TO GROUND	
• Disconnect: Brake Pedal Position Switch C278. • Measure resistance of circuit 729 (RD/WH) at C278-5.  A0050540 • **Is the resistance 10 K ohms or less?**	**Yes** SERVICE circuit 729 (RD/WH) for short to ground. TEST the system for normal operation. **No** GO to E4 .
E4 TEST CIRCUIT 729 (RD/WH) FOR OPEN	
• Measure resistance between output side of fuse 5 (7.5A) and Brake Pedal Position Switch Connector C278-5, circuit 729 (RD/WH).	**Yes** GO to E5 . **No** SERVICE circuit 729 (RD/WH) for open. RETEST the system.

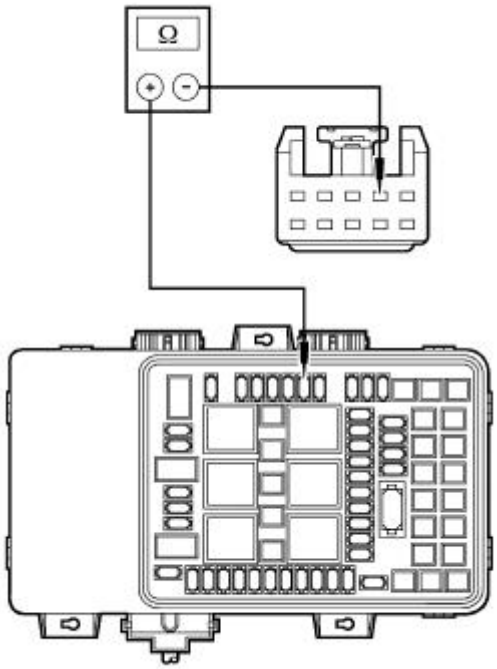
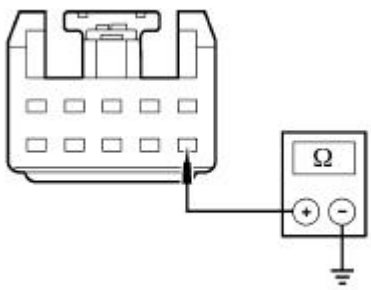


A0050532

- **Is resistance 5 ohms or less?**

E5 TEST BRAKE PEDAL POSITION SWITCH	
• Measure resistance of brake pedal position switch while open (OFF) and closed (ON).  A0050529 • **Is the resistance of switch greater than 10 K ohms while OFF and 5 ohms or less while ON?**	**Yes** GO to E6 . **No** INSTALL a new brake pedal position switch. TEST the system for normal operation.
E6 CHECK CIRCUIT 810 (RD/LG) FOR SHORT TO GROUND	
• Disconnect: Shift Lock Actuator C2008. • Measure resistance of circuit 810 (RD/LG), pin C2008-2.  A0050530 • **Is the resistance 10 K ohms or less?**	**Yes** SERVICE circuit 810 (RD/LG) for short to ground. TEST the system for normal operation. **No** GO to E7 .
E7 CHECK CIRCUIT 810 (RD/LG) FOR OPEN	

• Measure the resistance of circuit 810 (RD/LG) between shift lock actuator pin C2008-2 and brake pedal position switch connector C278-6.  A0050531 • **Is the resistance 5 ohms or less?**	**Yes** GO to E8 . **No** SERVICE circuit 810 (RD/LG) for open. TEST the system for normal operation.
E8 TEST FOR B+ ON CIRCUIT 1003 (GY/YE)	
• Measure voltage at shift lock actuator pin C2008-3, circuit 1003 (GY/YE).  A0051039 • **Is B+ present?**	**Yes** GO to E12 . **No** GO to E9 .
E9 TEST FUSE 27 (5A)	
• Check fuse: Fuse 27 (5A). • **Is the resistance 5 ohms or less?**	**Yes** GO to E11 . **No** GO to E10 .
E10 TEST CIRCUIT 1003 (GY/YE) FOR SHORT TO GROUND	
• Measure resistance at pin C2008-2, circuit 1003 (GY/YE).  A0051215 • **Is the resistance 10 K ohms or less?**	**Yes** SERVICE circuit 1003 (GY/YE) for short to ground. TEST the system for normal operation. **No** GO to E11 .
E11 TEST CIRCUIT 1003 (GY/YE) FOR OPEN	
• Measure resistance of circuit 1003 (GY/YE) between output side of fuse 27 (5A) and shift lock actuator pin C2008-2.	**Yes** GO to E12 . **No** SERVICE circuit 1003

 A0050538 ● **Is the resistance 5 ohms or less?**	(GY/YE) for open. TEST the system for normal operation.
E12 TEST CIRCUIT 57 (BK) FOR OPEN	
● Measure the resistance of shift lock actuator C2008-6, circuit 57 (BK).  A0050535 ● **Is the resistance 5 ohms or less?**	**Yes** INSTALL a new shift lock actuator. TEST the system for normal operation. **No** SERVICE circuit 57 (BK) for open. TEST the system for normal operation.

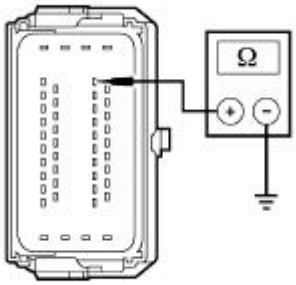
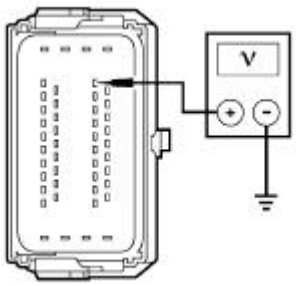
PINPOINT TEST F: THE SHIFT CONTROL IS OUT OF CORRECT GEAR RELATIONSHIP

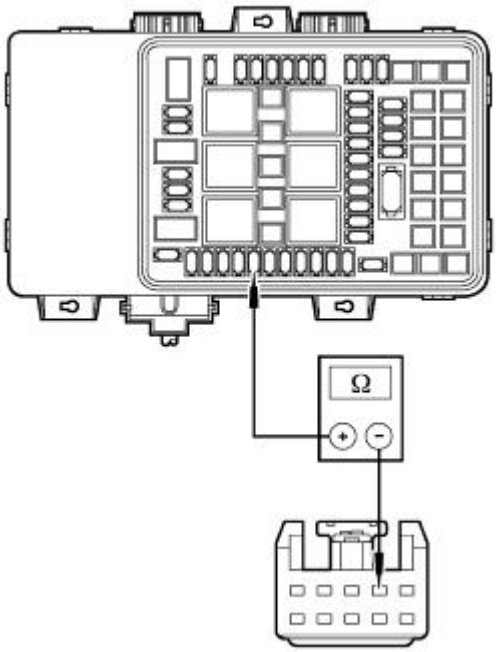
Test Step	Result / Action to Take
F1 CHECK SHIFT CONTROL LINKAGE	
● Apply the brake pedal. ● Gain access to the shift control linkage. ● Actuate the transmission range selector lever in all ranges. ● Observe all linkages during operation.	**Yes** INSTALL a new floor shifter. TEST the system for normal operation. **No** GO to F2 .

• **Is the linkage damaged?**	
F2 CHECK TRANSMISSION SHIFT CABLE	
• Check transmission shift cable and bracket installation and tightness. • **Is the transmission shift cable correctly installed and adjusted?**	**Yes** VERIFY the transmission shift cable adjustment. REFER to Cable and Bracket Adjustment—Floor Shift in this section. ADJUST the transmission shift cable if necessary. VERIFY the digital transmission range (TR) sensor for correct adjustment. REFER to Section 307-01B (4R100). Adjust digital TR or TR sensor if necessary. GO to F3 . **No** REPAIR as necessary. TEST the system for normal operation.
F3 CHECK LINKAGE/CABLE FOR CORRECT GEAR RELATIONSHIP	
• Apply the brake pedal. • Actuate the transmission range selector lever in all ranges. • **Does the indicator match the gear selection?**	**Yes** System OK. TEST the system for normal operation. **No** REFER to Cable and Bracket Adjustment—Floor Shift in this section. TEST the system for normal operation.

PINPOINT TEST G: THE TRANSMISSION CONTROL SWITCH (TCS) IS INOPERATIVE

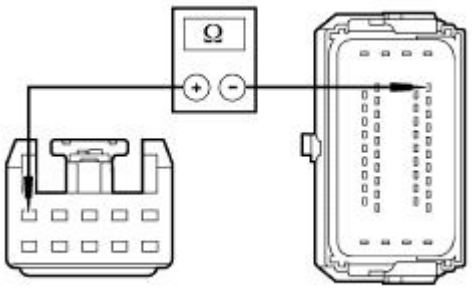
Test Step	Result / Action to Take
G1 CHECK FUSE 27	
• Check fuse: Fuse Junction Panel Fuse 27 (5A). • **Is the resistance less than 5 ohms?**	**Yes** GO to G3 . **No** INSTALL a new fuse. TEST the system for normal operation. If the fuse fails again, GO to G2 .
G2 CHECK CIRCUIT 224 (TN/WH) FOR SHORT TO GROUND	
• Disconnect: Powertrain Control Module C175b. • Inspect for damaged or pushed-out pins, corrosion, loose wires, etc. Repair as necessary. • Measure the resistance between circuit 224 (TN/WH), pin C175b-22 and ground.	**Yes** GO to G3 . **No** REPAIR circuit 224 (TN/WH). TEST the system for normal operation.

 A0050536 ● **Is the resistance greater than 10 K ohms?**	
G3 CHECK TRANSMISSION CONTROL SWITCH (TCS) CIRCUIT 224 (TN/WH) FOR VOLTAGE	
● Disconnect: Powertrain Control Module C175b. ● Inspect for damaged or pushed-out pins, corrosion, loose wires, etc. Repair as necessary. ● Leave PCM disconnected. ● Measure the voltage at C175b-22, circuit 224 (TN/WH) and ground while cycling the TCS several times.  A0050537 ● **Does the voltage cycle?**	**Yes** INSTALL a new PCM. TEST the system for normal operation. **No** GO to G4 .
G4 CHECK CIRCUIT 1003 (GY/YE) FOR OPEN	
● Disconnect: Power Distribution Junction Box. ● Disconnect: Transmission Control Switch (TCS) C2135. ● Inspect both ends for damaged or pushed-out pins, moisture, corrosion, loose wires, etc. Repair as necessary. ● Measure the resistance between the PDJB fuse 27 (5A) and the power side of the TCS vehicle harness C2135-2, circuit 1003 (GY/YE).	**Yes** GO to G5 . **No** REPAIR open circuit. RECONNECT all components. TEST the system for normal operation.



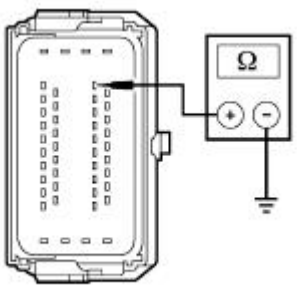
A0051038

- Measure the resistance between C2135-1, circuit 224 (TN/WH) and signal side of the transmission control switch vehicle harness C175b-22, circuit 224 (TN/WH).

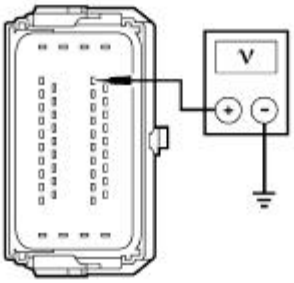


A0051037

- **Is the resistance less than 5 ohms for both circuits?**

G5 CHECK CIRCUIT 224 (TN/WH) FOR SHORT TO POWER - Measure the resistance between C175b-22, circuit 224 (TN/WH) and C175b-34.  A0050536 - **Is the resistance greater than 10 K ohms?**	**Yes** INSTALL a new transmission control switch. RECONNECT all components. TEST the system for normal operation. **No** REPAIR circuit 224 (TN/WH). RECONNECT all components. TEST the system for normal operation.

PINPOINT TEST H: TRANSMISSION CONTROL INDICATOR LAMP (TCIL) IS NOT OPERATING CORRECTLY

Test Step	Result / Action to Take
H1 CHECK TRANSMISSION CONTROL INDICATOR LAMP (TCIL) CIRCUIT FOR VOLTAGE	
• Disconnect: Powertrain Control Module (PCM) C175b. • Inspect for damaged or pushed-out pins, corrosion, loose wires, etc. Repair as necessary. • Measure the voltage at C175b-22, circuit 224 (TN/WH).  A0050537 • **Is the voltage reading greater than 2 volts?**	**Yes** GO to H2 . **No** CHECK the indicator bulb and the fuse. If OK, REPAIR the wiring between ignition switch and the PCM harness connector. REPAIR as necessary. TEST the system for normal operation.
H2 CYCLE TRANSMISSION CONTROL SWITCH (TCS)	
• Cycle the transmission control switch (TCS). • **Does the transmission control indicator lamp (TCIL) illuminate and then go off?**	**Yes** OK at this time. Concern may be intermittent. **No** GO to H3 .
H3 CHECK CIRCUIT 911 (WH/LG) FOR SHORT TO GROUND	
• Disconnect: Powertrain Control Module (PCM) C175b. • Inspect both ends for damage or pushed-out pins, moisture, corrosion, loose wires, etc. Repair as necessary. • **Does the TCIL remain on?**	**Yes** REPAIR circuit 911 (WH/LG). RECONNECT all components. TEST the system for normal operation. **No** INSTALL a new PCM. TEST the system for normal operation.

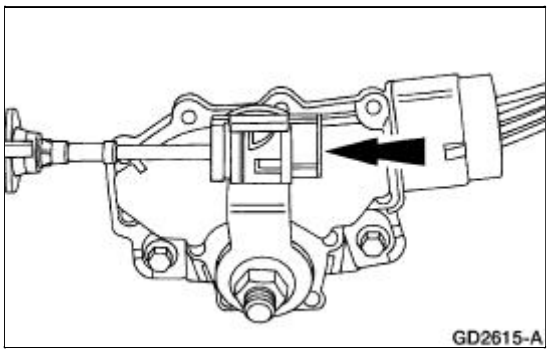
Cable and Bracket Adjustment —Column Shift

1. Place the gearshift lever in the (D) position.
   - Place a three pound weight on the gearshift lever.

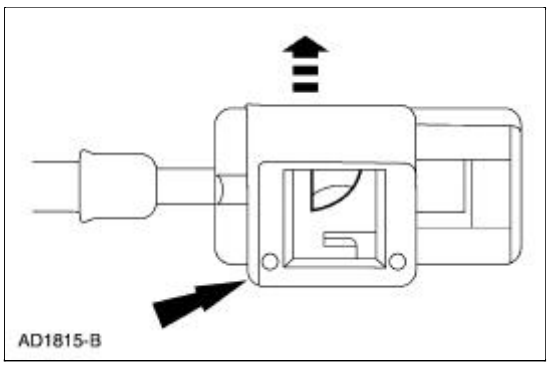
2. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the RH kick panel area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

   Position the vehicle on a hoist. For additional information, refer to Section 100-02 .

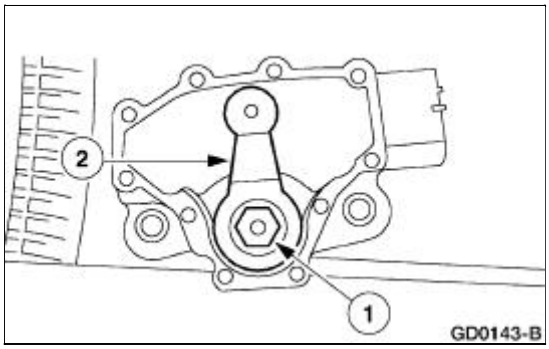
3. Disconnect the transmission shift cable from the manual control lever.



4. Unlock the lock tab on the transmission shift cable.

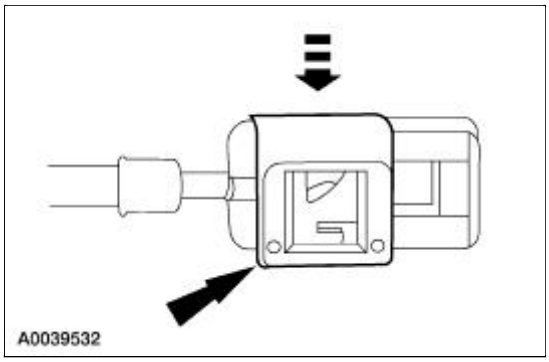


5. Place the manual control lever in the (D) position.
   1. Place the manual control lever in the first gear position.
   2. Move the manual control lever two detents to the (D) position.



6. Connect the transmission shift cable to the manual control lever.

7. Lock the transmission shift cable lock tab.



8. **NOTE:** If equipped with air suspension, reactivate the system by turning on the air suspension switch.

   Lower the vehicle.

9. Remove the three pound weight.

10. Carefully move the manual control lever from detent to detent and compare with transmission settings. Verify that the vehicle will start in PARK or NEUTRAL and backup lamps illuminate in REVERSE. If not, Steps 1-5 must be repeated and include digital transmission range (TR) or transmission range (TR) sensor adjustment in NEUTRAL. For additional information, refer to Section 307-01A .
    - Readjust if necessary.

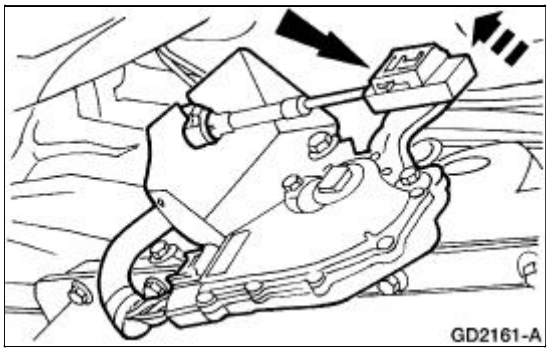
Cable and Bracket Adjustment —Floor Shift

1. Place the gearshift lever in the (D) position.

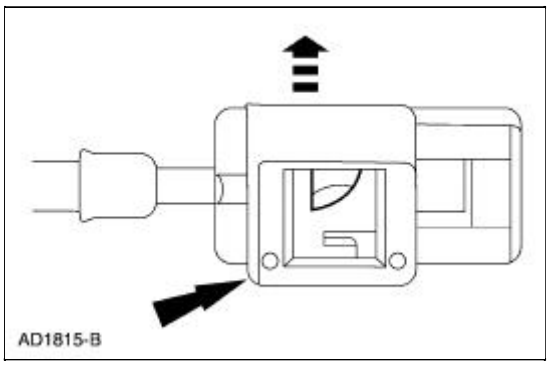
2. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the RH kick panel area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

   Position the vehicle on a hoist. For additional information, refer to Section 100-02 .

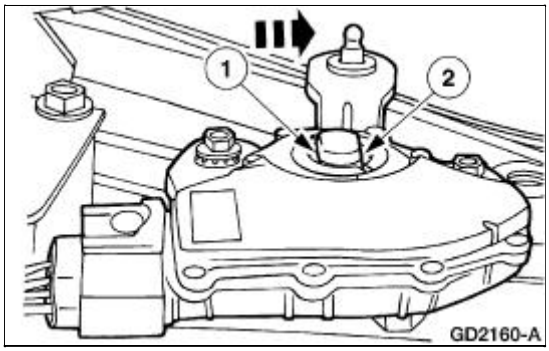
3. Disconnect the transmission shift cable from the manual control lever.



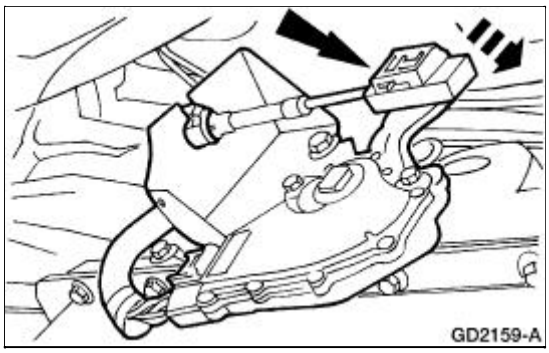
4. Unlock the lock tab on the transmission shift cable.



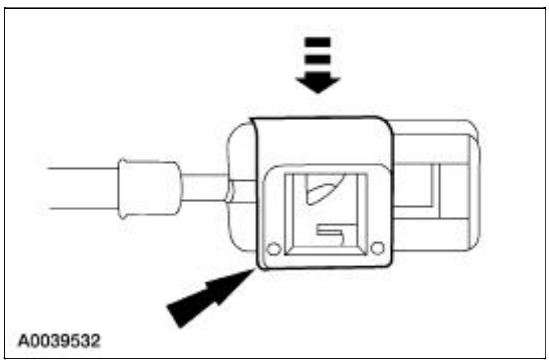
5. Place the manual control lever in the (D) position.
   1. Place the manual control lever in the first gear position.
   2. Move the manual control lever two detents to the (D) position.



6. Connect the transmission shift cable to the manual control lever.



7. Lock the transmission shift cable lock tab.



8. **NOTE:** If equipped with air suspension, reactivate the system by turning on the air suspension switch.

   Position the vehicle.

9. Carefully move the manual control lever from detent to detent and compare with transmission settings. Verify that the vehicle will start in PARK or NEUTRAL and backup lamps illuminate in REVERSE. If not, Steps 1-5 must be repeated and include digital transmission range (TR) or transmission range (TR) sensor adjustment in NEUTRAL. For additional information, refer to Section 307-01B .
   - Readjust if necessary.

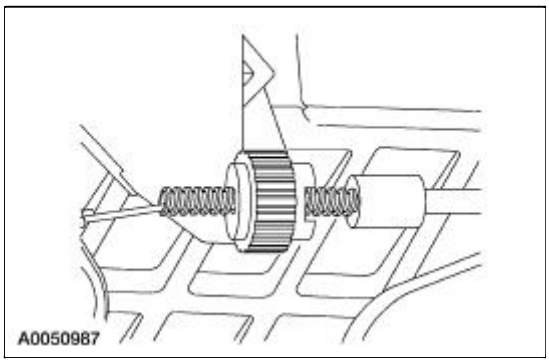
Selector Lever Indicator Adjustment

1. Remove the upper instrument panel steering column cover. For additional information, refer to Section 501-12 .

2. Place the transmission control selector lever in the (D) position.
   - Rotate the transmission control selector lever clockwise until it bottoms out (first gear), then rotate two detents counterclockwise ((D) position).

3. Hang a three pound weight on the transmission control selector lever.

4. Center the pointer in the middle of the (D) position.
   - Rotate the thumbwheel located on the bottom of the steering column to adjust the pointer.



5. Remove the three pound weight.

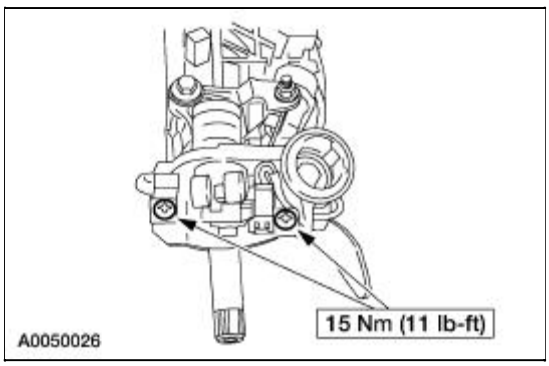
6. Carefully move the shift control selector lever from detent to detent and compare with transmission settings.
   - Readjust if necessary.

7. Install the upper instrument panel steering column cover. For additional information, refer to Section 501-12 .

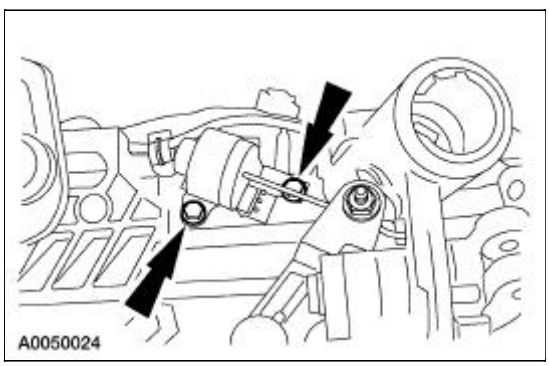
Brake Shift Interlock Actuator —Column Shift

Removal and Installation

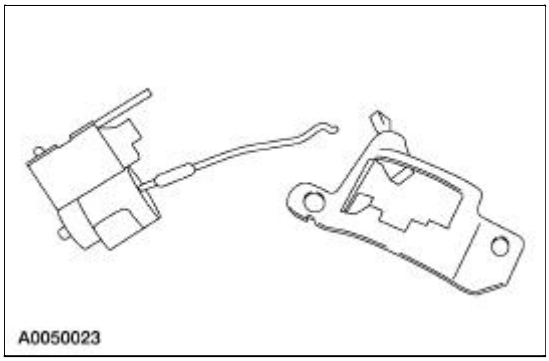
1. Remove the steering column. For additional information, refer to Section 211-04 .
2. Remove the shift lever while in the DRIVE position.
3. Remove the two insert plate screws.
   - Remove the brake switch interlock actuator interupt switch bracket.
   - Position the PARK detection switch aside.



4. Carefully remove the brake switch interlock interrupt switch from the steering column housing.
5. Confirm the two retaining holes for the brake switch interlock interrupt switch are free of plastic material.
6. Remove the wire harness from the retaining clips.
7. Remove the two screws retaining the brake shift interlock actuator from the steering column housing.



8. Rotate the brake shift interlock actuator rod to remove the blocker on the insert plate from the actuator.

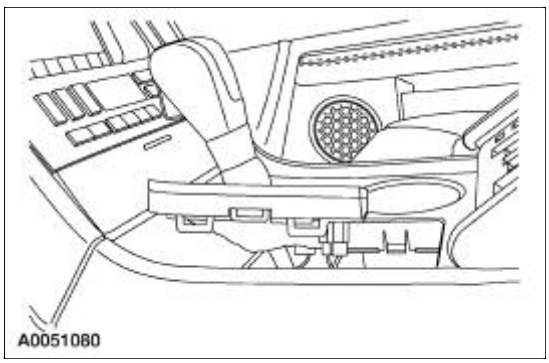


9. To install, reverse the removal procedure.

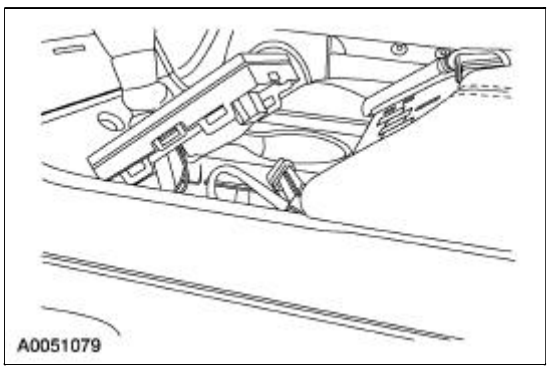
Brake Shift Interlock Actuator —Floor Shift

Removal and Installation

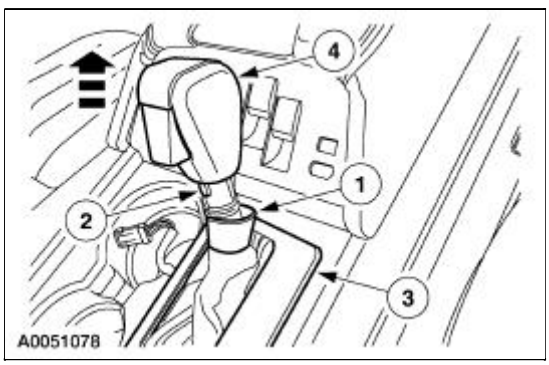
1. Lift the floor shift PRNDL bezel.



2. Disconnect the PRNDL bezel wire harness connector.

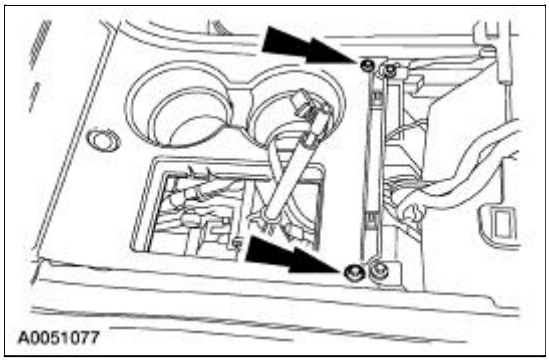


3. Remove the shift lever handle and cover.
    1. Slide the handle bezel down.
    2. Remove the screw.
    3. Disconnect the TCS wire harness.
    4. Lift assembly from the shifter lever.

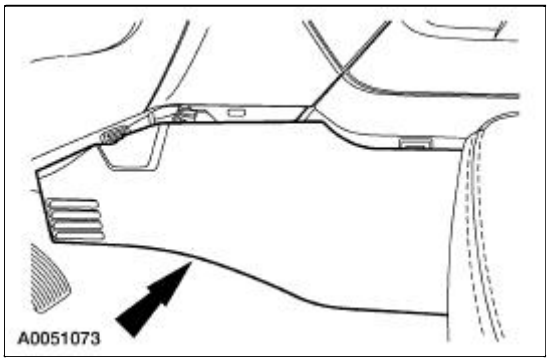


4. Position the window regulator control panel aside.

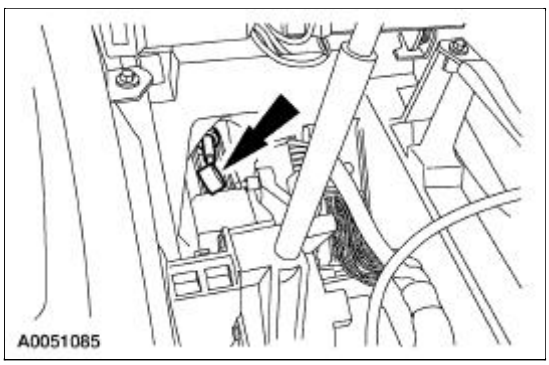
5. Remove the screws and the console finish panel.



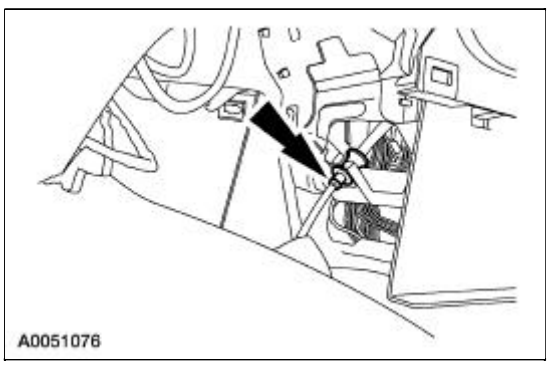
6. Remove the left side console access panel.



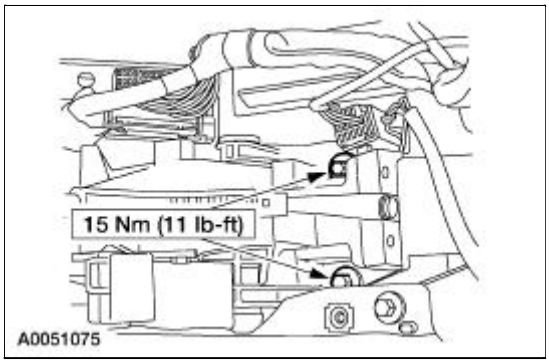
7. Disconnect the transmission shift cable from the transmission selector arm.



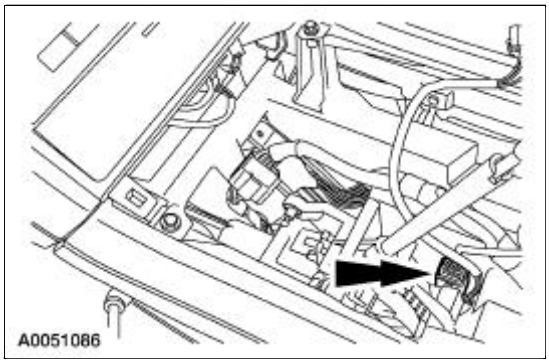
8. Remove the transmission shift cable retaining clip from the floor shift mechanism through the console access.



9. Remove the four bolts retaining the floor shift mechanism to the floor.

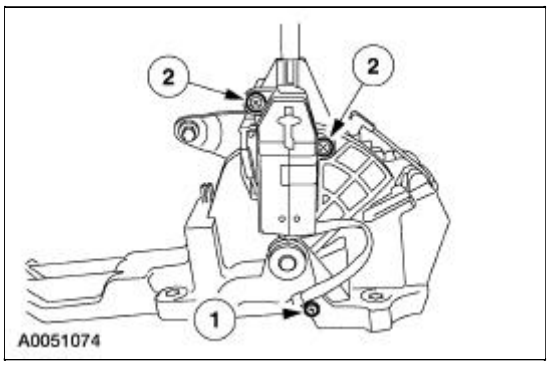


10. Disconnect the floor shift mechanism wire harness connector.



11. Remove the floor shift mechanism from the console.

12. Remove the brake shift interlock actuator and harness.
    1. Remove the wire harness retainers.
    2. Remove the two screws retaining the brake shift interlock assembly.



13. To install, reverse the removal procedure.

Selector Lever Cable and Bracket —Column Shift

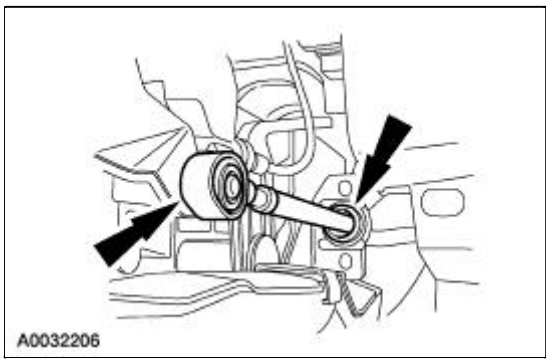
Removal and Installation

1. Remove the instrument panel lower finish panel. For additional information, refer to Section 413-01 .

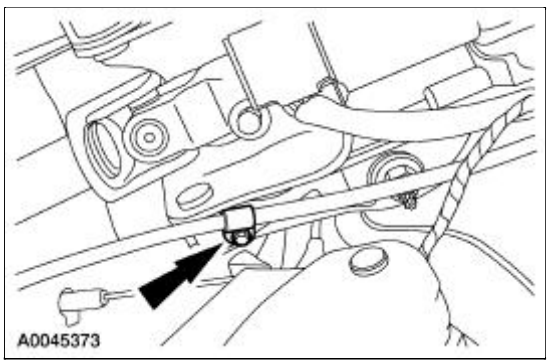
2. **NOTE:** To prevent cable damage, do not apply force to the transmission shift cable assembly between the steering column transmission selector lever arm and the steering column bracket.

   Disconnect the transmission shift cable from the steering column.

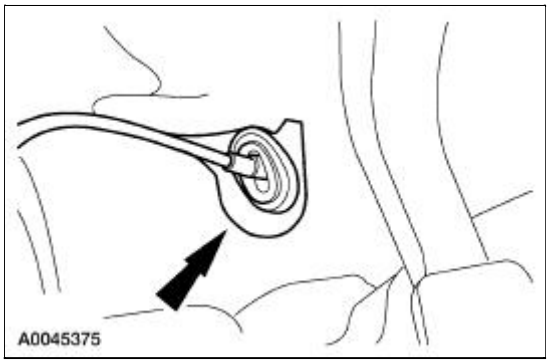
   - Disconnect the transmission shift cable from the transmission selector lever arm and support.
   - Carefully lift the two locking tabs and disconnect the transmission shift cable from the steering column bracket.



3. Remove the cable retaining screw.



4. Push the rubber grommet and transmission shift cable through the floor panel.

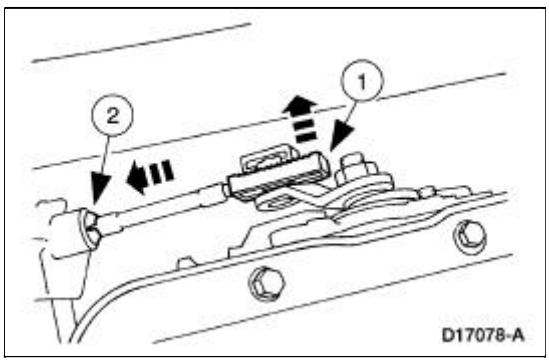


5. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the RH kick panel area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

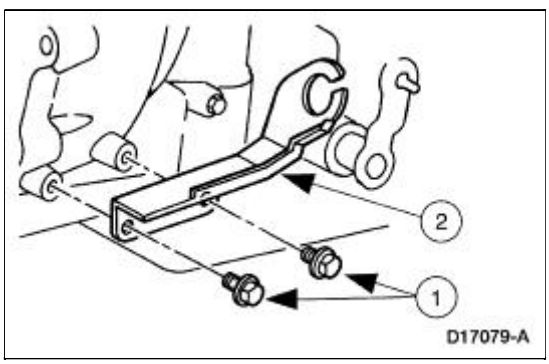
   Put the vehicle in NEUTRAL and position on a hoist. For additional information, refer to Section 100-02 .

6. **NOTE:** To prevent shift cable damage, do not apply force to the transmission shift cable between the manual control lever and the transmission shift cable bracket.

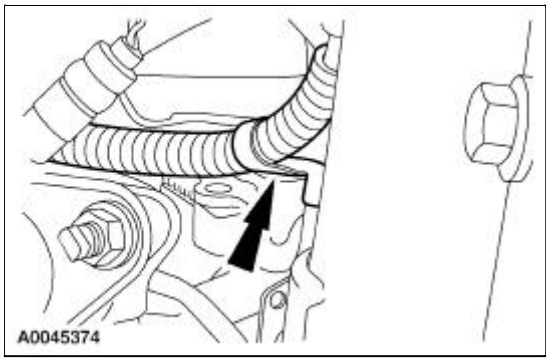
   Remove the transmission shift cable from the automatic transmission.
   1. Disconnect the transmission shift cable from the manual control lever.
   2. Depress the lock tabs to release the transmission shift cable and disconnect the transmission shift cable from the transmission shift cable bracket.



7. Remove the shift cable bracket from the transmission (4R70W).
   1. Remove the bolts.
   2. Remove the bracket.



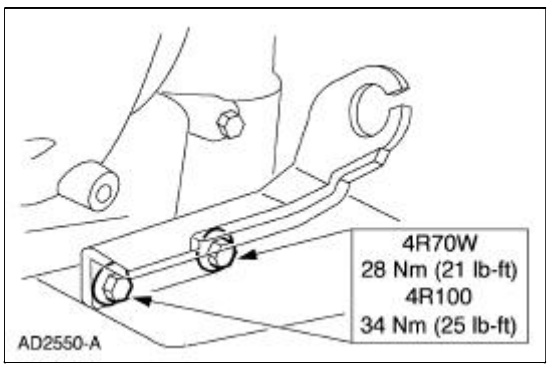
8. Remove the cable from the cable route assist clip located at the transmission bell housing.



9. To install, reverse the removal procedure.

CAUTION: Make sure the cable is inserted into the cable route assist clip. Failure to do so can result in exhaust contact.

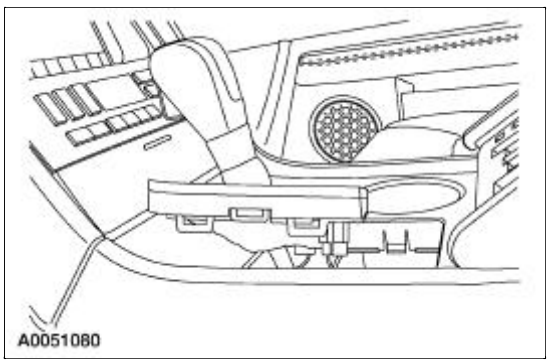
- Adjust the shift cable. For additional information, refer to Cable and Bracket Adjustment—Column Shift in this section.



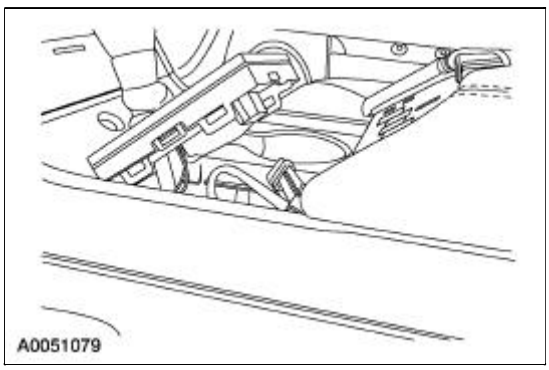
Selector Lever Cable and Bracket —Floor Shift

Removal

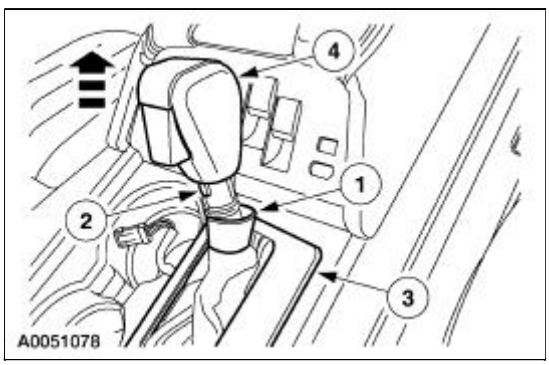
1. Lift the floor shift PRNDL bezel.



2. Disconnect the PRNDL bezel wire harness connector.

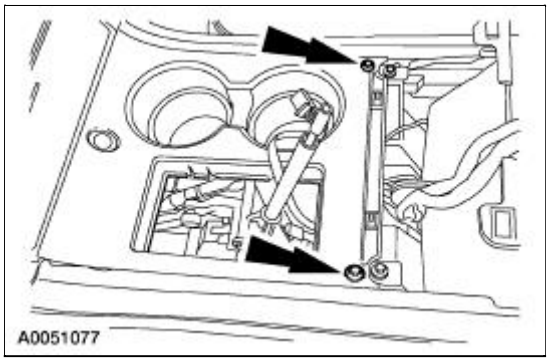


3. Remove the handle and PRNDL bezel.
    1. Slide the handle bezel down.
    2. Remove the screw.
    3. Disconnect the TCS wire harness.
    4. Remove the handle and bezel.

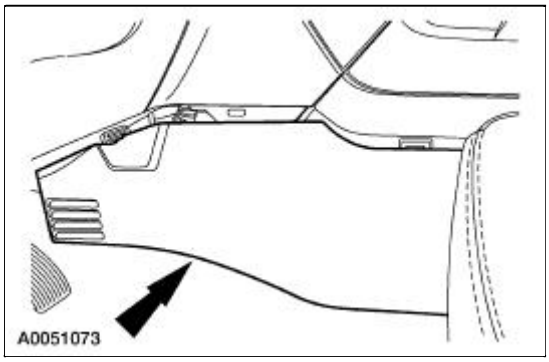


4. Remove the window regulator control panel.

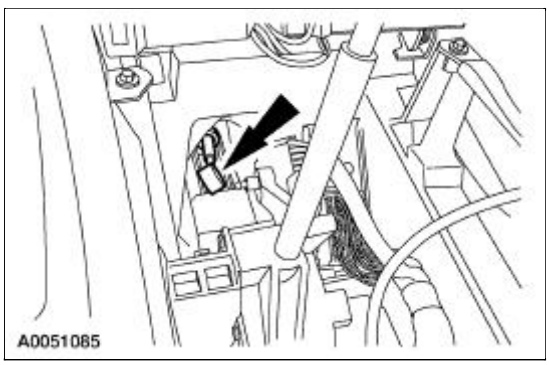
5. Remove the screws and the console finish panel.



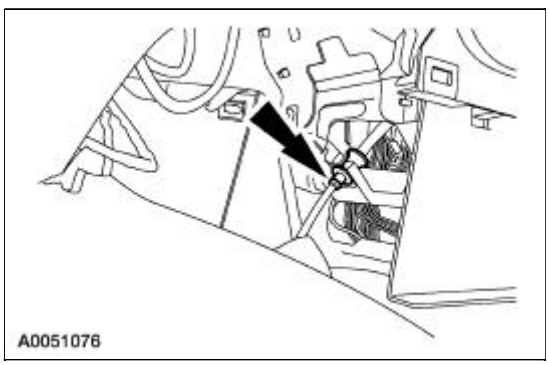
6. Remove the left side console access panel.



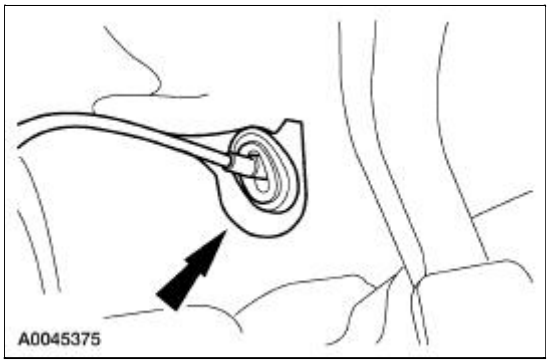
7. Disconnect the transmission shift cable from the transmission selector lever arm.



8. Remove the transmission shift cable retaining clip from the floor shift mechanism through the console access panel.



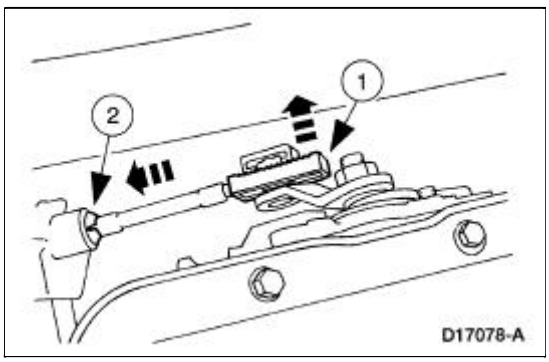
9. Push the rubber grommet and transmission shift cable through the floor panel.



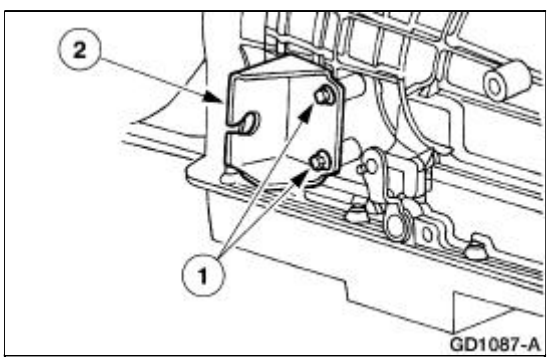
10. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rh kick panel area. Failure to do so may result in unexpected inflation or deflation of the air springs which may result in shifting of the vehicle during these operations.**

    Place the shifter lever in NEUTRAL and position the vehicle on a hoist. For additional information, refer to Section 100-02 .

11. Remove the transmission shift cable from the automatic transmission.
    1. Disconnect the transmission shift cable from the manual control lever.
    2. Depress the lock tabs to release the transmission shift cable and disconnect the transmission shift cable from the transmission shift cable bracket.



12. Remove the shift cable bracket from the transmission.
    1. Remove the bolts.
    2. Remove the shift cable bracket.

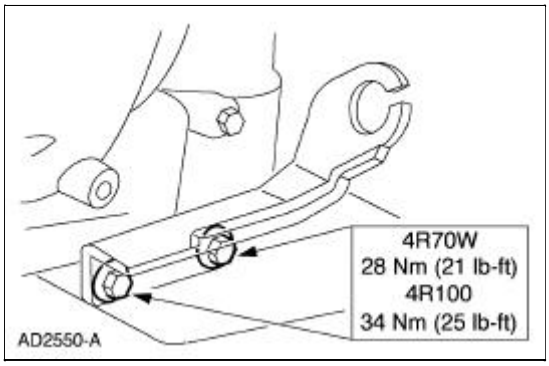


Installation

1. **NOTE:** If equipped with air suspension, reactivate the system by turning on the air suspension switch.

Follow the removal procedure in reverse order.

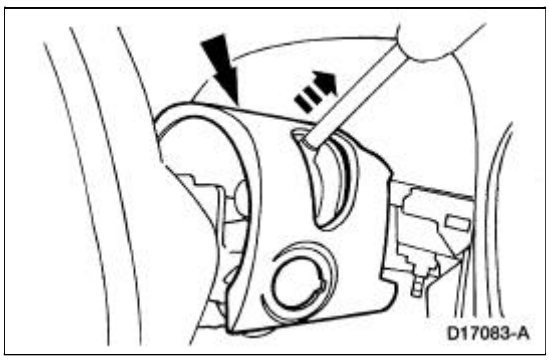
- Adjust the shift cable. For additional information, refer to Cable and Bracket Adjustment—Floor Shift in this section.



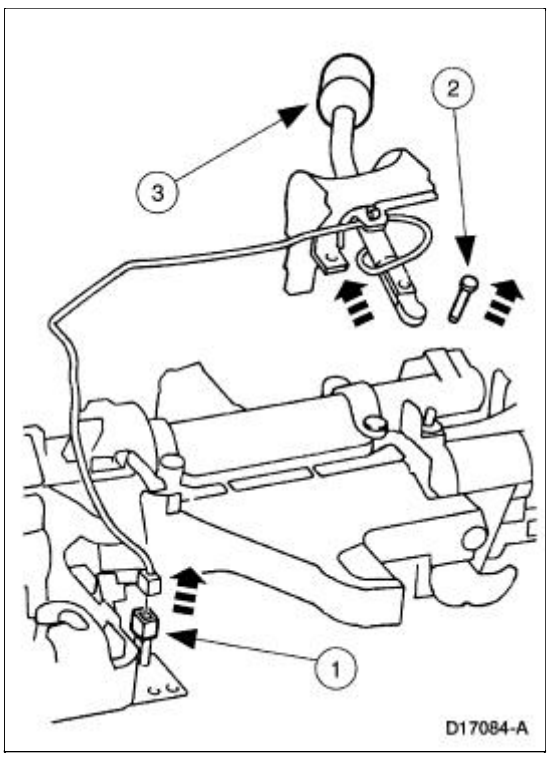
Selector Lever —Column Shift

Removal

1. Remove the ignition switch lock cylinder. For additional information, refer to Section 211-05 .
2. Remove the steering wheel. For additional information, refer to Section 211-04 .
3. Remove the upper steering column shroud.



4. Remove the gearshift lever.
    1. Disconnect the electrical connector.
    2. Remove and discard the gearshift lever pin.
    3. Remove the gearshift lever.



Installation

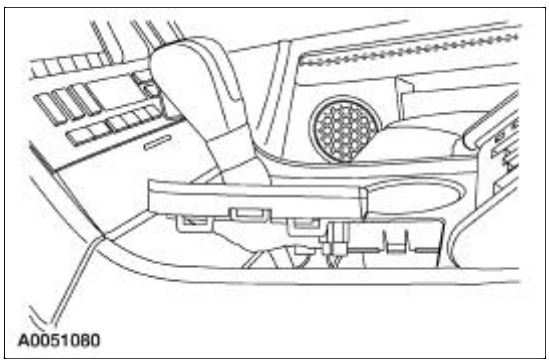
1. **NOTE:** A new gearshift lever pin must be installed whenever removed.

   Follow the removal procedure in reverse order.

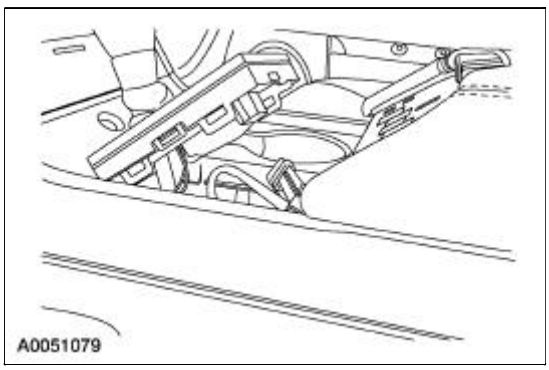
Selector Lever —Floor Shift

Removal and Installation

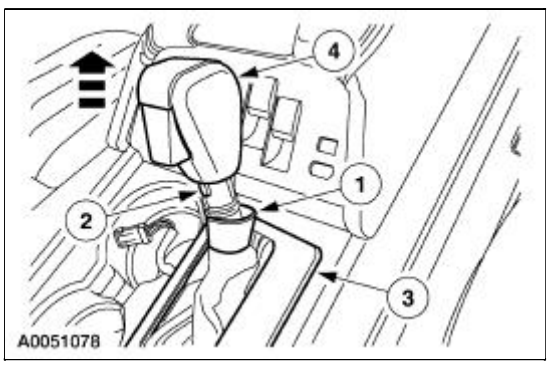
1. Lift the floor shift PRNDL bezel.



2. Disconnect the PRNDL bezel wire harness connector.

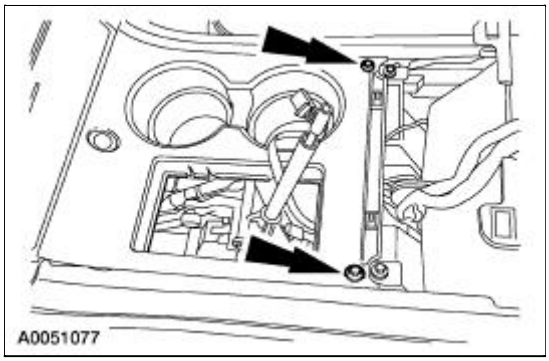


3. Remove the shift lever handle and cover.
    1. Slide the handle bezel down.
    2. Remove the screw.
    3. Disconnect the TCS wire harness.
    4. Lift assembly from the shifter lever.

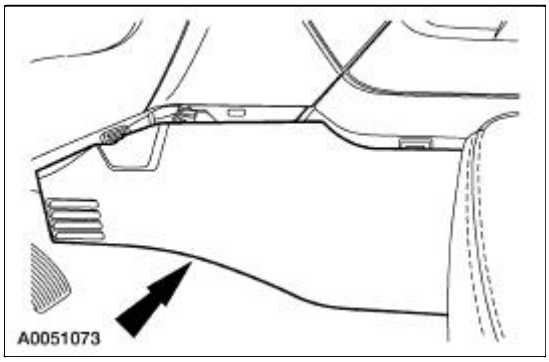


4. Position the window regulator control panel aside.

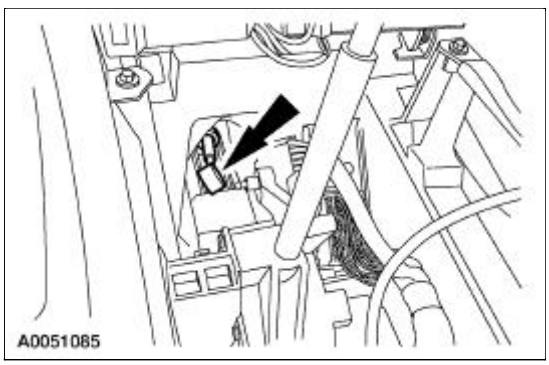
5. Remove the screws and the console finish panel.



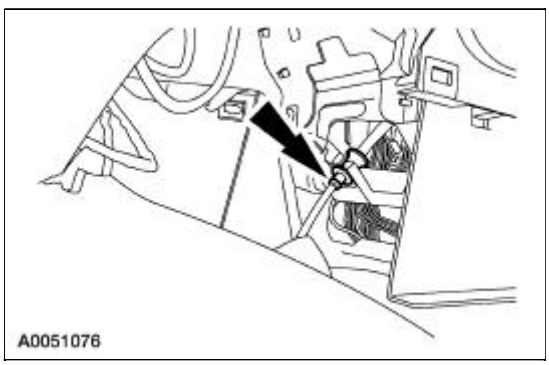
6. Remove the left side console access panel.



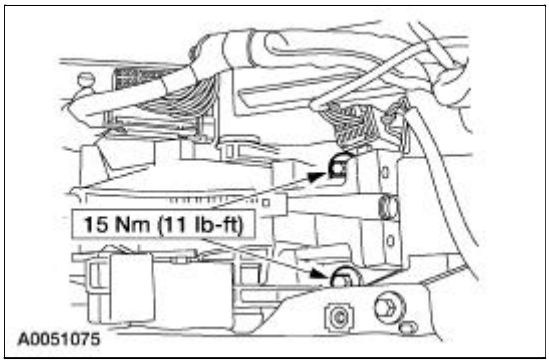
7. Disconnect the transmission shift cable from the transmission selector arm.



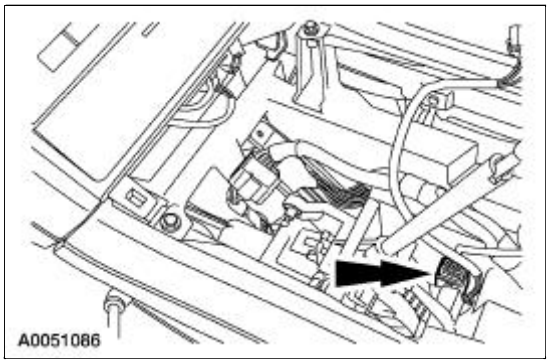
8. Remove the transmission shift cable retaining clip from the floor shift mechanism through the console access.



9. Remove the four bolts retaining the floor shift mechanism to the floor.

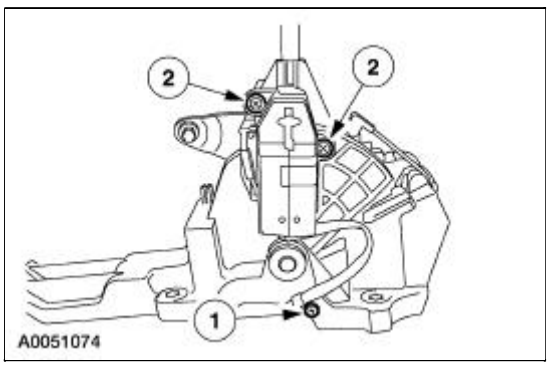


10. Disconnect the floor shift mechanism wire harness connector.



11. Remove the floor shift mechanism from the console.

12. Remove the brake shift interlock actuator, parking brake release mechanism and harness.
    - Remove the wire harness retainers.
    - Remove the wire harness retainers.
    - Remove the two screws retaining the brake shift interlock assembly.
    - Remove the two screws retaining the parking brake controller.

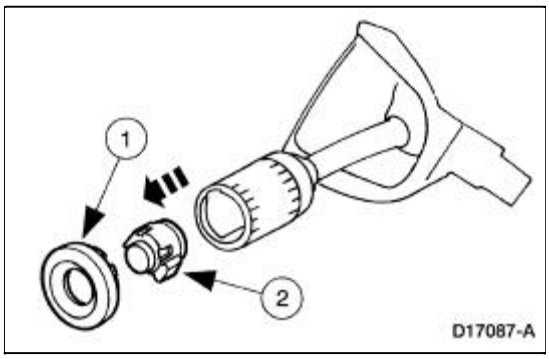


13. To install, reverse the removal procedure.

Transmission Control (TC) Switch —Column Shift

Removal and Installation

1. Remove the transmission control (TC) switch.
    1. Remove the TC switch cover.
    2. Remove the TC switch.

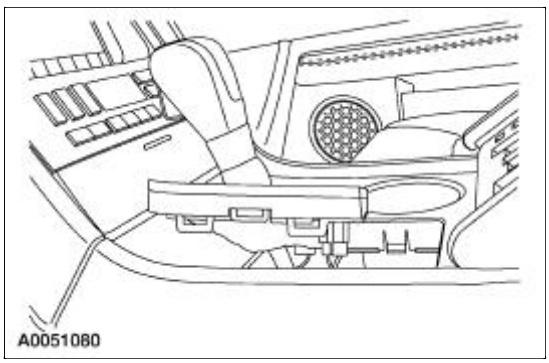


2. To install, reverse the removal procedure.

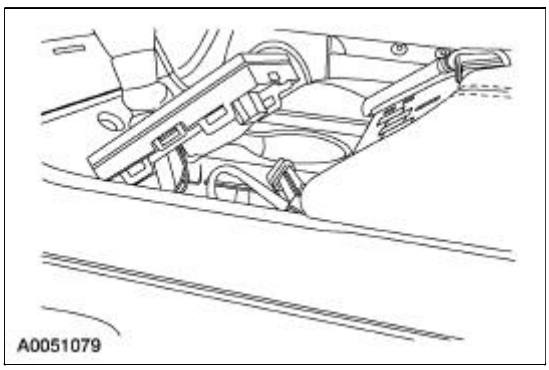
Transmission Control (TC) Switch —Floor Shift

Removal and Installation

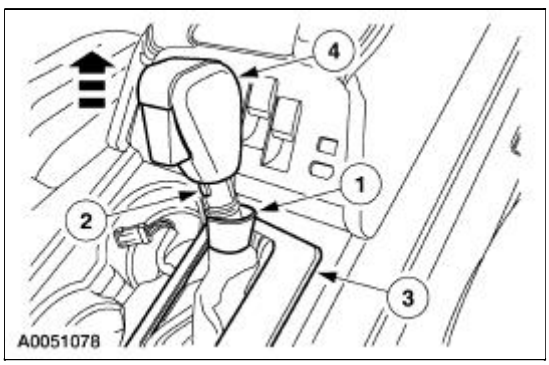
1. Lift the floor shift PRNDL bezel.



2. Disconnect the PRNDL bezel wire harness connector.

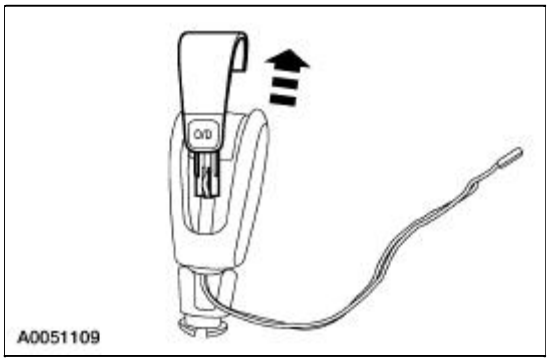


3. Remove the shift lever handle and cover.
    1. Slide the handle bezel down.
    2. Remove the screw.
    3. Disconnect the TCS wire harness.
    4. Lift assembly from the shifter lever.



4. Remove TCS switch from shift handle.
    - Lift switch from handle body.

- Route harness through handle passage.



5. To install, reverse the removal procedure.

Four-Wheel Drive Systems

The automatic 4-wheel drive transfer case system consists of the following:

- automatic 4WD indicator light
- brake pedal position (BPP) switch
- integrated wheel ends (IWE) solenoid
- torque on demand (TOD) relay
- 4WD control module
- 4WD high indicator light
- 4WD low indicator light
- 4WD mode select switch (MSS)
- shift position sensor
- throttle position output (TPO) from the powertrain control module (PCM)
- transmission range sensor
- average front and rear wheel speed signals from the anti-lock brake system

Four-Wheel Drive Systems

Refer to Wiring Diagrams Cell 24 , Engine Controls for schematic and connector information.

Refer to Wiring Diagrams Cell 23 , Engine Controls for schematic and connector information.

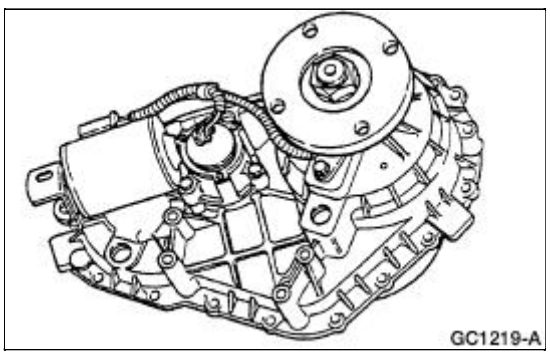
Refer to Wiring Diagrams Cell 34 , All-Wheel Drive for schematic and connector information.

Refer to Wiring Diagrams Cell 59 , Generic Electronic Module for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052 or equivalent scan tool
 ST1176-A	Vacuum Pump 014-R1054 or equivalent

Principles of Operation


GC1219-A

The automatic four-wheel drive (A4WD) system is an electronic-shift 4WD system that allows the operator to choose between 2WD and three different 4WD modes. The operator can switch between A4WD and 4WD HIGH modes at any speed. To engage or disengage 4WD LOW range, the vehicle

speed must be less than 5 km/h (3.1 mph), the brake pedal must be pressed and the transmission must be in NEUTRAL.

Wheel slip is sensed using one axle shaft speed sensor on each axle. Based on throttle position and wheel slip, a pulse width modulated (PWM) signal is transmitted to the transfer case clutch when a predetermined slip-threshold is exceeded.

The 4WD control module will provide the IVD brake system with current clutch duty cycle and whether or not IVD may command the clutch duty cycle.

The brake subsystem sends the following information signals to the 4WD system:

- occurrences of brake events and failures (for additional information, refer to Section 206-09.)
- steering wheel angle status (for additional information, refer to Section 206-09.)
- average rear wheel speed (for additional information, refer to Section 206-09.)
- average front wheel speed (for additional information, refer to Section 206-09.)
- delta front wheel speeds (for additional information, refer to Section 206-09.)

A concern with any of the above listed brake system signals will affect operation of the 4WD system.

The throttle position output signal is provided to the 4WD control module from the powertrain control module (PCM). This signal is used by the 4WD control module in controlling the 4WD clutch.

The shift motor sense plate, an integral part of the gearmotor encoder assembly, informs the 4WD control module of the transfer case position.

The digital transmission range (TR) sensor is located on the LH side of the transmission. This sensor informs the 4WD control module when the transmission is in NEUTRAL.

The electric shift motor is mounted externally to the gearmotor encoder assembly at the rear of the transfer case. It drives a rotary cam which moves the mode fork and range fork within the transfer case between the HIGH range (A4WD, 4WD HIGH) and 4WD LOW range positions.

The 4WD shift motor is controlled by the 4WD control module which shifts the transfer case shift motor between HIGH range (A4WD, 4WD HIGH), and 4WD LOW modes.

The solid-state clutch is duty-cycled by the 4WD control module to activate the 4WD clutch within the transfer case.

In the A4WD system, the 4WD control module varies the torque sent to the front driveline by controlling the transfer case clutch. At rest and under cruising conditions, the 4WD control module activates the transfer case clutch a minimum duty cycle (percentage of time the clutch is turned on), which allows for the slight difference between the front and rear driveshafts which normally occurs when negotiating a corner on dry pavement. Under any of the following conditions, the 4WD control module will increase the duty cycle in order to prevent or control slip:

- slip is detected
- heavy acceleration (throttle position)

Feature inputs:

- brake ON/OFF switch
- mode select switch (MSS)
- digital TR sensor (automatic transmission only)

- vehicle speed signal (transmitted from the ABS module)
- front and rear driveshaft speed sensors
- throttle position information (transmitted from the PCM)
- gearmotor encoder contact plate position inputs A, B, C, D

Feature outputs:

- solid state clutch (pulse width modulated signal)
- 4WD LOW indicator
- 4WD shift motor outputs

Shifts between A4WD and 4WD HIGH can be made at any speed. Listed below are the inputs and outputs needed by the 4WD control module to execute a change between any of these modes.

Feature inputs:

- front and rear driveshaft speed sensors
- vehicle speed signal
- throttle position information
- 4WD Mode Select Switch (MSS)

Feature outputs:

- solid state clutch (pulse width modulated signal)
- 4WD HIGH switch indicator

When shifting into or out of LOW range, the 4WD control module requires that the vehicle speed is less than 5 km/h (3 mph), the brake is applied, and the transmission is in NEUTRAL.

Feature inputs:

- throttle position information (transmitted from PCM)
- MSS
- gearmotor encoder contact plate position inputs A, B, C, D
- vehicle speed signal (transmitted from ABS module)
- brake ON/OFF (BOO) switch input (battery voltage when brake pedal is depressed, open circuit when not activated)
- digital TR sensor (ground when transmission is in NEUTRAL, open circuit otherwise)

Feature outputs:

- 4WD shift motor outputs
- 4WD LOW switch indicator
- solid state clutch (pulse width modulated signal)

Inspection and Verification

1. Verify the customer concern.

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

Visual Inspection Chart

Mechanical	Electrical
● Axle shafts and universal joints ● Driveshaft and universal joints ● Fluid leaks ● Matching tire size	● Central junction box (CJB) fuses: ■ 11(10A) ■ 115 (30A) ■ 20 (30A) ● 4WD control module ● Wiring harness ● MSS ● Gearmotor encoder assembly ● Connector(s) ● Circuitry

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

4. If the cause is not visually evident, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:

- check that the program card is correctly installed.
- check the connections to the vehicle.
- check the ignition switch position.

5. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool operating manual.

6. Carry out the DATA LINK DIAGNOSTICS test. If the diagnostic tool responds with:

- CKT930, CKT914, CKT 915 and CKT70= ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
- NO RESP/NOT EQUIP for 4WD control module, go to Pinpoint Test B.
- SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out the 4WD control module self-test.

7. If the DTCs retrieved are related to the concern, go to the 4WD Control Module Diagnostic Trouble Code (DTC) Index to continue diagnostics.

4WD Control Module Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1317	Battery Voltage High	4WD	Go To Pinpoint Test B .

		control module	
B1318	Battery Voltage Low	4WD control module	Go To Pinpoint Test B .
B1342	ECU is Defective	4WD control module	CLEAR the DTCs. REPEAT the 4WD control module self-test. If DTC B1342 is retrieved, INSTALL a new 4WD control module. REFER to Four-Wheel Drive (4WD) Control Module in this section. CLEAR the DTCs. REPEAT the self-test.
B2105	Throttle Position Input Out of Range Low	4WD control module	Go To Pinpoint Test A .
B2106	Throttle Position Input Out of Range High	4WD control module	Go To Pinpoint Test A .
C1728	Transfer Case Unable to Transition Between 2H and 4H.	4WD control module	Go To Pinpoint Test C .
C1729	Transfer Case Unable to Transition Between 4WD HIGH and 4WD LOW	4WD control module	Go To Pinpoint Test C .
C1979	IWE Solenoid Circuit Failure	4WD control module	Go To Pinpoint Test A .
C1980	IWE Solenoid Short to Battery	4WD control module	Go To Pinpoint Test A .
P1812	Transmission 4-Wheel Drive Mode Select Circuit Failure	4WD control module	Go To Pinpoint Test A .
P1815	Transmission 4-Wheel Drive Mode Select Short Circuit to Ground	4WD control module	Go To Pinpoint Test A .
P1824	Transmission 4-Wheel Drive Clutch Relay Circuit Failure	4WD control module	Go To Pinpoint Test A .
P1826	Transmission 4-Wheel Drive Low Clutch Relay Short Circuit to Battery	4WD control module	Go To Pinpoint Test A .
P1827	Transmission 4-Wheel Drive Low Clutch Relay Short Circuit to Ground	4WD control module	Go To Pinpoint Test A .
P1849	Transmission Transfer Case Contact Plate A Short Circuit to Ground	4WD control module	Go To Pinpoint Test C .
P1853	Transmission Transfer Case Contact Plate B Short Circuit to Ground	4WD control module	Go To Pinpoint Test C .
P1857	Transmission Transfer Case Contact Plate C Short Circuit to Ground	4WD control module	Go To Pinpoint Test C .
P1861	Transmission Transfer Case Contact Plate D	4WD control	Go To Pinpoint Test C .

	Short Circuit to Ground	module	
P1867	Transmission Transfer Case Contact Plate General Circuit Failure	4WD control module	Go To Pinpoint Test C .
P1874	Transmission Automatic Hall Effect Sensor Power Circuit Failure	4WD control module	Go To Pinpoint Test A .
P1875	Transmission Automatic Hall Effect Sensor Power Circuit Short to Battery	4WD control module	Go To Pinpoint Test A .
P1891	Transmission Transfer Case Contact Plate Ground Return Open Circuit	4WD control module	Go To Pinpoint Test C .
U1900	CAN Communication BUS Fault	4WD control module	Section 418-00 .
U1950	UBP Communication BUS Fault	4WD control module	Section 418-00 .
U2023	External Node Fault	4WD control module	Section 418-00 .
U2306	Invalid UBP Data From Instrument Cluster (Node 60)	4WD control module	Section 418-00 .
U2226	Invalid UBP Data From PCM (Node 10)	4WD control module	Section 418-00 .
—	For All Other DTCs	4WD control module	REFER to Section 419-10 .

Functional Test — Electronic Shift

PINPOINT TEST A: ELECTRONIC SHIFT FUNCTIONAL TEST

Test Step	Result / Action to Take
CAUTION: The function test must be carried out on a hard surface in a vacant area without traffic.	
A1 CHECK FOR 2WD INDICATED ● Make sure the hublocks are in the AUTO position. ● Start the vehicle and allow to idle. ● Apply the brake pedal and hold. ● For automatic transmission, shift to NEUTRAL. ● Turn the mode select switch (MSS) to 2WD while holding the	**Yes** GO to A3 . **No** GO to A2 .

shift conditions. ● Observe the 4X4 and 4X4 LOW indicators. ● **Are both indicators off?**	
A2 CHECK FOR THE PRESENCE OF 4X4	**Yes** RETRIEVE 4WD Control Module self-test DTCs. If a self-test DTC related to the concern is retrieved, REFER to the 4WD Control Module Diagnostic Trouble Code (DTC) Index in this section. If no DTC is retrieved, REFER to Section 308-07B and REPAIR the transfer case as necessary. **No** If the 4X4 indicator is ON, Go To Pinpoint Test E. If the 4X4 indicator is OFF, GO to A3.
● **CAUTION: Make sure there is a clear area behind the vehicle before backing up.** ● Shift the transmission to REVERSE and back the vehicle up 3 meters (10 feet) to relieve driveline wind-up. ● Drive the vehicle forward for 3 meters (10 feet) and stop. ● Press the brake pedal and hold. ● For automatic transmission, shift to NEUTRAL. ● Execute tight turns on a hard surface. ● Check for the presence of driveline wind-up and tire scuff. ● **Is driveline wind-up and tire scuff present?**	
A3 CHECK INDICATOR PROVE-OUT	**Yes** GO to A4. **No** REPAIR the instrument cluster as necessary. REFER to Section 413-01.
● Key in OFF position. ● turn the ignition switch to start and observe the 4X4 and 4X4 LOW indicators for prove-out. ● **Did the indicators prove out?**	
A4 VERIFY SHIFT TO 4X4	**Yes** GO to A6. **No** GO to A5.
● Turn the MSS to 4X4. ● Listen for relay clicks and gearmotor operation. ● Wait for 20 seconds after the MSS is turned to 4X4. ● **Is the 4X4 indicator ON?**	
A5 ATTEMPT MECHANICAL ASSIST ENGAGEMENT	**Yes** GO to A6. **No** RETRIEVE the 4WD control module self-test DTCs. If a self-test DTC related to the concern is retrieved, REFER to the 4WD Control Module Diagnostic Trouble Code (DTC) Index in this section. If no DTC related to the concern is retrieved, Go To Pinpoint Test D.
● Drive the vehicle above 8 kmh (5 mph) for at least 20 seconds. ● Stop the vehicle. ● Observe the 4X4 indicator. ● **Is the 4X4 indicator on?**	
A6 CHECK FOR MECHANICAL ENGAGEMENT OF 4X4	**Yes** GO to A9. **No** 4X4 did not mechanically engage. RETRIEVE 4WD
● Drive the vehicle for two minutes above 16 kmh (10 mph). ● Execute tight turns on a hard surface. ● Check for the presence of	

driveline wind-up and tire scuff. ● **Is driveline wind-up and tire scuff present?**	control module self-test DTCs. If a self-test DTC related to the concern is retrieved, REFER to the 4WD Control Module Diagnostic Trouble Code (DTC) Index in this section. If no DTC related to the concern is retrieved, GO to A7 .
A7 CHECK FOR FRONT AXLE ENGAGEMENT ● Raise and support the front tires off the ground until they can be spun freely. Refer to Section 100-02 . ● Rotate the left front tire one revolution forward and one revolution backward while observing the left front axle shaft and universal joint. ● Rotate the right front tire one revolution forward and one revolution backward while observing the right front axle shaft and universal joint. ● **Did both front axle shafts rotate?**	**Yes** GO to A8 . **No** Go To Pinpoint Test E .
A8 CHECK FOR FRONT AXLE/DIFFERENTIAL ENGAGEMENT ● Rotate the front driveshaft. ● **Does either front axle shaft turn?**	**Yes** Go To Pinpoint Test B . **No** REPAIR the front differential or axle as necessary. REFER to Section 205-03 .
A9 CHECK FOR CORRECT INDICATOR OPERATION ON 4X4 LOW ENGAGEMENT ● While driving the vehicle forward above 8 kmh (5 mph), turn the MSS to 4X4 LOW while observing the indicators for five seconds. ● Shift the MSS to 4X4. ● Stop the vehicle and apply the parking brake. ● For automatic transmission, shift the transmission to PARK and release the brake pedal. ● **Did the 4X4 LOW indicator stay off?**	**Yes** GO to A10 . **No** RETRIEVE 4WD control module self-test DTCs. If a self-test DTC related to the concern is retrieved, REFER to the 4WD Control Module Diagnostic Trouble Code (DTC) Index in this section. If no DTC related to the concern is retrieved, refer to Section 413-01 .
A10 CHECK THE 4X4 LOW INDICATOR ON IN ERROR ● Turn the MSS to 4X4 LOW. ● Apply and hold the brake pedal. ● **Is the 4X4 LOW indicator OFF?**	**Yes** GO to A11 . **No** RETRIEVE 4WD control module self-test DTCs. If a self-test DTC related to the concern is retrieved, REFER to the 4WD Control Module Diagnostic Trouble Code (DTC) Index in this section. If no DTC related to the concern is retrieved, refer to Section 413-01 .

A11 CHECK THE 4X4 LOW INDICATOR FOR ON IN 4X4 LOW • For automatic transmission, shift the transmission to NEUTRAL. • Listen for relay clicks and gearmotor operation. • Hold the shift conditions for 20 seconds. • **Is the 4X4 LOW indicator ON?**	**Yes** GO to A13 . **No** GO to A12 .
A12 ATTEMPT MECHANICAL ASSIST OF 4X4 LOW ENGAGEMENT •  **CAUTION: Make sure there is a clear area behind the vehicle before backing up.** • Shift the transmission to REVERSE and back the vehicle up 3 meters (10 feet) to relieve driveline wind-up and stop. • Drive the vehicle forward for 3 meters (10 feet) and stop. • Apply the brake pedal and hold. • For automatic transmission, shift to NEUTRAL. • Observe the 4X4 LOW indicator. • **Is the 4X4 LOW indicator ON?**	**Yes** GO to A13 . **No** RETRIEVE 4WD control module self-test DTCs. If a self-test DTC related to the concern is retrieved, REFER to the 4WD Control Module Diagnostic Trouble Code (DTC) Index in this section. If no DTC related to the concern is retrieved, Go To Pinpoint Test D .
A13 CHECK FOR MECHANICAL ENGAGEMENT OF 4X4 LOW • **NOTE:** Driveline wind-up and tire scuff is present in both 4X4 and 4X4 LOW. However, vehicle speed is severely limited in 4X4 LOW. • Execute tight turns on a hard surface. • Check for the presence of driveline wind-up, tire scuff and reduced vehicle speed. • **Is driveline eind-up, tire scuff and reduced speed present?**	**Yes** GO to A14 . **No** 4X4 LOW did not mechanically engage. RETRIEVE 4WD control module self-test DTCs. If self-test DTC related to the concern is retrieved, REFER to the 4WD Control Module Diagnostic Trouble Code (DTC) Index in this section. If no DTC related to the concern is retrieved, Go To Pinpoint Test D .
A14 CHECK FOR CORRECT INDICATOR OPERATION ON 4X4 LOW DISENGAGEMENT • While driving the vehicle forward above 8 km/h (5 mph), turn the MSS to 4X4 while observing the indicators. • Turn the MSS to 4X4 LOW. • Stop the vehicle and apply the parking brake. • For automatic transmission, shift to PARK and release the brake pedal. • **Is the 4X4 LOW indicator ON?**	**Yes** GO to A15 . **No** RETRIEVE 4WD control module self-test DTCs. If a self-test DTC related to the concern is retrieved, REFER to the 4WD Control Module Diagnostic Trouble Code (DTC) Index in this section. If no DTC related to the concern is retrieved, Go To Pinpoint Test D .
A15 CHECK THE 4X4 LOW INDICATOR • Turn the MSS to 4X4. • Apply and hold the brake pedal.	**Yes** GO to A16 .

• **Is the 4X4 Low indicator ON?**	**No** RETRIEVE 4WD control module self-test DTCs. If a self-test DTC related to the concern is retrieved, REFER to the 4WD Control Module Diagnostic Trouble Code (DTC) Index in this section. If no DTC related to the concern is retrieved, REFER to Section 413-01 .
A16 CHECK FOR 4X4 LOW INDICATOR OFF IN 4X4 • Press and hold the brake pedal. • For automatic transmission, shift the transmission to NEUTRAL. • Listen for relay clicks and gearmotor operation. • Hold the shift conditions for 20 seconds. (The system will use up to five cycles of shift attempts trying to engage 4X4.) • **Is the 4X4 LOW indicator OFF?**	**Yes** GO to A18 . **No** GO to A17 .
A17 ATTEMPT MECHANICAL ASSIST OF 4X4 LOW DISENGAGEMENT • Drive the vehicle forward above 8 kmh (5 mph) for at least five seconds. • Stop the vehicle. • Apply the brake pedal and hold. • For automatic transmission, shift to NUETRAL. • Observe the 4X4 LOW indicator. • **Is the 4X4 LOW indicator OFF?**	**Yes** GO to A18 . **No** RETRIEVE 4WD control module self-test DTCs. If a self-test DTC related to the concern is retrieved, REFER to the 4WD Control Module Diagnostic Trouble Code (DTC) Index in this section. If no DTC related to the concern is retrieved, REFER to Section 413-01 .
A18 CHECK FOR MECHANICAL 4X4 LOW DISENGAGEMENT AND 4X4 ENGAGEMENT • Apply the brake. • **CAUTION: Make sure there is a clear area behind the vehicle before backing up.** • Shift the transmission to REVERSE and back the vehicle up 3 meters (10 feet) to relieve driveline wind-up. • Stop the vehicle. • Drive the vehicle forward and execute tight turns on a hard surface. • **NOTE:** Driveline wind-up and tire scuff are present in both 4X4 and 4X4 LOW. However, vehicle speed is severely limited in 4X4 LOW. • Verify the presence of driveline wind-up and tire scuff. Also verify the increased vehicle speed from when 4X4 LOW was engaged. • **Did 4X4 engage and the vehicle speed increase?**	**Yes** GO to A19 . **No** 4X4 LOW is mechanically bound or locked. REPAIR the transfer case as necessary. REFER to Section 308-07B .

A19 CHECK THE 4X4 TO 2WD SHIFT • Stop the vehicle. • Turn the MSS to 2WD and wait 20 seconds. • Listen for relay clicks and gearmotor operation. • **Are the 4X4 and 4X4 LOW indicators OFF?**	**Yes** GO to A21 . **No** GO to A20 .
A20 ATTEMPT MECHANICAL ASSIST OF 4X4 DISENGAGEMENT • Drive the vehicle forward above 8 kmh (5 mph) for at least 20 seconds. • Stop the vehicle. • Observe the 4X4 and 4X4 LOW indicators. • **Are the 4X4 and 4X4 LOW indicators OFF?**	**Yes** GO to A21 . **No** RETRIEVE 4WD control module self-test DTCs. If a self-test DTC related to the concern is retrieved, REFER to the 4WD Control Module Diagnostic Trouble Code (DTC) Index in this section. If no DTC related to the concern is retrieved, GO to A22 .
A21 VERIFY THE HUBLOCKS DISENGAGE • Raise and support the front tires off the ground until they can be spun freely. Refer to Section 100-02 . • Rotate the left front tire one revolution forward and one revolution backward, while observing the left front axle shaft and universal joint. • Rotate the right front tire one revolution forward and one revolution backward, while observing the right front axle shaft and universal joint. • **Did either axle shaft rotate?**	**Yes** Go To Pinpoint Test E . **No** GO to A22 .
A22 VERIFY THE TRANSFER CASE MECHANICALLY DISENGAGED • Apply the parking brake. • Rotate the front driveshaft. • **Does the front driveshaft turn?**	**Yes** GO to A23 . **No** The transfer case did not disengage from 4X4. REPAIR the transfer case as necessary. REFER to Section 308-07B .
A23 VERIFY THE HUBLOCKS WILL LOCK MANUALLY • Turn the MSS to 4X4. • Rotate the left front tire one revolution forward and one revolution backward while observing the left front axle shaft and universal joint. • Rotate the right front tire one revolution forward and one revolution backward while observing the right front axle shaft and universal joint.	**Yes** GO to A24 . **No** Go To Pinpoint Test E .

• **Do both axles rotate?**	
A24 VERIFY THE HUBLOCKS WILL UNLOCK MANUALLY • Turn the MSS to 2WD. • Rotate the left front tire one revolution forward and one revolution backward while observing the left front axle shaft and universal joint. • Rotate the right front tire one revolution forward and one revolution backward while observing the right front axle shaft and universal joint. • **Does either axle rotate?**	**Yes** INSTALL a new hublock. REFER to Hublock in this section. **No** The transfer case is operating correctly. INSTRUCT the customer on correct system operation.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• The vehicle does not operate correctly in A4WD and 4WD HIGH modes	• Central junction box (CJB) fuses: ■ 11 (10A). ■ 115 (30A). ■ 20 (30A). • Mode select switch (MSS). • Transfer case shaft speed sensors. • Transfer case electric clutch. • 4WD control module. • Powertrain control module (PCM). • IVD. • IWE solenoid. • Circuitry.	• Go To Pinpoint Test B .
• No communication with the 4WD control module	• Central junction box (CJB) fuses: ■ 115 (30A). ■ 20 (30A). • 4WD control module. • 4WD control module connectors. • Circuitry.	• Go To Pinpoint Test C .
• The vehicle does not shift between 4X4AUTO/4WD HIGH and 4WD LOW modes correctly	• Central junction box (CJB) fuses: ■ 11 (10A). ■ 115 (30A). ■ 20 (30A). • Mode select switch (MSS). • Gearmotor encoder contact plate A, B, C, or D. • Gearmotor encoder assembly. • Circuitry.	• Go To Pinpoint Test D .

	• 4WD control module. • Transfer case internal mechanism. • Transfer case shift motor. • Digital TR sensor. • BPP switch. • IVD. • IWE solenoid. • 4WABS control module. • Instrument cluster. • PCM.	

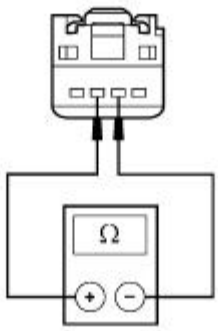
Pinpoint Tests

PINPOINT TEST B: THE VEHICLE DOES NOT OPERATE CORRECTLY IN A4WD AND 4WD HIGH MODES

Test Step	Result / Action to Take
B1 CHECK INDICATOR PROVE-OUT	
• Key in OFF position. • Start the vehicle while observing the 4WD indicators for prove out. • **Did indicators prove out?**	**Yes** GO to B3 . **No** GO to B2 .
B2 CHECK FOUR-WHEEL DRIVE (4WD) CONTROL MODULE COMMUNICATION	
• Key in ON position. • Connect the diagnostic tool. • Retrieve the 4WD control module self-test DTCs. • **Did the 4WD control module respond?**	**Yes** REPAIR the instrument cluster as necessary. REFER to Section 413-01 . **No** Go To Pinpoint Test C .
B3 CHECK FOR A4WD SYSTEM ERROR	
• Turn the vehicle off and restart the vehicle. • **Is the 4WD HIGH indicator flashing several times?**	**Yes** GO to B13 . **No** GO to B4 .
B4 CHECK FOR THE PRESENCE OF 4WD	
• Select 4 HIGH on the mode select switch (MSS). • Execute tight turns on a hard surface. • Check for the presence of driveline windup and tire scuff. • **Are driveline windup and tire scuff present with 4X4 HIGH indicator on?**	**Yes** GO to B5 . **No** GO to B21 .
B5 REVIEW THE FOUR-WHEEL DRIVE (4WD) CONTROL DIAGNOSTIC TROUBLE CODES	
• CARRY OUT the 4WD control module self-test. • **Are any DTCs retrieved?**	**Yes** If DTC B1317 or B1318 is retrieved,

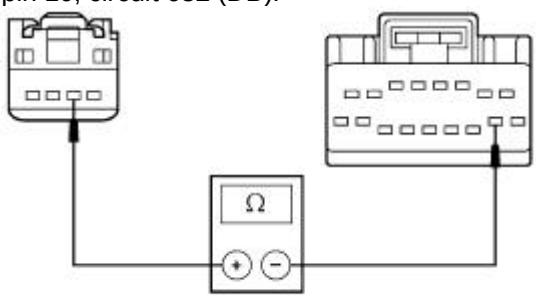
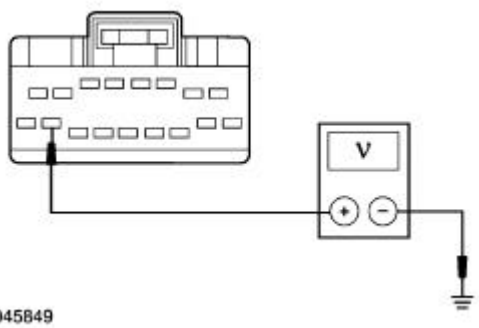
	Go To Pinpoint Test C . If DTC C1728, C1729, P1849, P1853, P1857, P1861, P1867 or P1891 is retrieved, Go To Pinpoint Test D . If DTC B2105 or B2106 or both are retrieved,GO to B19 . If DTC C1979 or C1980 or both is retreived, GO to B22 . If DTC P1824, P1826 or P1827 is retrieved, GO to B14 . **No** GO to B6 .
B6 CHECK THE 4WD MODE SELECT SWITCH IN THE 2WD POSITION (MONITOR THE PID 4WD_SW) ● Monitor the PID 4WD_SW. ● Select 2WD on the 4WD MSS. ● **Does the PID 4WD_SW indicate 2WD?**	**Yes** GO to B7 . **No** GO to B10 .
B7 CHECK THE 4WD MODE SELECT SWITCH IN THE A4WD POSITION (MONITOR THE PID 4WD_SW) ● Monitor the PID 4WD_SW. ● Select A4WD on the 4WD MSS. ● **Does the PID 4WD_SW indicate A4WD?**	**Yes** GO to B8 . **No** GO to B10 .
B8 CHECK THE 4WD MODE SELECT SWITCH IN THE 4WD HIGH POSITION (MONITOR THE PID 4WD_SW) ● Monitor the PID 4WD_SW. ● Select 4WD HIGH on the 4WD MSS. ● **Does the PID 4WD_SW indicate 4WD HIGH?**	**Yes** GO to B9 . **No** GO to B10 .
B9 CHECK THE 4WD MODE SELECT SWITCH IN THE 4WD LOW POSITION (MONITOR THE PID 4WD_SW) ● Monitor the PID 4WD_SW. ● Select 4WD LOW on the 4WD MSS. ● **Does the PID 4WD_SW indicate 4WD LOW?**	**Yes** GO to B12 . **No** GO to B10 .
B10 CHECK THE MODE SELECT (MSS) SWITCH ● Key in OFF position. ● Disconnect: Mode Select Switch (MSS) C284. ● Rotate the MSS to the A4WD, 4H, and 4L positions. ● Measure the resistance between MSS terminals 2 and 3 while rotating the switch through all positions; refer to the following chart. **Mode Select Switch (MSS) Position** / **Resistance Range** A4WD / 264.33 - 269.67 4WD HIGH / 128.7 - 131.3 4WD LOW / 61.38 - 62.62	**Yes** GO to B11 . **No** INSTALL a new MSS. CLEAR the DTCs. TEST the system for normal operation.

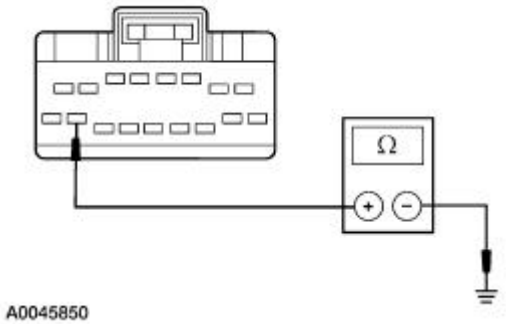
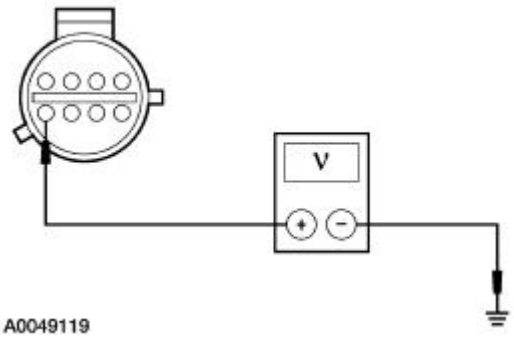
2WD HIGH	616.9 - 623.1

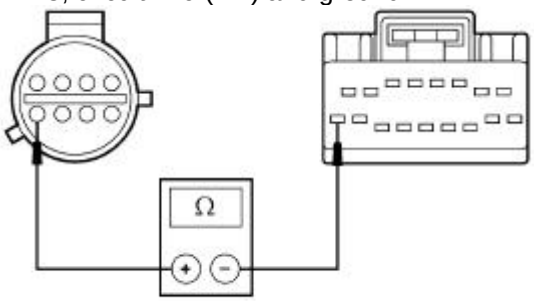
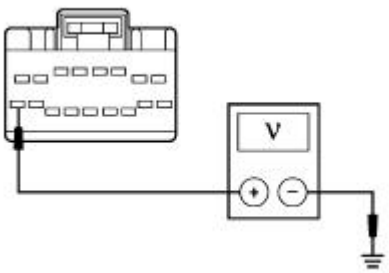
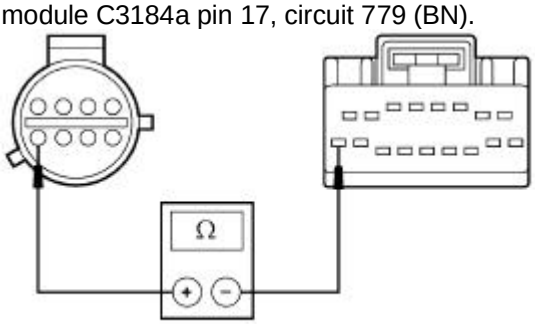


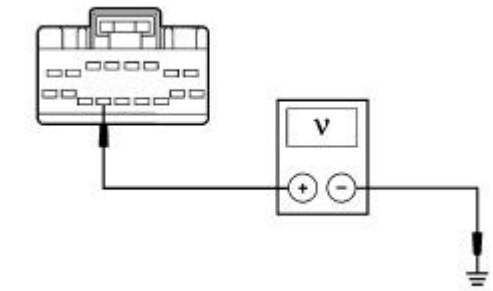
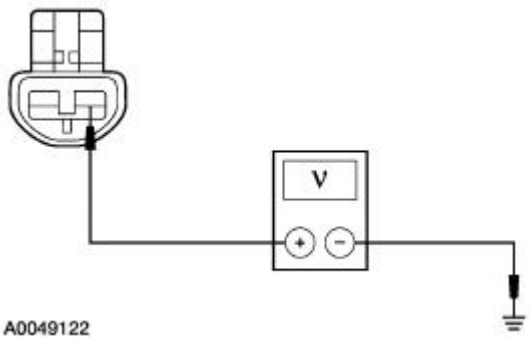
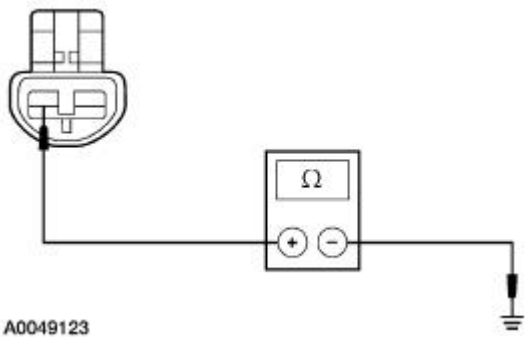
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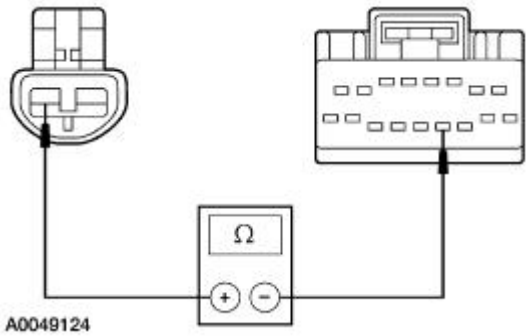
- **Are the resistances within specification?**

B11 CHECK CIRCUIT 682 (DB) FOR AN OPEN	
• Key in OFF position. • Disconnect: Mode Select Switch C284. • Disconnect: 4WD Module C3184b. • Measure the resistance between MSS C284 pin 2, circuit 682 (DB) and 4WD control module C4184b pin 10, circuit 682 (DB).  A0049118 • **Is the resistance less than 5 ohms?**	**Yes** GO to B12 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
B12 CHECK CIRCUIT 780 (DB) FOR A SHORT TO VOLTAGE	
• Key in ON position. • Measure the voltage between 4WD control module C3184b, pin 16, circuit 780 (DB) and ground.  A0045849 • **Is any voltage present?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. **No** GO to B13 .
B13 CHECK CIRCUIT 780 (DB) FOR A SHORT TO GROUND	
• Key in OFF position. • Measure the resistance between 4WD control module C3184b, pin 16, circuit 780 (DB) and ground.	**Yes** GO to B14 . **No**

 A0045850 ● **Is the resistance greater than 10,000 ohms?**	REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
B14 CHECK THE ELECTRIC CLUTCH—ENERGIZED ● Connect: 4WD Control Module C3184a. ● Connect: 4WD Control Module C3184b. ● Key in ON position. ● Select NEUTRAL. ● Select 4WD HIGH on the MSS. ● Raise and support the vehicle; refer to Section 100-02 . ● Connect the diagnostic tool. ● Trigger the electric clutch control output command (CLUTCHSOL). Set the command to 100 percent. ● Rotate the front driveshaft. ● **Does the front driveshaft lock to the rear?**	**Yes** GO to B15 . **No** GO to B16 .
B15 CHECK THE ELECTRIC CLUTCH—NOT ENERGIZED ● Connect the diagnostic tool. ● Trigger the electric clutch control output command (CLUTCHSOL). Set the command to zero percent. ● Rotate the front driveshaft. ● **Does the front driveshaft lock to the rear?**	**Yes** GO to B17 . **No** GO to Section 206-09.
B16 CHECK THE VOLTAGE TO THE ELECTRIC CLUTCH— ENERGIZED ● Key in OFF position. ● Disconnect: Transfer Case C350. ● Key in ON position. ● Trigger the electric clutch control output command (CLUTCHSOL). Set the command to 100 percent. ● Measure the voltage between transfer case C350 pin 8, circuit 779 (BN) and ground.  A0049119 ● **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new electric clutch. REFER to Section 308-07B . CLEAR the DTCs. TEST the system for normal operation. **No** GO to B19 .
B17 CHECK THE VOLTAGE TO THE ELECTRIC CLUTCH—NOT ENERGIZED ● Key in OFF position. ● Disconnect: Transfer Case C350.	**Yes** INSTALL a new electric clutch.

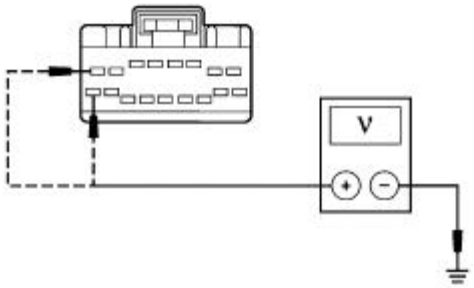
• Key in ON position. • Measure the voltage between transfer case C350 Pin 8, circuit 779 (BN) and ground.  A0049120 • **Is the voltage zero volts?**	REFER to Section 308-07B . CLEAR the DTCs. TEST the system for normal operation. **No** GO to B18 .
B18 CHECK CIRCUIT 779 (BN) FOR SHORT TO VOLTAGE	
• Key in OFF position. • Disconnect: 4WD Control Module C3184a. • Key in ON position. • Measure the voltage between 4WD control module C3184a pin 17, circuit 779 (BN), harness side and ground.  A0045851 • **Is any voltage present?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. **No** GO to B19 .
B19 CHECK CIRCUIT 779 (BN) FOR AN OPEN	
• Key in OFF position. • Measure the resistance between transfer case C350 pin 8, circuit 779 (BN) and 4WD control module C3184a pin 17, circuit 779 (BN).  A0049120 • **Is the resistance less than 5 ohms?**	**Yes** GO to B20 . **No** REPAIR the circuit. CLEAR the DTCs. TEST the system for normal operation.
B20 CHECK THE THROTTLE POSITION INPUT—MONITOR THE 4WD PID TPI	
• Key in ON position. • Monitor the PID: TPI while pressing and releasing the accelerator pedal. • **Does the PID: TPI increase when the**	**Yes** DISCONNECT 4WD control module connector C3184b and the PCM connector C1752. INSPECT circuit

accelerator pedal is pressed and decrease when the accelerator pedal is released?	1498 (PK/OG) for signs of corrosion or damage. If OK, RECONNECT the connectors making sure they seat correctly. CLEAR the DTCs. TEST the system for normal operation. **No** GO to B21 .
B21 CHECK CIRCUIT 1498 (PK/OG) FOR A SHORT TO VOLTAGE ● Key in ON position. ● Measure the voltage between 4WD control module C3184b pin 14, circuit 1498 (PK/OG), harness side and ground.  A0045859 ● **Is any voltage indicated?**	**Yes** REPAIR the circuit. CLEAR the DTCs. TEST the system for normal operation. **No** REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
B22 CHECK CIRCUIT 474 (OG/LG) FOR OPEN ● Disconnect: IWE Solenoid C1157. ● Measure the voltage between IWE solenoid C1157 pin 1, circuit 474 (OG/LG) and ground.  A0049122 ● **Is the voltage greater than 10 volts?**	**Yes** GO to B23 . **No** REPAIR the circuit. CLEAR the DTCs. TEST the system for normal operation.
B23 CHECK CIRCUIT 605 (RD) FOR SHORT TO GROUND ● Measure the resistance between IWE solenoid C1157 pin 2, circuit 605 (RD) and ground.  A0049123 ● **Is the resistance greater than 10,000 ohms?**	**Yes** GO to B24 . **No** REPAIR the circuit. CLEAR the DTCs. TEST the system for normal operation.

B24 CHECK CIRCUIT 605 (RD) FOR OPEN	
• Disconnect: 4WD Control Module C3184b. • Measure the resistance between IWE solenoid C1157 pin 2, circuit 605 (RD) and 4WD control module C3184b pin 12, circuit 605 (RD).  • **Is the resistance less than 5 ohms?**	**Yes** GO to B25 . **No** REPAIR the circuit. CLEAR the DTCs. TEST the system for normal operation.
B25 CHECK IWE SOLENOID	
• Carry out the IWE solenoid component test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. • **Did the IWE solenoid pass the component tests?**	**Yes** GO to B26 . **No** INSTALL a new IWE solenoid. CLEAR the DTCs. TEST the system for normal operation.
B26 CHECK FOR CORRECT 4WD CONTROL MODULE OPERATION	
• Disconnect all 4WD control module connectors. • Check for: ◦ corrosion ◦ pushed-out pins • Connect all 4WD control module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new 4WD control module. CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

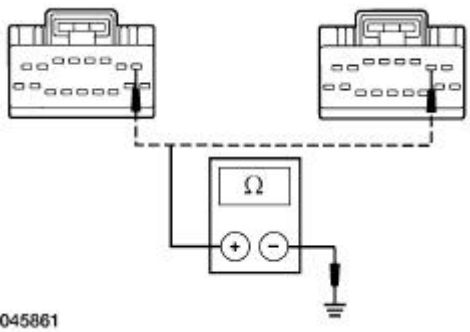
PINPOINT TEST C: NO COMMUNICATION WITH THE FOUR-WHEEL DRIVE (4WD) CONTROL MODULE

Test Step	Result / Action to Take
C1 CHECK POWER TO 4WD CONTROL MODULE	
• Key in OFF position. • Disconnect: 4WD Control Module C3184b. • Key in ON position. • Measure the voltage between 4WD control module and ground. Refer to the following chart: **4WD Control Module Pin** / **Circuit** C3184b pin 8 / 1524 (DB) C3184b pin 17 / 704 (DG/LG)	**Yes** GO to C2 . **No** REPAIR the circuit(s) in question. TEST the system for normal operation.



A0045860

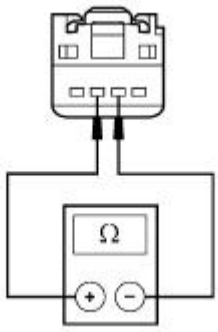
- **Are all of the voltage measurements greater than 10 volts?**

C2 CHECK 4WD CONTROL MODULE GROUND CIRCUITS	
• Key in OFF position. • Disconnect: 4WD Control Module C3184a. • Disconnect: 4WD Control Module C3184b. • Measure the resistance between 4WD control module C3184a, pin 1, circuit 57 (BK), harness side and ground; and between 4WD control module C3184b, pin 2, circuit 875 (BK/LB), harness side and ground.  A0045861 • **Are both resistance less than 5 ohms?**	**Yes** GO to C3 . **No** REPAIR the circuit. TEST the system for normal operation.
C3 CHECK FOR CORRECT 4WD CONTROL MODULE OPERATION	
• Disconnect all 4WD control module connectors (C3184a and C3184b), and the transfer case connector (C350). • Check for: • corrosion • pushed-out pins • Connect all 4WD control module connectors and the transfer case connector and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new 4WD control module. CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST D: THE VEHICLE DOES NOT SHIFT BETWEEN AUTO/4WD HIGH AND 4WD LOW MODES CORRECTLY

Test Step	Result / Action to Take

D1 REVIEW THE FOUR-WHEEL DRIVE (4WD) CONTROL DIAGNOSTIC TROUBLE CODES	
• Connect the diagnostic tool. • CARRY OUT the 4WD control module self-test. • **Are any DTCs retrieved?**	**Yes** If DTC B2105, B2106, C1979 or C1980 are retrieved, Go To Pinpoint Test B. IF DTC U1900, U1950, U2023, U2306 or U2226 is retrieved, REFER to Section 418-00. For all other DTCs, GO to D2. **No** GO to D2.
D2 CHECK THE DIGITAL TRANSMISSION RANGE (TR) SENSOR	
• CARRY OUT the instrument cluster module self-test. • **Are any DTCs retrieved?**	**Yes** Section 413-01. **No** GO to D3.
D3 CHECK BRAKE PEDAL SWITCH PID	
• Monitor the ABS module brake input switch status PID. • Step on the brake pedal. • **Does the brake input switch status PID indicate active?**	**Yes** GO to D4. **No** REFER to Section 206-09.
D4 CHECK WHEEL SPEED SENSOR INPUTS	
• Monitor the ABS module wheel speed sensor inputs. • **Do the wheel speed sensor inputs indicate 0 kph (0 mph)?**	**Yes** GO to D5. **No** REFER to Section 206-09.
D5 CHECK THE MODE SELECT SWITCH (MSS)—MONITOR THE 4WD CONTROL MODULE PID 4WD_SW	
• Key in ON position. • Monitor the 4WD control module PID: 4WD_SW while selecting each of the positions on the mode select switch (MSS). • **Do the 4WD control module PID values agree with the MSS positions?**	**Yes** GO to D7. **No** GO to D6.
D6 CHECK THE MSS — ALL POSITIONS	
• Disconnect: MSS C284. • Measure the resistance between MSS terminals 2 and 3 while rotating the switch through all positions. Refer to the following chart: **MSS Position** / **Resistance** A4WD: 264.33 - 269.67 4WD HIGH: 128.7 - 131.3 4WD LOW: 61.38 - 62.62 2WD HIGH: 616.9 - 623.1	**Yes** GO to D7. **No** INSTALL a new MSS. REFER to Mode Select Switch (MSS) in this section. CLEAR the DTCs. REPEAT the self-test.



- **Are all the resistances within the specified values?**

D7 CHECK FOR CORRECT 4WD CONTROL MODULE OPERATION

- Key in OFF position.
- Disconnect both 4WD control module connectors (C3184a and C3184b) and the transfer case connector (C350).
- Check for:
  - corrosion
  - pushed-out pins
- Connect both 4WD control module connectors (C3184a and C3184b) and the transfer case connector (C350), making sure they seat correctly.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**

Yes
GO to D8 .

No
The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

D8 CHECK THE CONTACT PLATE ENCODER SWITCH

- Place the transmission range selector lever in NEUTRAL (for manual transmission, press and hold the clutch pedal).
- Press and hold the brake pedal.
- Monitor mode select switch (MSS) PID.
- Monitor the contact plate PIDs: PLATE_A, PLATE_B, PLATE _C and PLATE_D.
- **NOTE:** The contact plate PIDs can only be read for approximately two seconds. To continue reading, cycle the MSS again.
- Cycle the MSS to A4WD and 4WD LOW two times.
- Compare the contact plate PID values for each shift position selected by the MSS. Refer to the following chart:

Plate PID	MSS PID A4WD	MSS PID 4WD LOW
PLATE_A	CLOSED	OPEN
PLATE_B	OPEN	CLOSED
PLATE_C	CLOSED	OPEN
PLATE_D	CLOSED	CLOSED

- **Do the contact plate PID values agree with the MSS PIDs?**

Yes
GO to D15 .

No
GO to D9 .

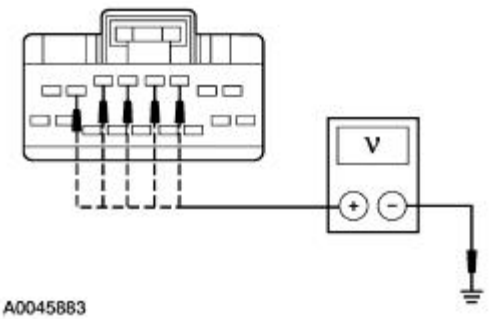
D9 CHECK CIRCUIT 762 (YE/WH), CIRCUIT 763 (OG/WH), CIRCUIT 764 (BN/WH), CIRCUIT 770 (WH), AND CIRCUIT 771 (VT/YE) FOR A SHORT TO VOLTAGE

- Key in OFF position.
- Disconnect: 4WD Control Module C3184a.
- Key in ON position.
- Measure the voltage between the following circuits at the 4WD control module connector pins and ground:

Yes
REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the self-test.

No

Circuit	4WD Control Module Connector and Pins
762 (YE/WH)	C3184a pin 3
763 (OG/WH)	C3184a pin 4
764 (BN/WH)	C3184a pin 5
770 (WH)	C3184a pin 6
771 (VT/YE)	C3184a pin 7



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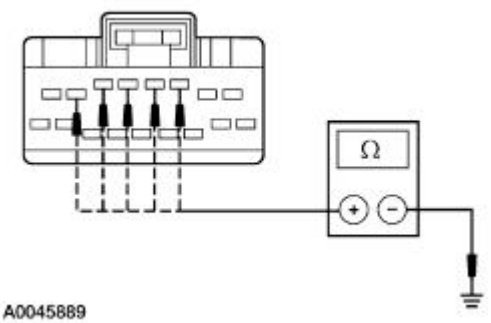
- **Is any voltage present?**

GO to D10 .

D10 CHECK CIRCUIT 762 (YE/WH), CIRCUIT 763 (OG/WH), CIRCUIT 764 (BN/WH), CIRCUIT 770 (WH), AND CIRCUIT 771 (VT/YE) FOR A SHORT TO GROUND

- Key in OFF position.
- Disconnect: Transfer Case C350.
- Measure the resistance between the following circuits at the 4WD control module connector pins and ground:

Circuit	4WD Control Module Connector and Pins
762 (YE/WH)	C3184a pin 3
763 (OG/WH)	C3184a pin 4
764 (BN/WH)	C3184a pin 5
770 (WH)	C3184a pin 6
771 (VT/YE)	C3184a pin 7



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- **Are the resistances all over 10,000 ohms?**

Yes
GO to D11 .

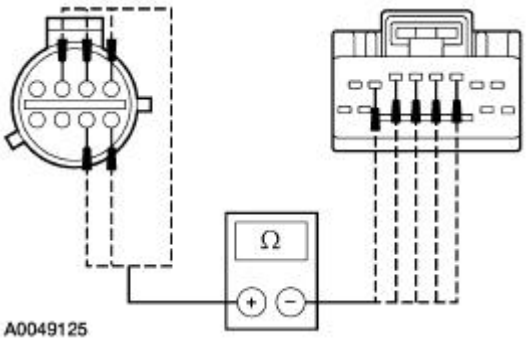
No
REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the self-test.

D11 CHECK CIRCUIT 762 (YE/WH), CIRCUIT 763 (OG/WH),

CIRCUIT 764 (BN/WH), CIRCUIT 770 (WH), AND CIRCUIT 771 (VT/YE) FOR AN OPEN

- Measure the resistance of the following circuits at the 4WD control module connector pins and transfer case connector pins shown.

Circuit	4WD Control Module Connector and Pins	Transfer Case Connector and Pins
762 (YE/WH)	C3184a pin 3	C350 pin 6
763 (OG/WH)	C3184a pin 4	C350 pin 3
764 (BN/WH)	C3184a pin 5	C350 pin 2
770 (WH)	C3184a pin 6	C350 pin 1
771 (VT/YE)	C3184a pin 7	C350 pin 5



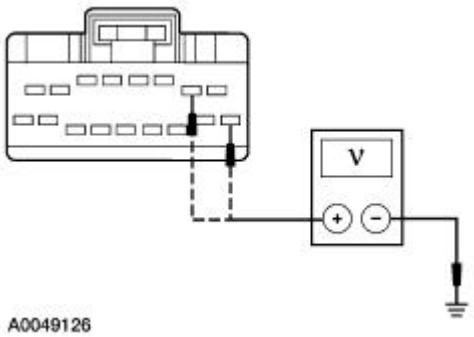
- **Are all the resistances less than 5 ohms?**

Yes
GO to D12 .

No
REPAIR the circuit or circuit (s) in question. CLEAR the DTCs. REPEAT the self-test.

D12 CHECK CIRCUIT 777 (YE) AND CIRCUIT 778 (OG) FOR A SHORT TO VOLTAGE

- Key in ON position.
- Measure the voltage between 4WD control module C3184a, pin 9, circuit 777 (YE), harness side and ground; and between 4WD control module C3184a, pin 2, circuit 778 (OG), harness side and ground.



- **Is any voltage present?**

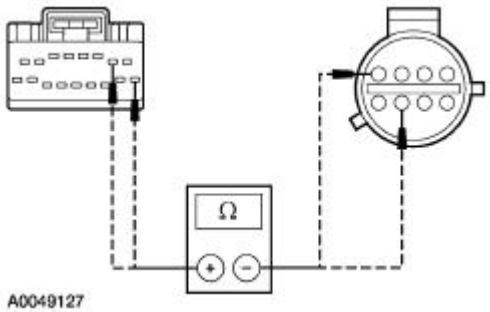
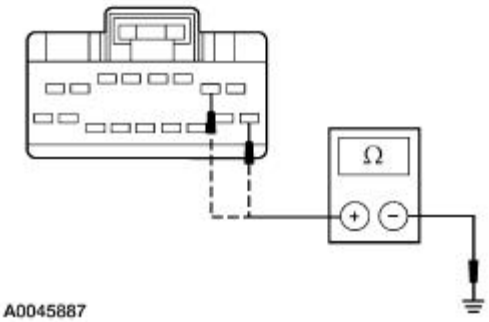
Yes
REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test.

No
GO to D13 .

D13 CHECK CIRCUIT 777 (YE) AND CIRCUIT 778 (OG) FOR AN OPEN

- Measure the resistance between 4WD control module C3184a, pin 9, circuit 777 (YE), harness side and transfer case C350, pin 4, circuit 777 (YE), harness side; and

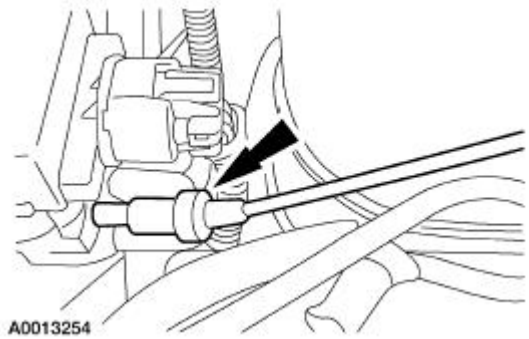
Yes
GO to D14 .

between 4WD control module C3184a, pin 2, circuit 778 (OG), harness side and transfer case C350, pin 7, circuit 778 (OG), harness side.  • **Are the resistances less than 5 ohms?**	**No** REPAIR the suspect circuit. CLEAR the DTCs. REPEAT the self-test.
D14 CHECK CIRCUIT 777 (YE) AND CIRCUIT 778 (OG) FOR A SHORT TO GROUND	
• Measure the resistance between 4WD control module C3184a, pin 9, circuit 777 (YE), harness side and ground; and between 4WD control module C3184a, pin 2, circuit 778 (OG), harness side and ground.  • **Are the resistances more than 10,000 ohms?**	**Yes** GO to D15 . **No** REPAIR the suspect circuit. CLEAR the DTCs. REPEAT the self-test.
D15 CHECK THE TRANSFER CASE	
• Key in OFF position. • Release the parking brake. • Using a wrench, manually shift the transfer case sector shaft to the full clockwise (AUTO) direction while turning the rear driveshaft. • Apply the parking brake. • Rotate the front driveshaft. • **Does the front driveshaft turn?**	**Yes** GO to D16 . **No** REPAIR the transfer case as necessary. REFER to Section 308-07B . TEST the system for normal operation.
D16 CHECK THE SECTOR SHAFT TURNING EFFORT	
NOTE: The transfer case has three detented shift positions. The full clockwise position is AUTO and the full counterclockwise position is 4WD LOW. Normal operation should not take more than 45 Nm (33 lb-ft) to manually shift the transfer case. • Release the parking brake. • Using a torque wrench, manually shift the transfer case sector shaft in a counterclockwise direction to the 4WD HIGH detent position while rotating the rear driveshaft. • **Did the torque required to shift exceed 45 Nm (33 lb-ft)?**	**Yes** REPAIR the transfer case as necessary. REFER to Section 308-07B . TEST the system for normal operation. **No** GO to D17 .
D17 CHECK THE TRANSFER CASE SHIFT TO 4WD HIGH AND 4WD LOW	
• Apply the parking brake. • Rotate the front driveshaft.	**Yes** REPAIR the transfer case

• **Does the front driveshaft rotate?**	as necessary. REFER to Section 308-07B . **No** INSTALL a new gearmotor encoder assembly. REFER to Gearmotor Encoder Assembly in this section. CLEAR the DTCs. REPEAT the self-test. If still inoperative, INSTALL a new 4WD control module. REFER to Four-Wheel Drive (4WD) Control Module in this section. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST E: THE FRONT AXLE DOES NOT ENGAGE CORRECTLY

Test Step	Result / Action to Take
E1 CHECK THE HUBLOCKS DISENGAGEMENT	**Yes** GO to E2 . **No** Go To Pinpoint Test D .
• Lift and support the vehicle off the ground until the front tires can be spun freely. Refer to Section 100-02 . • **NOTE:** The engine is required to be at idle during the following steps to supply the vaccum required for the hublocks to engage and disengage. • • Start engine and allow to idle. • Place the shift selector into 2H mode. • Spin the tires. • **Are the hub locks engaged?**	
E2 CHECK FOR GROSS VACCUM LEAK	**Yes** REPAIR or INSTALL a new vacuum supply hose or vacuum reservior as necessary. REFER to Section 412-00 . **No** GO to E3 .
• Set the heater control to FLOOR. • Check heat output at defroster vents. • **Is the heater mode selector stuck at DEFROST?**	
E3 CHECK FOR VACUUM LEAK IN FRONT AXLE HUB LOCK SYSTEM	**Yes** GO to E4 . **No** GO to E7 .
• Disconnect the vacuum line at the IWE solenoid (located on the firewall behind the battery).	

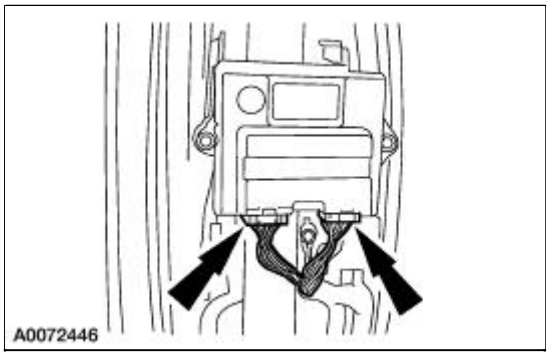
 A0013254 ● Connect the vacuum pump to the vacuum supply line. ● Apply a vaccum of 20 inches of mercury to the hublock vacuum for 30 seconds. ● **Is a vacuum leak greater than 25 mm (1 in) Hg/minutes indicated?**	
E4 CHECK FOR VACUUM LEAK IN RIGHT FRONT AXLE HUBLOCK	
● Disconnect and plug the vacuum line at the RF hublock. ● Apply a vacuum of 20 inches of mercury directly to RF hublock assembly. ● Monitor the hublock vacuum for 30 seconds. ● **Does the RF hublock leak down at a rate less than 1 inHg/minute?**	**Yes** GO to E5 . **No** INSTALL a new hublock. REFER to Section 205-03 .
E5 CHECK FOR VACUUM LEAK IN LEFT FRONT AXLE HUBLOCK	
● Disconnect and plug the vacuum line at the LF hublock. ● Apply a vacuum of 20 inches of mercury directly to the LF hublock. ● Monitor the system vacuum for 30 seconds. ● **Does the LF hublock leak down at a rate less than 1 inHg/minute?**	**Yes** GO to E6 . **No** INSTALL a new hublock. REFER to Section 205-03 .
E6 CHECK FOR VACUUM LEAK IN VACUUM LINES	
● Connect the vacuum pump to the vacuum supply line. Cap off the vacuum delivery line at both actuators. ● Apply a vacuum of 20 inches of mercury to the hublock vacuum system. ● Monitor the system vacuum for 30 seconds. ● **Is a vacuum leak greater than 1 inHg/minute indicated?**	**Yes** REPAIR or INSTALL a new vacuum supply hose or tube as necessary. **No** GO to E7 .
E7 CHECK FOR CORRECT FOUR-WHEEL DRIVE CONTROL MODULE OPERATION	
● Key off. ● Disconnect all four-wheel drive control module connectors (C3184a and C3184b) and the transfer case connector (C350). ● Check for: ● corrosion ● pushed-out pins ● Connect all four-wheel drive control module connectors (C3184a and C3184b) and the transfer case connector (C350), and make sure that they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new four-wheel drive control module. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector.

Four-Wheel Drive (4WD) Control Module

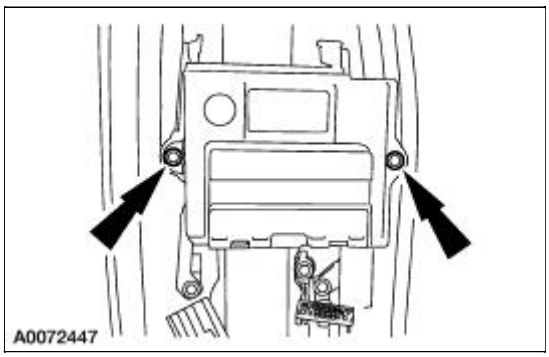
Removal

CAUTION: Prior to removal of the four-wheel drive (4WD) control module, it is necessary to upload module configuration information to a diagnostic tool. This information needs to be downloaded into the new module once installed. For additional information, refer to Section 418-01 .

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the LH B-pillar interior trim panel. For additional information, refer to Section 501-05 .



3. Disconnect the connectors from the 4WD module.



4. Remove the bolts and the 4WD module.
5. **CAUTION: Once the new 4WD control module is installed, it is necessary to download the module configuration information from the diagnostic tool into the new module. For additional information, refer to Section 418-01 .**

   To install, reverse the removal procedure.

General Specifications

Item	Specification
Fluid	
Motorcraft MERCON® Automatic Transmission Fluid	XT-2-QDX or -DDX
Transfer case fluid capacity	1.805-1.995 liters (3.8-4.2 pints)

Torque Specifications

Description	Nm	lb-ft	lb-in
Coil nuts	10	—	89
Transfer case bolts	24	18	—
Drain plug	15	11	—
Fill plug	15	11	—
Front driveshaft shield nuts	18	13	—
Output speed sensor bolt	5	—	44
Shift motor bolts	10	—	89
Transmission-to-transfer case bolts	47	35	—

Transfer Case —Automatic Four-Wheel Drive (A4WD)

Features and Operation

The automatic four-wheel drive (A4WD) transfer case uses an electronic shift 4x4 system that allows the operator to choose between four different operational modes. The operator can switch between 2WD, A4WD and 4WD HIGH modes at any speed. However, to engage or disengage LOW Range, the 4WD Control Module requires that the vehicle speed is less than 5 km/h (3 mph), the brake is applied, and the transmission is in NEUTRAL.

In A4WD, the 4WD Control Module varies the torque split between front and rear drivelines by controlling the transfer case clutch. Under most conditions, the 4WD Control Module activates the transfer case clutch at a minimum duty cycle (percentage of time the clutch is turned on) which allows for a slight speed difference between the front and rear drivelines which normally occurs when negotiating a corner on dry pavement. When the rear wheels are overpowered, the 4WD Control Module detects this slip condition, and the duty cycle to the transfer case clutch is increased until the speed difference between front and rear drivelines is reduced. In this manner, the 4WD Control Module can redirect engine torque to the front wheels when the rear wheels lose traction yet still allow operation in the A4WD mode on dry pavement.

When the ABS system is active, the 4WD Control Module will default to a minimum duty cycle for the transfer case clutch.

Feature Inputs:

- Shift range selector switch.
- ABS active input (battery voltage when ABS is active, grounded when inactive).
- Contact plate position inputs A, B, C, D grounded when closed, open circuit when open.

Feature Outputs:

- Solid state clutch relay (pulse width modulated signal: grounded when relay is on, battery potential when relay is off).

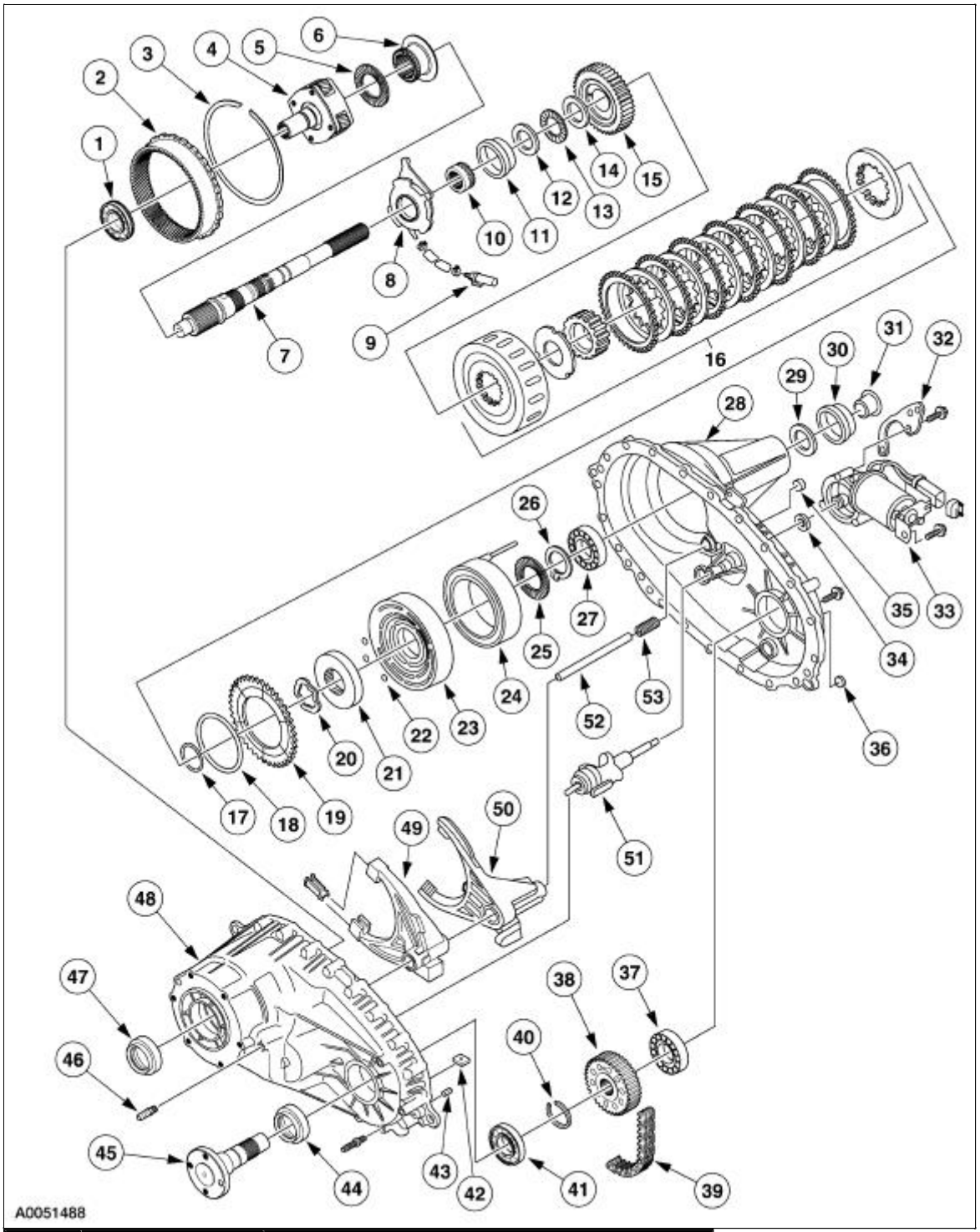
Shifting Between 2WD, A4WD and 4WD HIGH

The operator can switch between 2WD, A4WD and 4WD HIGH mode at any speed.

Shifting Into/Out of LOW RANGE

When shifting into or out of LOW RANGE, the 4WD control module requires that the vehicle speed is less than 5 km/h (3 mph), the brake is applied, and the transmission is in NEUTRAL.

Transfer Case Exploded View



Item	Part Number	Description
1	7025	Bearing (front planet)
2	7A153	Ring gear
3	7C122	Snap ring
4	7A398	Front planet
5	7D221	Thrust bearing
6	7100	Reduction hub
7	7061	Output shaft
8	7A149	Oil pump assembly

9	7A098	Oil pickup and filter
10	7D164	Output shaft hub
11	7106	Lockup collar and assembly
12	7C341	Thrust washer (bearing race)
13	7D221	Thrust bearing
14	7C341	Thrust washer (bearing race)
15	7177	Drive sprocket
16	7C108	Clutch pack assembly
17	7917	Snap ring
18	7Z104	Insulator washer
19	7H150	Clutch pack plate (hold armature)
20	7G159	Wave spring
21	7R428	Cam
22	7A534	Balls (cam/coil assembly)
23	7G362	Cam/coil housing
24	7G361	Coil
25	7D271	Thrust bearing
26	7917	Snap ring
27	7025	Bearing
28	7005	Case (rear half)
29	—	Sealing ring (packing for shipping)
30	—	Oil seal (part of 7005)
31	—	Shipping plug (part of 7005)
32	—	Wire loom hold-down (part of 7G360)
33	7G360	Transfer case shift motor
34	7288	Shifter shaft seal
35	7A010	Fill plug
36	7A010	Drain plug
37	7025	Bearing
38	7177	Driven sprocket
39	7A029	Drive chain assembly
40	7917	Snap ring
41	7025	Bearing (front output shaft support)
42	7L027	Oil pan magnet
43	—	Alignment dowel (part of 7005)
44	7B215	Oil seal
45	7061	Front output shaft with dust shield
46	7034	Vent
47	—	Oil seal (part of 7005)
48	7005	Case

49	7289	Reduction shift fork assembly
50	7289	Lockup fork
51	7F063	Shift cam assembly
52	7240	Shift fork shaft
53	7219	Lockup shift fork spring

Transfer Case

Refer to Section 308-07A .

Transfer Case Draining and Filling

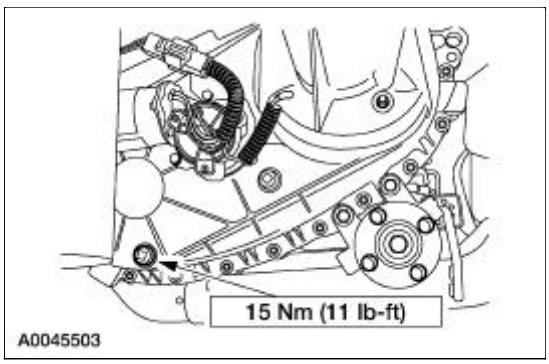
Special Tool(s)

 ST2323-A	Oil Suction Gun 303-D104 (D94T-9000-A)

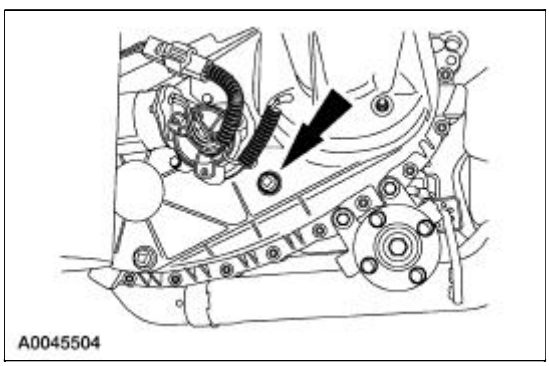
Material

Item	Specification
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®
Pipe Sealant with Teflon® D8AZ-19554-A	WSK-M2G350-A2

1. Remove the drain plug and drain the fluid. Clean the drain plug and the drain plug area. Apply pipe sealant to the drain plug threads, then install the drain plug.



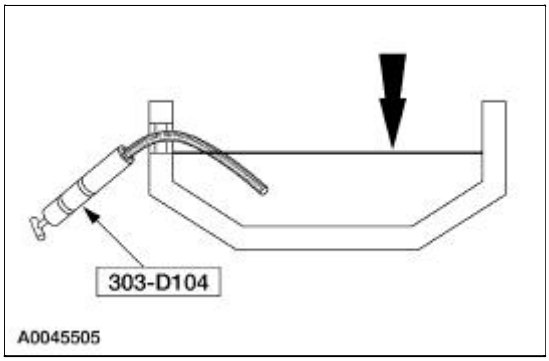
2. Clean the area around the fill plug. Remove the fill plug.



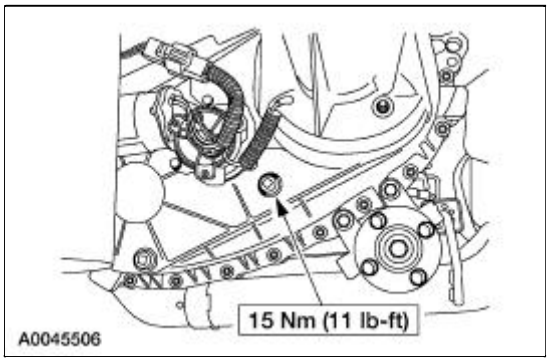
3. **CAUTION: Incorrect fluid fill can result in transfer case failure.**

Using the special tool, fill the transfer case to specification.

- The fluid must be just below the fill plug hole. Fill the case until the fluid slowly flows over the fill plug threads. Clean the fluid from the fill plug area.



4. Apply pipe sealant to the fill plug threads, then install the fill plug.



Transfer Case Rear Output Shaft Oil Seal

Special Tool(s)

 ST2261-A	Installer, Input Shaft Oil Seal 308-249 (T96T-7127-A)

Removal

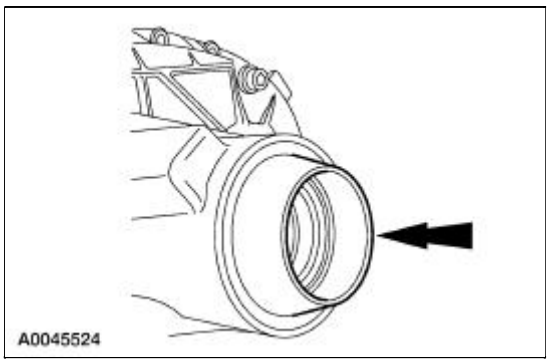
1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking, or towing an air suspension vehicle. Failure to do this will result is unexpected inflation or deflation of the vehicle during these operations.**

   Position the vehicle on a hoist. For additional information, refer to Section 100-02 .

2. **NOTE:** Index-mark the rear driveshaft yoke and pinion flange to maintain initial driveshaft balance during installation.

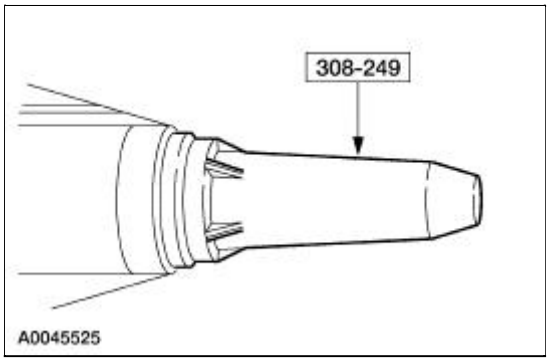
   Remove the rear driveshaft. For additional information, refer to Section 205-01 .

3. Using a suitable tool, remove the oil seal.



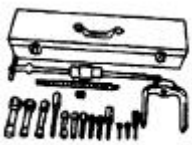
Installation

1. To install, reverse the removal procedure.
   - Using the special tool, install the oil seal.


308-249
A0045525

Transfer Case

Special Tool(s)

 ST1200-A	Remover, Bearing Cup 308-047 (T77F-1102-A)
 ST1255-A	Handle 205-D055 (D81L-4000-A) or equivalent
 ST1144-A	Universal Puller Set 303-DS005 (D80L-100-A)
 ST1788-A	Installer, Mainshaft Bearing 308-060 (T77J-7025-K)
 ST1186-A	Holding Fixture, Transmission 307-003 (T57L-500-B)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
 ST2239-A	Installer, Output Shaft Front Bearing 308-410
	Installer, Front Axle Oil Seal 205-350 (T95T-3010-A)

 ST1786-A	
 ST2305-A	Installer, Input Shaft Oil Seal 308-186 (T90T-7127-B)
 ST2261-A	Installer, Input Shaft Oil Seal 308-249 (T96T-7127-A)
 ST1466-A	Installer, Valve Stem Oil Seal 303-367 (T90P-6510-AH)

Material

Item	Specification
Black Non-Acid Cure Silicone Rubber E7TZ-19562-A	ESL-M4G273-A
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®

Disassembly

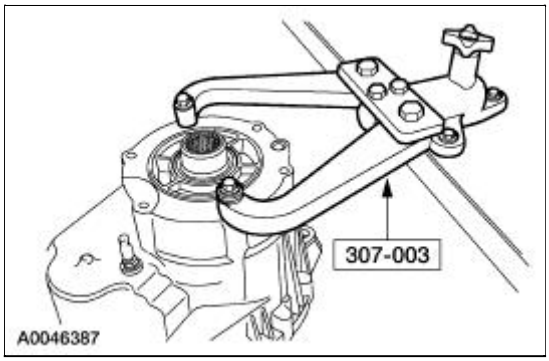
1. **WARNING: Make sure protective eyewear is in place.**

   WARNING: Use a petroleum-based solvent to clean the transfer case. Refer to the solvent manufacturer's safety precautions to prevent personal injury or transfer case damage.

   CAUTION: Seal all openings before cleaning the transfer case exterior. This will prevent entry of dirt and water, which can cause damage to internal components.

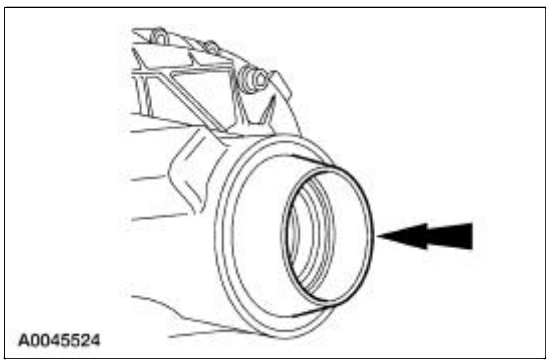
   Clean the transfer case exterior with solvent and dry with compressed air.

2. Using the special tool, secure the transfer case to a work bench. Rotate the transfer case so that the output shaft is pointing upward.

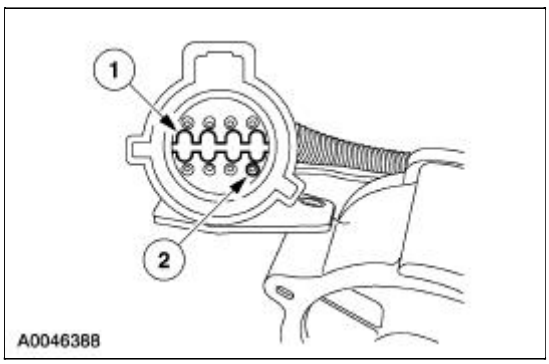


3. Drain the fluid from the transfer case, if not done previously.

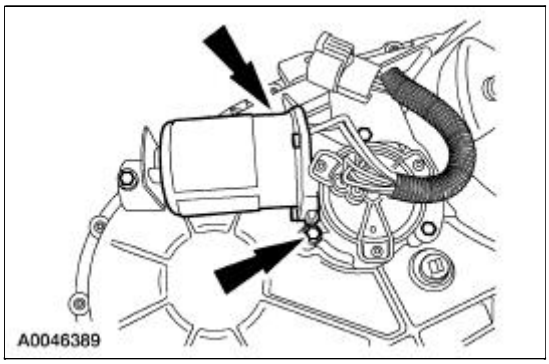
4. Using a suitable tool, remove and discard the oil seal.



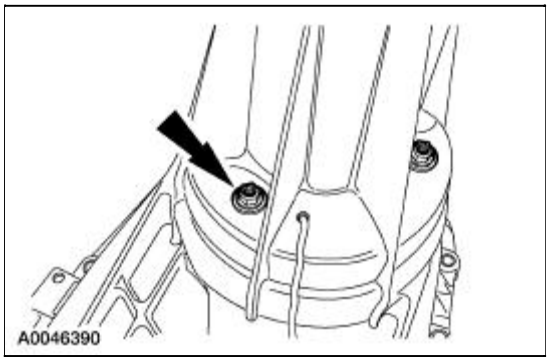
5. Remove the coil wire pin from the electrical connector.
    1. Remove the wire connector spacer.
    2. Remove the coil wire pin (tan wire).
        - Use an electrical connector pin extractor tool.



6. Remove the bolts and transfer case shift motor.

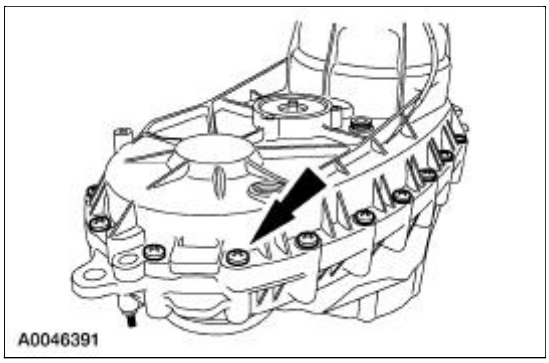


7. Remove the three coil nuts and washers.

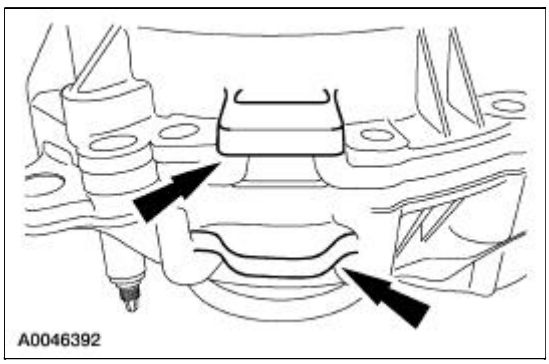


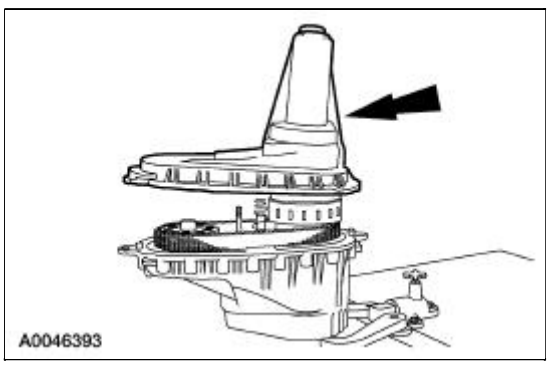
8. **NOTE:** It is normal to find metal shavings after removing the self-tapping transfer case bolts.

   Remove the 20 bolts.

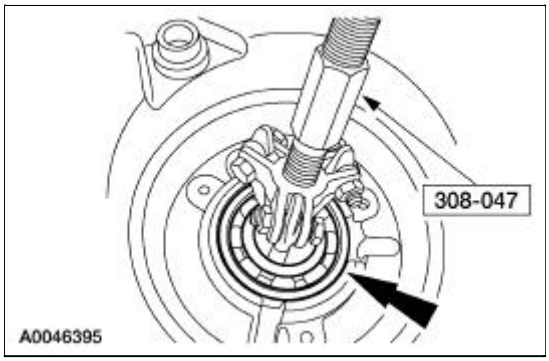


9. Separate the transfer case halves.
   - Use the pry bosses to separate the case halves.

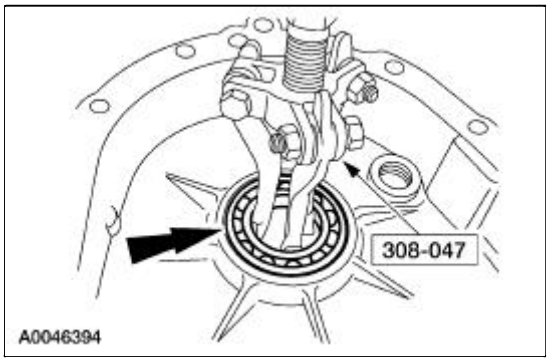




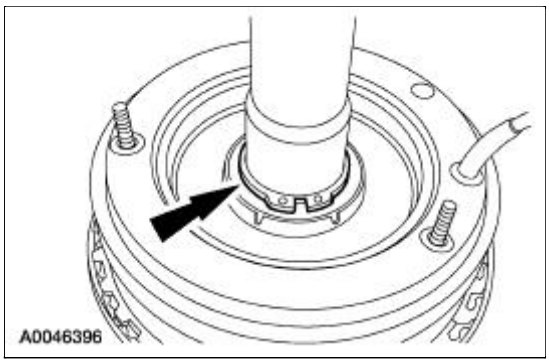
10. Using the special tools, remove the rear output shaft support bearing.



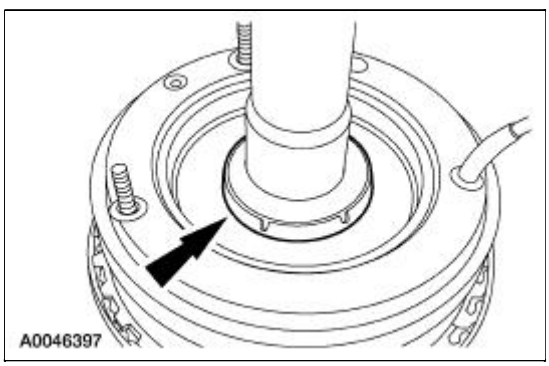
11. Using the special tools, remove the front output shaft rear bearing.



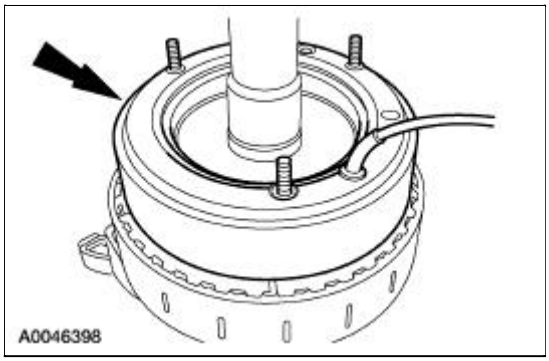
12. Remove the snap ring.
    - Inspect the snap ring for wear or damage. Install a new snap ring as necessary.



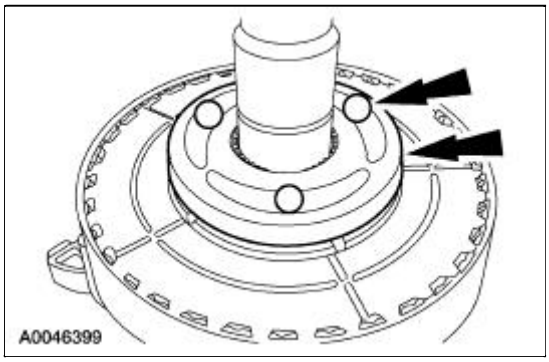
13. Remove the caged thrust bearing assembly.
    - Inspect the bearing for wear or damage. Install a new bearing as necessary.



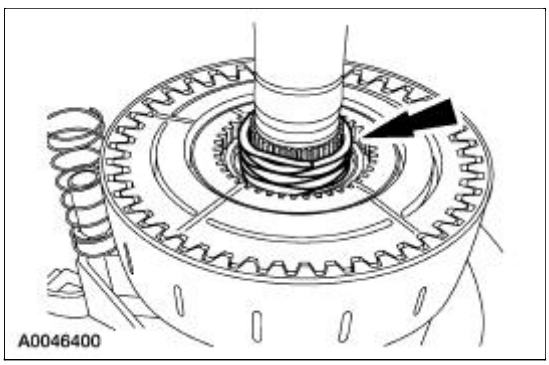
14. Remove the cam/coil housing.



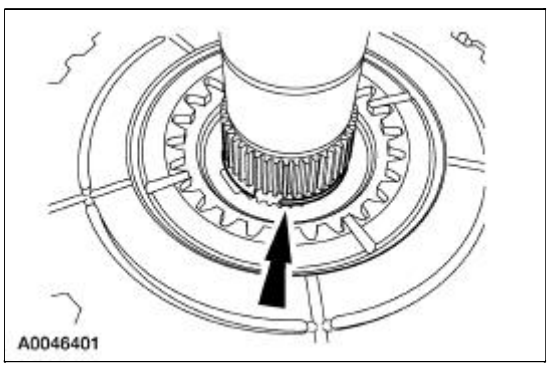
15. Remove the steel balls and the cam.



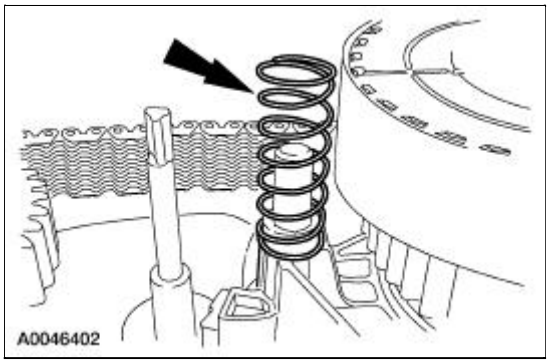
16. Remove the wave spring.



17. Remove and discard the snap ring.

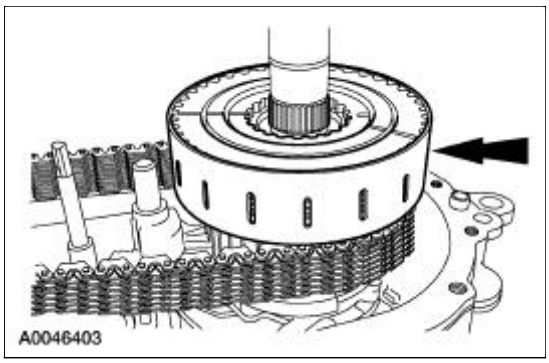


18. Remove the lockup shift fork spring.

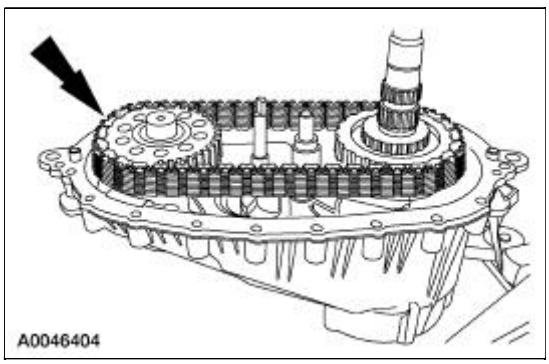


19. **CAUTION: When removing the clutch pack assembly, do not separate the clutch pack assembly. Keep tension on the clutch pack upon removal. Set the clutch pack assembly on the bench in the same position as located in the transfer case. The thrust washer in the lower clutch pack uses tabs to hold it in place. If the thrust washer is not in place, a transfer case clearance problem can occur.**

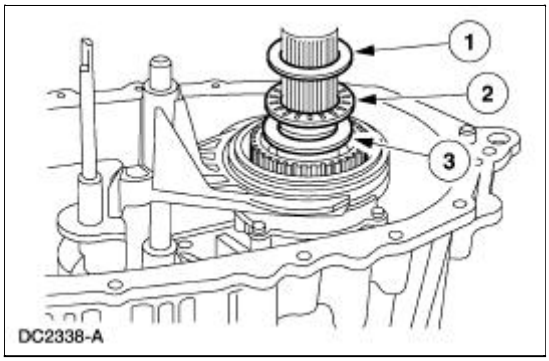
    Remove the clutch pack assembly.



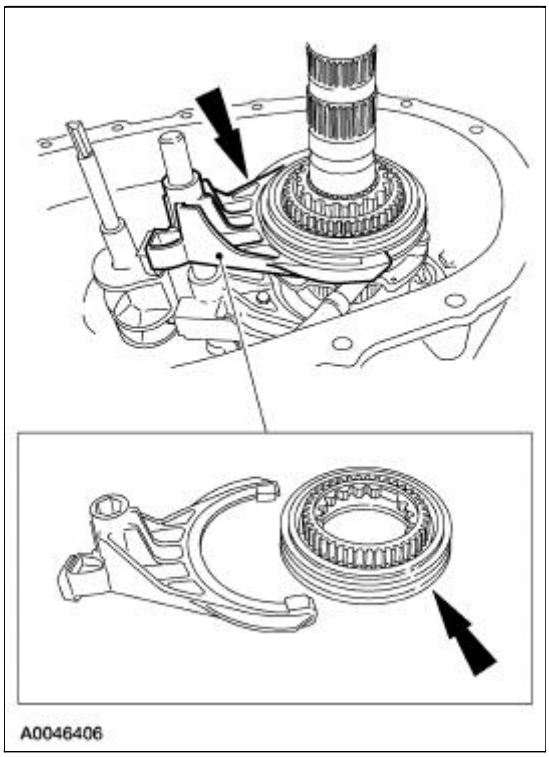
20. Remove the drive chain and the sprockets as an assembly.
    - Inspect the drive chain for wear or damage. Inspect the sprockets for broken or cracked teeth. Install new components as necessary.



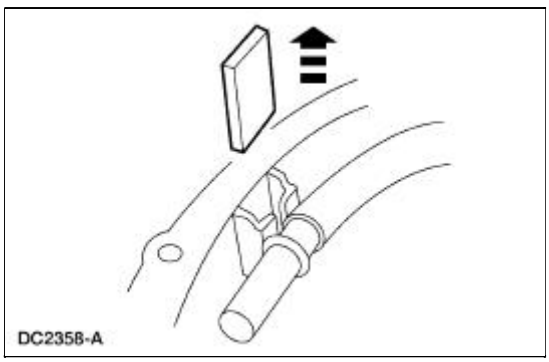
21. Remove the thrust bearing assembly.
    1. Remove the thrust washer.
        - The upper thrust washer may be attached to the sprocket.
    2. Remove the thrust bearing.
    3. Remove the thrust washer.
    - Inspect the washers and bearing for wear or damage. Install new components as necessary.



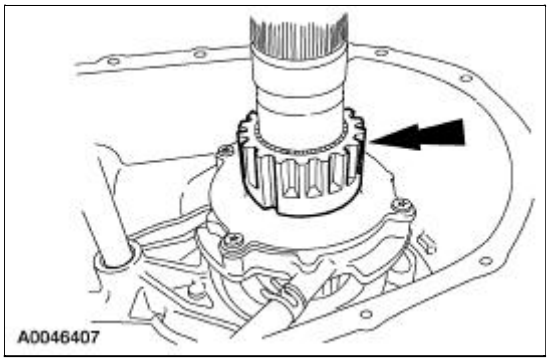
22. Remove the lockup collar and the lockup fork as an assembly.
    - Separate and inspect the lockup collar and the lockup fork for wear or damage.



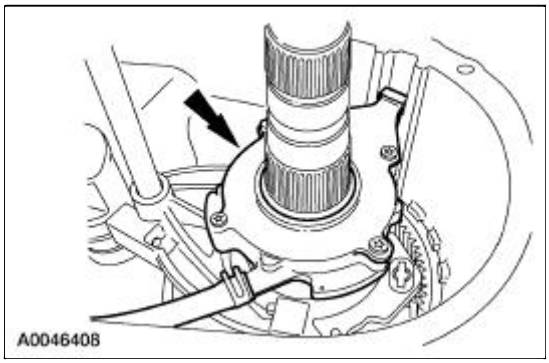
23. Remove and clean the oil pan magnet.



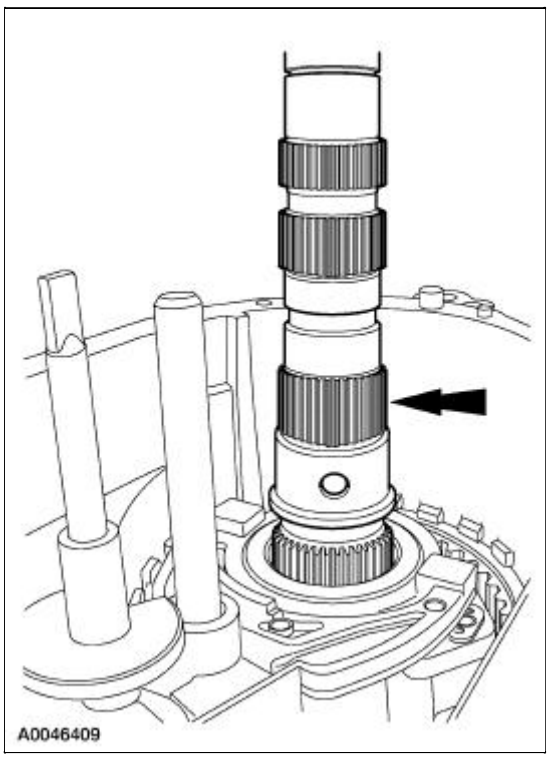
24. Remove the output shaft hub.



25. Remove the oil pump assembly.



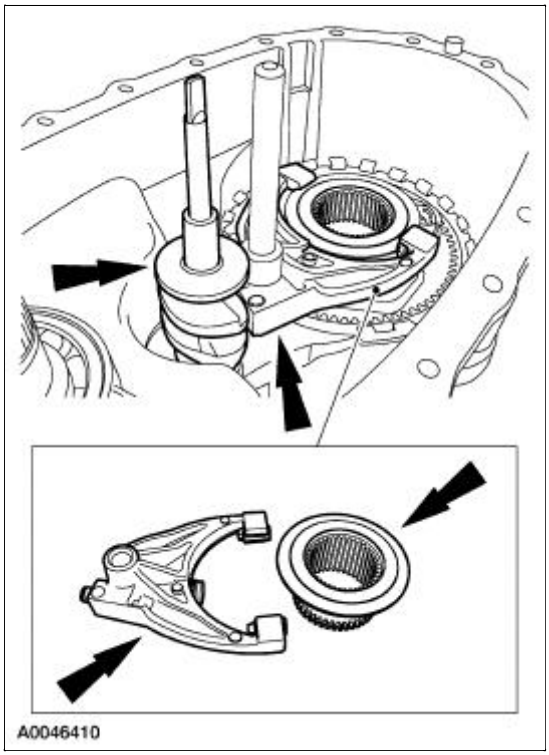
26. Remove the output shaft.



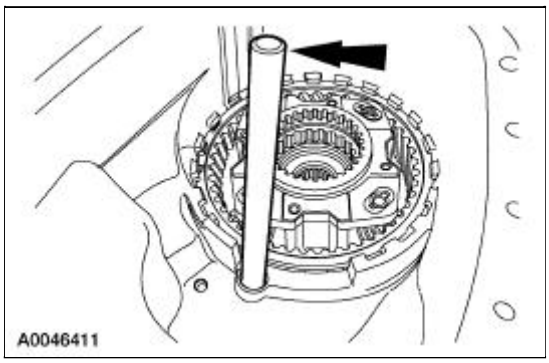
27. **WARNING: Do not disassemble the shift cam assembly.**

Remove the reduction shift fork, the reduction hub, and the shift cam as an assembly.

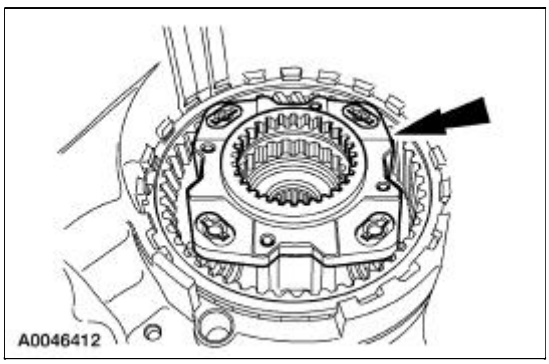
- Separate and inspect the reduction hub and the reduction shift fork for wear or damage.



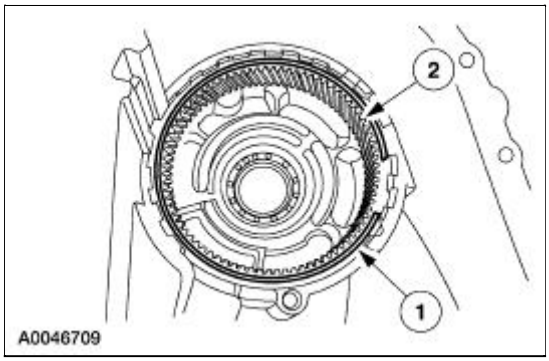
28. Remove the shift fork shaft.



29. Remove the front planet.
    - Using a drift and a hammer, remove the front planet needle bearing, if necessary.



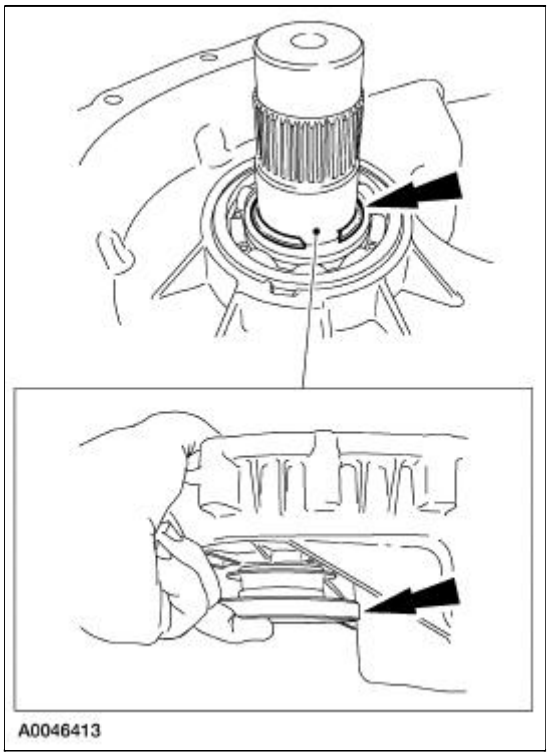
30. Remove the ring gear.
    1. Remove the snap ring.
        - Inspect the snap ring for wear or damage. Install a new snap ring as necessary.
    2. Remove the ring gear.



31. **CAUTION: Do not let the front output shaft fall when removing the snap ring.**

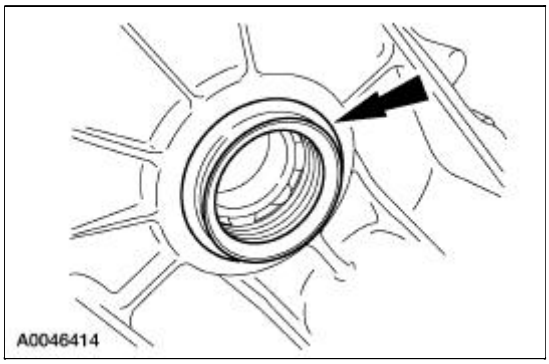
Remove the snap ring and the front output shaft.

- Inspect the snap ring for wear or damage. Install a new snap ring as necessary.



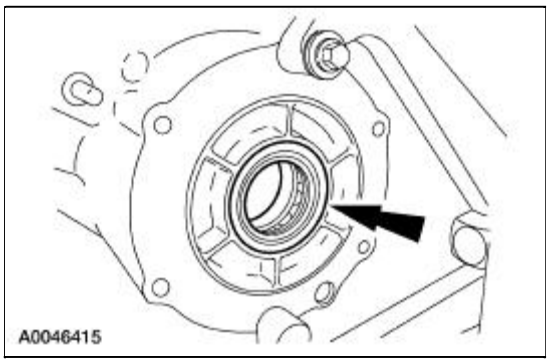
32. **NOTE:** Carefully remove the seal, do not damage the seal bore.

Remove and discard the front output shaft oil seal.

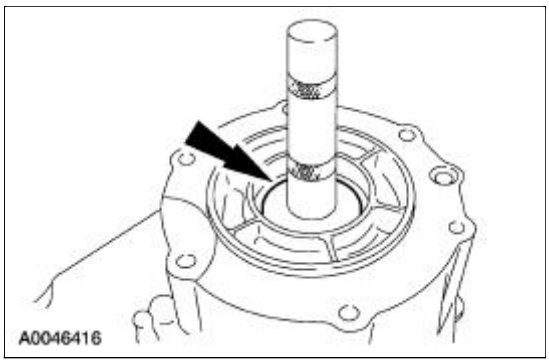


33. **NOTE:** Carefully remove the seal, do not damage the seal bore.

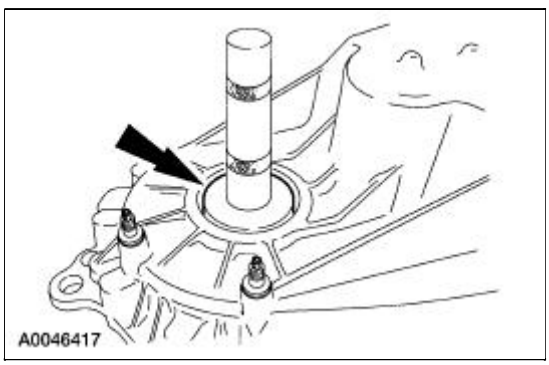
    Remove and discard the front input shaft oil seal.



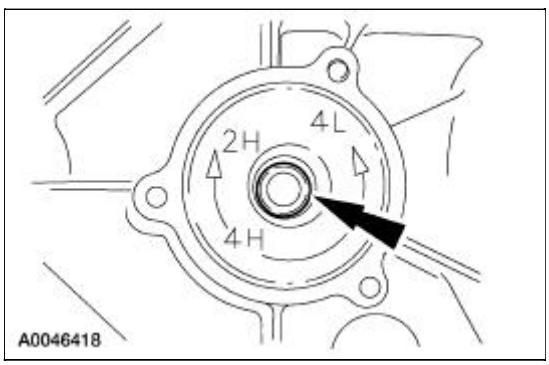
34. Using a suitable driver, remove the front planet support bearing.



35. Using a suitable driver, remove the front output shaft support bearing.



36. Using a suitable tool, remove and discard the shifter shaft seal.

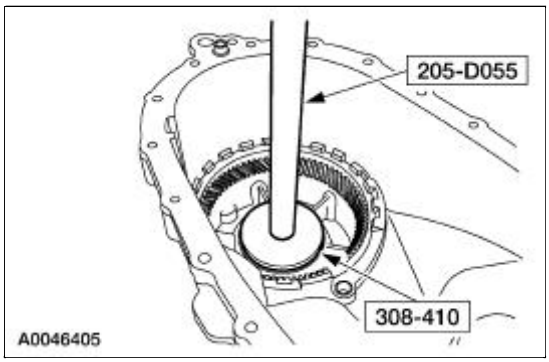


Assembly

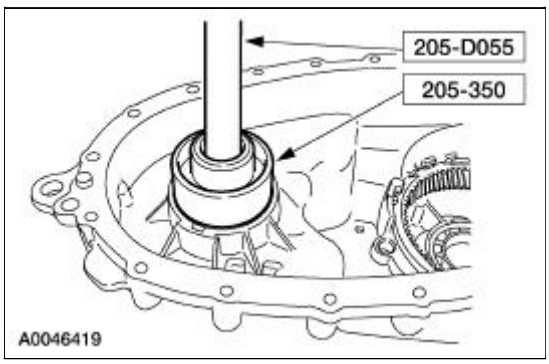
1. Lubricate all internal components with the recommended transfer case lubricant during reassembly.

2. Clean the mating surfaces of the cases.

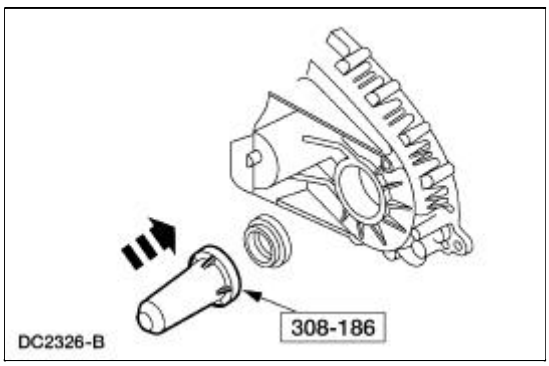
3. Using a suitable press and the special tools, install the front planet support bearing.



4. Using a suitable press and the special tools, install the front output shaft support bearing.

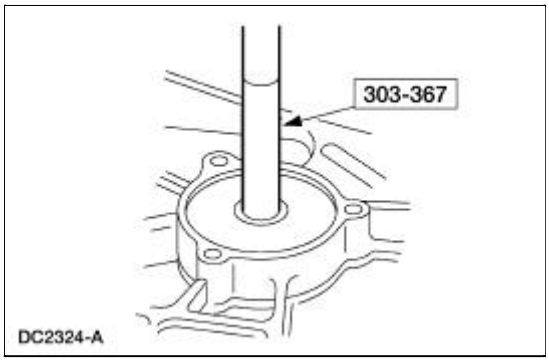


5. Using the special tool, install a new oil seal.



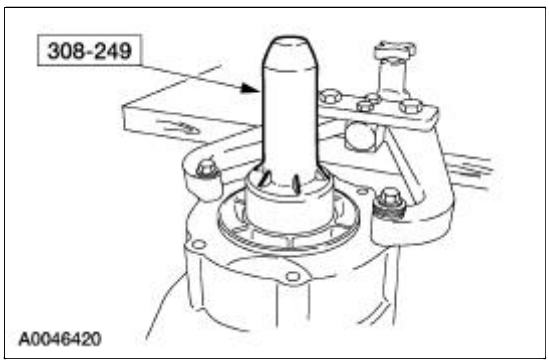
6. **CAUTION: Be careful not to crush the seal.**

   Using the special tool, install a new shifter shaft seal.

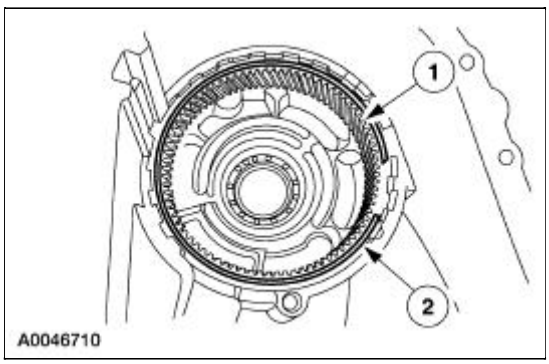


7. Install the case to the transmission holding fixture. Secure the case to the work bench.

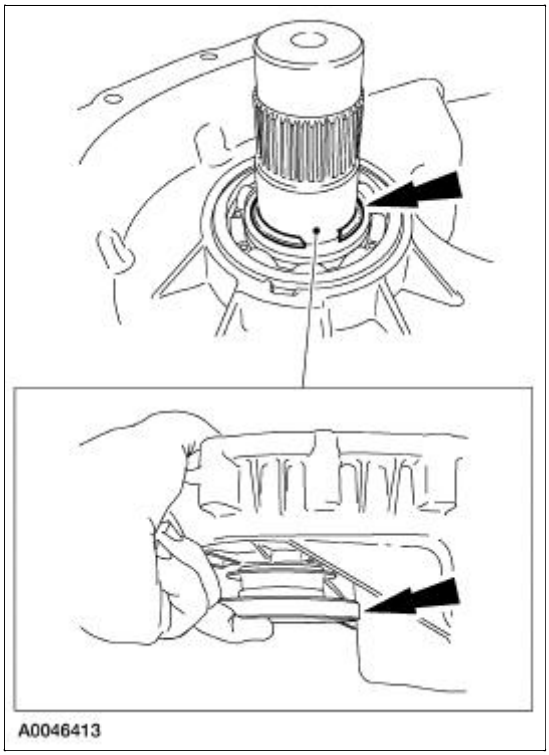
8. Using the special tools, install a new oil seal.



9. Install the ring gear.
    1. Position the ring gear in the case.
    2. Install the snap ring.

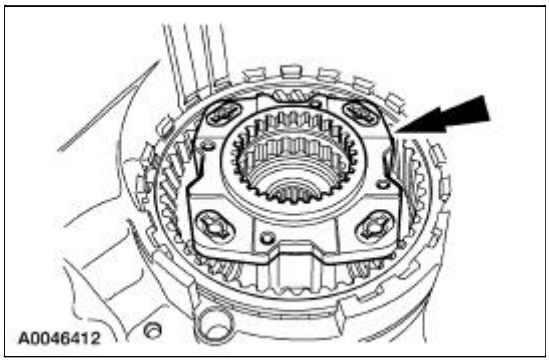


10. Install the front output shaft and the snap ring.

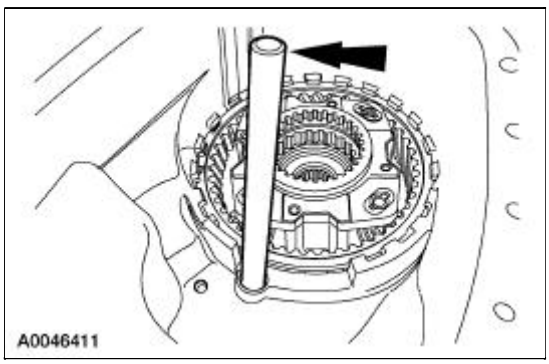


11. **NOTE:** If removed, using a suitable press and the special tool 308-085, install the needle bearing into the front planet. Be careful not to crush the bearing cage.

    Install the front planet.

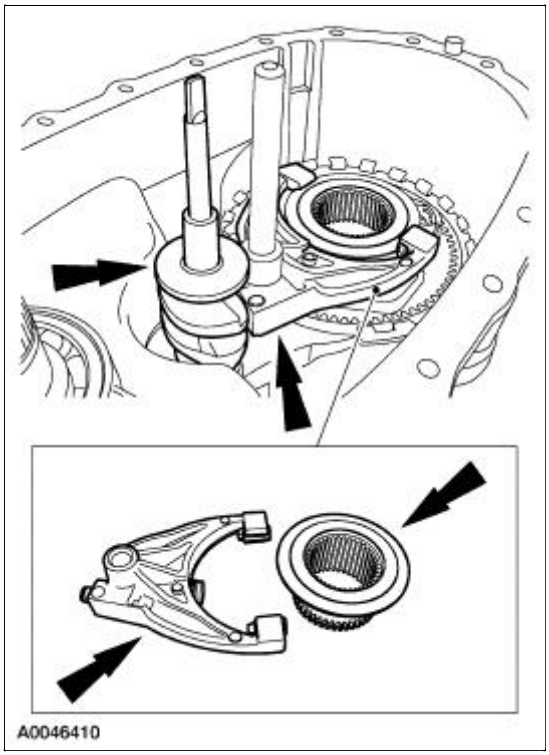


12. Install the shift fork shaft.

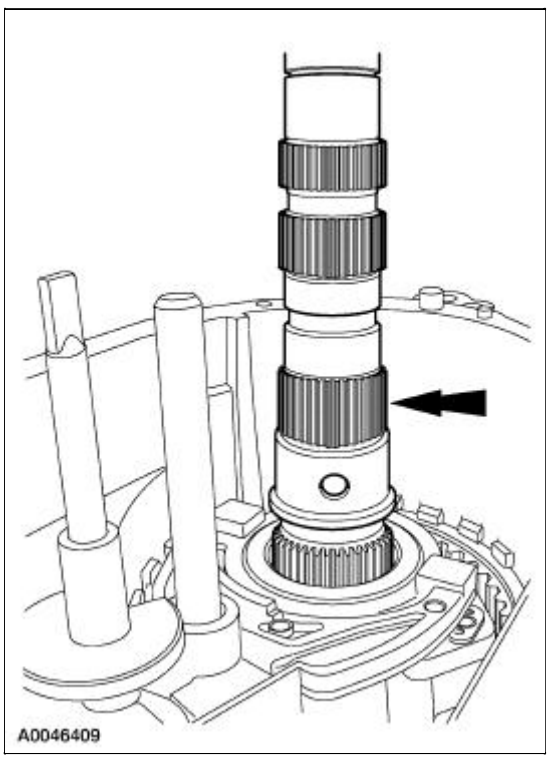


13. **NOTE:** Assemble the reduction hub and the reduction shift fork.

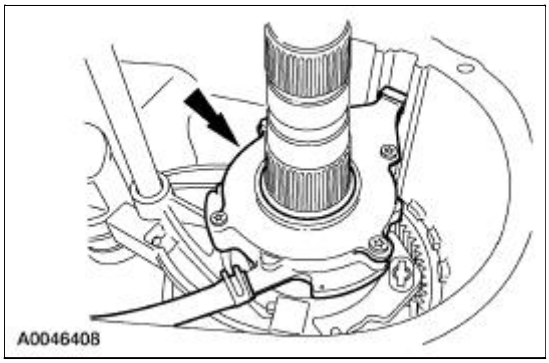
    Install the reduction shift fork, the reduction hub, and the shift cam as an assembly.



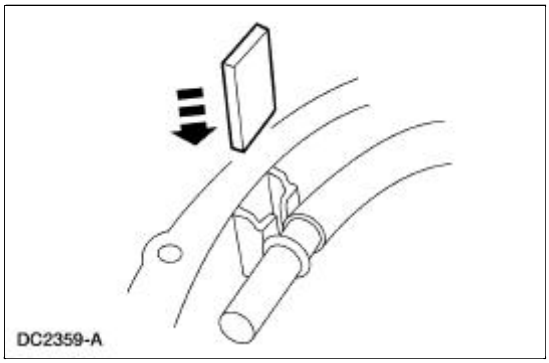
14. Install the output shaft.



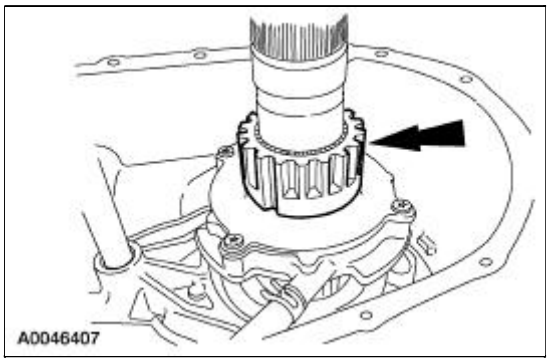
15. Install the oil pump assembly.
    - Make sure the oil pump finger is in the slot in the case.



16. Install the oil pan magnet into its slot in the case.

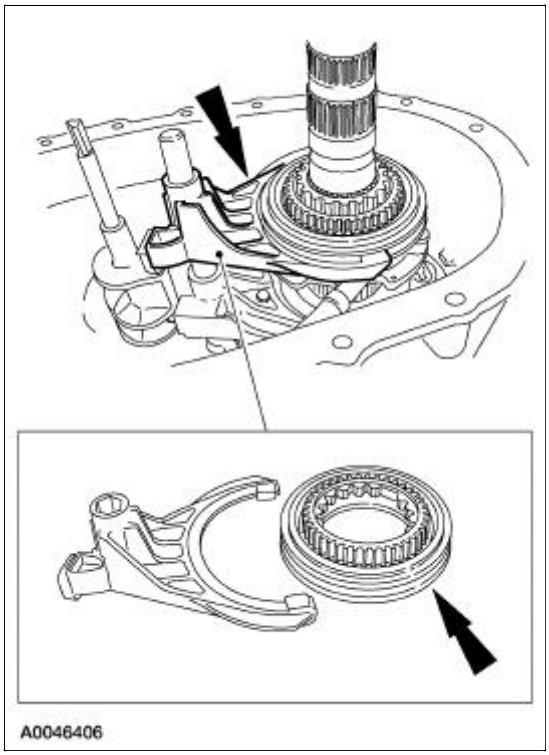


17. Install the output shaft hub.

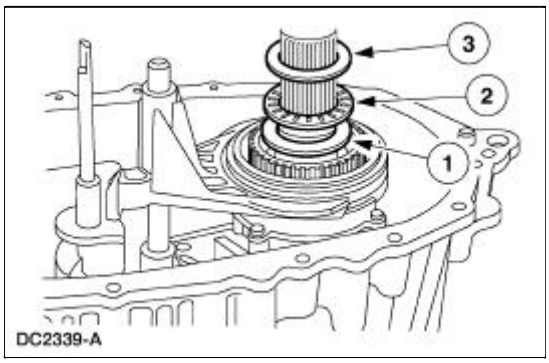


18. **NOTE:** Assemble the lockup collar and the lockup fork.

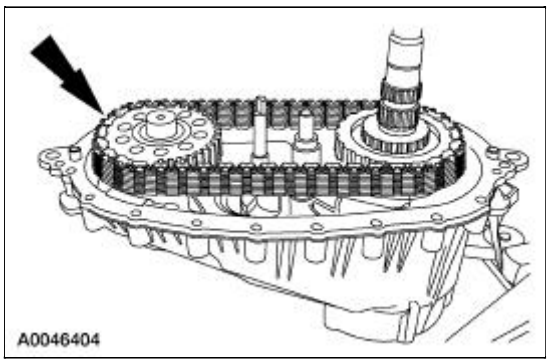
    Install the lockup collar and the lockup fork as an assembly.



19. Install the three-piece thrust bearing assembly.
    1. Install the thrust washer.
    2. Install the thrust bearing.
    3. Install the thrust washer.

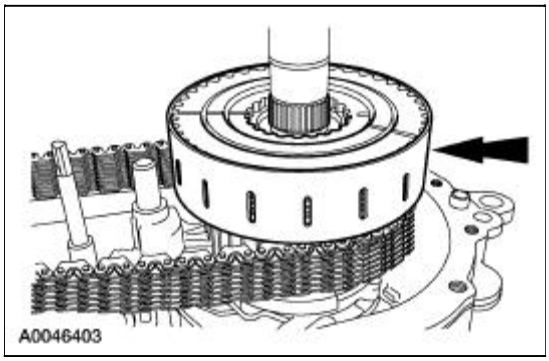


20. Install the drive chain and the sprockets as an assembly.

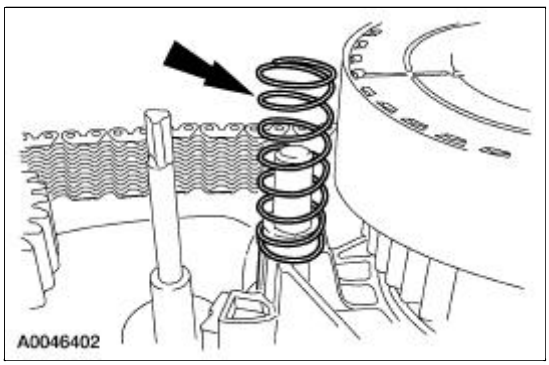


21. **CAUTION: When installing the clutch assembly, do not separate the clutch pack assembly. The thrust washer in the lower clutch pack uses tabs to hold it in place. If the thrust washer is not in place, a transfer case clearance problem can occur.**

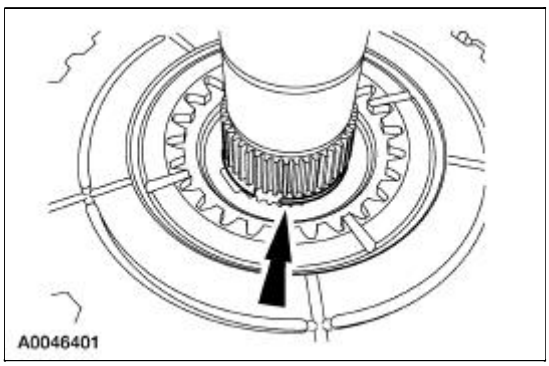
Install the clutch pack assembly.



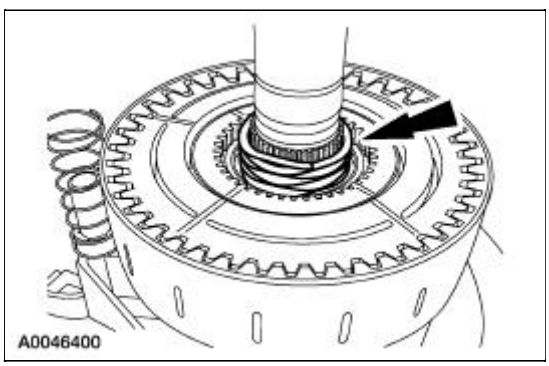
22. Install the lockup shift fork spring.



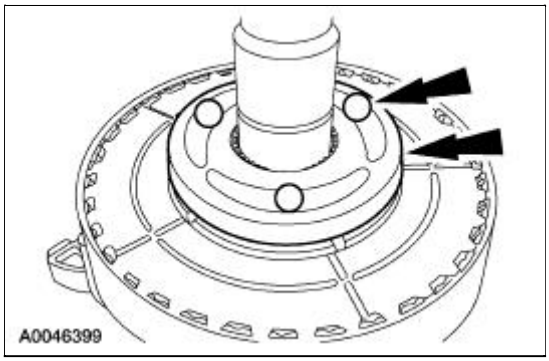
23. Install a new snap ring.



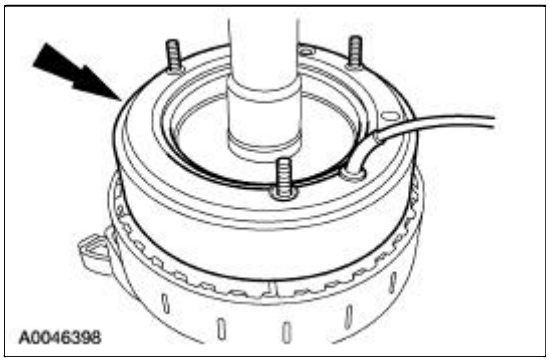
24. Install the wave spring.



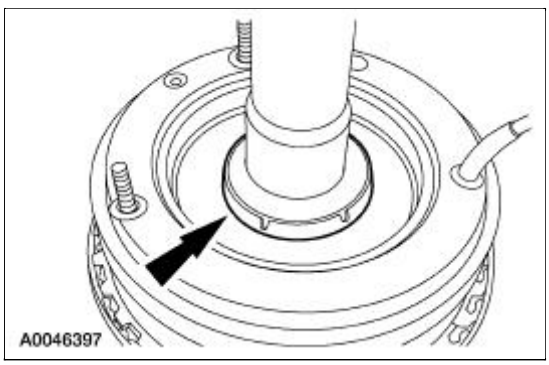
25. Install the cam and the steel balls.



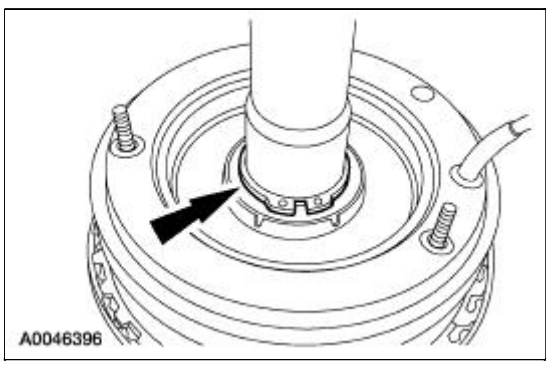
26. Install the cam/coil housing.



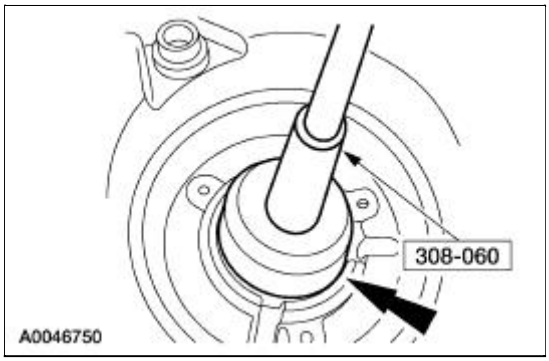
27. Install the thrust bearing assembly.



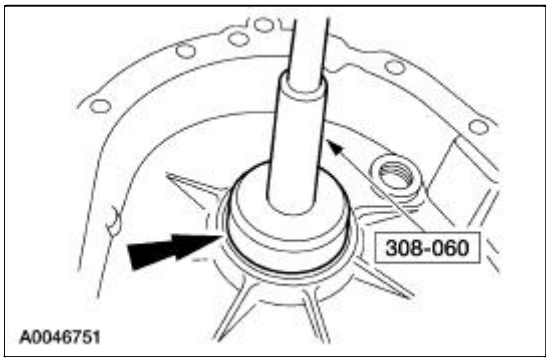
28. Install the snap ring.



29. Using a suitable press and the special tool, install the rear output shaft support bearing.



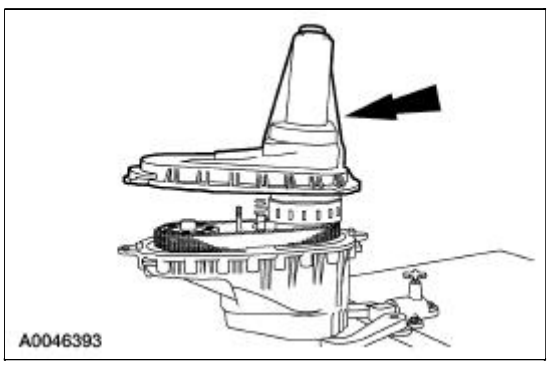
30. Using a suitable press and the special tool, install the front output shaft rear bearing.

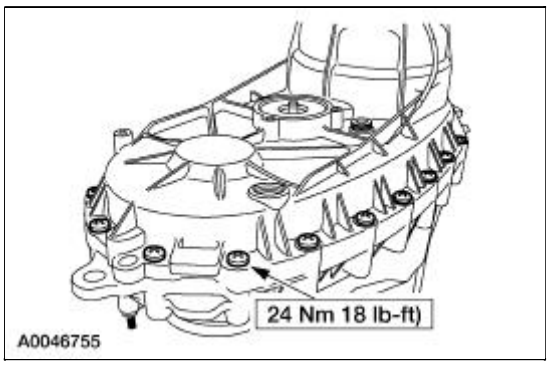


31. **CAUTION: Applying too much silicone sealant can plug the fluid filter and cause transfer case failure.**

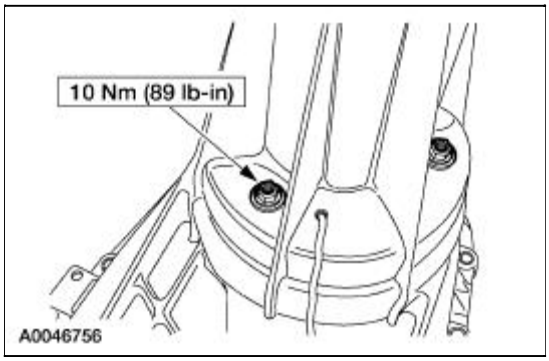
Apply a bead of silicone sealant to the transfer case mating surfaces, then position the two transfer case halves together. Tighten the bolts evenly in a star pattern.

- Position the coil studs through the case holes, make sure the shift cam shaft is aligned with its case bore, and the lockup shift fork spring is in position.

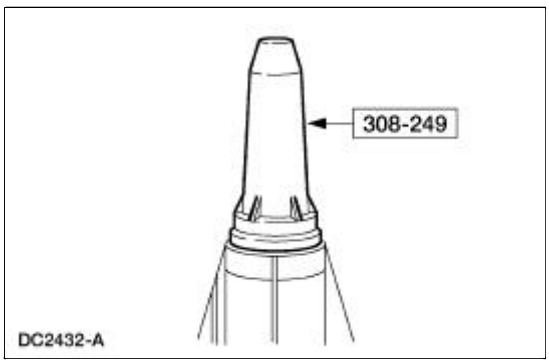




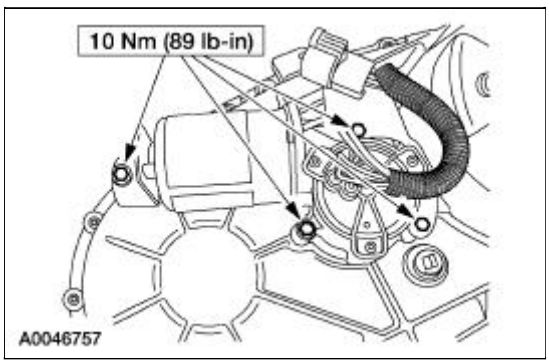
32. Install the coil washers and nuts.



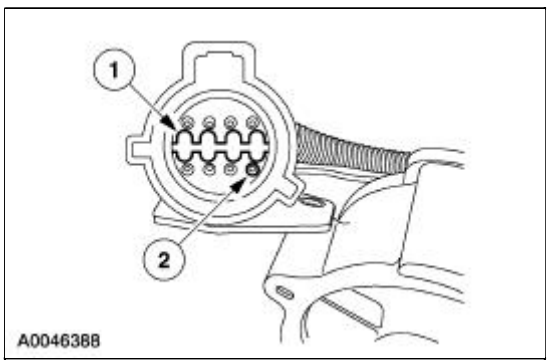
33. Using the special tool, install the oil seal.



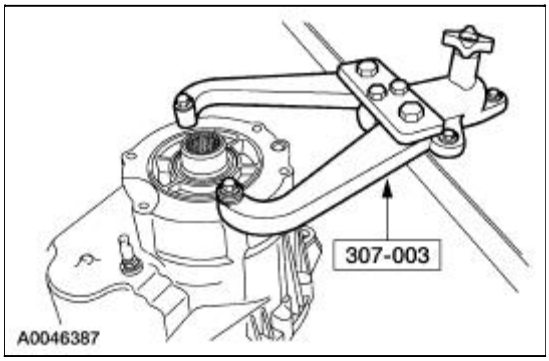
34. Install the transfer case shift motor.



35. Install the coil wire pin in the electrical connector.
    1. Remove the wire connector spacer.
    2. Install the coil wire pin. Reinstall the wire connector spacer.



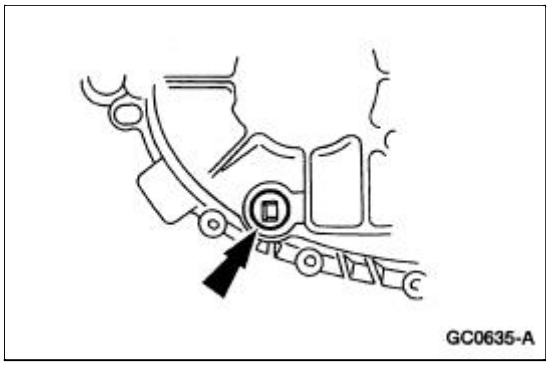
36. Remove the transfer case from the special tool.



Transfer Case —4R100 Transmission

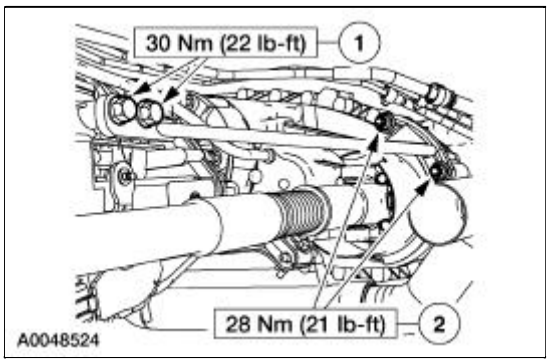
1. With the vehicle in NEUTRAL position the vehicle on a hoist. For additional information, refer to Section 100-02 .

2. Drain the fluid if the transfer case is to be disassembled.
   - Install the drain plug when finished draining.

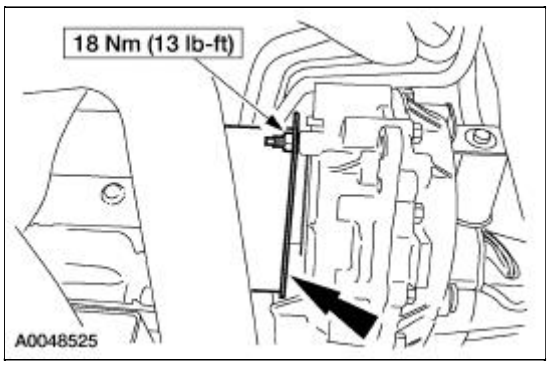


3. **NOTE:** The catalytic converter is removed for clarity.

   Remove the transfer case-to-transmission brace.
   1. Remove the bolts from the transmission.
   2. Remove the nuts from the transfer case.



4. Remove the two nuts and the front driveshaft shield.



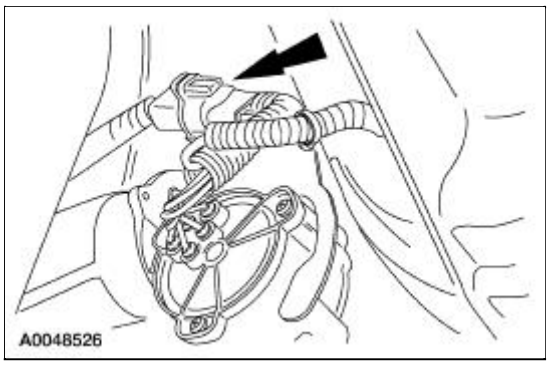
5. **NOTE:** Index-mark the driveshaft to maintain initial driveshaft balance during installation.

Remove the front driveshaft. For additional information, refer to Section 205-01 .

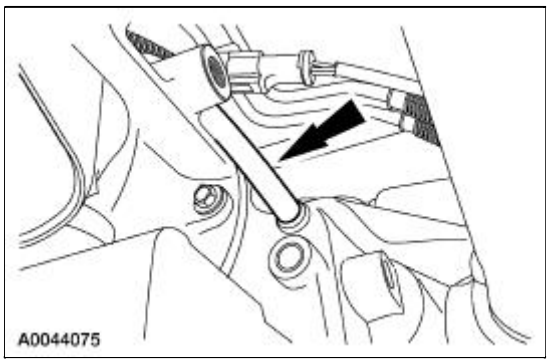
6. **NOTE:** Index-mark the driveshaft to maintain initial driveshaft balance during installation.

   Remove the rear driveshaft. For additional information, refer to Section 205-01 .

7. Disconnect the electrical connector.

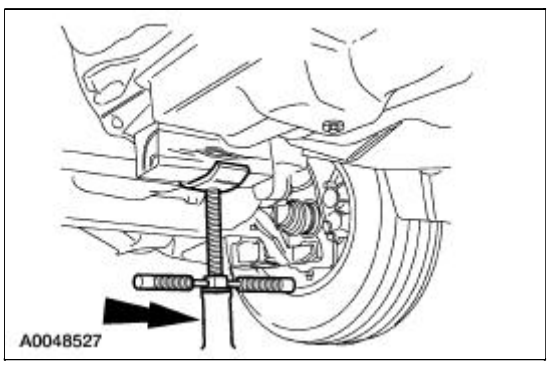


8. Disconnect the vent hose.



9. **CAUTION: Never support the transmission from the bottom of the transmission pan.**

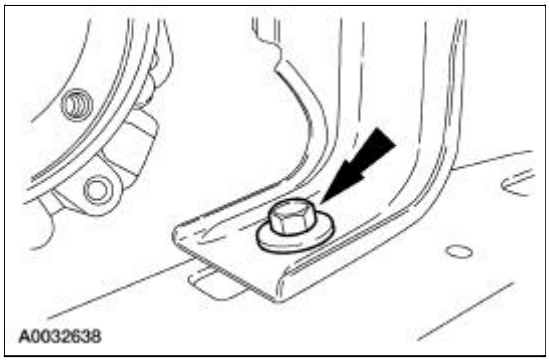
   Using a suitable jack stand, support the transmission.



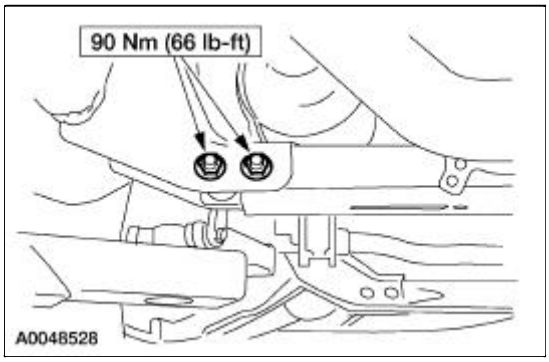
10. **CAUTION: Secure the transfer case to the jack with a safety strap.**

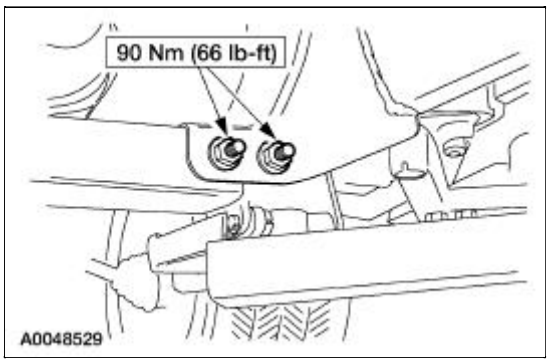
    Using a suitable transmission jack, support the transfer case.

11. Remove the two exhaust heat shield-to-crossmember bolts.

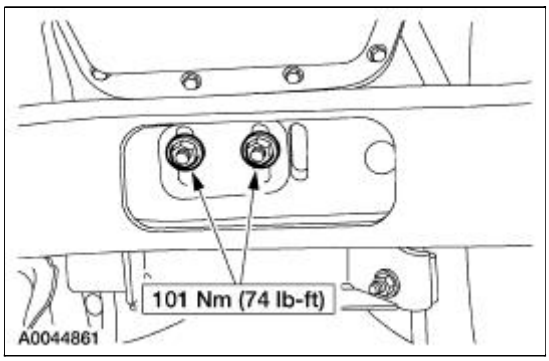


12. Remove the crossmember-to-frame nuts and bolts.

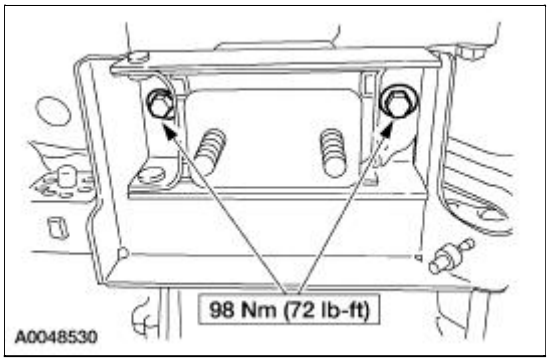




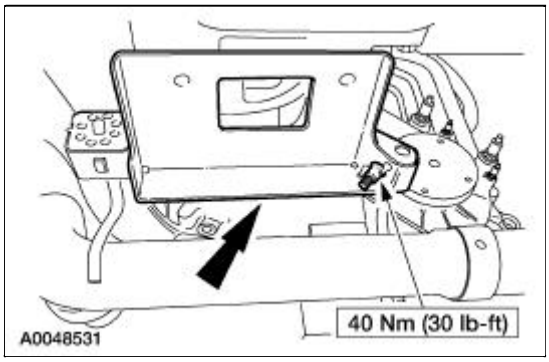
13. Remove the transmission mount-to-crossmember nuts, then remove the crossmember.



14. Remove the bolts and the transmission mount.

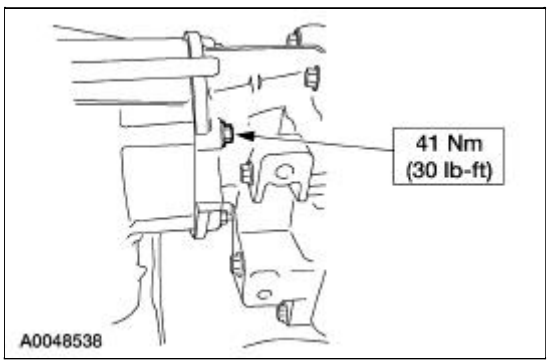


15. Remove the bolt and the exhaust hanger bracket.



16. **NOTE:** Position a suitable drain pan below the transmission extension housing.

    Remove the six transfer case-to-transmission extension housing bolts.

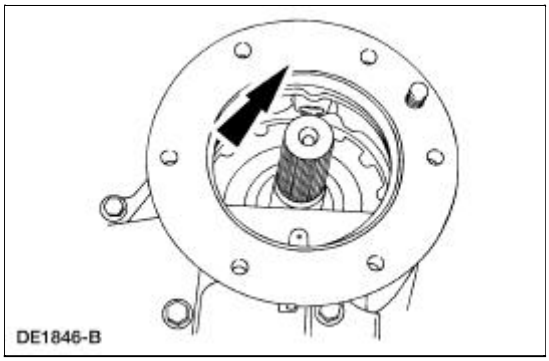


17. **NOTE:** Watch for obstructions.

    Separate the transfer case from the transmission extension housing, move the transfer case rearward off the output shaft, then lower the transfer case from the vehicle.

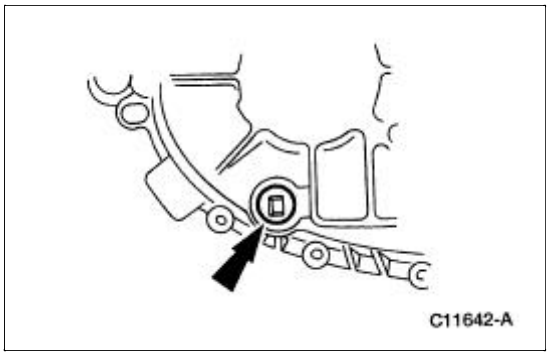
18. **CAUTION: Carefully clean the gasket surfaces. Nicks and gouges cause fluid leaks.**

    Remove the transfer case-to-transmission gasket and clean the mating surfaces.

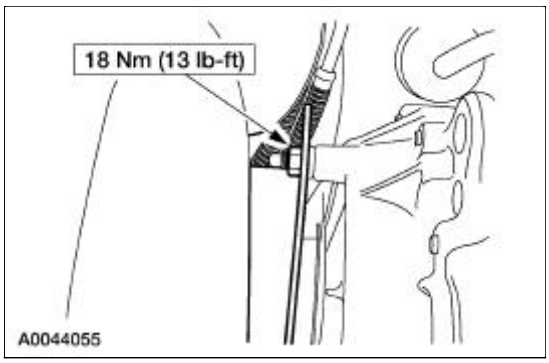

DE1846-B

Transfer Case —4R70W Transmission

1. With the vehicle in NEUTRAL, position the vehicle on a hoist. For additional information, refer to Section 100-02 .
2. Drain the fluid if the transfer case is to be disassembled.
   - Install the drain plug when finished draining.



3. Remove the two nuts and the front driveshaft shield.



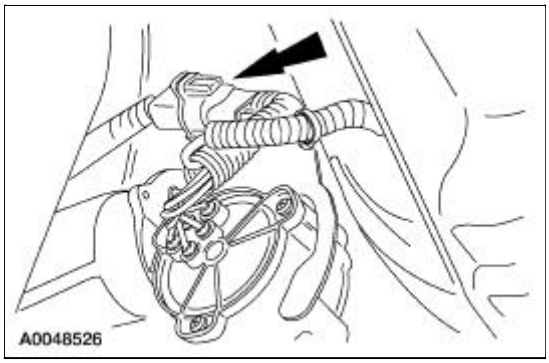
4. **NOTE:** Index-mark the driveshaft to maintain initial driveshaft balance during installation.

   Remove the front driveshaft. For additional information, refer to Section 205-01 .

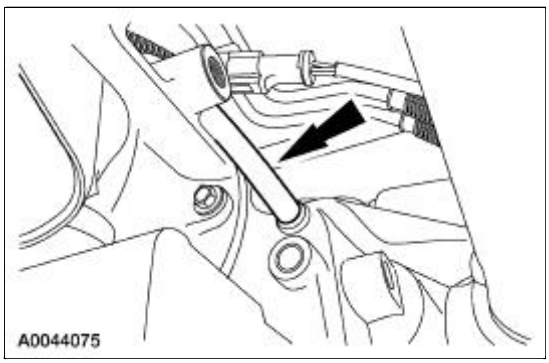
5. **NOTE:** Index-mark the driveshaft to maintain initial driveshaft balance during installation.

   Remove the rear driveshaft. For additional information, refer to Section 205-01 .

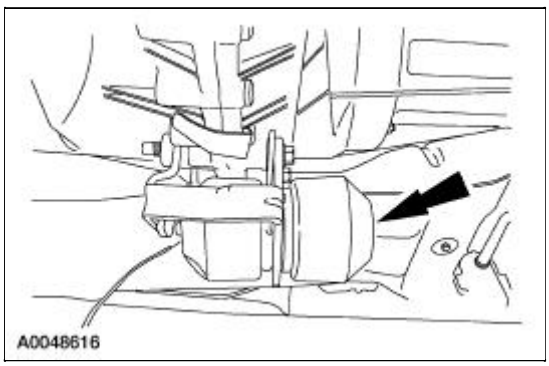
6. Disconnect the electrical connector.



7. Disconnect the vent hose.

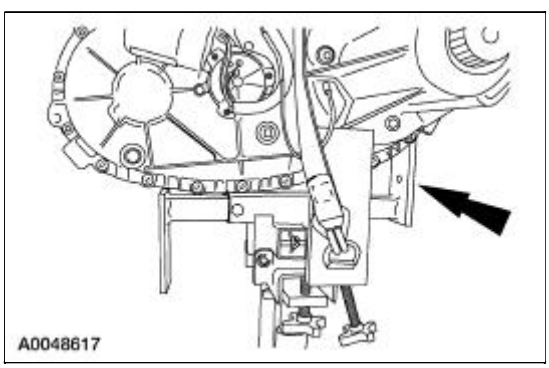


8. Remove the bolts and the damper.



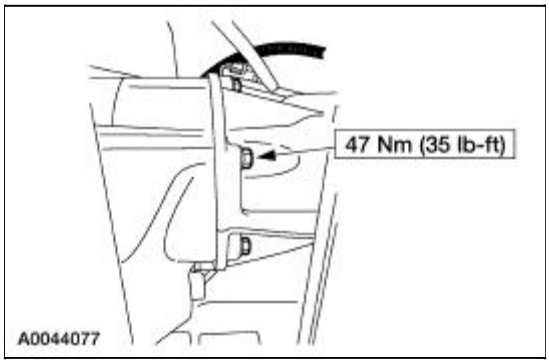
9. **CAUTION: Secure the transfer case to the jack with a safety strap.**

   Using a suitable transmission jack, support the transfer case.



10. **NOTE:** Position a suitable drain pan below the transmission extension housing.

Remove the six transfer case-to-transmission extension housing bolts.

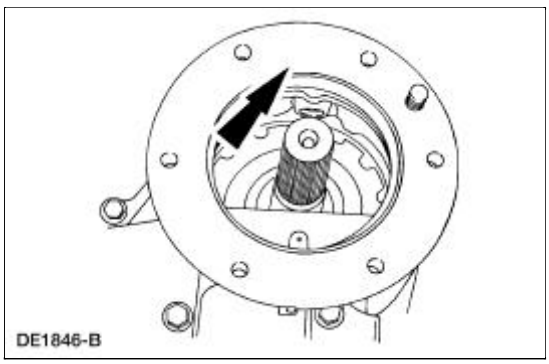


11. **NOTE:** Watch for obstructions.

    Separate the transfer case from the transmission extension housing, move the transfer case rearward off the output shaft, then lower the transfer case from the vehicle.

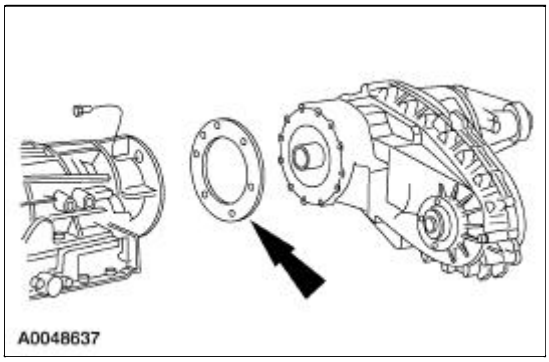
12. **CAUTION: Carefully clean the gasket surfaces. Nicks and gouges cause fluid leaks.**

    Remove the transfer case-to-transmission gasket and clean the mating surfaces.



Transfer Case

1. To install, reverse the removal procedure.
    - Install a new transfer case-to-transmission gasket.
    - Fill the transfer case. For additional information, refer to Transfer Case Draining and Filling in the General Procedures portion of this section when refilling the transfer case. Refer to Specifications in this section for the correct type and quantity of fluid.
    - Tighten the transfer case-to-transmission bolts evenly in a star pattern.



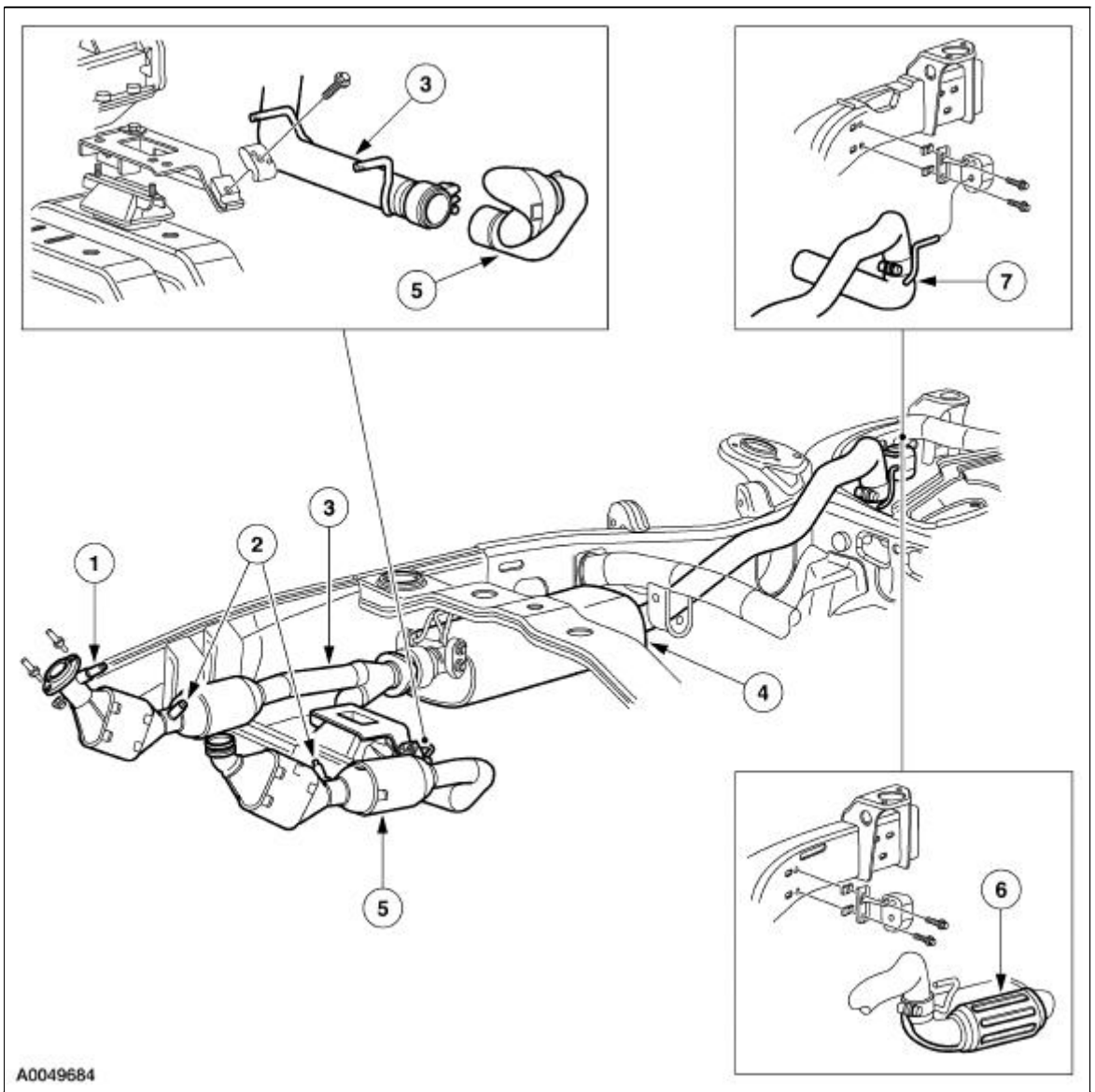
Torque Specifications

Description	Nm	lb-ft
Catalytic converter-to-exhaust manifold nuts	40	30
Exhaust clamp nut	48	35
Converter bracket and insulator bolt	40	30
Converter-to-muffler bolts	40	30
Exhaust hanger-to-frame bolts	20	15
Heated oxygen and catalyst monitor sensors	40	30

Exhaust System

The exhaust system consists of the components shown in the following illustrations.

Exhaust System Components — 4.6L and 5.4L 2V shown, 5.4L 4Vsimilar



Item	Part Number	Description
1	9F472	Heated oxygen sensor
2	9F472	Catalyst monitor sensor
3	5E212	RH catalytic converter
4	5230	Muffler
5	5E212	LH catalytic converter
6	—	Resonator (5.4L 4V only)

7	5202	Extension pipe (4.6L and 5.4V 2V)

Exhaust System

Inspection and Verification

1. Verify the customer's concern by running the engine or road testing the vehicle to duplicate the condition.
2. Visually inspect for obvious signs of mechanical and electrical damage. Refer to the following chart.

Visual Inspection Chart

Mechanical
● Exhaust pipe pinched, crushed. ● Broken or damaged muffler. ● Broken or damaged exhaust pipe. ● Broken or damaged catalytic converter. ● Cracked exhaust manifold.

3. If the fault is not visually evident, determine the symptom and GO to Symptom Chart.

Symptom Chart

SYMPTOM CHART

Condition	Possible Sources	Action
● Noisy or leaking exhaust	● Exhaust leak. ● Misaligned exhaust. ● Loose clamps. ● Restricted exhaust.	● REPAIR as necessary.
● Loss of power	● Kinked or damaged exhaust pipe. ● Clogged catalytic converter. ● Foreign object in exhaust pipe.	● REPAIR as necessary.

Exhaust System Alignment

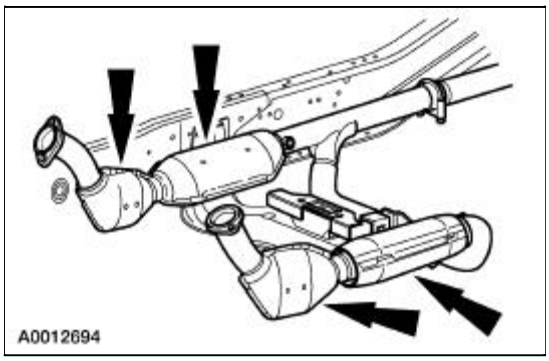
1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Check for loose, damaged, or missing heat shields. Install new heat shields as necessary. Check for any trapped debris between the heat shields and the exhaust system components.
3. Loosen all exhaust component fasteners and clamps from the exhaust manifolds to the muffler extension pipe.
4. **NOTE:** Make sure the exhaust insulators are hanging straight up and down and are free to move.

   Beginning at the front of the vehicle, align the exhaust system to establish the maximum clearance. Make sure that all slip fit pipes are pushed all the way into the preceding pipe and the notches are correctly lined up with the tabs.
5. Beginning at the front of the vehicle, tighten all fasteners and clamps to specification. For additional information, refer to Specifications in this section.
6. Start the engine and check the exhaust system for leaks.

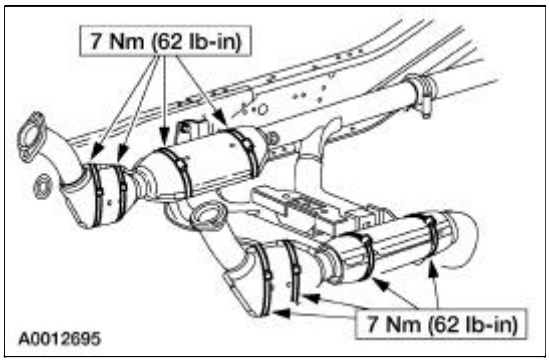
Exhaust Heat Shields

Removal and Installation

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Inspect the exhaust system for loose or missing heat shields or debris trapped between the heat shields and the exhaust system components.



3. If any heat shields are loose, install worm gear clamps.
   - Use one of the following clamps: FOTZ-5A231–A or W705949–S300.
   - Trim off the excess ear of the worm clamp.

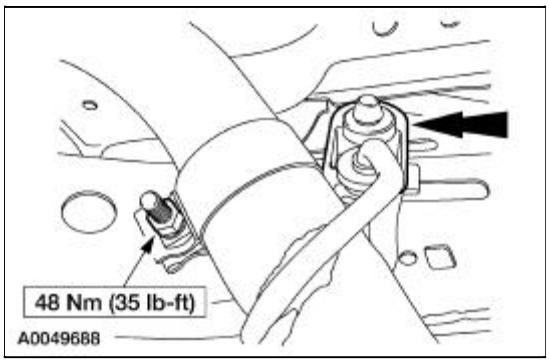


4. If the heat shields are missing, install new heat shields or exhaust system components as necessary.
5. Lower the vehicle.

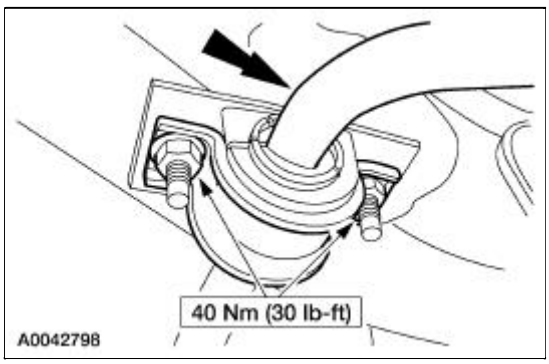
Muffler And Tailpipe

Removal and Installation

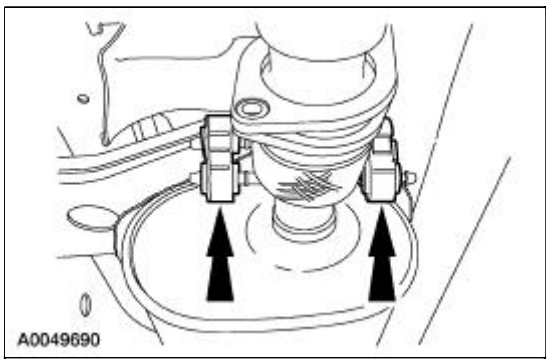
1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Loosen the clamp, detach the isolator and remove the extension pipe or, if equipped, remove the resonator.



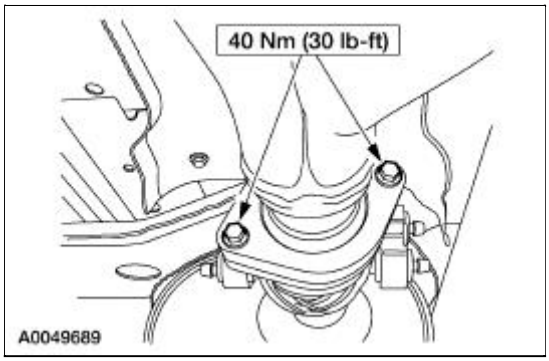
3. Remove the four nuts and two stabilizer bar brackets.
   - Allow the bar to hang from the links.



4. Using a suitable jack stand, support the muffler.
5. Detach the isolators from the muffler.

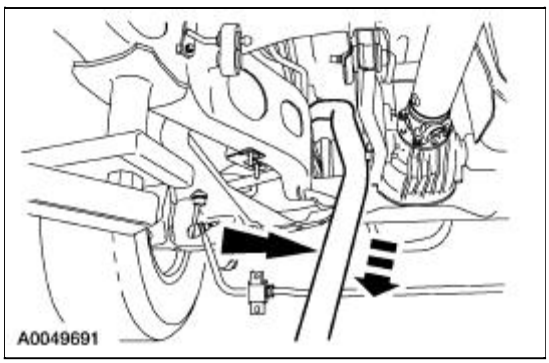


6. Remove and discard the bolts and flag nuts.



7. **CAUTION: Make sure not to make contact with the axle boots while routing the muffler outlet over the rear axle or damage to the boots may result.**

   Remove the muffler and tailpipe assembly.



8. To install, reverse the removal procedure.

Dual Converter Y-Pipe

Material

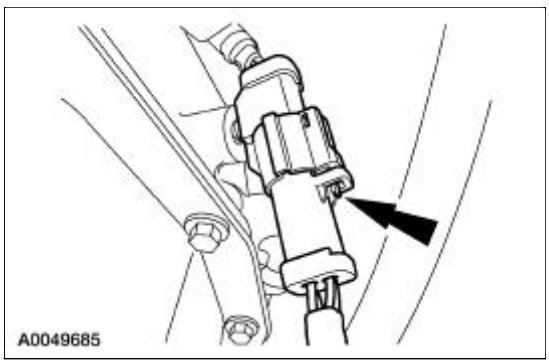
Item	Specification
High Temperature Nickel Anti-Seize Lubricant F6AZ-9L494-AA	ESE-M12A4-A

Removal and Installation

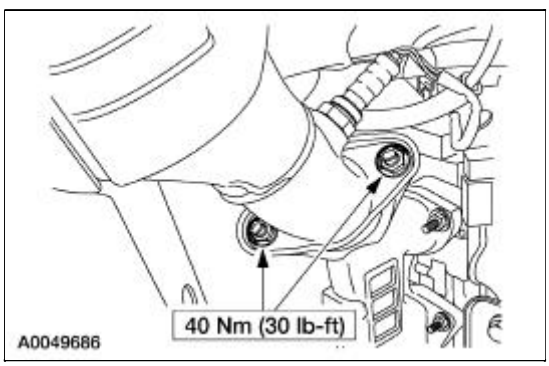
NOTE: The dual converter Y-pipe is a two-piece assembly. The RH and LH converters can be serviced separately as needed.

Both RH and LH converters

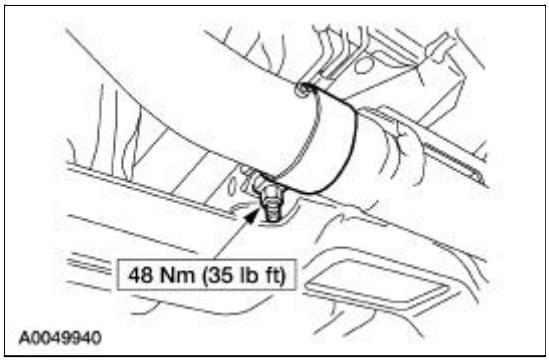
1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Disconnect the heated oxygen and catalyst monitor sensors.



3. Remove and discard the catalytic converter-to-exhaust manifold nuts.



4. Loosen the clamp.

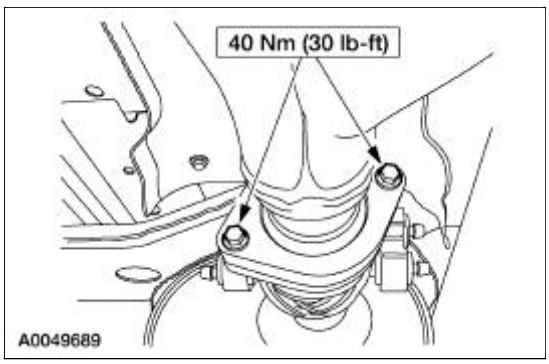


LH converter only

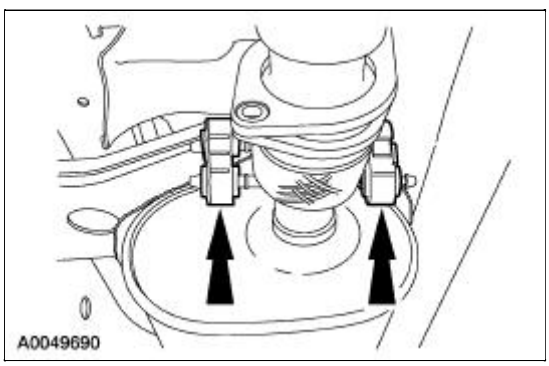
5. Separate and remove the LH converter.

RH converter only

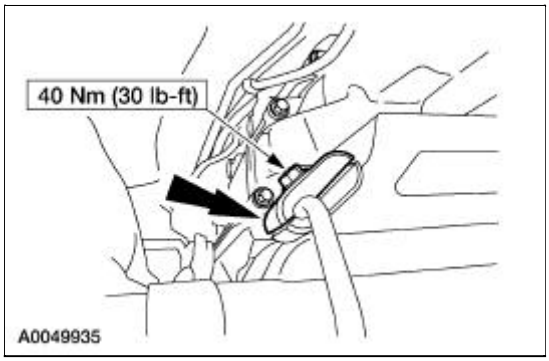
6. Remove and discard the bolts and flag nuts.



7. Using a suitable jack stand, support the muffler.
8. Detach the isolators and lower the muffler assembly.



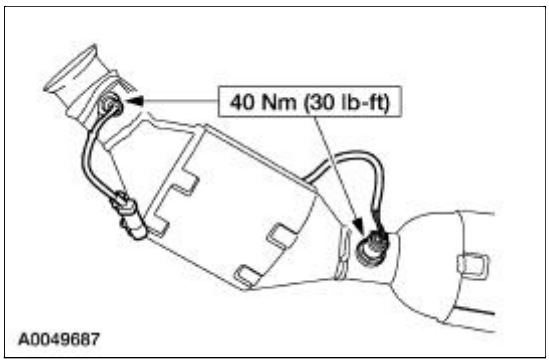
9. Remove the bolt, isolator cap and the RH converter.



Both RH and LH converters

10. **NOTE:** Make sure to apply anti-seize lubricant to the threads of the sensors before installation.

    If necessary, remove the heated oxygen and the catalyst monitor sensors.



11. **CAUTION: Do not tighten the fasteners until all components are assembled, making sure to tighten all fasteners beginning at the front of the vehicle.**

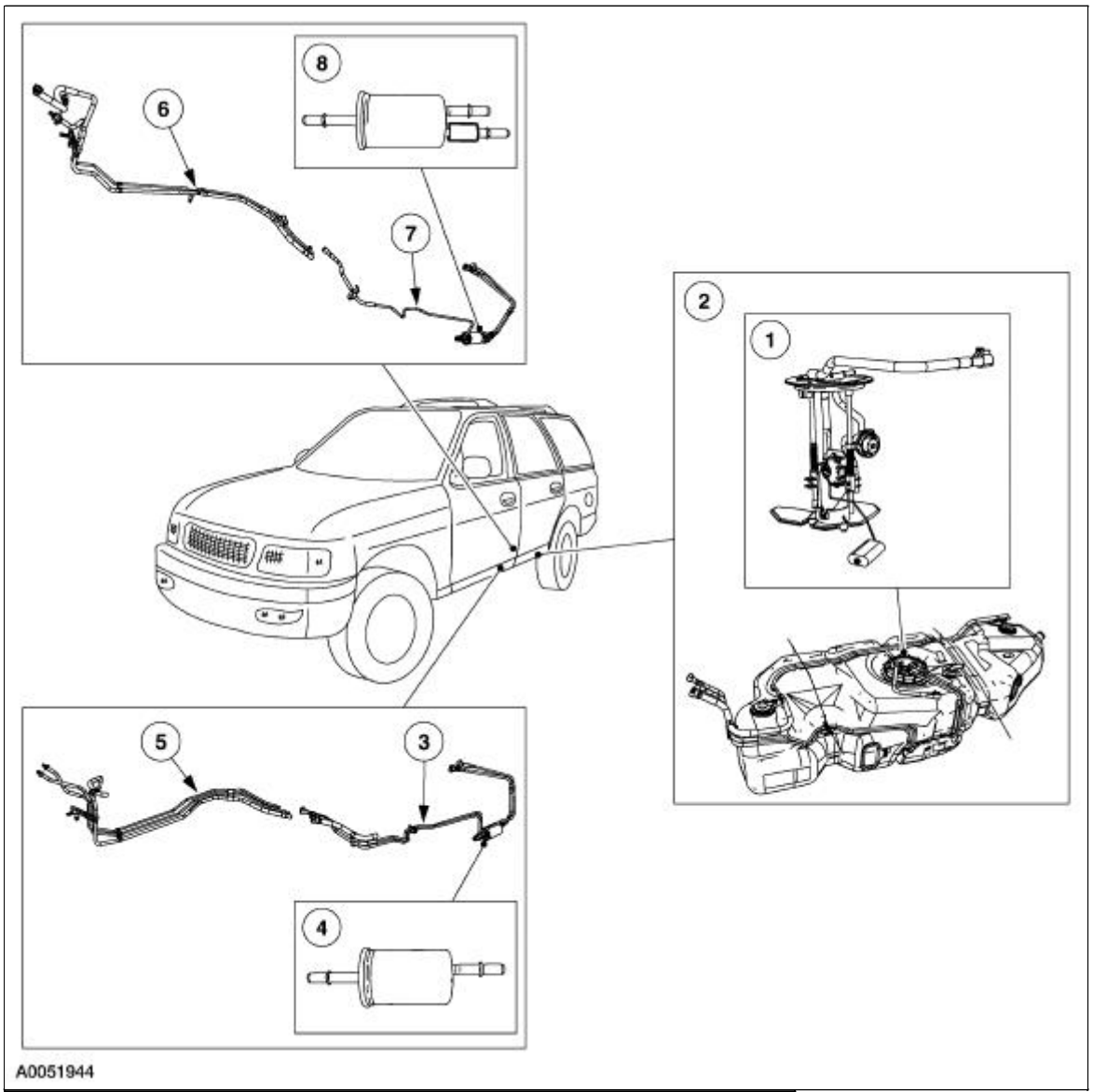
    To install, reverse the removal procedure.

General Specifications

Item	Specification
Fuel Tank Capacity	106 L (28.0 Gal.)
Fuel Pressure	
5.4L 4V key on, engine off kPa (psi)	242-310 (35-45)
5.4L 4V engine running kPa (psi)	193-310 (28-45)
5.4L 2V key on, engine off kPa (psi)	379 (55)
5.4L 2V engine running kPa (psi)	379 (55)
4.6L 2V key on, engine off kPa (psi)	345 (50)
4.6L 2V engine running kPa (psi)	345 (50)
Lubricants	
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Fuel System

Component Location



Item	Part Number	Description
1	9H307	Fuel pump and sender assembly
2	9K007	Fuel tank assembly
3	9J337	Tank fuel line assembly (Navigator)
4	9155	Fuel filter (Navigator)
5	9J279	Fuel supply, return and vapor tube (Navigator)
6	2S284	Fuel supply and vapor tube (Expedition)
7	9J337	Tank fuel line assembly (Expedition)
8	9155	Fuel filter (Expedition)

The vehicle:

- is equipped with a multiport fuel injection system.
- has separately controlled fuel injectors mounted to the intake manifold for each cylinder.
- has fuel injectors that are supplied with pressurized fuel from the fuel pump through the fuel injection supply manifold.

The 5.4L 4V engine:

- has a fuel injection supply manifold which is equipped with a fuel pressure regulator.
- has a fuel pressure regulator controlling the pressure going to the fuel injectors.
- has excess fuel to the fuel injectors returned to the fuel tank.

The 4.6L and 5.4L (2V) engines:

- have a returnless fuel supply manifold.
- have a fuel pressure regulator mounted to the fuel pump assembly inside the fuel tank.
- have a fuel injection supply manifold which is equipped with a fuel pressure damper.

Fuel System

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Fuel System Pressure Release

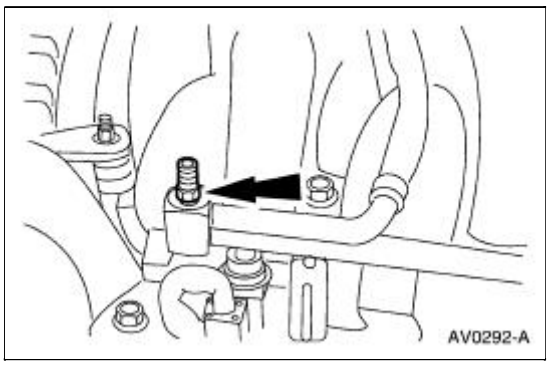
Special Tool(s)

 ST1371-A	Fuel Pressure Gauge 310-012 (T80L-9974-B)

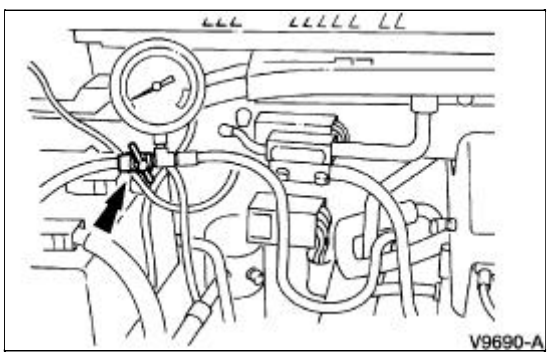
WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related component. Highly flammable mixtures are always present and may be ignited, resulting in possible personal injury.

WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before servicing or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved to prevent accidental spraying of fuel, causing personal injury or a fire hazard.

1. Remove the schrader valve cap and install the special tool.



2. Open the manual valve slowly on the special tool and relieve the fuel pressure.
   - This will drain some fuel out of the system. Place the fuel in a suitable container.



Fuel Tank Draining

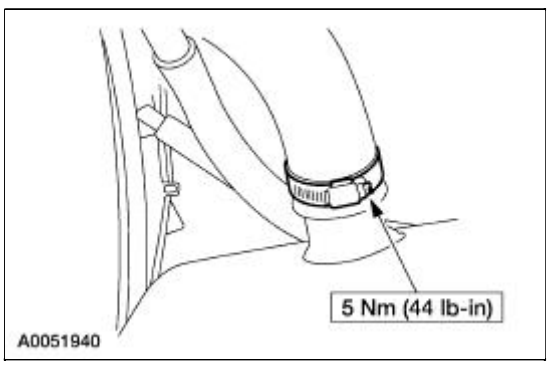
Special Tool(s)

 ST2134-A	Fuel Tank Drain Hose 310-F013
 ST1114-A	Hand Operated Fuel Storage Tank 164-R3201 or equivalent

WARNING: Do not smoke, carry lighted tobacco or open flame of any type when working on or near any fuel- related component. Highly flammable mixtures are always present and can be ignited, resulting in possible personal injury.

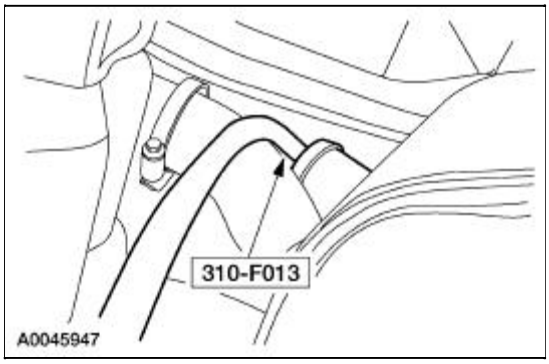
1. If equipped, turn the air suspension switch off.
2. Release the fuel system pressure. For additional information, refer to Fuel System Pressure Release in this section.
3. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
4. **CAUTION: The fuel filter is located near the left side frame rail on the fuel tank. Correct placement of the vehicle hoisting equipment is necessary to prevent damaging any fuel system components.**

   Raise and support the vehicle. For additional information, refer to Section 100-02 .
5. Disconnect the fuel tank filler pipe from the fuel tank.



6. **NOTE:** Follow the operating instructions of the equipment manufacturer.

Using the special tool, siphon the fuel from the fuel tank opening into a suitable container.



Spring Lock Couplings

Special Tool(s)

 ST1146-A	Disconnect Tool, Spring Lock Coupling (3/8 inch) 310-D004 (D87L-9280-A) or equivalent
 ST1147-A	Disconnect Tool, Spring Lock Coupling (1/2 inch) 310-D005 (D87L-9280-B) or equivalent

Material

Item	Specification
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Disconnect

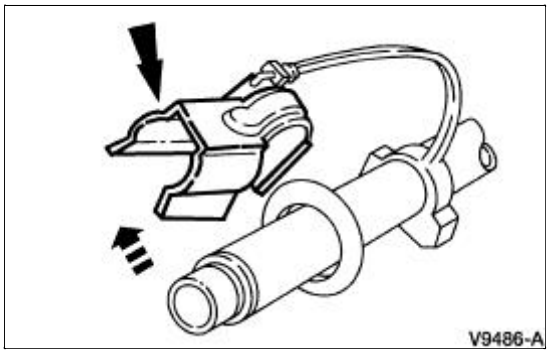
WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel- related component. Highly flammable mixtures are always present and may be ignited, resulting in possible personal injury.

WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before servicing or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved to prevent accidental spraying of fuel, causing personal injury or a fire hazard.

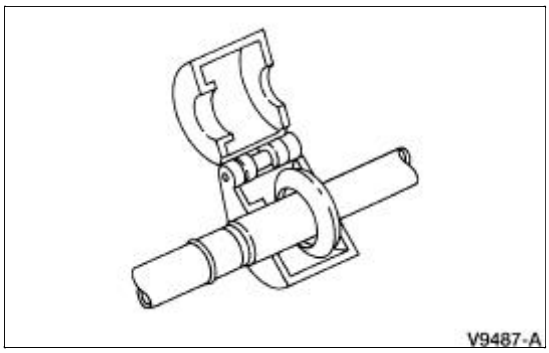
NOTE: These couplings are used to connect the fuel hoses to the fuel supply manifold.

1. Relieve the fuel pressure. For additional information, refer to Fuel System Pressure Release in this section.

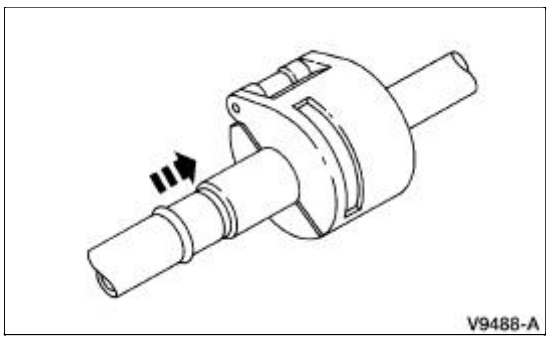
2. Remove the fuel tube clip.



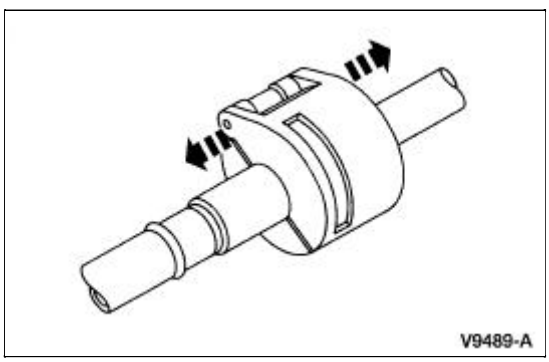
3. Install the Disconnect Tool.



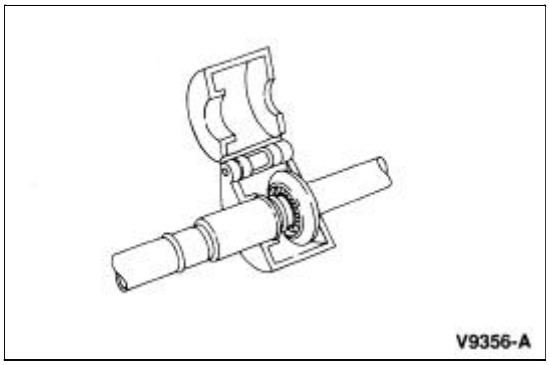
4. Close and push the Disconnect Tool into the open side of the cage.



5. Separate the fitting.

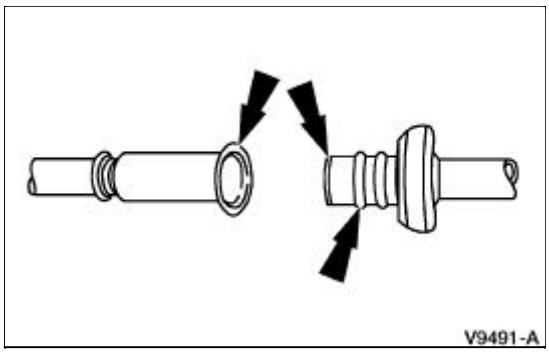


6. Remove the Disconnect Tool.



Connect

1. To connect the fittings, reverse the disconnect procedure.
    - Inspect and clean both the coupling ends.
    - Lubricate the O-rings with clean engine oil.



Quick Release Coupling

Disconnect

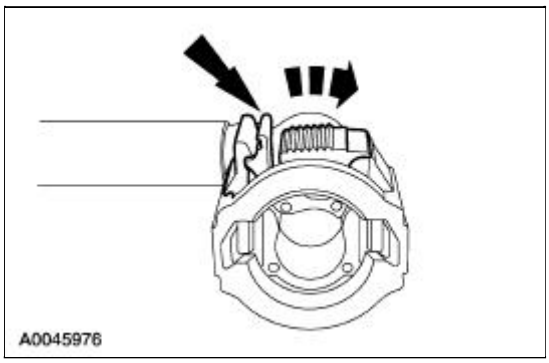
WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel- related component. Highly flammable mixtures are always present and can be ignited, resulting in possible personal injury.

WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before servicing or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved to prevent accidental spraying of fuel, causing personal injury or a fire hazard.

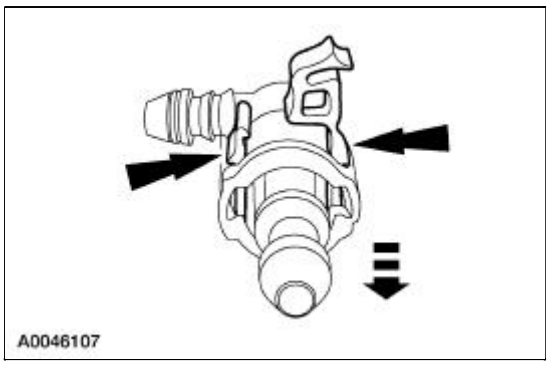
NOTE: These couplings are used to connect the fuel tank fuel lines to the front fuel lines, and the pump/sender assembly ports.

1. Release the fuel system pressure. For additional information, refer to Fuel System Pressure Release in this section.

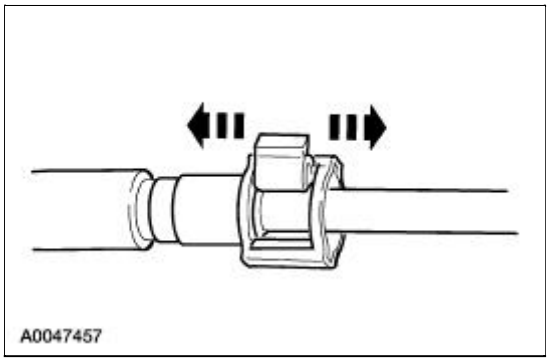
2. Unclip the tab.



3. Depress the tabs and press the clip downward.



4. Separate the fittings.



5. To connect the fittings, reverse the disconnect procedure.

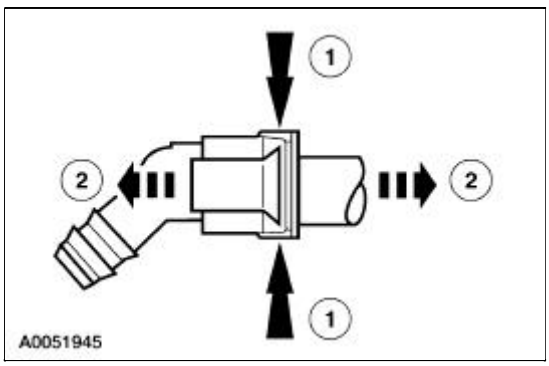
Vapor Tube Fittings

Removal

1. **WARNING: The evaporative emission system contains fuel vapor and condensed fuel vapor. Although not present in large quantities, it still presents the danger of explosion or fire. Disconnect the battery ground cable from the battery to minimize the possibility of an electrical spark occurring, possibly causing a fire or explosion if fuel vapor or fuel liquid is present in the area.**

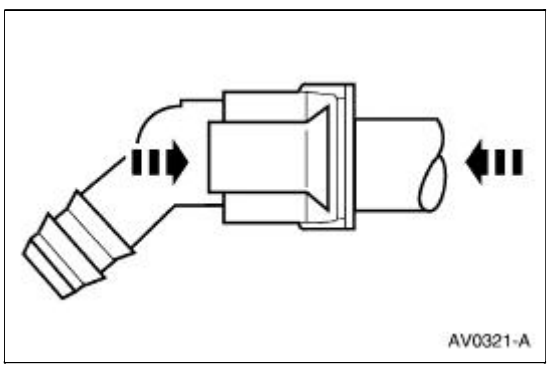
   Disconnect the battery ground cable.

2. Disconnect the vapor tube from the fitting.
   1. Squeeze the fitting.
   2. Disconnect the vapor tube from the fitting.

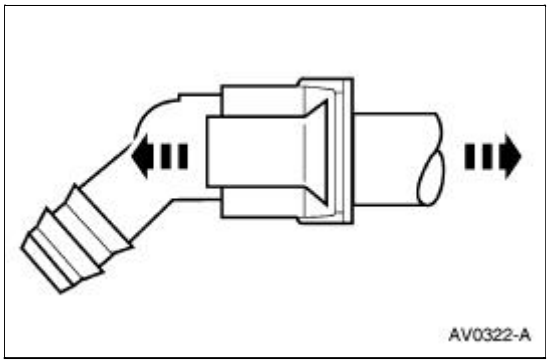


Installation

1. Inspect the fitting and the tube for damage.
2. Remove any dirt or obstructions.
3. Push the tube into the fitting until it snaps in place.



4. Pull on the connection to make sure the fitting is secure.

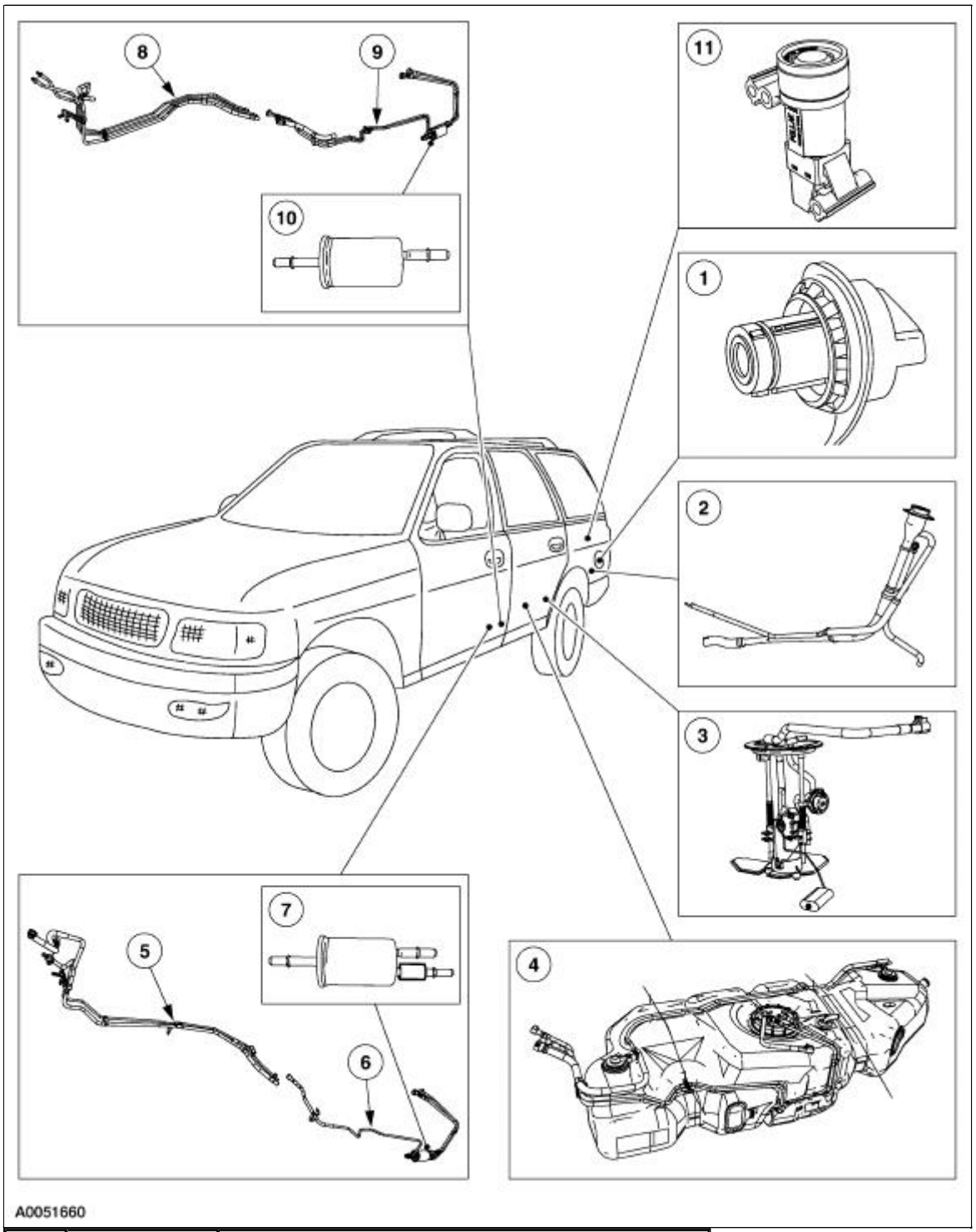

AV0322-A

Torque Specifications

Description	Nm	lb-ft	lb-in
Fuel pump sending unit ring	95	70	—
Fuel tank support strap bolts	55	41	—
Skid plate bolts	25	18	—
Fuel filler neck bracket bolts (2 req'd)	18	13	—
Fuel lines rear bracket nut (Expedition 4x2)	20	15	—
Fuel line rear bracket nut (Navigator and Expedition 4x4)	9	—	80
Fuel tank filler pipe vent hose and fill pipe hose clamps	5	—	44

Fuel Tank And Lines

Component Location



Item	Part Number	Description
1	9030	Fuel tank filler cap
2	9034	Fuel tank filler pipe assembly

3	9H307	Fuel pump and sender assembly
4	9K007	Fuel tank assembly
5	2S284	Fuel supply and vapor tube (Expedition)
6	9J337	Tank fuel line assembly (Expedition)
7	9155	Fuel filter (Expedition)
8	9J279	Fuel supply, return and vapor hose (Navigator)
9	9J337	Tank fuel line assembly (Navigator)
10	9155	Fuel filter (Navigator)
11	9341	Inertia fuel shutoff switch

The fuel system consists of:

- the fuel tank assembly.
- the fuel tank filler pipe which contains a restrictor plate to permit only unleaded fuel to be pumped into the fuel tank.
- a 1/8 turn type fuel tank filler cap.
- a fuel filter to protect the fuel injectors located on the fuel tank assembly.
- fuel lines.
- fuel pressure regulator, located on the fuel supply manifold for Navigator and inside the fuel tank assembly on the fuel pump for Expedition.
- a fuel pump containing:
    - the electric fuel pump which provides pressurized fuel to the engine.
    - the fuel level sensor.
    - an inlet filter.
    - a check valve which maintains system pressure after the pump is shut off.
    - a pressure relief valve for overpressure protection in the event of restricted flow.

The fuel pump is controlled by the powertrain control module (PCM) which energizes the fuel pump relay. Electrical power to the pump is provided through the inertia fuel shutoff switch.

Fuel Tank And Lines

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Fuel Tank

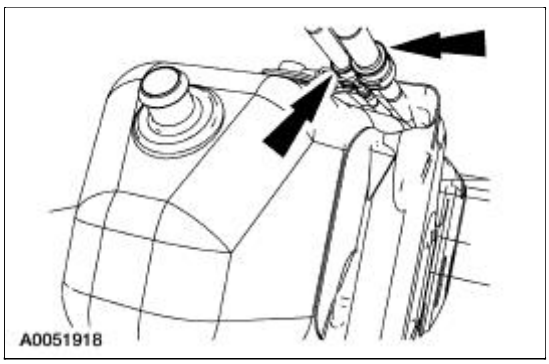
Removal

WARNING: Do not smoke, carry lighted tobacco or open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and can be ignited, resulting in possible personal injury.

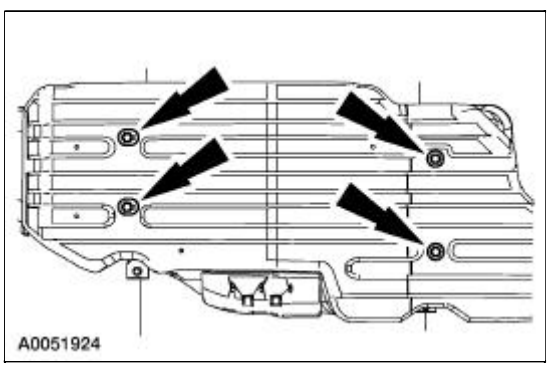
WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before servicing or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved to prevent accidental spraying of fuel, causing personal injury or a fire hazard.

CAUTION: The fuel filter is located near the left side frame rail on the fuel tank. Correct placement of the vehicle hoisting equipment is necessary to prevent damaging any fuel system components.

1. Release the fuel system pressure. For additional information, refer to Section 310-00 .
2. Drain the fuel tank. For additional information, refer to Section 310-00 .
3. Disconnect the vapor hoses at the rear of the fuel tank.

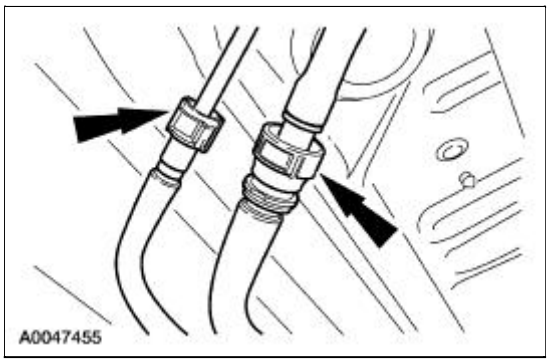


4. If equipped, remove the fuel tank skid plate.



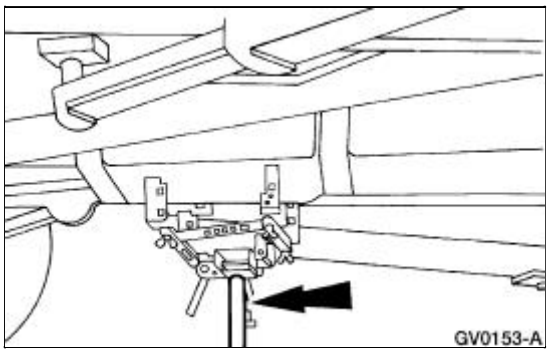
5. **NOTE:** The 4.6L and 5.4L (2V) engines are equipped with returnless fuel systems. The 5.4L 4V engine is equipped with a return-type fuel system.

Disconnect the vapor hose and the fuel hose(s) forward of the fuel tank. For additional information, refer to Section 310-00 .



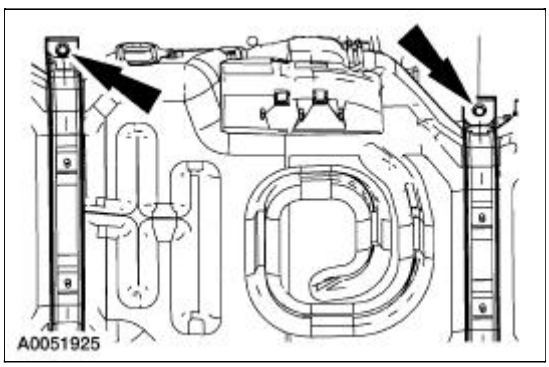
6. **CAUTION: Do not support the fuel tank directly beneath the fuel pump mounting area. Damage to the fuel pump assembly can occur.**

   Position a suitable jack under the fuel tank.

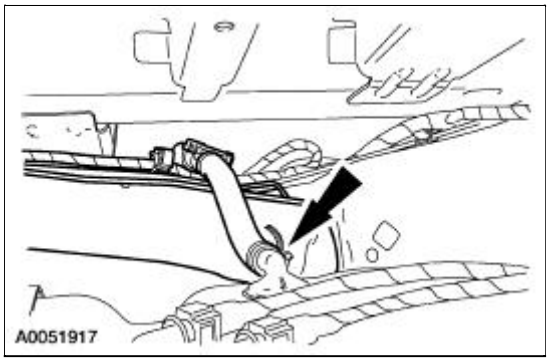


7. **NOTE:** The location of the fuel vent hose is critical to fuel system operation. Note the routing of the fuel vent hose at this time.

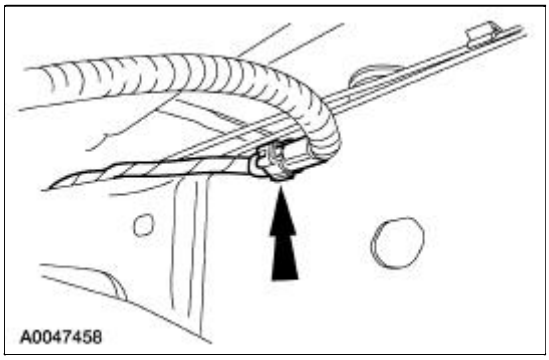
   Remove the fuel tank front and rear support straps and lower the front of the fuel tank approximately 25 mm (1 in).



8. Loosen the clamp and disconnect the vent hose from the fuel tank vent spout.



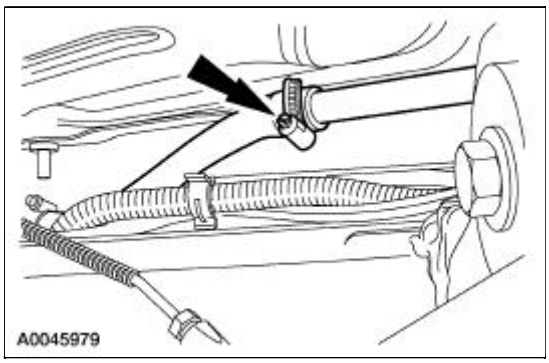
9. Disconnect the fuel pump electrical connector.



10. Remove the fuel tank from the vehicle.

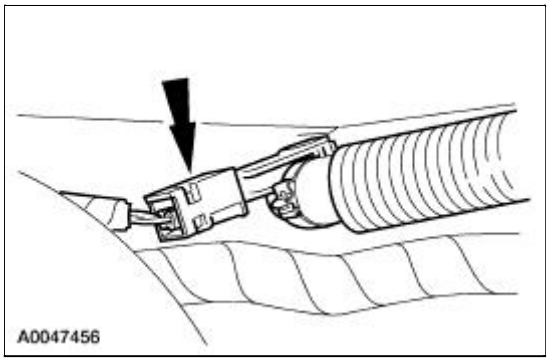
11. **NOTE:** The clamp is located on the top of the left side frame rail.

    Loosen the clamp and disconnect the hose from the fuel fill pipe vent tube.

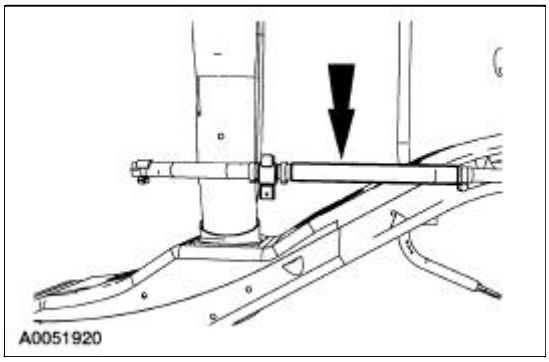


12. **NOTE:** The fuel tank pressure sensor is located forward of the left rear wheel well above the frame rail.

    Disconnect the fuel tank pressure sensor electrical connector.

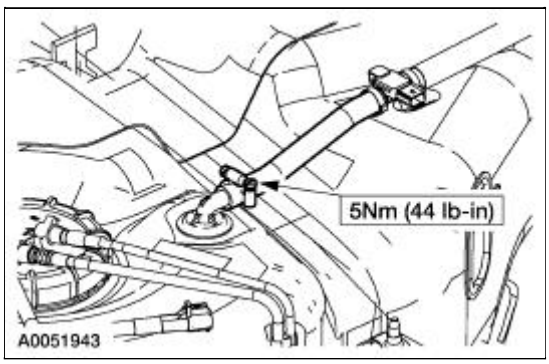


13. Remove the vent hose assembly.



Installation

1. Install the vent hose to the fuel tank vent spout.

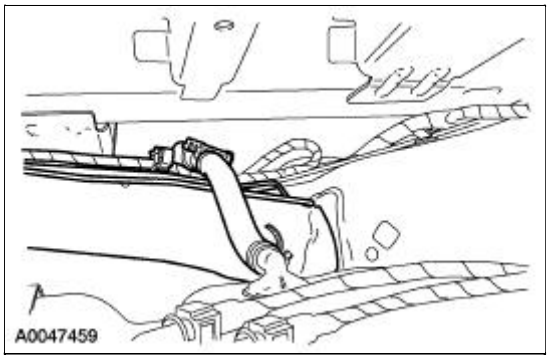


2. **CAUTION: Do not support the fuel tank directly beneath the fuel pump mounting area. Damage to the fuel pump assembly can occur.**

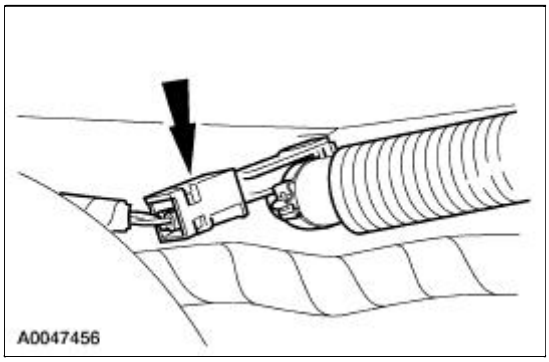
   CAUTION: Correct routing of the fuel vent hose and fuel tank pressure sensor is critical to fuel system operation. Make sure that the fuel vent hose and fuel tank pressure sensor are routed above the crossmember and brake cables.

   NOTE: If a new fuel tank is being installed, transfer the fuel vent hose and fuel tank pressure sensor to the new tank.

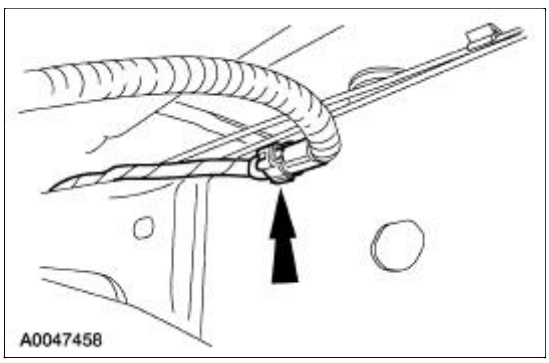
   Position the fuel tank in the vehicle.



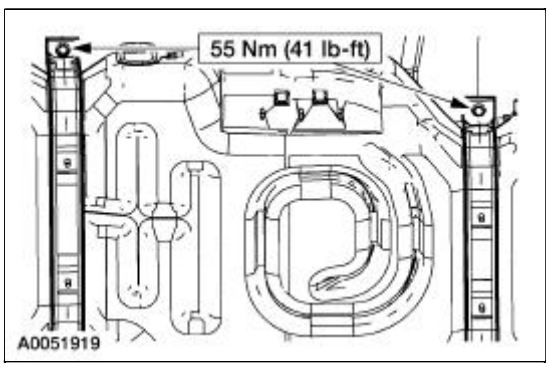
3. Connect the fuel tank pressure sensor electrical connector.



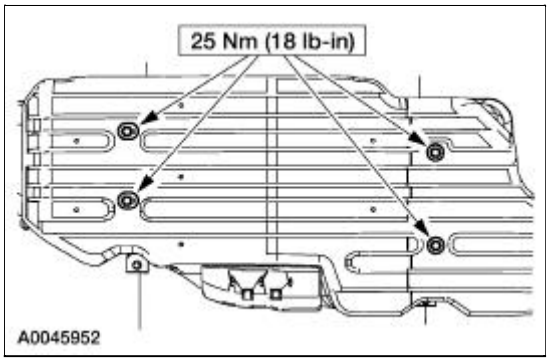
4. Connect the fuel pump electrical connector.



5. Install the front and rear support straps.

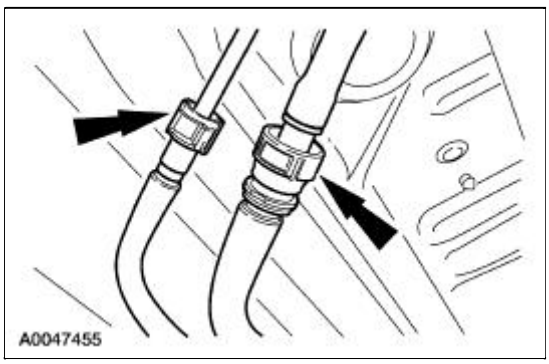


6. If equipped, install the fuel tank skid plate.

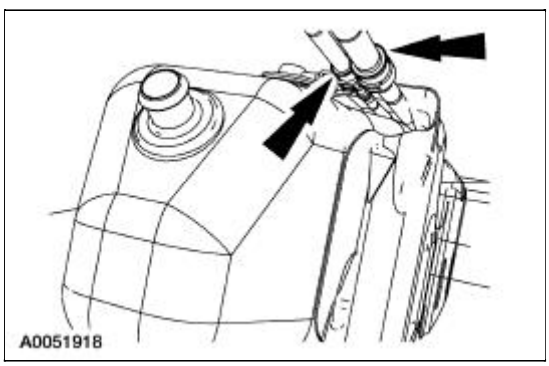


7. **NOTE:** The 4.6L and 5.4L (2V) engines are equipped with returnless fuel systems. The 5.4L 4V engine is equipped with a return-type fuel system.

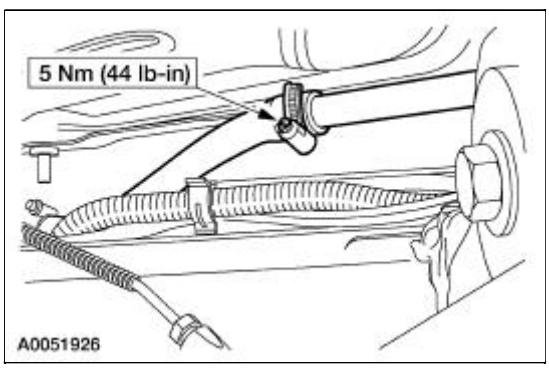
   Connect the vapor hose and the fuel hose(s) forward of the fuel tank. For additional information, refer to Section 310-00 .



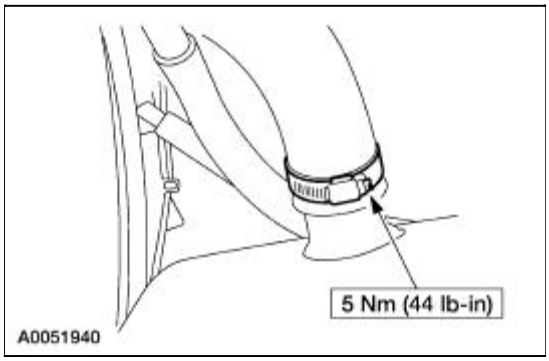
8. Connect the vapor hoses at the rear of the fuel tank.



9. Connect the vent hose to the filler pipe.



10. Connect the fuel filler hose.



11. Fill the fuel tank.

Fuel Pump Module

Special Tool(s)

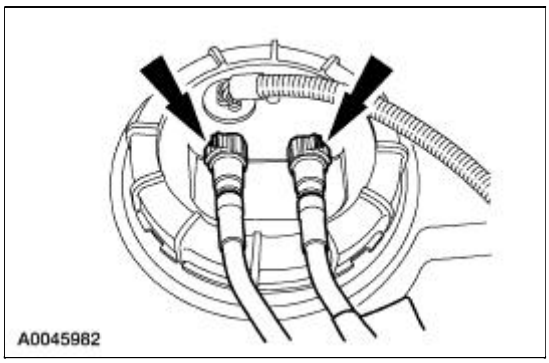
 ST2672-A	310-075 Wrench, Fuel Tank Lock Ring

Removal and Installation

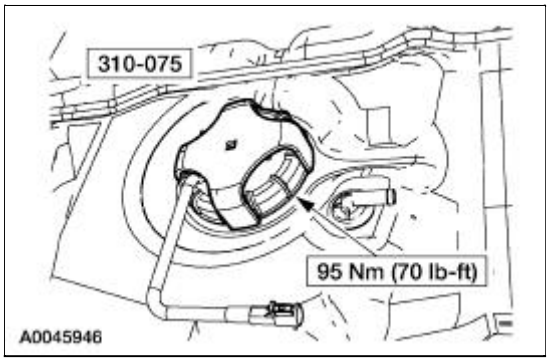
WARNING: Do not smoke, carry lighted tobacco or open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and can be ignited, resulting in possible personal injury.

WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before servicing or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved to prevent accidental spraying of fuel, causing personal injury or a fire hazard.

1. Remove the fuel tank. For additional information, refer to Fuel Tank in this section.
2. Disconnect the quick release fittings from the fuel pump. For additional information, refer to Section 310-00 .



3. Using the special tool, remove the fuel pump lock ring.

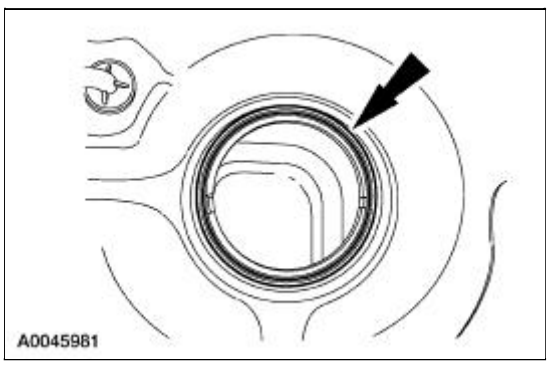


4. **CAUTION: Carefully remove the fuel pump assembly to avoid damaging the fuel level sensor.**

   Remove the fuel pump assembly.

5. **CAUTION: Note the location of the fuel pump alignment tabs.**

   Remove the O-ring.



6. Remove the fuel level sensor. For additional information, refer to Fuel Level Sensor in this section.

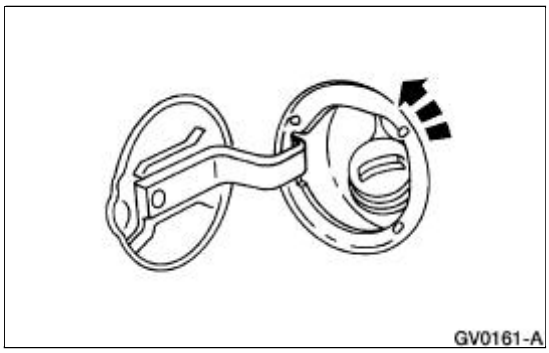
7. To install, reverse the removal procedure.

Fuel Tank Filler Pipe

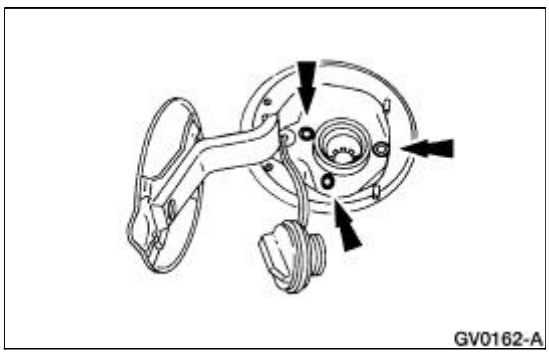
Removal and Installation

WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and can be ignited, resulting in possible personal injury.

1. Remove the fuel tank filler cap.



2. Remove the screws.

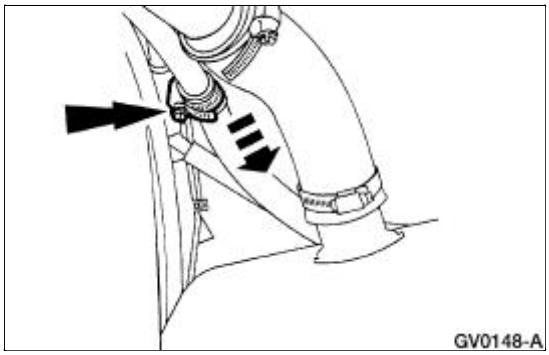


3. **CAUTION: The fuel filter is located near the left side frame rail on the fuel tank. Correct placement of the vehicle hoisting equipment is necessary to prevent damaging any fuel system components.**

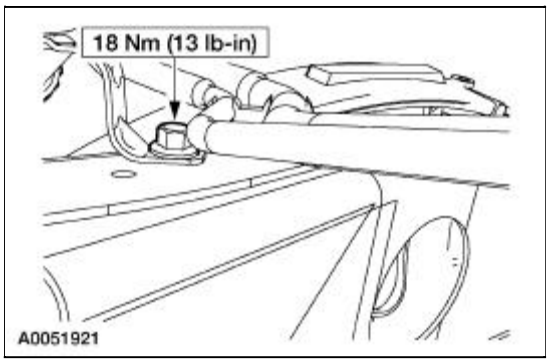
   Raise the vehicle on a hoist. For additional information, refer to Section 100-02 .

4. Remove the evaporative emissions canister assembly. For additional information, refer to Section 303-13 .

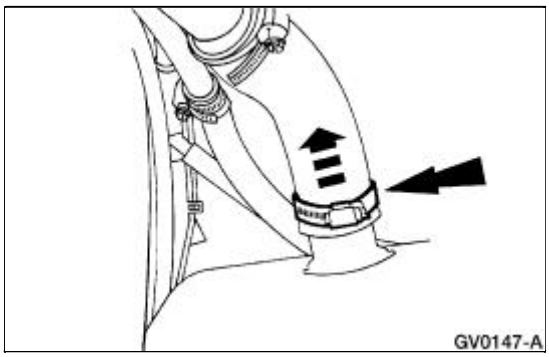
5. Loosen the hose clamp and disconnect the fuel filler vent hose from the fuel tank filler pipe.



6. Remove the two bolts from the filler pipe bracket.



7. Disconnect the fuel tank from the filler pipe hose and remove the fuel tank filler pipe.



8. To install, reverse the removal procedure.

Fuel Filter

Removal and Installation

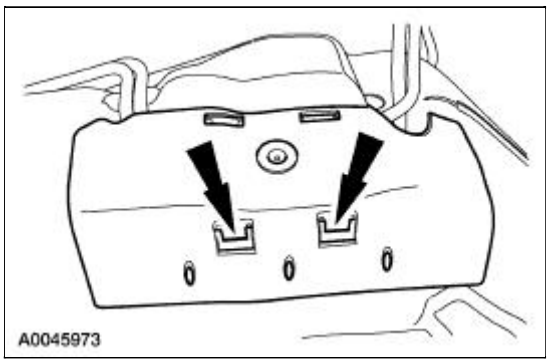
All vehicles

WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel- related component. Highly flammable mixtures are always present and can be ignited, resulting in possible personal injury.

WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before servicing or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved to prevent accidental spraying of fuel, causing personal injury or a fire hazard.

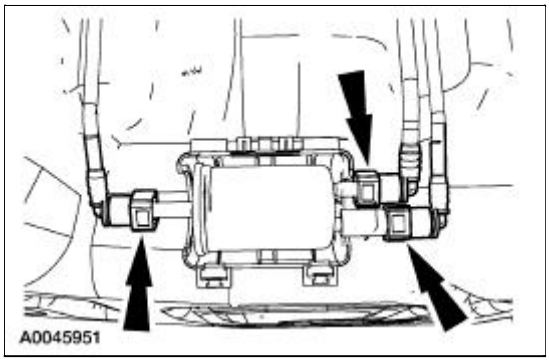
1. Release the fuel system pressure. For additional information, refer to Section 310-00 .
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
3. **CAUTION: The fuel filter is located near the left side frame rail on the fuel tank. Correct placement of the vehicle hoisting equipment is necessary to prevent damaging any fuel system components.**

   Raise and support the vehicle on a hoist. For additional information, refer to Section 100-02 .
4. Insert a medium flat-blade screwdriver in the the fuel filter protective cover tabs, turn 45 degrees, and gently remove the cover from the tank.



Vehicles equipped with 4.6L and 5.4L (2V) engines

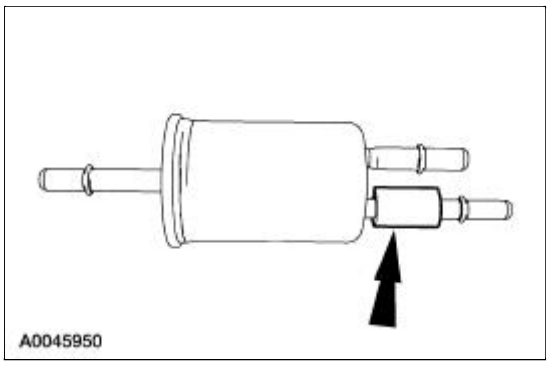
5. Disconnect the fittings.



6. **NOTE:** Note the location of the fuel tube orientation sleeve.

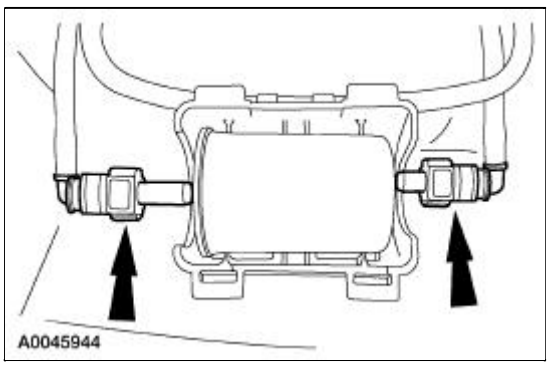
   Remove the fuel filter.

7. Remove the fuel tube orientation sleeve from the fuel filter.

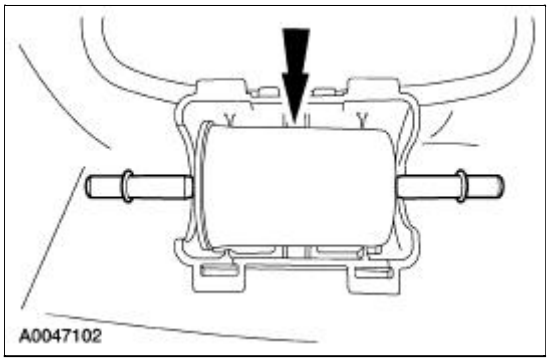


Vehicles equipped with 5.4L (4V) engines

8. Disconnect the fittings.



9. Remove the fuel filter.



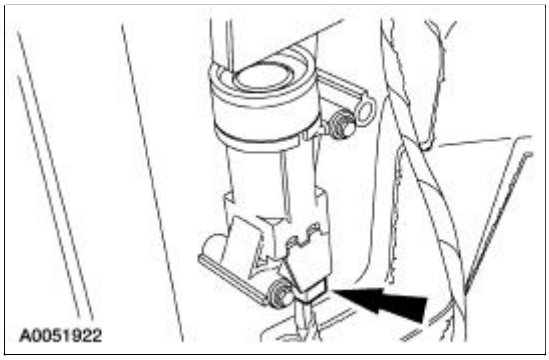
All vehicles

10. To install, reverse the removal procedure.

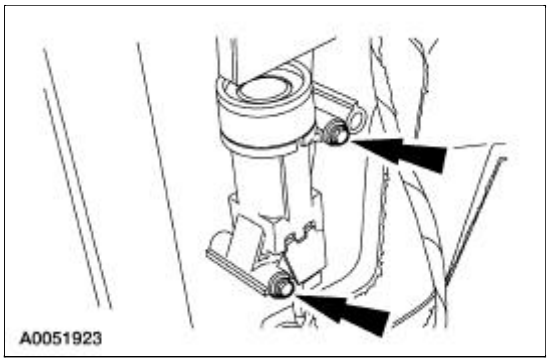
Inertia Fuel Shutoff (IFS) Switch

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the LH rear interior trim panel.
3. Disconnect the inertia fuel shutoff (IFS) switch electrical connector.



4. Remove the bolts and the inertia fuel shutoff (IFS) switch.

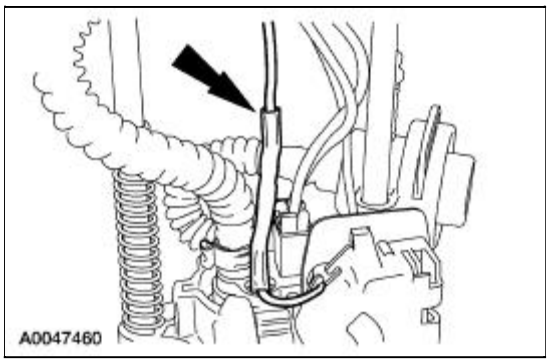


5. To install, reverse the removal procedure.

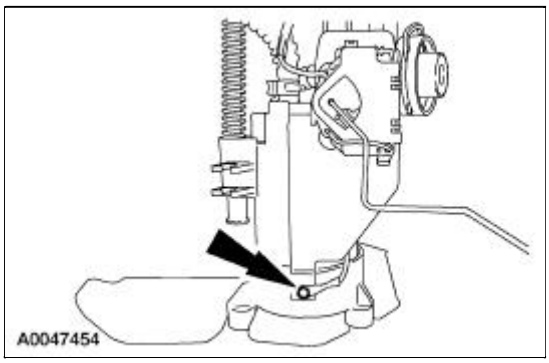
Fuel Level Sensor

Removal and Installation

1. Remove the fuel pump module. For additional information, refer to Fuel Pump Module in this section.
2. Remove the shrink wrap and disconnect the electrical connector.



3. Remove the fastener and lift the fuel level sensor from the fuel pump module.



4. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-ft	lb-in
Accelerator pedal bolts	25	18	—
Appearance cover nuts	10	—	89
Appearance cover mounting bracket bolts	10	—	89
Accelerator cable bracket bolts	10	—	89

Acceleration Control

The throttle is controlled by an accelerator cable attached to the accelerator pedal. The accelerator pedal should travel smoothly from the idle position to the wide open throttle position. Hesitation or binding should not be experienced at any portion of the accelerator pedal travel. Surrounding components such as wiring, hoses, sound insulator and floor carpet must not contact the sliding inner member of the accelerator cable, or interfere with the accelerator pedal.

All vehicles are equipped with adjustable pedals. This allows both the accelerator and brake pedals to be adjusted simultaneously forward or rearward. A rocker switch on the instrument panel provides adjustment on the pedal's assembly when it is activated. On vehicles with the memory seat option, the pedal's position can be controlled by the memory selection, as well as the rocker switch. The accelerator pedal can be serviced separately from the brake pedal. The components in the acceleration control system are not adjustable and new components must be installed if damaged or worn.

Acceleration Control

Inspection and Verification

1. Verify the customer's concern by operating the acceleration control system to duplicate the condition.
2. Inspect to determine if any of the following mechanical concerns apply:

Visual Inspection Chart

Mechanical
● Damaged accelerator pedal and shaft ● Damaged linkage ● Damaged accelerator cable ● High engine idle speed ● Damaged throttle body ● Damaged or binding adjustable pedal assembly

3. If the inspection reveals an obvious concern that can be readily identified, repair it as required.
4. If the concern remains after the inspection, determine the symptom(s). GO to Symptom Chart .

Symptom Chart

Symptom Chart

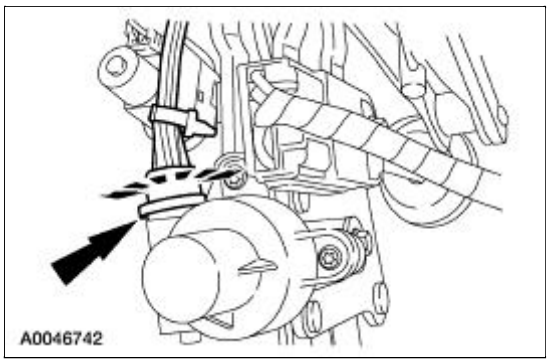
Condition	Possible Sources	Action
● Excessive effort is needed to depress accelerator cable	● Interference between accelerator cable and foreign object or another component under dash.	● CORRECT interference condition.
	● Interference between accelerator pedal and foreign object or another component.	● CORRECT interference condition.
	● Accelerator cable binding.	● INSTALL a new accelerator cable.
	● Worn or damaged throttle body.	● INSTALL a new throttle body. REFER to Section 303-04A (4.6L, 5.4L 2V) or Section 303-04B (5.4L 4V).
	● Worn accelerator lever pivot bushing.	● INSTALL a new accelerator pedal.

• Accelerator pedal binds or sticks	• Foreign object caught under pedal or in linkage under dash. • Floormat interference with pedal. • Kinked accelerator cable. • Worn or damaged throttle body.	• CHECK accelerator pedal and linkage. • CHECK floormat and floormat hook. • INSTALL a new accelerator cable. • INSTALL a new throttle body. REFER to Section 303-04A (4.6L, 5.4L 2V) or Section 303-04B (5.4L 4V).
• Engine idle speed is high and throttle is held off the throttle body idle stop	• Foreign object caught in accelerator pedal linkage. • Kinked or bound accelerator cable.	• CHECK the accelerator pedal linkage. • INSTALL a new accelerator cable.
• Engine idle speed is high and throttle is NOT held off the throttle body idle stop.	• Vacuum leak. • Electronic engine control system.	• CHECK for disconnected or damaged vacuum lines. • Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
• The accelerator pedal feels rough or raspy	• Frayed or binding accelerator cable. • Worn or damaged throttle body.	• INSTALL a new accelerator cable. • Install a new throttle body. REFER to Section 303-04A (4.6L, 5.4L 2V) or Section 303-04B (5.4L 4V).
• Adjustable accelerator pedal does not adjust	• Foreign object caught in accelerator pedal linkage. • Accelerator pedal assembly drive cable disconnected or broken. • Adjustable pedal assembly drive motor.	• CHECK the accelerator pedal linkage. • CHECK that the adjustable pedal assembly drive cable is connected to the brake pedal assembly. • REFER to Section 206-00 for adjustable pedal assembly diagnostics.

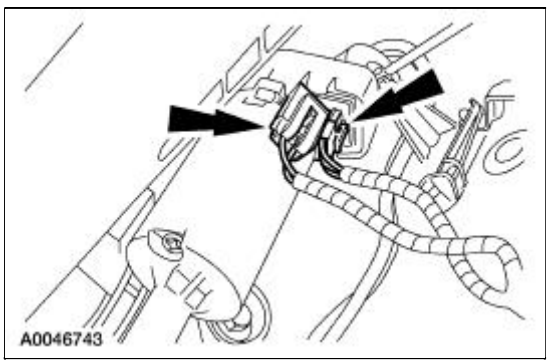
Accelerator Pedal

Removal and Installation

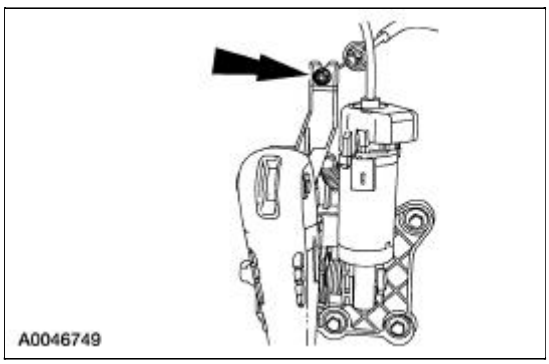
1. Turn the locking cap 90 degrees in either direction and remove the drive cable from the brake pedal assembly.



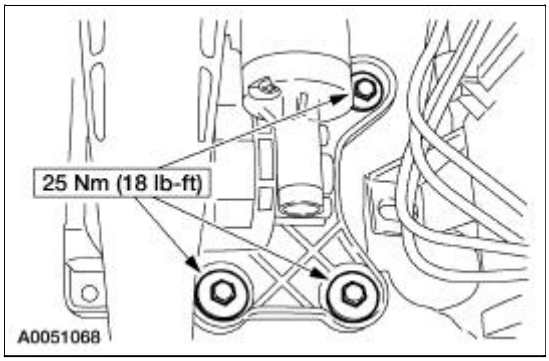
2. Disconnect the drive motor electrical connectors.



3. Disconnect the accelerator cable from the accelerator pedal.



4. Remove the bolts and the accelerator pedal.

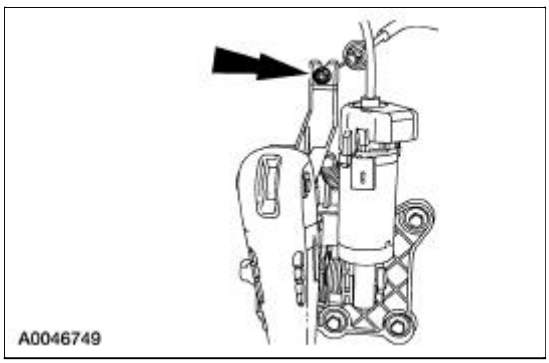


5. To install, reverse the removal procedure.

Accelerator Cable —4.6L

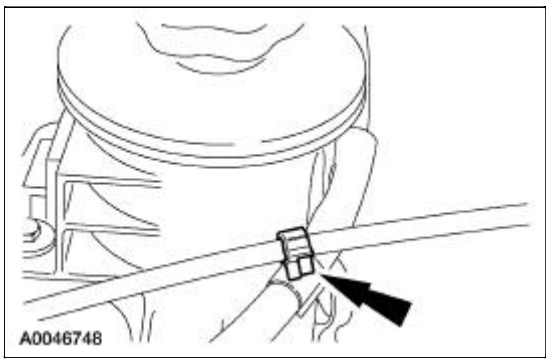
Removal and Installation

1. Disconnect the accelerator cable from the accelerator pedal.

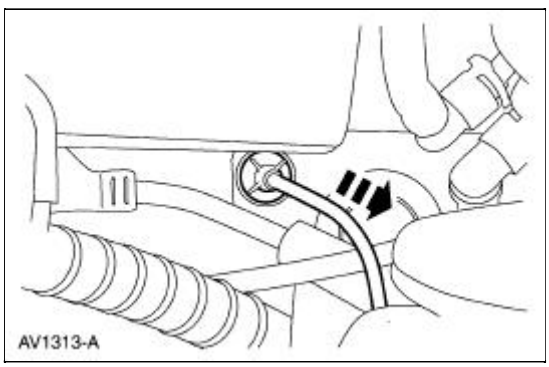


2. Remove the air cleaner outlet pipe. For additional information, refer to Section 303-12 .

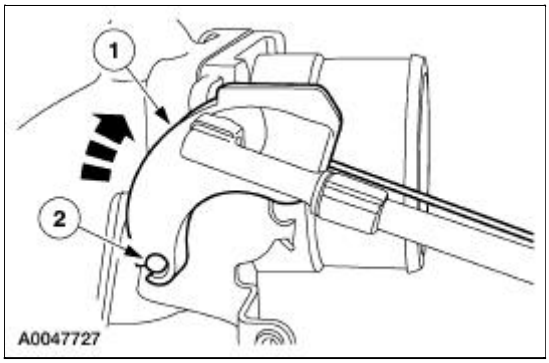
3. Detach the accelerator cable from the routing clip.



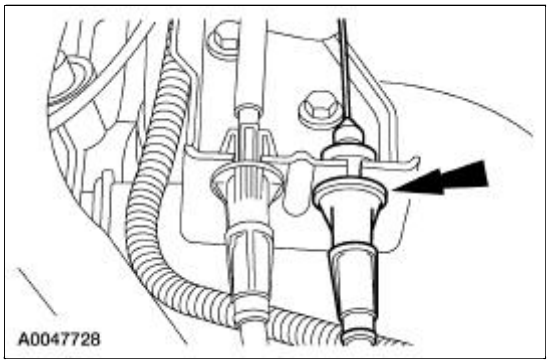
4. Squeeze the accelerator cable lock tabs on the inside of the passenger compartment and push the accelerator cable into the engine compartment.



5. Disconnect the accelerator cable from the throttle lever to remove the accelerator cable.
    1. Rotate the throttle body cam forward.
    2. Slide the accelerator cable end from the throttle body cam.



6. Depress the locking tabs and remove the accelerator cable from the accelerator cable bracket.

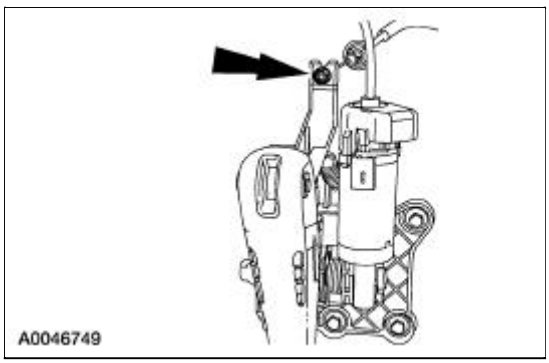


7. To install, reverse removal procedure.

Accelerator Cable —5.4L (2V)

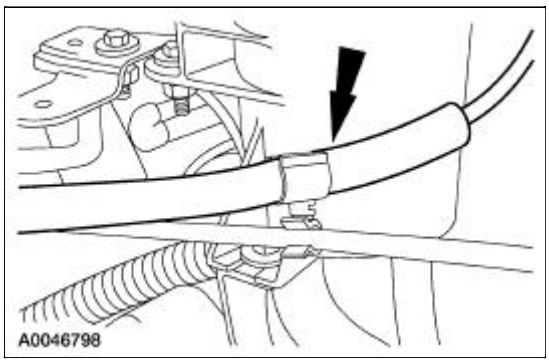
Removal and Installation

1. Disconnect the accelerator cable from the accelerator pedal.

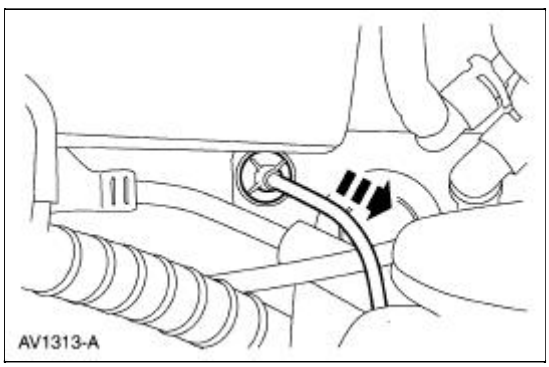


2. Remove the air cleaner outlet pipe. For additional information, refer to Section 303-12 .

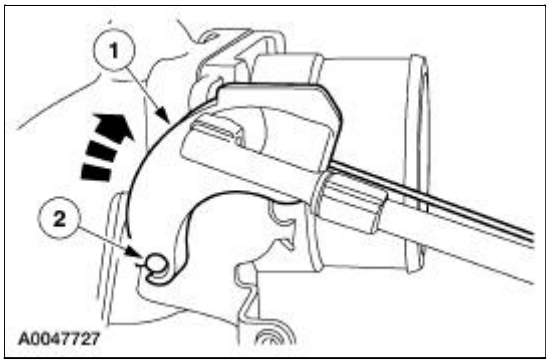
3. Detach the accelerator cable from the routing clip.



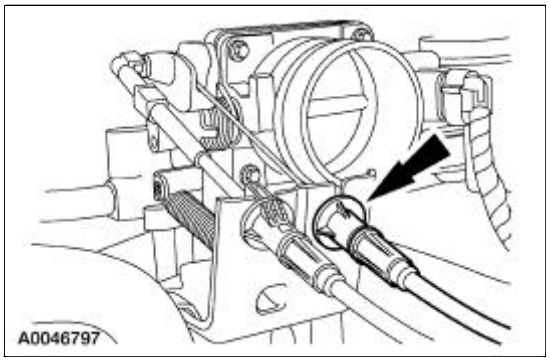
4. Squeeze the accelerator cable lock tabs on the inside of the passenger compartment and push the accelerator cable into the engine compartment.



5. Disconnect the accelerator cable from the throttle body cam.
    1. Rotate the throttle body cam forward.
    2. Slide the accelerator cable end from the throttle body cam.



6. Depress the locking tabs and remove the accelerator cable from the accelerator cable bracket.

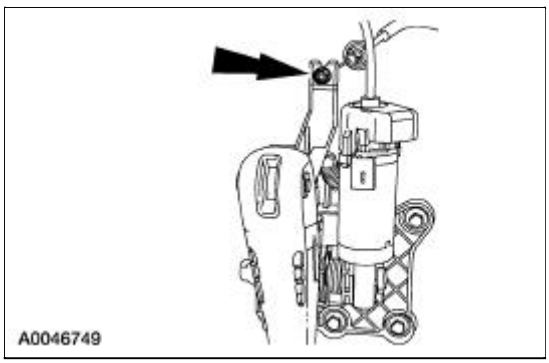


7. To install, reverse the removal procedure.

Accelerator Cable —5.4L (4V)

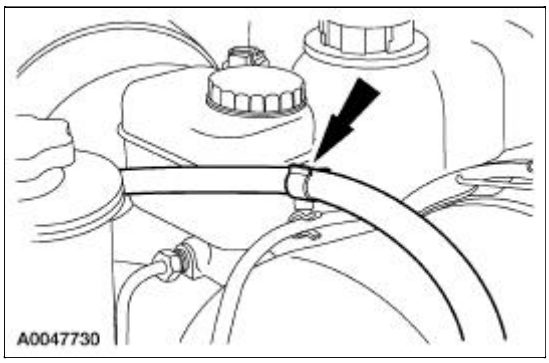
Removal and Installation

1. Disconnect the accelerator cable from the accelerator pedal.

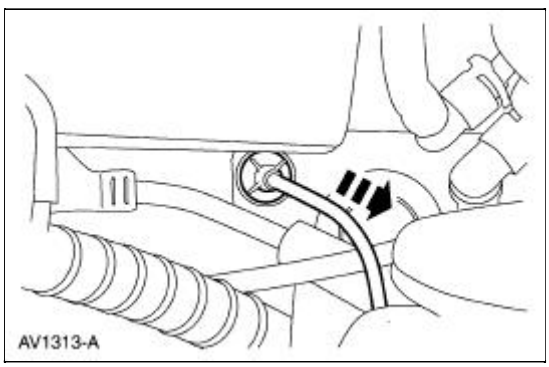


2. Remove the air cleaner outlet pipe. For additional information, refer to Section 303-12 .

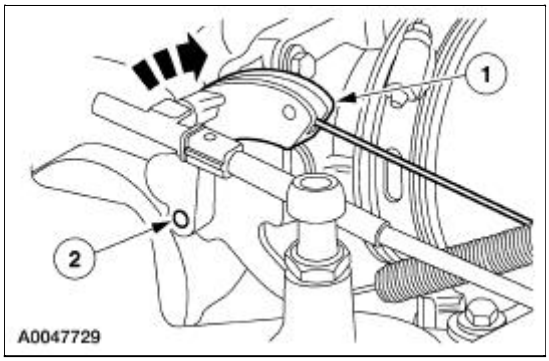
3. Detach the accelerator cable from the routing clip.



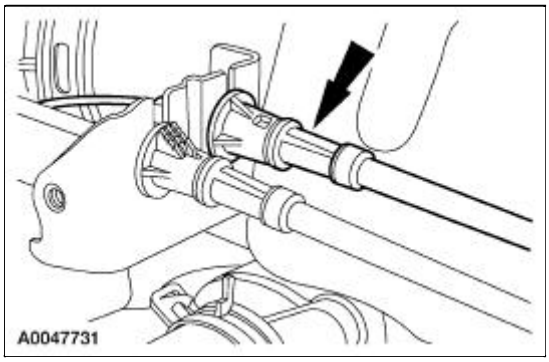
4. Squeeze the accelerator cable lock tabs on the inside of the passenger compartment and push the accelerator cable into the engine compartment.



5. Disconnect the accelerator cable from the throttle body cam.
    1. Rotate the throttle body cam forward.
    2. Slide the accelerator cable end from the throttle body cam.



6. Depress the tabs and remove the accelerator cable from the accelerator cable bracket.

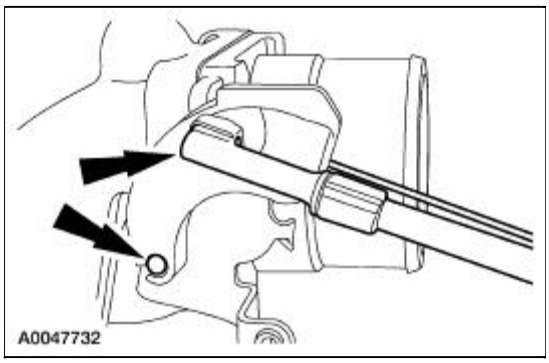


7. To install, reverse the removal procedure.

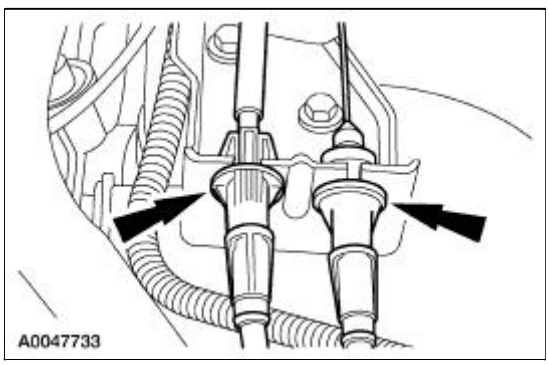
Accelerator Cable Bracket —4.6L

Removal and Installation

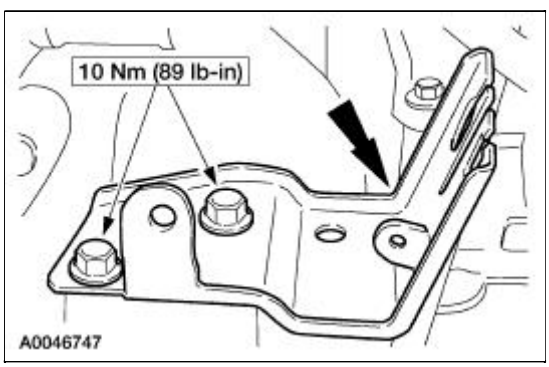
1. Remove the air cleaner outlet pipe. For additional information, refer to Section 303-12 .
2. Disconnect the accelerator cable and the speed control cable from the throttle body cam.



3. Disconnect the accelerator cable and the speed control cable from the accelerator cable bracket.



4. Remove the throttle return spring from the accelerator cable bracket.
5. Remove the accelerator cable bracket.

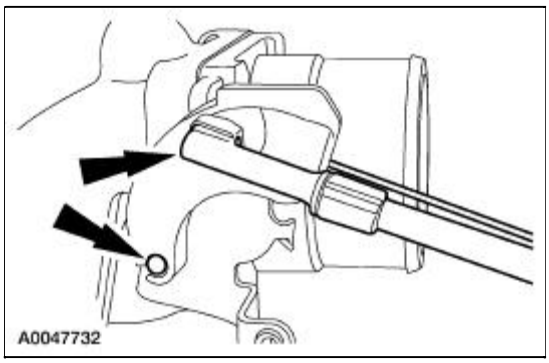


6. To install, reverse the removal procedure.

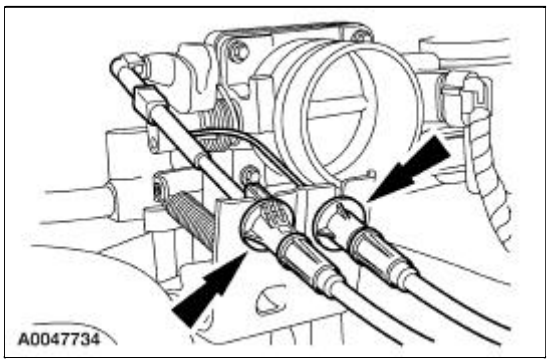
Accelerator Cable Bracket —5.4L (2V)

Removal and Installation

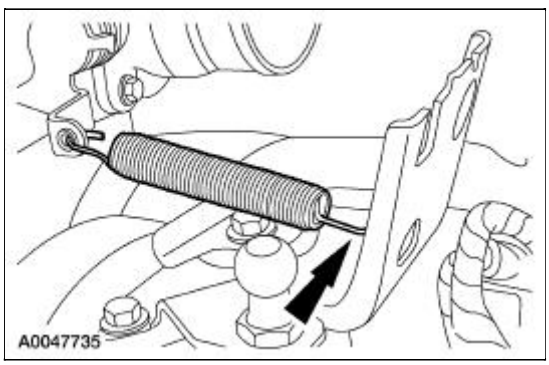
1. Remove the air cleaner outlet pipe. For additional information, refer to Section 303-12 .
2. Disconnect the accelerator cable and the speed control cable from the throttle body cam.



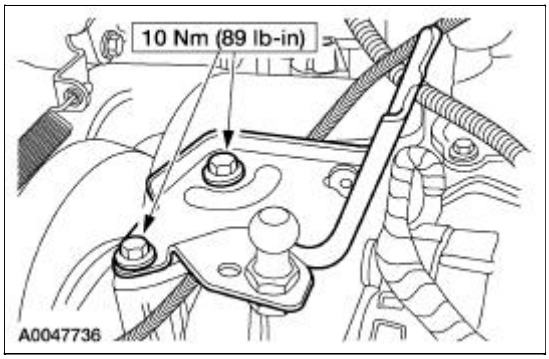
3. Disconnect the accelerator cable and the speed control cable from the accelerator cable bracket.



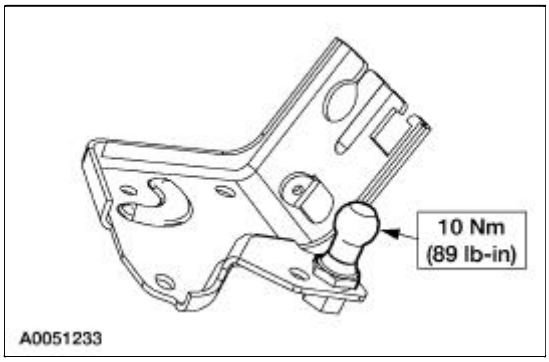
4. Remove the throttle return spring from the accelerator cable bracket.



5. Remove the accelerator cable bracket.



6. Remove the ball stud from the accelerator bracket.

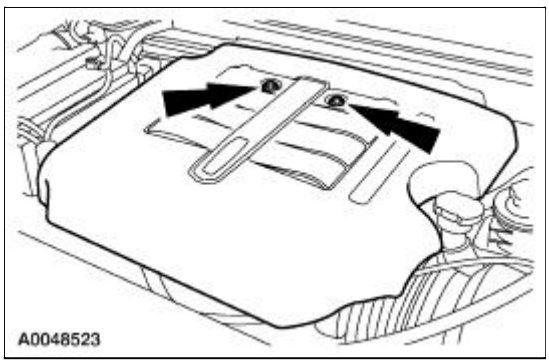


7. To install, reverse the removal procedure.

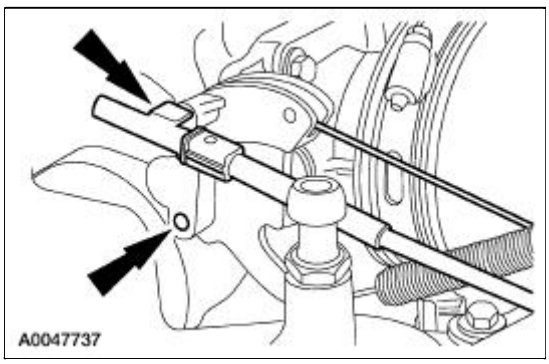
Accelerator Cable Bracket —5.4L (4V)

Removal and Installation

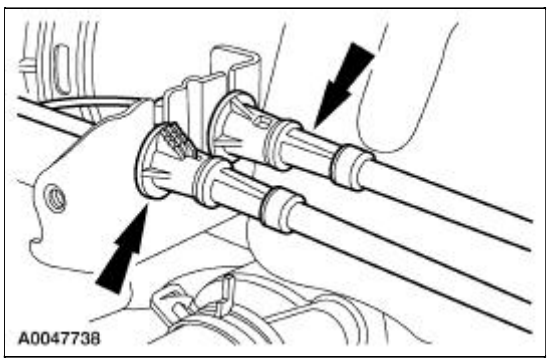
1. Remove the appearance cover.



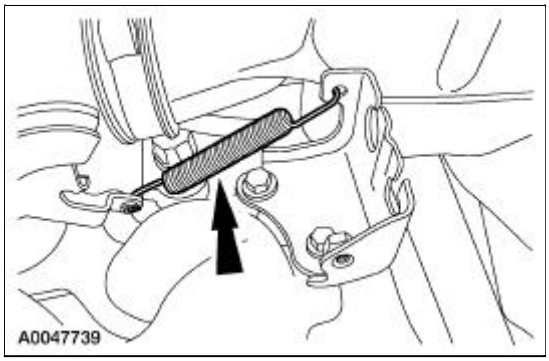
2. Disconnect the accelerator cable and the speed control cable from the throttle body cam.



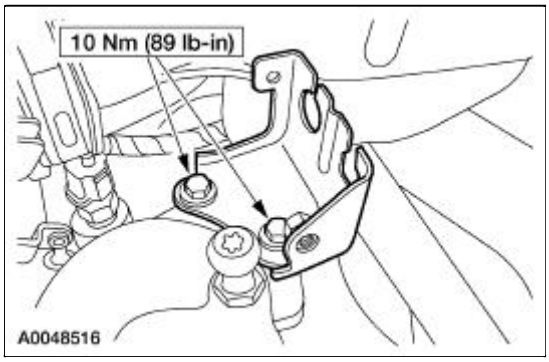
3. Disconnect the accelerator cable and the speed control cable from the accelerator cable bracket.



4. Remove the throttle return spring from the accelerator cable bracket.



5. Remove the accelerator cable bracket.



6. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-ft	lb-in
Deactivator switch	18	13	—
Speed control actuator bracket bolts	9	—	80
Speed control actuator bracket screws	12	9	—
Speed control switch	7	—	62

Speed Control

The speed control system consists of the following components:

- brake pedal position (BPP) switch
- deactivator switch
- speed control actuator
- speed control actuator cable
- speed control actuator switches
- powertrain control module (PCM)

Speed Control

Refer to Wiring Diagrams Cell 31 , Speed Control for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter or equivalent 105-R0057
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052 or equivalent diagnostic tool

Refer to Wiring Diagrams Cell 31 for schematic and connector information.

Principles of Operation

The speed control system is designed to maintain a selected vehicle speed between approximately 40 and 200 km/h (25 and 125 mph).

The electronic stepper motor (internal to the speed control actuator) is controlled by turning the three phases of the motor on and off in sequence. The sequence determines the motor direction (open throttle or closed throttle based on vehicle speed).

The speed control module is fully integrated into the powertrain control module (PCM). The PCM strategy uses engine control to accelerate smoothly. In instances where the vehicle tends to want to exceed the set speed, the PCM will invoke an engine braking strategy to help maintain the desired vehicle speed.

Whenever the system is engaged and active, a speed control set indicator will be illuminated in the instrument cluster.

The brake pedal position (BPP) switch is a normally open switch. When the brake pedal is applied with the speed control system engaged, the BPP switch closes to battery voltage, putting the vehicle speed control in stand-by mode.

NOTE: The deactivator switch is provided as an additional safety feature.

Normally, when the brake pedal is pressed, the PCM will deactivate the speed control system. Under increased brake pedal effort, the deactivator switch, a normally closed switch, will open and remove power to the speed control actuator clutch, releasing the throttle independently of the PCM.

The clockspring provides the electrical interface between the steering column wiring and the speed

control switches in the steering wheel.

The PCM sends a standard corporate protocol (SCP) output message to the instrument cluster to indicate when the vehicle speed control system is active.

Inspection and Verification

1. Verify the customer concern.
2. Verify the speedometer operates correctly without speed control by test driving the vehicle. If the speedometer does not operate correctly, refer to Section 413-01 .
3. Verify the stoplamps operate correctly with the ignition switch in the OFF position. If the stoplamps do not operate correctly, refer to Section 417-01 .
4. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
● Speed control cable ● Throttle lever ● Speed control actuator ● Brake pedal position (BPP) switch ● Power control module (PCM)	● Central junction box (CJB) fuses: ■ 5 (7.5A) ■ 12 (10A) ■ 28 (5A) ● Circuitry

5. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
6. If the cause of the fault is not visually evident, proceed to diagnoses of the speed control system by:

- connecting the diagnostic tool or
- entering the speed control self-test.

Diagnostic tool

7. Connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel, and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
    - check that the program card is correctly installed.
    - check the connections to the vehicle.
    - check the ignition switch position.
8. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool operating manual.
9. Carry out the DATA LINK DIAGNOSTICS test. If the diagnostic tool responds with:

- CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
- NO RESP/NOT EQUIP for PCM, Go To Pinpoint Test A .
- SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out the KOEO Test.

10. If the DTCs retrieved are related to the concern, go to the PCM Diagnostic Trouble Code (DTC) Index to continue diagnostics.

11. If no DTCs related to the concern are retrieved, proceed to the Symptom Chart to continue diagnostics.

NOTE: DTC P0703 and DTC P1572 must be repaired before any other DTC.

Speed Control Actuator Diagnostic Trouble Code (DTC) Index

DTCs	Description	Source	Action
P0500	Vehicle Speed Error	PCM	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1572	Brake On/Off Failure	PCM	Go To Pinpoint Test G .
P0703	Brake Switch Input Malfunction	PCM	Go To Pinpoint Test F .

Speed Control Self-Test Diagnostics

WARNING: This test is a key on engine off (KOEO) test only that is conducted in PARK only with the emergency brake fully engaged.

1. Enter the Self-Test Diagnostics by depressing the speed control OFF switch while turning the ignition key ON, making sure the engine does not start and is not running. Five additional flashes at this point indicate a defective speed control actuator. Release the OFF switch.

2. Press the remaining switches in this sequence: ON, RESUME, COAST and SET/ACCEL or CANCEL (for Navigator).
   If the "ON" switch is not pressed within five seconds after entering the diagnostic mode, the module times out and the procedure must be started over.
   The speed control indicator lamp will flash as each switch is pressed. Press each switch in the sequence immediately after the indicator light goes out for the previous switch.

3. **NOTE:** There will be a slight delay when the last button is pressed and the lamp flashes.

   A lamp flash with the last button (SET/ACCEL) or CANCEL (for Navigator) indicates that the STATIC test passed. If the lamp does not flash with the last button and there are no additional flashes of the lamp, the switches are defective.
   If the lamp does not flash with the last button, and additional flashes occur, follow the chart below for trouble codes:

NOTE: If unable to enter self-test, Go To Pinpoint Test D .

Flashes	Source
2 Flashes	BPP defective, circuit is defective, brake applied
3 Flashes	Deactivator switch is open or circuit defective

4. Immediately after the STATIC test, the speed control servo does a DYNAMIC test by automatically actuating the throttle lever from 8 mm (0.315 in) to 12 mm (0.472 in) of travel from the idle position. During the DYNAMIC throttle pull, observe throttle movement to witness any binding or sticking of the speed control cable and correct connection of speed control cable to throttle lever. Make sure the throttle returns back to the idle position.

5. Return the ignition switch to the OFF position and proceed to the Symptom Chart.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• No communication with the powertrain control module (PCM)	• Central junction box (CJB) fuses: ■ 5 (7.5A) ■ 34 (20A) • Circuitry. • PCM.	• Go To Pinpoint Test A .
• The speed control is inoperative—no DTCs	• Circuitry. • Deactivator switch. • Digital transmission range (TR) sensor. • Low battery voltage.	• Go To Pinpoint Test B .
• The speed control does not disengage when the brake are applied	• Speed control actuator. • BPP switch. • Speed control switch. • Deactivator switch.	• Go To Pinpoint Test C .
• The speed control switches are inoperative—no DTCs	• Speed control switch.	• Go To Pinpoint Test D .
• The speed control indicator lamp is always on	• Instrument cluster.	• REFER to Section 413-01 .
• Flash code 2 — brake pedal position switch circuit failure.	• Circuitry. • BPP switch. • Speed control servo.	• Go To Pinpoint Test E .
• Flash code 3 — deactivator switch circuit failure.	• CJB fuse 34 (10A). • Circuitry. • Deactivator switch. • Speed control servo.	• Go To Pinpoint Test F .

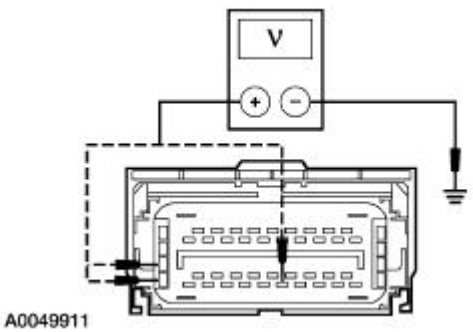
Pinpoint Test

PINPOINT TEST A: NO COMMUNICATION WITH THE POWERTRAIN CONTROL MODULE (PCM)

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>A1 CHECK THE PCM POWER CIRCUITS</td><td rowspan="2">Yes
GO to A2 .

No
REPAIR the circuit.
REPEAT the self-test.</td></tr>
<tr><td>

Key in OFF position.
Disconnect: PCM C175b.
Key in ON position.
Measure the voltage between the PCM C175b and ground as follows:

<table>
<tr><th>Pin</th><th>Circuit</th></tr>
<tr><td>34</td><td>361 (RD)</td></tr>
<tr><td>40</td><td>729 (RD/WH)</td></tr>
<tr><td>46</td><td>361 (RD)</td></tr>
</table>


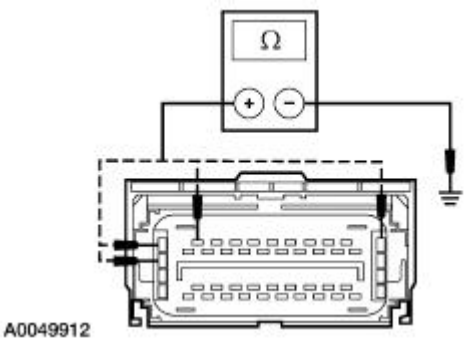
A0049911

Are the voltages greater than 10 volts?

</td></tr>
<tr><td>A2 CHECK THE PCM GROUND CIRCUITS</td><td rowspan="2">Yes
REFER to Section 418-00 .

No
REPAIR the circuit.
REPEAT the self-test.</td></tr>
<tr><td>

Key in OFF position.
Measure the resistance between the PCM C175b and ground as follows:

<table>
<tr><th>Pin</th><th>Circuit</th></tr>
<tr><td>1</td><td>570 (BK/WH)</td></tr>
<tr><td>10</td><td>567 (BK)</td></tr>
<tr><td>11</td><td>570 (BK/WH)</td></tr>
<tr><td>23</td><td>570 (BK/WH)</td></tr>
</table>


A0049912

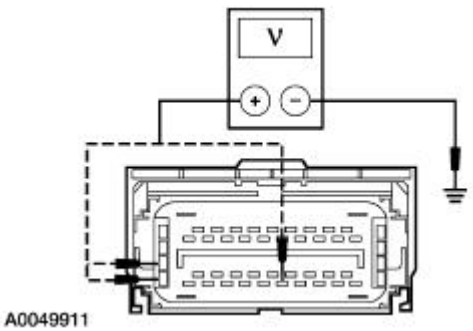
Are the resistances less than 5 ohms?

</td></tr>
</table>

PINPOINT TEST B: THE SPEED CONTROL IS INOPERATIVE—NO DTCs

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>B1 CHECK THE PCM POWER CIRCUITS</td><td></td></tr>
<tr><td>

Key in OFF position.
Disconnect: PCM C175b.
Key in ON position.
Measure the voltage between the PCM C175b and ground as follows:

<table>
<tr><th>Pin</th><th>Circuit</th></tr>
<tr><td>34</td><td>361 (RD)</td></tr>
<tr><td>40</td><td>729 (RD/WH)</td></tr>
<tr><td>46</td><td>361 (RD)</td></tr>
</table>


Are the voltages greater than 10 volts?

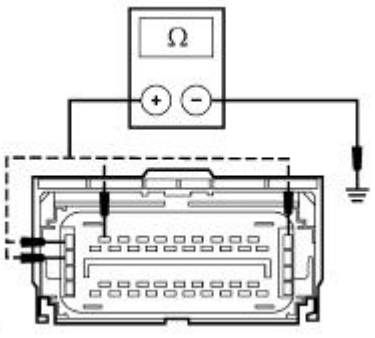
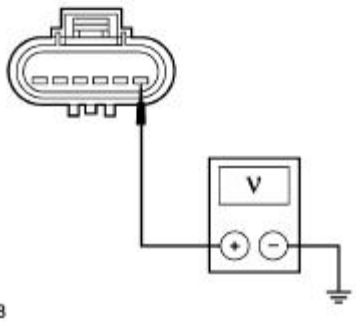
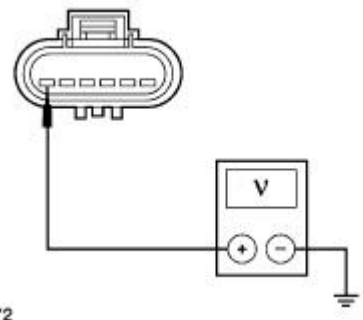
</td><td>Yes
GO to B2 .

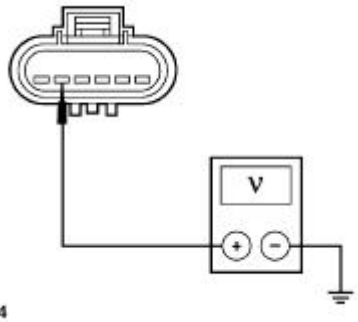
No
REPAIR the circuit.
REPEAT the self-test.</td></tr>
<tr><td>B2 CHECK THE PCM GROUND CIRCUITS</td><td></td></tr>
<tr><td>

Key in OFF position.
Measure the resistance between the PCM C175b and ground as follows:

<table>
<tr><th>Pin</th><th>Circuit</th></tr>
<tr><td>1</td><td>570 (BK/WH)</td></tr>
<tr><td>10</td><td>567 (BK)</td></tr>
<tr><td>11</td><td>570 (BK/WH)</td></tr>
<tr><td>23</td><td>570 (BK/WH)</td></tr>
</table>
</td><td>Yes
GO to B3 .

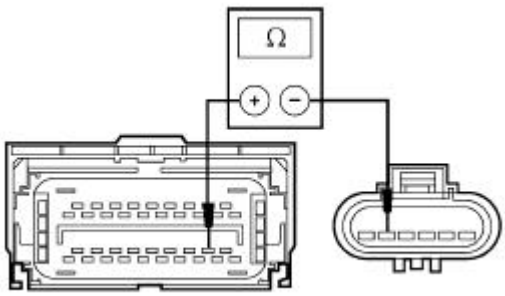
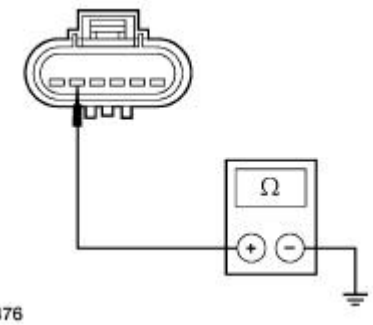
No
REPAIR the circuit.
REPEAT the self-test.</td></tr>
</table>

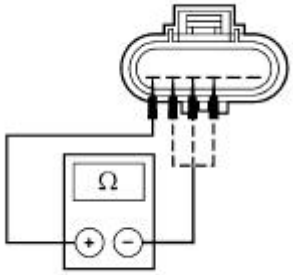
 A0049912 ● **Are the resistances less than 5 ohms?**	
B3 CHECK CIRCUIT 1928 (RD/WH) FOR AN OPEN	
● Key in OFF position. ● Disconnect: Speed Control Actuator C122. ● Key in ON position. ● Measure the voltage between the speed control actuator C122 pin 1, circuit 1928 (RD/WH), harness side and ground.  A0005468 ● **Is the voltage greater than 10 volts?**	**Yes** GO to B4 . **No** REPAIR the circuit. REPEAT the self-test.
B4 CHECK THE DEACTIVATOR SWITCH CIRCUITRY FOR AN OPEN	
● Measure the voltage between the speed control actuator C122 pin 6, circuit 307 (BK/YE), harness side and ground.  A0005472 ● **Is the voltage greater than 10 volts?**	**Yes** GO to B5 . **No** REPAIR the circuit. REPEAT the self-test.
B5 CHECK CIRCUIT 1927 (TN) FOR SHORT TO POWER	
● Key in ON position. ● Measure the voltage between the speed control actuator C122 pin 5, circuit 1927 (TN), harness side and ground.	**Yes** REPAIR the circuit. REPEAT the self-test. **No** GO to B6 .



A0005474

- **Is any voltage present?**

B6 CHECK CIRCUIT 1927 (TN) FOR AN OPEN	
• Key in OFF position. • Measure the resistance between the speed control actuator C122 pin 5, circuit 1927 (TN), harness side and the PCM C175b pin 26, circuit 1927 (TN), harness side.  A0049919 • **Is the resistance less than 5 ohms?**	**Yes** GO to B7 . **No** REPAIR the circuit. REPEAT the self-test.
B7 CHECK CIRCUIT 1927 (TN) FOR SHORT TO GROUND	
• Measure the resistance between the speed control actuator C122 pin 5, circuit 1927 (TN), harness side and ground.  A0005476 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to B8 . **No** REPAIR the circuit. REPEAT the self-test.
B8 CHECK THE SPEED CONTROL ACTUATOR	
• Key in OFF position. • Measure the resistance between the speed control actuator pins (component side) as follows: **Speed Control Actuator** Pin 1 — Pin 2 Pin 1 — Pin 3 Pin 1 — Pin 4	**Yes** GO to B9 . **No** INSTALL a new speed control actuator. REFER to Speed Control Actuator in this section. REPEAT the self-test.



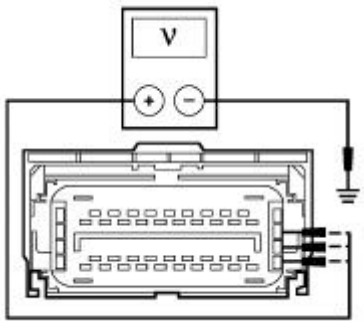
A0006460

- **Are the resistances between 2 and 3 ohms?**

B9 CHECK THE SPEED CONTROL ACTUATOR CIRCUITRY FOR SHORT TO POWER

- Disconnect: PCM C175b.
- Key in ON position.
- Measure the voltage between the PCM C175b, harness side and ground as follows:

PCM C175b	Circuit
Pin 35	1924 (DG/WH)
Pin 24	1925 (PK/BK)
Pin 12	1926 (VT/YE)



A0049917

- **Is any voltage present?**

Yes
REPAIR the circuit(s).
REPEAT the self-test.

No
GO to B10 .

B10 CHECK THE SPEED CONTROL ACTUATOR CIRCUITRY FOR AN OPEN

- Key in OFF position.
- Measure the resistance between the PCM C175b, harness side and the speed control actuator C122, harness side as follows:

PCM C175b	Speed Control Actuator C122	Circuit
Pin 35	Pin 4	1924 (DG/WH)
Pin 24	Pin 3	1925 (PK/BK)
Pin 12	Pin 2	1926 (VT/YE)

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

Yes
GO to B11 .

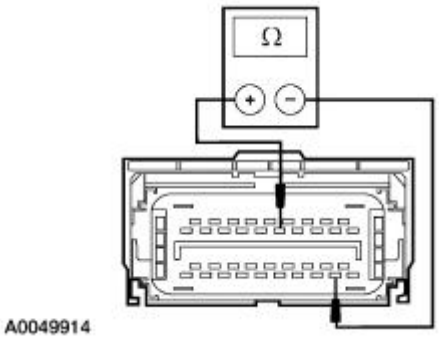
No
REPAIR the circuit(s).
REPEAT the self-test.

B11 CHECK FOR CONTINUITY

- Key in OFF position.

Yes

- Disconnect: PCM C175b.
- Measure the resistance between the PCM C175b pin 37, circuit 151 (LB/BK), harness side and the PCM C175b pin 17, circuit 848, (DG/OG), harness side.



- **Is the resistance between 4,085 and 4,515 ohms?**

GO to B12 .

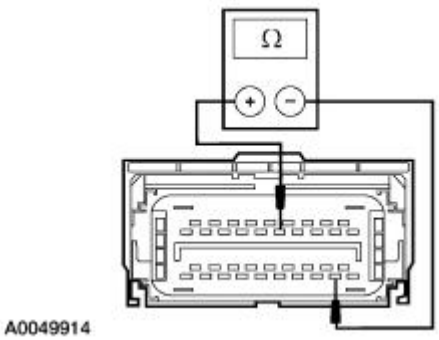
No
GO to B13 .

B12 CHECK THE SPEED CONTROL SWITCHES

- Measure the resistance between the PCM C175b pin 37, circuit 151 (LB/BK), harness side and the PCM C175b pin 17, circuit 848, (DG/OG), harness side while pressing the switches.

Speed Control Switch with remote audio/climate control

Speed Control Actuator Switch	Resistance Value
Cancel	Between 114 and 126 ohms
Coast	Between 285 and 315 ohms
SET/ACCEL	Between 570 and 630 ohms
Resume	Between 1,055 and 1,165 ohms
On	Between 1,995 and 2,205 ohms
Off	Less than 5 ohms



- **Are the speed control actuator switch resistances values OK?**

Yes
GO to B16 .

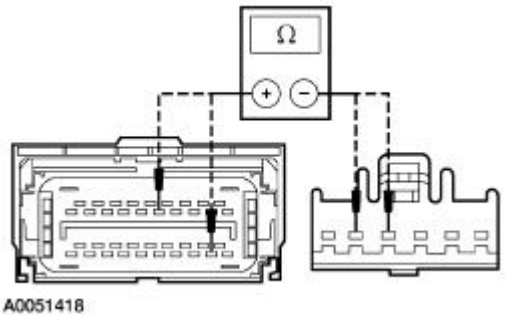
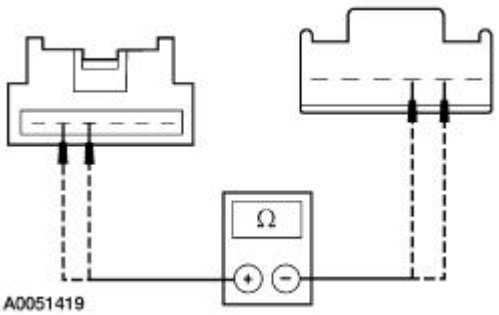
No
INSTALL a new speed control switch. REFER to Speed Control Switch—With Remote Audio/Climate Control or Speed Control Switch—Without Remote Audio/Climate Control in this section. TEST the system for normal operation.

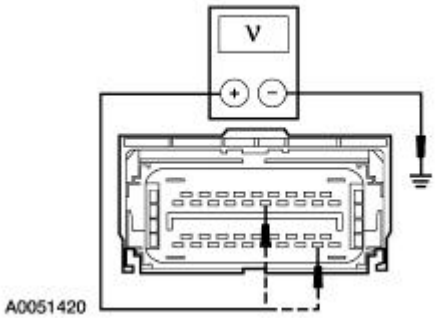
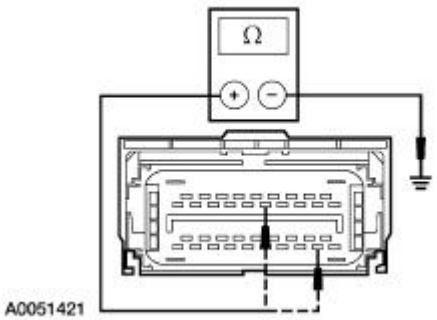
B13 CHECK CIRCUIT 151 (LB/BK) AND 848 (DG/OG) FOR OPEN

- Disconnect: Clockspring C218b.
- Measure the resistance between the PCM C175b pin 37, circuit 151 (LB/BK), harness side and the clockspring C218b pin 4, circuit 151 (LB/BK), harness side; and measure the resistance between the PCM C175b pin 17, circuit 848

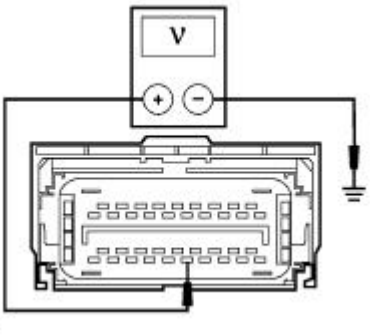
Yes
GO to B14 .

No
REPAIR the circuit. REPEAT the self-test.

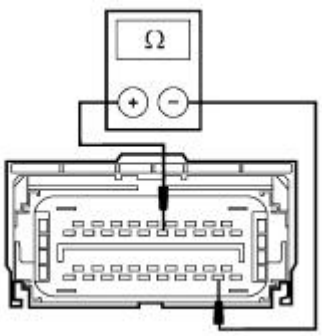
(DG/OG), harness side and the clockspring C218b pin 5, circuit 848 (DG/OG), harness side.  ● **Are the resistances less than 5 ohms?**	
B14 CHECK THE CLOCKSPRING	
● Remove the driver side air bag. Refer to Section 501-20B . ● Disconnect: Horn Switch Wiring Harness Connector. ● Measure the resistance between the clockspring C218b pin 4, circuit 151, (component side) and the upper clockspring pin 3, circuit 151, (component side); and measure the resistance between the clockspring C218b pin 5, circuit 848, (component side) and the upper clockspring pin 2, circuit 848, (component side).  ● **Are the resistances less than 5 ohms?**	**Yes** GO to B15 . **No** INSTALL a new clockspring. REFER to Section 501-20B . TEST the system for normal operation.
B15 CHECK THE HORN SWITCH WIRING HARNESS	
● Disconnect: Speed Control Switches. ● Inspect the horn switch wiring harness for shorts, opens or any damage. ● **Is the horn switch wiring harness OK?**	**Yes** INSTALL a new speed control switch. REFER to Speed Control Switch—With Remote Audio/Climate Control or Speed Control Switch—Without Remote Audio/Climate Control in this section. TEST the system for normal operation. **No** REPAIR or INSTALL a new horn switch wiring harness. TEST the system for normal operation.
B16 CHECK CIRCUIT 151 (LB/BK) AND 848 (DG/OG) FOR SHORT TO POWER	
● Key in OFF position. ● Disconnect: Clockspring C218b.	**Yes** REPAIR the circuit in

• Key in ON position. • Measure the voltage between the PCM C175b pin 37, circuit 151 (LB/BK), harness side and ground; and between the PCM C175b pin 17, circuit 848 (DG/OG), harness side and ground.  A0051420 • **Is any voltage present?**	questions. TEST the system for normal operation. **No** GO to B17 .
B17 CHECK CIRCUIT 151 (LB/BK) AND 848 (DG/OG) FOR SHORT TO GROUND	
• Key in OFF position. • Disconnect: Clockspring C218b. • Key in ON position. • Measure the resistance between the PCM C175b pin 37, circuit 151 (LB/BK), harness side and ground; and between the PCM C175b pin 17, circuit 848 (DG/OG), harness side and ground.  A0051421 • **Is the resistance less than 5 ohms?**	**Yes** REPAIR the circuit. REPEAT the self-test. **No** GO to B18 .
B18 CHECK FOR CORRECT PCM OPERATION	
• Disconnect all the PCM connectors. • Check for: • corrosion • pushed-out pins • Connect all PCM connectors and make sure they are seated correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PCM. REFER to Section 303-14 . REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. REPEAT the self-test.

PINPOINT TEST C: SPEED CONTROL DOES NOT DISENGAGE WHEN THE BRAKES ARE APPLIED

Test Step	Result / Action to Take
C1 CHECK THE BRAKE PEDAL POSITION (BPP) INPUT TO PCM	
• Key in OFF position. • Disconnect: PCM C175b. • Key in ON position. • Measure the voltage between the PCM C175b pin 40, circuit 810 (RD/LG), harness side and ground while depressing the brake pedal.  A0049923 • **Is the voltage greater than 10 volts?**	**Yes** GO to C2 . **No** REPAIR the circuit. TEST the system for normal operation.
C2 CHECK FOR CORRECT PCM OPERATION	
• Key in OFF position. • Disconnect all the PCM connectors. • Check for: • corrosion • pushed-out pins • Connect all PCM connectors and make sure they are seated correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PCM. REFER to Section 303-14 . REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. REPEAT the self-test.

PINPOINT TEST D: THE SPEED CONTROL SWITCHES ARE INOPERATIVE

Test Step	Result / Action to Take
D1 CHECK FOR CONTINUITY	
• Key in OFF position. • Disconnect: PCM C175b. • Measure the resistance between the PCM C175b pin 37, circuit 151 (LB/BK), harness side and the PCM C175b pin 17, circuit 848, (DG/OG), harness side.  A0049914	**Yes** GO to D2 . **No** GO to D3 .

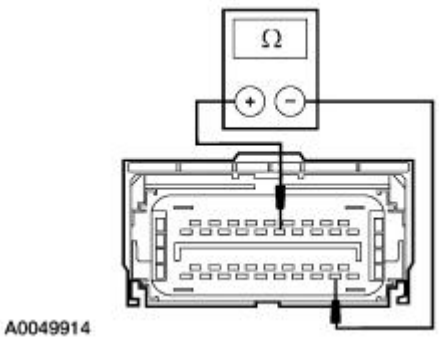
- **Is the resistance between 4,085 and 4,515 ohms?**

D2 CHECK THE SPEED CONTROL SWITCHES

- Measure the resistance between the PCM C175b pin 37, circuit 151 (LB/BK), harness side and the PCM C175b pin 17, circuit 848, (DG/OG), harness side while pressing the switches.

Speed Control Switch with remote audio/climate control

Speed Control Actuator Switch	Resistance Value
Cancel	Between 114 and 126 ohms
Coast	Between 285 and 315 ohms
SET/ACCEL	Between 570 and 630 ohms
Resume	Between 1,055 and 1,165 ohms
On	Between 1,995 and 2,205 ohms
Off	Less than 5 ohms



A0049914

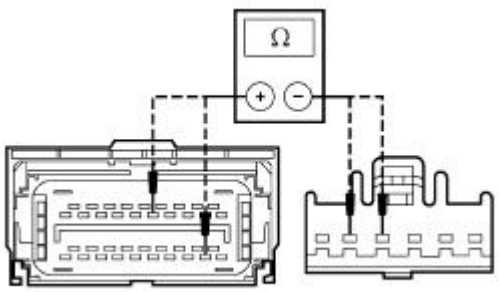
- **Are the speed control actuator switch resistances values OK?**

Yes
GO to D6.

No
INSTALL a new speed control switch. REFER to Speed Control Switch—With Remote Audio/Climate Control or Speed Control Switch—Without Remote Audio/Climate Control in this section. TEST the system for normal operation.

D3 CHECK CIRCUIT 151 (LB/BK) AND 848 (DG/OG) FOR OPEN

- Disconnect: Clockspring C218b.
- Measure the resistance between the PCM C175b pin 37, circuit 151 (LB/BK), harness side and the clockspring C218b pin 4, circuit 151 (LB/BK), harness side; and measure the resistance between the PCM C175b pin 17, circuit 848 (DG/OG), harness side and the clockspring C218b pin 5, circuit 848 (DG/OG), harness side.



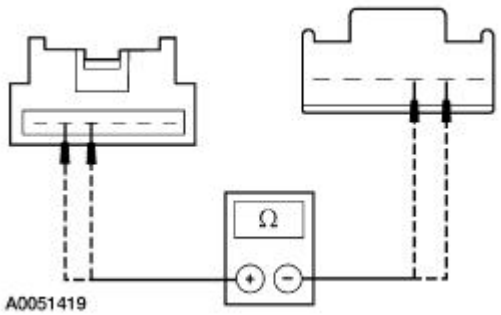
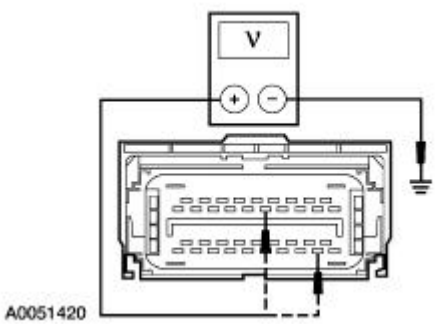
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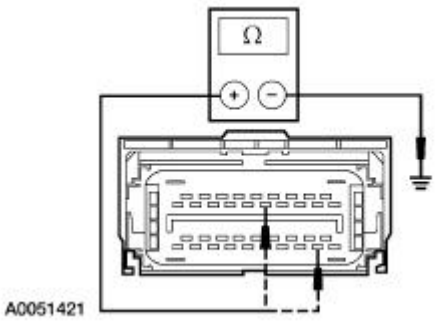
- **Are the resistances less than 5 ohms?**

Yes
GO to D4.

No
REPAIR the circuit. REPEAT the self-test.

D4 CHECK THE CLOCKSPRING

• Remove the driver side air bag. Refer to Section 501-20B . • Disconnect: Horn Switch Wiring Harness Connector. • Measure the resistance between the clockspring C218b pin 4, circuit 151, (component side) and the upper clockspring pin 3, circuit 151, (component side); and measure the resistance between the clockspring C218b pin 5, circuit 848, (component side) and the upper clockspring pin 2, circuit 848, (component side).  • **Are the resistances less than 5 ohms?**	**Yes** GO to D5 . **No** INSTALL a new clockspring. REFER to Section 501-20B . TEST the system for normal operation.
D5 CHECK THE HORN SWITCH WIRING HARNESS	
• Disconnect: Speed Control Switches. • Inspect the horn switch wiring harness for shorts, opens or any damage. • **Is the horn switch wiring harness OK?**	**Yes** INSTALL a new speed control switch. REFER to Speed Control Switch—With Remote Audio/Climate Control or Speed Control Switch—Without Remote Audio/Climate Control in this section. TEST the system for normal operation. **No** REPAIR or INSTALL a new horn switch wiring harness. TEST the system for normal operation.
D6 CHECK CIRCUIT 151 (LB/BK) AND 848 (DG/OG) FOR SHORT TO POWER	
• Key in OFF position. • Disconnect: Clockspring C218b. • Key in ON position. • Measure the voltage between the PCM C175b pin 37, circuit 151 (LB/BK), harness side and ground; and between the PCM C175b pin 17, circuit 848 (DG/OG), harness side and ground.  	**Yes** REPAIR the circuit in questions. TEST the system for normal operation. **No** GO to D7 .

• **Is any voltage present?**	
D7 CHECK CIRCUIT 151 (LB/BK) AND 848 (DG/OG) FOR SHORT TO GROUND	
• Key in OFF position. • Disconnect: Clockspring C218b. • Key in ON position. • Measure the resistance between the PCM C175b pin 37, circuit 151 (LB/BK), harness side and ground; and between the PCM C175b pin 17, circuit 848 (DG/OG), harness side and ground.  • **Is the resistance less than 5 ohms?**	**Yes** REPAIR the circuit. REPEAT the self-test. **No** GO to D8 .
D8 CHECK FOR CORRECT PCM OPERATION	
• Disconnect all the PCM connectors. • Check for: • corrosion • pushed-out pins • Connect all PCM connectors and make sure they are seated correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PCM. REFER to Section 303-14 . REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. REPEAT the self-test.

PINPOINT TEST E: FLASH WITH LAST SWITCH PRESSED AND NO DYNAMIC PULL OCCURS AT THROTTLE AND SPEED CONTROL INOPERATIVE

Test Step	Result / Action to Take
E1 CHECK THE SPEED CONTROL CABLE	
• Disconnect the speed control cable at the throttle body. • Check the speed control cable slack by pulling the speed control cable end taut from within the speed control cable housing. • **Is the speed control cable slack greater than 0 mm (0 in) and less than 0.24 in (6 mm) ?**	**Yes** GO to E2 . **No** INSTALL a new speed control cable. REFER to Speed Control Cable in this section. REPEAT the self-test.
E2 CHECK FOR DAMAGE, STICKING OR BINDING SPEED CONTROL CABLE	
• Disconnect the speed control cable from the speed control actuator.	**Yes** GO to E3 .

- Check the speed control cable for damage, sticking or binding.
- **Is the speed control cable OK?**

No
INSTALL a new speed control cable. REFER to Speed Control Cable in this section. REPEAT the self-test.

E3 CHECK THE SPEED CONTROL ACTUATOR OUTPUT

- Key in ON position.
- Check the speed control actuator pulley for movement while triggering the on-demand self-test.
- **Does the speed control actuator pulley move?**

Yes
REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.

No
GO to E4.

E4 CHECK THE SPEED CONTROL ACTUATOR

- Key in OFF position.
- Disconnect: Speed Control Actuator C122.
- Measure the resistance between the speed control actuator pins (component side) as follows:

Speed Control Actuator	Speed Control Actuator	Expected Value
Pin 1	Pin 2	Between 2 and 3 ohms
Pin 1	Pin 3	Between 2 and 3 ohms
Pin 1	Pin 4	Between 2 and 3 ohms
Pin 5	Pin 6	Between 20 and 30 ohms

- **Are the resistances OK?**

Yes
GO to E5.

No
INSTALL a new speed control actuator. REFER to Speed Control Actuator in this section. REPEAT the self-test.

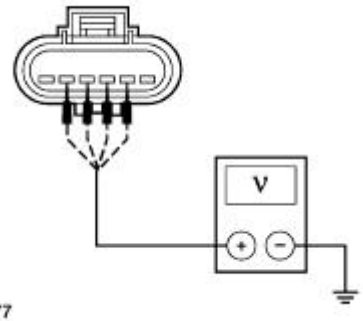
E5 CHECK THE SPEED CONTROL ACTUATOR CIRCUITRY FOR SHORT TO POWER

- Disconnect: PCM C175b.
- Key in ON position.
- Measure the voltage between the speed control actuator C122, harness side and ground as follows:

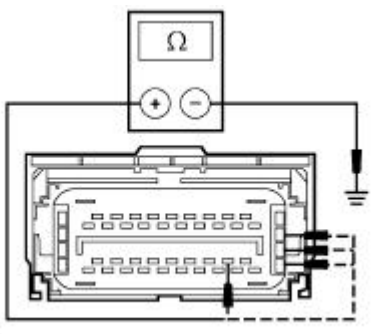
Speed Control Actuator C122	Circuit
Pin 2	1926 (VT/YE)
Pin 3	1925 (PK/BK)
Pin 4	1924 (DG/WH)
Pin 5	1927 (TN)

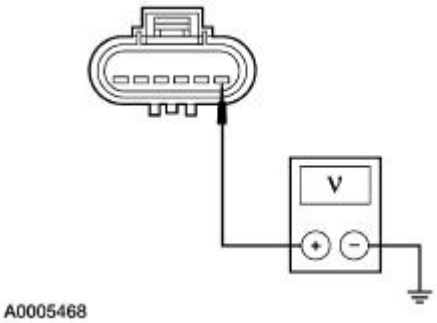
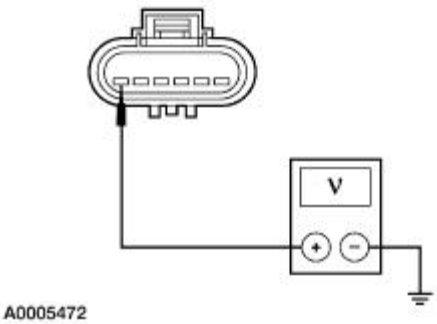
Yes
REPAIR the circuit(s). REPEAT the self-test.

No
GO to E6.



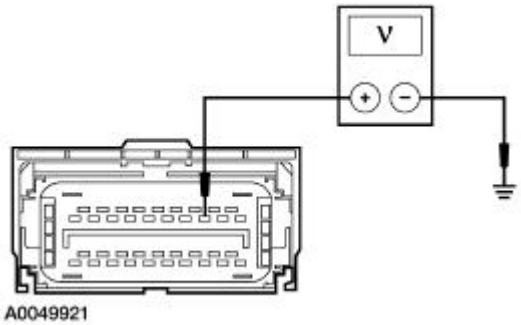
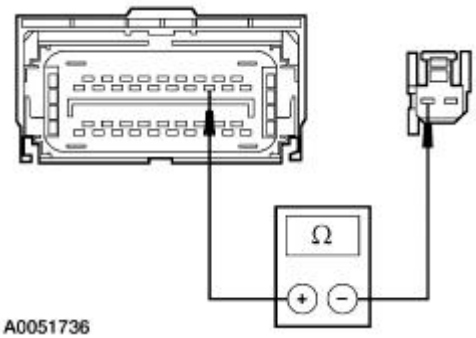
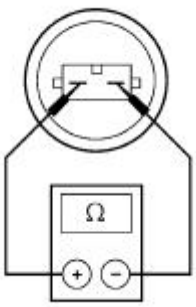
- **Is any voltage present?**

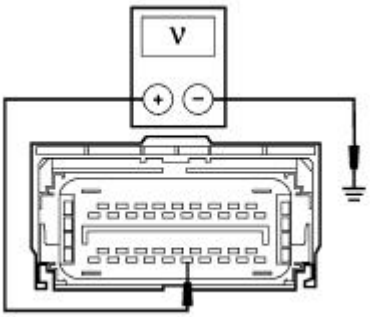
E6 CHECK THE SPEED CONTROL ACTUATOR CIRCUITRY FOR AN OPEN CIRCUIT	
• Key in OFF position. • Measure the resistance between the PCM C175b, harness side and the speed control actuator C122, harness side as follows: **PCM C175b** / **Speed control actuator C122** / **Circuit** Pin 12 / Pin 2 / 1926 (VT/YE) Pin 24 / Pin 3 / 1925 (PK/BK) Pin 35 / Pin 4 / 1924 (DG/WH) Pin 26 / Pin 5 / 1927 (TN) • **Are the resistances less than 5 ohms?**	**Yes** GO to E7 . **No** REPAIR the circuit(s). REPEAT the self-test.
E7 CHECK THE SPEED CONTROL ACTUATOR CIRCUITRY FOR SHORT TO GROUND	
• Measure the resistances between the PCM C175b, harness side and ground as follows: **PCM C175b** / **Circuit** Pin 26 / 1927 (TN) Pin 35 / 1924 (DG/WH) Pin 24 / 1925 (PK/BK) Pin 12 / 1926 (VT/YE)  • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to E8 . **No** REPAIR the circuit(s). REPEAT the self-test.
E8 CHECK CIRCUIT 1928 (RD/WH) FOR AN OPEN	

• Key in ON position. • Measure the voltage between the speed control actuator C122 pin 1, circuit 1928 (RD/WH), harness side and ground.  A0005468 • **Is the voltage greater than 10 volts?**	**Yes** GO to E9 . **No** REPAIR the circuit. REPEAT the self-test.
E9 CHECK THE DEACTIVATOR SWITCH CIRCUITRY FOR AN OPEN	
• Key in OFF position. • Measure the voltage between the speed control actuator C122 pin 6, circuit 307 (BK/YE), harness side and ground.  A0005472 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new speed control actuator. REFER to Speed Control Actuator in this section. REPEAT the self-test. **No** REPAIR the circuit. REPEAT the self-test.

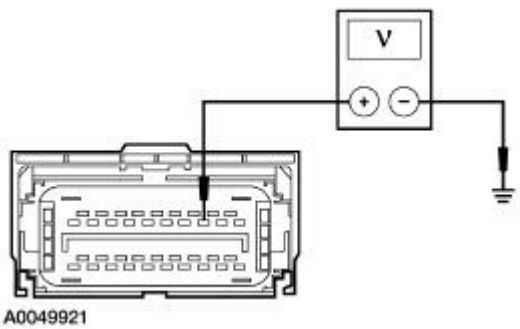
PINPOINT TEST F: FLASH CODE 2 —BRAKE PEDAL POSITION SWITCH CIRCUIT FAILURE

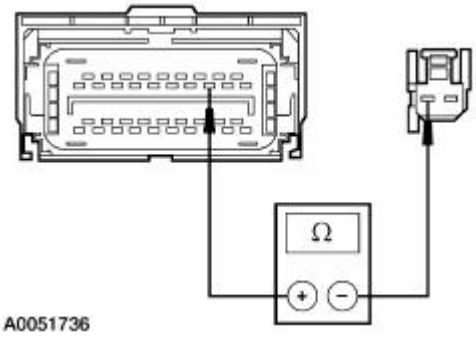
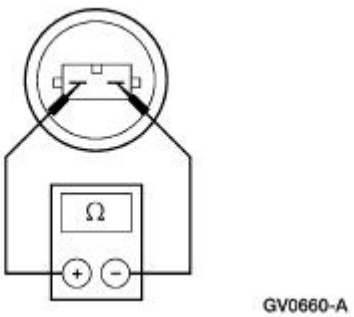
Test Step	Result / Action to Take
F1 MONITOR THE PCM PID BPP_SW	
• Key in ON position. • Monitor the PCM PID BPP_SW without pressing the brake pedal. • **Does the PCM BPP_SW PID indicate ON?**	**Yes** GO to F2 . **No** GO to F5 .
F2 CHECK FOR AN OPEN CIRCUIT	
• Key in OFF position. • Disconnect: PCM C175b. • Key in ON position. • Measure the voltage between the PCM C175b pin 15, circuit 307 (BK/YE), harness side and ground.	**Yes** GO to F6 . **No** GO to F3 .

 A0049921 ● **Is the voltage greater than 10 volts?**	
F3 CHECK CIRCUIT 307 (BK/YE)	
● Key in OFF position. ● Disconnect: Deactivator Switch C277. ● Measure the resistance between the PCM C175b pin 15, circuit 307 (BK/YE), harness side and the deactivator switch C277 pin 2, circuit 307 (BK/YE), harness side.  A0051736 ● **Is the resistance less than 5 ohms?**	**Yes** GO to F4 . **No** REPAIR the circuit. REPEAT the self-test.
F4 CHECK THE DEACTIVATOR SWITCH	
● Measure the resistance between the deactivator switch pins, (component side) while pressing and releasing the brake pedal.  GV0660-A ● **Is the resistance less than 5 ohms with the brake pedal released and greater than 10,000 ohms with the brake pedal depressed?**	**Yes** REPAIR the CIRCUIT. CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new deactivator switch. REFER to Speed Control Deactivator Switch in this section. CLEAR the DTCs. REPEAT the self-test.
F5 CHECK THE BRAKE PEDAL POSITION (BPP) INPUT TO PCM	
● Key in OFF position. ● Disconnect: PCM C175t. ● Key in ON position. ● Measure the voltage between the PCM C175t pin 40, circuit 810 (RD/LG), harness side and ground while depressing the brake pedal.	**Yes** GO to F6 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

 A0049923 ● **Is the voltage greater than 10 volts?**	
F6 CHECK FOR CORRECT PCM OPERATION	
● Key in OFF position. ● Disconnect all the PCM connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all PCM connectors and make sure they are seated correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new PCM. REFER to Section 303-14 . CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. REPEAT the self-test.

PINPOINT TEST G: FLASH CODE 3—DEACTIVATOR SWITCH CIRCUIT FAILURE

Test Step	Result / Action to Take
G1 MONITOR THE PCM PID BPA_SW	
● Key in ON position. ● Monitor the PCM PID BPA_SW without pressing the brake pedal. ● **Does the PID BPA_SW indicate ON?**	**Yes** GO to G2 . **No** GO to G5 .
G2 CHECK FOR AN OPEN CIRCUIT	
● Key in OFF position. ● Disconnect: PCM C175b. ● Key in ON position. ● Measure the voltage between the PCM C175b pin 15, circuit 307 (BK/YE), harness side and ground.  A0049921 ● **Is the voltage greater than 10 volts?**	**Yes** GO to G5 . **No** GO to G3 .

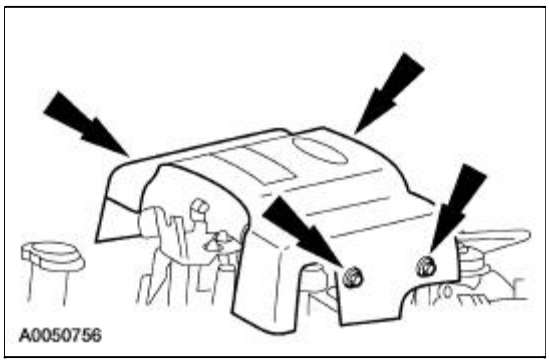
G3 CHECK CIRCUIT 307 (BK/YE)	
• Key in OFF position. • Disconnect: Deactivator Switch C277. • Measure the resistance between the PCM C175b pin 15, circuit 307 (BK/YE), harness side and the deactivator switch C277 pin 2, circuit 307 (BK/YE), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** GO to G4 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
G4 CHECK THE DEACTIVATOR SWITCH	
• Measure the resistance between the deactivator switch pins, (component side) while pressing and releasing the brake pedal.  • **Is the resistance less than 5 ohms with the brake pedal released and greater than 10,000 ohms with the brake pedal depressed?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new deactivator switch. REFER to Speed Control Deactivator Switch in this section. REPEAT the self-test.
G5 CHECK FOR CORRECT PCM OPERATION	
• Key in OFF position. • Disconnect all the PCM connectors. • Check for: ◦ corrosion ◦ pushed-out pins • Connect all PCM connectors and make sure they are seated correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PCM. REFER to Section 303-14 . REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Speed Control Cable

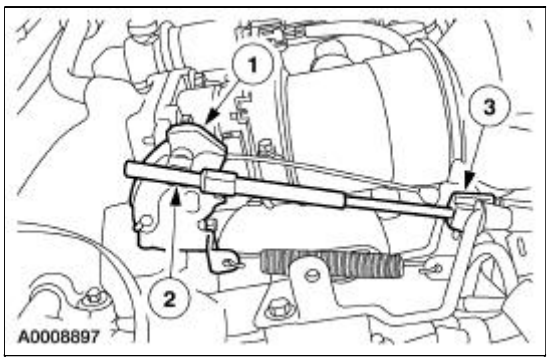
Removal

NOTE: 5.4L 2-valve Triton V8 shown; others are similar.

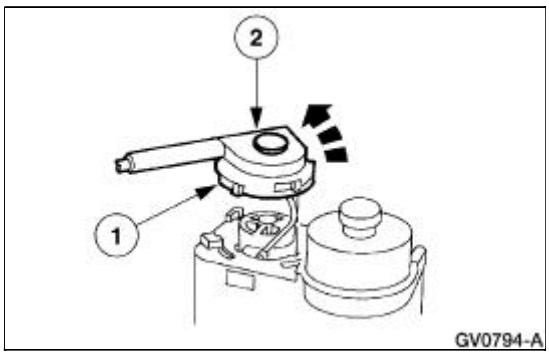
1. Remove the screws and the accelerator control splash shield.



2. Remove the speed control actuator cable.
    1. Open the throttle valve.
    2. Slide the throttle cable back to remove it from the throttle cam nail head.
    3. Squeeze the speed control actuator cable tabs and remove from the accelerator bracket.

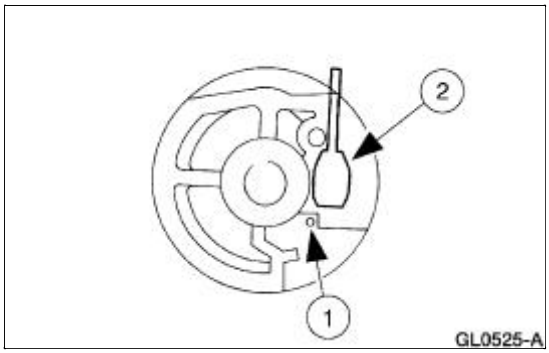


3. Remove the speed control actuator cable cap from the speed control actuator.
    1. Push in the locking arm on the speed control actuator cable cap.
    2. Rotate the speed control actuator cable cap counterclockwise.



4. Remove the speed control actuator cable.

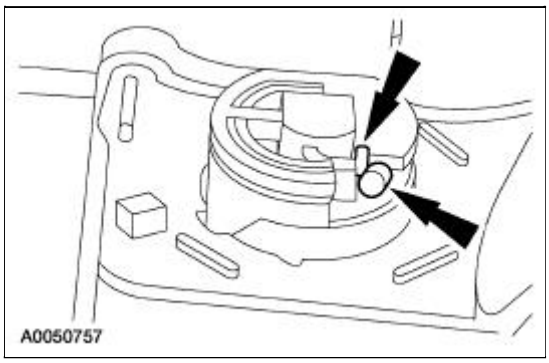
1. Press the spring retainer.
2. Slide the core wire end out of the speed control actuator pulley and remove the speed control actuator cable.



5. Remove the cable from the retainer clips.

Installation

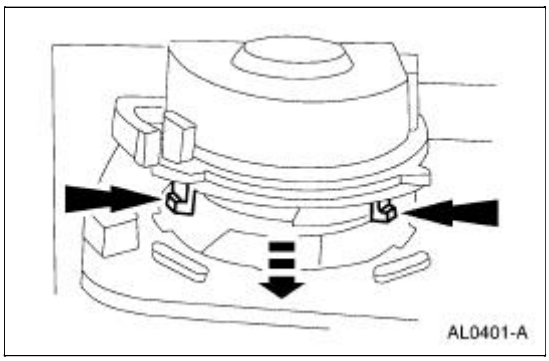
1. Insert the speed control cable slug into the speed control actuator pulley slot.
    1. Gently compress the speed control actuator spring.



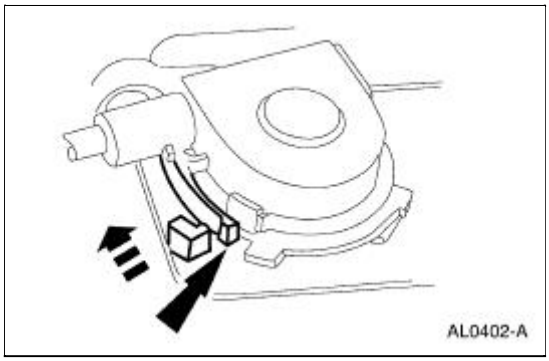
2. **NOTE:** Make sure the rubber seal is fully seated onto the speed control actuator cable cap.

   NOTE: Incorrect wrapping of the speed control actuator cable around the speed control actuator pulley may result in a high idle condition.

   Release the compressed spring while aligning the speed control actuator cable cap tabs with the slots in the speed control actuator housing

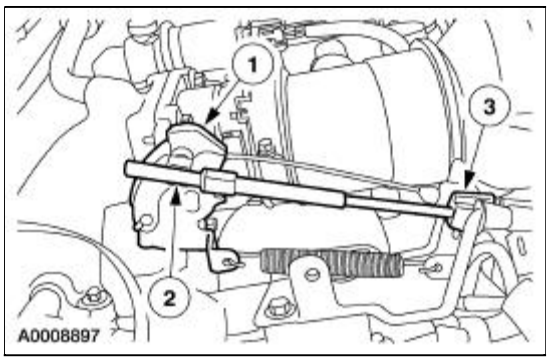


3. Rotate the speed control actuator cable cap until the locking arm engages.



4. **NOTE:** Make sure the speed control cable is installed to all cable retainer clips.

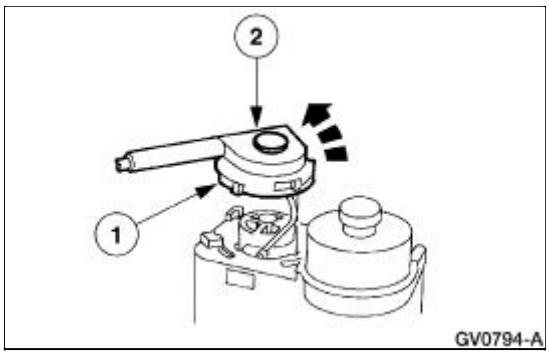
   Install the speed control actuator cable.
   1. Open the throttle valve.
   2. Install the speed control cable to the throttle valve.
   3. Install the speed control cable to the bracket.



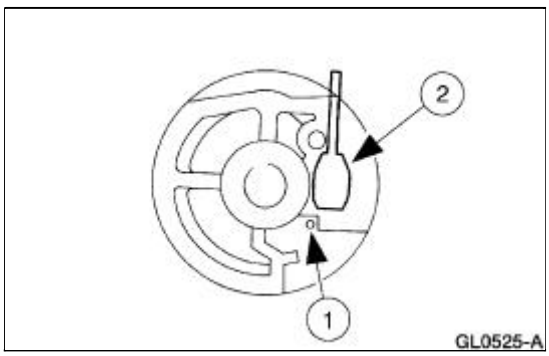
Speed Control Actuator

Removal

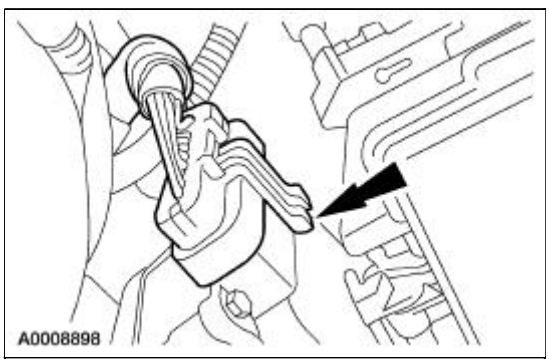
1. Remove the speed control actuator cable cap from the speed control actuator.
    1. Push in the locking arm on the speed control actuator cable cap.
    2. Rotate the speed control actuator cable cap counterclockwise.



2. Disconnect the speed control actuator cable from the speed control actuator.
    1. Depress the spring retainer.
    2. Slide the core wire end out of the speed control actuator pulley.

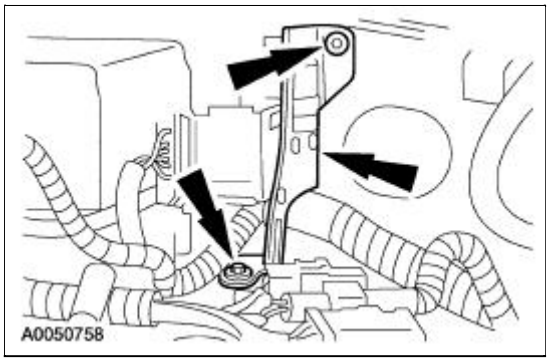


3. Disconnect the speed control actuator electrical connector.
    - Depress the connector tab.

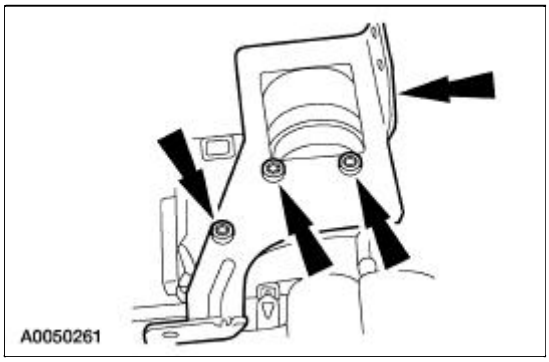


4. **NOTE:** Do not remove the rubber grommets from the speed control actuator bracket.

   Remove the bolts and the speed control actuator and bracket.



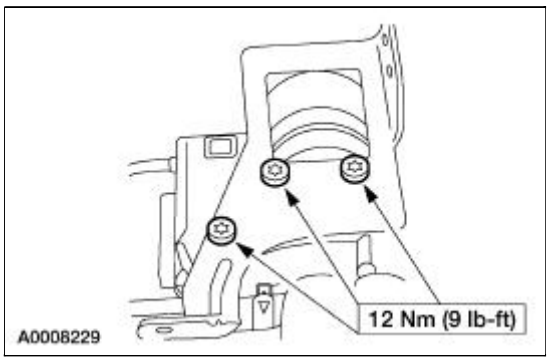
5. Remove the screws and the speed control actuator bracket.



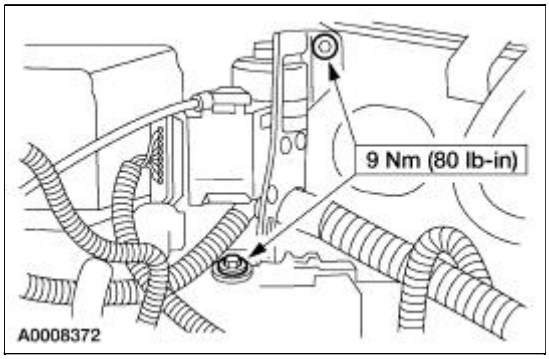
Installation

1. **NOTE:** The rubber grommets must be correctly seated in the speed control actuator bracket for correct noise and vibration isolation.

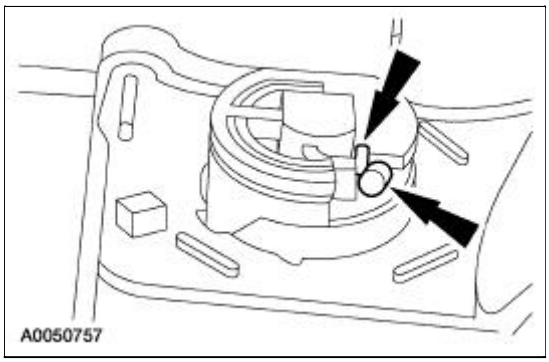
   Install the speed control actuator bracket.



2. Install the speed control actuator.



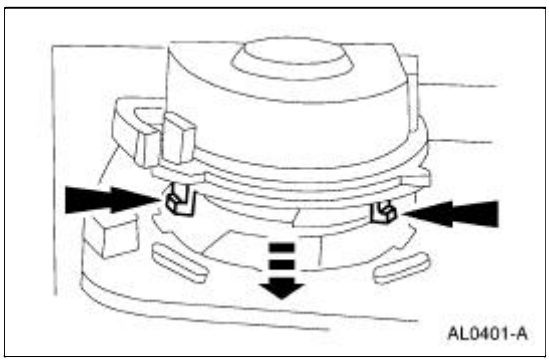
3. Insert the speed control cable slug into the speed control actuator pulley slot.
    1. Gently compress the speed control actuator spring.



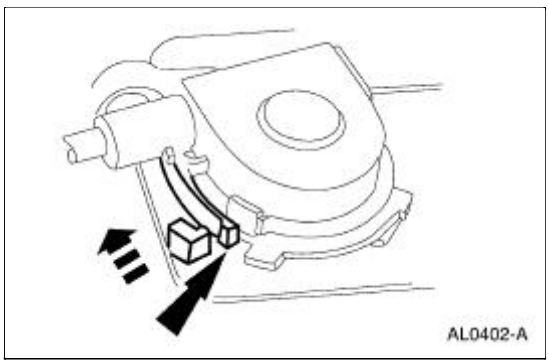
4. **NOTE:** Make sure the rubber seal is fully seated onto the speed control actuator cable cap.

   NOTE: Incorrect wrapping of the speed control actuator cable around the speed control actuator pulley may result in a high idle condition.

   Release the compressed spring while aligning the speed control actuator cable cap tabs with the slots in the speed control actuator housing.



5. Rotate the speed control actuator cable cap until the locking arm engages.



Speed Control Switch —With Remote Audio/Climate Control

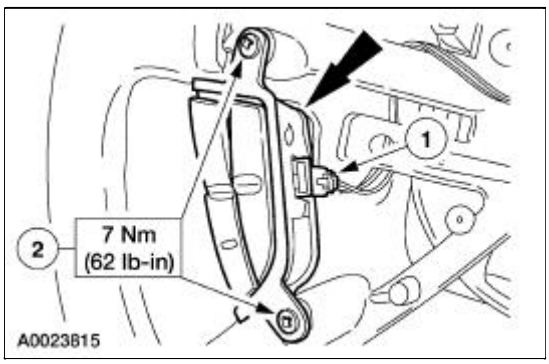
Removal and Installation

All vehicles

1. Remove the driver side air bag module. For additional information, refer to Section 501-20B .

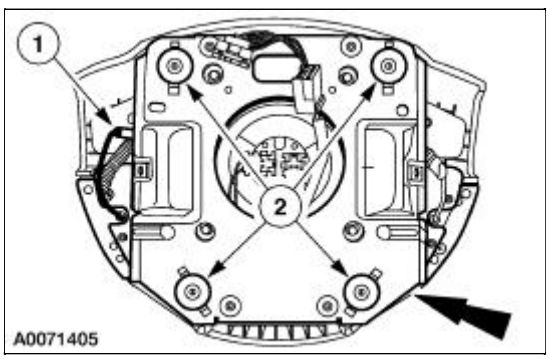
Expedition

2. Remove the speed control switch.
    1. Disconnect the electrical connector.
    2. Remove the screws.

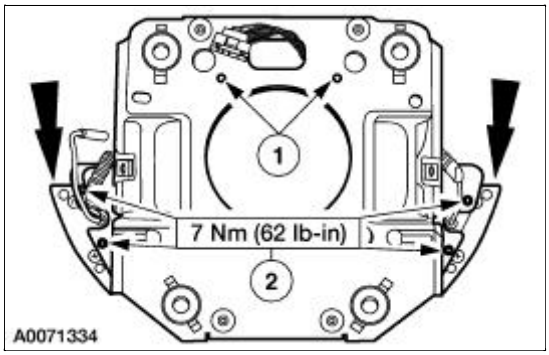


Navigator

3. Remove the horn switch.
    1. Disconnect the electrical connector.
    2. Remove the bolts.



4. Remove the speed control switch.
    1. Disconnect the wiring harness locators.
    2. Remove the screws.



All vehicles

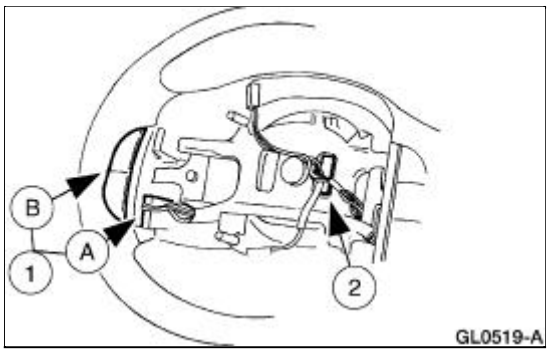
5. To install, reverse the removal procedure.

Speed Control Switch —Without Remote Audio/Climate Control

Removal and Installation

1. Remove the driver side air bag module. Refer to Section 501-20B .

2. Remove the speed control actuator switch.
    1. Release the four (A) speed control actuator switch clips and remove the (B) speed control actuator switch.
    2. Disconnect the speed control actuator switch electrical connector.

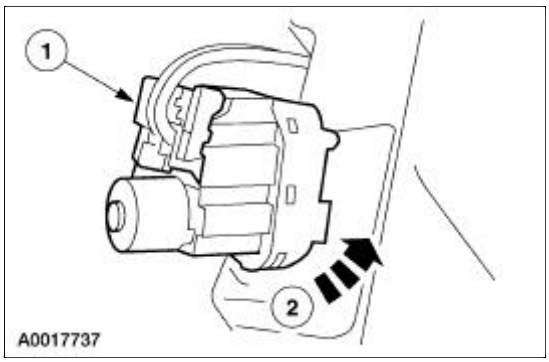


3. To install, reverse the removal procedure.

Speed Control Deactivator Switch

Removal

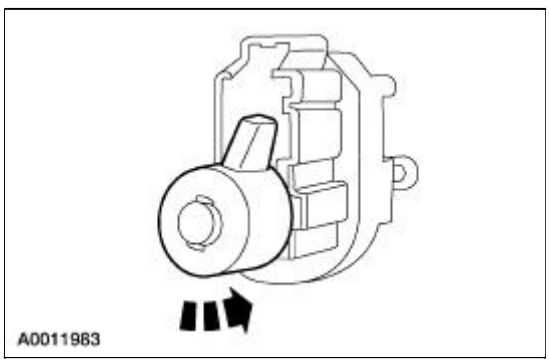
1. Remove the deactivator switch.
    1. Disconnect the electrical connector.
    2. Rotate counterclockwise 45 degrees and remove the deactivator switch.



Installation

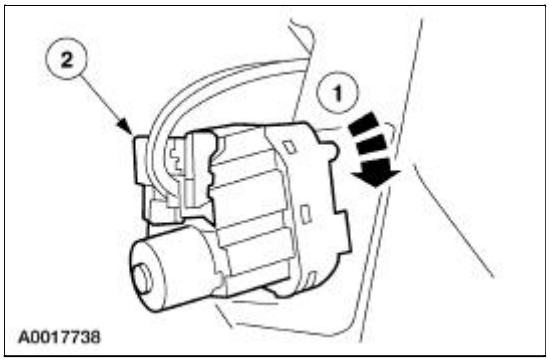
All vehicles

1. Release the plunger lock (if equipped).
    - Turn the lock knob counterclockwise until first click is felt.



2. Fully depress the brake pedal.

3. Install the deactivator switch.
    1. Position the deactivator switch in the bracket and rotate clockwise 45 degrees.
    2. Connect the electrical connector.



Vehicles equipped with locking tab

4. **NOTE:** There should be an extra click heard when tugging on the brake pedal.

   Slowly release the brake pedal and tug moderately once the pedal reaches the rest position.

General Specifications

Item	Specification
A/C Compressor	
Type	SC115 fixed scroll
Displacement	115 cc (7 cu in)
A/C Pressure Relief Valve [a]	
Open pressures	3,792-4,137 kPa (550-600 psi)
Coolant Hose Lubricant	
MERPOL®	ESE-M99B144-B
Magnetic Clutch	
Air gap clearance	0.35-0.75 mm (0.014-0.030 in)
Pressure Cutoff Switch [a]	
Open status	3,137-3,413 kPa (455-495 psi)
Closed status	2,034-2,448 kPa (295-355 psi)
Low Charge Protection Switch [a]	
Open pressure	62-76 kPa (9-11 psi)
Closed pressure	110-165 kPa (16-24 psi)
Thermostatic A/C Cycling Switch	
On temperatures	2.2-3.3°C (36-38°F)
Off temperatures	2.2-3.3°C (36-38°F)
Refrigerant Lubricant and Capacity	
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B
Capacity without auxiliary climate control	266 ml (9 oz)
Capacity with auxiliary climate control	414 ml (14 oz)
Refrigerant and Capacity	
R-134a Refrigerant YN-19	WSH-M17B19-A
Capacity without auxiliary climate control	1.0 kg (32 oz)
Capacity with auxiliary climate control	1.53 kg (54 oz)
Refrigerant System Cleaner	
A/C Systems Flushing Solvent F4AZ-19579-A	—

[a] Manifold gauge set pressures may vary slightly depending on the distance between the service gauge port valve and the A/C pressure relief valve, A/C cycling switch, and pressure cutoff switch locations.

Torque Specifications

Description	Nm	lb-in
Peanut fitting	8	71

Climate Control System

WARNING: To avoid accidental deployment and possible injury, the air bag system backup power supply must be depleted before repairing any climate control components. To deplete the backup power supply, disconnect the battery ground cable and wait one minute. Failure to follow these instructions may result in personal injury.

WARNING: Carbon monoxide is colorless, odorless and dangerous. If it is necessary to operate the engine with vehicle in a closed area such as a garage, always use an exhaust collector to vent the exhaust gases outside the closed area. Failure to follow these instructions may result in personal injury.

WARNING: R-134a is classified as a safe refrigerant, but misuse can make it dangerous. The following precautions must be observed. Failure to follow these instructions may result in personal injury.

- **Always wear safety goggles when repairing an air conditioning system.**
- **Avoid contact with liquid refrigerant R-134a. R-134a vaporizes at approximately -25°C (-13°F) under atmospheric pressure and it will freeze skin tissue.**
- **Never allow refrigerant R-134a gas to escape in quantity in an occupied space. R-134a is non-toxic, but it will displace the oxygen needed to support life.**
- **Never use a torch in an atmosphere containing R-134a gas. R-134a is non-toxic at all normal conditions, but when it is exposed to high temperatures, such as a torch flame, it decomposes. During decomposition, it releases irritating and toxic gases (as described in the MSDS sheet from the manufacturer). Decomposition products are hydrofluoric acid, carbon dioxide and water.**
- **Do not allow any portion of the charged air conditioning system to become too hot. The pressure in an air conditioning system rises as the temperature rises, and temperatures of approximately 85°C (185°F) can be dangerous.**
- **Allow the engine to cool sufficiently prior to performing maintenance or serious burns and injury can occur.**

CAUTION: To avoid damaging the vehicle or A/C components, the following precautions must be observed:

- **The A/C refrigerant of all vehicles must be identified and analyzed prior to refrigerant charging. Failure to due so can contaminate the shop bulk refrigerant and other vehicles.**
- **Do not add R-12 refrigerant to an A/C system that requires the use of R-134a refrigerant. These two types of refrigerant must never be mixed. Doing so can damage the A/C system.**
- **Charge the A/C system with the engine running only at the low-pressure side to prevent refrigerant slugging from damaging the A/C compressor.**
- **Use only R-134a refrigerant. Due to environmental concerns, when the air conditioning system is drained, the refrigerant must be collected using refrigerant recovery/recycling equipment. Federal law requires that R-134a be recovered into appropriate equipment and the process be conducted by qualified technicians who have been certified by an approved organization, such as MACS, ASI, etc. Use of a recovery machine dedicated to**

R-134a is necessary to reduce the possibility of oil and refrigerant incompatibility concerns. Refer to the instructions provided by the equipment manufacturer when removing refrigerant from or charging the air conditioning system.

- **Refrigerant R-134a must not be mixed with air for leak testing or used with air for any other purpose above atmospheric pressure. R-134a is combustible when mixed with high concentrations of air and higher pressures.**
- **Some manufacturers are producing refrigerant products that are described as direct substitutes for refrigerant R-134a. The use of any unauthorized substitute refrigerant can severely damage the A/C components. If repair is required, use only new or recycled refrigerant R-134a.**

 **CAUTION: To avoid contamination of the A/C system:**

- **Never open or loosen a connection before discharging the system.**
- **When loosening a connection, if any residual pressure is evident, allow it to leak out before opening the fitting.**
- **Evacuate a system that has been opened to install a component or one that has discharged through leakage before charging.**
- **Seal open fitting with a cap or plug immediately after disconnecting a component from the system.**
- **Clean the outside of the fittings thoroughly before disconnecting a component from the system.**
- **Do not remove the sealing caps from a new component until ready to install.**
- **Refrigerant oil will absorb moisture from the atmosphere if left uncapped. Do not open an oil container until ready to use, and install the cap immediately after using. Store the oil in a clean, moisture-free container.**
- **Install a new O-ring seal before connecting an open fitting. Coat the fitting and O-ring seal with PAG oil before connecting.**
- **When installing a refrigerant line, avoid sharp bends. Position the line away from the exhaust or any sharp edges that can chafe the line.**
- **Tighten threaded fittings only to specifications. The steel and aluminum fittings used in the refrigerant system will not tolerate overtightening.**
- **When disconnecting a fitting, use a wrench on both halves of the fitting to prevent twisting of the refrigerant lines or tubes.**
- **Do not open a refrigerant system or uncap a replacement component unless it is as close as possible to room temperature. This will prevent condensation from forming inside a component that is cooler than the surrounding air.**

The manual climate control system heats or cools the vehicle depending on the function selector switch position and the temperature selected.

- The function selector switch position determines air distribution.
- The temperature control setting determines the air temperature.
- The heater blower motor switch (18578) varies the blower motor speed.

The electronic automatic temperature control system maintains the selected vehicle interior temperature by heating or cooling the air.

- During A/C operation, the system also reduces the relative humidity of the air.
- The driver may override the automatic mode of operation.

Principles of Operation

There are four main principles involved with the basic theory of operation:

- Heat transfer
- Latent heat of vaporization
- Relative humidity
- Effects of pressure

Heat Transfer

If two substances of different temperature are placed near each other, the heat in the warmer substance will transfer to the colder substance.

Latent Heat of Vaporization

When a liquid boils (converts to gas) it absorbs heat without raising the temperature of the resulting gas. When the gas condenses (converts back to a liquid), it gives off heat without lowering the temperature of the resulting liquid.

Relative Humidity

The amount of moisture (water vapor content) that the air can hold is directly related to the air temperature. The more heat there is in the air, the more moisture the air can hold. The lower the moisture content in the air, the more comfortable you feel. Removing moisture from the air lowers its relative humidity and improves personal comfort.

Effects of Pressure on Boiling or Condensation

As the pressure is increased on a liquid, the temperature at which the liquid boils (converts to gas) also increases. Conversely, when the pressure on a liquid is reduced, its boiling point is also reduced. When in the gas state, an increase in pressure causes an increase in temperature, while a decrease in pressure will decrease the temperature of the gas.

Compressor Anti-Slugging Strategy

Liquid refrigerant may accumulate in the A/C compressor under certain conditions. To alleviate damage to the A/C compressor, compressor anti-slugging strategy (CASS) is utilized.

CASS is initiated only under specific conditions:

- The ignition is off for more than 8 hours.
- The ambient temperature is above -4°C (25°F).
- Battery voltage is above 8.5 volts during engine cranking.

When these conditions are present, the powertrain control module (PCM) will activate the A/C control relay prior to cranking of the engine. The A/C control relay engages the A/C compressor for approximately 4-15 A/C compressor revolutions or a maximum of two seconds (depending upon vehicle application), allowing the liquid refrigerant to be pushed from the A/C compressor. CASS is initiated by the PCM regardless of the function selector switch position or the EATC system settings.

The Refrigerant Cycle

During stabilized conditions (air conditioning system shutdown), the refrigerant is in a vaporized state and pressures are equal throughout the system. When the A/C compressor is in operation, it increases pressure on the refrigerant vapor raising its temperature. The high-pressure, high-temperature vapor is then released into the top of the A/C condenser core.

The A/C condenser core, being close to ambient temperature, causes the refrigerant vapor to condense into a liquid when heat is removed from the refrigerant by ambient air passing over the fins and tubing. The now liquid refrigerant, still at high pressure, exits from the bottom of the A/C condenser core and enters the inlet side of the receiver/drier.

The receiver/drier is designed to remove moisture from the refrigerant. The refrigerant, still at high pressure, exits the receiver/drier and enters the thermostatic expansion valve.

The thermostatic expansion valve is the restriction in the refrigerant system that creates the high-pressure buildup in the A/C condenser core and separates the high and low-pressure sides of the A/C system. As the liquid refrigerant leaves this restriction, its pressure and boiling point are reduced.

The liquid refrigerant is now at its lowest pressure and temperature. As it passes through the A/C evaporator core, it absorbs heat from the passenger compartment airflow passing over the plate/fin sections of the A/C evaporator core. This addition of heat causes the refrigerant to boil (convert to gas). The now cooler passenger compartment air can no longer support the same humidity level of the warmer air and this excess moisture condenses on the exterior of the evaporator coils and fins and drains outside the vehicle.

The refrigerant cycle is now repeated with the A/C compressor again increasing the pressure and temperature of the refrigerant.

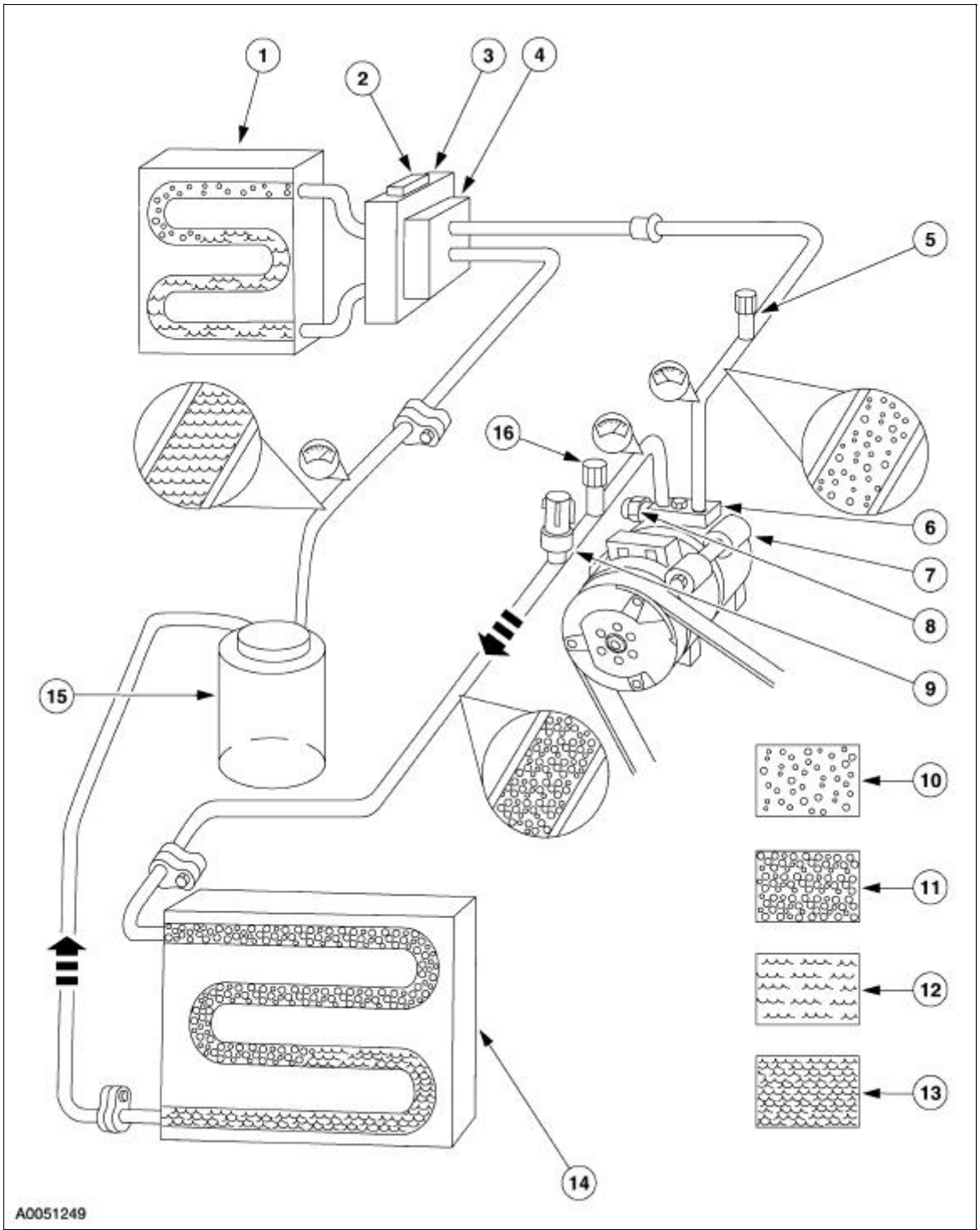
The A/C thermostatic cycling switch interrupts compressor operation before the external temperature of the A/C evaporator core gets low enough to cause the condensed water vapor (excess humidity) to turn to ice. It does this by supplying an ON/OFF command to the PCM.

The low charge protection switch protects the A/C compressor in the event of a low refrigerant charge. The low charge protection switch interrupts the voltage to the A/C thermostatic cycling switch when the low side refrigerant pressure drops below acceptable levels.

The high side line pressure is also monitored so that A/C compressor operation can be interrupted if system pressure becomes too high.

The A/C compressor relief valve will open and vent refrigerant to relieve unusually high system pressure.

Clutch Cycling Thermostatic Expansion Valve Type Refrigerant System



Item	Part Number	Description
1	19860	A/C evaporator core
2	19C734	A/C thermostatic cycling switch
3	19849	Thermostatic expansion valve
4	19835	Thermostatic expansion valve manifold and tube assembly
5	19D701	Low side charge valve port
6	19D734	Compressor manifold and tube assembly
7	19703	A/C compressor

8	19D644	A/C pressure relief valve
9	19D594	A/C pressure sensor
10	—	Low pressure vapor
11	—	High pressure vapor
12	—	Low pressure liquid
13	—	High pressure liquid
14	19712	A/C condenser core
15	19959	A/C receiver/drier
16	19D701	High side charge valve port

System Airflow Description — Manual Climate Control

Max A/C

When MAX A/C is selected:

- The air inlet door vacuum control motor is at full vacuum, closing off outside air and admitting only recirculated air.
- The panel door and floor/defrost door vacuum control motors are at full vacuum, directing airflow to the instrument panel A/C registers. A small amount of airflow from the side window demisters will be present.
- Blended air temperature is not available.
- The A/C request button is illuminated and will be disabled.
- The A/C compressor will operate if the outside temperature is above approximately 2°C (35°F).
- The blower motor is on.
- The auxiliary blower motor is enabled, if equipped.

PANEL

When PANEL is selected:

- The air inlet door vacuum control motor is at no vacuum, admitting only outside air into the passenger compartment.
- The panel door and floor/defrost door vacuum control motors are at full vacuum, directing airflow to the instrument panel A/C registers. A small amount of airflow from the side window demisters will be present.
- Blended air temperature is available.
- The A/C request button is enabled. The A/C compressor will operate and the indicator will illuminate if the A/C request button is selected and the outside temperature is above approximately 2°C (35°F).
- The blower motor is on.
- The auxiliary blower motor is enabled, if equipped.

PANEL/FLOOR

When PANEL/FLOOR is selected:

- The air inlet door vacuum control motor is at no vacuum, admitting only outside air into the passenger compartment.
- The floor/defrost door vacuum control motor is at full vacuum and the panel door vacuum control motor is at partial vacuum, directing airflow to the floor duct and the instrument panel A/C registers. A small amount of airflow from the side window demisters will be present.
- Blended air temperature is available.
- The A/C request button is enabled. The A/C compressor will operate and the indicator will illuminate if the A/C request button is selected and the outside temperature is above approximately 2°C (35°F).
- The blower motor is on.
- The auxiliary blower motor is enabled, if equipped.

OFF

When OFF is selected:

- The air inlet door vacuum control motor is at full vacuum, closing off outside air from entering the passenger compartment.
- The panel door and floor/defrost door vacuum control motors are at no vacuum.
- The A/C request button is disabled.
- The blower motor is off.
- The auxiliary blower motor is disabled, if equipped.

FLOOR

When FLOOR is selected:

- The air inlet door vacuum control motor is at no vacuum, admitting only outside air into the passenger compartment.
- The floor/defrost door vacuum control motor is at partial vacuum and the panel door vacuum control motor is at no vacuum, directing airflow to the floor duct. A small amount of airflow from the instrument panel A/C registers, defroster duct and side window demisters will be present.
- Blended air temperature is available.
- The A/C request button is enabled. The A/C compressor will operate and the indicator will illuminate if the A/C request button is selected and the outside temperature is above approximately 2°C (35°F).
- The blower motor is on.
- The auxiliary blower motor is enabled, if equipped.

FLOOR/DEFROST

When the FLOOR/DEFROST is selected:

- The air inlet door vacuum control motor is at no vacuum, admitting only outside air into the passenger compartment.
- The floor/defrost door vacuum control motor is at partial vacuum and the panel door vacuum control motor is at no vacuum, directing airflow to the floor duct, the defroster duct and the side window demisters. A small amount of airflow from the instrument panel A/C registers will be present.

- Blended air temperature is available.
- The A/C request button will not illuminate and is disabled. To reduce fogging, the A/C compressor will operate automatically if the outside temperature is above approximately 2°C (35°F).
- The blower motor is on.
- The auxiliary blower motor is enabled, if equipped.

DEFROST

When DEFROST is selected:

- The air inlet door vacuum control motor is at no vacuum, admitting only outside air into the passenger compartment.
- The panel door and floor/defrost door vacuum control motors are at no vacuum, directing airflow to the defroster duct and side window demisters. A small amount of airflow from the instrument panel A/C registers and floor duct will be present.
- Blended air temperature is available.
- The A/C request button will not illuminate and is disabled. To reduce fogging, the A/C compressor will operate automatically if the outside temperature is above approximately 2°C (35°F).
- The blower motor is on.
- The auxiliary blower motor is enabled, if equipped.

System Airflow Description — EATC/DATC

AUTO

When AUTO is selected:

- The temperature control setting(s) is/are manually set to the desired setting(s).
- The air inlet door vacuum control motor is automatically controlled by the EATC/DATC module, based on the temperature setting(s).
- The mode door vacuum control motors are automatically controlled by the EATC/DATC module based on the temperature setting(s).
- The A/C compressor is automatically controlled by the EATC/DATC module based on the temperature settings. The A/C compressor will not operate if the outside temperature is below approximately 2°C (35°F).
- The A/C request button or the RECIRC request button, if pressed, will transfer the system to manual operation.
- The blower motor is on. The blower motor speed is automatically controlled by the EATC/DATC module based on the temperature settings, but can be manually overridden.

OFF

When OFF is selected:

- The air inlet door vacuum control motor is at full vacuum, closing off outside air from entering the passenger compartment.
- The panel door and floor/defrost door vacuum control motors are at no vacuum.
- The A/C request button is disabled.

- The blower motor is off.
- The auxiliary blower motor is disabled, if equipped.

PANEL

When PANEL is selected:

- The recirc request button is enabled. If the recirc request button is selected (indicator on), the air inlet door vacuum control motor will be at full vacuum, closing off outside air from entering the passenger compartment. If the recirc request button is not selected (indicator off), the air inlet door vacuum control motor will be at no vacuum, admitting only outside air into the passenger compartment.
- The panel door and floor/defrost door vacuum control motors are at full vacuum, directing airflow to the instrument panel A/C registers. A small amount of airflow from the side window demisters will be present.
- Blended air temperature is available. Only when A/C compressor operation has been selected by pressing the A/C request button (indicator on), can the airflow temperature be cooled below the outside air temperature.
- The A/C request button is enabled. The A/C compressor will operate and the indicator will illuminate if the A/C request button is selected and the outside temperature is above approximately 2°C (35°F).
- The blower motor is on.
- The auxiliary blower motor is enabled, if equipped.

PANEL/FLOOR

When PANEL/FLOOR is selected:

- The Recirc request button is enabled. If the recirc request button is selected (indicator on), the air inlet door vacuum control motor will be at full vacuum, closing off outside air from entering the passenger compartment. If the recirc request button is not selected (indicator off), the air inlet door vacuum control motor will be at no vacuum, admitting only outside air into the passenger compartment.
- The floor/defrost door vacuum control motor is at full vacuum and the panel door vacuum control motor is at partial vacuum, directing airflow to the floor duct and the instrument panel A/C registers. A small amount of airflow from the side window demisters will be present.
- Blended air temperature is available. Only when A/C compressor operation has been selected by pressing the A/C request button (indicator on), can the airflow temperature be cooled below the outside air temperature.
- The A/C request button is enabled. The A/C compressor will operate and the indicator will illuminate if the A/C request button is selected and the outside temperature is above approximately 2°C (35°F).
- The blower motor is on.
- The auxiliary blower motor is enabled, if equipped.

FLOOR

When FLOOR is selected:

- The recirc request button is enabled. If the recirc request button is selected (indicator on), the air inlet door vacuum control motor will be at full vacuum, closing off outside air from entering the passenger compartment. If the recirc request button is not selected (indicator off), the air

inlet door vacuum control motor will be at no vacuum, admitting only outside air into the passenger compartment.

- The floor/defrost door vacuum control motor is at partial vacuum and the panel door vacuum control motor is at no vacuum, directing airflow to the floor duct. A small amount of airflow from the instrument panel A/C registers, defroster duct and side window demisters will be present.
- Blended air temperature is available. Only when A/C compressor operation has been selected by pressing the A/C request button (indicator on), can the airflow temperature be cooled below the outside air temperature.
- The A/C request button is enabled. The A/C compressor will operate and the indicator will illuminate if the A/C request button is selected and the outside temperature is above approximately 2°C (35°F).
- The blower motor is on.
- The auxiliary blower motor is enabled, if equipped.

FLOOR/DEFROST

When the FLOOR/DEFROST is selected:

- The recirc request button is disabled. The air inlet door vacuum control motor will be at no vacuum, admitting only outside air into the passenger compartment.
- The floor/defrost door vacuum control motor is at partial vacuum and the panel door vacuum control motor is at no vacuum, directing airflow to the floor duct, the defroster duct and the side window demisters. A small amount of airflow from the instrument panel A/C registers will be present.
- Blended air temperature is available.
- The A/C request button will not illuminate and is disabled. To reduce fogging, the A/C compressor will operate automatically if the outside temperature is above approximately 2°C (35°F).
- The blower motor is on.
- The auxiliary blower motor is enabled, if equipped.

DEFROST

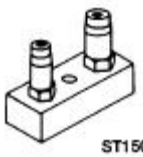
When DEFROST is selected:

- The recirc request button is enabled. If the recirc request button is selected (indicator on), the air inlet door vacuum control motor will be at full vacuum, closing off outside air from entering the passenger compartment. If the recirc request button is not selected (indicator off), the air inlet door vacuum control motor will be at no vacuum, admitting only outside air into the passenger compartment.
- The panel door and floor/defrost door vacuum control motors are at no vacuum, directing airflow to the defroster duct and side window demisters. A small amount of airflow from the instrument panel A/C registers and floor duct will be present.
- Blended air temperature is available.
- The A/C request button will not illuminate and is disabled. To reduce fogging, the A/C compressor will operate automatically if the outside temperature is above approximately 2°C (35°F).
- The blower motor is on.
- The auxiliary blower motor is enabled, if equipped.

Climate Control System

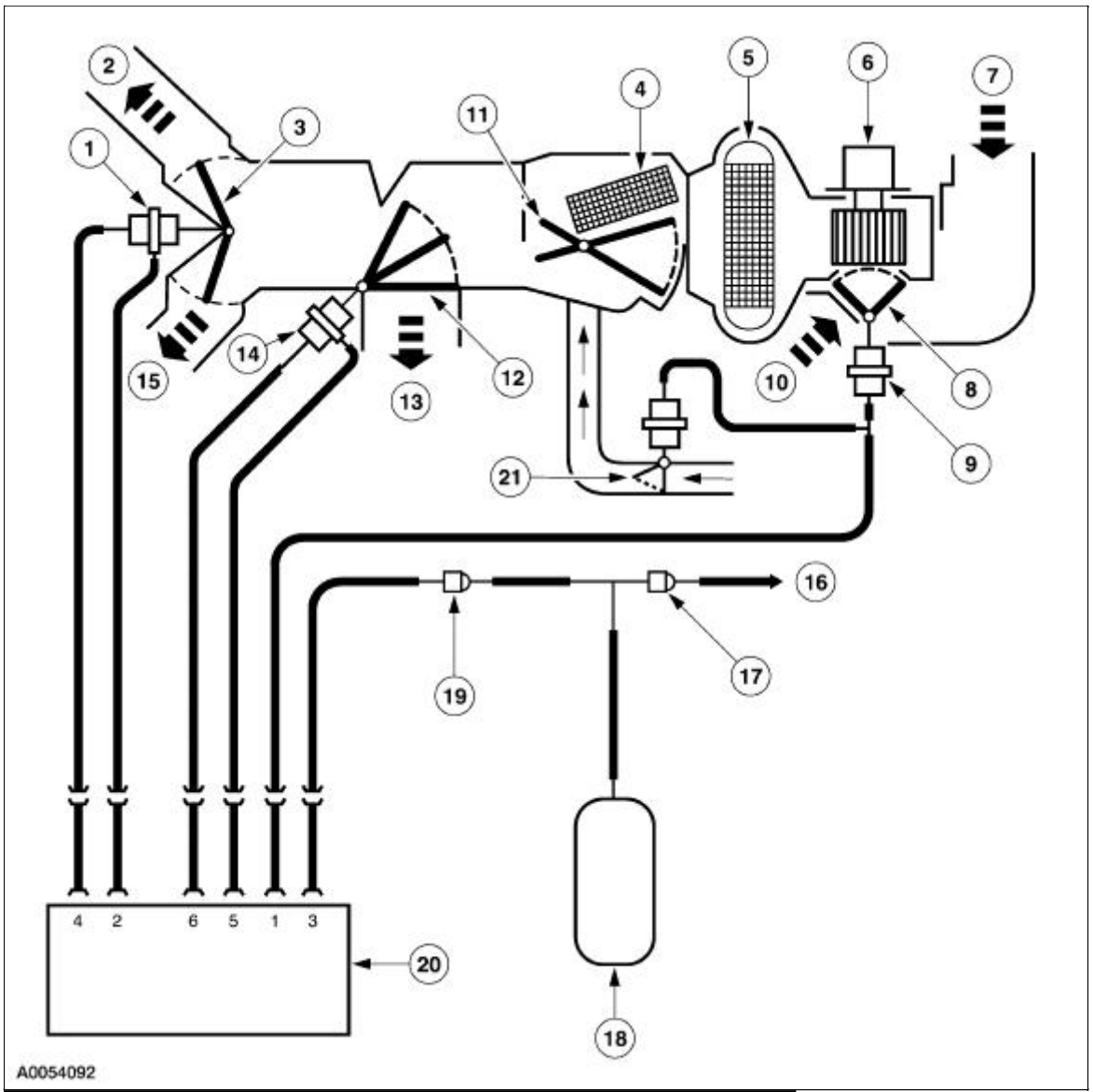
Refer to Wiring Diagrams Cell 54 for schematic and connector information.

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool
 ST1928-A	R-134a Manifold Gauge Set 176-R032A or equivalent
 ST1501-A	Connector, Refrigerant Pressure Line 412-093 (T94P-19623-E)
 ST1252-A	Set, A/C Fittings 412-DS028 (D93L-19703-B) or equivalent
 ST2351-A	Refrigerant Leak Detector 216-00001 or equivalent
 ST1474-A	Pressure Tester 014-R1072 or equivalent
	Fluke 77 III Automotive Meter 105-R0056 or equivalent

 ST1137-A	

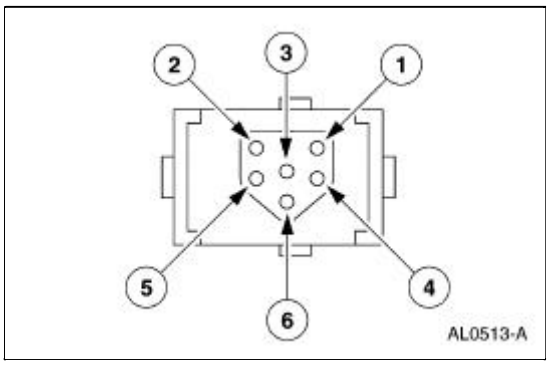
Vacuum Schematic — Manual A/C



Item	Part Number	Description
1	18A318	Vacuum control motor — floor/defrost door
2	—	Defrost air flow
3	18A478	Floor/defrost door
4	18476	Heater core
5	19860	Evaporator core
6	19805	Blower motor
7	—	Outside air inlet

8	19A813	Air inlet door
9	18A318	Vacuum control motor — air inlet door
10	—	Recirculated air inlet
11	18B545	Temperature blend door
12	18A559	Panel door
13	—	Panel air flow
14	18A318	Vacuum control motor — panel door
15	—	Floor air flow
16	—	Vacuum from the engine intake manifold
17	19A563	A/C vacuum check valve
18	19A566	Vacuum reservoir tank and bracket
19	19A563	A/C vacuum check valve
20	19B888	Function selector switch
21	18495	Heater control valve

Function Selector Switch Vacuum Connector End View



Port	Hose Color	Function
1	White	Air Inlet Door
2	Blue	Floor/Defrost Door
3	Black	Vacuum Source
4	Yellow	Floor/Defrost Door
5	Red	Panel Door
6	Orange	Panel Door

Vacuum Application Chart — Manual A/C

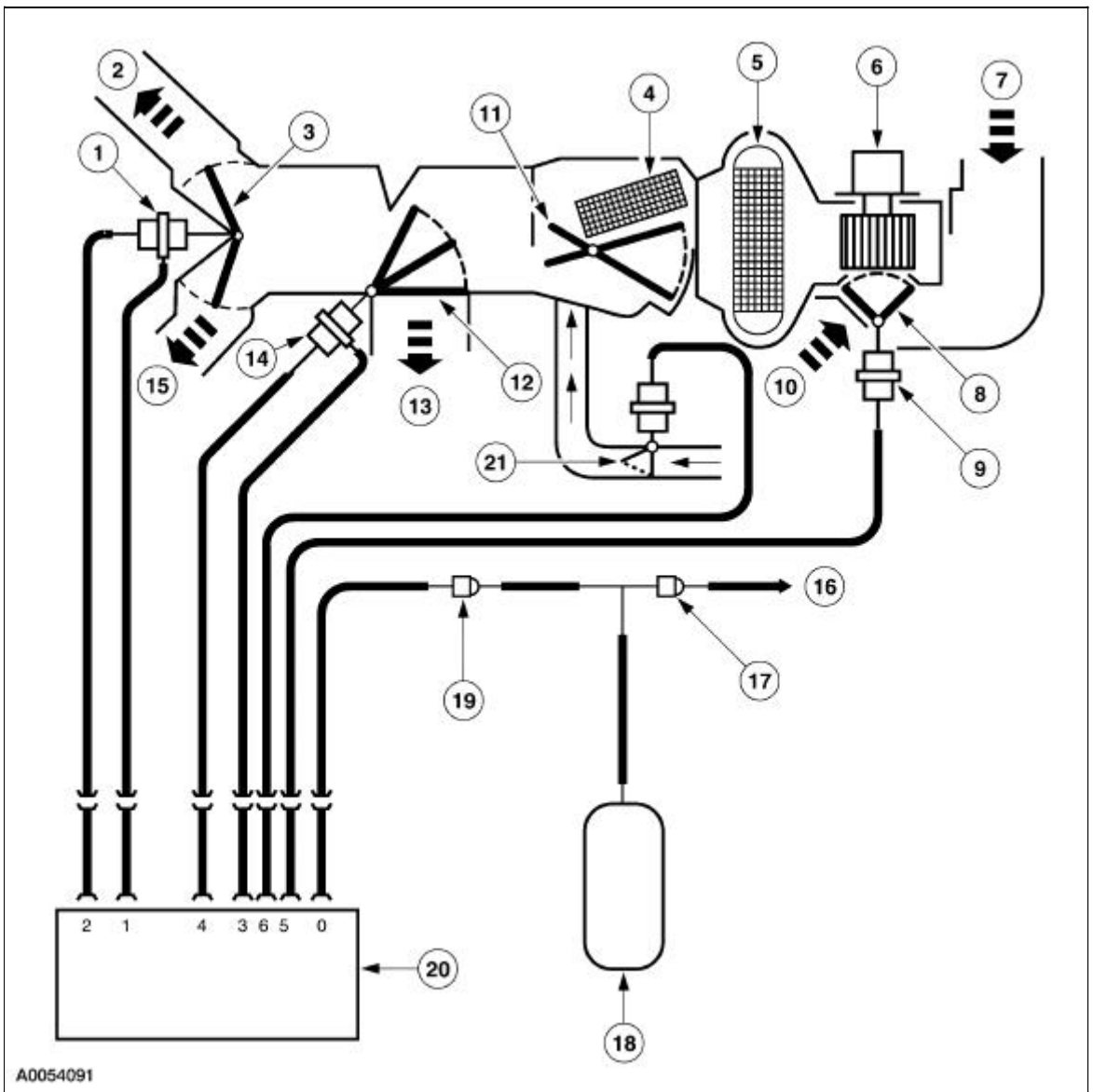
Switch Port	Color	Function	Function Selector Switch Position						
			MAX A/C	PANEL	PNL/FLR	OFF	FLOOR	FLR/ DEF	DEF
1	White	Recirc/ Fresh	V	NV	NV	V	NV	NV	NV
2	Blue	Floor/ Defrost	NV	V	V	NV	V	V	NV

3	Black	Vacuum Source	V	V	V	V	V	V	V
4	Yellow	Floor/ Defrost	NV	V	V	NV	V	NV	NV
5	Red	Panel	V	V	V	NV	NV	NV	NV
6	Orange	Panel	V	V	NV	NV	NV	NV	NV

V = Vacuum

NV= No Vacuum

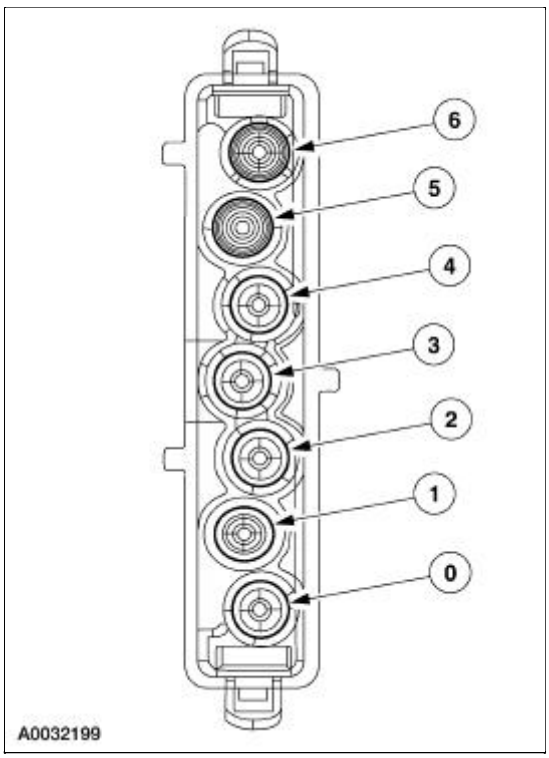
Vacuum Schematic—EATC



Item	Part Number	Description
1	18A318	Vacuum control motor — floor/defrost door
2	—	Defrost air flow
3	18A478	Floor/defrost door

4	18476	Heater core
5	19860	Evaporator core
6	19805	Blower motor
7	—	Outside air inlet
8	19A813	Air inlet door
9	18A318	Vacuum control motor — air inlet door
10	—	Recirculated air inlet
11	18B545	Temperature blend door
12	18A559	Panel door
13	—	Panel air flow
14	18A318	Vacuum control motor — panel door
15	—	Floor air flow
16	—	Vacuum from the engine intake manifold
17	19A563	A/C vacuum check valve
18	19A566	Vacuum reservoir tank and bracket
19	19A563	A/C vacuum check valve
20	19B888	ATC solenoid and manifold
21	18495	Heater control valve

ATC Solenoid and Manifold Vacuum Connector End View



Port	Hose Color	Function
0	Black	Vacuum Source
1	Blue	Floor/Defrost Door

2	Yellow	Floor/Defrost Door
3	Red	Panel Door
4	Orange	Panel Door
5	White	Air Inlet Duct Door
6	Gray	Heater Control Valve

Vacuum Application Chart — EATC

Port	Color	Function	Manual Override Buttons					
			OFF	PANEL	PNL/FLR	FLR	FLR/DEF	DEF
0	Black	Vacuum Source	V	V	V	V	V	V
1	Blue	Floor/ Defrost	NV	V	V	V	V	NV
2	Yellow	Floor/ Defrost	NV	V	V	V	NV	NV
3	Red	Panel	NV	V	V	NV	NV	NV
4	Orange	Panel	NV	V	NV	NV	NV	NV
5	White	Air Inlet [a]	V	NV/V	NV/V	NV/V	NV/V	NV/V
6	Gray	Heater Control Valve [b]	V	—	—	—	—	—

[a] The DATC/EATC system may be manually set to enable or disable the recirculation of cabin air by pressing the RECIRCULATION manual override button in all manual override modes except DEFROST.

[b] The automatic temperature control solenoid and manifold will supply vacuum and close the heater control valve depending on the DATC module settings and ambient conditions in any setting except OFF.

V = Vacuum

NV= No Vacuum

Inspection and Verification

1. Verify the customer concern by operating the climate control system to duplicate the condition.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
● Loose, missing or damaged A/C compressor drive belt ● Loose or disconnected A/C clutch ● Loose, misrouted or damaged vacuum lines [a] ● Broken or leaking vacuum control motor [a] ● Discharged A/C system ● Broken or leaking refrigerant	● Open fuses ● Blower motor inoperative ● A/C compressor inoperative ● Circuitry open/shorted ● Disconnected, loose fitting, or incorrectly installed electrical connectors and pins

lines	

[a] A leak in the vacuum control circuit may occur during acceleration (slow leak), may exist at all times (large leak), and may exist only when specific functions are selected (indicating a leak in that portion of the circuit). The vacuum hoses used in the passenger compartment control circuit are constructed from PVC plastic material. The vacuum hoses used in the engine compartment are constructed of Hytrel®. Because of the materials used, never pinch the vacuum hoses off during diagnosis to locate a leak. A golf tee can be used as a plug when it is necessary to plug one end of the vacuum hose for leak test purposes.

3. As pinpoint tests and measurements are being carried out, be sure to inspect for any disconnected, loose-fitting, or incorrectly installed component, module and in-line electrical connectors and pins.

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

5. If the cause is not visually evident, connect a diagnostic tool to the data link connector and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

6. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool operating manual.

7. Carry out the DATA LINK DIAGNOSTICS test. If the diagnostic tool responds with:
   - CKT 914, CKT 915, or CKT 70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 to diagnose the network concern.
   - If the powertrain control module (PCM) is not listed for a communication concern, turn the A/C controls to OFF and execute the self-test diagnostics for the PCM.
   - If the DATC/EATC module is not listed for a communication concern, execute self-test diagnostics for the DATC/EATC module.

8. If any PCM or DATC/EATC DTCs are retrieved, and are related to the concern, go to the Powertrain Control Module Diagnostic Trouble Code (DTC) Index or the Electronic Automatic Temperature Control (DATC/EATC) Module Diagnostic Trouble Code (DTC) Index to continue diagnostics.

9. If no DTCs related to the concern are retrieved, GO to Symptom Chart to continue diagnostics.

10. If the DATC/EATC module cannot be accessed by the diagnostic tool, Go To Pinpoint Test G .

Dual/Electronic Automatic Temperature Control Module — Diagnostic Methods

The dual/electronic automatic temperature control system must be diagnosed by first retrieving any DTCs, if present.

- An on-demand (hard fault) DTC indicates that the fault is currently present. An on-demand DTC suggests a wiring fault, disconnected connector, or component failure.
- A continuous (intermittent) DTC alone (corresponding on-demand DTC is not present) indicates that the fault is an intermittent condition and may not be currently present. A continuous only DTC suggests a poor wiring connection, loose pin or terminal, or intermittent component failure.

On-demand (hard fault) or continuous (intermittent fault) DTCs can be retrieved using a diagnostic tool.

If using a diagnostic tool, refer to the diagnostic tool operating manual.

On-demand DTCs can also be retrieved by carrying out the Dual/Electronic Automatic Temperature Control Module Self-Test. To retrieve and/or clear continuous DTCs, carry out the Dual/Electronic Automatic Temperature Control Module — Retrieve Continuous DTCs procedure. Always carry out the Electronic Automatic Temperature Control Module Self-Test before retrieving continuous DTCs.

If no DTCs are present, GO to Symptom Chart for the appropriate diagnostic action.

Dual/Electronic Automatic Temperature Control Module Self-Test

- The DATC/EATC module self-test will not detect concerns associated with data link messages like engine coolant temperature or vehicle speed signals. A diagnostic tool must be used to retrieve these concerns.
- The DATC/EATC module self-test will detect concerns in the system control functions and will display hard diagnostic trouble codes (DTCs) in addition to intermittent diagnostic trouble codes for concerns that occur during system operation. The vehicle interior temperature should be between 4-32°C (40-90°F) when performing the self-test. If the temperatures are not within the specified ranges, false in-car temperature sensor DTCs will be displayed.
- The self-test can be initiated after cycling the ignition switch from OFF to ON. Normal operation of the climate control system stops when the self-test is activated.
- To enter the self-test, press the OFF and FLOOR buttons simultaneously and then press the AUTOMATIC button within two seconds. The display will show a pulse tracer going around the center of the display window. The test may run as long as 30 seconds. Record all DTCs displayed.
- If any DTCs appear during the self-test, follow the diagnostics procedure given under ACTION for each DTC given.
- If a condition exists but no DTCs appear during the self-test, GO to Symptom Chart Condition: The DATC/EATC System Is Inoperative, Intermittent or Improper Operation.
- To exit self-test and retain all intermittent DTCs, push the blue (cooler temperature) button. The control will exit self-test, retain all intermittent DTCs and then turn OFF (display blank).
- To exit self-test and clear all DTCs, press the DEFROST button. The vacuum fluorescent display window will show 888 and all function symbols for one second. Then, the DATC/EATC control assembly will turn OFF (display blank) and all DTCs will be cleared.
- Always exit the self-test before powering the system down (system turned OFF).
- Intermittent DTCs will be deleted after 80 ignition switch ON cycles after the intermittent condition occurs.

Dual/Electronic Automatic Temperature Control Module — Retrieve Continuous DTCs

The DATC/EATC module will retrieve only continuous (intermittent) DTCs when carrying out this procedure.

- Retrieval of continuous DTCs can be initiated after cycling the ignition switch from OFF to ON. Normal operation of the climate control system stops when retrieving continuous DTCs.
- To retrieve continuous DTCs, press the OFF and PANEL buttons simultaneously and release, then press the AUTO button within two seconds. All vacuum fluorescent segments will be displayed if there are no continuous DTCs present. Continuous DTCs are indicated by the presence of the degrees Celsius symbol (°C) on the DATC/EATC module display. Record all DTCs displayed.

- If any DTCs appear, carry out the diagnostic procedure. Refer to the Dual/Electronic Automatic Temperature Control Module Diagnostic Trouble Code Index and follow the ACTION for each DTC given.
- If a condition exists but no DTCs appear, GO to Symptom Chart Condition: The DATC/EATC System Is Inoperative, Intermittent or Incorrect Operation.
- To exit and retain all continuous DTCs, press any button except DEFROST. The DATC/EATC module will exit the retrieve continuous DTCs mode and retain all continuous DTCs.
- To exit and clear all continuous DTCs, press the DEFROST button. The DATC/EATC module will exit the retrieve continuous DTCs mode and all continuous DTCs will be cleared.
- Always exit the procedure before powering the system down (system turned OFF). Once the procedure is exited the ignition switch must remain ON for at least 30 seconds to allow the temperature blend door actuators to automatically recalibrate.
- Continuous DTCs will be deleted after 80 ignition switch ON cycles after the intermittent fault occurs.

Diagnostic Trouble Code Index

DUAL/ELECTRONIC AUTOMATIC TEMPERATURE CONTROL (DATC/EATC) MODULE DIAGNOSTIC TROUBLE CODE (DTC) INDEX

DTC	DATC/EATC DTC displayed	Notes	Description	Action to Take
B2266	2266	N/A	(LH) lower blend door failure or short	Go To Pinpoint Test A.
B2267	2267	DATC Only	(RH) upper blend door failure or short	Go To Pinpoint Test A.
B1251	1251	N/A	A/C in-vehicle temperature sensor open circuit	Go To Pinpoint Test B.
B1253	1253	N/A	A/C in-vehicle temperature sensor circuit short to ground	Go To Pinpoint Test B.
B1255	1255	N/A	A/C ambient temperature sensor open circuit	Go To Pinpoint Test C.
B1257	1257	N/A	A/C ambient temperature sensor circuit short to ground	Go To Pinpoint Test C.
B1259	1259	N/A	A/C solar radiation sensor open circuit	Go To Pinpoint Test D.
B1261	1261	N/A	A/C solar radiation sensor circuit short to ground	Go To Pinpoint Test D.
B2268	2268	N/A	Steering wheel control switch open circuit	Go To Pinpoint Test E.
B2269	2269	N/A	Steering wheel control switch circuit short to ground	Go To Pinpoint Test E.
B2411	2411	DATC Only	A/C humidity sensor open circuit	Go To Pinpoint Test F.
B2412	2412	DATC Only	A/C humidity sensor circuit short to ground	Go To Pinpoint Test F.
B2413	2413	DATC Only	A/C humidity sensor failure	Go To Pinpoint Test F.
B2477	N/A	N/A	Module not configured	Configure DATC/EATC module.

Symptom Chart

SYMPTOM CHART

Condition	Possible Sources	Action
• No communication with the dual/electronic automatic temperature control module	• Circuitry short/open • DATC/EATC module communication network	• Go To Pinpoint Test G .
• The DATC/EATC system is inoperative, intermittent or incorrect operation	• Circuitry short/open • Input sensor (s)/erratic input signals • Automatic temperature control sensor hose and elbow	• Go To Pinpoint Test H .
• Incorrect/erratic direction of airflow from outlet — manual climate control	• Function selector switch. • Vacuum hose. • A/C vacuum reservoir tank and check valve. • Vacuum control motor. • Vacuum actuator arm. • Mode door.	• Go To Pinpoint Test I .
• Incorrect/erratic direction of airflow from outlet — DATC/EATC	• DATC/EATC module. • ATC solenoid and manifold assembly. • Vacuum hose. • A/C vacuum reservoir tank and check valve. • Vacuum control motor. • Vacuum actuator arm. • Mode door.	• Go To Pinpoint Test J .
• Insufficient, erratic, or no heat	• Low engine coolant level. • Engine overheating. • Plugged or partially plugged heater core. • Temperature blend door is binding or stuck. • A/C electric blend door actuator.	• Go To Pinpoint Test K .

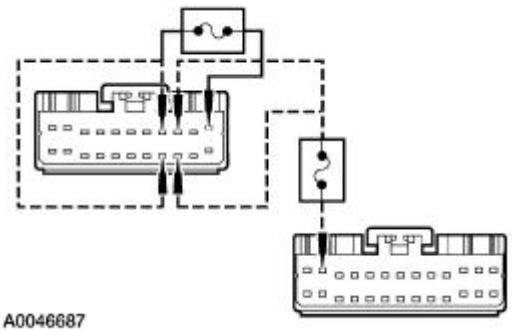
	• Incorrect heater control valve operation. • Heater hose is kinked or binding.	
• The A/C is inoperative/does not operate correctly	• Open fuse. • Circuitry short/open. • A/C thermostatic switch. • A/C system discharged/low charge. • A/C pressure cutoff switch. • A/C control. • Function selector switch. • A/C low charge protection switch.	• Go To Pinpoint Test L .
• The A/C is always on	• Circuitry short. • A/C control. • A/C compressor clutch air gap.	• Go To Pinpoint Test M .
• The temperature control is inoperative/does not operate correctly — manual climate control	• Temperature blend door actuator control. • Temperature blend door. • A/C electronic blend door actuator motor. • Circuitry open/shorted.	• Go To Pinpoint Test N .
• The blower motor is inoperative — manual climate control	• Fuse. • Circuitry open/shorted. • A/C blower motor switch. • A/C blower motor resistor. • Blower motor relay. • A/C blower motor.	• Go To Pinpoint Test O .
• The blower motor does not operate correctly — manual climate control	• Circuitry short. • A/C blower motor resistor. • A/C blower motor switch.	• Go To Pinpoint Test P .
• The blower motor is inoperative — DATC/EATC	• Circuitry short/open. • Blower motor relay. • A/C blower motor. • A/C blower motor speed control.	• Go To Pinpoint Test Q .
• The blower motor	• A/C blower motor	• Go To Pinpoint Test R .

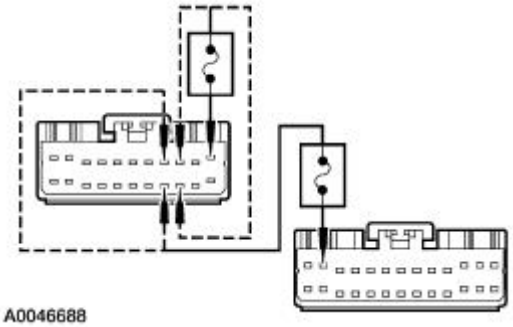
does not operate correctly — DATC/EATC	speed control. ● A/C blower motor. ● DATC/EATC module.	
● The auxiliary blower motor is inoperative	● Fuse. ● Circuitry short/open. ● Auxiliary blower motor relay. ● Auxiliary blower motor.	● Go To Pinpoint Test S .
● The auxiliary blower motor does not operate correctly using the front auxiliary climate controls	● Fuse. ● Circuitry short/open. ● Auxiliary blower motor switch. ● Auxiliary blower motor resistor.	● Go To Pinpoint Test T .
● The auxiliary blower motor does not operate correctly using the rear auxiliary climate controls	● Fuse. ● Circuitry short/open. ● Auxiliary blower motor switch. ● Auxiliary blower motor resistor.	● Go To Pinpoint Test U .
● The panel/floor control is inoperative using the front auxiliary climate controls	● Fuse. ● Circuitry short/open. ● Auxiliary mode control panel. ● Auxiliary mode door actuator. ● Mode door.	● Go To Pinpoint Test V .
● The panel/floor control is inoperative using the rear auxiliary climate controls	● Fuse. ● Circuitry short/open. ● Auxiliary mode control panel. ● Auxiliary mode door actuator.	● Go To Pinpoint Test W .
● The temperature control is inoperative using the front auxiliary climate controls	● Fuse. ● Circuitry short/open. ● Auxiliary temperature control panel. ● Auxiliary blend door actuator. ● Temperature blend door.	● Go To Pinpoint Test X .
● The temperature control is inoperative using the rear auxiliary climate controls	● Fuse. ● Circuitry short/open. ● Auxiliary temperature control panel. ● Auxiliary blend door actuator.	● Go To Pinpoint Test Y .

• The panel/floor and cool/warm controls are inoperative using the front auxiliary climate controls	• Fuse. • Circuitry short/open. • Auxiliary blower motor switch. • Auxiliary climate control panel.	• Go To Pinpoint Test Z .
• The panel/floor and cool/warm controls are inoperative using the rear auxiliary climate controls	• Fuse. • Circuitry short/open. • Auxiliary blower motor switch. • Auxiliary climate control panel.	• Go To Pinpoint Test AA .
• Insufficient air conditioning (A/C) cooling	• Restricted A/C evaporator core orifice. • Low refrigerant level. • A/C low charge protection switch. • Evaporator discharge air temperature sensor. • Temperature blend door actuator control. • A/C pressure cutoff switch. • Heater control valve. • Vacuum line blocked or leaking.	• Go To Pinpoint Test AB .
• The dual temperature control is inoperative/does not operate correctly — DATC	• Temperature blend door/actuator broken/binding • DATC module	• CHECK the temperature blend doors/actuators for a binding or broken condition. If no condition is found, INSTALL a new DATC/EATC module.
• The temperature set point does not repeat after turning the ignition switch OFF	• Open fuse • Circuitry short/open • DATC/EATC module	• CHECK circuit 729 (LB/BK) for a short or open and repair as necessary. If okay, INSTALL a new DATC/EATC module.
• The temperature display will not switch between Celsius and Fahrenheit	• DATC/EATC module	• PRESS the MAX A/C and DEFROST buttons simultaneously for at least 0.75 second. If the temperature display does not switch between Celsius and Fahrenheit, INSTALL a new DATC/EATC module.

Pinpoint Tests

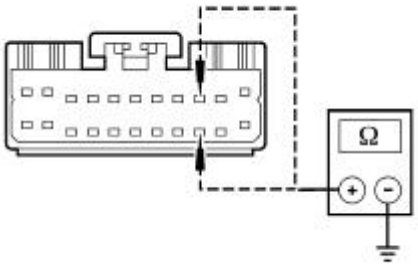
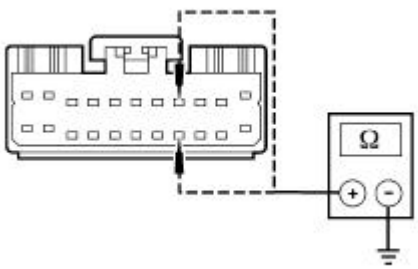
PINPOINT TEST A: DTC B2266 OR DTC B2267 — BLEND DOOR FAILURE OR SHORT

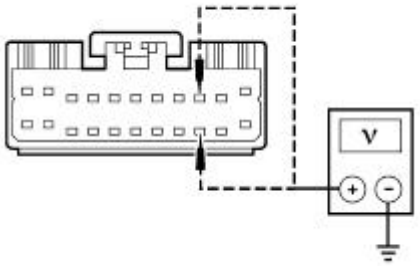
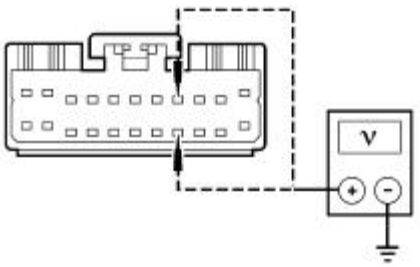
Test Step	Result / Action to Take
A1 CHECK THE BLEND DOOR ACTUATOR CLOCKWISE OPERATION	
• Disconnect: DATC/EATC Module C228a. • Disconnect: DATC/EATC Module C228b. • Remove the door actuator and disengage the actuator driveshaft from the actuator door. Refer to Section 412-04 . • Mark the door actuator driveshaft position. • Key in ON position. • Connect a fused jumper wire between: ▪ For DTC B2266, DATC/EATC module C228b-19, circuit 250 (OG) and DATC/EATC module C228b-11, circuit 729 (RD/WH). Connect a second fused jumper wire between DATC/EATC module C228b-20, circuit 249 (DB/LG) and DATC/EATC module C228a-2, circuit 875 (BK/LB). ▪ For DTC B2267, DATC module C228b-8, circuit 1136 (RD/WH) and DATC module C228b-11, circuit 729 (RD/WH). Connect a second fused jumper wire between DATC module C228b-9, circuit 1137 (YE/LG) and DATC module C228a-2, circuit 875 (BK/LB).  A0046687 • **Does the actuator motor move in the clockwise direction?**	**Yes** GO to A2 . **No** GO to A3 .
A2 CHECK THE BLEND DOOR ACTUATOR COUNTERCLOCKWISE OPERATION	
• Connect a fused jumper wire between: ▪ For DTC B2266, DATC/EATC module C228b-20, circuit 249 (DB/LG) and DATC/EATC module C228b-11, circuit 729 (RD/WH). Connect a second fused jumper wire between DATC/EATC module C228b-19, circuit 250 (OG) and DATC/EATC module C228a-2, circuit 875 (BK/LB). ▪ For DTC B2267, DATC module C228b-9, circuit 1137 (YE/LG) and DATC module C228b-11, circuit 729 (RD/WH). Connect a second fused jumper wire between DATC module C228b-8, circuit 1136 (RD/WH) and DATC module C228a-2, circuit 875 (BK/LB).	**Yes** GO to A9 . **No** GO to A3 .

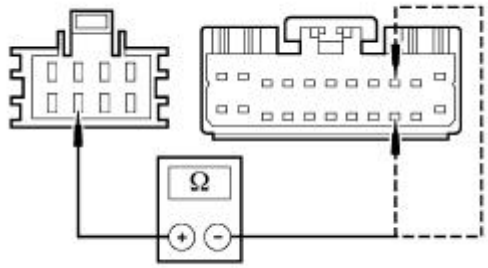


A0046688

- **Does the actuator motor move in the counterclockwise direction?**

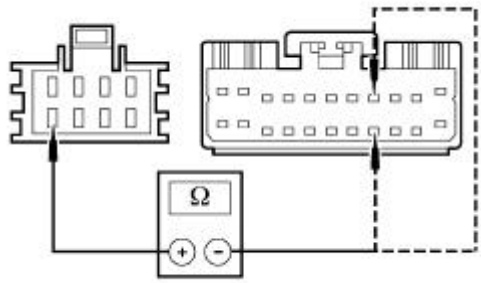
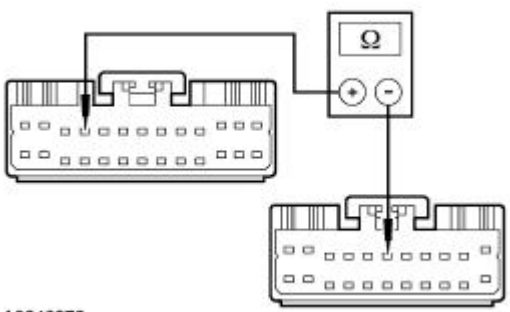
A3 CHECK CIRCUIT 249 (DB/LG) OR CIRCUIT 1137 (YE/LG) FOR A SHORT TO GROUND	
• Key in OFF position. • Disconnect: Temperature Blend Door Actuator C2091 or C2092. • Measure the resistance between ground and: ■ For DTC B2266, DATC/EATC module C228b-20, circuit 249 (DB/LG). ■ For DTC B2267, DATC module C228b-9, circuit 1137 (YE/LG).  A0046689 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to A4 . **No** REPAIR circuit 249 (DB/LG) or circuit 1137 (YE/LG) for a short to ground. TEST the system for normal operation.
A4 CHECK CIRCUIT 250 (OG) OR CIRCUIT 1136 (RD/WH) FOR A SHORT TO GROUND	
• Measure the resistance between ground and: ■ For DTC B2266, DATC/EATC module C228b-19, circuit 250 (OG). ■ For DTC B2267, DATC module C228b-8, circuit 1136 (RD/WH).  A0046690 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to A5 . **No** REPAIR circuit 250 (OG) or circuit 1136 (RD/WH) for a short to ground. TEST the system for normal operation.
A5 CHECK CIRCUIT 249 (DB/LG) OR CIRCUIT 1137 (YE/LG) FOR A SHORT TO POWER	

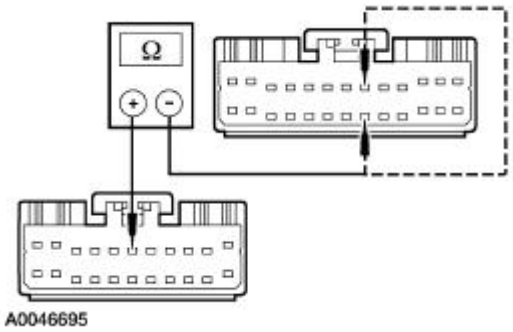
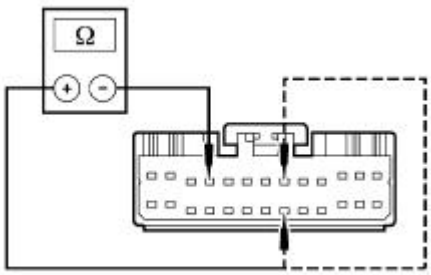
• Key in ON position. • Measure the voltage between ground and: ■ For DTC B2266, DATC/EATC module C228b-20, circuit 249 (DB/LG). ■ For DTC B2267, DATC module C228b-9, circuit 1137 (YE/LG).  A0046691 • **Is voltage present?**	**Yes** REPAIR circuit 249 (DB/LG) or circuit 1137 (YE/LG) for a short to power. TEST the system for normal operation. **No** GO to A6 .
A6 CHECK CIRCUIT 250 (OG) OR CIRCUIT 1136 (RD/WH) FOR A SHORT TO POWER	
• Measure the voltage between ground and: ■ For DTC B2266, DATC/EATC module C228b-19, circuit 250 (OG). ■ For DTC B2267, DATC module C228b-8, circuit 1136 (RD/WH).  A0046692 • **Is voltage present?**	**Yes** REPAIR circuit 250 (OG) or circuit 1136 (RD/WH) for a short to power. TEST the system for normal operation. **No** GO to A7 .
A7 CHECK CIRCUIT 249 (DB/LG) OR CIRCUIT 1137 (YE/LG) FOR AN OPEN	
• Key in OFF position. • Measure the resistance between: ■ For DTC B2266, DATC/EATC module C228b-20, circuit 249 (DB/LG) and the temperature blend door actuator C2091-7, circuit 249 (DB/LG). ■ For DTC B2267, DATC module C228b-9, circuit 1137 (YE/LG) and the temperature blend door actuator C2092-7, circuit 1137 (YE/LG).	**Yes** GO to A8 . **No** REPAIR circuit 249 (DB/LG) or circuit1137 (YE/LG) for an open. TEST the system for normal operation.

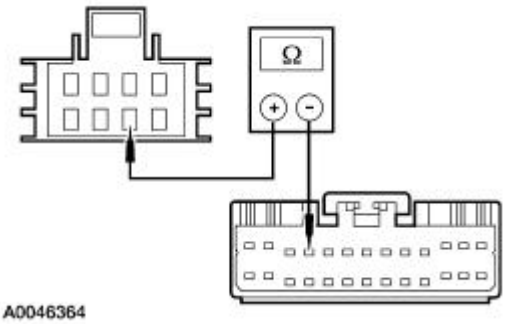


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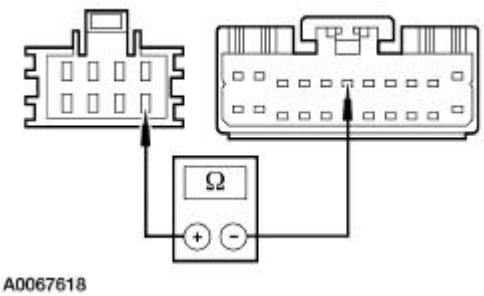
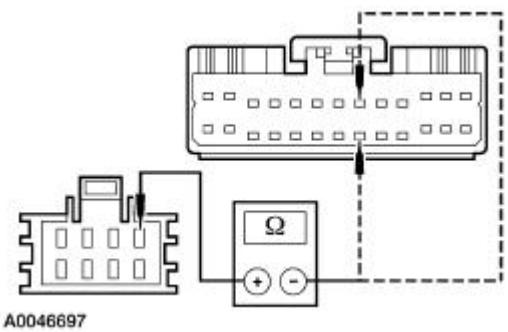
- **Is the resistance less than 5 ohms?**

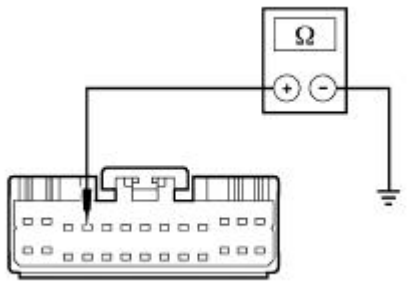
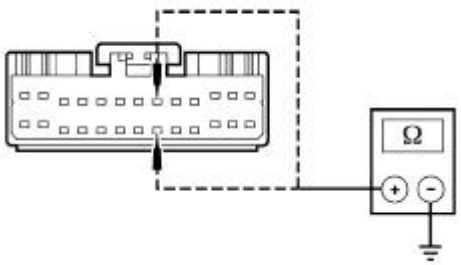
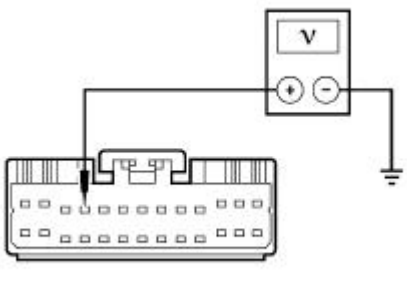
A8 CHECK CIRCUIT 250 (OG) OR CIRCUIT 1136 (RD/WH) FOR AN OPEN	
• Measure the resistance between: ■ For DTC B2266, DATC/EATC module C228b-19, circuit 250 (OG) and the temperature blend door actuator C2091-8, circuit 250 (OG). ■ For DTC B2267, DATC module C228b-8, circuit 1136 (RD/WH) and the temperature blend door actuator C2092-8, circuit 1136 (RD/WH).  A0046694 • **Is the resistance less than 5 ohms?**	**Yes** INSPECT for binding or broken linkage. If no condition is found, INSTALL a new door actuator. REFER to Section 412-04 . TEST the system for normal operation. **No** REPAIR circuit 250 (OG) or circuit 1136 (RD/WH) for an open. TEST the system for normal operation.
A9 CHECK THE FEEDBACK POTENTIOMETER TOTAL RESISTANCE	
• Connect: For DTC B2266, Temperature Blend Door Actuator C2091. • Connect: For DTC B2267, Temperature Blend Door Actuator C2092. • Measure the resistance between DATC/EATC module C228a-4, circuit 436 (RD/LG) and DATC/EATC module C228b-6, circuit 438 (RD/WH).  A0040073 • **Is the resistance between 5,000 and 6,000 ohms?**	**Yes** GO to A10 . **No** If the resistance is greater than 6,000 ohms, GO to A12 . If the resistance is less than 5,000 ohms, GO to A20 .
A10 CHECK POTENTIOMETER LOW SIDE RESISTANCE	
• Measure the resistance between DATC/EATC module C228b-6,	**Yes**

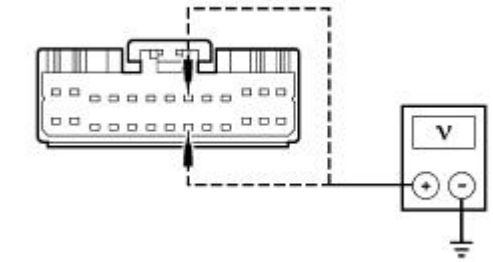
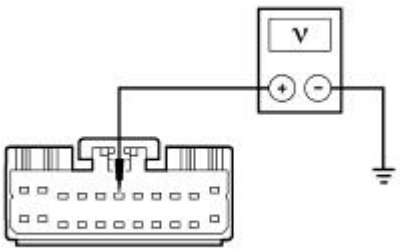
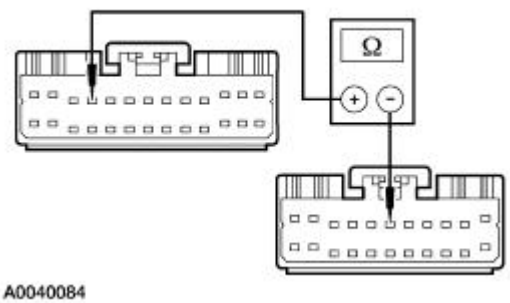
circuit 438 (RD/WH). ■ For DTC B2266, DATC/EATC module C228a-21, circuit 437 (YE/LG). ■ For DTC B2267, DATC module C228a-8, circuit 1122 (RD).  A0046695 ● **Is the resistance between 250 and 5,500 ohms?**	GO to A11 . **No** If the resistance is greater than 5,500 ohms, GO to A13 . If the resistance is less than 250 ohms, GO to A21 .
A11 CHECK POTENTIOMETER HIGH SIDE RESISTANCE	
● Measure the resistance between DATC/EATC module C228a-4, circuit 436 (RD/LG) and ■ For DTC B2266, DATC/EATC module C228a-21, circuit 437 (YE/LG). ■ For DTC B2267, DATC module C228a-8, circuit 1122 (RD).  A0046696 ● **Is the resistance between 250 and 5,500 ohms?**	**Yes** GO to A15 . **No** If the resistance is greater than 5,500 ohms, GO to A12 . If the resistance is less than 250 ohms, GO to A22 .
A12 CHECK 436 (RD/LG) CIRCUIT FOR AN OPEN	
● Disconnect: For DTC B2266, Temperature Blend Door Actuator C2091. ● Disconnect: For DTC B2267, Temperature Blend Door Actuator C2092. ● Measure the resistance between DATC/EATC module C228a-4, circuit 436 (RD/LG) and: ■ For DTC B2266, temperature blend door actuator C2091-6, circuit 436 (RD/LG). ■ For DTC B2267, temperature blend door actuator C2092-6, circuit 436 (RD/LG).	**Yes** GO to A13 . **No** REPAIR circuit 436 (RD/LG) for an open. TEST the system for normal operation.

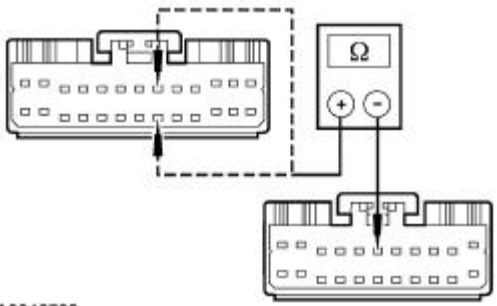
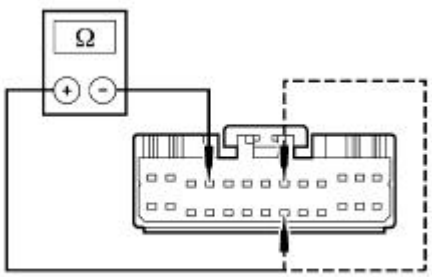


- **Is the resistance less than 5 ohms?**

A13 CHECK THE ACTUATOR RETURN CIRCUIT 438 (RD/WH) FOR AN OPEN	
• Disconnect: For DTC B2266, Temperature Blend Door Actuator C2091 (If not previously disconnected). • Disconnect: For DTC B2267, Temperature Blend Door Actuator C2092 (If not previously disconnected). • Measure the resistance between DATC/EATC module C228b-6, circuit 438 (RD/WH) and: ■ For DTC B2266, temperature blend door actuator C2091-5, circuit 438 (RD/WH). ■ For DTC B2267, temperature blend door actuator C2092-5, circuit 438 (RD/WH).  • **Is the resistance less than 5 ohms?**	**Yes** GO to A14 . **No** REPAIR circuit 438 (RD/WH) for an open. TEST the system for normal operation.
A14 CHECK CIRCUIT 437 (YE/LG) OR CIRCUIT 1122 (RD) FOR AN OPEN	
• Measure the resistance between: ■ For DTC B2266, DATC/EATC module C228a-21, circuit 437 (YE/LG) and temperature blend door actuator C2091-1, circuit 437 (YE/LG). ■ For DTC B2267, DATC module C228a-8, circuit 1122 (RD) and temperature blend door actuator C2092-1, circuit 1122 (RD).  	**Yes** INSTALL a new door actuator. REFER to Section 412-04 . TEST the system for normal operation. **No** REPAIR circuit 437 (YE/LG) or circuit 1122 (RD) for an open. TEST the system for normal operation.

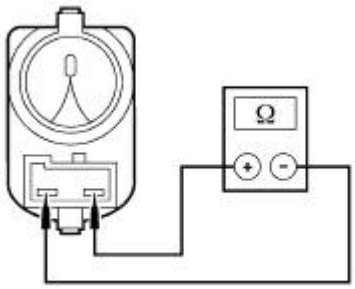
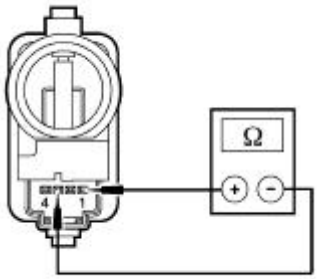
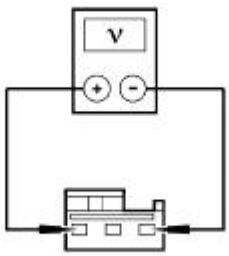
• **Is the resistance less than 5 ohms?**	
A15 CHECK CIRCUIT 436 (RD/LG) FOR A SHORT TO GROUND	
• Measure the resistance between DATC/EATC module C228a-4, circuit 436 (RD/LG) and ground.  A0040079 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to A16 . **No** REPAIR circuit 436 (RD/LG) for a short to ground. TEST the system for normal operation.
A16 CHECK CIRCUIT 437 (YE/LG) OR CIRCUIT 1122 (RD) FOR A SHORT TO GROUND	
• Measure the resistance between ground and: ■ For DTC B2266, DATC/EATC module C228a-21, circuit 437 (YE/LG). ■ For DTC B2267, DATC module C228a-8, circuit 1122 (RD).  A0046698 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to A17 . **No** REPAIR circuit 437 (YE/LG) or circuit 1122 (RD) for a short to ground. TEST the system for normal operation.
A17 CHECK CIRCUIT 436 (RD/LG) FOR A SHORT TO POWER	
• Key in ON position. • Measure the voltage between DATC/EATC module C228a-4, circuit 436 (RD/LG) and ground.  A0040081 • **Is voltage present?**	**Yes** REPAIR circuit 436 (RD/LG) for a short to power. TEST the system for normal operation. **No** GO to A18 .
A18 CHECK CIRCUIT 437 (YE/LG) OR CIRCUIT 1122 (RD) FOR A SHORT TO POWER	
• Measure the voltage between ground and: ■ For DTC B2266, DATC/EATC module C228a-21, circuit	**Yes** REPAIR circuit 437

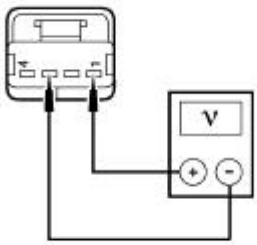
437 (YE/LG). ■ For DTC B2267, DATC module C228a-8, circuit 1122 (RD).  A0046699 ● **Is voltage present?**	(YE/LG) or circuit 1122 (RD) for a short to power. TEST the system for normal operation. **No** GO to A19 .
A19 CHECK CIRCUIT 438 (RD/WH) FOR A SHORT TO POWER	
● Measure the voltage between DATC/EATC module C228b-6, circuit 438 (RD/WH) and ground.  A0040083 ● **Is voltage present?**	**Yes** REPAIR circuit 438 (RD/WH) for a short to power. TEST the system for normal operation. **No** INSTALL a new door actuator. REFER to Section 412-04 . TEST the system for normal operation.
A20 CHECK CIRCUIT 438 (RD/WH) AND CIRCUIT 436 (RD/LG) FOR A SHORT TOGETHER	
● Disconnect: For DTC B2266, Temperature Blend Door Actuator C2091. ● Disconnect: For DTC B2267, Temperature Blend Door Actuator C2092. ● Measure the resistance between DATC/EATC module C228b-6, circuit 438 (RD/WH) and DATC/EATC module C228a-4, circuit 436 (RD/LG).  A0040084 ● **Is the resistance less than 5 ohms?**	**Yes** REPAIR circuits 438 (RD/WH) and circuit 436 (RD/LG) for a short together. TEST the system for normal operation. **No** INSTALL a new door actuator. REFER to Section 412-04 . TEST the system for normal operation.
A21 CHECK CIRCUIT 438 (RD/WH) AND CIRCUIT 437 (YE/LG) OR CIRCUIT 1122 (RD) FOR A SHORT TOGETHER	
● Disconnect: For DTC B2266, Temperature Blend Door Actuator C2091. ● Disconnect: For DTC B2267, Temperature Blend Door Actuator	**Yes** REPAIR circuits 438 (RD/WH) and circuit

C2092. ● Measure the resistance between DATC/EATC module C228b-6, circuit 438 (RD/WH) and: ■ For DTC B2266, DATC/EATC module C228a-21, circuit 437 (YE/LG). ■ For DTC B2267, DATC module C228a-8, circuit 1122 (RD).  A0046700 ● **Is the resistance less than 5 ohms?**	437 (YE/LG) or circuit 1122 (RD) for a short together. TEST the system for normal operation. **No** INSTALL a new door actuator. REFER to Section 412-04 . TEST the system for normal operation.
A22 CHECK CIRCUIT 436 (RD/LG) AND CIRCUIT 437 (YE/LG) OR CIRCUIT 1122 (RD) FOR A SHORT TOGETHER	
● Disconnect: For DTC B2266, Temperature Blend Door Actuator C2091. ● Disconnect: For DTC B2267, Temperature Blend Door Actuator C2092. ● Measure the resistance between DATC/EATC module C228a-4, circuit 436 (RD/LG) and: ■ For DTC B2266, DATC/EATC module C228a-21, circuit 437 (YE/LG). ■ For DTC B2267, DATC module C228a-8, circuit 1122 (RD).  A0046696 ● **Is the resistance less than 5 ohms?**	**Yes** REPAIR circuits 436 (RD/LG) and circuit 437 (YE/LG) or circuit 1122 (RD) for a short together. TEST the system for normal operation. **No** INSTALL a new door actuator. REFER to Section 412-04 . TEST the system for normal operation.

PINPOINT TEST B: DTC B1251 OR DTC1253 — A/C IN-VEHICLE TEMPERATURE SENSOR OPEN CIRCUIT OR SHORT TO GROUND

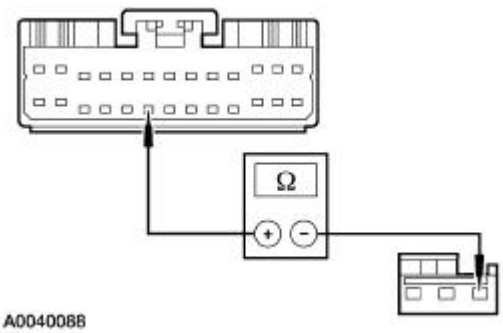
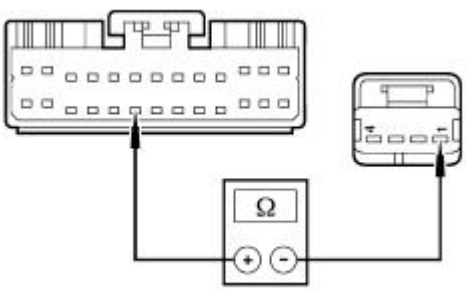
Test Step	Result / Action to Take
B1 CHECK THE SENSOR RESISTANCE	
● Key in OFF position. ● Disconnect: In-Vehicle Temperature Sensor C233. ● **NOTE:** EATC system only. ● Measure the resistance between the in-vehicle temperature	**Yes** GO to B2 . **No**

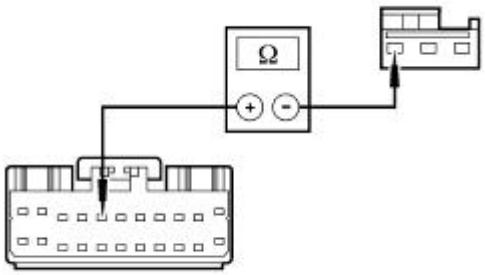
sensor terminals.  A0013635 ● **NOTE:** DATC system only. ● Measure the resistance between the in-vehicle temperature sensor terminals 1 and 3.  A0047071 ● **Is the resistance within the specified values for these temperature ranges: 10-20°C (50-68°F), 37,000-58,000 ohms; 20-30°C (68-86°F), 24,000-37,000 ohms; 30-40°C (86-104°F), 16,000-24,000 ohms?**	INSTALL a new in-car temperature sensor. TEST the system for normal operation.
B2 CHECK THE DATC/EATC SENSOR OUTPUT VOLTAGE ● Key in ON position. ● Press the AUTOMATIC button. ● **NOTE:** EATC system only. ● Measure the voltage between the in-vehicle temperature sensor C233, circuit 790 (WH/OG) and circuit 470 (PK/BK).  A0040087 ● **NOTE:** DATC system only. ● Measure the voltage between the in-vehicle temperature sensor C233, circuit 790 (WH/OG) and circuit 470 (PK/BK).	**Yes** INSTALL a new DATC/EATC module. TEST the system for normal operation. **No** If diagnosing DTC B1251, GO to B3 . If diagnosing DTC B1253, GO to B5 .



A0047072

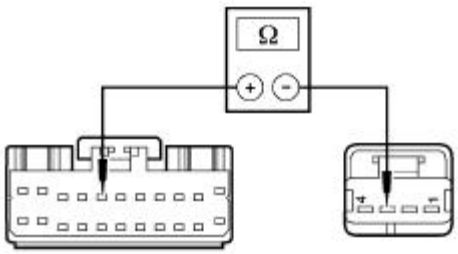
- **Is the voltage between 4.7 and 5.1 volts?**

B3 CHECK CIRCUIT 790 (WH/OG) FOR AN OPEN	
• Key in OFF position. • Disconnect: DATC/EATC Module C228a. • **NOTE:** EATC system only. • Measure the resistance between the DATC/EATC module C228a-19, circuit 790 (WH/OG) and the in-vehicle temperature sensor C233, circuit 790 (WH/OG).  A0040088 • **NOTE:** DATC system only. • Measure the resistance between the DATC/EATC module C228a-19, circuit 790 (WH/OG) and the in-vehicle temperature sensor C233, circuit 790 (WH/OG).  A0047073 • **Is the resistance less than 5 ohms?**	**Yes** GO to B4 . **No** REPAIR circuit 790 (WH/OG) for an open. TEST the system for normal operation.
B4 CHECK CIRCUIT 470 (PK/BK) FOR AN OPEN	
• Disconnect: DATC/EATC Module C228b. • **NOTE:** EATC system only. • Measure the resistance between the DATC/EATC module C228b-5, circuit 470 (PK/BK) and the in-vehicle temperature sensor C233, circuit 470 (PK/BK).	**Yes** INSTALL a new DATC/EATC module. TEST the system for normal operation. **No** REPAIR circuit 470 (PK/BK) for an open. TEST the system for normal operation.



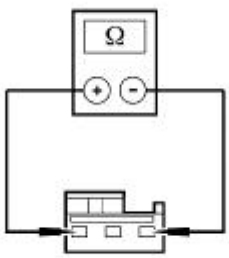
A0040089

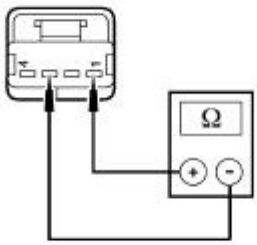
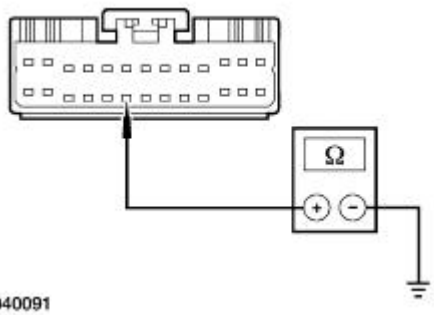
- **NOTE:** DATC system only.
- Measure the resistance between the DATC/EATC module C228b-5, circuit 470 (PK/BK) and the in-vehicle temperature sensor C233, circuit 470 (PK/BK).



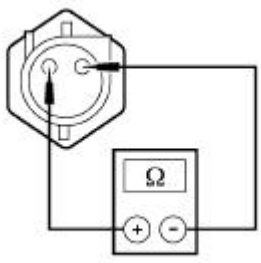
A0047074

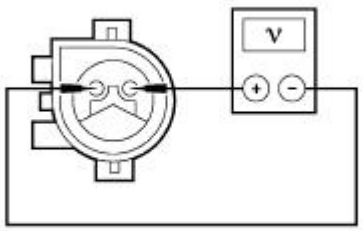
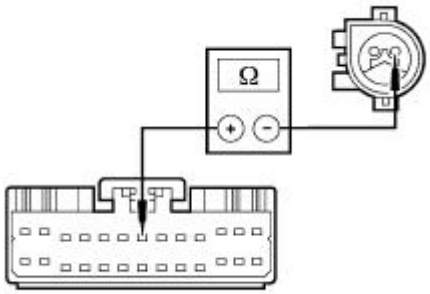
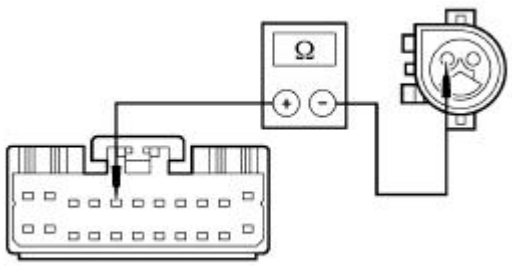
- **Is the resistance less than 5 ohms?**

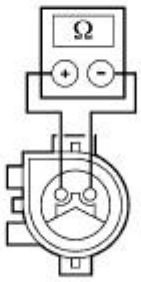
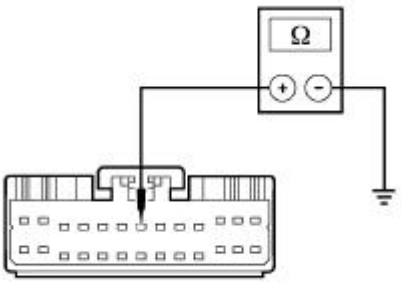
B5 CHECK CIRCUIT 790 (WH/OG) FOR A SHORT TO CIRCUIT 470 (PK/BK)	
• Key in OFF position. • Disconnect: DATC/EATC Module C228a. • Disconnect: DATC/EATC Module C228b. • **NOTE:** EATC system only. • Measure the resistance between the in-vehicle temperature sensor C233, circuit 790 (WH/OG) and circuit 470 (PK/BK).  A0040090 • **NOTE:** DATC system only. • Measure the resistance between the in-vehicle temperature sensor C233, circuit 790 (WH/OG) and circuit 470 (PK/BK).	**Yes** GO to B6 . **No** REPAIR circuit 790 (WH/OG) for a short to circuit 470 (PK/BK). TEST the system for normal operation.

 A0047075 ● **Is the resistance greater than 10,000 ohms?**	
B6 CHECK CIRCUIT 790 (WH/OG) FOR A SHORT TO GROUND	
● Measure the resistance between the DATC/EATC module C228a-19, circuit 790 (WH/OG) and ground.  A0040091 ● **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new DATC/EATC module. TEST the system for normal operation. **No** REPAIR circuit 790 (WH/OG) for a short to ground. TEST the system for normal operation.

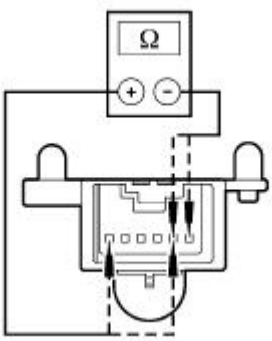
PINPOINT TEST C: DTC B1255 OR DTC B1257 — A/C AMBIENT TEMPERATURE SENSOR OPEN CIRCUIT OR SHORT TO GROUND

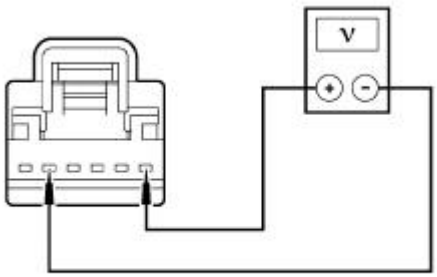
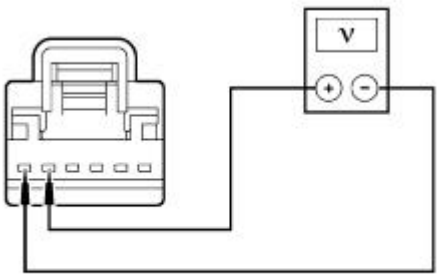
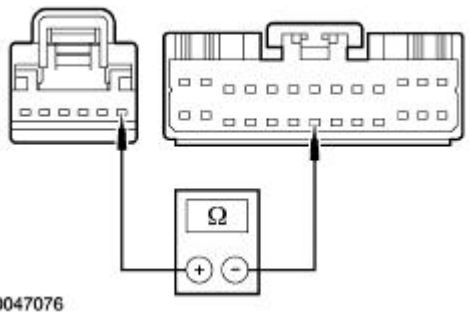
Test Step	Result / Action to Take
C1 CHECK THE AMBIENT TEMPERATURE SENSOR RESISTANCE	
● Key in OFF position. ● Disconnect: Ambient Temperature Sensor C132. ● Measure the resistance between the ambient temperature sensor terminals.  A0013640 ● **Is the resistance within the specified values for these temperature ranges: 10-20°C (50-68°F), 37,000-58,000 ohms; 20-30°C (68-86°F), 24,000-37,000 ohms; 30-40°C (86-104°F), 16,000-24,000 ohms?**	**Yes** GO to C2 . **No** INSTALL a new ambient air temperature sensor and bracket. TEST the system for normal operation.
C2 CHECK THE DATC/EATC MODULE OUTPUT VOLTAGE	

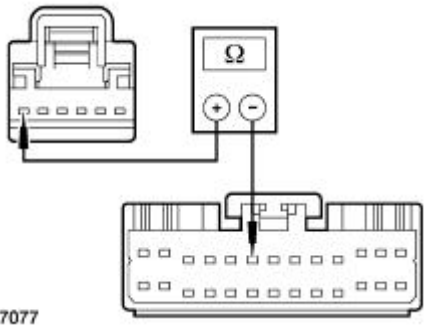
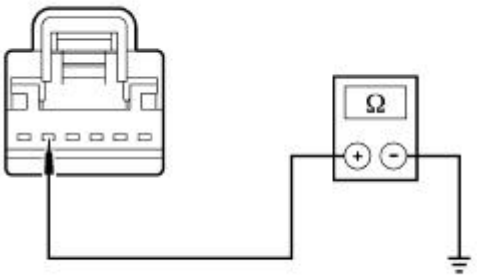
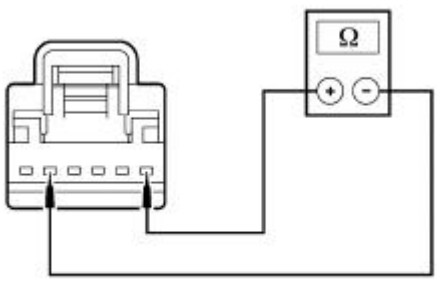
• Key in ON position. • Press the AUTOMATIC button. • Measure the voltage between the ambient temperature sensor C132, circuit 767 (LB/OG) and circuit 470 (PK/BK).  A0013641 • **Is the voltage between 4.7 and 5.1 volts?**	**Yes** INSTALL a new DATC/EATC module. TEST the system for normal operation. **No** If diagnosing DTC 1255, GO to C3 . If diagnosing DTC 1257, GO to C5 .
C3 CHECK CIRCUIT 767 (LB/OG) FOR AN OPEN	
• Key in OFF position. • Disconnect: DATC/EATC Module C228a. • Measure the resistance between the DATC/EATC module C228a-7, circuit 767 (LB/OG) and the ambient temperature sensor C132, circuit 767 (LB/OG).  A0040092 • **Is the resistance less than 5 ohms?**	**Yes** GO to C4 . **No** REPAIR circuit 767 (LB/OG) for an open. TEST the system for normal operation.
C4 CHECK CIRCUIT 470 (PK/BK) FOR AN OPEN	
• Measure the resistance between the DATC/EATC module C228b-5, circuit 470 (PK/BK) and the ambient temperature sensor C132, circuit 470 (PK/BK).  A0067617 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new DATC/EATC module. TEST the system for normal operation. **No** REPAIR circuit 470 (PK/BK) for an open. TEST the system for normal operation.
C5 CHECK CIRCUIT 767 (LB/OG) FOR A SHORT TO CIRCUIT 470 (PK/BK)	
• Key in OFF position. • Disconnect: DATC/EATC Module C228a. • Disconnect: DATC/EATC Module C228b. • Measure the resistance between the in-car temperature sensor C132, circuit 767 (LB/OG) and circuit 470 (PK/BK).	**Yes** GO to C6 . **No** REPAIR circuit 767

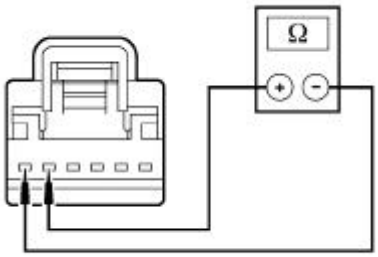
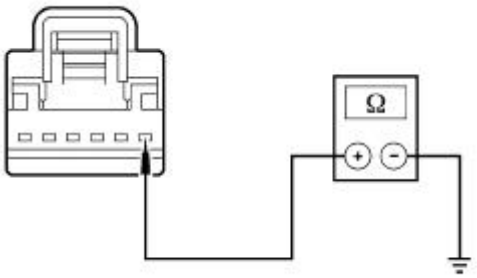
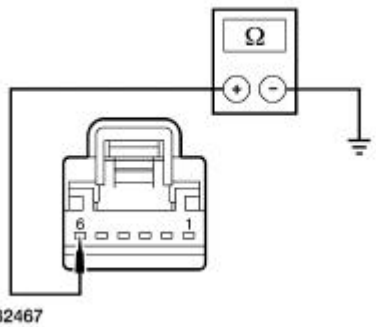
 A0038068 ● **Is the resistance greater than 10,000 ohms?**	(LB/OG) for a short to circuit 470 (PK/BK). TEST the system for normal operation.
C6 CHECK CIRCUIT 767 (LB/OG) FOR A SHORT TO GROUND	
● Key in OFF position. ● Measure the resistance between the DATC/EATC module C228a-7, circuit 767 (LB/OG) and ground.  A0040094 ● **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new DATC/EATC module. TEST the system for normal operation. **No** REPAIR circuit 767 (LB/OG) for a short to ground. TEST the system for normal operation.

PINPOINT TEST D: DTC B1259 OR DTC B1261 — SOLAR RADIATION SENSOR OPEN CIRCUIT OR SHORT TO GROUND

Test Step	Result / Action to Take
D1 CHECK THE SOLAR RADIATION SENSOR RESISTANCE	
● Key in OFF position. ● Disconnect: Solar Radiation Sensor C286. ● Measure the resistance between the solar radiation sensor terminals C286-1 and C286-5 and if vehicle is equipped with DATC, between C286-5 and C286-6.  A0032464 ● **Is continuity present and the resistance greater than 0 ohms?**	**Yes** GO to D2 . **No** INSTALL a new solar radiation sensor and bracket. TEST the system for normal operation.
D2 CHECK THE DATC/EATC MODULE OUTPUT VOLTAGE	
● Key in ON position.	**Yes**

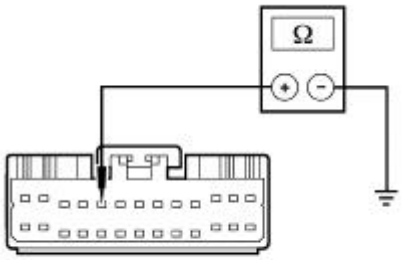
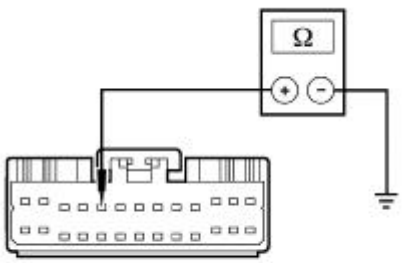
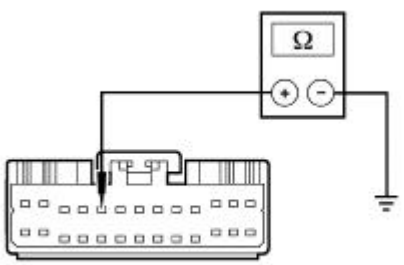
• Press the AUTOMATIC button. • Measure the voltage between the solar radiation sensor C286-1, circuit 468 (BN) and C286-5, circuit 875 (BK/LB).  A0015935 • **NOTE:** Vehicles equipped with DATC only. • Measure the voltage between the solar radiation sensor C286-5, circuit 875 (BK/LB) and C286-6, circuit 1958 (GY/YE).  A0038234 • **Are the voltages between 4.7 and 5.1 volts?**	INSTALL a new DATC/EATC module. TEST the system for normal operation. **No** If diagnosing DTC 1259, GO to D3 . If diagnosing DTC 1261, GO to D5 .
D3 CHECK CIRCUIT 468 (BR) AND CIRCUIT 1958 (GY/YE) FOR AN OPEN	
• Key in OFF position. • Disconnect: DATC/EATC Module C228a. • Measure the resistance between the DATC/EATC module C228a-20, circuit 468 (BR) and the solar radiation sensor C286-1, circuit 468 (BR).  A0047076 • **NOTE:** Vehicles equipped with DATC only. • Measure the resistance between the DATC/EATC module C228a-6, circuit 1958 (GY/YE) and the solar radiation sensor C286-6, circuit 1958 (GY/YE).	**Yes** GO to D4 . **No** REPAIR the circuit for an open. TEST the system for normal operation.

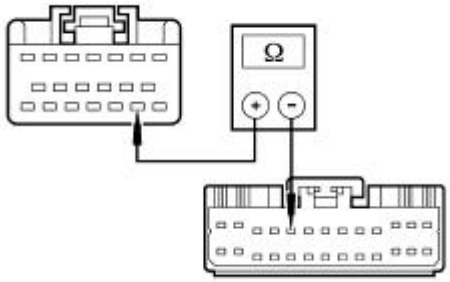
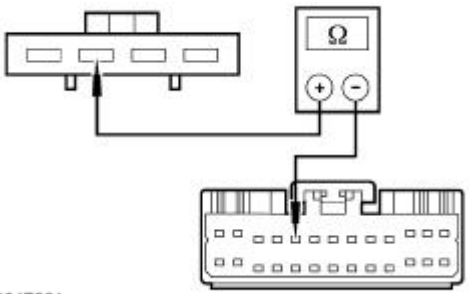
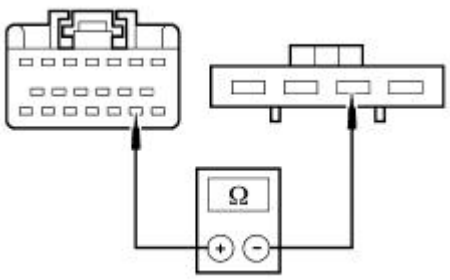
 A0047077 ● **Is the resistance less than 5 ohms?**	
D4 CHECK CIRCUIT 875 (BK/LB) FOR AN OPEN ● Measure the resistance between the solar radiation sensor C286-5, circuit 875 (BK/LB) and ground.  A0015937 ● **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new DATC/EATC module. TEST the system for normal operation. **No** REPAIR circuit 875 (BK/LB) for an open. TEST the system for normal operation.
D5 CHECK CIRCUIT 468 (BR) AND 1958 (GY/YE) FOR A SHORT TO CIRCUIT 875 (BK/LB) ● Key in OFF position. ● Disconnect: DATC/EATC Module C228a. ● Measure the resistance between the solar radiation sensor C286-1, circuit 468 (BR) and circuit C286-5, 875 (BK/LB).  A0047078 ● **NOTE:** Vehicles equipped with DATC only. ● Measure the resistance between the solar radiation sensor C286-6, circuit 1958 (GY/YE) and circuit C286-5, 875 (BK/LB).	**Yes** GO to D6 . **No** REPAIR circuit 468 (BR) and 1958 (GY/YE) for a short to circuit 875 (BK/LB). TEST the system for normal operation.

 A0047079 ● **Are the resistances greater than 10,000 ohms?**	
D6 CHECK CIRCUIT 468 (BR) AND CIRCUIT 1958 (GY/YE) FOR A SHORT TO GROUND	
● Measure the resistance between the solar radiation sensor C286-1, circuit 468 (BR) and ground.  A0015938 ● **NOTE:** Vehicles equipped with DATC only. ● Measure the resistance between the solar radiation sensor C286-6, circuit 1958 (GY/YE) and ground.  A0032467 ● **Are the resistances greater than 10,000 ohms?**	**Yes** INSTALL a new DATC/EATC module. TEST the system for normal operation. **No** REPAIR circuit 468 (BR) or 1958 (GY/YE) for a short to ground. TEST the system for normal operation.

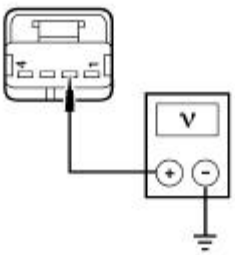
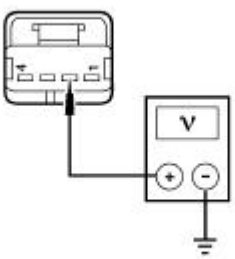
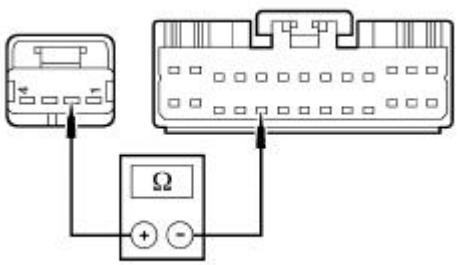
PINPOINT TEST E: DTC B2268 OR DTC B2269 — STEERING WHEEL CONTROL SWITCH OPEN CIRCUIT OR SHORT TO GROUND

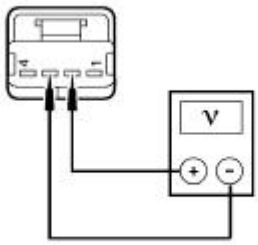
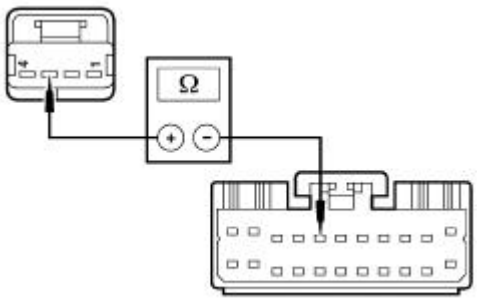
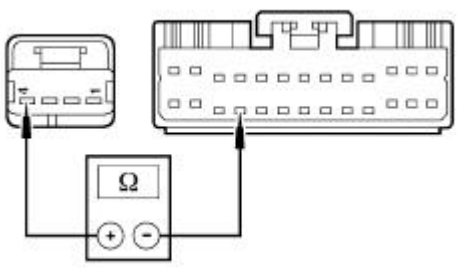
Test Step	Result / Action to Take
NOTE: Before carrying out the following test, verify that the vehicle is equipped with, and the module is configured for, redundant steering wheel controls.	
E1 CHECK THE INPUT TO THE DATC/EATC MODULE	
● Key in OFF position. ● Disconnect: DATC/EATC Module C228a. ● Measure the resistance between the DATC/EATC module C228a-5, circuit 1070 (BN/LB) and ground.	**Yes** GO to E2 . **No** If the resistance is less

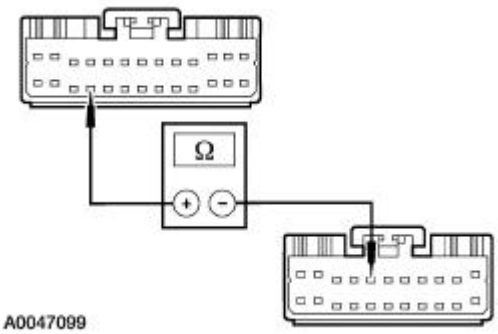
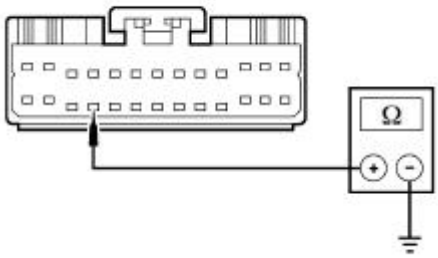
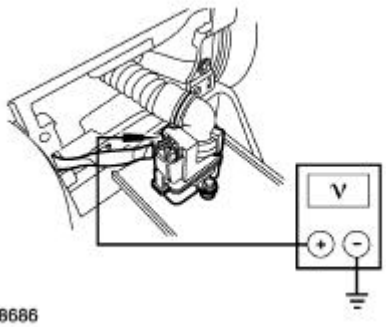
 A0040195 ● **Is the resistance reading between 4,500 and 5,000 ohms?**	than 4,500 ohms, GO to E3 . If the resistance is greater than 5,000 ohms, GO to E5 .
E2 CHECK THE STEERING WHEEL CONTROL SWITCH OUTPUT	
● Measure the resistance between the DATC/EATC module C228a-5, circuit 1070 (BN/LB) and ground.  A0040195 ● Press each steering wheel control switch and compare the resistance reading to the chart below. **Switch** / **Resistance (ohms)** TEMP UP: 336-375 TEMP DOWN: 1620-1810 FAN UP: 736-821 FAN DOWN: 123-138 ● **Are the resistance readings within the range?**	**Yes** INSTALL a new DATC/EATC module. TEST the system for normal operation. **No** INSTALL a new steering wheel control switch. TEST the system for normal operation.
E3 CHECK CIRCUIT 1070 (BN/LB) FOR A SHORT TO GROUND	
● Disconnect: Steering Wheel Control Switch. ● Measure the resistance between the DATC/EATC module C228a-5, circuit 1070 (BN/LB) and ground.  A0040195 ● **Is the resistance reading less than 10,000 ohms?**	**Yes** REPAIR circuit 1070 (BN/LB) for a short to ground. TEST the system for normal operation. **No** GO to E4 .
E4 CHECK CIRCUIT 1070 (BN/LB) FOR A SHORT TO CIRCUIT	

848 (DG/OG)	
• Disconnect: Radio C290b. • Measure the resistance between the DATC/EATC module C228a-5, circuit 1070 (BN/LB) and the radio C290b-15, circuit 848 (DG/OG).  A0047080 • **Is the resistance reading greater than 10,000 ohms?**	**Yes** INSTALL a new steering wheel control switch. TEST the system for normal operation. **No** REPAIR circuit 1070 (BN/LB) for a short to circuit 848 (DG/OG). TEST the system for normal operation.
E5 CHECK CIRCUIT 1070 (BN/LB) FOR AN OPEN	
• Disconnect: Steering Wheel Control Switch. • Measure the resistance between the DATC/EATC module C228a-5, circuit 1070 (BN/LB) and the steering wheel control switch connector (LB/RD).  A0047081 • **Is the resistance less than 5 ohms?**	**Yes** GO to E6 . **No** REPAIR circuit 1070 (BN/LB) for an open. TEST the system for normal operation.
E6 CHECK CIRCUIT 848 (DG/OG) FOR AN OPEN	
• Disconnect: Clockspring C218b. • Measure the resistance between the radio C290b-15, circuit 848 (DG/OG) and the steering wheel control switch connector.  A0047082 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new steering wheel control switch. TEST the system for normal operation. **No** REPAIR circuit 848 (DG/OG) for an open. TEST the system for normal operation.

PINPOINT TEST F: DTC B2411, DTC B2412 OR DTC B2413 — A/C HUMIDITY SENSOR OPEN CIRCUIT, SHORT TO GROUND OR FAILURE

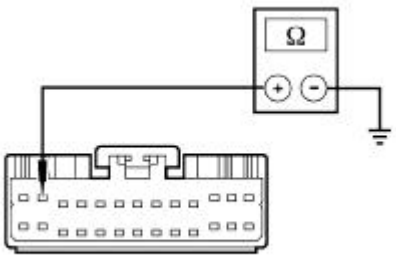
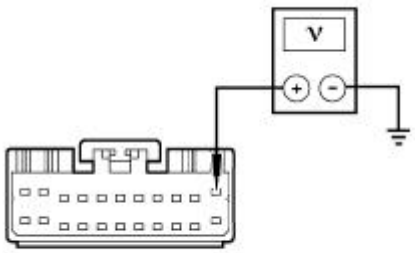
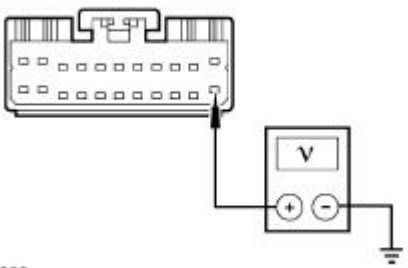
Test Step	Result / Action to Take
F1 CHECK THE A/C HUMIDITY SENSOR VOLTAGE INPUT	
• Key in OFF position. • Disconnect: A/C Humidity Sensor C2247. • Key in ON position. • Press the AUTO button on the DATC module. • Measure the voltage between the A/C humidity sensor C2247-2, circuit 3062 (BK/WH) and ground.  A0047094 • **Is the voltage between 4.7 and 5.1 volts?**	**Yes** GO to F4 . **No** GO to F2 .
F2 CHECK THE CIRCUIT 3062 (BK/WH) FOR A SHORT TO VOLTAGE	
• Key in OFF position. • Disconnect: DATC Module C228a and C228b. • Key in ON position. • Measure the voltage between the A/C humidity sensor C2247-2, circuit 3062 (BK/WH) and ground.  A0047094 • **Is voltage present?**	**Yes** REPAIR circuit 3062 (BK/WH) for a short to voltage. TEST the system for normal operation. **No** GO to F3 .
F3 CHECK THE CIRCUIT 3062 (BK/WH) FOR AN OPEN	
• Key in OFF position. • Measure the resistance between the DATC module C2248a-18, circuit 3062 (BK/WH) and the A/C humidity sensor C2247-2, circuit 3062 (BK/WH).  A0047095 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new DATC module. TEST the system for normal operation. **No** REPAIR circuit 3062 (BK/WH) for an open. TEST the system for normal operation.
F4 CHECK THE A/C HUMIDITY SENSOR GROUND	

• Measure the voltage between the A/C humidity sensor C2247-2, circuit 3062 (BK/WH) and A/C humidity sensor C2247, circuit 470 (PK/BK).  A0047096 • **Is the voltage between 4.7 and 5.1 volts?**	**Yes** GO to F6 . **No** GO to F5 .
F5 CHECK CIRCUIT 470 (PK/BK) FOR AN OPEN	
• Key in OFF position. • Disconnect: DATC Module C228a and C228b. • Measure the resistance between the DATC module C228b-5, circuit 470 (PK/BK) and the A/C humidity sensor C2247-3, circuit 470 (PK/BK).  A0047097 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new DATC module. TEST the system for normal operation. **No** REPAIR circuit 470 (PK/BK) for an open. TEST the system for normal operation.
F6 CHECK CIRCUIT 3063 (TN/OG) FOR AN OPEN	
• Key in OFF position. • Disconnect: DATC Module C228a and C228b. • Measure the resistance between the DATC module C228a-17, circuit 3063 (TN/OG) and the A/C humidity sensor C2247-4, circuit 3063 (TN/OG).  A0047098 • **Is the resistance less than 5 ohms?**	**Yes** GO to F7 . **No** REPAIR circuit 3063 (TN/OG) for an open. TEST the system for normal operation.
F7 CHECK CIRCUIT 3063 (TN/OG) FOR A SHORT TO CIRCUIT 470 (PK/BK)	
• Measure the resistance between the DATC module C228a-17, circuit 3063 (TN/OG) and the DATC module C228b-5, circuit 470 (PK/BK).	**Yes** GO to F8 . **No**

 A0047099 ● **Is the resistance greater than 10,000 ohms?**	REPAIR circuit 3063 (TN/OG) for a short to circuit 470 (PK/BK). TEST the system for normal operation.
F8 CHECK CIRCUIT 3063 (TN/OG) FOR A SHORT TO GROUND	
● Measure the resistance between the DATC module C228a-17, circuit 3063 (TN/OG) ground.  A0047100 ● **Is the resistance greater than 10,000 ohms?**	**Yes** GO to F9 . **No** REPAIR circuit 3063 (TN/OG) for a short ground. TEST the system for normal operation.
F9 CHECK THE A/C HUMIDITY SENSOR VOLTAGE OUTPUT	
● Key in ON position. ● Measure the voltage between the A/C humidity sensor C2247-4, circuit 3063 (TN/OG) and ground by back-probing the A/C humidity sensor C2247.  A0048686 ● **Is the voltage between 0.3 and 4.3 volts?**	**Yes** INSTALL a new DATC module. TEST the system for normal operation. **No** INSTALL a new A/C humidity sensor. TEST the system for normal operation.

PINPOINT TEST G: NO COMMUNICATION WITH THE DUAL/ELECTRONIC AUTOMATIC TEMPERATURE CONTROL MODULE

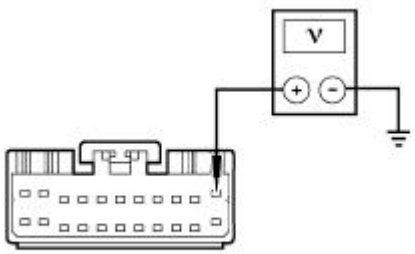
Test Step	Result / Action to Take
G1 CHECK CIRCUIT 875 (BK/LB) FOR AN OPEN	
● Key in OFF position. ● Disconnect: DATC/EATC Module C228a. ● Measure the resistance between the DATC/EATC module	**Yes** GO to G2 .

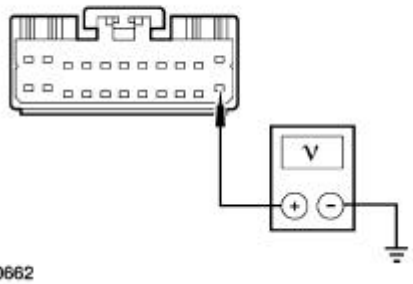
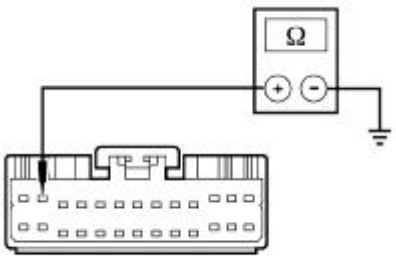
C228a-2, circuit 875 (BK/LB) and ground.  A0040170 ● **Is the resistance less than 25 ohms?**	**No** REPAIR circuit 875 (BK/LB) for an open. TEST the system for normal operation.
G2 CHECK CIRCUIT 729 (RD/WH) FOR B+	
● Disconnect: DATC/EATC module C228b. ● Measure the voltage between the DATC/EATC module C228b-11, circuit 729 (RD/WH) and ground.  A0050661 ● **Is the voltage B+?**	**Yes** GO to G3 . **No** REPAIR circuit 729 (RD/WH) for an open. TEST the system for normal operation.
G3 CHECK CIRCUIT 296 (WH/VT) FOR B+	
● Key in ON position. ● Measure the voltage between the DATC/EATC module C228b-22, circuit 296 (WH/VT) and ground.  A0050662 ● **Is the voltage B+?**	**Yes** REFER to Section 418-00 to diagnose a network concern. **No** REPAIR circuit 296 (WH/VT) for an open. TEST the system for normal operation.

PINPOINT TEST H: THE DATC/EATC SYSTEM IS INOPERATIVE, INTERMITTENT OR INCORRECT OPERATION

Test Step	Result / Action to Take
H1 VERIFY AUTOMATIC OPERATION	
● Key in START position. ● Press the AUTOMATIC button. ● **Does the indicator above the AUTO button illuminate**	**Yes** GO to H2 .

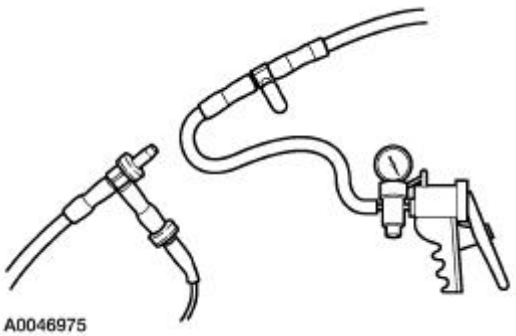
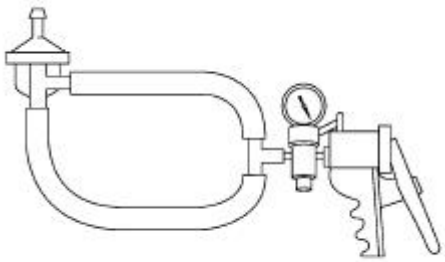
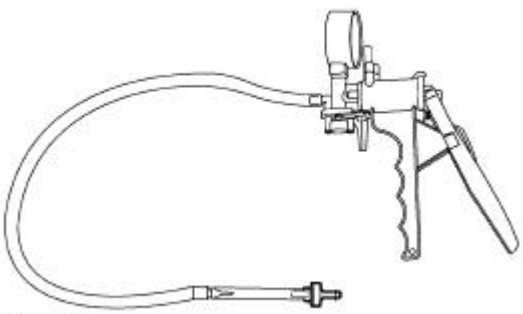
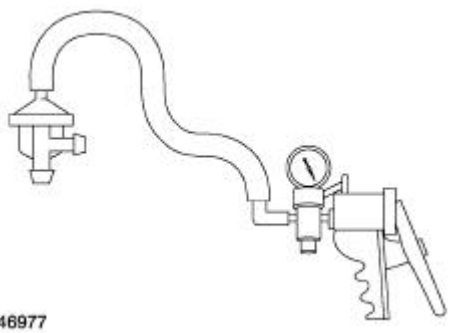
and the selected temperature for both the driver and passenger appear in the display window?	**No** GO to H11 .
H2 PERFORM THE DATC/EATC MODULE SELF-TEST	
• Key in ON position. • Carry out the DATC/EATC module self-test. Refer to the Electronic Automatic Temperature Control Module Self-Test in this section. Record the DTCs displayed, if any. • **Were any DTCs displayed as a result of the DATC/EATC self-test?**	**Yes** REFER to the DATC/EATC Module Diagnostic Trouble Code (DTC) Index. CARRY OUT the necessary diagnosis and REPAIR as required. **No** GO to H3 .
H3 CHECK THE VACUUM FLUORESCENT DISPLAY	
• Exit self-test by pressing the DEFROST button. Observe the button indicators and function symbols displayed on the vacuum fluorescent display while changing the temperature, blower speed and functions. • **Are the display and indicators correct and complete without any missing elements?**	**Yes** GO to H4 . **No** INSTALL a new DATC/EATC module. TEST the system for normal operation.
H4 CHECK THE BLOWER MANUAL OVERRIDE OPERATION	
• Press the blower motor speed override control fully up and fully down. • **Does the blower motor speed increase from low speed to high and high speed to low?**	**Yes** GO to H5 . **No** If the blower motor is inoperative, Go To Pinpoint Test L . If the blower motor does not operate correctly, Go To Pinpoint Test M .
H5 VERIFY THE DEFROST OVERRIDE OPERATION	
• Press the override button for DEFROST operation. • **Is outside air being discharged from the windshield defroster nozzle and the side window demisters?**	**Yes** GO to H6 . **No** Go To Pinpoint Test G .
H6 VERIFY THE FLOOR OVERRIDE OPERATION	
• Press the override button for FLOOR operation. • **Is outside air being discharged from the floor duct?**	**Yes** GO to H7 . **No** Go To Pinpoint Test G .
H7 VERIFY THE PANEL OVERRIDE OPERATION	
• Press the override button for PANEL operation. • **Is outside air being discharged from the instrument panel registers?**	**Yes** GO to H8 . **No** Go To Pinpoint Test G .
H8 VERIFY THE A/C CLUTCH DOES NOT ENGAGE IN THE PANEL MODE	
• In PANEL operation, listen for the compressor clutch to engage.	**Yes** REFER to the Powertrain

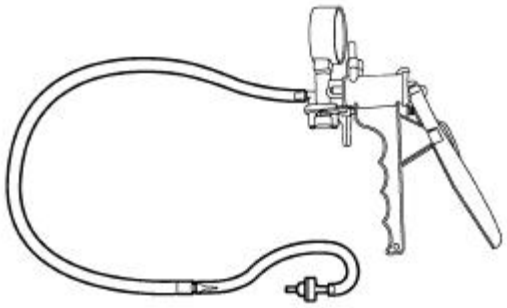
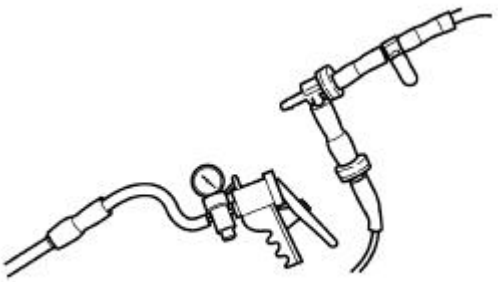
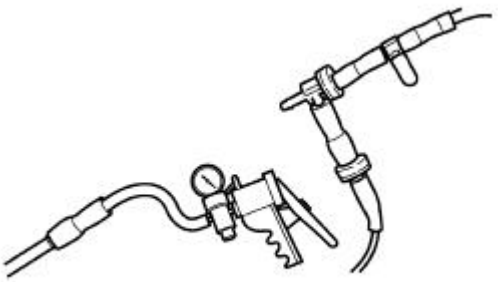
• **Does the A/C clutch engage with the PANEL override button pressed?**	Control/Emissions Diagnosis (PC/ED) manual. **No** GO to H9 .
H9 VERIFY A/C CLUTCH ENGAGEMENT IN THE A/C MODE	
• Make sure the ambient air temperature is above 2°C (35° F). • Press the override button for A/C operation. • **Does the A/C clutch engage when the A/C override button is pressed?**	**Yes** GO to H10 . **No** Go To Pinpoint Test I .
H10 VERIFY THE RECIRC OVERRIDE OPERATION	
• Press the PANEL and RECIRC override buttons. • **Is recirculated air being discharged from the instrument panel registers?**	**Yes** The test is complete. The system is functioning normally. **No** Go To Pinpoint Test G .
H11 CHECK THE DATC/EATC MODULE FUNCTIONS	
• Press each function button and observe the display. • **Does the DATC/EATC perform and display any functions?**	**Yes** INSTALL a new DATC/EATC module. TEST the system for normal operation. **No** GO to H12 .
H12 CHECK THE VOLTAGE TO THE DATC/EATC	
• Key in OFF position. • Disconnect: DATC/EATC C228b. • Key in ON position. • Measure the voltage between ground and DATC/EATC module C228b-11, circuit 729 (RD/WH).  A0050661 • Measure the voltage between ground and DATC/EATC module C228b-22, circuit 296 (WH/VT).	**Yes** GO to H13 . **No** REPAIR the affected circuit. TEST the system for normal operation.

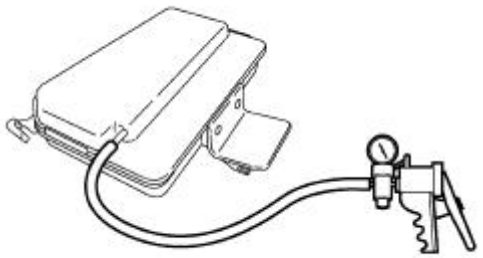
 A0050662 ● **Are the voltages greater than 10 volts?**	
H13 CHECK THE GROUND CIRCUIT TO THE DATC/EATC	**Yes** INSTALL a new DATC/EATC module. TEST the system for normal operation. **No** REPAIR circuit 875 (BK/LB) for an open. TEST the system for normal operation.
● Key in OFF position. ● Disconnect: DATC/EATC C228a. ● Measure the resistance between the DATC/EATC module C228a-2, circuit 875 (BK/LB) and ground.  A0040170 ● **Is the resistance less than 5 ohms?**	

PINPOINT TEST I: INCORRECT/ERRATIC DIRECTION OF AIRFLOW FROM OUTLET(S) — MANUAL CLIMATE CONTROL

Test Step	Result / Action to Take
I1 CHECK THE SYSTEM AIRFLOW	**Yes** The system is operating normally. **No** If the airflow is from the defrost outlet only in all settings, GO to I2. If the airflow is incorrect in one setting only, NOTE the non-functional setting. GO to I10.
● Key in START position. ● Set the blower motor speed to maximum. ● Check for proper airflow in each function selector switch position at engine idle and under acceleration. ● **Is the airflow correct in each function selector switch position?**	
I2 CHECK FOR VACUUM AT THE CHECK VALVE	**Yes** GO to I3. **No** REPAIR or INSTALL
● Disconnect the vacuum check valve and connect the vacuum pump to the vacuum source line and check for manifold vacuum.	

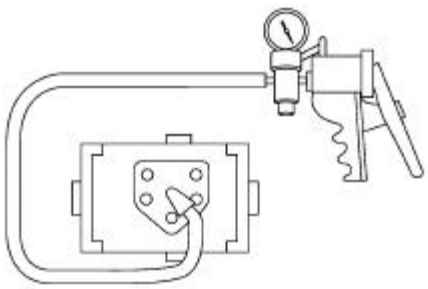
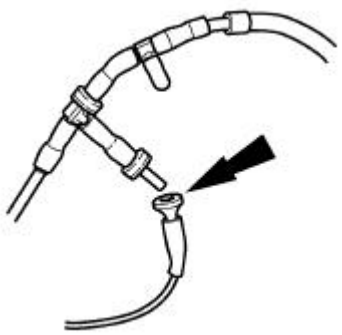
 A0046975 ● **Is manifold vacuum present at the check valve vacuum source line?**	a new check valve vacuum source line. TEST the system for normal operation.
I3 CHECK THE VACUUM CHECK VALVES FOR LEAKAGE	
● Key in OFF position. ● Disconnect: A/C Check Valves. ● Connect the vacuum pump to the open ports on the vacuum check valve and attempt to pull a vacuum.  AL0547-A ● Connect the vacuum pump to the open port on the vacuum check valve and attempt to pull a vacuum.  A0033876 ● **Can a vacuum be pulled on the vacuum check valves?**	**Yes** GO to I4 . **No** INSTALL a new vacuum check valve. TEST the system for normal operation.
I4 CHECK THE VACUUM CHECK VALVES FOR BLOCKAGE	
● Connect the vacuum pump to the open port on the vacuum check valve and attempt to pull a vacuum.  A0046977	**Yes** GO to I5 . **No** INSTALL a new vacuum check valve. TEST the system for normal operation.

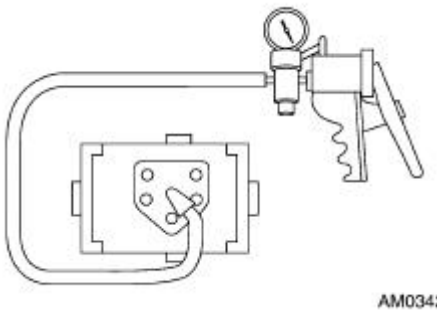
• Connect the vacuum pump to the open port on the vacuum check valve and attempt to pull a vacuum.  A0047027 • **Can a vacuum be pulled on the vacuum check valves?**	
I5 CHECK THE VACUUM RESERVOIR LINE FOR LEAKS	**Yes** REPAIR or INSTALL a new vacuum reservoir line. TEST the system for normal operation. **No** GO to I6 .
• Disconnect the vacuum reservoir line at the vacuum reservoir. • Plug the vacuum reservoir line at the vacuum reservoir connection. • Leak test the vacuum reservoir line, using the vacuum pump.  A0046978 • **Does the vacuum reservoir line leak?**	
I6 CHECK THE VACUUM RESERVOIR LINE FOR BLOCKAGE	**Yes** REPAIR or INSTALL a new vacuum reservoir line. TEST the system for normal operation. **No** GO to I7 .
• Unplug the vacuum reservoir line at the vacuum reservoir connection. • Connect the vacuum pump to the vacuum reservoir line at the vacuum check valve connection and attempt to pull a vacuum.  A0046978 • **Can a vacuum be pulled on the vacuum reservoir line?**	
I7 CHECK THE VACUUM RESERVOIR FOR A LEAK	**Yes** INSTALL a new vacuum reservoir. TEST the system for normal operation. **No** GO to I8 .
• Connect the vacuum pump reservoir line to the vacuum reservoir. • With the vacuum pump connected to the vacuum reservoir line, leak test the vacuum reservoir.	



A0046979

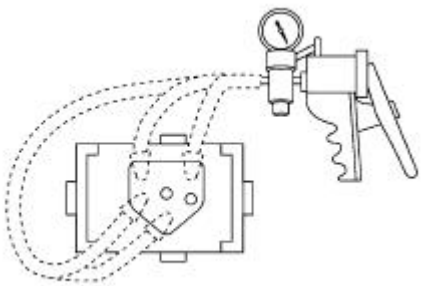
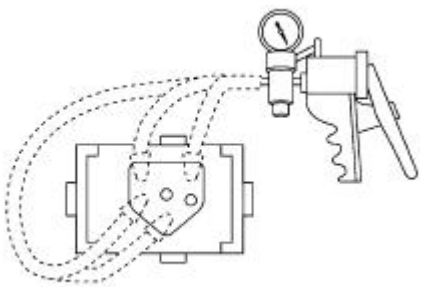
- **Does the vacuum reservoir leak?**

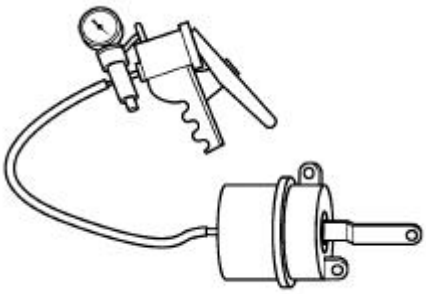
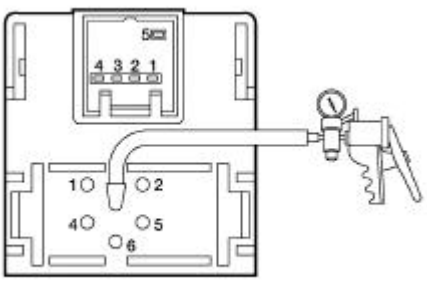
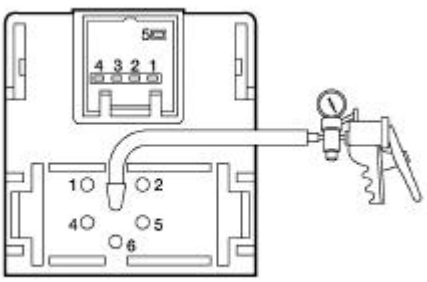
I8 CHECK THE FUNCTION SELECTOR SWITCH VACUUM SOURCE LINE FOR BLOCKAGE	
• Disconnect the function selector switch vacuum connector. • Connect the vacuum pump to the function selector switch vacuum source line and attempt to pull a vacuum.  AM0342-A • **Can a vacuum be pulled on the function selector switch vacuum source line?**	**Yes** REPAIR or INSTALL a new function selector switch vacuum source line. TEST the system for normal operation. **No** GO to I9 .
I9 CHECK THE FUNCTION SELECTOR SWITCH VACUUM SOURCE LINE FOR LEAKS	
• Plug the function selector switch vacuum source line at the vacuum check valve connection.  A0046980 • Leak test the function selector switch vacuum source line using the vacuum pump.	**Yes** REPAIR or INSTALL a new function selector switch vacuum source line. TEST the system for normal operation. **No** GO to I14 .

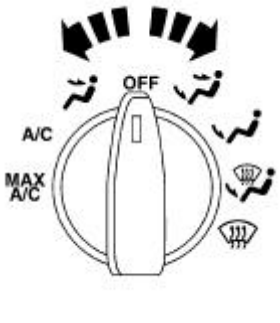


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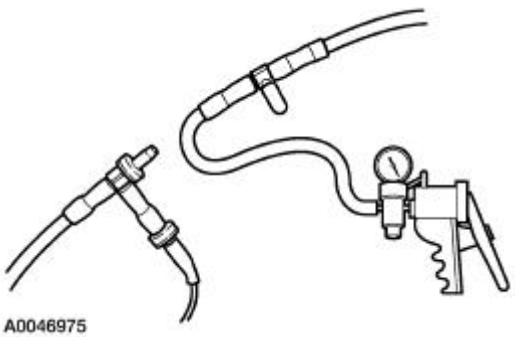
- **Does the function selector switch vacuum source line leak?**

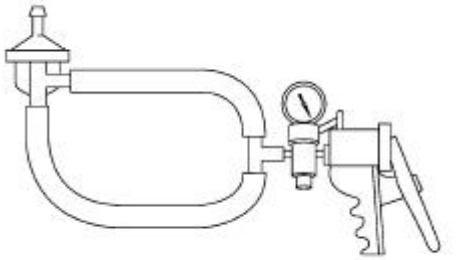
I10 CHECK THE VACUUM CONTROL MOTOR LINE FOR BLOCKAGE	
• Key in OFF position. • Disconnect the function selector switch vacuum connector. • Disconnect the vacuum line from the appropriate vacuum control motor and/or heater control valve, noted in step I1. • Connect the vacuum pump to the appropriate vacuum control motor line noted in step I1, and attempt to pull a vacuum.  AM0350-A • **Can a vacuum be pulled on the vacuum control motor line?**	**Yes** REPAIR or INSTALL a new vacuum harness. TEST the system for normal operation. **No** GO to I11 .
I11 CHECK THE VACUUM CONTROL MOTOR LINE FOR LEAKS	
• Plug the vacuum control motor line at the vacuum control motor connection. • Leak test the vacuum control motor line using the vacuum pump.  AM0350-A • **Does the vacuum control motor line leak?**	**Yes** REPAIR or INSTALL a new vacuum harness. TEST the system for normal operation. **No** GO to I12 .
I12 CHECK THE VACUUM CONTROL MOTOR FOR LEAKS AND CORRECT OPERATION	
• Connect the vacuum pump to the appropriate vacuum control motor and pull a vacuum.	**Yes** GO to I13 . **No** INSTALL a new vacuum control motor (18A318). TEST the

 AL0136-A ● **Does the vacuum control motor operate and hold vacuum?**	system for normal operation.
I13 CHECK THE MODE DOOR LINKAGE AND MOVEMENT ● Inspect the mode door linkage and verify correct movement of the mode door. ● **Is the mode door or mode door linkage broken, binding or otherwise obstructed?**	**Yes** REPAIR the mode door or mode door linkage as necessary. TEST the system for normal operation. **No** GO to I14 .
I14 CHECK THE FUNCTION SELECTOR SWITCH FOR BLOCKAGE ● Connect a vacuum pump to the function selector switch vacuum supply port and try to pull a vacuum in each function selector switch position except DEFROST. If the vacuum pump can pull and hold a vacuum, the switch is plugged. If the vacuum pump pulls a vacuum that slowly decays, the switch is restricted.  A0047083 ● **Is the switch plugged or restricted?**	**Yes** INSTALL a new function selector switch. REFER to Section 412-04 . TEST the system for normal operation. **No** GO to I15 .
I15 LEAK TEST THE FUNCTION SELECTOR SWITCH ● Disconnect: Function Selector Switch Vacuum Harness. ● Connect a vacuum pump to the function selector switch vacuum supply port and plug each control port.  A0047083 ● At each function selector switch position, apply 51 kPa (15 in-Hg) of vacuum.	**Yes** INSTALL a new function selector switch. REFER to Section 412-04 . TEST the system for normal operation. **No** The system is operating normally.

 AM0418-A ● **Does the vacuum drop exceed 3.37 kPa (1 in-Hg) per minute?**	

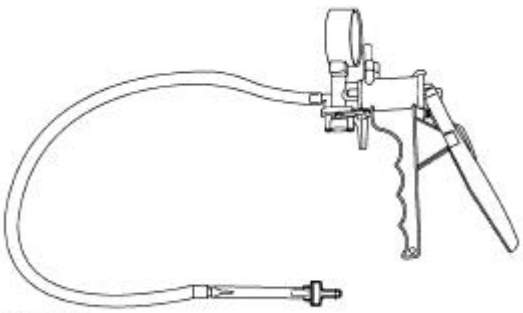
PINPOINT TEST J: INCORRECT/ERRATIC DIRECTION OF AIRFLOW FROM OUTLET(S) — DATC/EATC

Test Step	Result / Action to Take
J1 CHECK THE AIRFLOW IN EACH SETTING	
● Key in START position. ● Check the airflow in each manual override setting on the DATC/EATC module during engine idle and under acceleration. ● **Is the airflow correct in each manual override setting?**	**Yes** The system is operating normally. **No** If the airflow is from the defrost outlet only in all settings, GO to J2. If the airflow is incorrect in one setting only, NOTE the non-functional setting. GO to J10.
J2 CHECK FOR VACUUM AT THE CHECK VALVE	
● Disconnect the vacuum check valve and connect the vacuum pump to the vacuum source line and check for manifold vacuum.  A0046975 ● **Is manifold vacuum present at the check valve vacuum source line?**	**Yes** GO to J3. **No** REPAIR or INSTALL a new check valve vacuum source line. TEST the system for normal operation.
J3 CHECK THE VACUUM CHECK VALVES FOR LEAKAGE	
● Key in OFF position. ● Disconnect: A/C Check Valves. ● Connect the vacuum pump to the open ports on the vacuum check valve and attempt to pull a vacuum.	**Yes** GO to J4. **No** INSTALL a new vacuum check valve. TEST the system for normal operation.



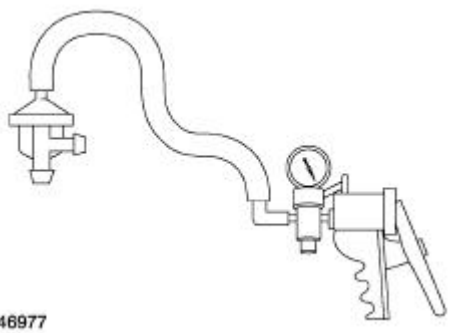
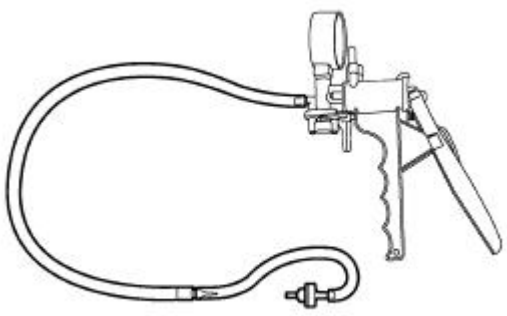
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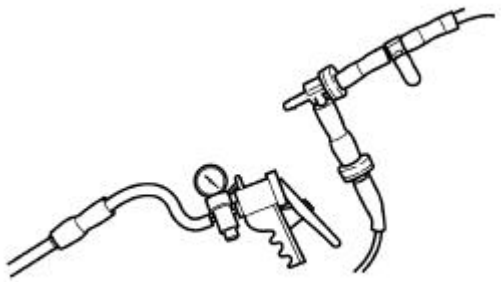
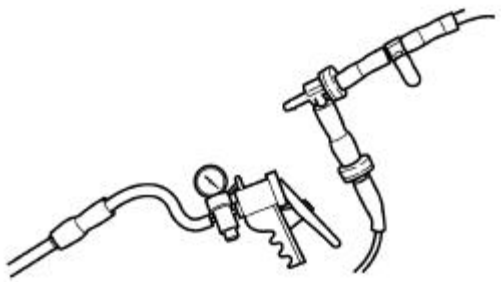
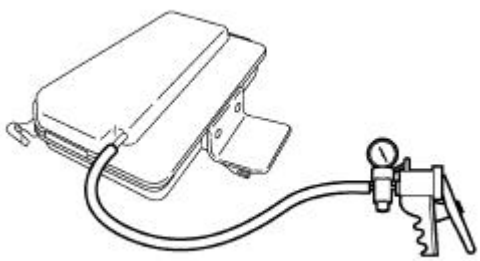
- Connect the vacuum pump to the open port on the vacuum check valve and attempt to pull a vacuum.

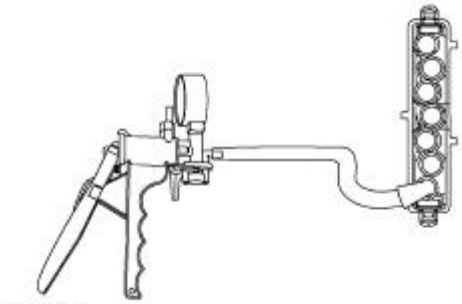
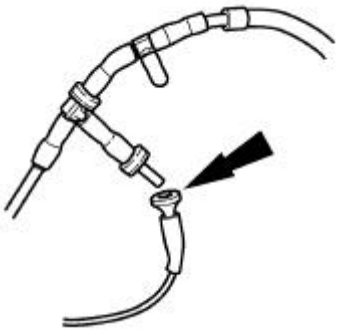
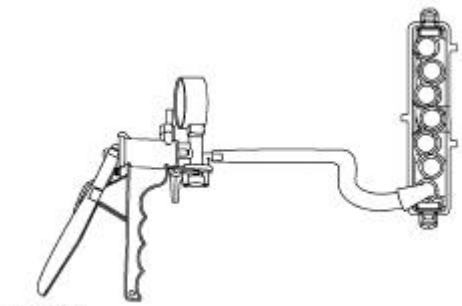


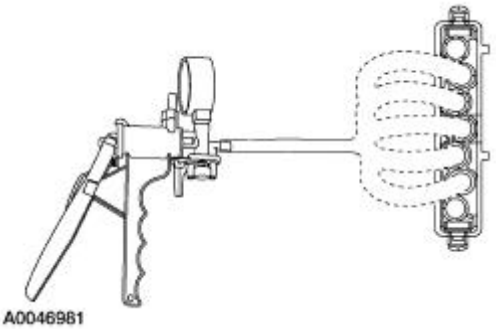
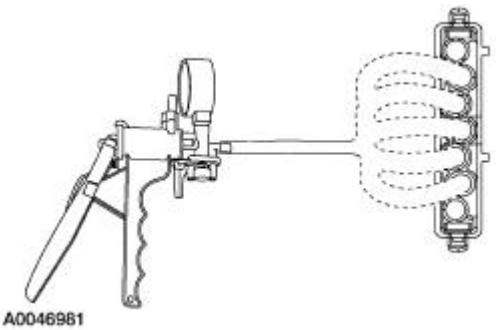
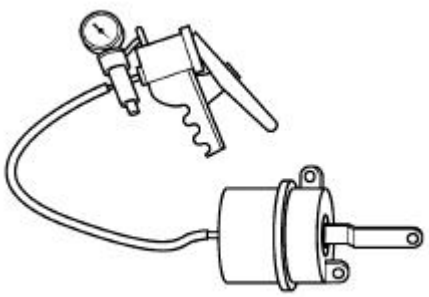
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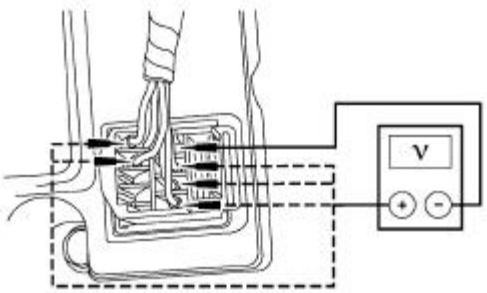
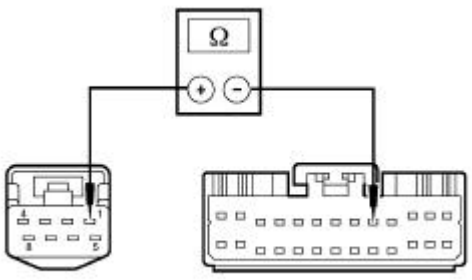
- **Can a vacuum be pulled on the vacuum check valves?**

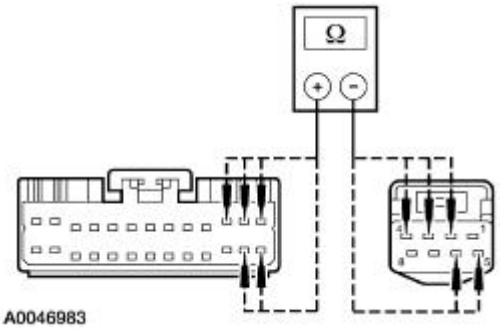
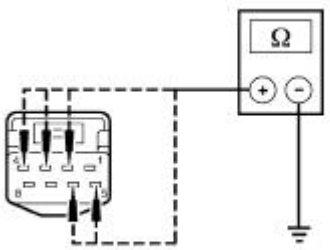
J4 CHECK THE VACUUM CHECK VALVES FOR BLOCKAGE	
- Connect the vacuum pump to the open port on the vacuum check valve and attempt to pull a vacuum.  A0046977 - Connect the vacuum pump to the open port on the vacuum check valve and attempt to pull a vacuum.  A0047027 - **Can a vacuum be pulled on the vacuum check valves?**	**Yes** GO to J5 . **No** INSTALL a new vacuum check valve. TEST the system for normal operation.
J5 CHECK THE VACUUM RESERVOIR LINE FOR LEAKS	
- Disconnect the vacuum reservoir line at the vacuum reservoir. - Plug the vacuum reservoir line at the vacuum reservoir	**Yes** REPAIR or INSTALL a new vacuum reservoir line. TEST

connection. ● Leak test the vacuum reservoir line, using the vacuum pump.  A0046978 ● **Does the vacuum reservoir line leak?**	the system for normal operation. **No** GO to J6 .
J6 CHECK THE VACUUM RESERVOIR LINE FOR BLOCKAGE	
● Unplug the vacuum reservoir line at the vacuum reservoir connection. ● Connect the vacuum pump to the vacuum reservoir line at the vacuum check valve connection and attempt to pull a vacuum.  A0046978 ● **Can a vacuum be pulled on the vacuum reservoir line?**	**Yes** REPAIR or INSTALL a new vacuum reservoir line. TEST the system for normal operation. **No** GO to J7 .
J7 CHECK THE VACUUM RESERVOIR FOR A LEAK	
● Connect the vacuum pump reservoir line to the vacuum reservoir. ● With the vacuum pump connected to the vacuum reservoir line, leak test the vacuum reservoir.  A0046979 ● **Does the vacuum reservoir leak?**	**Yes** INSTALL a new vacuum reservoir. TEST the system for normal operation. **No** GO to J8 .
J8 CHECK THE RSA MODULE VACUUM SOURCE LINE FOR BLOCKAGE	
● Disconnect the RSA module vacuum connector. ● Connect the vacuum pump to the RSA module vacuum source line and attempt to pull a vacuum.	**Yes** REPAIR or INSTALL a new RSA module vacuum source line. TEST the system for

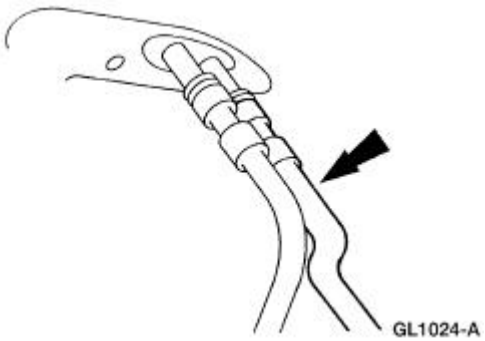
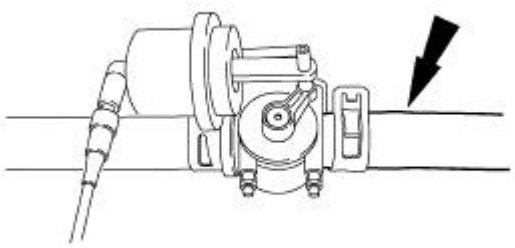
 A0046976 ● **Can a vacuum be pulled on the RSA module vacuum source line?**	normal operation. **No** GO to J9 .
J9 CHECK THE RSA MODULE VACUUM SOURCE LINE FOR LEAKS	
● Plug the RSA module vacuum source line at the vacuum check valve connection.  A0046980 ● Leak test the RSA module vacuum source line, using the vacuum pump.  A0046976 ● **Does the RSA module vacuum source line leak?**	**Yes** REPAIR or INSTALL a new RSA module vacuum source line. TEST the system for normal operation. **No** INSTALL a new RSA module. TEST the system for normal operation.
J10 CHECK THE VACUUM CONTROL MOTOR LINE FOR BLOCKAGE	
● Key in OFF position. ● Disconnect the RSA module vacuum connector. ● Disconnect the vacuum line from the appropriate vacuum control motor noted in step J1. ● Connect the vacuum pump to the appropriate vacuum control motor line noted in step J1, and attempt to pull a vacuum.	**Yes** REPAIR or INSTALL a new vacuum or RSA module harness. TEST the system for normal operation. **No** GO to J11 .

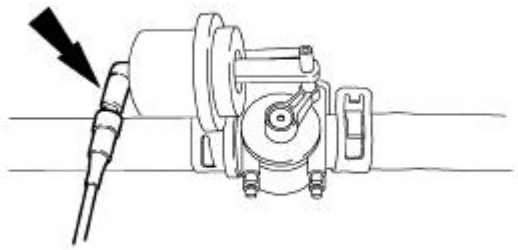
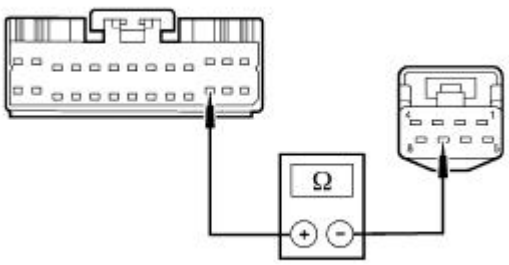
 A0046981 ● **Can a vacuum be pulled on the vacuum control motor line?**	
J11 CHECK THE VACUUM CONTROL MOTOR LINE FOR LEAKS	
● Plug the vacuum control motor line at the vacuum control motor connection. ● Leak test the vacuum control motor line, using the vacuum pump.  A0046981 ● **Does the vacuum control motor line leak?**	**Yes** REPAIR or INSTALL a new vacuum harness. TEST the system for normal operation. **No** GO to J12 .
J12 CHECK THE VACUUM CONTROL MOTOR FOR LEAKS AND CORRECT OPERATION	
● Connect the vacuum pump to the appropriate vacuum control motor and pull a vacuum.  AL0136-A ● **Does the vacuum control motor operate and hold vacuum?**	**Yes** GO to J13 . **No** INSTALL a new vacuum control motor (18A318). TEST the system for normal operation.
J13 CHECK THE MODE DOOR LINKAGE AND MOVEMENT	
● Inspect the mode door linkage and verify correct movement of the mode door. ● **Is the mode door or mode door linkage broken, binding or otherwise obstructed?**	**Yes** REPAIR the mode door or mode door linkage as necessary. TEST the system for normal operation. **No** GO to J14 .

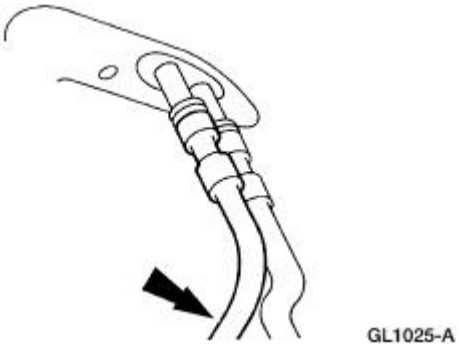
J14 CHECK THE ATC SOLENOID AND MANIFOLD	
• Connect the vacuum harness connector to the ATC solenoid and manifold. • Key in START position. • Press the PANEL/FLOOR button then the RECIRCULATION button on the DATC/EATC module. • **NOTE:** The following measurements must be taken by back-probing the ATC solenoid and manifold C2093. • Measure the voltage between ATC solenoid and manifold C2093-1, circuit 1957 (LB/RD) and: ■ pin 2, circuit 1952 (OG/LG). ■ pin 3, circuit 1953 (WH/VT). ■ pin 4, circuit 1954 (DG/VT). ■ pin 5, circuit 1955 (DB/OG). ■ pin 6, circuit 1956 (TN/WH).  A0046982 • **Are all the voltages greater than 10 volts?**	**Yes** INSTALL a new ATC solenoid and manifold. TEST the system for normal operation. **No** If none of the circuits measure greater than 10 volts, GO to J15 . If some of the circuits measure greater than 10 volts, GO to J16 .
J15 CHECK CIRCUIT 1957 (LB/RD)	
• Key in OFF position. • Disconnect: DATC/EATC Module C228a and ATC Solenoid and Manifold C2093. • Measure the resistance between the DATC/EATC module C228a-9, circuit 1957 (LB/RD) and the ATC solenoid and manifold C2093-1, circuit 1957 (LB/RD).  A0040175 • **Is the resistance less than 5 ohms?**	**Yes** GO to J16 . **No** REPAIR circuit 1957 (LB/RD) for an open. TEST the system for normal operation.
J16 CHECK THE ATC SOLENOID AND MANIFOLD CIRCUITS FOR AN OPEN	
• Key in OFF position. • Measure the resistance between the harness side of the connectors/pins indicated below that corresponds to the affected circuits. ■ Circuit 1952 (OG/LG), DATC/EATC C228a-13 and ATC solenoid and manifold C2093-2. ■ Circuit 1953 (WH/VT), DATC/EATC C228a-26 and ATC solenoid and manifold C2093-3. ■ Circuit 1954 (DG/VT), DATC/EATC C228a-25 and ATC solenoid and manifold C2093-4.	**Yes** GO to J17 . **No** REPAIR the affected circuit for an open. TEST the system for normal operation.

■ Circuit 1955 (DB/OG), DATC/EATC C228a-12 and ATC solenoid and manifold C2093-5. ■ Circuit 1956 (TN/WH), DATC/EATC C228a-11 and ATC solenoid and manifold C2093-6.  ● **Is the resistance less than 5 ohms?**	
J17 CHECK THE ATC SOLENOID AND MANIFOLD CIRCUITS FOR A SHORT TO GROUND	
● Measure the resistance between the harness side of the connectors/pins indicated below that corresponds to the affected circuits and ground. ■ Circuit 1952 (OG/LG), ATC solenoid and manifold C2093-2. ■ Circuit 1953 (WH/VT), ATC solenoid and manifold C2093-3. ■ Circuit 1954 (DG/VT), ATC solenoid and manifold C2093-4. ■ Circuit 1955 (DB/OG), ATC solenoid and manifold C2093-5. ■ Circuit 1956 (TN/WH), ATC solenoid and manifold C2093-6.  ● **Is the resistance greater than 10,000 ohms?**	**Yes** GO to J18 . **No** REPAIR the affected circuit for a short to ground. TEST the system for normal operation.
J18 CHECK THE ATC SOLENOID AND MANIFOLD	
● Carry out the ATC solenoid and manifold component test in this section. ● **Does the ATC solenoid and manifold test good?**	**Yes** INSTALL a new DATC/EATC module. TEST the system for normal operation. **No** INSTALL a new ATC solenoid and manifold. TEST the system for normal operation.

PINPOINT TEST K: INSUFFICIENT, ERRATIC OR NO HEAT

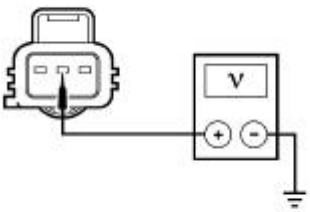
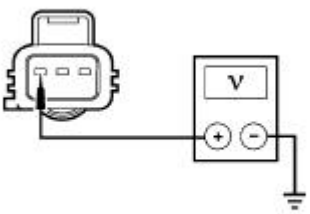
Test Step	Result / Action to Take
K1 CHECK FOR PROPER ENGINE COOLANT LEVEL	
• Key in OFF position. • Check the engine coolant level when hot and cold. • **Is the engine coolant at the correct level (hot/cold) as indicated on the engine coolant recovery reservoir?**	**Yes** GO to K3 . **No** GO to K2 .
K2 CHECK THE ENGINE COOLING SYSTEM FOR LEAKS	
• Pressure test the cooling system for leaks. Refer to Section 303-03 . • **Does the engine cooling system leak?**	**Yes** REPAIR the engine coolant leak. TEST the system for normal operation. **No** GO to K3 .
K3 CHECK FOR COOLANT FLOW TO THE HEATER CORE	
WARNING: The heater core inlet hose will become too hot to handle and may cause serious burns if the system is working correctly. • Key in START position. • Run the engine until it reaches normal operation temperature. Select the FLOOR position on the control assembly. Set the temperature control to full WARM. • Feel the heater core inlet hose to see if it is hot.  GL1024-A • **Is the heater core inlet hose hot?**	**Yes** GO to K8 . **No** GO to K4 .
K4 CHECK FOR COOLANT FLOW TO THE HEATER CONTROL VALVE	
WARNING: The heater control valve inlet hose will become too hot to handle and may cause serious burns if the system is working correctly. • Feel the heater control valve inlet hose to see if it is hot.  A0035188 • **Is the heater control valve inlet hose hot?**	**Yes** GO to K5 . **No** REFER to Section 303-03 .
K5 CHECK FOR VACUUM AT THE HEATER CONTROL	

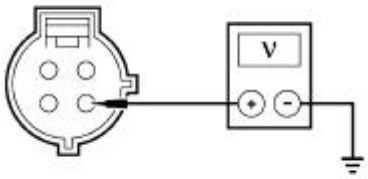
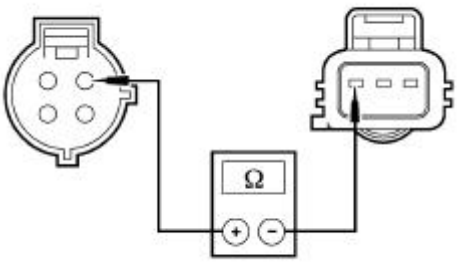
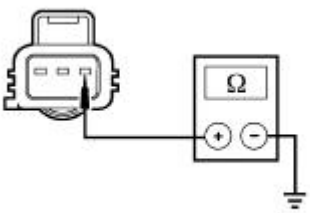
VALVE ● Disconnect the heater control valve vacuum connector and check for vacuum.  A0035187 ● **Is vacuum present at the heater control valve?**	**Yes** Manual climate control system, GO to K6 . DATC/EATC, GO to K7 . **No** INSTALL a new heater control valve. TEST the system for normal operation.
K6 CHECK FOR INCORRECT VACUUM LINE PLACEMENT ● Key in OFF position. ● Inspect the heater control valve and A/C vacuum lines for correct placement. ● **Is the vacuum line placement correct?**	**Yes** INSTALL a new climate control assembly or RSA module. REFER to Section 412-04 . TEST the system for normal operation. **No** CORRECT the vacuum line placement. TEST the system for normal operation.
K7 CHECK THE CIRCUIT FOR AN OPEN ● Key in OFF position. ● Disconnect: DATC/EATC Module C228a. ● Disconnect: RSA Module C2093. ● Measure the resistance between the DATC/EATC Module C228a-24, circuit 773 (DG/OG) and the RSA module C2093-7, circuit 773 (DG/OG).  A0067616 ● **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new RSA module. REFER to Section 412-04 . TEST the system for normal operation. **No** REPAIR the circuit for an open. TEST the system for normal operation.
K8 CHECK FOR A PLUGGED OR RESTRICTED HEATER CORE **WARNING: The heater core outlet hose will become too hot to handle and may cause serious burns if the system is operating correctly.** ● Feel the heater core outlet hose to see if it is hot.	**Yes** Vehicles with manual climate control, Go To Pinpoint Test M . Vehicles with EATC, Go To Pinpoint Test A . **No** INSTALL a new heater

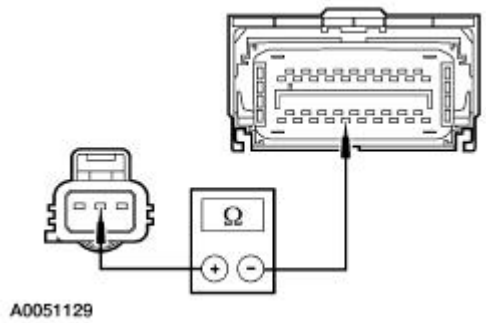
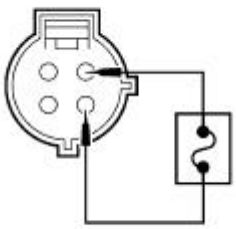
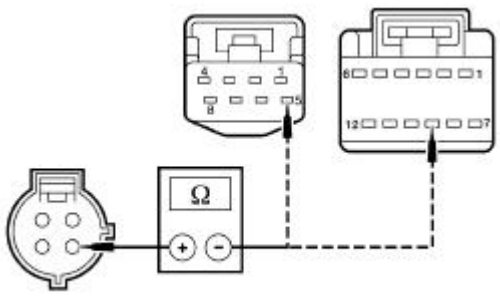
 GL1025-A ● **Is the heater core outlet hose hot?**	core. REFER to Section 412-02 . TEST the system for normal operation.

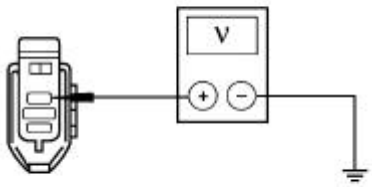
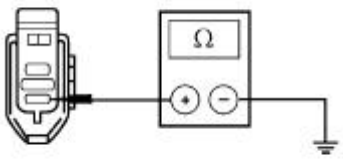
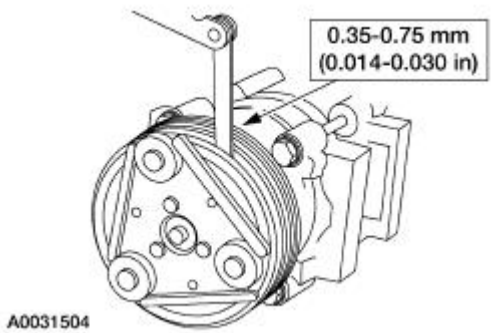
PINPOINT TEST L: THE A/C DOES NOT OPERATE/DOES NOT OPERATE CORRECTLY

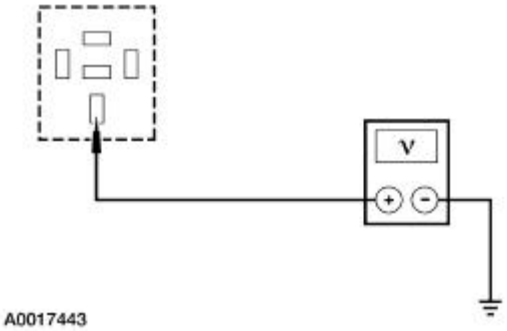
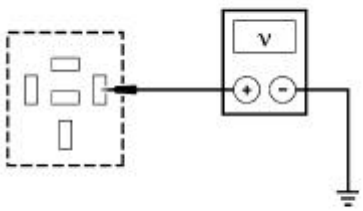
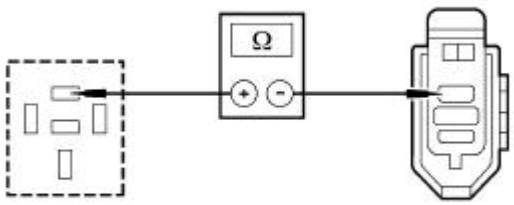
Test Step	Result / Action to Take
NOTE: Before carrying out the following test, diagnose any PCM DTCs.	
NOTE: Before carrying out the following test, check that the A/C system pressure is above 290 kPa (42 psi). If the pressure is below 290 kPa (42 psi), Refer to Fluorescent Dye Leak Detection in this section.	
L1 CHECK A/C REQUEST PID WITH THE A/C OFF ● Key in START position. ● Place the function selector switch to the OFF position, or press the OFF manual override button on the DATC/EATC module. ● Enter the following diagnostic mode on the diagnostic tool: PCM A/C REQUEST PID. ● **Does the PCM A/C REQUEST PID read ON?**	**Yes** DATC/EATC systems, INSTALL a new DATC/EATC module. TEST the system for normal operation. Manual climate control systems, GO to L6 . **No** GO to L2 .
L2 CHECK A/C CLUTCH RELAY PID WITH THE A/C OFF ● Enter the following diagnostic mode on the diagnostic tool: PCM A/C CLUTCH RELAY PID. ● **Does the PCM A/C CLUTCH RELAY PID read ON?**	**Yes** REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual. **No** DATC/EATC systems, GO to L3 . Manual climate control systems, GO to L4 .
L3 CHECK THE A/C SWITCH PID WITH THE A/C ON ● Enter the following diagnostic mode on the diagnostic tool: PCM A/C SWITCH PID. ● Press the PANEL and A/C manual override buttons on the DATC module. ● **Does the PCM A/C SWITCH PID read ON?**	**Yes** GO to L4 . **No** INSTALL a new DATC/EATC module. TEST the system for normal operation.
L4 CHECK THE A/C REQUEST PID WITH THE A/C ON ● Enter the following diagnostic mode on the diagnostic tool: PCM A/C REQUEST PID. ● Place the function selector switch in the MAX A/C position, or press the DEFROST button on the	**Yes** GO to L5 . **No**

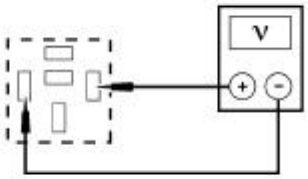
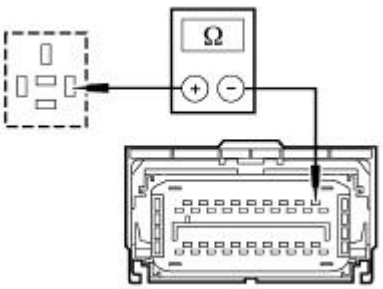
DATC/EATC module. ● **Does the PCM A/C REQUEST PID read ON?**	INSTALL a new PCM. TEST the system for normal operation.
L5 CHECK THE A/C CLUTCH RELAY PID WITH THE A/C ON	
● Enter the following diagnostic mode on the diagnostic tool: PCM A/C CLUTCH RELAY PID. ● **Does the PCM A/C CLUTCH RELAY PID read ON?**	**Yes** GO to L15 . **No** GO to L7 .
L6 CHECK CIRCUIT 1932 (OG/LB) FOR A SHORT TO VOLTAGE	
● Key in OFF position. ● Disconnect: A/C Thermostatic Switch C1373 and PCM C175. ● Key in ON position. ● Measure the voltage between the A/C thermostatic switch C1373-2, circuit 1932 (OG/LB) and ground.  A0047090 ● **Is any voltage present?**	**Yes** REPAIR circuit 1932 (OG/LB) for a short to voltage. TEST the system for normal operation. **No** INSTALL a new function selector switch. TEST the system for normal operation.
L7 CHECK THE A/C THERMOSTATIC SWITCH VOLTAGE	
● Key in OFF position. ● Disconnect: A/C Thermostatic Switch C1373. ● Key in ON position. ● Measure the voltage between the A/C thermostatic switch C1373, circuit 441 (RD/YE) and ground.  A0047084 ● **Is the voltage greater than 10 volts?**	**Yes** GO to L11 . **No** GO to L8 .
L8 CHECK THE A/C PRESSURE CUTOFF SWITCH VOLTAGE	
● Key in OFF position. ● Disconnect: A/C Pressure Cutoff Switch C1078. ● Key in ON position. ● Measure the voltage between the A/C pressure cutoff switch C1078, circuit 348 (VT) and ground.	**Yes** GO to L9 . **No** Vehicles with manual climate control, GO to L14 . Vehicles with DATC/EATC, REPAIR circuit 348

 A0008130 ● **Is the voltage greater than 10 volts?**	(VT). TEST the system for normal operation.
L9 CHECK THE CIRCUIT 441 (RD/YE) FOR AN OPEN	
● Key in OFF position. ● Measure the resistance between the A/C pressure cutoff switch C1078, circuit 441 (RD/YE) and A/C thermostatic switch C1373, circuit 441 (RD/YE).  A0047085 ● **Is the resistance less than 5 ohms?**	**Yes** GO to L10 . **No** REPAIR circuit 441 (RD/YE) for an open. TEST the system for normal operation.
L10 CHECK THE A/C SYSTEM PRESSURE	
● Key in OFF position. ● Connect the manifold gauge set. Refer to Manifold Gauge Set Connection in this section. ● **Is the pressure reading between 345 kPa (50 psi) and 1,724 kPa (250 psi)?**	**Yes** INSTALL a new A/C pressure cutoff switch. TEST the system for normal operation. **No** CHECK the system for refrigerant leaks. REFER to Electronic Leak Detection and Fluorescent Dye Leak Detection in this section.
L11 CHECK CIRCUIT 875 (BK/LB) FOR AN OPEN	
● Key in OFF position. ● Measure the resistance between the A/C thermostatic switch C1373-3, circuit 875 (BK/LB) and ground.  A0047086 ● **Is the resistance less than 5 ohms?**	**Yes** GO to L12 . **No** REPAIR circuit 875 (BK/LB) for an open. TEST the system for normal operation.
L12 CHECK CIRCUIT 1932 (OG/LB) FOR AN OPEN	

• Disconnect: PCM C175. • Measure the resistance between the PCM C175-41, circuit 1932 (OG/LB) and the A/C thermostatic switch C1373-2, circuit 1932 (OG/LB).  A0051129 • **Is the resistance less than 5 ohms?**	**Yes** GO to L13. **No** REPAIR circuit 1932 (OG/LB) for an open. TEST the system for normal operation.
L13 CHECK A/C LOW CHARGE PROTECTION SWITCH	
• Key in OFF position. • Connect: PCM C175. • Connect: A/C Thermostatic Switch C1373. • Key in ON position. • Connect a fused jumper between the A/C low charge protection switch terminals.  A0008127 • **Does the A/C operate correctly?**	**Yes** INSTALL a new A/C low charge protection switch. REFER to Section 412-04. TEST the system for normal operation. **No** INSTALL a new A/C thermostatic switch. REFER to Section 412-04. TEST the system for normal operation. If the A/C is still inoperative, INSTALL a new PCM. REFER to Section 303-14. TEST the system for normal operation.
L14 CHECK CIRCUIT 348 (VT) FOR AN OPEN	
• Key in OFF position. • Disconnect: Function Selector Switch C294b and C294c. • Measure the resistance between the A/C pressure cutoff switch C1078, circuit 348 (VT) and the function selector switch: ▪ C294b-5, circuit 348 (VT). ▪ C294c-9, circuit 348 (VT).  A0047088 • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new function selector switch. REFER to Section 412-04. TEST the system for normal operation. **No** REPAIR circuit 348 (VT). TEST the system for normal operation.
L15 CHECK THE VOLTAGE AT THE A/C COMPRESSOR	

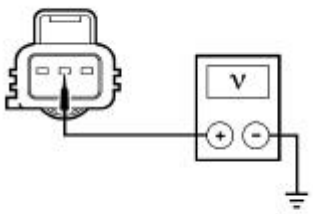
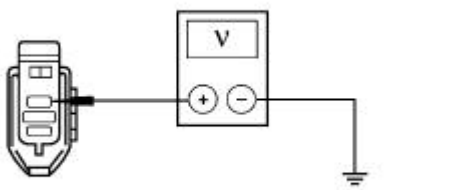
CLUTCH FIELD COIL	
• Key in OFF position. • Disconnect: A/C Compressor Clutch Field Coil C100. • Key in ON position. • Measure the voltage between the A/C compressor clutch field coil C100, circuit 321 (GY/WH) and ground.  GL1034-A • **Is the voltage greater than 10 volts?**	**Yes** GO to L16 . **No** GO to L18 .
L16 CHECK THE GROUND AT THE A/C COMPRESSOR CLUTCH FIELD COIL	
• Key in OFF position. • Measure the resistance between the A/C compressor clutch field coil C100, circuit 57 (BK) and ground.  GL1035-A • **Is the resistance less than 5 ohms?**	**Yes** GO to L17 . **No** REPAIR circuit 57 (BK). TEST the system for normal operation.
L17 CHECK THE A/C COMPRESSOR CLUTCH AIR GAP	
• Measure the A/C compressor clutch air gap at three equally spaced locations between the clutch hub and the A/C compressor clutch pulley.  A0031504 • **Is the A/C compressor clutch air gap greater than 0.75 mm (0.030 in)?**	**Yes** ADJUST the A/C compressor clutch field coil. REFER to Air Conditioning (A/C) Clutch Air Gap Adjustment in this section. TEST the system for normal operation. **No** INSTALL a new A/C compressor clutch field coil. REFER to Section 412-03A . TEST the system for normal operation.
L18 CHECK CIRCUIT 883 (PK/LB)	
• Key in OFF position. • Disconnect: A/C Control Relay. • Key in ON position.	**Yes** GO to L19 .

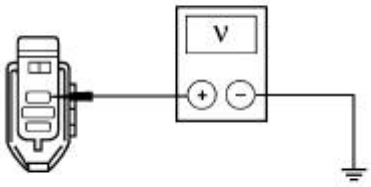
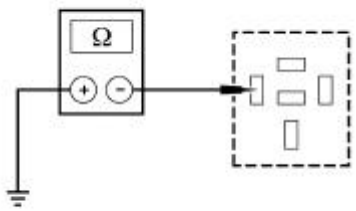
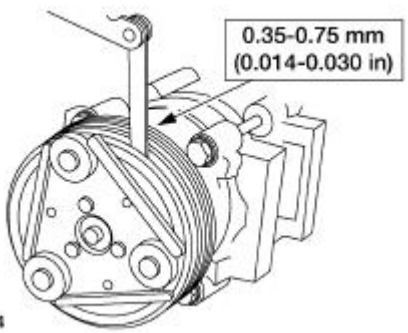
• Measure the voltage between the A/C control relay socket pin 30, circuit 883 (PK/LB) and ground.  A0017443 • **Is the voltage greater than 10 volts?**	**No** REPAIR circuit 883 (PK/LB). TEST the system for normal operation.
L19 CHECK CIRCUIT 391 (RD/YE)	
• Measure the voltage between the A/C control relay socket pin 86, circuit 391 (RD/YE) and ground.  A0020210 • **Is the voltage greater than 10 volts?**	**Yes** GO to L20 . **No** REPAIR circuit 391 (RD/YE). TEST the system for normal operation.
L20 CHECK CIRCUIT 321 (GY/WH)	
• Key in OFF position. • Measure the resistance between the A/C control relay socket pin 87, circuit 321 (GY/WH) and the A/C compressor clutch field coil C100, circuit 321 (GY/WH).  A0017427 • **Is the resistance less than 5 ohms?**	**Yes** GO to L21 . **No** REPAIR circuit 321 (GY/WH). TEST the system for normal operation.
L21 CHECK THE WAC OUTPUT FROM THE PCM	
• Key in START position. • Measure the voltage between the A/C control relay socket pin 85, circuit 331 (PK/YE) and socket pin 86, circuit 391 (RD/YE).	**Yes** INSTALL a new A/C control relay. CLEAR the DTCs. TEST the system for normal operation. **No** GO to L22 .

 A0034149 ● **Is the voltage greater than 10 volts?**	
L22 CHECK CIRCUIT 331 (PK/YE)	
● Key in OFF position. ● Disconnect: PCM C175. ● Measure the resistance between the A/C control relay socket pin 85, circuit 331 (PK/YE) and the PCM C175-41 circuit 331 (PK/YE).  A0051128 ● **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation. **No** REPAIR circuit 331 (PK/YE). CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST M: THE A/C IS ALWAYS ON

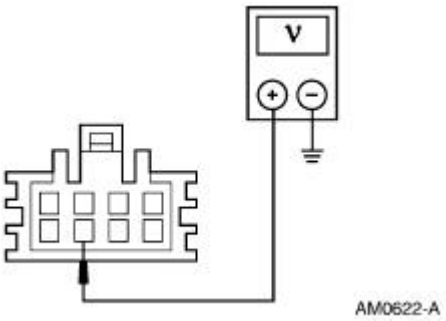
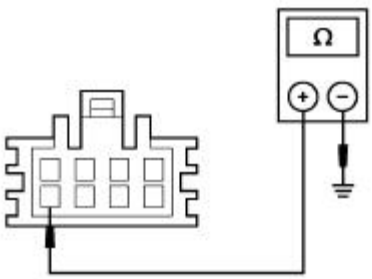
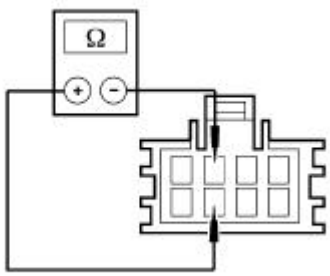
Test Step	Result / Action to Take
M1 CHECK A/C CLUTCH RELAY FAULT PID WITH THE A/C OFF	
● Key in ON position. ● Place the function selector switch to the OFF position or press the OFF manual override button on the DATC/EATC module. ● Enter the following diagnostic mode on the diagnostic tool: PCM A/C CLUTCH RELAY FAULT PID. ● **Does the PCM A/C CLUTCH RELAY FAULT PID read YES?**	**Yes** REPAIR circuit 331 (PK/YE). TEST the system for normal operation. **No** DATC/EATC systems, GO to M2 . Manual climate control systems, GO to M3 .
M2 CHECK A/C SWITCH PID WITH THE A/C OFF	
● Enter the following diagnostic mode on the diagnostic tool: PCM A/C SWITCH PID. ● **Does the PCM A/C SWITCH PID read ON?**	**Yes** INSTALL a new DATC/EATC module. TEST the system for normal operation. **No** GO to M3 .
M3 CHECK A/C REQUEST PID WITH THE A/C OFF	
● Enter the following diagnostic mode on the diagnostic	**Yes**

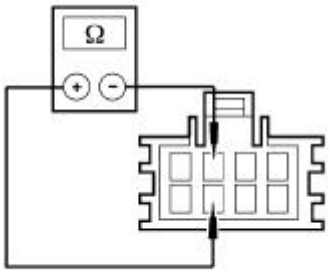
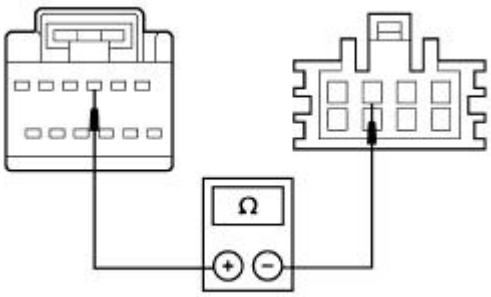
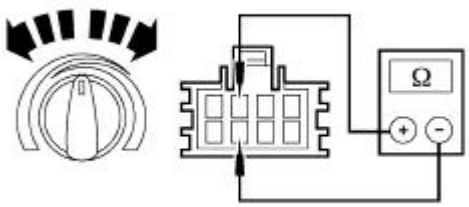
tool: PCM A/C REQUEST PID. ● **Does the PCM A/C REQUEST PID read ON?**	DATC/EATC systems, INSTALL a new PCM. TEST the system for normal operation. Manual climate control systems, Go To Pinpoint Test L . **No** GO to M4 .
M4 CHECK CIRCUIT 1932 (OG/LB) FOR A SHORT TO VOLTAGE	
● Key in OFF position. ● Disconnect: A/C Thermostatic Switch C1373 and PCM C175. ● Key in ON position. ● Measure the voltage between the A/C thermostatic switch C1373-2, circuit 1932 (OG/LB) and ground.  A0047090 ● **Is the voltage greater than 10 volts?**	**Yes** REPAIR circuit 1932 (OG/LB) for a short to voltage. TEST the system for normal operation. **No** GO to M5 .
M5 CHECK FOR VOLTAGE TO THE A/C COMPRESSOR CLUTCH FIELD COIL	
● Key in OFF position. ● Disconnect: A/C Compressor Clutch Field Coil C100. ● Key in ON position. ● Measure the voltage between the A/C compressor clutch field coil C100, circuit 321 (GY/WH) and ground.  GL1034-A ● **Is the voltage greater than 10 volts?**	**Yes** GO to M6 . **No** GO to M8 .
M6 CHECK CIRCUIT 321 (GY/WH) FOR A SHORT TO VOLTAGE	
● Key in OFF position. ● Disconnect: A/C Control Relay. ● Key in ON position. ● Measure the voltage between the A/C compressor clutch field coil C100, circuit 321 (GY/WH) and ground.	**Yes** REPAIR circuit 321 (GY/WH). TEST the system for normal operation. **No** GO to M7 .

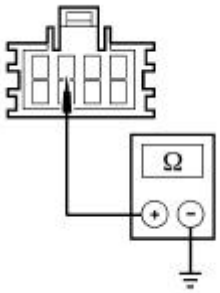
 GL1034-A ● **Is the voltage greater than 10 volts?**	
M7 CHECK CIRCUIT 331 (PK/YE) FOR A SHORT TO GROUND	
● Measure the resistance between the A/C control relay socket pin 85, circuit 331 (PK/YE) and ground.  A0013869 ● **Is the resistance less than 5 ohms?**	**Yes** REPAIR circuit 321 (GY/WH). TEST the system for normal operation. **No** INSTALL a new A/C control relay. TEST the system for normal operation.
M8 CHECK THE A/C COMPRESSOR CLUTCH AIR GAP	
● Key in OFF position. ● Measure the A/C compressor clutch air gap at three equally spaced locations between the clutch hub and the A/C compressor clutch pulley.  A0031504 ● **Is the A/C compressor clutch air gap greater than 0.75 mm (0.030 in)?**	**Yes** ADJUST the A/C compressor clutch field coil. REFER to Air Conditioning (A/C) Clutch Air Gap Adjustment in this section. TEST the system for normal operation. **No** INSTALL a new A/C compressor clutch field coil. REFER to Section 412-03A . TEST the system for normal operation.

PINPOINT TEST N: THE TEMPERATURE CONTROL IS INOPERATIVE/DOES NOT OPERATE CORRECTLY — MANUAL CLIMATE CONTROL

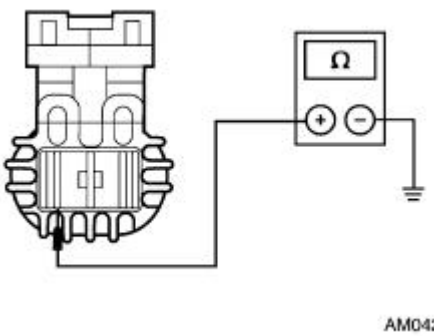
Test Step	Result / Action to Take
N1 CHECK THE VOLTAGE TO THE BLEND DOOR ACTUATOR	
● Key in OFF position.	**Yes**

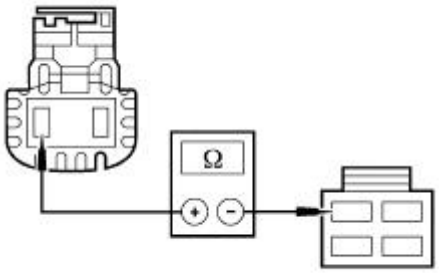
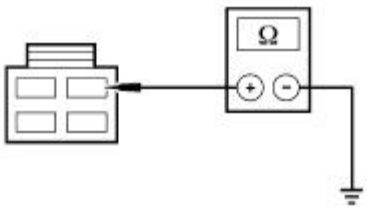
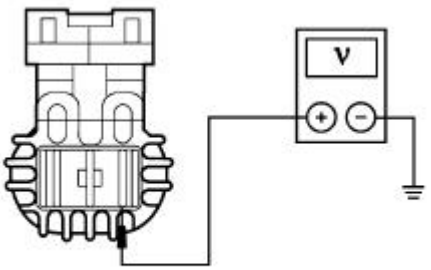
• Disconnect: A/C Electronic Blend Door Actuator Motor C289. • Key in ON position. • Measure the voltage between blend door actuator motor C289, circuit 295 (LB/BK), harness side and ground.  AM0622-A • **Is the voltage greater than 10 volts?**	GO to N2 . **No** REPAIR the circuit. TEST the system for normal operation.
N2 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
• Key in OFF position. • Measure the resistance between the blend door actuator motor C289, circuit 57 (BK), harness side and ground.  AM2240-A • **Is the resistance less than 5 ohms?**	**Yes** GO to N3 . **No** REPAIR the circuit. TEST the system for normal operation.
N3 CHECK THE TEMPERATURE CONTROL POTENTIOMETER TOTAL RESISTANCE	
• Key in OFF position. • Measure the resistance between temperature blend door actuator C289, circuit 295 (LB/BK) and circuit 437 (YE/LG).  A0044539 • **Is the resistance between 4,000 and 5,000 ohms?**	**Yes** GO to N6 . **No** If the resistance is less than 5,000 ohms, GO to N4 . If the resistance is greater than 6,000 ohms, GO to N5 .
N4 CHECK CIRCUITS 295 (LB/BK) AND 437 (YE/LG) FOR A SHORT TOGETHER	
• Disconnect: Climate Control Switch C294c. • Measure the resistance between temperature blend door actuator C289, circuit 295 (LB/BK) and circuit 437 (YE/LG).	**Yes** REPAIR circuits 295 (LB/BK) and 437 (YE/LG) for a short together. TEST the system for normal

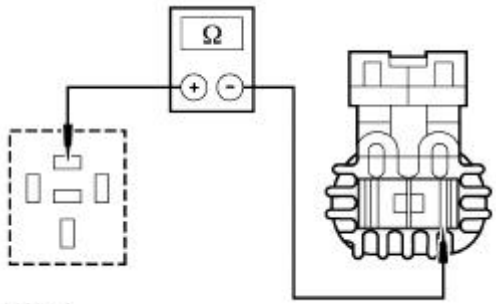
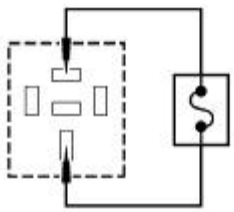
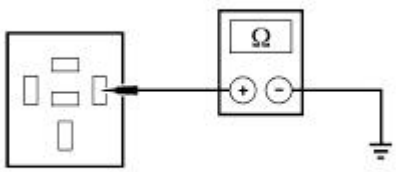
 A0044539 ● **Is the resistance less than 5 ohms?**	operation. **No** INSTALL a new climate control switch. REFER to Section 412-04 . TEST the system for normal operation.
N5 CHECK 437 (YE/LG) FOR OPEN	
● Disconnect: Climate Control Switch C294c. ● Measure the resistance between blend door actuator control connector C289, circuit 437 (YE/LG), harness side and the front A/C control head C294c, circuit 437 (YE/LG), harness side.  AM2154-A ● **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new climate control switch. REFER to Section 412-04 . TEST the system for normal operation. **No** REPAIR circuit 437 (YE/LG) for an open. TEST the system for normal operation.
N6 CHECK THE TEMPERATURE CONTROL POTENTIOMETER OPERATION	
● Measure the resistance between temperature blend door actuator C289, circuit 295 (LB/BK) and circuit 437 (YE/LG) while rotating the temperature control potentiometer from full WARM to full COOL.  A0044541 ● **Does the resistance vary between 250 and 5,500 ohms?**	**Yes** GO to N7 . **No** INSTALL a new climate control switch. TEST the system for normal operation.
N7 CHECK CIRCUIT 437 (YE/LG) FOR A SHORT TO GROUND	
● Disconnect: Climate Control Switch C294c. ● Measure the resistance between blend door actuator C289, circuit 437 (YE/LG) and ground.	**Yes** GO to N8 . **No** REPAIR circuit 437 (YE/LG) for a short to ground. TEST the system for normal

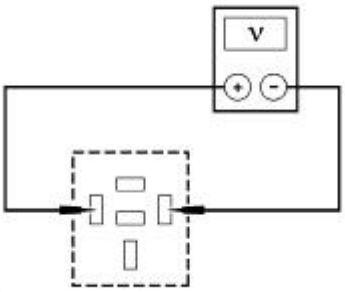
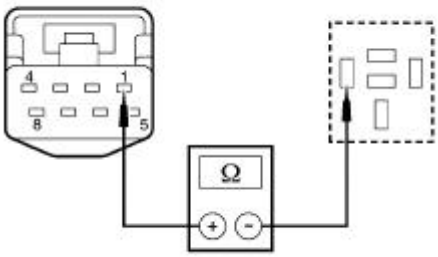
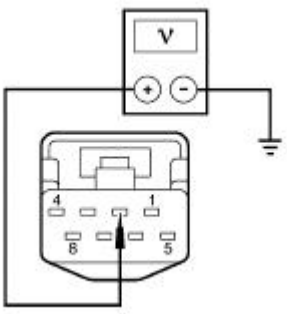
 A0044542 ● **Is the resistance greater than 10,000 ohms?**	operation.
N8 CHECK FOR A BINDING, STUCK OR BROKEN BLEND DOOR	
● Key in OFF position. ● Remove the actuator. Refer to Section 412-04 . ● Inspect for a binding, stuck or broken blend door or linkage. ● **Is there a binding, stuck or broken blend door or linkage condition?**	**Yes** REPAIR the blend door/linkage. REFER to Section 412-04 . TEST the system for normal operation. **No** INSTALL a new temperature blend door actuator. REFER to Section 412-04 . TEST the system for normal operation.

PINPOINT TEST O: THE BLOWER MOTOR IS INOPERATIVE — MANUAL CLIMATE CONTROL

Test Step	Result / Action to Take
O1 CHECK CIRCUIT 261 (OG/BK)	
● Disconnect: Blower Motor C288. ● Turn the blower motor switch to the HIGH position. ● Measure the resistance between the A/C blower motor connector C288, circuit 261 (OG/BK) and ground.  AM0420-A ● **Is the resistance less than 5 ohms?**	**Yes** GO to O4 . **No** GO to O2 .
O2 CHECK CIRCUIT 261 (OG/BK)	
● Disconnect: Blower Motor Switch C294a. ● Measure the resistance between the blower motor switch C294a, circuit 261 (OG/BK) and blower motor C288, circuit 261 (OG/BK).	**Yes** GO to O3 . **No** REPAIR circuit 261

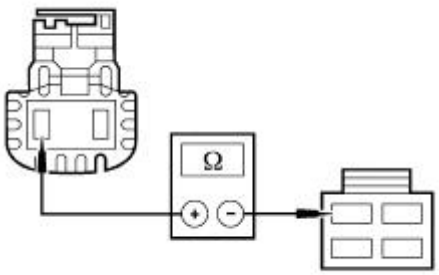
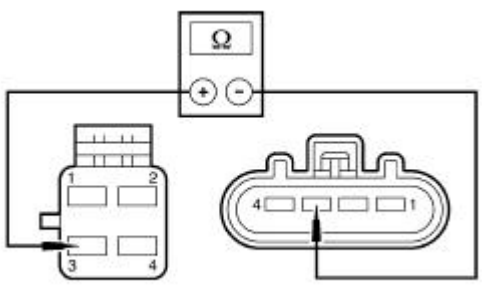
 A0040183 ● **Is the resistance less than 5 ohms?**	(OG/BK). TEST the system for normal operation.
O3 CHECK CIRCUIT 57 (BK) ● Measure the resistance between the blower motor switch C294a, circuit 57 (BK) and ground.  A0040182 ● **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new blower motor switch. REFER to Section 412-04 . TEST the system for normal operation. **No** REPAIR circuit 57 (BK). TEST the system for normal operation.
O4 CHECK A/C BLOWER MOTOR CIRCUIT 399 (BN/YE) FOR VOLTAGE ● Key in ON position. ● Measure the voltage between the A/C blower motor connector C288, circuit 399 (BN/YE) and ground.  AM0416-A ● **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new blower motor. REFER to Section 412-04 . TEST the system for normal operation. **No** GO to O5 .
O5 CHECK CIRCUIT 399 (BN/YE) ● Key in OFF position. ● Disconnect: Blower Motor Relay. ● Measure the resistance between the blower motor relay connector pin 87, circuit 399 (BN/YE) and the blower motor C288, circuit 399 (BN/YE).	**Yes** GO to O6 . **No** REPAIR circuit 399 (BN/YE). TEST the system for normal operation.

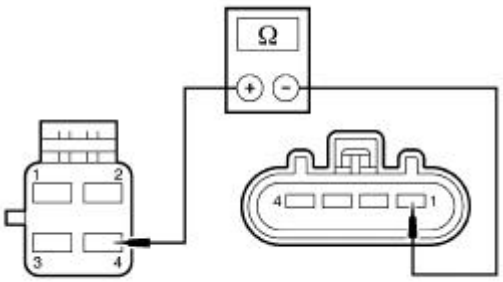
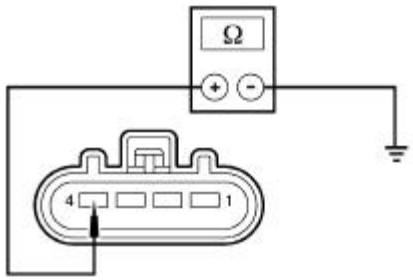
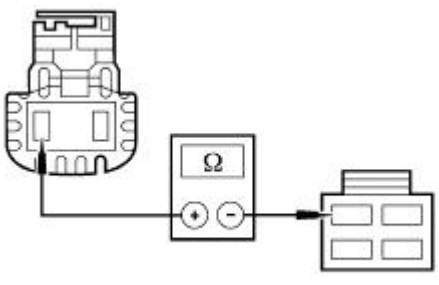
 A0032572 ● **Is the resistance less than 5 ohms?**	
O6 CHECK THE BLOWER MOTOR RELAY ● Connect: Blower Motor C288. ● Key in ON position. ● Connect a fused jumper lead between the blower motor relay socket pin 30 and pin 87, circuit 399 (BN/YE).  A0032587 ● **Does the blower motor operate?**	**Yes** GO to O7 . **No** REPAIR the relay power circuit. TEST the system for normal operation.
O7 CHECK CIRCUIT 57 (BK) ● Key in OFF position. ● Measure the resistance between the blower motor relay socket pin 86, circuit 57 (BK) and ground.  A0042416 ● **Is the resistance less than 5 ohms?**	**Yes** GO to O8 . **No** REPAIR circuit 57 (BK). TEST the system for normal operation.
O8 CHECK THE BLOWER MOTOR RELAY ● Key in ON position. ● Measure the voltage between the blower motor relay socket pin 85, circuit 753 (YE/RD) and socket pin 86, circuit 57 (BK).	**Yes** INSTALL a new blower motor relay. TEST the system for normal operation. **No** GO to O9 .

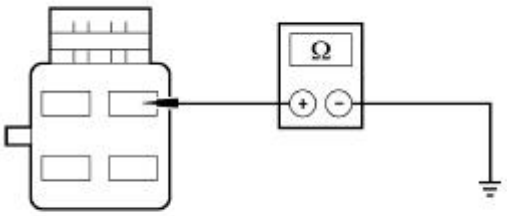
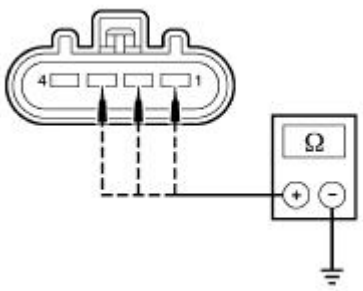
 A0038291 ● **Is the voltage greater than 10 volts?**	
O9 CHECK CIRCUIT 753 (YE/RD)	**Yes** GO to O10 . **No** REPAIR circuit 753 (YE/RD). TEST the system for normal operation.
● Key in OFF position. ● Measure the resistance between the blower motor relay connector pin 85, circuit 753 (YE/RD) and the function selector switch C294b-1, circuit 753 (YE/RD).  A0047091 ● **Is the resistance less than 5 ohms?**	
O10 CHECK CIRCUIT 296 (WH/VT) FOR VOLTAGE	**Yes** INSTALL a new function selector switch. REFER to Section 412-04 . TEST the system for normal operation. **No** REPAIR circuit 296 (WH/VT). TEST the system for normal operation.
● Key in ON position. ● Measure the voltage between the blower motor switch C294b, circuit 296 (WH/VT) and ground.  A0032574 ● **Is the voltage greater than 10 volts?**	

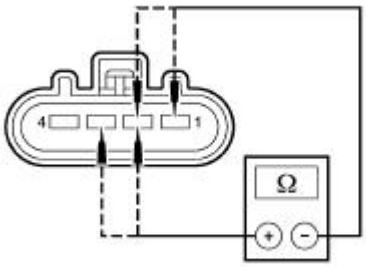
PINPOINT TEST P: THE BLOWER MOTOR DOES NOT OPERATE CORRECTLY — MANUAL CLIMATE CONTROL

Test Step	Result / Action to Take
P1 CHECK THE BLOWER MOTOR OPERATION	**Yes** If the blower motor does not operate in HI, GO to
● Key in ON position. ● Turn the function selector switch to the FLOOR position.	

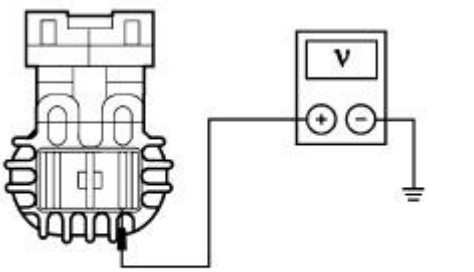
 L10572-A ● Select all blower speed positions. ● **Does the blower motor operate in any position?**	P2 . If the blower motor does not operate in MED-HI, GO to P3 . If the blower motor does not operate in MED-LO, GO to P4 . If the blower motor does not operate in LO, GO to P5 . For all other symptoms, , GO to P9 . **No** Go To Pinpoint Test N .
P2 CHECK CIRCUIT 261 (OG/BK)	
● Key in OFF position. ● Disconnect: Blower Motor Switch C294a. ● Disconnect: Blower Motor C288. ● Measure the resistance between the blower motor switch C294a, circuit 261 (OG/BK) and the blower motor C288, circuit 261 (OG/BK).  A0040183 ● **Is the resistance less than 5 ohms?**	**Yes** GO to P7 . **No** REPAIR circuit 261 (OG/BK). TEST the system for normal operation.
P3 CHECK CIRCUIT 752 (YE/RD)	
● Key in OFF position. ● Disconnect: Blower Motor Switch C294a. ● Disconnect: Blower Motor Resistor C2185. ● Measure the resistance between the blower motor switch C294a, circuit 752 (YE/RD) and the blower motor Resistor C2185, circuit 752 (YE/RD).  A0035322 ● **Is the resistance less than 5 ohms?**	**Yes** GO to P4 . **No** REPAIR circuit 752 (YE/RD). TEST the system for normal operation.
P4 CHECK CIRCUIT 754 (LG/WH)	

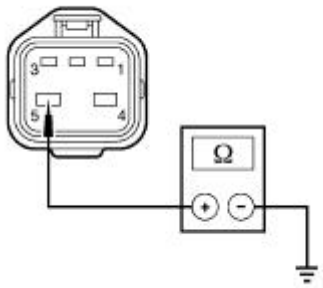
• Key in OFF position. • Disconnect: Blower Motor Switch C294a. • Disconnect: Blower Motor Resistor C2185. • Measure the resistance between the blower motor switch C294a, circuit 754 (LG/WH) and the blower motor Resistor C2185, circuit 754 (LG/WH).  A0035325 • **Is the resistance less than 5 ohms?**	**Yes** GO to P5 . **No** REPAIR circuit 754 (LG/WH). TEST the system for normal operation.
P5 CHECK BLOWER MOTOR RESISTOR GROUND CIRCUIT 57 (BK)	
 A0035320 • Measure the resistance between the blower motor resistor C2185, circuit 57 (BK) and ground. • **Is the resistance less than 5 ohms?**	**Yes** GO to P6 . **No** REPAIR circuit 57 (BK). TEST the system for normal operation.
P6 CHECK THE BLOWER MOTOR RESISTOR CIRCUIT 261 (OG/BK)	
• Connect: Blower Motor C288. • Measure the resistance between the blower motor resistor C2185, circuit 261 (OG/BK) and blower motor C288, circuit 261 (OG/BK).  A0040183 • **Is the resistance less than 5 ohms?**	**Yes** GO to P7 . **No** REPAIR circuit 261 (OG/BK). TEST the system for normal operation.
P7 CHECK THE BLOWER MOTOR SWITCH CIRCUIT 57 (BK)	
• Measure the resistance between the blower motor switch C294a, circuit 57 (BK) and ground.	**Yes** GO to P8 .

 A0020414 ● **Is the resistance less than 5 ohms?**	**No** REPAIR circuit 57 (BK). TEST the system for normal operation.
P8 CHECK THE BLOWER MOTOR RESISTOR	
● Carry out the blower motor resistor component test in this section. ● **Does the blower motor resistor test good?**	**Yes** INSTALL a new blower motor switch. REFER to Section 412-04 . TEST the system for normal operation. **No** INSTALL a new blower motor resistor. REFER to Section 412-04 . TEST the system for normal operation.
P9 CHECK CIRCUITS 261 (OG/BK), 752 (YE/RD) AND 754 (LG/WH) FOR A SHORT TO GROUND	
● Key in OFF position. ● Disconnect: Blower Motor C288. ● Disconnect: Blower Motor Resistor C2185. ● Place the blower switch in the lowest setting. ● Measure the resistance between ground and the blower motor resistor C1308, circuit: ● 261 (OG/BK) pin 2 ● 752 (YE/RD) pin 3 ● 754 (LG/WH) pin 1  A0051664 ● **Are the resistances less than 5 ohms?**	**Yes** GO to P10 . **No** REPAIR the affected circuit. TEST the system for normal operation.
P10 CHECK THE BLOWER MOTOR CIRCUITS FOR SHORTS TOGETHER	
● Measure the resistance between the blower motor resistor C2185: ■ pin 1, circuit 754 (LG/WH) and pin 2, circuit 261 (OG/BK). ■ pin 1, circuit 754 (LG/WH) and pin 3, circuit 752 (YE/RD).	**Yes** INSTALL a new blower motor switch. REFER to Section 412-04 . TEST the system for normal operation.

■ pin 2, circuit 261 (OG/BK) and pin 3, circuit 752 (YE/RD).  A0051665 ● **Are the resistances greater than 10,000 ohms?**	**No** REPAIR the affected circuits. TEST the system for normal operation.

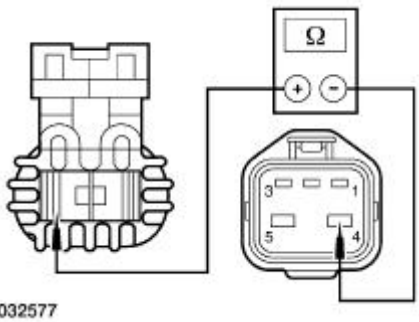
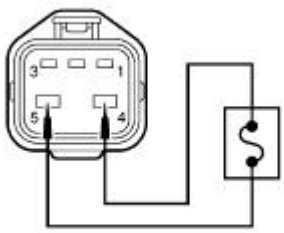
PINPOINT TEST Q: THE BLOWER MOTOR IS INOPERATIVE — DATC/EATC

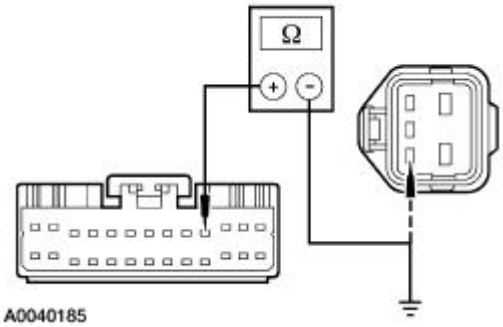
Test Step	Result / Action to Take
Q1 VERIFY THE BLOWER MOTOR OPERATION	
● Key in ON position. ● Press the PANEL button on the DATC/EATC module. Adjust the blower motor setting to LO and then to HI. ● **Is the blower motor inoperative in all settings?**	**Yes** GO to Q2 . **No** Go To Pinpoint Test S .
Q2 CHECK FOR VOLTAGE TO THE BLOWER MOTOR	
● Key in OFF position. ● Disconnect: Blower Motor C288. ● Key in ON position. ● Measure the voltage between the blower motor C288, circuit 399 (BN/YE) and ground.  AM0416-A ● **Is the voltage greater than 10 volts?**	**Yes** GO to Q3 . **No** GO to Q8 .
Q3 CHECK CIRCUIT 57 (BK)	
● Key in OFF position. ● Disconnect: Blower Motor Speed Control C297. ● Measure the resistance between the blower motor speed control C297-5, circuit 57 (BK) and ground.	**Yes** GO to Q4 . **No** REPAIR circuit 57 (BK). TEST the system for normal operation.



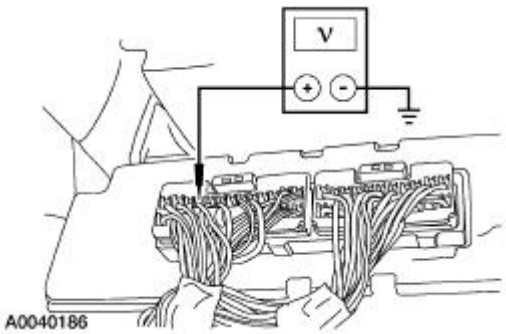
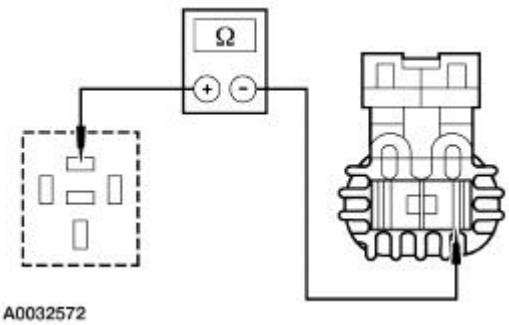
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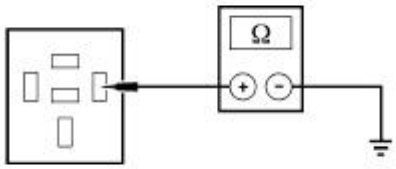
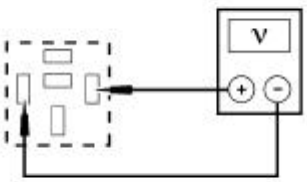
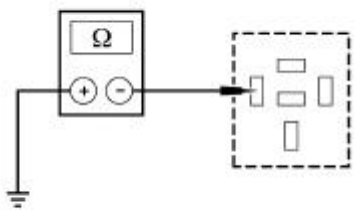
- **Is the resistance less than 5 ohms?**

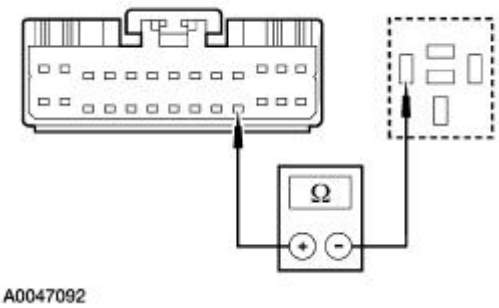
Q4 CHECK CIRCUIT 755 (BN/WH)	
• Measure the resistance between the blower motor C288, circuit 755 (BN/WH) and the blower motor speed control C297-4, circuit 755 (BN/WH).  A0032577 • **Is the resistance less than 5 ohms?**	**Yes** GO to Q5 . **No** REPAIR circuit 755 (BN/WH). TEST the system for normal operation.
Q5 CHECK THE BLOWER MOTOR	
• Connect: Blower Motor C288. • Connect a fused jumper lead between the blower motor speed control C297-4, circuit 755 (BN/WH) and C297-5, circuit 57 (BK).  A0032579 • Key in ON position. • **Does the blower motor operate?**	**Yes** GO to Q6 . **No** INSTALL a new blower motor. TEST the system for normal operation.
Q6 CHECK CIRCUIT 757 (RD/WH) FOR AN OPEN OR SHORT TO GROUND	
• Key in OFF position. • Removed the fused jumper lead from the blower motor speed control C297. • Disconnect: DATC/EATC Module C228a. • Measure the resistance between the DATC/EATC module C228a-10, circuit 757 (RD/WH) and the blower motor speed control C297-3, circuit 757 (RD/WH), and measure the resistance between the DATC/EATC module C228a-10, circuit 757 (RD/WH) and ground.	**Yes** GO to Q7 . **No** REPAIR circuit 757 (RD/WH). TEST the system for normal operation.



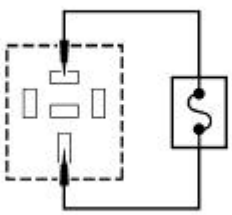
- **Is the resistance less than 5 ohms between the DATC/EATC module and the blower motor speed control and greater than 10,000 ohms between the DATC/EATC module and ground?**

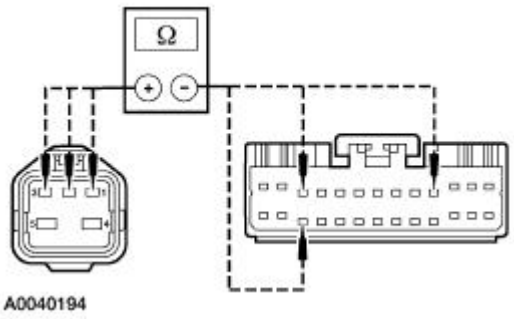
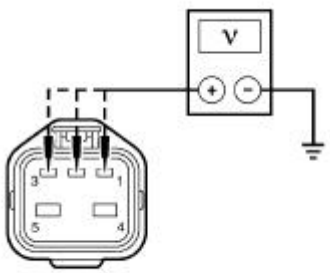
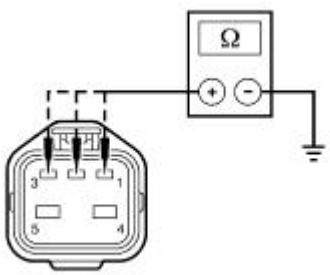
Q7 CHECK THE DATC/EATC MODULE OUTPUT	
• Connect: DATC/EATC Module C228a. • Connect: Blower Motor Speed Control C297. • Key in ON position. • Adjust the blower motor speed to HI. • Measure the voltage between the DATC/EATC module C228a-10, circuit 757 (RD/WH) and ground by back-probing the DATC/EATC module C228a.  • **Is the voltage within 2 volts of battery voltage?**	**Yes** INSTALL a new blower motor speed control. TEST the system for normal operation. **No** INSTALL a new DATC/EATC module. TEST the system for normal operation.
Q8 CHECK CIRCUIT 399 (BN/YE)	
• Key in OFF position. • Disconnect: Blower Motor Relay. • Measure the resistance between the blower motor relay socket pin 87, circuit 399 (BN/YE) and the blower motor C288, circuit 399 (BN/YE).  • **Is the resistance less than 5 ohms?**	**Yes** GO to Q9 . **No** REPAIR circuit 399 (BN/YE). TEST the system for normal operation.
Q9 CHECK CIRCUIT 57 (BK)	
• Measure the resistance between the blower motor relay socket pin 86, circuit 57 (BK) and ground.	**Yes** GO to Q10 . **No**

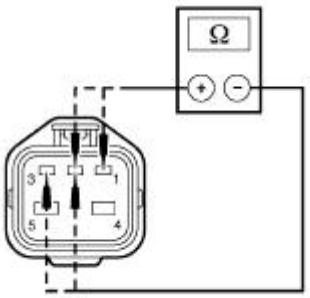
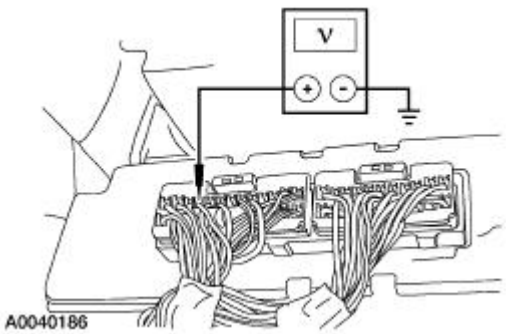
 A0042416 ● **Is the resistance less than 5 ohms?**	REPAIR circuit 57 (BK). TEST the system for normal operation.
Q10 CHECK THE DATC/EATC MODULE OUTPUT	
● Key in ON position. ● Measure the voltage between the blower motor relay socket pin 86, circuit 57 (BK) and socket pin 85, circuit 461 (OG).  A0034149 ● **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new blower motor relay. TEST the system for normal operation. **No** GO to Q11 .
Q11 CHECK CIRCUIT 461 (OG) FOR SHORT TO GROUND	
● Key in OFF position. ● Disconnect: DATC/EATC Module C228a. ● Key in ON position. ● Measure the resistance between the blower motor relay socket pin 85, circuit 461 (OG) and ground.  A0013869 ● **Is the resistance greater than 10,000 ohms?**	**Yes** GO to Q12 . **No** REPAIR circuit 461 (OG). TEST the system for normal operation.
Q12 CHECK CIRCUIT 461 (OG)	
● Measure the resistance between the DATC/EATC module C228a-23, circuit 461 (OG) and the blower motor relay socket pin 85, circuit 461 (OG).	**Yes** INSTALL a new DATC/EATC module. TEST the system for normal operation. **No** REPAIR circuit 461 (OG). TEST the

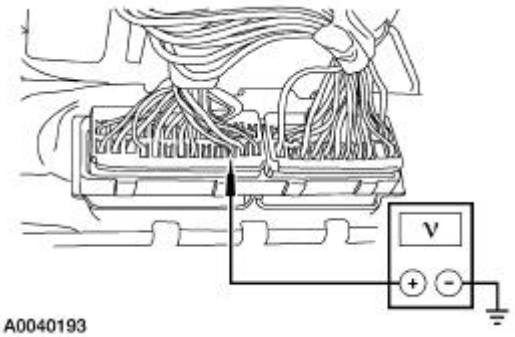
 A0047092 ● **Is the resistance less than 5 ohms?**	system for normal operation.

PINPOINT TEST R: THE BLOWER MOTOR DOES NOT OPERATE CORRECTLY —DATC/ EATC

Test Step	Result / Action to Take
R1 CHECK CIRCUIT 755 (BN/WH) FOR A SHORT TO GROUND ● Key in OFF position. ● Disconnect: Blower Motor Speed Control C297. ● Key in ON position. ● Press the PANEL button on the DATC/EATC module. Adjust the blower motor setting to LO and then to HI. ● **Does the blower motor operate?**	**Yes** REPAIR circuit 755 (BN/WH) for a short to ground. TEST the system for normal operation. **No** GO to R2 .
R2 CHECK THE BLOWER MOTOR SPEED CONTROL ● Key in OFF position. ● Connect: Blower Motor Speed Control C297. ● Disconnect: DATC/EATC Module C228a. ● Disconnect: Blower Motor Relay. ● Connect a fused jumper lead between the blower motor relay socket pin 30 and pin 87, circuit 399 (BN/YE).  A0032587 ● **Does the blower motor operate?**	**Yes** INSTALL a new blower motor speed control module. TEST the system for normal operation. **No** GO to R3 .
R3 CHECK THE BLOWER MOTOR SPEED CONTROL CIRCUITS FOR AN OPEN ● Key in OFF position. ● Connect: Blower Motor Relay. ● Disconnect: Blower Motor Speed Control C297. ● Measure the resistance between the blower motor speed control C297: ■ pin 1, circuit 184 (TN/OG) and the DATC/EATC module C228a-3, circuit 184 (TN/OG). ■ pin 2, circuit 758 (VT/WH) and the DATC/EATC module	**Yes** GO to R4 . **No** REPAIR the affected circuit. TEST the system for normal operation.

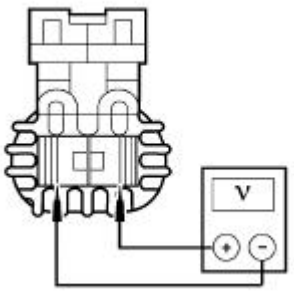
C228a-16, circuit 758 (VT/WH). ■ pin 3, circuit 757 (RD/WH) and the DATC/EATC module C228a-10, circuit 757 (RD/WH).  A0040194 ● **Are the resistances less than 5 ohms?**	
R4 CHECK THE BLOWER MOTOR SPEED CONTROL CIRCUITS FOR A SHORT TO VOLTAGE ● Key in ON position. ● Measure the voltage between the blower motor speed control C297 ■ pin 1, circuit 184 (TN/OG) and ground. ■ pin 2, circuit 758 (VT/WH) and ground. ■ pin 3, circuit 757 (RD/WH) and ground.  A0033862 ● **Is voltage present?**	**Yes** REPAIR the affected circuit. TEST the system for normal operation. **No** GO to R5 .
R5 CHECK THE BLOWER MOTOR SPEED CONTROL CIRCUITS FOR A SHORT TO GROUND ● Key in OFF position. ● Measure the resistance between the blower motor speed control C297: ■ pin 1, circuit 184 (TN/OG) and ground. ■ pin 2, circuit 758 (VT/WH) and ground. ■ pin 3, circuit 757 (RD/WH) and ground.  A0033863 ● **Are the resistances greater than 10,000 ohms?**	**Yes** GO to R6 . **No** REPAIR the affected circuit. TEST the system for normal operation.

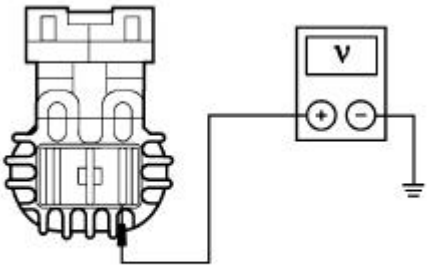
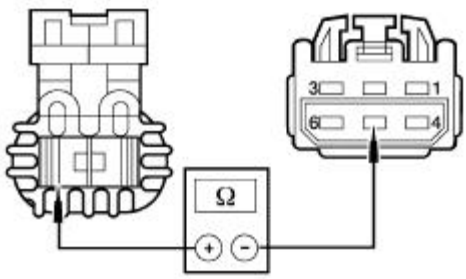
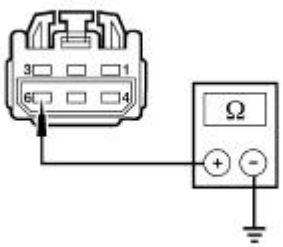
R6 CHECK THE BLOWER MOTOR SPEED CONTROL CIRCUITS FOR SHORTS	
• Measure the resistance between the blower motor speed control C297: ▪ pin 1, circuit 184 (TN/OG) and pin 2, circuit 758 (VT/WH). ▪ pin 1, circuit 184 (TN/OG) and pin 3, circuit 757 (RD/WH). ▪ pin 2, circuit 758 (VT/WH) and pin 3, circuit 757 (RD/WH).  A0033864 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to R7 . **No** REPAIR the affected circuits. TEST the system for normal operation.
R7 CHECK THE DATC/EATC MODULE HIGH BLOWER OUTPUT	
• Connect: DATC/EATC C228a. • Connect: Blower Motor Speed Control C297. • Key in ON position. • Adjust the blower motor speed to HI. • Measure the voltage between the DATC/EATC module C228a-10, circuit 757 (RD/WH) and ground by back-probing the DATC/EATC module C228a.  A0040186 • **Is the voltage within 2 volts of battery voltage?**	**Yes** GO to R8 . **No** INSTALL a new DATC/EATC module. TEST the system for normal operation.
R8 CHECK THE DATC/EATC MODULE BLOWER CONTROL OUTPUT	
• Adjust the blower motor speed to LO. • Measure the voltage between the DATC/EATC module C228a-16, circuit 758 (VT/WH) and ground by back-probing the DATC/EATC module C228a.	**Yes** INSTALL a new blower motor speed control. TEST the system for normal operation. **No** INSTALL a new DATC/EATC module. TEST the system for normal operation.

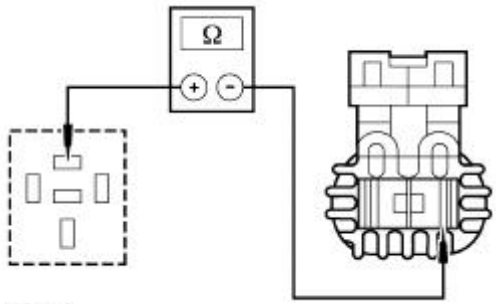
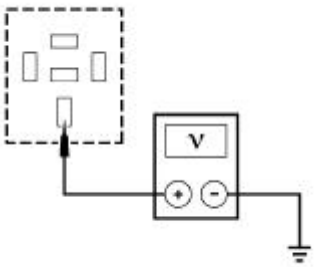
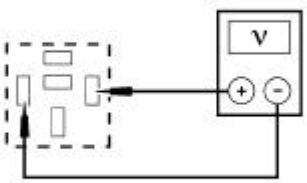


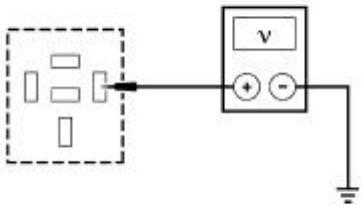
- **Is the voltage greater than 1 volt?**

PINPOINT TEST S: THE AUXILIARY BLOWER MOTOR IS INOPERATIVE

Test Step	Result / Action to Take
NOTE: On vehicles with manual climate control, the auxiliary blower motor is enabled only when the ignition switch is ON and the function selector switch is in any setting except OFF. On vehicles with DATC/EATC the auxiliary blower motor is enabled when the ignition switch is ON, regardless of the DATC/EATC module setting.	
S1 CHECK FOR VOLTAGE AND GROUND TO THE AUXILIARY BLOWER MOTOR • Key in OFF position. • Disconnect: Auxiliary Blower Motor C4106. • **NOTE:** Manual climate control only. • Turn the function selector switch to the FLOOR position.  • Place the front auxiliary blower motor switch to HI. • Key in ON position. • Measure the voltage between the auxiliary blower motor C4106, circuit 536 (BK/LG) and circuit 515 (OG/RD).  • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new auxiliary blower motor. TEST the system for normal operation. **No** GO to S2 .

S2 CHECK FOR VOLTAGE TO THE AUXILIARY BLOWER MOTOR ● Measure the voltage between the auxiliary blower motor C4106, circuit 536 (BK/LG) and ground.  AM0416-A ● **Is the voltage greater than 10 volts?**	**Yes** GO to S3 . **No** GO to S5 .
S3 CHECK CIRCUIT 515 (OG/RD) ● Key in OFF position. ● Disconnect: Front Auxiliary Climate Control Assembly C989a-5. ● Measure the resistance between the front auxiliary climate control assembly C989a-5, circuit 515 (OG/RD) and the auxiliary blower motor C4106, circuit 515 (OG/RD).  A0046460 ● **Is the resistance less than 5 ohms?**	**Yes** GO to S4 . **No** REPAIR circuit 515 (OG/RD). TEST the system for normal operation.
S4 CHECK CIRCUIT 57 (BK) ● Measure the resistance between the front auxiliary climate control assembly C989a-6, circuit 57 (BK) and ground.  A0046461 ● **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new front auxiliary climate control assembly. TEST the system for normal operation. **No** REPAIR circuit 57 (BK). TEST the system for normal operation.
S5 CHECK CIRCUIT 536 (BK/LG) ● Key in OFF position. ● Disconnect: Auxiliary Blower Motor Relay. ● Measure the resistance between the auxiliary blower motor relay socket pin 87, circuit 536 (BK/LG) and the auxiliary blower motor C4106, circuit 536 (BK/LG).	**Yes** GO to S6 . **No** REPAIR circuit 536 (BK/LG). TEST the system for normal operation.

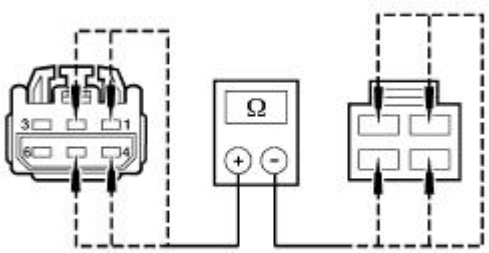
 A0032572 ● **Is the resistance less than 5 ohms?**	
S6 CHECK CIRCUIT 371 (PK/WH)	
● Measure the voltage between the auxiliary blower motor relay socket pin 30, circuit 371 (PK/WH) and ground.  A0032573 ● **Is the voltage greater than 10 volts?**	**Yes** GO to S7 . **No** REPAIR circuit 371 (PK/WH). TEST the system for normal operation.
S7 CHECK THE AUXILIARY BLOWER MOTOR RELAY	
● Key in ON position. ● Measure the voltage between the auxiliary blower motor relay socket pin 85, DATC/EATC circuit 462 (VT), manual climate control circuit 753 (YE/RD) and socket pin 86, circuit 57 (BK).  A0034149 ● **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new auxiliary blower motor relay. TEST the system for normal operation. **No** GO to S8 .
S8 CHECK CIRCUIT 462 (VT) OR 753 (YE/RD)	
● Measure the voltage between the auxiliary blower motor relay C3023 socket pin 85, DATC/EATC circuit 462 (VT), manual climate control circuit 753 (YE/RD) and ground.	**Yes** REPAIR circuit 57 (BK). TEST the system for normal operation. **No** REPAIR circuit 462 (VT) or 753 (YE/RD). TEST the system for normal operation.

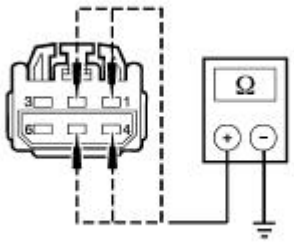
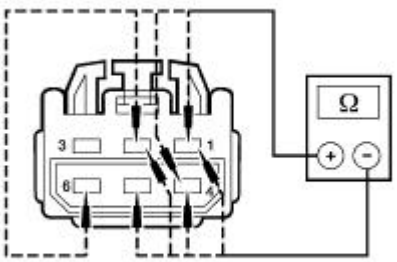


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- **Is the voltage greater than 10 volts?**

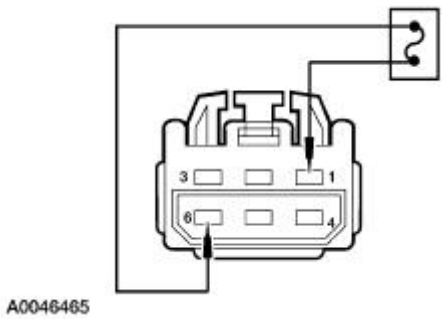
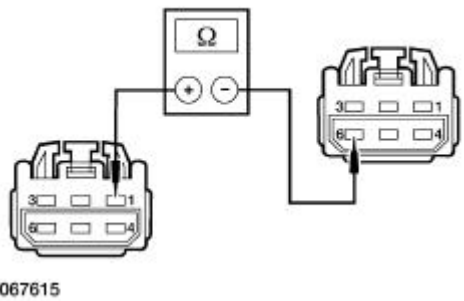
PINPOINT TEST T: THE AUXILIARY BLOWER MOTOR DOES NOT OPERATE CORRECTLY USING THE FRONT AUXILIARY CLIMATE CONTROLS

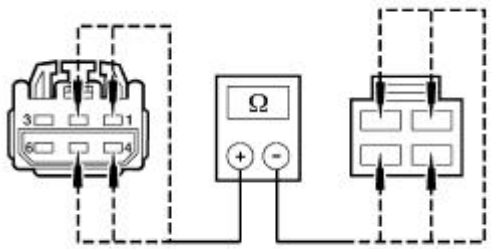
Test Step	Result / Action to Take
T1 CHECK THE AUXILIARY BLOWER MOTOR CIRCUITS FOR AN OPEN	
• Disconnect: Auxiliary Blower Motor Resistor C4107. • Disconnect: Front Auxiliary Climate Control Assembly C989a. • Measure the resistance between the rear auxiliary climate control assembly C3198a and the auxiliary blower motor resistor C4107 as follows: C989a / C4107 / Circuit: Pin 2 / Pin 3 / 269 (LB/OG) Pin 4 / Pin 1 / 751 (YE/RD) Pin 5 / Pin 2 / 515 (OG/RD) Pin 1 / Pin 4 / 756 (RD/PK) [a] [a] Only on vehicles equipped with a rear auxiliary climate control assembly.  A0046466 • **Are the resistances less than 5 ohms?**	**Yes** GO to T2 . **No** REPAIR the affected circuit(s). TEST the system for normal operation.
T2 CHECK THE AUXILIARY BLOWER MOTOR CIRCUITS FOR A SHORT TO GROUND	
• Measure the resistance between the auxiliary climate control assembly C989a: ■ pin 1, circuit 1120 (BK/WH) or circuit 756 (RD/PK) and ground. ■ pin 2, circuit 269 (LB/OG) and ground.	**Yes** GO to T3 . **No** REPAIR the affected

■ pin 4, circuit 751 (YE/RD) and ground. ■ pin 5, circuit 515 (OG/RD) and ground.  A0046464 ● **Are the resistances greater than 10,000 ohms?**	circuit(s). TEST the system for normal operation.
T3 CHECK THE AUXILIARY BLOWER MOTOR CIRCUITS FOR A SHORT	
● Measure the resistance between the auxiliary climate control assembly C989a: ■ pin 6, circuit 57 (BK) and pin 1, circuit 1120 (BK/WH) or circuit 756 (RD/PK). ■ pin 6, circuit 57 (BK) and pin 2, circuit 269 (LB/OG). ■ pin 6, circuit 57 (BK) and pin 4, circuit 751 (YE/RD). ■ pin 6, circuit 57 (BK) and pin 5, circuit 515 (OG/RD). ■ pin 1, circuit 1120 (BK/WH) or circuit 756 (RD/PK) and pin 2, circuit 269 (LB/OG). ■ pin 1, circuit 1120 (BK/WH) or circuit 756 (RD/PK) and pin 4, circuit 751 (YE/RD). ■ pin 1, circuit 1120 (BK/WH) or circuit 756 (RD/PK) and pin 5, circuit 515 (OG/RD). ■ pin 2, circuit 269 (LB/OG) and pin 4, circuit 751 (YE/RD). ■ pin 2, circuit 269 (LB/OG) and pin 5, circuit 515 (OG/RD). ■ pin 4, circuit 751 (YE/RD) and pin 5, circuit 515 (OG/RD).  A0046467 ● **Are the resistances greater than 10,000 ohms?**	**Yes** GO to T4 . **No** REPAIR the affected circuit(s). TEST the system for normal operation.
T4 CHECK THE AUXILIARY BLOWER MOTOR RESISTOR	
● Carry out the auxiliary blower motor resistor component test in this section. ● **Does the auxiliary blower motor resistor test good?**	**Yes** INSTALL a new front auxiliary climate control assembly. TEST the system for normal operation. **No** INSTALL a new blower

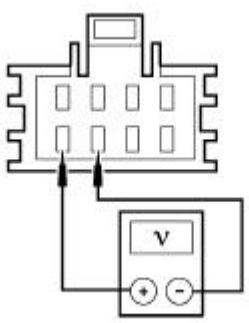
	motor resistor. REFER to Section 412-04 . TEST the system for normal operation.

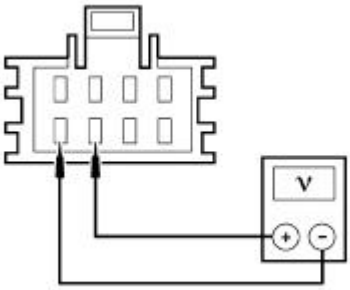
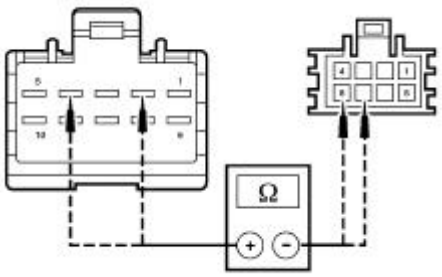
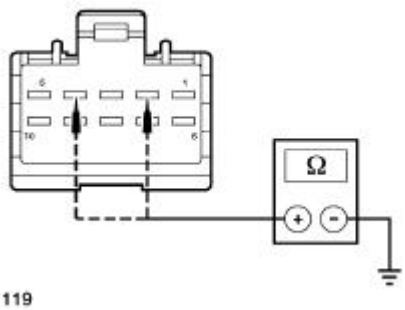
PINPOINT TEST U: THE AUXILIARY BLOWER MOTOR DOES NOT OPERATE CORRECTLY USING THE REAR AUXILIARY CLIMATE CONTROLS

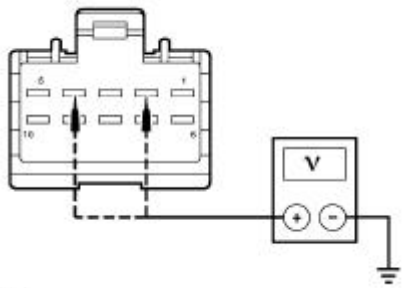
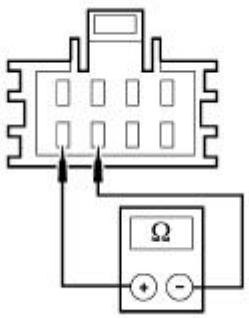
Test Step	Result / Action to Take
NOTE: Carry out this test only if the front auxiliary blower motor switch operates correctly in all settings except REAR.	
U1 BYPASS THE FRONT AUXILIARY CLIMATE CONTROL ASSEMBLY ● Key in OFF position. ● Disconnect: Front Auxiliary Climate Control Assembly C989a. ● Connect a fused jumper lead between the front auxiliary climate control assembly C989a-6, circuit 57 (BK) and C989a-1, circuit 1120 (BK/WH).  A0046465 ● Key in ON position. ● Check the auxiliary blower motor operation in each rear auxiliary blower motor switch position. ● **Does the rear auxiliary climate control assembly correctly operate the auxiliary blower motor?**	**Yes** INSTALL a new front auxiliary climate control assembly. TEST the system for normal operation. **No** GO to U2 .
U2 CHECK CIRCUIT 1120 (BK/WH) ● Key in OFF position. ● Disconnect: Rear Auxiliary Climate Control Assembly C3198a. ● Measure the resistance between the front auxiliary climate control assembly C989a-1, circuit 1120 (BK/WH) and the rear auxiliary climate control assembly C3198a-6, circuit 1120 (BK/WH).  A0067615 ● **Is the resistance less than 5 ohms?**	**Yes** GO to U3 . **No** REPAIR circuit 1120 (BK/WH). TEST the system for normal operation.
U3 CHECK THE AUXILIARY BLOWER MOTOR CIRCUITS FOR AN	

OPEN • Disconnect: Auxiliary Blower Motor Resistor C4107. • Measure the resistance between the rear auxiliary climate control assembly C3198a and the auxiliary blower motor resistor C4107 as follows: **C3198a** / **C4107** / **Circuit** Pin 1 / Pin 1 / 756 (RD/PK) Pin 2 / Pin 2 / 269 (LB/OG) Pin 4 / Pin 3 / 751 (YE/RD) Pin 5 / Pin 4 / 515 (OG/RD)  A0046466 • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new rear auxiliary climate control assembly. TEST the system for normal operation. **No** REPAIR the affected circuit(s). TEST the system for normal operation.

PINPOINT TEST V: THE PANEL/FLOOR CONTROL IS INOPERATIVE USING THE FRONT AUXILIARY CLIMATE CONTROLS

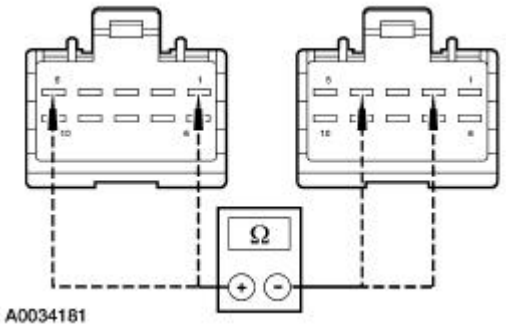
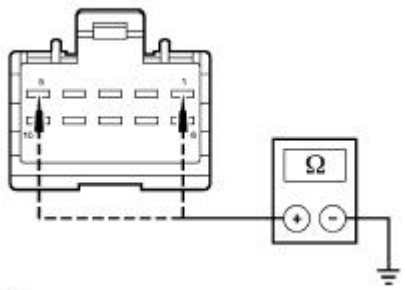
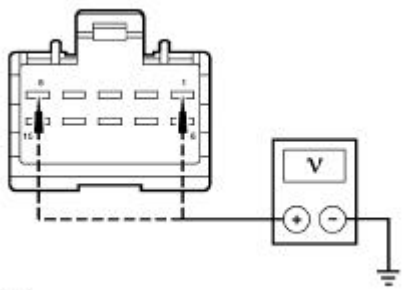
Test Step	Result / Action to Take
V1 CHECK THE FLOOR MODE OUTPUT • Disconnect: Air Distribution Door Actuator C3044. • Key in ON position. • Vehicles with manual climate control, place the function selector switch in FLOOR. • Place the front auxiliary blower motor switch in HI and set the front auxiliary climate control assembly to FLOOR. • Measure the voltage between the air distribution door actuator C3044-8, circuit 1131 (LG) and C3044-7, circuit 1137 (YE/LG).  A0051118 • **Is the voltage greater than 10 volts?**	**Yes** GO to V2 . **No** GO to V3 .
V2 CHECK THE PANEL MODE OUTPUT	

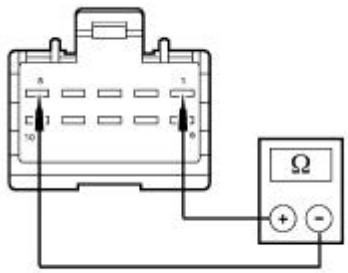
• Set the front auxiliary climate control assembly to PANEL. • Measure the voltage between the air distribution door actuator C3044-7, circuit 1137 (YE/LG) and C3044-8, circuit 1131 (LG).  A0051117 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new air distribution door actuator. TEST the system for normal operation. **No** GO to V3 .
V3 CHECK THE AIR DISTRIBUTION DOOR CIRCUITS	
• Key in OFF position. • Disconnect: Front Auxiliary Climate Control Assembly C989b. • Measure the resistance between the front auxiliary climate control assembly C989b-2, circuit 1131 (LG) and the air distribution door actuator C3044-7, circuit 1131 (LG), and between the front auxiliary climate control assembly C989b-4, circuit 1137 (YE/LG) and the air distribution door actuator C3044-8, circuit 1137 (YE/LG).  A0034159 • **Are the resistances less than 5 ohms?**	**Yes** GO to V4 . **No** REPAIR the affected circuit. TEST the system for normal operation.
V4 CHECK CIRCUIT 1131 (LG) AND CIRCUIT 1137 (YE/LG) FOR A SHORT TO GROUND	
• Measure the resistance between ground and the front auxiliary climate control assembly: • C989b-2, circuit 1131 (LG). • C989b-4, circuit 1137 (YE/LG).  A0051119 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to V5 . **No** REPAIR the affected circuit. TEST the system for normal operation.
V5 CHECK CIRCUIT 1131 (LG) AND CIRCUIT 1137 (YE/LG) FOR A SHORT TO VOLTAGE	
• Key in ON position.	**Yes**

• Measure the voltage between ground and the front auxiliary climate control assembly: • C989b-2, circuit 1131 (LG). • C989b-4, circuit 1137 (YE/LG).  A0051120 • **Is voltage present?**	GO to V6 . **No** REPAIR the affected circuit. TEST the system for normal operation.
V6 CHECK CIRCUIT 1137 (YE/LG) FOR A SHORT TO CIRCUIT 1131 (LG)	
• Key in OFF position. • Measure the resistance between the front auxiliary climate control assembly C989a-8, circuit 1137 (YE/LG) and C989a-7, circuit 1131 (LG).  A0051121 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new front auxiliary climate control assembly. TEST the system for normal operation. **No** REPAIR the affected circuit. TEST the system for normal operation.

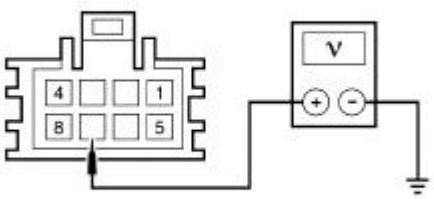
PINPOINT TEST W: THE PANEL/FLOOR CONTROL IS INOPERATIVE USING THE REAR AUXILIARY CLIMATE CONTROLS

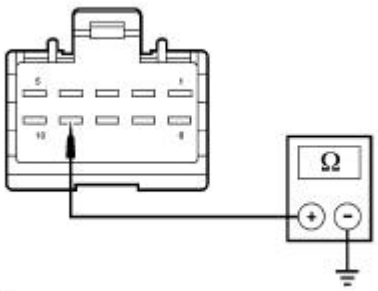
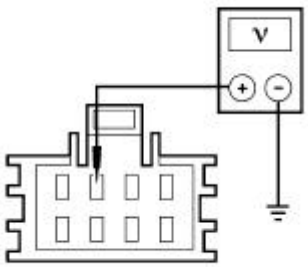
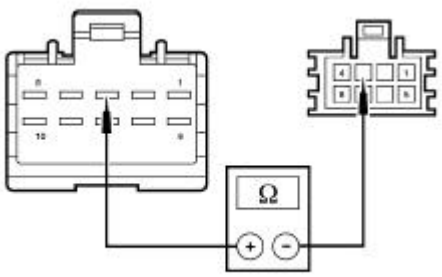
Test Step	Result / Action to Take
NOTE: Carry out this test only if the front auxiliary climate control assembly correctly operates the PANEL/FLOOR control.	
W1 CHECK THE AIR DISTRIBUTION DOOR CIRCUITS	
• Disconnect: Front Auxiliary Climate Control Assembly C989b. • Disconnect: Rear Auxiliary Climate Control Assembly C3198b. • Measure the resistance between the front auxiliary climate control assembly C989b-1, circuit 1129 (BN/WH) and the rear auxiliary climate control assembly C3198b-2, circuit 1129 (BN/WH), and between the front auxiliary climate control assembly C989b-5, circuit 1128 (GY/LB) and the rear auxiliary climate control assembly C3198b-4, circuit 1128 (GY/LB).	**Yes** GO to W2 . **No** REPAIR the affected circuit (s). TEST the system for normal operation.

 A0034181 ● **Are the resistances less than 5 ohms?**	
W2 CHECK CIRCUIT 1128 (GY/LB) AND CIRCUIT 1129 (BN/WH) FOR A SHORT TO GROUND	
● Measure the resistance between ground and the front auxiliary climate control assembly: ● C989b-5, circuit 1128 (GY/LB) ● C989b-1, circuit 1129 (BN/WH)  A0051122 ● **Is the resistance greater than 10,000 ohms?**	**Yes** GO to W3 . **No** REPAIR the affected circuit (s). TEST the system for normal operation.
W3 CHECK CIRCUIT 1128 (GY/LB) AND CIRCUIT 1129 (BN/WH) FOR A SHORT TO VOLTAGE	
● Key in ON position. ● Measure the voltage between ground and the front auxiliary climate control assembly: ● C989b-5, circuit 1128 (GY/LB) ● C989b-1, circuit 1129 (BN/WH)  A0051123 ● **Is voltage present?**	**Yes** GO to W4 . **No** REPAIR the affected circuit (s). TEST the system for normal operation.
W4 CHECK CIRCUIT 1128 (GY/LB) FOR A SHORT TO CIRCUIT 1129 (BN/WH)	
● Key in OFF position. ● Measure the voltage between the front auxiliary climate control assembly C989b-5, circuit 1128 (GY/LB) and C989b-1, circuit 1129 (BN/WH).	**Yes** GO to W5 . **No**

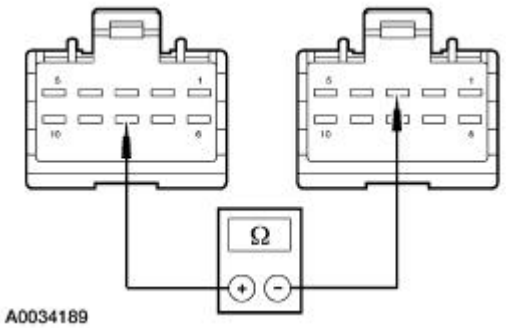
 A0051124 ● **Is the resistance greater than 10,000 ohms?**	REPAIR the affected circuit (s). TEST the system for normal operation.
W5 CHECK THE REAR AUXILIARY CLIMATE CONTROL ASSEMBLY	
● Carry out the rear auxiliary climate control assembly component test in this section. ● **Does the rear auxiliary climate control assembly test good?**	**Yes** INSTALL a new front auxiliary climate control assembly. TEST the system for normal operation. **No** INSTALL a new rear auxiliary climate control assembly. TEST the system for normal operation.

PINPOINT TEST X: THE TEMPERATURE CONTROL IS INOPERATIVE USING THE FRONT AUXILIARY CLIMATE CONTROLS

Test Step	Result / Action to Take
X1 CHECK VOLTAGE TO BLEND DOOR ACTUATOR	
● Disconnect: Auxiliary Temperature Blend Door Actuator C3004. ● Key in ON position. ● Measure the voltage between the auxiliary temperature blend door actuator C3004-7, circuit 294 (WH/LB) and ground.  A0032565 ● **Is the voltage greater than 10 volts?**	**Yes** GO to X2 . **No** REPAIR circuit 294 (WH/LB). TEST the system for normal operation.
X2 CHECK THE BLEND DOOR ACTUATOR GROUND CIRCUIT	

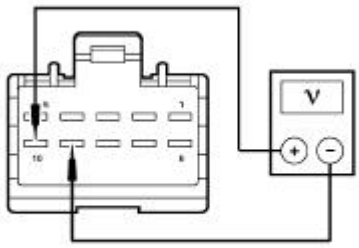
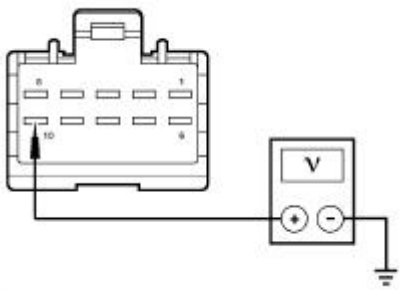
• Key in OFF position. • Measure the resistance between the front auxiliary climate control assembly C989b-9, circuit 57 (BK) and ground.  A0067614 • **Is the resistance less than 5 ohms?**	**Yes** GO to X3. **No** REPAIR circuit 57 (BK). TEST the system for normal operation.
X3 CHECK THE TEMPERATURE BLEND DOOR ACTUATOR SIGNAL	
• Key in ON position. • Place the front auxiliary blower motor switch in HI. • Measure the voltage between the auxiliary temperature blend door actuator C3004-3, circuit 1126 (LB) and ground. Rotate the temperature control switch to full COOL then to full WARM.  A0051126 • **Does the voltage vary from greater than 10 volts (full COOL) to less than 1 volt (full WARM)?**	**Yes** INSTALL a new auxiliary temperature blend door actuator. TEST the system for normal operation. **No** GO to X4.
X4 CHECK CIRCUIT 1126 (LB)	
• Key in OFF position. • Disconnect: Front Auxiliary Climate Control Assembly C989b. • Measure the resistance between the front auxiliary climate control assembly C989b-3, circuit 1126 (LB) and the auxiliary temperature blend door actuator C3004-3, circuit 1126 (LB).  A0034185 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new front auxiliary climate control assembly. TEST the system for normal operation. **No** REPAIR circuit 1126 (LB). TEST the system for normal operation.

PINPOINT TEST Y: THE TEMPERATURE CONTROL IS INOPERATIVE USING THE REAR AUXILIARY CLIMATE CONTROLS

Test Step	Result / Action to Take
NOTE: Carry out this test only if the front auxiliary climate control assembly temperature control operates correctly.	
Y1 CHECK CIRCUIT 1130 (PK/LG)	
• Disconnect: Front Auxiliary Climate Control Assembly C989b. • Disconnect: Rear Auxiliary Climate Control Assembly C3198b. • Measure the resistance between the front auxiliary climate control assembly C989b-8, circuit 1130 (PK/LG) and the rear auxiliary climate control assembly C3198b-3, circuit 1130 (PK/LG).  • **Is the resistance less than 5 ohms?**	**Yes** GO to Y2 . **No** REPAIR circuit 1130 (PK/LG). TEST the system for normal operation.
Y2 CHECK THE REAR AUXILIARY CLIMATE CONTROL ASSEMBLY	
• Carry out the rear auxiliary climate control assembly component test in this section. • **Does the rear auxiliary climate control assembly test good?**	**Yes** INSTALL a new front auxiliary climate control assembly. TEST the system for normal operation. **No** INSTALL a new rear auxiliary climate control assembly. TEST the system for normal operation.

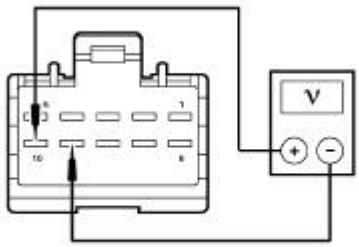
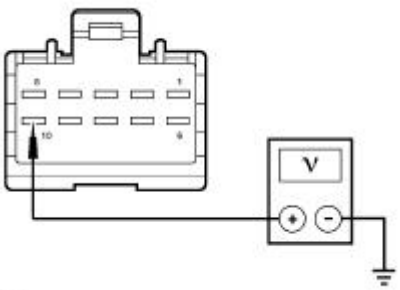
PINPOINT TEST Z: THE PANEL/FLOOR AND COOL/WARM CONTROLS ARE INOPERATIVE USING THE FRONT AUXILIARY CLIMATE CONTROLS

Test Step	Result / Action to Take
Z1 CHECK FOR VOLTAGE TO THE FRONT AUXILIARY CLIMATE CONTROL ASSEMBLY	
• Key in OFF position. • Vehicles with manual climate control, place the function selector switch in FLOOR. • Disconnect: Front Auxiliary Climate Control Assembly C989b. • Key in ON position. • Measure the voltage between the front auxiliary climate control assembly C989b-10, circuit 294 (WH/LB) and C989b-9, circuit 57 (BK).	**Yes** INSTALL a new front auxiliary climate control assembly. TEST the system for normal operation. **No** GO to Z2 .

 A0034192 ● **Is the voltage greater than 10 volts?**	
Z2 CHECK CIRCUIT 294 (WH/LB) ● Measure the voltage between the front auxiliary climate control assembly C989b-10, circuit 294 (WH/LB) and ground.  A0034193 ● **Is the voltage greater than 10 volts?**	**Yes** REPAIR circuit 57 (BK). TEST the system for normal operation. **No** REPAIR circuit 294 (WH/LB). TEST the system for normal operation.

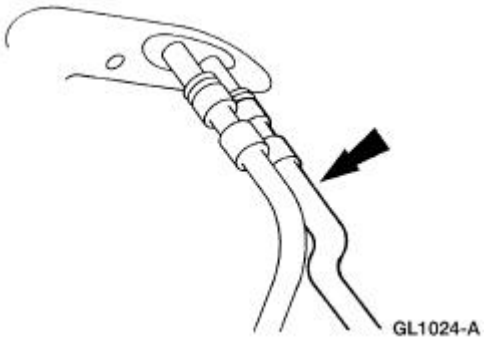
PINPOINT TEST AA: THE PANEL/FLOOR AND COOL/WARM CONTROLS ARE INOPERATIVE USING THE REAR AUXILIARY CONTROLS

Test Step	Result / Action to Take
NOTE: Carry out this test only if the front auxiliary climate control assembly correctly operates the PANEL/FLOOR and COOL/WARM controls.	
AA1 CHECK FOR VOLTAGE TO THE REAR AUXILIARY CLIMATE CONTROL ASSEMBLY ● Key in OFF position. ● Disconnect: Rear Auxiliary Climate Control Assembly C3198b. ● Key in ON position. ● **NOTE:** Manual climate control only. ● Turn the function selector switch to the FLOOR position. ● Place the front auxiliary climate control assembly in REAR. ● Measure the voltage between the rear auxiliary climate control assembly C3198b-10, circuit 243 (LG/OG) and C3198b-9, circuit 57 (BK).	**Yes** INSTALL a new rear auxiliary climate control assembly. TEST the system for normal operation. **No** GO to AA2 .

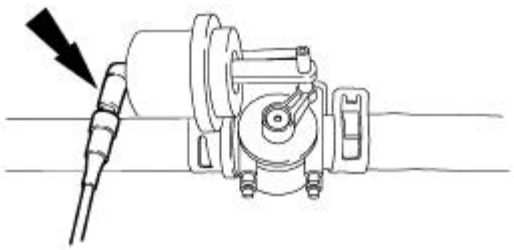
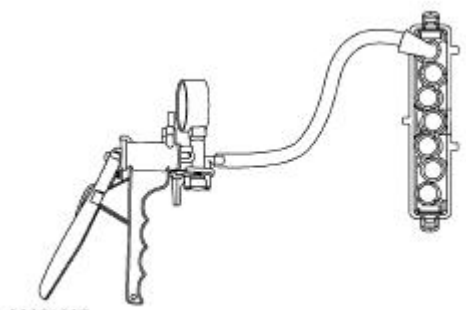
 A0034192 ● **Is the voltage greater than 10 volts?**	
AA2 CHECK CIRCUIT 243 (LG/OG)	
● Measure the voltage between the rear auxiliary climate control assembly C3198b-10, circuit 243 (LG/OG) and ground.  A0034193 ● **Is the voltage greater than 10 volts?**	**Yes** REPAIR circuit 57 (BK). TEST the system for normal operation. **No** REPAIR circuit 243 (LG/OG). TEST the system for normal operation.

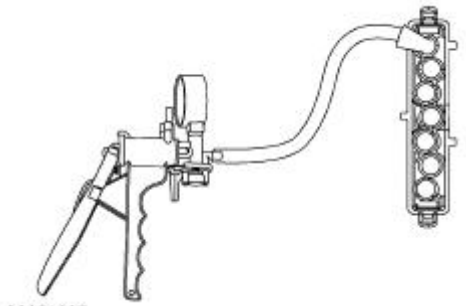
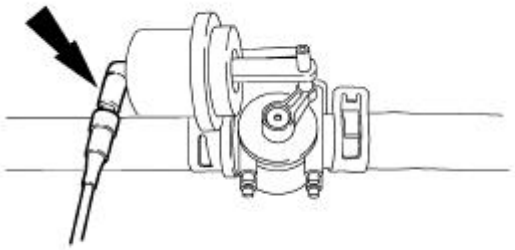
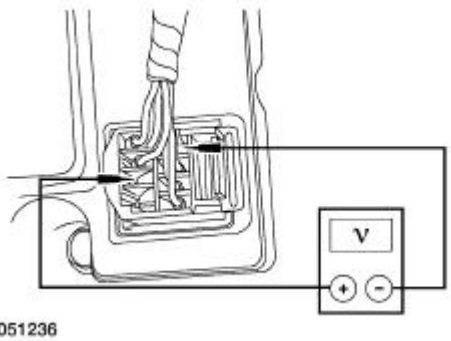
PINPOINT TEST AB: INSUFFICIENT AIR CONDITIONING (A/C) COOLING

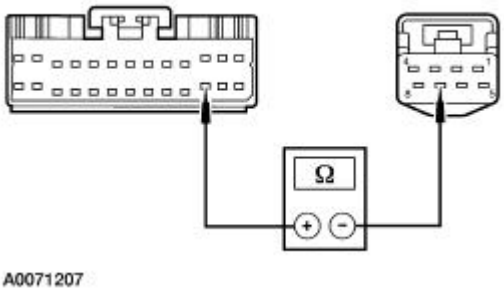
Test Step	Result / Action to Take
AB1 CHECK FOR COOLANT FLOW TO THE HEATER CORE	
WARNING: The heater core inlet hose will become too hot to handle and may cause serious burns if the system is working correctly. ● Key in START position. ● Run the engine until it reaches normal operation temperature. ● **NOTE:** Manual climate control only. ● Select the FLOOR position on the control assembly. Set the temperature control to full COOL. ● **NOTE:** DATC/EATC only. ● Press the PANEL, RECIRC and A/C buttons on the DATC/EATC module. Set the temperature control to full COOL. ● Feel the heater core inlet hose to see if it is hot.	**Yes** GO to AB2 . **No** Go to Refrigerant System Tests in this section.



- **Is the heater core inlet hose hot?**

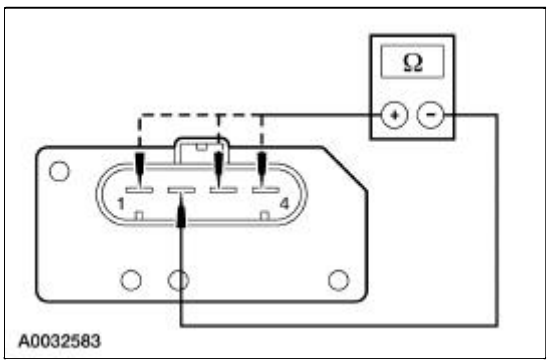
AB2 CHECK FOR VACUUM AT THE HEATER CONTROL VALVE	
• Disconnect the heater control valve vacuum connector and check for vacuum.  A0035187 • **Is vacuum present at the heater control valve?**	**Yes** INSTALL a new heater control valve. TEST the system for normal operation. **No** Manual climate control system, Go To Pinpoint Test I and diagnose the RECIRC circuit. DATC/EATC, GO to AB3 .
AB3 CHECK THE HEATER CONTROL VALVE VACUUM LINE FOR BLOCKAGE	
• Key in OFF position. • Disconnect the ATC solenoid and manifold vacuum connector. • Connect the vacuum pump to the heater control valve vacuum line and attempt to pull a vacuum.  A0051237 • **Can a vacuum be pulled on the heater control valve vacuum line?**	**Yes** INSTALL a new vacuum harness. TEST the system for normal operation. **No** GO to AB4 .
AB4 CHECK THE HEATER CONTROL VALVE VACUUM LINE FOR LEAKS	
• Plug the heater control valve vacuum line at the heater control valve connection. • Leak test the heater control valve vacuum line, using the vacuum pump.	**Yes** INSTALL a new vacuum harness. TEST the system for normal operation. **No** GO to AB5 .

 A0051237 ● **Does the heater control valve vacuum line leak?**	
AB5 CHECK THE VACUUM CONTROL MOTOR FOR LEAKS AND CORRECT OPERATION	
● Connect the vacuum pump to the heater control valve and pull a vacuum.  A0035187 ● **Does the heater control valve operate and hold vacuum?**	**Yes** GO to AB6 . **No** INSTALL a new heater control valve. TEST the system for normal operation.
AB6 CHECK THE ATC SOLENOID AND MANIFOLD CIRCUIT VOLTAGE	
● Connect the vacuum harness connector to the ATC solenoid and manifold. ● Key in START position. ● Press the PANEL, RECIRC and A/C buttons on the DATC/EATC module. ● **NOTE:** The following measurement must be taken by back-probing the ATC solenoid and manifold C2093. ● Measure the voltage between ATC solenoid and manifold C2093-1, circuit 1957 (LB/RD) and C2093-7, circuit 773 (DG/OG).  A0051236 ● **Is all the voltage greater than 10 volts?**	**Yes** INSTALL a new ATC solenoid and manifold. TEST the system for normal operation. **No** GO to AB7 .
AB7 CHECK THE ATC SOLENOID AND MANIFOLD CIRCUIT	
● Key in OFF position. ● Disconnect: DATC/EATC Module C228a and ATC Solenoid and Manifold C2093. ● Measure the resistance between the DATC/EATC module	**Yes** INSTALL a new DATC/EATC module. TEST the system for

C228a-24, circuit 773 (DG/OG) and the ATC solenoid and manifold C2093-7, circuit 773 (DG/OG).  • **Is the resistance less than 5 ohms?**	normal operation. **No** REPAIR the for an open. TEST the system for normal operation.

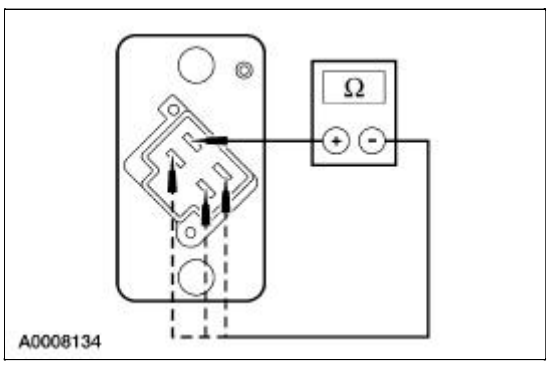
Component Tests

Blower Motor Resistor



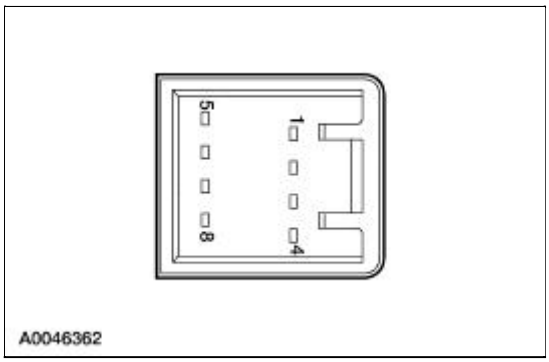
Blower Motor Resistor Pins	Resistance
4 and 2	2.3-2.9 ohms
2 and 3	0.8-1.1 ohms
2 and 1	0.2-0.4 ohms

Auxiliary Blower Motor Resistor



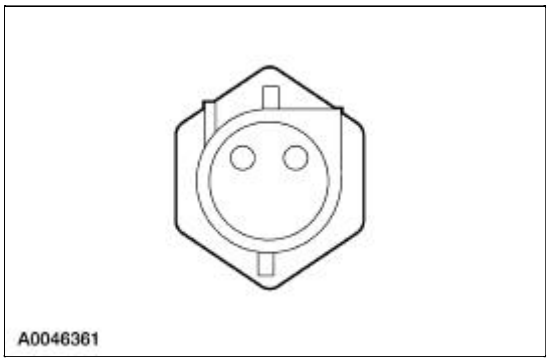
Blower Motor Resistor Pins	Resistance
3 and 4	0.2-0.4 ohms
3 and 1	0.8-1.1 ohms
3 and 2	2.1-2.6 ohms

ATC Solenoid and Manifold



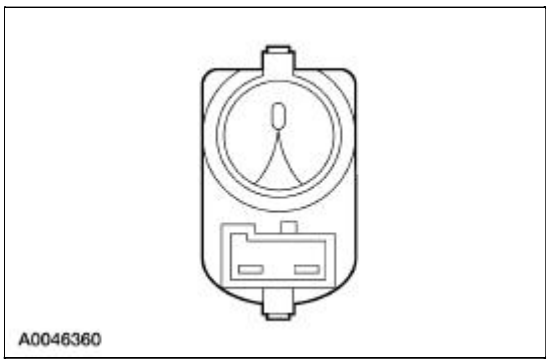
ATC Solenoid and Manifold Pins	Resistance
1 and 2	44-54 ohms
1 and 3	44-54 ohms
1 and 4	44-54 ohms
1 and 5	44-54 ohms
1 and 6	44-54 ohms

Ambient Temperature Sensor



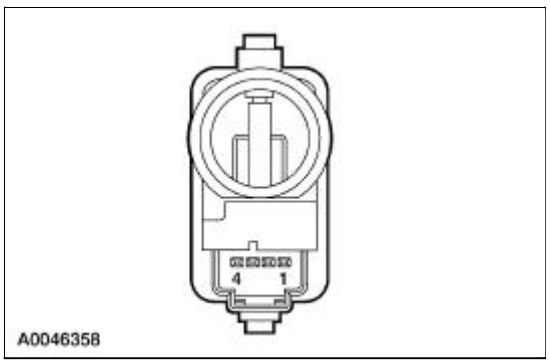
Ambient Temperature	Resistance
10-20°C (50-68°F)	37,000-58,000 ohms
20-30°C (68-86°F)	24,000-37,000 ohms
30-40°C (86-104°F)	16,000-24,000 ohms

In-Vehicle Temperature Sensor — EATC



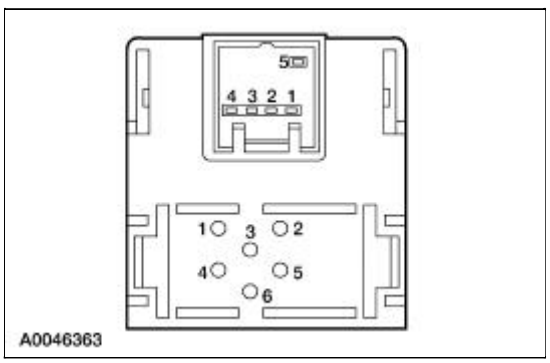
Temperature	Resistance
10-20°C (50-68°F)	37,000-58,000 ohms
20-30°C (68-86°F)	24,000-37,000 ohms
30-40°C (86-104°F)	16,000-24,000 ohms

In-Vehicle Temperature Sensor — DATC



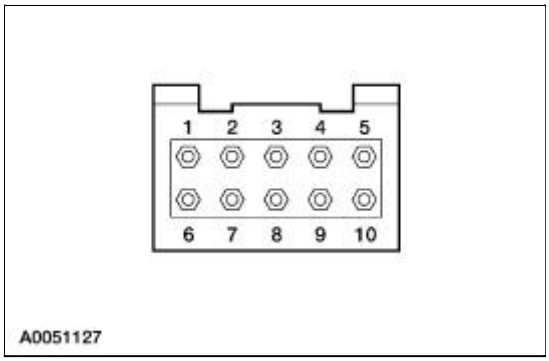
Temperature	Resistance between pins 1 and 3
10-20°C (50-68°F)	37,000-58,000 ohms
20-30°C (68-86°F)	24,000-37,000 ohms
30-40°C (86-104°F)	16,000-24,000 ohms

Function Selector Switch



Function selection	Continuity between electrical pins
MAX A/C	1,2,3 and 4
PANEL	1,2 and 4
PANEL/FLOOR	1,2 and 4
OFF	None
FLOOR	1,2 and 4
FLOOR/DEFROST	1,2 and 5
DEFROST	1,2 and 5

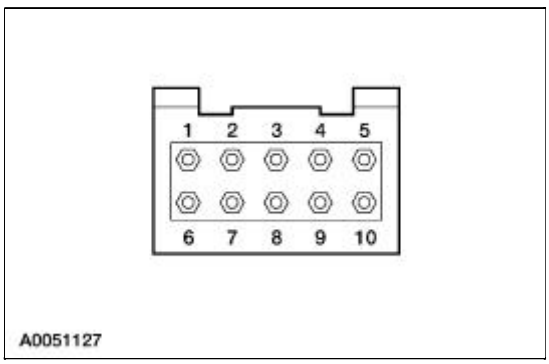
Front Auxiliary Climate Control Assembly



Blower Mode	Airflow Mode	Continuity between pins
HIGH	FLOOR	4 and 9, 2 and 10
HIGH	PANEL	4 and 10, 2 and 9
REAR	FLOOR/PANEL	10 and 7, 4 and 5
REAR	FLOOR/PANEL	2 and 1, 3 and 8

Resistance between pins	Resistance Range (approx.)
3 and 9	50 ohms (WARM)-3,000 ohms (COOL)
3 and 10	50 ohms (COOL)-3,000 ohms (WARM)

Rear Auxiliary Climate Control Assembly



Airflow Mode	Continuity between pins
FLOOR	4 and 9, 2 and 10
PANEL	4 and 10, 2 and 9

Resistance between pins	Resistance Range (approx.)
3 and 9	50 ohms (WARM)-3,000 ohms (COOL)
3 and 10	50 ohms (COOL)-3,000 ohms (WARM)

Heater Core

WARNING: Carbon monoxide is colorless, odorless and dangerous. If it is necessary to operate the engine with the vehicle in a closed area such as a garage, always use an exhaust

collector to vent the exhaust gases outside the closed area.

1. **NOTE:** Testing of returned heater cores reveals that a large percentage of heater cores were good and did not require replacement. If a heater core leak is suspected, the heater core must be tested by carrying out the plugged heater core component test before the heater core pressure test. Carry out a system inspection by checking the heater system thoroughly as follows:

   Inspect for evidence of coolant leakage at the heater water hose to heater core attachments. A coolant leak in the heater water hose could follow the heater core tube to the heater core (18476) and appear as a leak in the heater core.

2. **NOTE:** Spring-type clamps are installed as original equipment. Installation and overtightening of non-specification clamps can cause leakage at the heater water hose connection and damage the heater core.

   Check the integrity of the heater water hose clamps.

Heater Core — Plugged

WARNING: The heater core inlet hose will become too hot to handle if the system is working correctly.

1. Check to see that the engine coolant is at the correct level.

2. Start the engine and turn on the heater.

3. When the engine coolant reaches operating temperature, feel the heater core outlet hose to see if it is hot.

If it is not hot:

- the heater core may have an air pocket.
- the heater core may be plugged.
- the thermostat is not working correctly.

Heater Core — Pressure Test

Use the Radiator/Heater Core Pressure Tester to perform the pressure test.

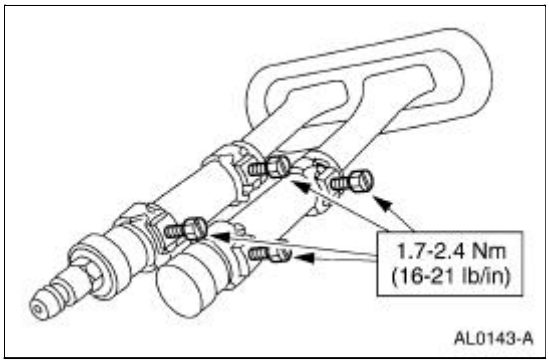
1. **NOTE:** Due to space limitations, a bench test may be necessary for pressure testing.

   Drain the coolant from the cooling system.

2. Disconnect the heater water hoses from the heater core. For additional information, refer to Section 412-02.

3. Install a short piece of heater water hose, approximately 101 mm (4 inches) long on each heater core tube.

4. Fill the heater core and heater water hoses with water and install Plug BT-7422-B and adapter BT-7422-A from the Radiator/Heater Core Pressure Tester in the heater water hose ends. Secure the heater water hoses, plug and adapter with hose clamps.



5. Attach the pump and gauge assembly from the Radiator/Heater Core Pressure Tester to the adapter.

6. Close the bleed valve at the base of the gauge. Pump 241 kPa (35 psi) of air pressure into the heater core.

7. Observe the pressure gauge for a minimum of three minutes.

8. If the pressure drops, check the heater water hose connections to the core tubes for leaks. If the heater water hoses do not leak, remove the heater core from the vehicle and perform the bench test.

Heater Core — Bench Test

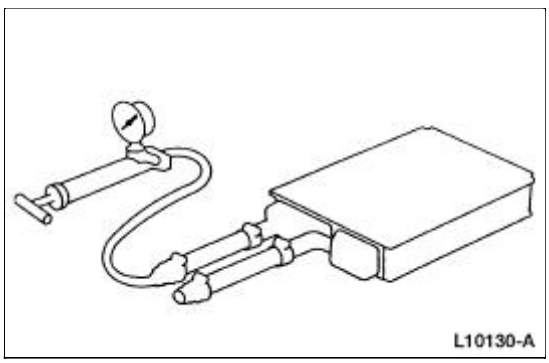
1. Remove the heater core from the vehicle. For additional information, refer to Section 412-02 .

2. Drain all of the coolant from the heater core.

3. Connect the 101 mm (4 inch) test heater water hoses with plug and adapter to the core tubes. Then connect the Radiator/Heater Core Pressure Tester to the adapter.

4. Apply 241 kPa (35 psi) of air pressure to the heater core. Submerge the heater core in water.

5. If a leak is observed, replace the heater core.



A/C Evaporator/Condenser Core — On Vehicle Leak Test

1. Recover the refrigerant. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.

2. **NOTE:** DO NOT leak test an A/C evaporator core with the suction accumulator/drier (19C836) attached to the core tubes.

   Disconnect the suspect A/C evaporator core or A/C condenser core from the A/C system. For

additional information, refer to Section 412-03A or Section 412-03B .

3. Clean the spring lock couplings. For additional information, refer to Spring Lock Coupling in this section.

4. Connect the appropriate test fittings from the R-12/R-134a Air Conditioning Test Fitting Set to the evaporator or condenser tube connections.

5. **NOTE:** The automatic shut-off valves on some gauge set hoses do not open when connected to the test fittings. If available, use hoses without shut-off valves. If hoses with shut-off valves are used, make sure the valve opens when attached to the test fittings or install an adapter which will activate the valve. The test is not valid if the shut-off valve does not open.

   Connect the red and blue hoses from the R-134a Manifold Gauge Set to the test fittings on the A/C evaporator core or A/C condenser core. Connect the yellow hose to a known good vacuum pump.

6. Open both gauge set valves and start the vacuum pump. Allow the vacuum pump to operate for a minimum of 45 minutes after the gauge set low pressure gauge indicates 101 kPa (30 in-Hg). The 45 minute evacuation is necessary to remove any refrigerant from oil left in the A/C evaporator core or A/C condenser core. If the refrigerant is not completely removed from the oil, outgassing will degrade the vacuum and appear as a refrigerant leak.

7. If the low pressure gauge reading will not drop to 101 kPa (30 in-Hg) when the valves on the gauge and manifold set are open and the vacuum pump is operating, close the gauge set valves and observe the low pressure gauge. If the pressure rises rapidly to zero, a large leak is indicated. Recheck the test fitting connections and gauge set connections before replacing the A/C evaporator core or A/C condenser core.

8. After evacuating for 45 minutes, close the gauge set valves and stop the vacuum pump. Observe the low pressure gauge; it should remain at the 101 kPa (30 in-Hg) mark.
   - If the low pressure gauge reading rises 34 or more kPa (10 or more in-Hg) of vacuum from the 101 kPa (30 in-Hg) position in 10 minutes, a leak is indicated.
   - If a very small leak is suspected, wait 30 minutes and observe the vacuum gauge.
   - If a small amount of vacuum is lost, operate the vacuum pump with gauge valves open for an additional 30 minutes to remove any remaining refrigerant from the oil in the A/C evaporator core or A/C condenser core. Then recheck for loss of vacuum.
   - If a very small leak is suspected, allow the system to set overnight with vacuum applied and check for vacuum loss.

9. If the A/C evaporator core or A/C condenser core does leak, as verified by the above procedure, install a new A/C evaporator core or A/C condenser core. For additional information, refer to Section 412-03A or Section 412-03B .

A/C Compressor — External Leak Test

1. Install the A/C Pressure Test Adapter on the rear head of the A/C compressor, using the existing manifold retaining bolt.

2. Connect the high and low pressure lines of a manifold gauge set or a refrigerant recovery/recycling station such as the R-134a A/C Service Center to the corresponding fittings on the A/C Pressure Test Adapter.

3. Attach the center hose of the manifold gauge set to a refrigerant container standing in an upright position.

4. Hand-rotate the compressor shaft 10 complete revolutions to distribute the oil inside the A/C compressor.

5. Open the low pressure gauge valve, the high pressure gauge valve and the valve on the refrigerant container to allow the refrigerant vapor to flow into the A/C compressor.

6. Using the Automatic Calibration Halogen Leak Detector, check the entire A/C compressor for leaks.

7. If an external leak is found, install a new A/C compressor. For additional information, refer to Section 412-03A .

8. When the leak test is complete, recover the refrigerant from the compressor.

Air Conditioning (A/C) System Check — Retail Procedure

NOTE: This Retail Procedure is not eligible for claiming on Ford paid repairs (warranty and ESP).

NOTE: The engine should be run at idle for 10 minutes with the air conditioning on and set to MAX A/C before carrying out this retail procedure.

NOTE: Read and follow all of the Warnings, Cautions and Notes at the beginning of this section before continuing.

Visual inspection

1. Open the hood and visually inspect the heating and air conditioning systems for the following:
    - Coolant reservoir for correct coolant level
    - Heater hoses for deterioration or loose connections
    - Radiator and condenser for debris or damaged fins restricting airflow, loose mounting or connections
    - Accessory drive belt(s) and cooling fan(s) for wear or physical damage
    - Refrigerant lines and connections for physical damage or loose connections
    - Compressor for physical damage or loose connections
    - Receiver/drier for physical damage or loose connections
    - Wiring and connectors for excessive wear, loose or damaged connections, or incorrect routing

A/C refrigerant analysis

2. Carry out air conditioning refrigerant analysis. For additional information, refer to Refrigerant Identification Testing in this section.
    - If the refrigerant fails the analysis, discontinue diagnosis and make recommendations for repairs.
    - If the refrigerant passes the analysis, carry out the air conditioning system check.

Air conditioning system check

3. Connect manifold gauge set or charging station with gauges to refrigerant system.
    - With the vehicle in park, parking brake set, thermometer installed in center panel vent, and air conditioning system on and set to FULL COOL, start the engine.
    - Record air refrigerant system pressures while running the engine at 1,500 rpm and allow engine to return to idle.
    - Operate the blower motor in all control positions and check for correct blower speed changes.
    - With the blower motor on HI, operate air discharge mode selector in all positions and check for correct airflow in each position.
    - Operate the temperature blend selector in all positions and check for correct change in discharge temperature. Check the air discharge temperature with the selector in the coolest position and the air conditioning on and set to FULL COOL to determine if the air

discharge temperature is acceptable for the current ambient air temperature.

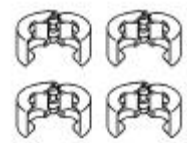
- Carry out the DATC self-test (if applicable).
  If the refrigerant system pressures were low, carry out the refrigerant system leak test.

Refrigerant system leak test

4. Use either an ultraviolet (UV) or an electronic leak detector to check for leaks at all refrigerant lines, connections, and components.
   After all tests have been completed, report all findings and recommended repairs to your service advisor before carrying out further diagnostic procedures.

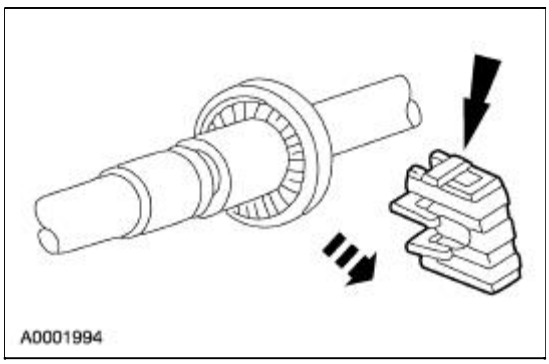
Spring Lock Coupling

Special Tool(s)

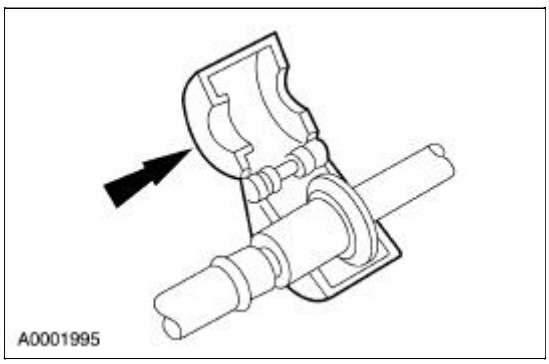
 ST2352-A	Remover, Refrigerant Coupling Spring 412-039 (T84L-19623-B)

Disconnect

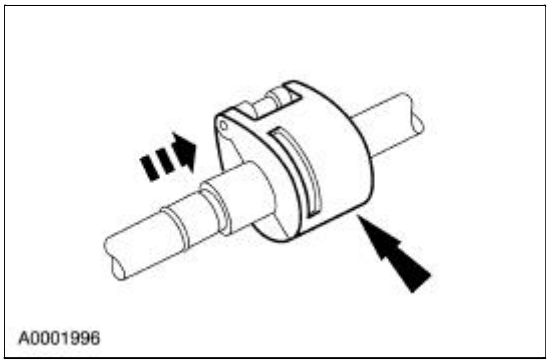
1. Remove the A/C tube lock coupling clip (19E746), if equipped.



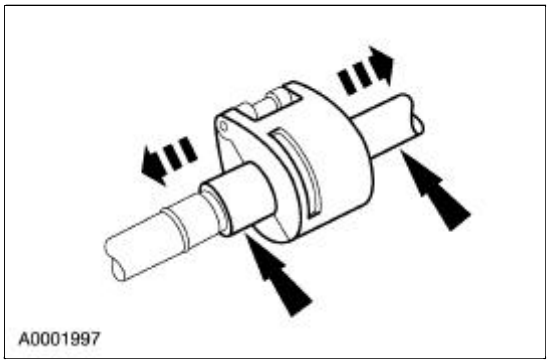
2. Fit the special tool to the spring lock coupling.



3. Push the tool into the cage opening to release the female fitting from the A/C tube lock coupling spring (19E576).

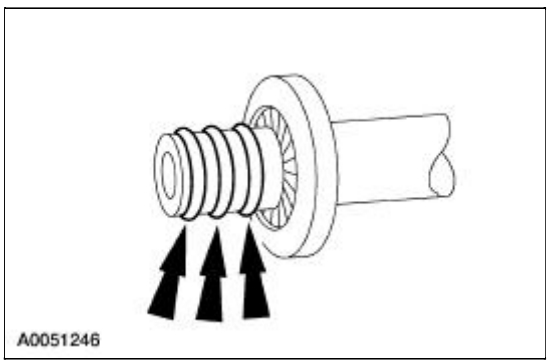


4. Pull the spring lock coupling fittings apart.



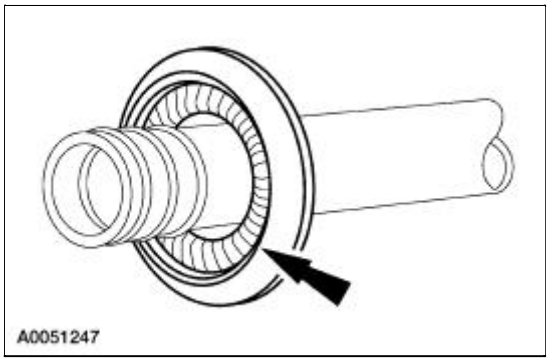
5. **CAUTION: Do not use metal tools to remove the O-ring seals. They can cause axial scratches across the O-ring seal grooves, resulting in refrigerant leaks.**

   Remove the O-ring seals with a non-metallic tool.



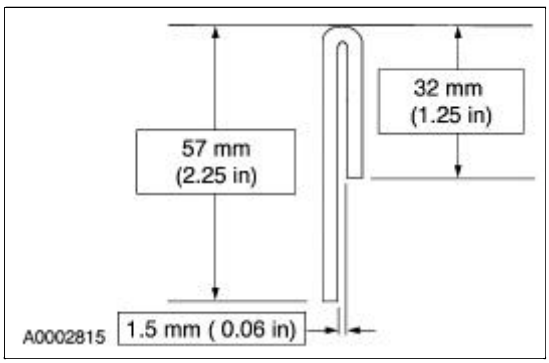
6. **CAUTION: Do not use a screwdriver or similar tool to remove the A/C tube lock coupling spring; this can cause axial scratches across the O-ring seal grooves resulting in refrigerant leaks.**

   Remove the A/C tube lock coupling spring with a small hooked wire.



Cleaning

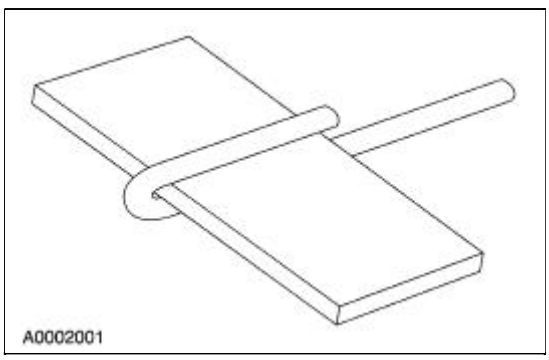
1. Fabricate a cleaning tool from a 1/8 inch diameter brazing rod.



2. Cut an abrasive pad from maroon colored 3M Scotch Brite® with the dimensions corresponding to the coupling size.

Coupling Size	Pad Size
3/8 inch	25 x 50 mm (1 x 2 inch)
1/2 inch	25 x 50 mm (1 x 2 inch)
5/8 inch	25 x 76 mm (1 x 3 inch)
3/4 inch	25 x 102 mm (1 x 4 inch)

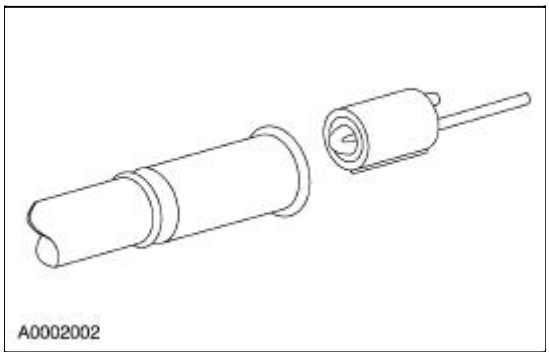
3. Assemble the pad to the tool.



4. Coat the abrasive pad with PAG Refrigerant Compressor Oil (R-134a Systems) or equivalent.
5. Roll the pad on the tool and install it in a variable speed drill motor.
6. **CAUTION: Maintain low speed drill rotation when inserting or removing the cleaning**

tool to prevent axial scratches which may cause future leaks.

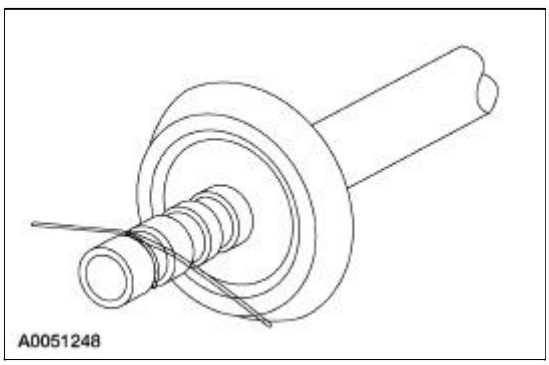
Polish for one minute at moderate speed (less than 1,500 rpm) or until the surface is clean and free of scratches or foreign material.



7. Clean the fitting with a lint-free cloth.

8. Inspect the surface for grooves or scratches. If grooves and scratches are still present, install a new component.

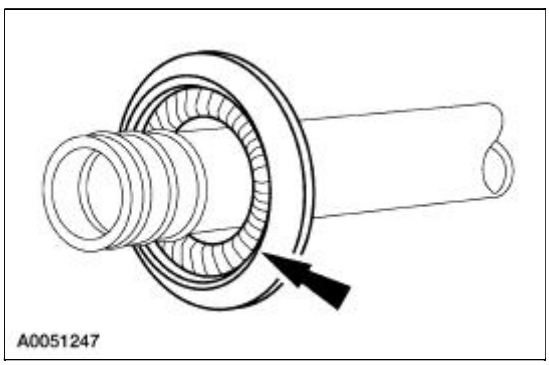
9. Clean the O-ring seal grooves with a 300 mm (12 inch) length of natural fiber string.
    - Loop the string around the grooves and pull the string back and forth.



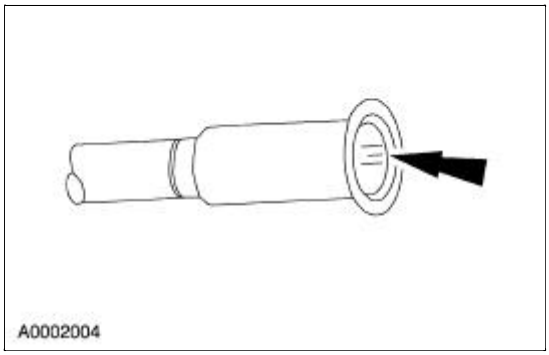
10. Remove any foreign material from the grooves with a lint-free cloth.

Connect

1. Install the A/C tube lock coupling spring.



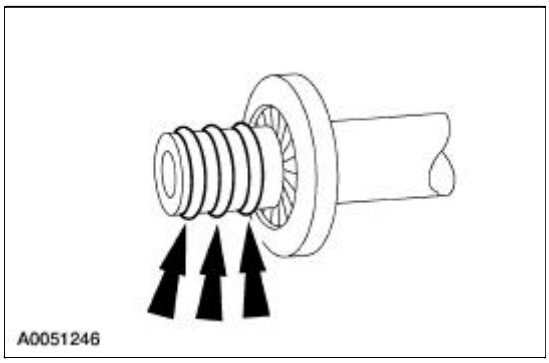
2. Lubricate the inside of the coupling with PAG Refrigerant Compressor Oil (R-134a Systems) or equivalent.



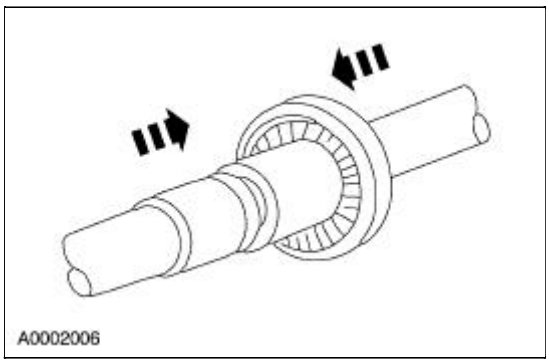
3. **CAUTION: Use only the new O-ring seals. The use of any O-ring seals other than those specified in the Ford Master Parts Catalog may result in intermittent leakage during vehicle operation.**

   Install the O-ring seals.

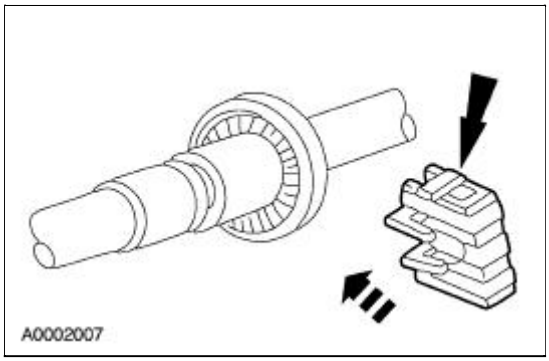
   - Lubricate the O-ring seals with PAG Refrigerant Compressor Oil (R-134a Systems) or equivalent.



4. Connect the spring lock coupling fittings with a twisting motion until the A/C tube lock coupling spring snaps over the flared end of the female fitting.



5. Install the A/C tube lock coupling clip.

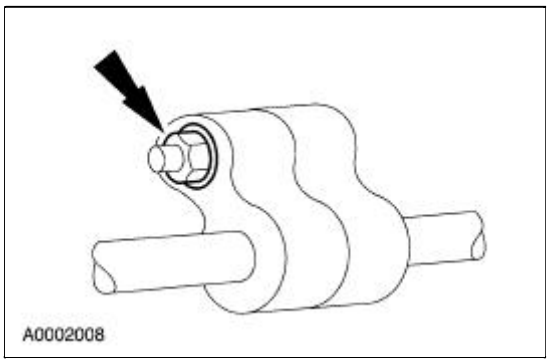

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Air Conditioning Line (Peanut) Fitting

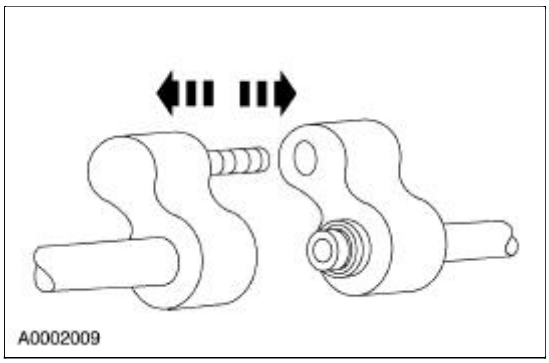
Disconnect

1. **CAUTION: Support the female fitting with a wrench to prevent the tubes from twisting.**

   Remove the nut from the peanut fitting.

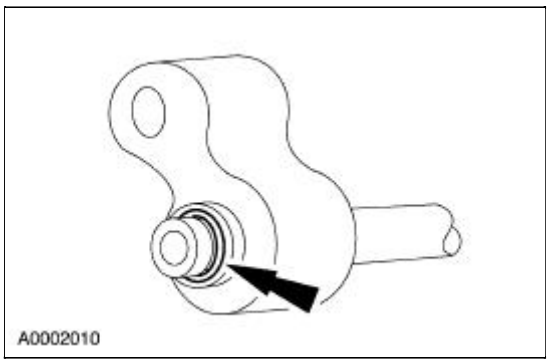


2. Pull the peanut fitting apart.



3. **CAUTION: Do not use metal tools to remove the O-ring seal. They can cause axial scratches across the O-ring seal groove, resulting in refrigerant leaks.**

   Remove the O-ring seal with a non-metallic tool.



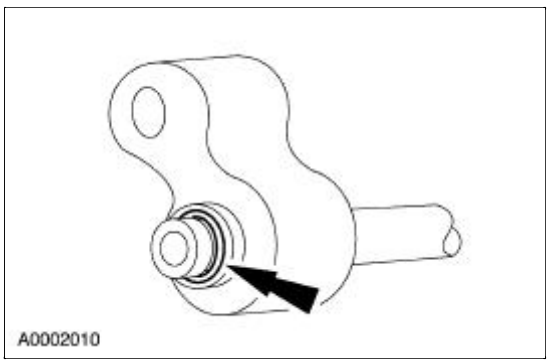
Connect

1. Clean all dirt or foreign material from the fittings.

2. **CAUTION: Use only the new O-ring seals. The use of any O-ring seals other than those specified in the Ford Master Parts Catalog may result in intermittent leakage during vehicle operation.**

   Install the O-ring seal.

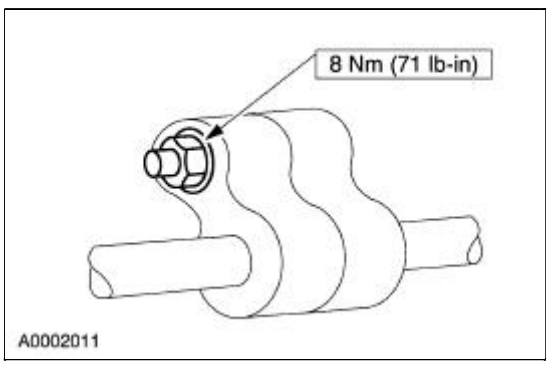
   - Lubricate the O-ring seal with PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B.



3. Lubricate the inside of the fittings with PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B.

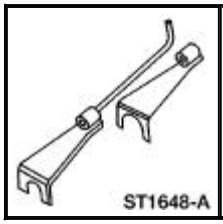
4. **NOTE:** When correctly assembled, the male and female fittings should be flush.

   Assemble the male and female fittings together.



Heater Hose Coupling

Special Tool(s)

 ST1648-A	Remover, Heater Hose Inlet Tube 412-042 (T85T-18539-AH)

Disconnect

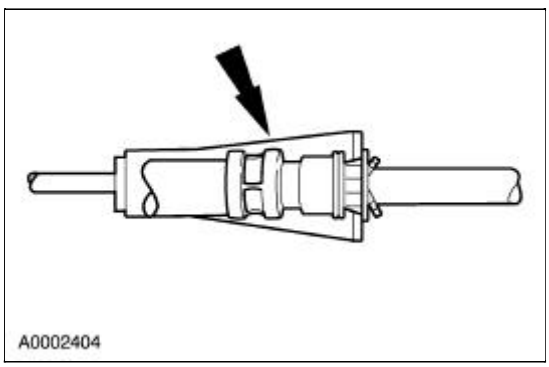
1. **WARNING: The engine must be off, fully cool and the cooling system fully depressurized before attempting to disconnect any heater water hoses. Failure to comply with this warning can result in serious injury or burns from hot liquid escaping out of the engine cooling system.**

   Depressurize the engine cooling system.

2. Push the heater water hose toward the tube to fully expose the locking tabs.

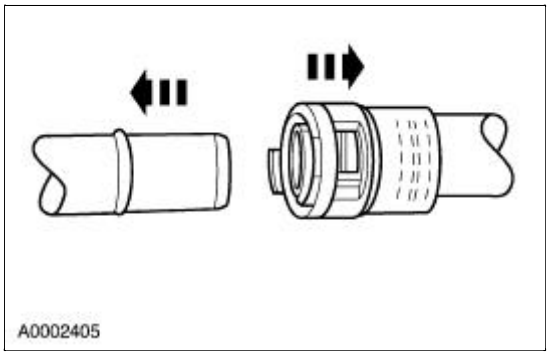
3. **NOTE:** When compressing the white coupling retainer, the Heater Hose Disconnect Tool must be perpendicular to and on the highest point of the coupling.

   Push the special tool over the coupling retainer windows to compress the retainer locking tabs.

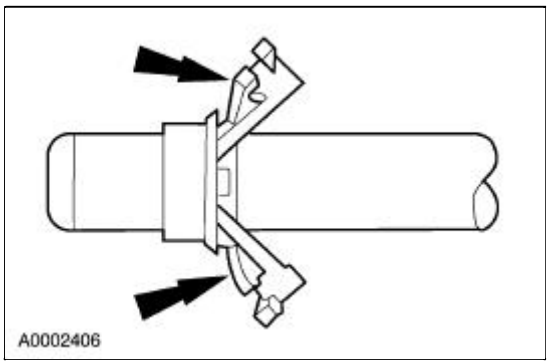


4. **NOTE:** A slight twisting motion while pulling on the heater water hose may be necessary to assist in the removal.

   Pull the heater water hose away from the heater core tube.



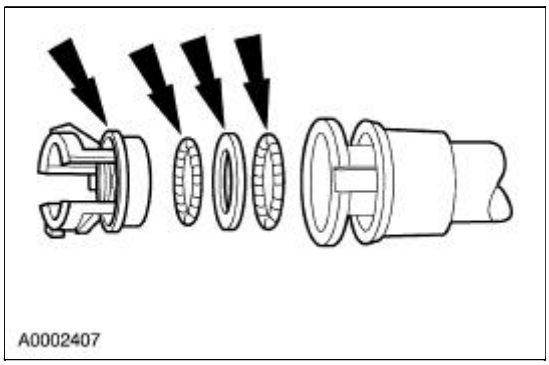
5. Plug the heater water hose.
6. Remove the white coupling retainer from the tube.
7. Spread the retainer tabs apart and slide the retainer off the tube.



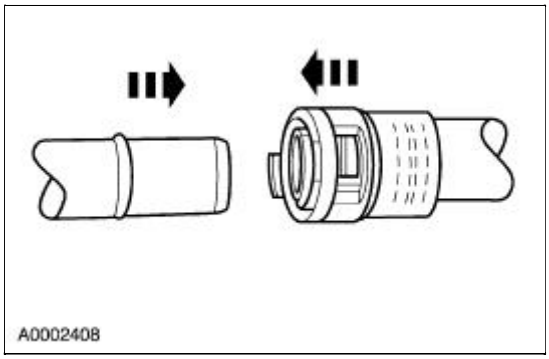
8. Discard the retainer.

Connect

1. Clean the tubes and lubricate with MERPOL® meeting Ford specification ESE-M99B144-B or plain water.
2. Install a new coupling retainer, spacer, and lubricated O-ring seals into the quick disconnect coupling housing.



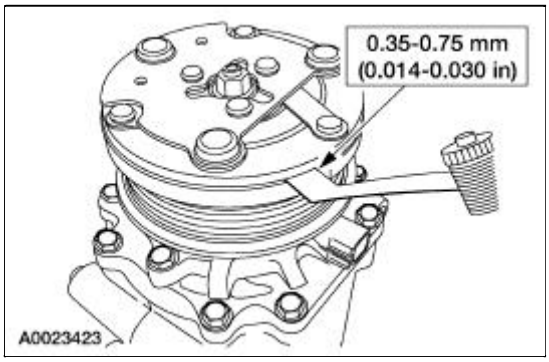
3. Push the heater water hose with a quick disconnect coupling onto the tube.



4. Make sure the coupling is fully engaged by lightly pulling on the heater water hose.

Air Conditioning (A/C) Clutch Air Gap Adjustment

1. Check the A/C clutch air gap at three equally spaced places between the clutch plate and the A/C clutch pulley.



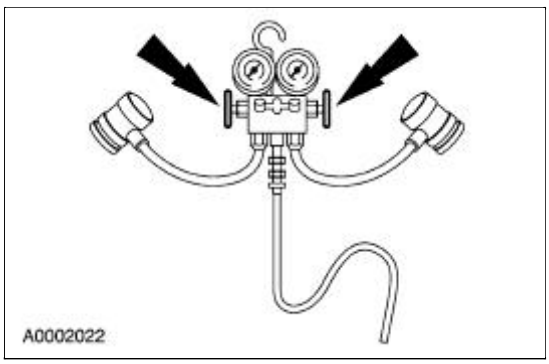
2. If the A/C clutch air gap is out of range, remove the clutch plate. Add or remove spacers between the clutch plate hub and the compressor shaft until the clearance is within specification.

Manifold Gauge Set Connection

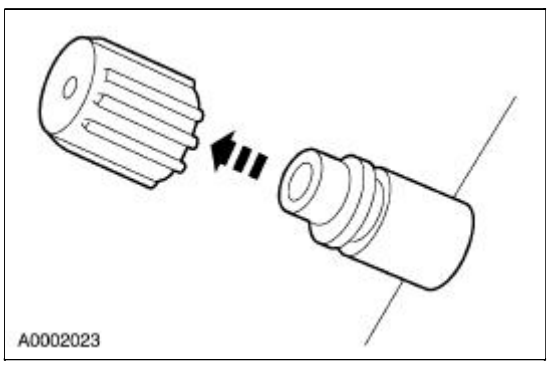
Special Tool(s)

 ST1928-A	R-134a Manifold Gauge Set 176-R032A or equivalent

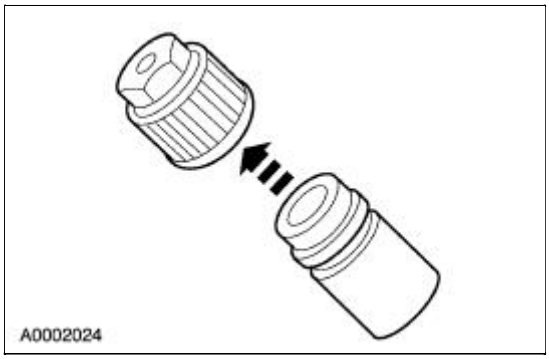
1. Turn both valves on the R-134a Manifold Gauge Set clockwise to close the low- and high-pressure hoses to the center manifold and center hose.



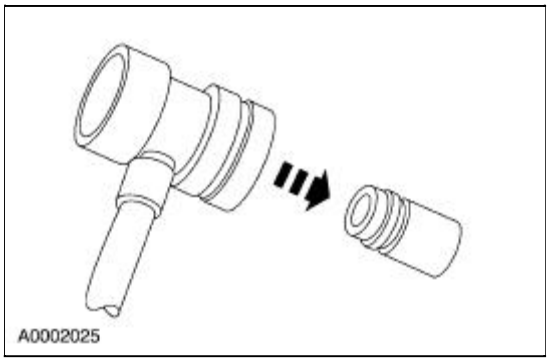
2. Remove the A/C charging valve cap (19D702) from the low-pressure service gauge port valve.



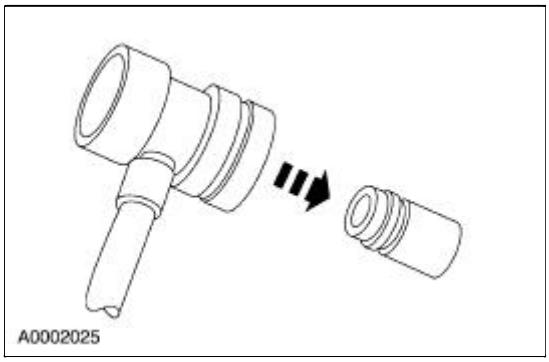
3. Remove the A/C charging valve cap from the high-pressure service gauge port valve.



4. Connect the R-134a Manifold Gauge Set low-pressure hose and the R-134a low side quick disconnect to the low-pressure service gauge port valve.



5. Connect the R-134a Manifold Gauge Set high-pressure hose and the R-134a high side quick disconnect to the high-pressure service gauge port valve.



Electronic Leak Detection

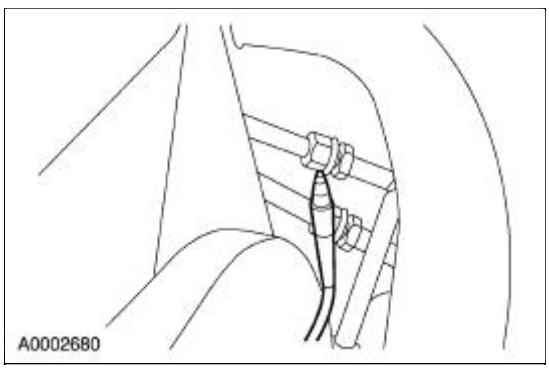
Special Tool(s)

 ST2351-A	H10PM Refrigerant Leak Detector With Battery 216-00001 or equivalent

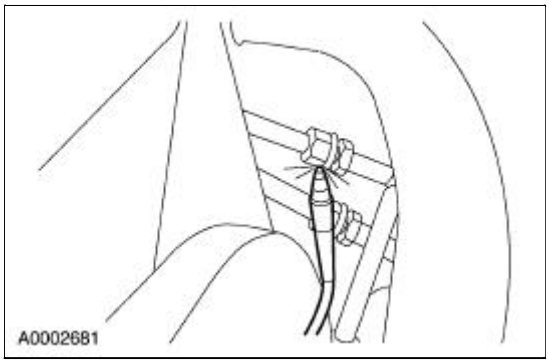
CAUTION: Good ventilation is necessary in the area where electronic A/C leak testing is to be carried out. If the surrounding air is contaminated with refrigerant gas, the leak detector will indicate this gas all the time. Odors from other chemicals such as antifreeze, diesel fuel, disc brake cleaner, or other cleaning solvents can cause the same problem. A fan, even in a well-ventilated area, is very helpful in removing small traces of contamination from the air that might affect the leak detector.

1. **NOTE:** The system pressure should be between 413-551 kPa (60-80 psi) at 24°C (75°F) with the engine off.

   Leak test the refrigerant system using the Refrigerant Leak Detector. Follow the instructions included with the leak detector for handling and operation techniques.

   
   A0002680

2. If a leak is found, discharge and recover the refrigerant. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.
   - Repair the system.
   - Test the system for normal operation.


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Fluorescent Dye Leak Detection

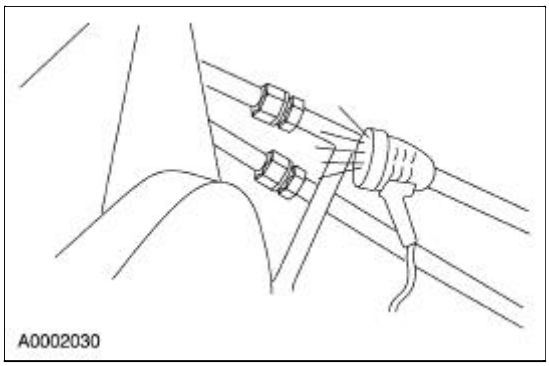
Special Tool(s)

 ST1834-A	R-134a Refrigerant Service Center 023-00153 or equivalent
 ST1261-A	120 Watt UV Spot Lamp 164-R0721 or equivalent
 ST1705-B	R-134a Fluorescent Dye Injector 164-R0775 or equivalent
 ST2651-A	High Intensity UV Lamp — 12 Volt 164-R6000
 ST2650-A	R-134a Leak Detection Dye 164-R6060
 ST1928-A	R-134a Manifold Gauge Set 176-R032A
 ST2649-A	Deluxe Injector Loop Kit 219-00069

Fluorescent Dye Detection

NOTE: Ford Motor Company vehicles are produced with R-134a fluorescent dye installed in the refrigerant system from the factory. The location of leaks can be pinpointed by the bright yellow-green glow of the fluorescent dye under a UV lamp. Since more than one leak can exist, make sure to inspect each component, line, and fitting in the refrigerant system for a leak.

1. Check for leaks using the special tool.
    - Inspect all components, lines, and fittings of the refrigerant system.



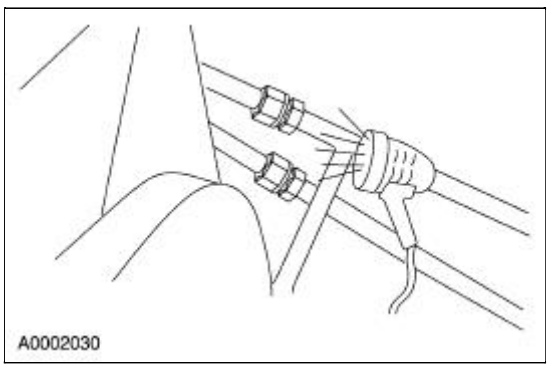
2. If a leak is found, recover the refrigerant. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.

3. Repair the refrigerant system leak(s).

4. Evacuate and charge the refrigerant system. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.

5. After the leak(s) is/are repaired, remove any traces of fluorescent dye with a general purpose oil solvent.

6. Verify the repair by running the vehicle for a short period of time and rechecking the area of the leak with the special tool.



Fluorescent Dye Injection — Using an A/C Refrigerant Center and Dye Injector

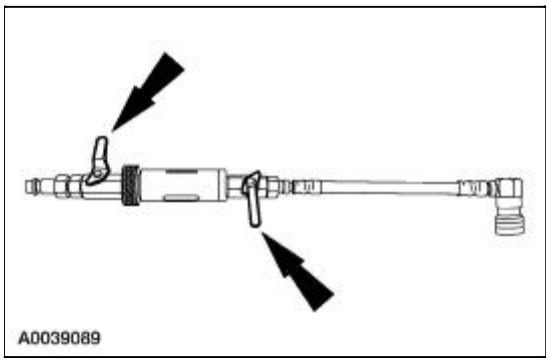
NOTE: Before using the R-134a fluorescent dye injector for the first time, refer to the manufacturers instructions on evacuation of any non-condensable gasses from the hoses.

NOTE: Only connect the R-134a fluorescent dye injector to a manifold and gauge set or R-134a service center when fluorescent dye is to be injected. The R-134a fluorescent dye injector has a one way check valve that will prevent refrigerant system recovery and evacuation.

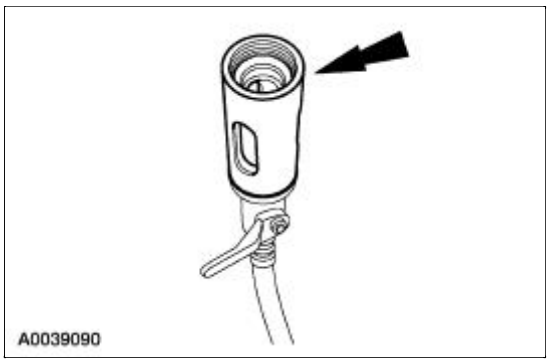
NOTE: Refrigerant system pressure should be between 413-551 kPa (60-80 psi) at 24°C (75°F) with the engine off.

1. Install an R-134a A/C refrigerant service center or a manifold and gauge set. For additional information, refer to Manifold and Gauge Set Connection in this section.

2. Verify that the valves on the special tool are closed.



3. Fill the special tool reservoir with 7 ml (0.25 oz) of fluorescent dye.



4. Install the special tool between the low-pressure service gauge port valve and the R-134a refrigerant service center or manifold gauge set.

5. Open all valves and inject the fluorescent dye into the refrigerant system.

6. When fluorescent dye injection is complete, close all valves.

7. Recover the refrigerant from the R-134a fluorescent dye injector.

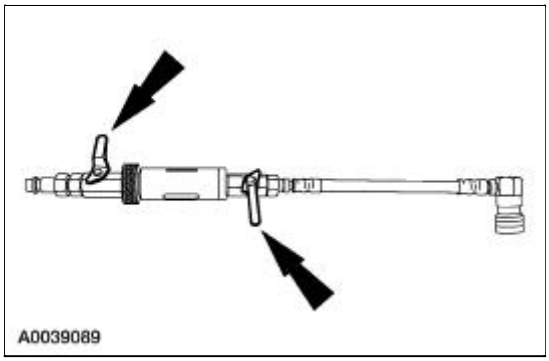
8. Remove the fluorescent dye injector from the low-pressure service gauge port valve and the R-134a A/C refrigerant service center or manifold gauge set.

Fluorescent Dye Injection — Using a Dye Injector Loop Kit

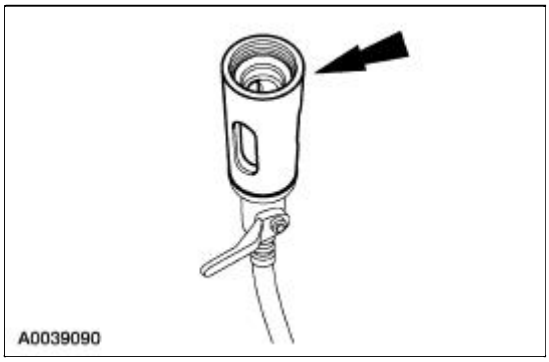
NOTE: Before using the R-134a fluorescent dye injector for the first time, refer to the equipment manufacturers instructions on evacuation of non-condensable gasses from the hoses.

NOTE: Refrigerant system pressure should be between 413-551 kPa (60-80 psi) at 24°C.

1. Verify that the valves on the special tool are closed.



2. Fill the special tool reservoir with 7 ml (0.25 oz) of fluorescent dye.

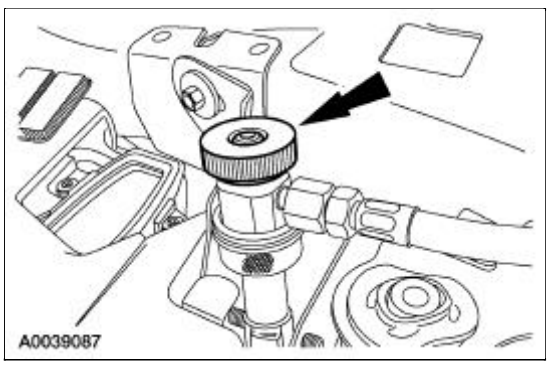


3. Install the special tool between the high-pressure and low-pressure service gauge port valves.

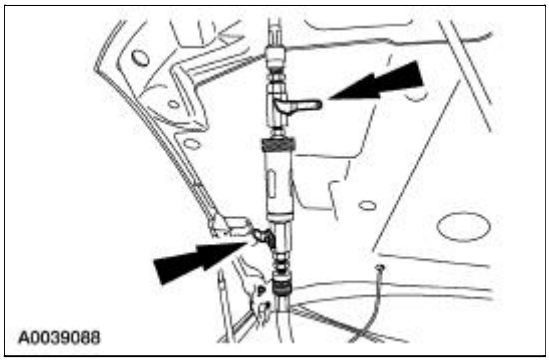
4. **CAUTION: Make sure all tools and hoses are clear of the engine cooling fan and drive belt before starting the engine.**

   Start the engine.

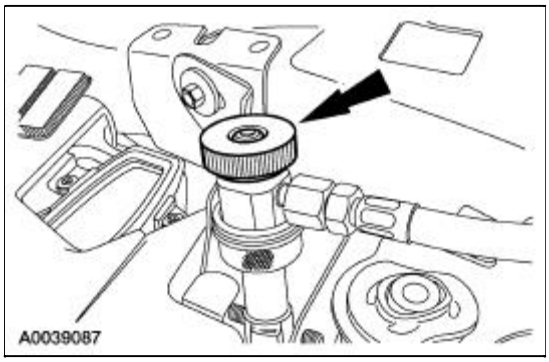
5. Open the high-pressure service valve.



6. Open the special tool valves and inject the fluorescent dye into the refrigerant system.

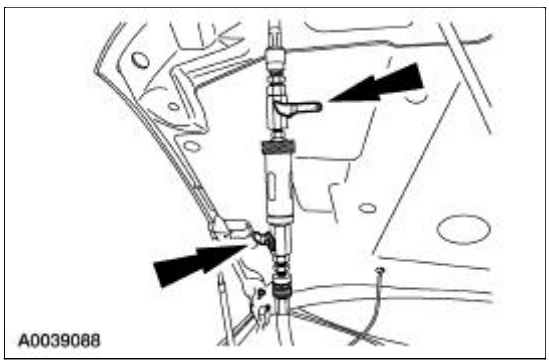


7. Close the high-pressure service valve to allow the pressure inside the special tool to equalize with the suction side of the refrigerant system.



8. **NOTE:** Close the valves on the special tool while the A/C compressor is operating.

   Close the valves on the special tool.

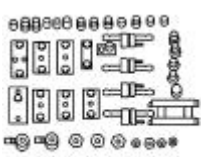


9. **NOTE:** Leave all valves on the special tool closed when not in use.

   Disconnect the high-pressure and low-pressure service valves and remove the special tool from the vehicle.

Air Conditioning (A/C) System Flushing

Special Tool(s)

 ST2466-A	Flushworks Mobile A/C Flush and Purge Machine 219-00022 (part of 219-00023) or equivalent
 ST2469-A	A/C Flush and Purge Fitting Kit 219-00024 (part of 219-00023) or equivalent

WARNING: Use extreme care and observe all safety and service precautions related to the use of refrigerants.

WARNING: Due to refrigerant hazards, always wear safety goggles and non-penetrable gloves when working on or flushing A/C systems.

CAUTION: An A/C refrigerant analyzer must be used before the recovery of any vehicle's A/C refrigerant. Failure to do so puts the shop's bulk refrigerant at risk of contamination. If the vehicle's A/C refrigerant is contaminated, refer the customer to the service facility that carried out the last A/C service. If the customer wishes to pay the additional cost, use the A/C recovery equipment that is designated for recovering contaminated A/C refrigerant. All contaminated A/C refrigerant must be disposed of as hazardous waste. For all equipment, follow the equipment manufacturer's procedures and instructions.

CAUTION: Suction accumulator/drier, muffler, hoses, thermal expansion valve, and evaporator core orifice should be removed when flushing the A/C system. Internal plumbing of these devices makes it impossible to correctly remove any residual-flushing agent. Except for the hoses, these components are typically discarded after A/C system contamination. Hoses can normally be reused unless they are clogged with foreign material. The 3.785 liters (1 gallon) of A/C Systems Flushing Solvent F4AZ-19579-A and FL1-A filter used in A/C Flush and Purge Machine 219-00022 are intended for use on one vehicle only. They may be used to flush both the A/C condenser core and the A/C evaporator core on an individual vehicle, but under no circumstances should they be used on more than one vehicle.

NOTE: Prior to using the A/C Flush and Purge Machine 219-00022 for the first time, review the operating instructions.

NOTE: Only the A/C Flush and Purge Machine kit 219-00023, which includes A/C Flush and Purge Machine 219-00022, A/C Flush and Purge Fitting Kit 219-00024, and the Ford Part number F4AZ-19579-A A/C Systems Flushing Solvent, is approved for use on Ford vehicles. No other flushing device or solvent is approved for flushing heat exchangers (A/C condenser, A/C evaporator). Use of any other flusher or solvent may cause damage to the A/C system and the flushing unit.

NOTE: Ford Motor Company has approved a procedure to provide technicians with a non-CFC method of flushing contaminated A/C system heat exchangers. The procedure allows the specific components to be cleaned and flushed while installed in their normal in-vehicle location. The types of contamination flushed include particle matter that results from A/C compressor or desiccant failure within the suction accumulator/drier and gummy residue that can form when refrigerant oil is overheated during A/C compressor seizure. The flushing process is a two-step procedure that involves the use of an A/C Flush and Purge Machine 219-00022 to:

- Circulate the flushing solvent through the heat exchanger in the reverse direction of normal refrigerant flow (back-flushing). Particulate matter picked up during flushing is filtered from the returning solvent before the solvent is returned to the reservoir for continued circulation.
- Remove the flushing solvent from the heat exchanger. In this step of the procedure, pressurized air 621-862 kPa (90-125 psi) is used to push and evaporate any remaining flush solvent from the heat exchanger.

1. Recover the refrigerant. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.

2. Disconnect the refrigerant lines from the heat exchanger(s) to be flushed.

3. Connect the A/C flush and purge machine fitting kit and the A/C flush and purge machine to the heat exchanger to be flushed. Do not flush through the evaporator core orifice, mufflers or hoses. Internal plumbing and material make-up of these components make it impossible to correctly remove foreign material or residual flushing solvent.

4. **NOTE:** Use 3.785 liters (one gallon) of A/C Systems Flushing Solvent part number F4AZ-19579-A to flush the heat exchanger for a minimum of 15 minutes. The flush solvent may be used for one or both heat exchangers in the A/C system. However, the flush solvent is intended for one vehicle only. The filter used on the flushing unit is also intended for use on one vehicle only.

   Flush the heat exchanger for a minimum of 15 minutes.

5. Apply 621-862 kPa (90-125 psi) pressurized air to the component for a minimum of 30 minutes. The 30-minute purge time is required to force and evaporate all residual solvent from the A/C system component. Failure to successfully remove all residual solvent within the component can result in system damage when reconnected and operated. Dispose of the used flush solvent and filter in accordance with local, state and federal regulations.

6. **NOTE:** A/C system filtering as described in this section is optional if system flushing is carried out. However, the filter kit use is recommended after flushing if the A/C system contamination is extensive.

   Install a new A/C evaporator core orifice in any vehicle being serviced for an internal A/C compressor or desiccant failure.

7. Install new refrigerant hoses if clogged with foreign material.

8. Install a new suction accumulator in any vehicle being serviced for an internal A/C compressor or desiccant failure.

9. Reconnect the heat exchanger being serviced.

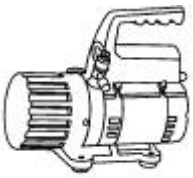
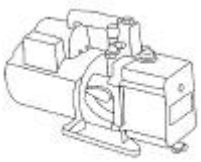
10. If a new A/C compressor is not to be installed, lubricate the refrigerant system with the correct amount of clean PAG oil. For additional information, refer to Refrigerant Oil Adding in this section.

11. If a new A/C compressor is not to be installed, evacuate, leak test and charge the A/C system. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and

Charging in this section.

Air Conditioning (A/C) System Recovery, Evacuation and Charging

Special Tool(s)

 ST1226-A	R-134a A/C Refrigerant Center 176-00002 or equivalent
 ST1834-A	R-134a A/C Refrigerant Center 023-00153 or equivalent
 ST1928-A	R-134a Manifold Gauge Set 176-R032A or equivalent
 ST1685-A	1.2 CFM Vacuum Pump 023-00162 or equivalent
 ST1686-A	4.0 CFM Vacuum Pump 023-00163 or equivalent

Refrigerant System Recovery

NOTE: Ford Motor Company recommends use of an A/C service center to carry out recovery, evacuation, and charging of the refrigerant system. If an A/C service center is not available, refrigerant system recovery, evacuation, and charging may be accomplished using a separate recovery station, vacuum pump, charging cylinder, and manifold gauge set.

1. Prior to recovering the refrigerant system, you must verify the purity of the refrigerant. For additional information, refer to Refrigerant Identification Testing in this section.

2. **NOTE:** Some R-134a service centers require the use of an A/C manifold gauge set. For additional information, refer to Manifold Gauge Set Connection in this section.

Connect an R-134a A/C service center to the low- and high-pressure service gauge port valves.

3. Recover the refrigerant from the system following the operating instructions provided by the equipment manufacturer.

4. Once the service center has recovered the vehicle A/C system refrigerant, close the service center inlet valve (if equipped). Then switch off the power supply.

5. Allow the vehicle A/C system to remain closed for about two minutes. Observe the system vacuum level as shown on the gauge. If the vacuum does not decrease, disconnect the refrigerant center hose(s).

6. If the system vacuum does decrease, repeat Steps 2 through 5 until the vacuum level remains stable for two minutes.

7. Carry out the required repairs.

Refrigerant System Evacuation

NOTE: Ford Motor Company recommends use of an A/C service center to carry out recovery, evacuation, and charging of the refrigerant system. If an A/C service center is not available, refrigerant system recovery, evacuation, and charging may be accomplished using a separate recovery station, vacuum pump, charging cylinder, and manifold gauge set.

1. Connect an R-134a service center to the low- and high-pressure service gauge port valves.

2. Evacuate the system until the low-pressure gauge reads at least 99.4 kPa (29.5 in-Hg) of vacuum and as close to 101.1 kPa (30 in-Hg) as possible. Continue to operate the vacuum pump for a minimum of 45 minutes.

3. Turn off the vacuum pump. Observe the low-pressure gauge for five minutes to make sure that the system vacuum is held. If vacuum is not held for five minutes, leak test the system, service the leak, and evacuate the system again.

Refrigerant System Charging

NOTE: Ford Motor Company recommends use of an A/C service center to carry out recovery, evacuation, and charging of the refrigerant system. If an A/C service center is not available, refrigerant system recovery, evacuation, and charging may be accomplished using a separate recovery station, vacuum pump, charging cylinder, and manifold gauge set.

1. Correctly oil match the system to verify that the correct amount of refrigerant oil is present in the system. For additional information, refer to Refrigerant Oil Adding in this section.

2. Charge the system with the specified amounts of refrigerant oil and refrigerant.

3. When no more refrigerant is being drawn into the system, start the engine and select MAX A/C operation. Adjust the blower motor speed to the maximum and allow the remaining refrigerant to be drawn into the system. Continue to add refrigerant into the system until the specified weight of R-134a has been added. Close the charging cylinder valve and allow the system to pull any remaining refrigerant from the hose. When the low-pressure drops to approximately 207 kPa (30 psi), close the charging hose valve.

Refrigerant System Filtering Following Air Conditioning (A/C) Component Installation

Special Tool(s)

 ST1252-A	A/C Fittings Set 412-DS028 (014-00333, D93L-19703-B) or equivalent

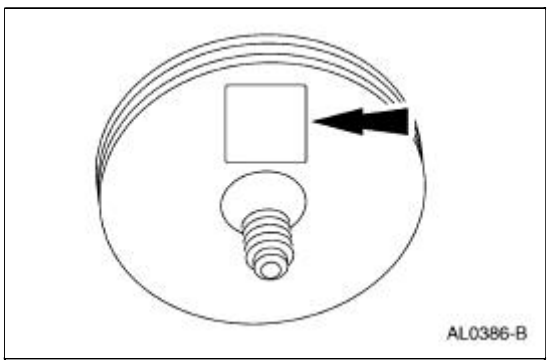
WARNING: Use extreme care and observe all safety and service precautions related to the use of refrigerants.

WARNING: Due to refrigerant hazards, always wear safety goggles and non-penetrable gloves when working on A/C systems.

CAUTION: An A/C refrigerant analyzer must be used before the recovery of any vehicle's A/C refrigerant. Failure to do so puts the shop's bulk refrigerant at risk of contamination. If the vehicle's A/C refrigerant is contaminated, refer the customer to the service facility that carried out the last A/C service. If the customer wishes to pay the additional cost, use the A/C recovery equipment that is designated for recovering contaminated A/C refrigerant. All contaminated A/C refrigerant must be disposed of as hazardous waste. For all equipment, follow the equipment manufacturer's procedures and instructions.

CAUTION: On vehicles being serviced for an internal compressor or desiccant failure, a new suction accumulator/drier, muffler, thermal expansion valve, and evaporator core orifice must be installed prior to filtering the A/C system. Internal plumbing of these devices makes it impossible to correctly remove any residual agent. These components are typically discarded after A/C system contamination. Hoses can normally be reused unless they are clogged with foreign material. The filter is intended for use on one vehicle only.

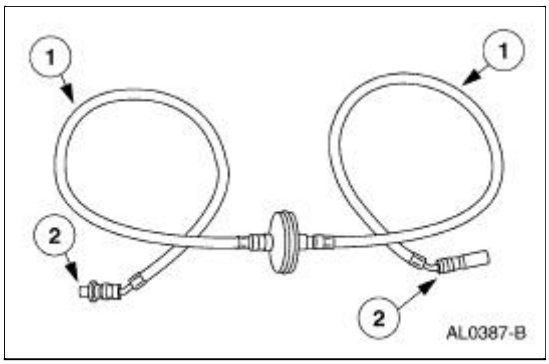
1. Orient the filter inlet toward the A/C condenser core.



2. **NOTE:** The pancake filter is not permanently installed and will be removed at the end of this procedure.

Temporarily install the pancake filter between the A/C condenser core and the condenser to evaporator tube.

1. Use flexible refrigerant hose of 17,238 kPa (2,500 psi) burst rating.
2. Make the connections using the A/C Test Fitting Set.



3. Lubricate the refrigerant system with the correct amount of clean PAG oil. For additional information, refer to Refrigerant Oil Adding in this section.

4. Evacuate and charge the refrigerant system. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.

5. Check all refrigerant system hoses, lines and the position of the newly installed filters to be sure they do not interfere with other engine compartment components. If necessary, use tie-straps to make adjustments.

6. Provide adequate airflow to the front of the vehicle (with a fan, if necessary). Select A/C operation and set the blower motor speed to maximum. Start the engine and let it idle briefly. Make sure the A/C system is operating correctly.

7. Gradually bring the engine up to 1,200 rpm by running it at lower rpms for short periods (first at 800 rpm, then at 1,000 rpm). Set the engine at 1,200 rpm and run it for one hour with the A/C system operating.

8. Stop the engine.

9. Recover the refrigerant. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.

10. Remove the fittings, flexible hoses and pancake filter from between the condenser and the condenser to evaporator tube.

11. Discard the pancake filter. It can be used one time only.

12. Reconnect the condenser to evaporator tube to the A/C condenser core.

13. Evacuate, charge and leak-test the refrigerant system. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.

Refrigerant Oil Adding

CAUTION: During normal A/C operation, oil is circulated through the system with the refrigerant, and a small amount is retained in each component. If certain components of the system are removed for new installation, some of the refrigerant oil will go with the component. To maintain the original total oil charge, it is necessary to compensate for the oil lost by adding oil to the system with the new part.

1. **NOTE:** Service A/C compressors are shipped without compressor oil.

   Rotate the A/C compressor shaft six to eight revolutions while collecting oil in a clean measuring device.

   - If the amount of oil drained from the old A/C compressor is between 85-142 ml (3-5 ounces), pour the same amount plus 30 ml (1 ounce) of clean PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) WSH M1C231-B or equivalent into the new A/C compressor.
   - If the amount of oil that was removed from the old A/C compressor is greater than 142 ml (5 ounces), pour the same amount drained of clean PAG Refrigerant Compressor Oil (R-134a Systems) or equivalent into the new A/C compressor.
   - If the amount of oil that was removed from the old A/C compressor is less than 85 ml (3 ounces), pour 85 ml (3 ounces) of clean PAG Refrigerant Compressor Oil (R-134a Systems) or equivalent into the new A/C compressor.

2. For the suction accumulator/drier, drill one 13 mm (0.52 in) hole in the suction accumulator/drier cylinder and drain the oil into a calibrated container.
   - Add a quantity of new oil to match that drained from the old suction accumulator/drier plus 60 ml (2 ounces) of clean PAG Refrigerant Compressor Oil (R-134a Systems) or equivalent.

3. For the A/C evaporator core, add 89 ml (3 ounces) of clean PAG Refrigerant Compressor Oil (R-134a Systems) or equivalent to the suction accumulator/drier inlet tube.

4. For the A/C condenser core, add 30 ml (1 ounce) of clean PAG Refrigerant Compressor Oil (R-134a Systems) or equivalent to the A/C condenser core or the suction accumulator/drier inlet tube.

5. Add 60 ml (2 ounces) of clean PAG Refrigerant Compressor Oil (R-134a Systems) or equivalent to the suction accumulator/drier inlet tube when carrying out each of the following repairs:
   - installation of a new A/C evaporator core orifice
   - installation of a new A/C compressor pressure relief valve (19D644)
   - installation of a new refrigerant line
   - repair of an O-ring seal leak
   - repair of a charge port leak

6. Installation of new components that do not require discharge of refrigerant and resulting oil loss, such as the A/C cycling switch and the A/C pressure switch, do not require additional oil.

Refrigerant Identification Testing

Special Tool(s)

 ST1457-A	Refrigerant Identifier with Air-Radicator 198-00003 or equivalent

1. **NOTE:** An A/C refrigerant analyzer must be used to identify gas samples taken directly from the refrigeration system or storage containers prior to recovering or charging the refrigerant system.

   Follow the instructions included with the Deluxe Refrigerant Diagnostic Tool to obtain the sample for testing.

2. The diagnostic tool will display one of the following:
   - If the purity level of R-134a or R-12 is 98% or greater by weight, the green "PASS" light emitting diode (LED) will light. The weight concentrations of R-134a, R-12, R-22, hydrocarbons, and air will be displayed on the digital display.
   - If refrigerants R-134a or R-12 do not meet the 98% purity levels, the red "FAIL" LED will light and a horn will sound alerting the user of potential hazards. The weight concentrations of R-134a, R-12, R-22, and hydrocarbons will be displayed on the digital display.
   - If hydrocarbon concentrations are 2% or greater by weight, the red "FAIL" LED will light, "Hydrocarbon High" will be displayed on the digital display, and a horn will sound alerting the user of potential hazards. The weight concentrations of R-134a, R-12, R-22, and hydrocarbons will also be displayed on the digital display.

3. The percentage of air contained in the sample will be displayed if the R-134a or R-12 content is 98% or greater. The diagnostic tool eliminates the effect of air when determining the refrigerant sample content because air is not considered a contaminant, although air can affect A/C system performance. When the diagnostic tool has determined that a refrigerant source is pure (R-134a or R-12 is 98% or greater by weight) and air concentration levels are 2% or greater by weight, the diagnostic tool will prompt the user if an air purge is desired.

4. If contaminated refrigerant is detected, repeat the refrigerant identification test to verify that the refrigerant is indeed contaminated.

5. **CAUTION: If contaminated refrigerant is detected, DO NOT recover the refrigerant into R-134a or R-12 recovery/recycling equipment.**

   Recover any contaminated refrigerant using suitable recovery-only equipment designed for capturing and storing contaminated refrigerant. For additional information, refer to Contaminated Refrigerant Handling in this section.

Contaminated Refrigerant Handling

1. **CAUTION: If contaminated refrigerant is detected, DO NOT recover the refrigerant into your recovery/recycling equipment.**

   Recover the contaminated refrigerant using suitable recovery-only equipment designed for capturing and storing contaminated refrigerant.

   - This equipment must only be used to recover contaminated refrigerant to prevent the spread to other vehicles.
   - If this equipment is not available, contact an A/C service facility in your area with the correct equipment to carry out this service.

2. Determine and correct the cause of the customer's initial concern.

3. **NOTE:** Residual refrigerant oil in the suction accumulator/drier must be drained and measured for correct oil system matching. For additional information, refer to Refrigerant Oil Adding in this section.

   The suction accumulator/drier cannot be cleaned. A new suction accumulator/drier must be installed.
   Remove the suction accumulator/drier.

4. Clean the A/C evaporator core and the A/C condenser core by flushing. For additional information, refer to Air Conditioning (A/C) System Flushing in this section.

5. Install the new suction accumulator/drier.

6. Correctly oil match the system. For additional information, refer to Refrigerant Oil Adding in this section.

7. Evacuate and charge the system. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.

8. Dispose of contaminated refrigerant according to all federal, state and local regulations.

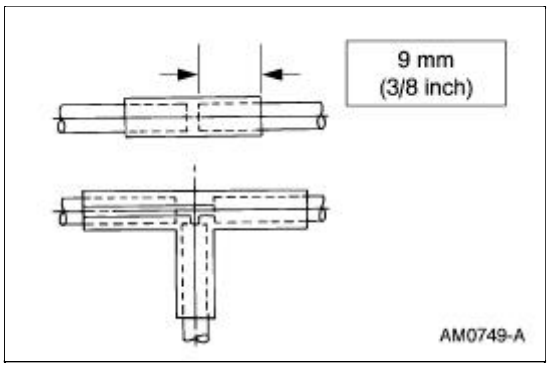
Vacuum Hose Repair —Mini-Tube

Special Tool(s)

 ST1176-A	Vacuum Pump Kit 416-D002 (D95L-7559-A) or equivalent

1. Measure the length of the damaged area of the mini-tube vacuum hose.
2. Cut a piece of standard 1/8 inch inner diameter vacuum hose approximately 25 mm (1 inch longer than the damaged area of the mini-tube vacuum hose).
3. Cut off the mini-tube vacuum hose on each side of the damaged area.
4. **WARNING: Read the warning information on the product label to prevent possible personal injury.**

   Dip the mini-tube hose ends in commercially available paint thinner containing methyl ethyl ketone (MEK). This solvent will seal the mini-tube in the vacuum hose.
5. Insert the ends of the mini-tube vacuum hose approximately 9 mm (3/8 inch) into the ends of the standard 1/8 inch repair vacuum hose section.



6. Shake the repair joint after assembly to make sure the solvent is dispersed and the vacuum line is not plugged.
7. Test the system for a vacuum leak in the repair area.
   - Use the Vacuum Pump or equivalent.

General Specifications

Item	Specification
Lubricants	
MERPOL® (coolant hose lubricant)	ESE-M99B144-B
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B

Torque Specifications

Description	Nm	lb-ft	lb-in
Powertrain control module bracket bolts	10	—	89
Plenum chamber mounting nuts	5	—	44

Air Distribution

NOTE: The air distribution system of this vehicle cannot be equipped with a cabin air filter.

There are two sources of air available to the air distribution system:

- outside air
- recirculated air

Recirculated air is only used when the climate control assembly is set to the MAX A/C and OFF modes on vehicles equipped with manual climate control. Vehicles equipped with EATC or DATC use recirculated air only when in the AUTOMATIC mode (if functioning to obtain selected temperatures), or when the RECIRC function is selected.

Air distribution within the vehicle is determined by the function selector switch position (manual A/C), or the EATC/DATC system in the AUTOMATIC mode. The air distribution mode on vehicles equipped with EATC or DATC can be overridden by the driver if desired. Airflow mode control doors are used to direct airflow within the heater air plenum chamber. Vacuum control motors are used to position these airflow mode control doors.

Vehicles equipped with DATC use a partitioned plenum chamber with two separate temperature blend doors. This allows for individual temperature settings to be selected for the RH and LH air outlets. The airflow mode doors are not partitioned for separate RH and LH airflow positions, therefore the airflow mode will always remain similar for the RH and LH sides of the vehicle regardless of the temperatures selected.

The air distribution system is designed to provide airflow from the defrost nozzle when no vacuum is applied to any of the vacuum control motors. This is done to prevent a situation where defrost cannot be obtained due to a system vacuum leak.

Air enters the passenger compartment from the:

- instrument panel A/C registers.
- heater outlet floor duct.
- windshield defroster hose nozzle.
- side window demisters.
- rear seat airflow duct (if equipped).

Passenger compartment air is exhausted from the vehicle through open windows or body air vents.

Air Distribution

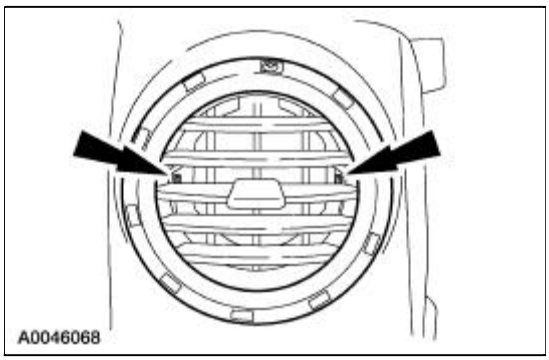
Refer to Section 412-00 .

Instrument Panel Registers —Expedition

Removal and Installation

1. **NOTE:** Do not separate the outer ring from the register assembly.

   Depress the tabs and remove the instrument panel register.

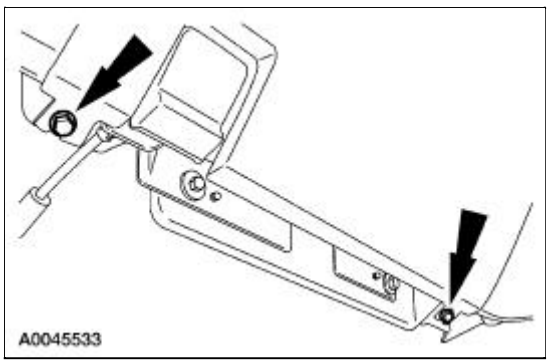


2. To install, reverse the removal procedure.

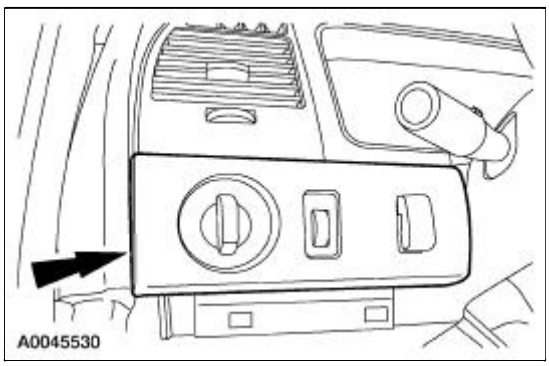
Driver Side Register —Navigator

Removal and Installation

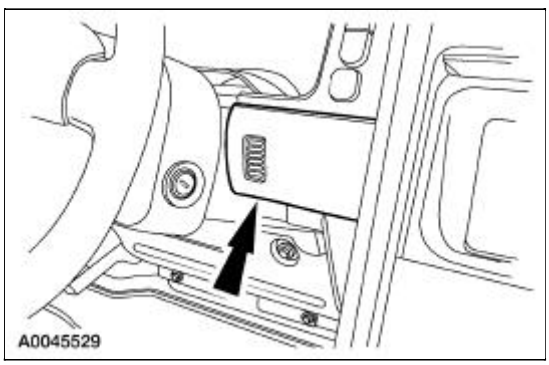
1. Remove the screws and remove the lower steering column cover.



2. Remove the headlamp switch trim panel.
   - Disconnect the electrical connectors.

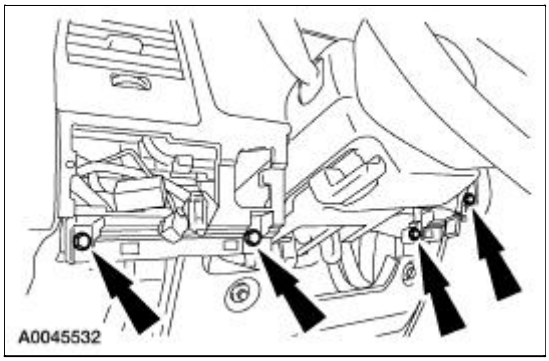


3. Remove the in-vehicle temperature sensor trim panel.
   - Disconnect the aspirator hose and in-vehicle temperature sensor electrical connector.

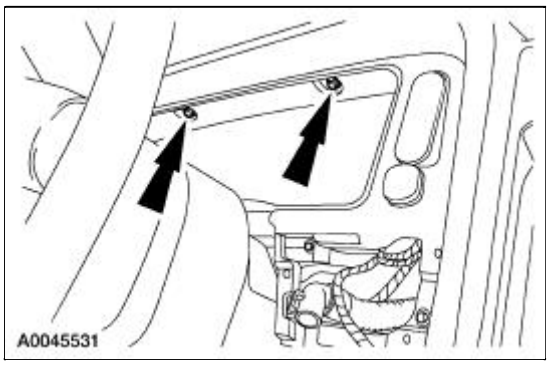


4. Lower the steering wheel to the lowest position.

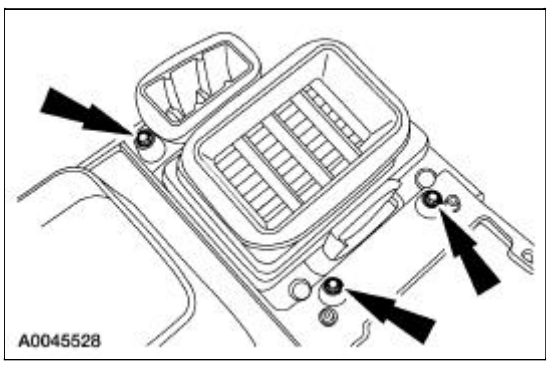
5. Remove the instrument cluster finish panel lower screws.



6. Remove the screws and remove the instrument panel finish panel.
    - Disconnect the electrical connectors.



7. Remove the screws and remove the driver side register.



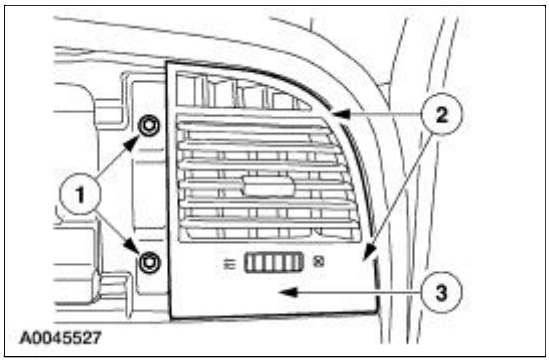
8. To install, reverse the removal procedure.

Passenger Side Register —Navigator

Removal and Installation

1. Remove the passenger airbag module. For additional information, refer to Section 501-20B .

2. Remove the passenger side register.
    1. Remove the screws.
    2. Disengage the clips.
    3. Remove the passenger side register.



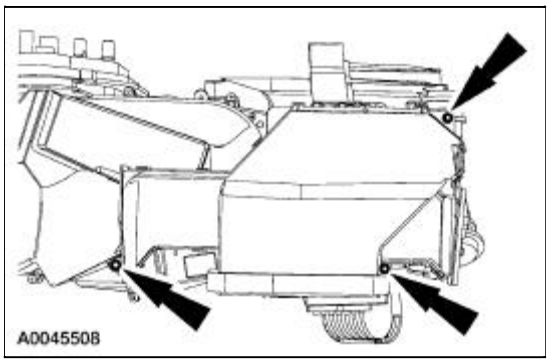
3. To install, reverse the removal procedure.

Floor Duct

Removal and Installation

1. Remove the plenum chamber. For additional information, refer to Plenum Chamber in this section.

2. Remove the screws and remove the floor duct.



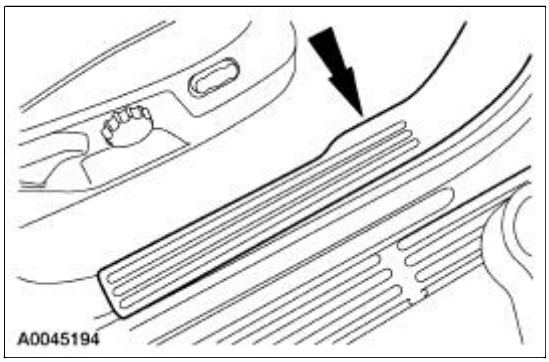
3. To install, reverse the removal procedure.

Rear Footwell Duct

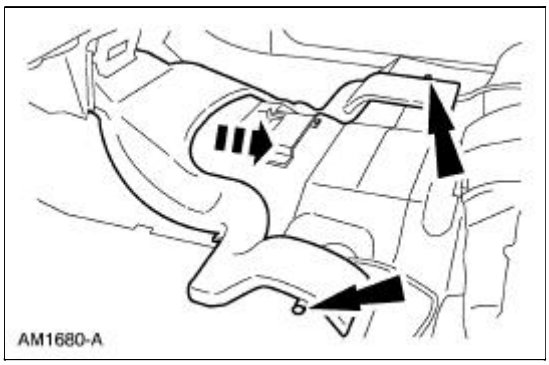
Removal and Installation

1. Remove the front seats. For additional information, refer to Section 501-10 .
2. Remove the center floor console. For additional information, refer to Section 501-12 .
3. **NOTE:** RH cowl trim and sill plate shown, LH similar.

   Remove the RH and LH cowl trim panel and sill plates.



4. Fold back the carpet to completely uncover the rear footwell duct.
5. Remove the pin-type retainers and remove the duct.



6. To install, reverse the removal procedure.

Plenum Chamber

Material

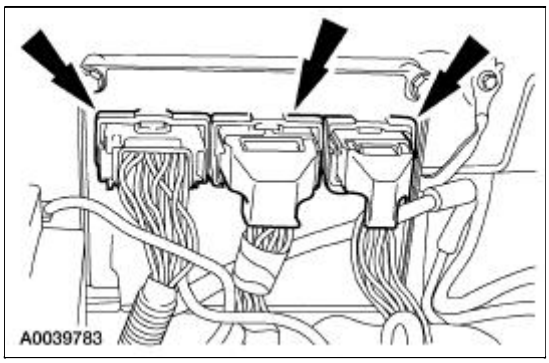
Item	Specification
MERPOL®	ESE-M99B144-B
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B

Removal and Installation

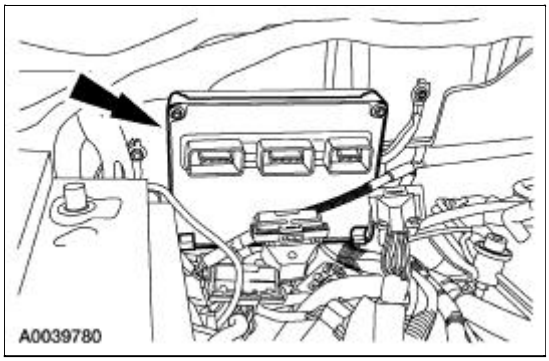
NOTE: If an evaporator core leak is suspected, the evaporator must be vacuum leak tested before it is removed from the vehicle. For additional information, refer to Section 412-00 .

NOTE: Installation of a new receiver/drier is not required when repairing the air conditioning system except when there is physical evidence of contamination from a failed A/C compressor or damage to the receiver/drier.

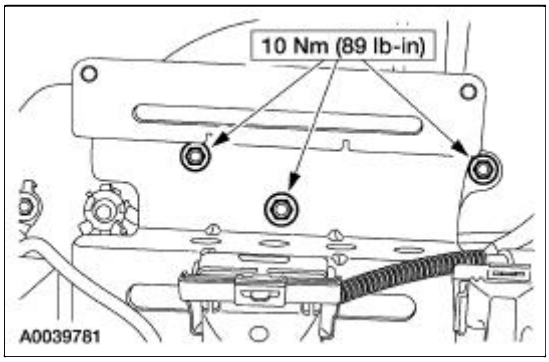
1. Recover the refrigerant. For additional information, refer to Section 412-00 .
2. Remove the instrument panel. For additional information, refer to Section 501-12 .
3. Remove the rear footwell duct. For additional information, refer to Rear Footwell Duct in this section.
4. Disconnect the powertrain control module (PCM) electrical connectors.



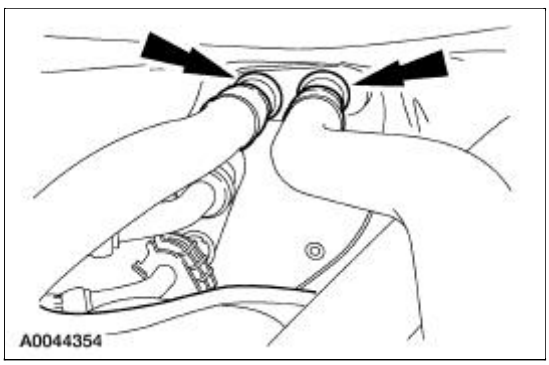
5. Remove the bolts and remove the PCM.



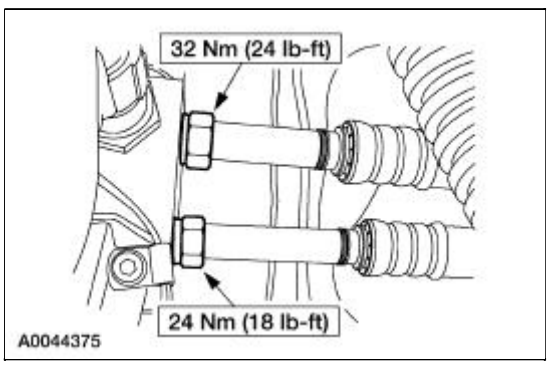
6. Remove the bolts and remove the PCM bracket.



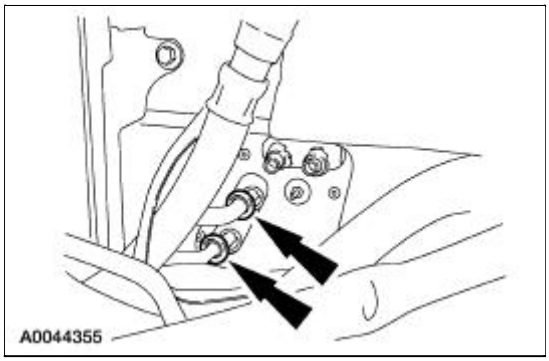
7. Clamp off the heater hoses and disconnect the quick-disconnect fittings at the heater core.



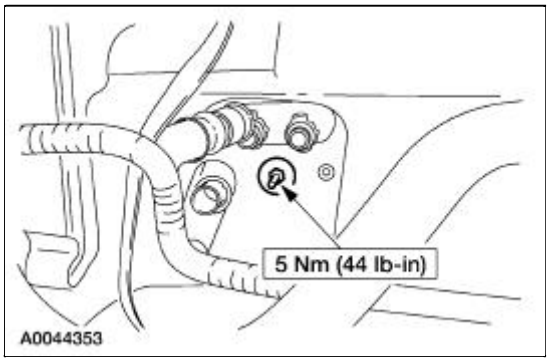
8. Disconnect the fittings at the thermostatic expansion valve.
    - Discard the O-ring seals.



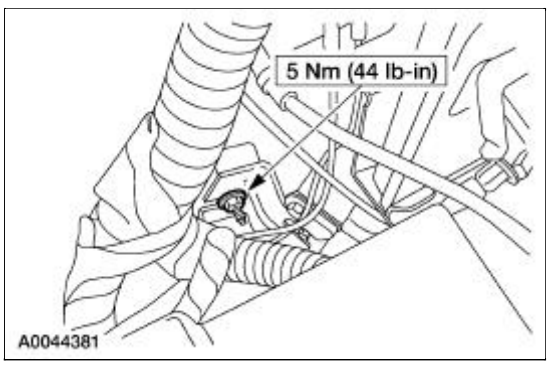
9. Disconnect the A/C fittings at the evaporator core.
    - Discard the O-ring seals.



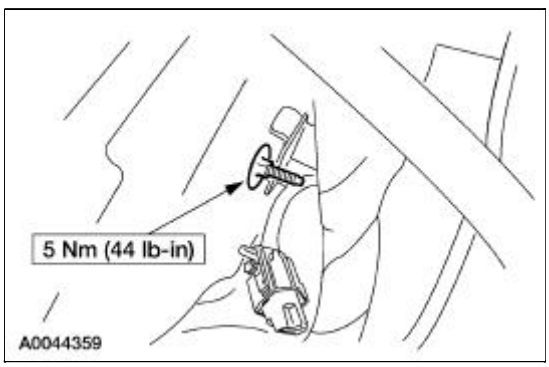
10. Remove the nut.



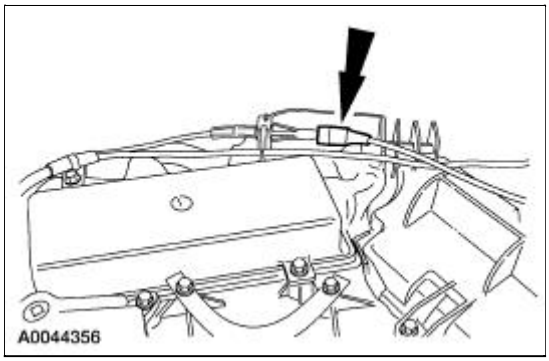
11. Remove the nut.



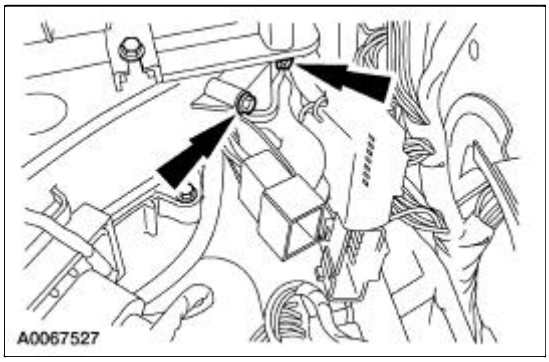
12. Remove the nut.



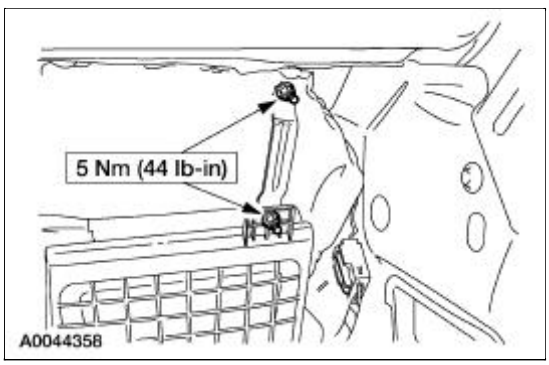
13. Disconnect the two vacuum lines at the top of the plenum chamber.



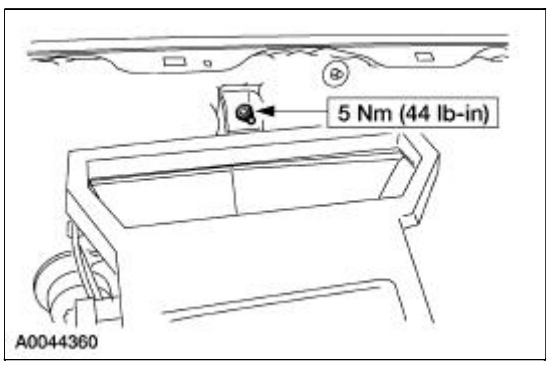
14. Remove the screws and position the wire harness aside.



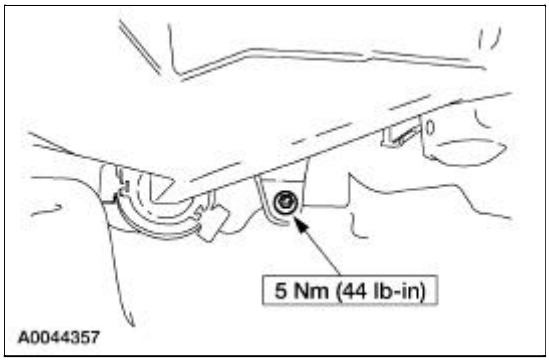
15. Remove the nuts.



16. Remove the nut.



17. Remove the nut and remove the plenum chamber.



18. To install, reverse the removal procedure.
    - Install new O-ring seals lubricated in clean PAG oil.
    - Lubricate the refrigerant system with the correct amount of clean PAG oil. For additional information, refer to Section 412-00 .
    - Clean and lubricate the coolant hoses with coolant hose lubricant or plain water only if needed.

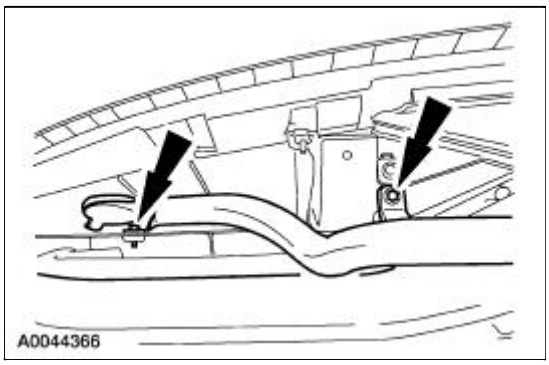
19. Refill the engine coolant level. For additional information, refer to Section 303-03 .

20. Evacuate, leak test and charge the refrigerant system. For additional information, refer to Section 412-00 .

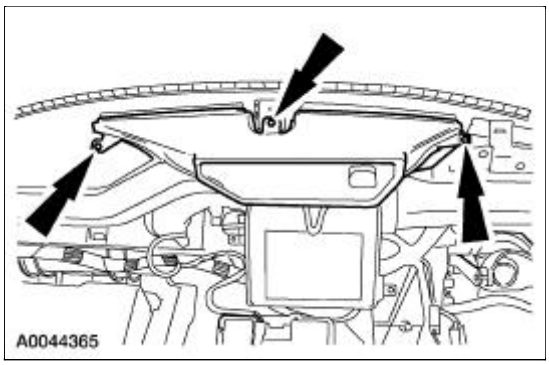
Instrument Panel Air Distribution Ducts —Expedition

Disassembly and Assembly

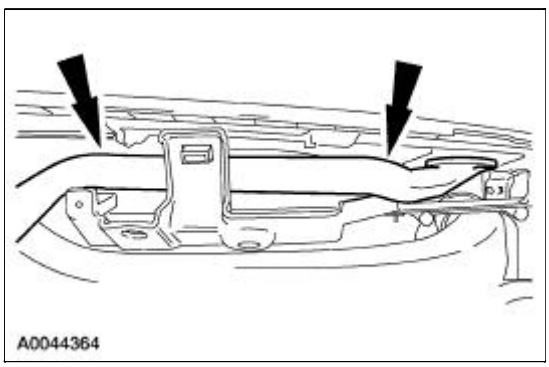
1. Remove the instrument panel. For additional information, refer to Section 501-12 .
2. Remove the screws and remove the RH demister.



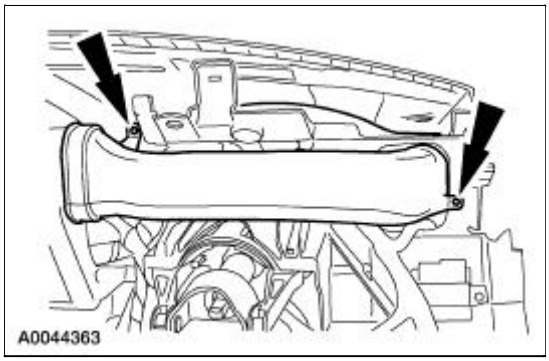
3. Remove the screws and remove the defroster duct.



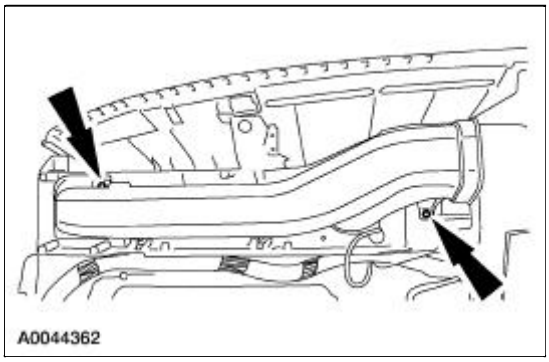
4. Remove the screws and remove the LH demister.



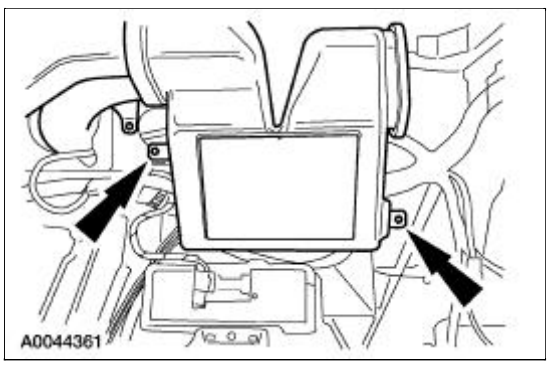
5. Remove the screws and remove the LH panel duct.



6. Remove the RH panel duct screws.



7. Remove the center panel duct screws and remove the center and RH panel ducts.

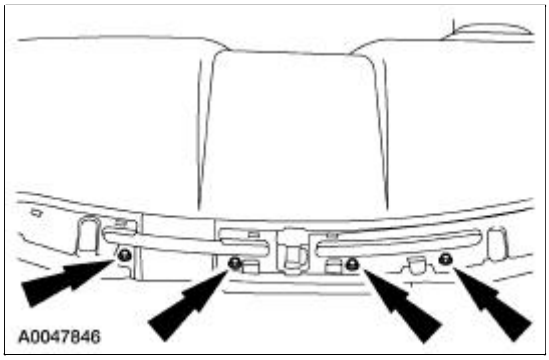


8. To assemble, reverse the disassembly procedure.

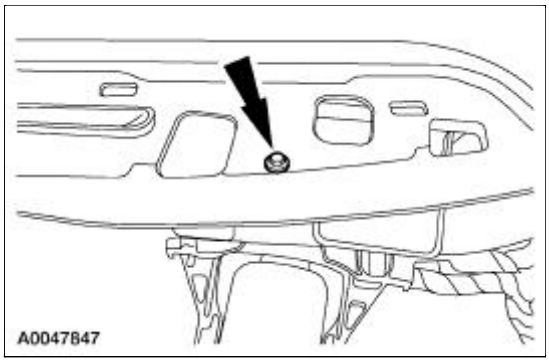
Instrument Panel Air Distribution Ducts —Navigator

Disassembly and Assembly

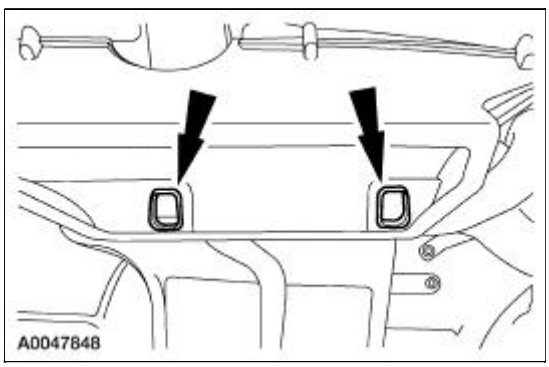
1. Remove the instrument cluster. For additional information, refer to Section 413-01 .
2. Remove the instrument panel. For additional information, refer to Section 501-12 .
3. Remove the defroster duct screws.



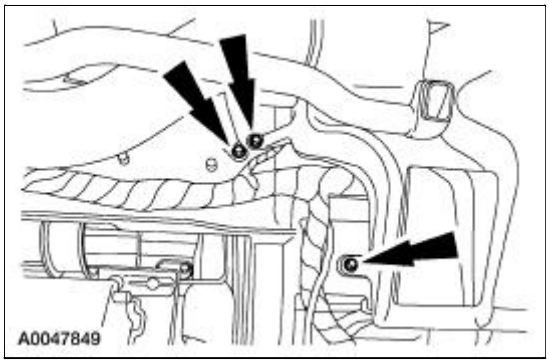
4. Remove the instrument panel upper pad screw.



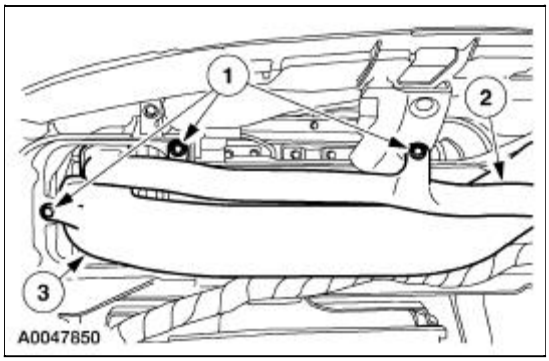
5. Detach the demisters and remove the defroster duct.



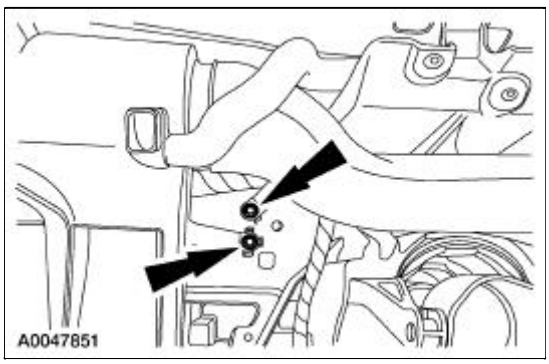
6. Remove the screws.



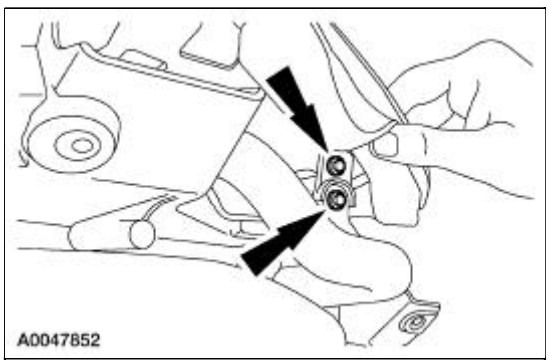
7. Remove the RH ducts.
    1. Remove the screws.
    2. Remove the RH demister.
    3. Remove the RH instrument panel duct.



8. Remove the screws and the center instrument panel duct.

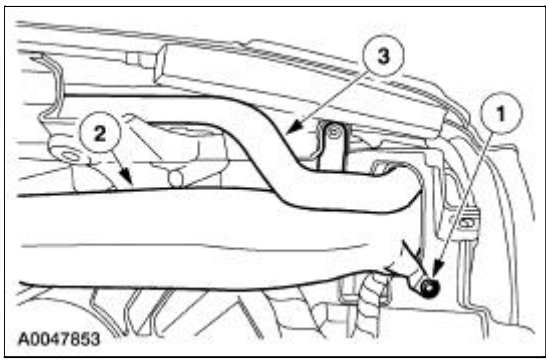


9. Remove the screws.



10. Remove the LH ducts.
    1. Remove the screw.

2. Rotate upwards, and remove the LH instrument panel duct.
3. Remove the LH demister.



11. To assemble, reverse the disassembly procedure.

Heating and Ventilation

The heating and ventilation system has the following features:

- Controls the temperature and, during A/C operation, reduces the relative humidity of the air inside the vehicle.
- Delivers heated or cooled air to maintain the vehicle interior temperature and comfort level.
- Controls the A/C blower motor speed.
- Cooling or heating can be adjusted to maintain the desired temperature.
- Uses a reheat method to provide conditioned air to the passenger compartment.
- The blower motor draws outside air through the air inlet duct, except for MAX A/C (manual climate control), or when the RECIRC mode (EATC/DATC) has been selected.
- All airflow from the blower motor passes through the A/C evaporator core.
- Temperature blending is controlled by the temperature blend door(s), which regulate(s) the amount of air that flows through and around the heater core, where it is then mixed and distributed.

Heater Core

The heater core consists of fins and tubes arranged to extract heat from the engine coolant and transfer the heat to air passing through the plenum.

Blower Motor

The blower motor pulls air from the air inlet and forces it into the plenum chamber where it is mixed and distributed.

Plenum Chamber

The plenum chamber directs airflow from the blower motor through the evaporator core and heater core. All airflow from the blower motor passes through the evaporator core. Airflow is then directed through or around the heater core by the temperature blend door(s). Vehicles equipped with DATC use a partitioned plenum chamber with two electric actuator-positioned temperature blend doors. This allows for separate temperatures to be selected for the driver and passenger sides of the passenger compartment. Manual systems and EATC systems use a single electric actuator-positioned temperature blend door to direct airflow through or around the heater core.

Heating and Ventilation

Refer to Section 412-00 .

Blower Motor

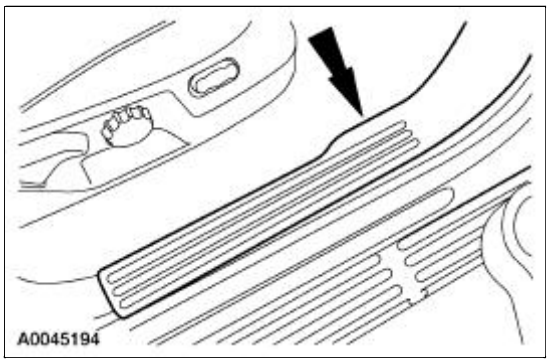
Removal and Installation

All vehicles

1. Remove the RH lower instrument panel insulator.

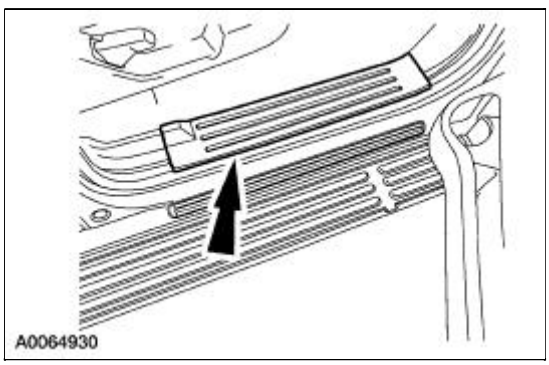
Navigator only

2. Remove the RH scuff plate.

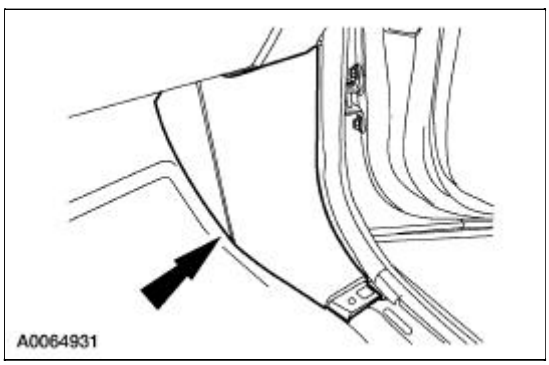


Expedition only

3. Remove the RH scuff plate.

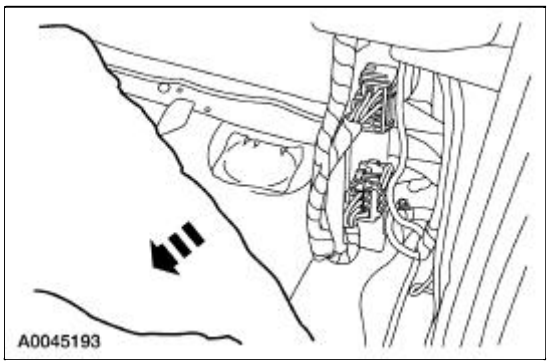


4. Remove the RH lower A-pillar trim panel.

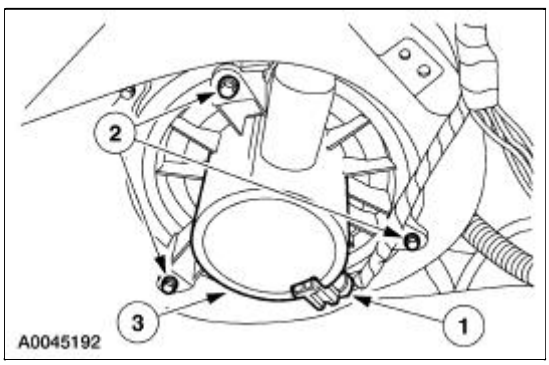


All vehicles

5. Position the carpet aside.



6. Remove the blower motor.
    1. Disconnect the electrical connector and position the wire harness aside.
    2. Remove the screws.
    3. Remove the blower motor.



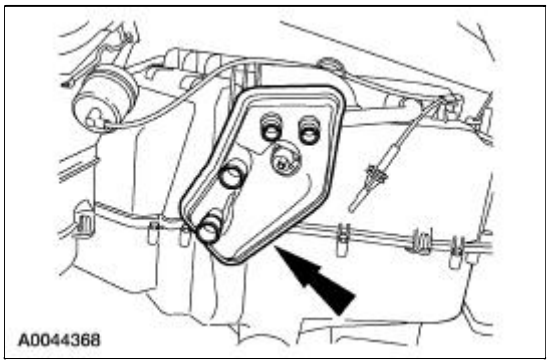
7. To install, reverse the removal procedure.

Heater Core

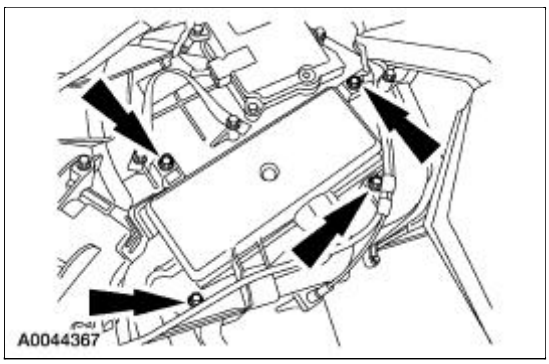
Removal and Installation

NOTE: If a heater core leak is suspected, the heater core must be leak tested before it is removed from the vehicle. For additional information, refer to Section 412-00 .

1. Remove the plenum chamber. For additional information, refer to Section 412-01 .
2. Remove the dash panel seal.



3. Remove the screws and the heater core cover.



4. Remove the heater core.
5. To install, reverse the removal procedure.

General Specifications

Item	Specification
Magnetic Clutch	
Air gap clearance	0.35-0.75 mm (0.014-0.030 in)
Lubricant	
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B

Torque Specifications

Description	Nm	lb-ft	lb-in
Compressor manifold and tube bolt	20	15	—
A/C Compressor mounting bolt/studs	25	18	—
PCM bracket bolts	10	—	89
Evaporator outlet line fitting at TXV	32	24	—
Evaporator inlet line fitting at TXV	24	18	—
TXV manifold and tube bolt	21	15	—
Air conditioning (peanut) fittings	8	—	71
Radiator bracket bolts	12	9	—
Condenser bracket bolts	9	—	80
TXV bracket bolts	9	—	80
Receiver/drier bracket nuts	12	9	—

Air Conditioning

The air conditioning system components are:

- A/C compressor (19703).
- A/C condenser core (19712).
- A/C evaporator core.
- receiver/drier (19959).
- connecting refrigerant lines.
- thermostatic expansion valve (19849).
- A/C thermostatic switch.
- A/C high pressure cutoff switch (19D594).
- A/C compressor pressure relief valve (19D644).
- low charge protection switch

The refrigerant system incorporates an A/C compressor controlled by the powertrain control module (PCM) through an A/C clutch relay.

The A/C compressor clutch will only be engaged by the PCM if all of the following conditions are met:

- The climate control assembly is set to a mode which provides an A/C request to the PCM.
- The A/C thermostatic switch is reading a temperature above 37°F.
- The high pressure cutoff switch is not open due to excessive pressure in the high side of the refrigerant system.
- The low charge protection switch is not open due to insufficient low side refrigerant system pressure.
- The A/C compressor relay is switched to the closed position by the PCM.
- The engine coolant temperature is not excessively high.
- The PCM has not detected a wide open throttle (WOT) condition.

For additional information concerning operating specifications, refer to Section 412-00 .

An A/C compressor pressure relief valve is installed in the compressor manifold and tube assembly (19D734) to protect the refrigerant system against excessively high refrigerant pressures.

Refrigerant flow into the evaporator core is metered by a thermostatic expansion valve.

For additional information concerning the refrigerant cycle and principles of A/C operation, refer to Section 412-00 .

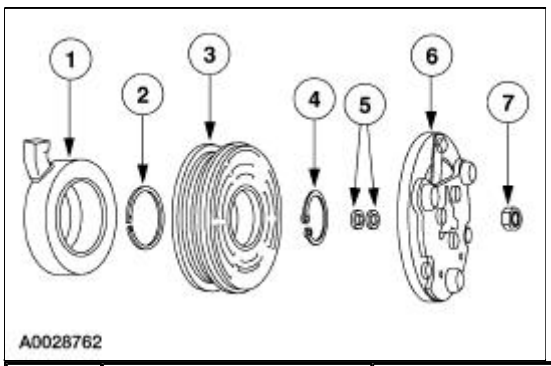
A/C Compressor and Clutch Assembly

NOTE: Internal A/C compressor components are not serviced separately. The SC115 A/C compressor is serviced only as an assembly. The clutch plate, clutch pulley and bearing (19D784), and clutch field coil (19D798) are serviceable.

NOTE: Installation of a new receiver/drier is not required when repairing the air conditioning system except when there is physical evidence of system contamination from a failed A/C compressor or damage to the receiver/drier.

The SC115 A/C compressor has the following characteristics:

- Tangential mount design - three lugs.
- The single manifold block of the compressor manifold and tube assembly fits to the suction and discharge ports. Two O-ring seals are used for sealing.
- An eccentric bushing is driven by the shaft of the A/C compressor.
- An orbiting scroll driven by the eccentric bushing compresses the refrigerant gas against the walls of the fixed scroll.
- Single reed-type discharge valve mounted on the back of the fixed scroll. There are no suction valves.
- Non-serviceable shaft seal fully supported on both sides by bearings.
- The A/C compressor uses PAG oil or equivalent. This oil contains special additives required for the A/C compressor.
- The A/C compressor oil from vehicles equipped with an SC115 A/C compressor may have some slightly dark-colored streaks while maintaining normal oil viscosity. This is normal for this A/C compressor because of break-in wear of the scroll seals that can discolor the oil.
- Use standard oil matching procedures when installing new compressors.



Item	Part Number	Description
1	19D798	A/C clutch field coil
2	W704579-S301	A/C clutch field coil snap ring
3	19D784	A/C clutch pulley
4	W701742-S301	A/C clutch pulley snap ring
5	19D648	A/C clutch hub spacer
6	19D786	A/C clutch
7	W704577-S301	A/C clutch nut

When battery voltage is applied to the A/C compressor clutch field coil, the clutch plate and hub assembly is drawn toward the A/C clutch pulley. The magnetic force locks the clutch plate and hub assembly and the A/C clutch pulley together as one unit, causing the compressor shaft to rotate. When battery voltage is removed from the A/C compressor clutch field coil, springs in the clutch plate and hub assembly move the clutch plate away from the A/C clutch pulley.

Thermostatic Expansion Valve

The thermostatic expansion valve (TXV) is located between the evaporator core lines and the thermostatic expansion valve manifold and tube assembly at the RH rear of the engine compartment.

The TXV provides a restriction to the flow of refrigerant from the high pressure side of the refrigerant system, and separates the low pressure and high pressure sides of the refrigerant system. Refrigerant entering and exiting the evaporator core passes through the TXV through two separate flow paths. An internal temperature sensing bulb senses the temperature of the refrigerant flowing out of the evaporator core and adjusts an internal pin-type valve to meter the refrigerant flow into the evaporator core. The internal pin-type valve decreases the amount of refrigerant entering the evaporator core at lower temperatures, and increases the amount of refrigerant entering the evaporator core at higher temperatures.

A/C Thermostatic Switch

The A/C thermostatic switch monitors the temperature of the refrigerant exiting the evaporator core into the TXV. It is used (by the PCM) to prevent freezing of the evaporator core by controlling A/C compressor clutch engagement/disengagement. Battery voltage is sent to the A/C thermostatic switch (via the low charge protection switch) when the ignition switch is in the RUN position. The A/C thermostatic switch either completes the circuit to the PCM (when the refrigerant temperature rises), or interrupts the circuit (when the refrigerant temperature drops). The PCM engages the A/C compressor clutch when the circuit is complete and an A/C request has been received from the climate control assembly. For specifications regarding operating temperature(s), refer to Section 412-00.

The A/C thermostatic switch is mounted on the TXV. Thermal grease must be applied to the A/C thermostatic switch probe when installing it into the TXV.

Low Charge Protection Switch

CAUTION: It is necessary to recover the refrigerant from the A/C system before removing the low charge protection switch.

The low charge protection switch (19E561) is used to prevent A/C compressor damage in the event of a low refrigerant charge, by interrupting voltage to the A/C thermostatic switch and the PCM, when the low side refrigerant pressure drops below acceptable levels. The electrical switch contacts open when the suction pressure drops below normal levels. The contacts close when the suction pressure rises. For specifications regarding operating pressure(s), refer to Section 412-00.

The low charge protection switch is mounted on the TXV.

High Pressure Cutoff Switch

The high pressure cutoff switch is used to interrupt A/C compressor operation by interrupting the voltage circuit to the low charge protection switch in the event of high system discharge pressures. When the A/C compressor discharge pressure rises, the switch contacts open to disengage the A/C compressor. When the pressure drops, the contacts close to allow operation of the A/C compressor. For specifications regarding operating pressure(s), refer to Section 412-00.

The high pressure cutoff switch is mounted on a Schrader valve-type fitting on the high pressure side of the compressor manifold and tube assembly. It is not necessary to discharge the refrigerant system to remove the high pressure cutoff switch.

Condenser Core

NOTE: Installation of a new receiver/drier is not required when repairing the air conditioning system except when there is physical evidence of system contamination from a failed A/C compressor or damage to the receiver/drier.

The condenser is an aluminum fin and tube design heat exchanger, located in front of the vehicle radiator (8005). It cools compressed refrigerant gas by allowing air to pass over fins and tubes to extract heat, and by condensing gas to liquid refrigerant as it is cooled.

Evaporator Core

NOTE: If an evaporator core leak is suspected, the evaporator core must be vacuum leak tested before it is removed from the vehicle. For additional information, refer to Section 412-00 .

NOTE: Installation of a new receiver/drier is not required when repairing the air conditioning system except when there is physical evidence of system contamination from a failed A/C compressor or damage to the receiver/drier.

The evaporator core is an aluminum plate/fin type and is located in the plenum chamber. A mixture of refrigerant and oil enters the bottom of the evaporator core through the evaporator core inlet tube, continues over to the remaining five plate/fin sections, and then moves out of the evaporator core through the evaporator core outlet tube. Air from the blower motor is cooled and dehumidified as it flows through the evaporator core fins.

Receiver/Drier

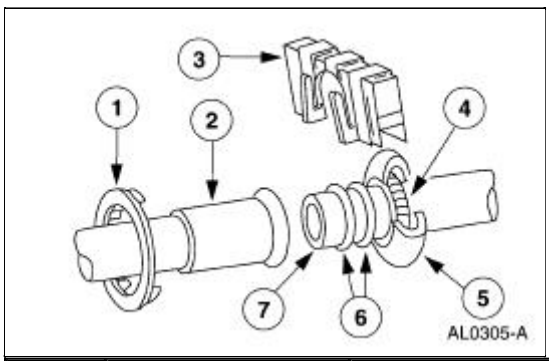
NOTE: Installation of a new receiver/drier is not required when repairing the refrigerant system except when there is physical evidence of contamination from a failed A/C compressor or damage to the receiver/drier.

The receiver/drier is mounted to the right of the radiator support. It stores high pressure liquid after it leaves the condenser core. A desiccant bag mounted inside the receiver/drier removes any retained moisture from the refrigerant.

A/C Compressor Pressure Relief Valve

An A/C compressor pressure relief valve is incorporated in the compressor manifold and tube assembly to prevent damage to the A/C compressor and other system components, and to avoid total refrigerant loss by relieving unusually high refrigerant system discharge pressure buildups. For additional information, regarding operating pressure(s) specifications, refer to Section 412-00 .

Spring Lock Coupling



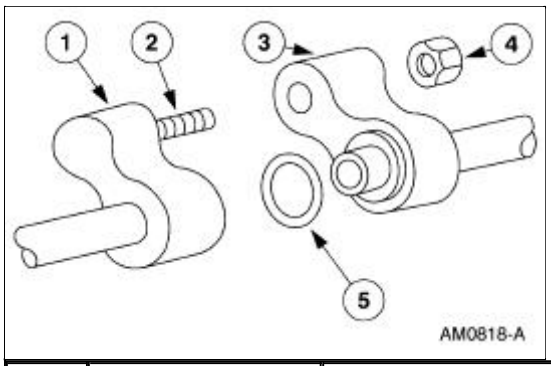
Item	Part Number	Description
1	—	Plastic indicator ring
2	—	Female fitting
3	19E746	A/C tube lock coupling clip
4	19E576	A/C tube lock coupling spring
5	—	Cage
6	—	O-ring seals (2 req'd)
7	—	Male fitting

NOTE: Use only the O-ring seals listed in the Ford Master Parts Catalog for the spring lock coupling.

The spring lock coupling is a refrigerant line coupling held together by a garter spring inside a circular cage. When the coupling is connected together, the flared end of the female fitting slips behind the garter spring inside the cage of the male fitting. The garter spring and cage then prevent the flared end of the female fitting from pulling out of the cage. Three O-ring seals are used to seal between the two halves of the couplings. A plastic indicator ring is used on the spring lock couplings of the evaporator core to indicate, during vehicle assembly, that the coupling is connected. Once the coupling is connected, the indicator ring is no longer necessary but will remain captive by the coupling near the cage opening. The indicator ring can also be used during service operations to indicate connection of the coupling. An A/C tube lock coupling clip (19E746) can be used to secure the coupling but is not required.

Peanut Fitting

Some A/C lines use peanut shaped fittings instead of spring lock couplings for attachment and sealing. The male and female blocks of the peanut fitting are retained with a nut. An O-ring seal is installed around the tube on the male block. When correctly assembled the male and female fittings should be flush.

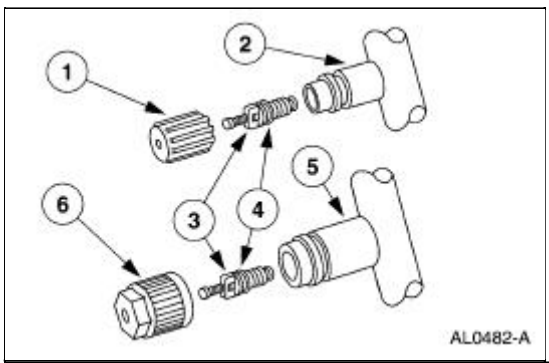


Item	Part Number	Description
1	—	Female block (part of tube assembly)
2	W701890-S426	Stud (part of female block)
3	—	Male block (part of 19712)
4	W520413-S301	Nut
5	—	O-ring seal

Service Gauge Port Valves

The high pressure service gauge port valve is located on the compressor manifold and tube assembly.

The low pressure service gauge port valve is located on the thermostatic expansion valve manifold and tube assembly suction tube.



Item	Part Number	Description
1	19D702	A/C charging valve cap

2	19D701	Low pressure service gauge port valve
3	—	Schrader-type valve
4	—	O-ring seal
5	19D701	High pressure service gauge port valve
6	19D702	A/C charging valve cap

NOTE: Always install the A/C charging valve cap (19D702) on the service gauge port valves after repairing the refrigerant system.

The fitting is an integral part of the refrigeration line or component, special couplings are required for both the high-side and low-side service gauge ports. A new Schrader-type valve core can be installed if the seal leaks.

Air Conditioning

Refer to Section 412-00 .

Air Conditioning (A/C) Compressor

Material

Item	Specification
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B

Removal and Installation

CAUTION: If installing a new air conditioning (A/C) compressor (19703) due to an internal failure of the old unit, you must carry out the following procedures to remove contamination from the air conditioning system:

- **If A/C flushing equipment is available, carry out flushing of the air conditioning system. For additional information, refer to Section 412-00 .**
- **If A/C flushing equipment is not available, carry out filtering of the air conditioning system after a new air conditioning compressor has been installed. For additional information, refer to Section 412-00 .**
- **Install a new thermostatic expansion valve (TXV) (19849) as directed by the A/C flushing or filtering procedure.**
- **Install a new receiver/drier (19959) as directed by the A/C flushing or filtering procedure.**

NOTE: Installation of a new receiver/drier is not required when repairing the air conditioning system except when there is physical evidence of contamination from a failed A/C compressor or damage to the receiver/drier.

4x4 vehicles

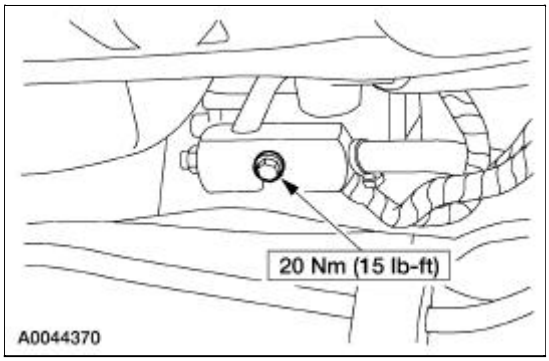
1. Remove the cooling fan and shroud. For additional information, refer to Section 303-03 .

All vehicles

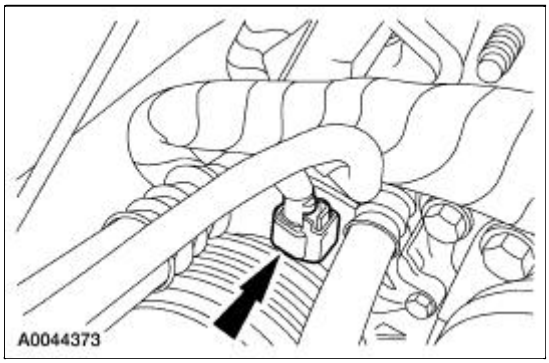
2. If flushing of the air conditioning system has not been carried out, recover the refrigerant. For additional information, refer to Section 412-00 .

3. Remove the drive belt from the A/C compressor pulley.

4. Loosen the bolt and detach the compressor manifold and tube assembly.
   - Discard the O-ring seals.

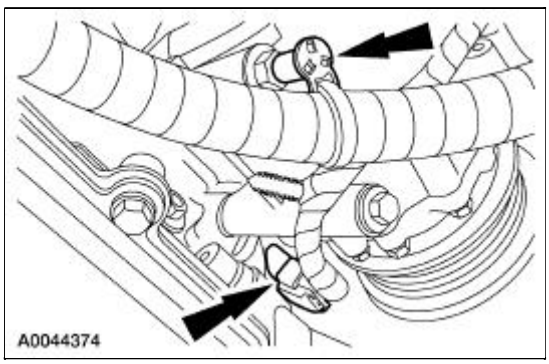


5. Disconnect the field coil electrical connector.

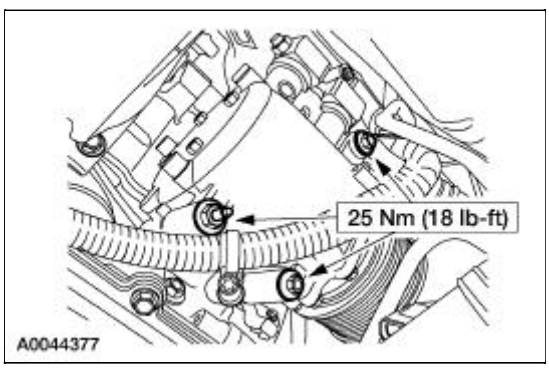


6. Raise the vehicle. For additional information, refer to Section 100-02 .

7. Disconnect the crankshaft position sensor electrical connector and detach the wiring harness.



8. Remove the bolts and the stud.



4x2 vehicles

9. Remove the A/C compressor.

4x4 vehicles

10. Lower the vehicle and remove the A/C compressor.

All vehicles

11. To install, reverse the removal procedure.
    - Install new O-ring seals lubricated in clean PAG oil.
    - If filtering of the refrigerant system is not to be carried out, lubricate the refrigerant system with the correct amount of clean PAG oil. For additional information, refer to Section 412-00 .
12. If filtering of the refrigerant system is not to be carried out, evacuate, charge and leak test the refrigerant system. For additional information, refer to Section 412-00 .

Thermostatic Expansion Valve

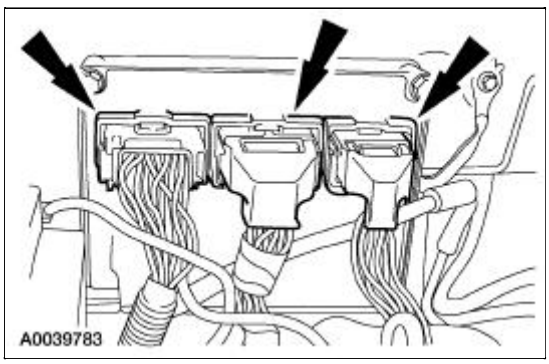
Material

Item	Specification
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B

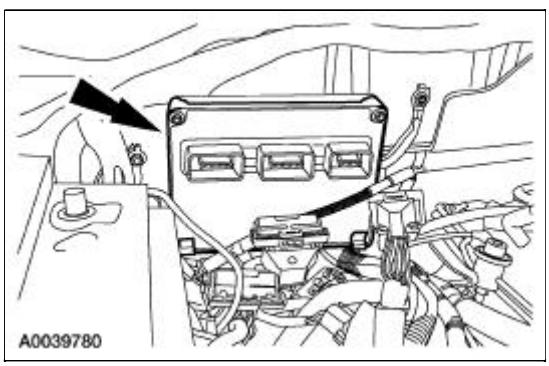
Removal and Installation

NOTE: Installation of a new receiver/drier is not required when repairing the air conditioning system except when there is physical evidence of system contamination from a failed A/C compressor or damage to the receiver/drier.

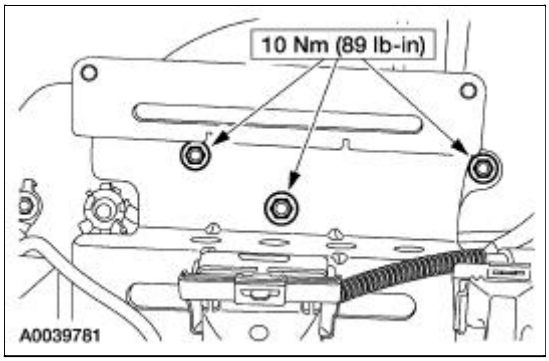
1. Recover the refrigerant. For additional information, refer to Section 412-00 .
2. Disconnect the negative battery cable. For additional information, refer to Section 414-01 .
3. Disconnect the powertrain control module (PCM) electrical connectors.



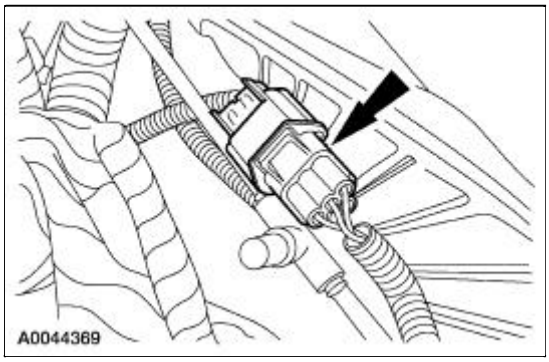
4. Remove the bolts and the PCM.



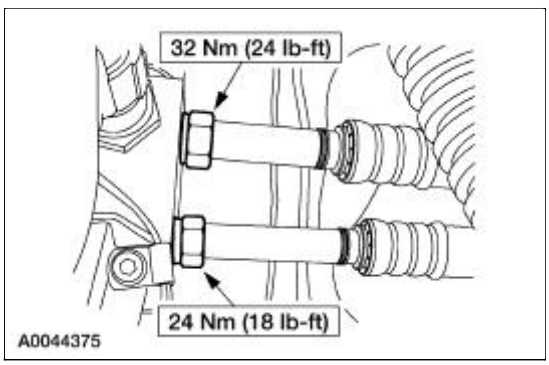
5. Remove the bolts and the PCM bracket.



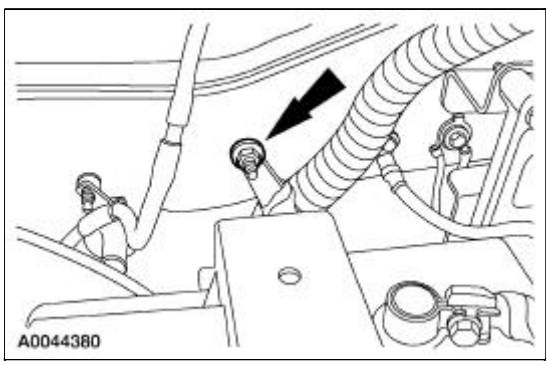
6. Disconnect the electrical connector.



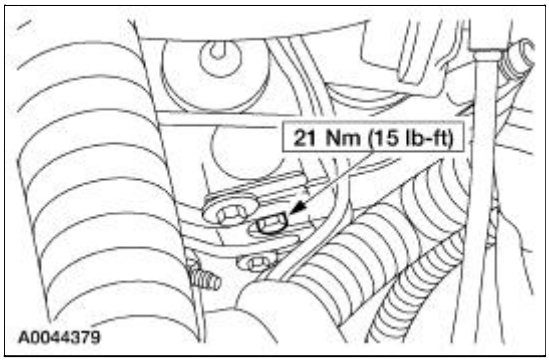
7. Disconnect the evaporator line fittings.
    - Discard the O-ring seals.



8. Remove the nut and position the wiring harness aside.



9. Remove the bolt and the thermostatic expansion valve.
    - Discard the O-ring seals.

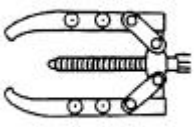


10. To install, reverse the removal procedure.

11. Evacuate, leak test and charge the refrigerant system. For additional information, refer to Section 412-00 .

Clutch and Clutch Field Coil

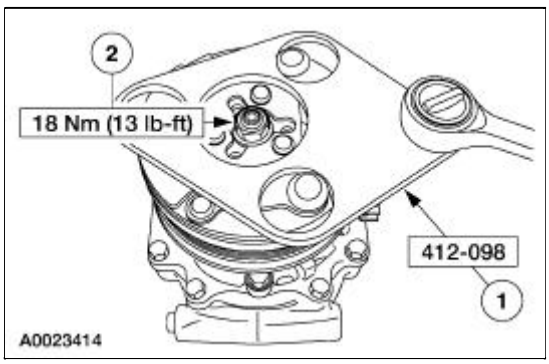
Special Tool(s)

 ST1260-A	2-Jaw Puller 205-D026 (D80L-1002-L) or equivalent
 ST1235-A	Holding Fixture, Compressor Clutch 412-098 (T94P-19703-AH)

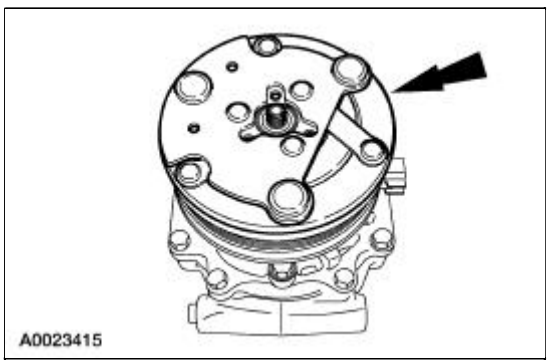
Removal and Installation

1. Remove the A/C compressor. For additional information, refer to Air Conditioning (A/C) Compressor in this section.

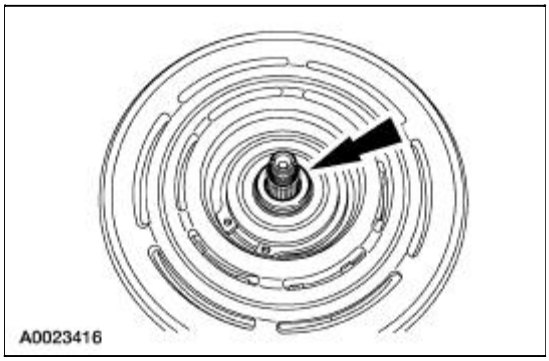
2. Remove the A/C clutch plate retaining nut.
   1. Using the special tool, hold the A/C clutch plate.
   2. Remove the nut.



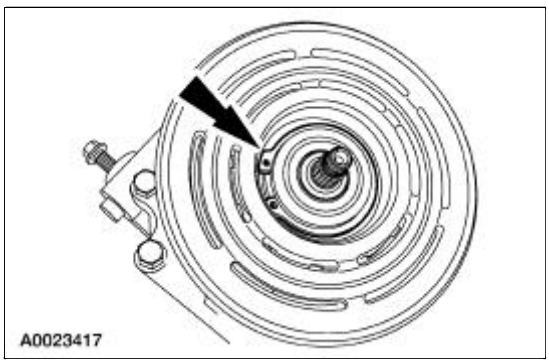
3. Remove the A/C clutch plate.



4. Remove the A/C clutch plate spacer.

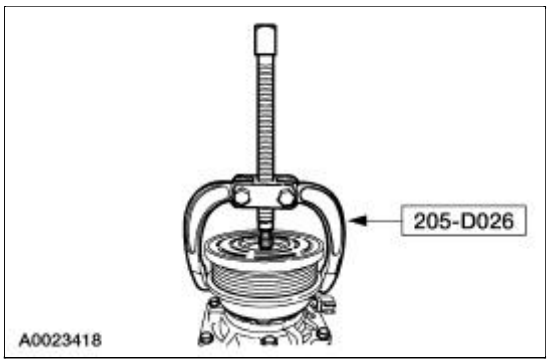


5. Remove the A/C clutch pulley snap-ring.

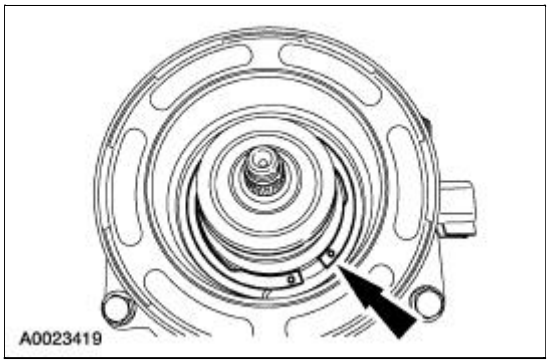


6. **CAUTION: Do not use air tools. Damage to the A/C clutch pulley may result.**

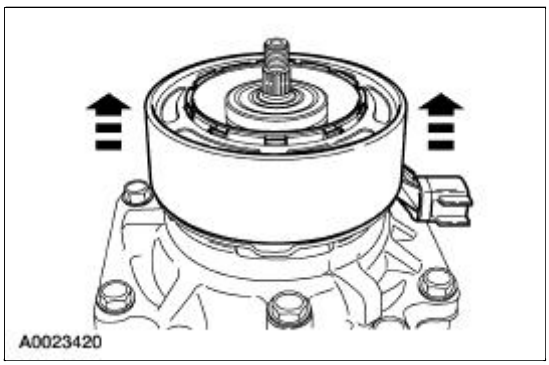
   Using the special tool, remove the A/C clutch pulley.



7. Note the location of the A/C clutch field coil connector.
8. Remove the A/C clutch field coil snap-ring.



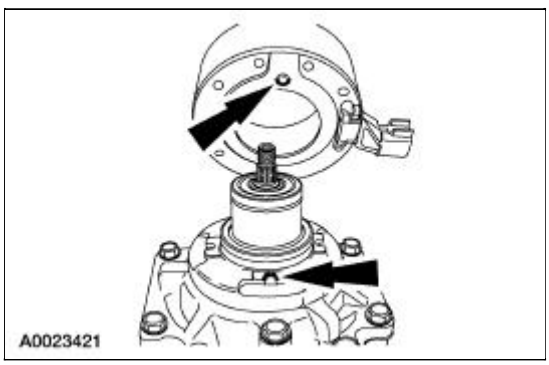
9. Remove the A/C clutch field coil.



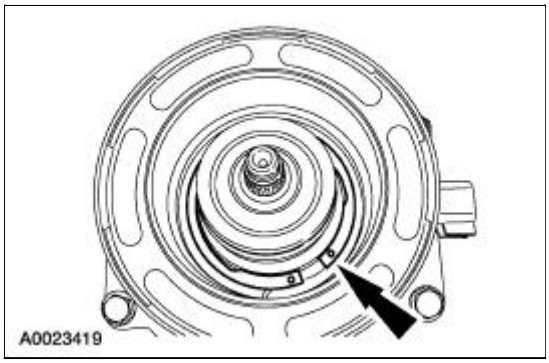
10. Clean the A/C compressor, A/C clutch field coil, and the A/C clutch pulley mounting surfaces.

11. **CAUTION: There is an indexing locator on the A/C clutch field coil mounting surface. Make sure it is correctly aligned during installation to the A/C compressor.**

    Align and install the A/C clutch field coil to the A/C compressor.

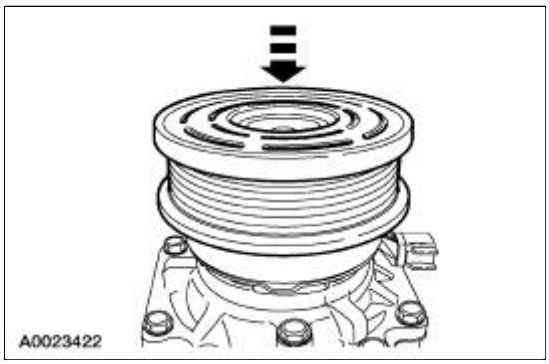


12. Install the A/C clutch field coil snap-ring.



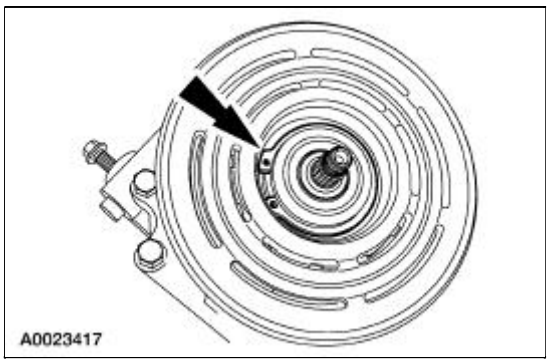
13. **NOTE:** The A/C clutch pulley fits tightly to the A/C compressor. It must be aligned correctly for installation.

    Install the A/C clutch pulley.

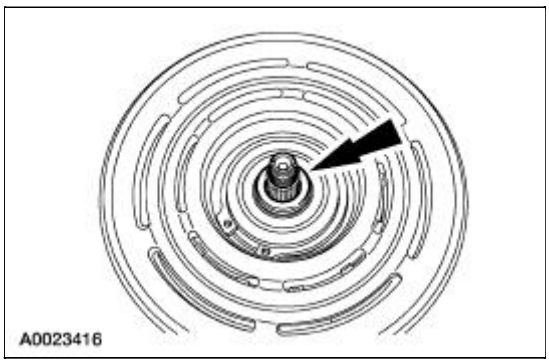


14. **NOTE:** The snap-ring must be installed with the bevel side up.

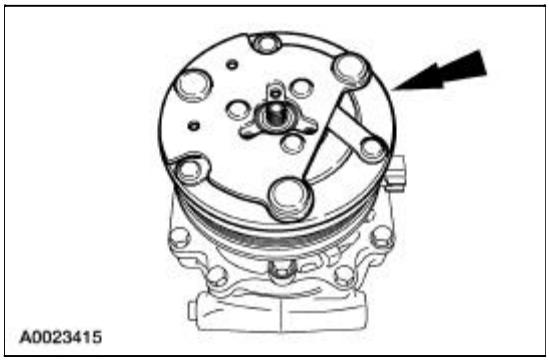
    Install the A/C clutch pulley snap-ring with the bevel side up.



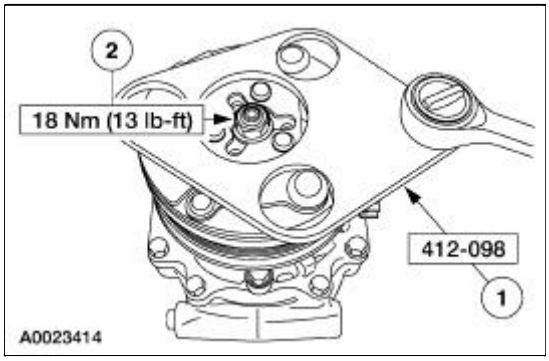
15. Install one nominal thickness A/C clutch plate spacer onto the A/C compressor shaft.



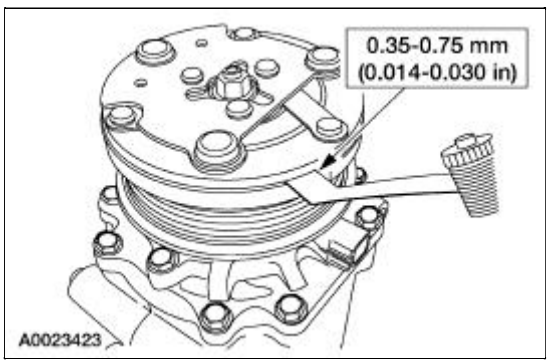
16. Install the A/C clutch plate.



17. Install the clutch plate retaining nut.
    1. Using the special tool, hold the A/C clutch plate.
    2. Tighten the nut.



18. Measure and adjust (if necessary) the A/C clutch air gap by removing or adding A/C clutch plate spacers. For additional information, refer to Section 412-00 .



19. Install the A/C compressor. For additional information, refer to Air Conditioning (A/C) Compressor in this section.

Evaporator Core

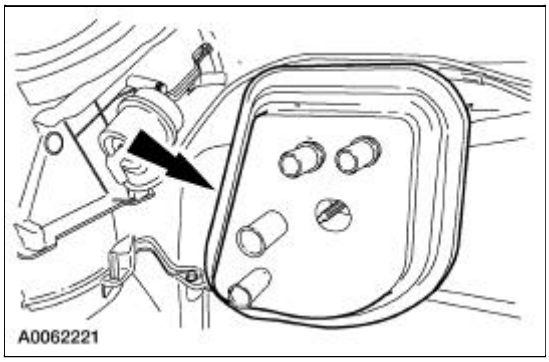
Removal and Installation

NOTE: If an evaporator core leak is suspected, the evaporator core must be vacuum leak tested before it is removed from the vehicle.

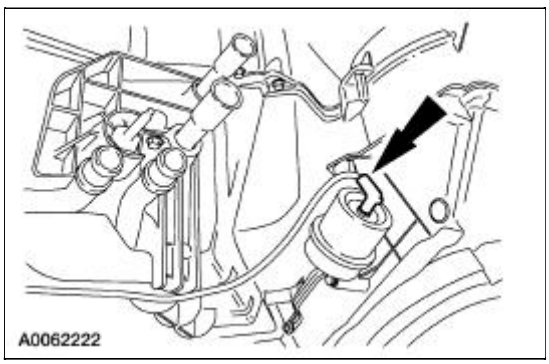
NOTE: Installation of a new receiver drier is not required when repairing the air conditioning system except when there is physical evidence of contamination from a failed A/C compressor or damage to the receiver drier.

NOTE: A new evaporator core seal is supplied as a kit with the evaporator core service part. Failure to install this seal, or failure to install it correctly, will result in air bypassing the evaporator core and loss of cooling efficiency.

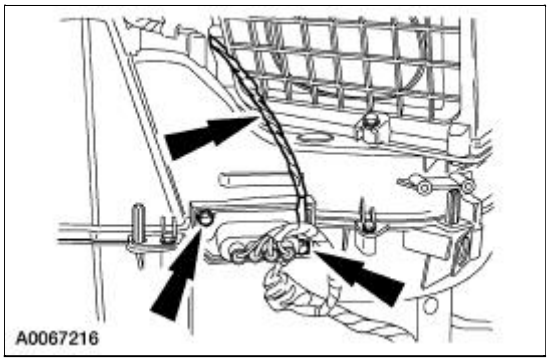
1. Remove the plenum chamber. For additional information, refer to Section 412-01 .
2. Remove the dash panel seal.



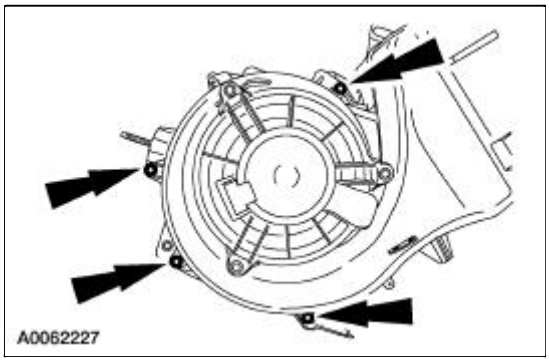
3. Detach the wire harness from the evaporator core cover.
4. Disconnect the air inlet vacuum control motor vacuum connector.



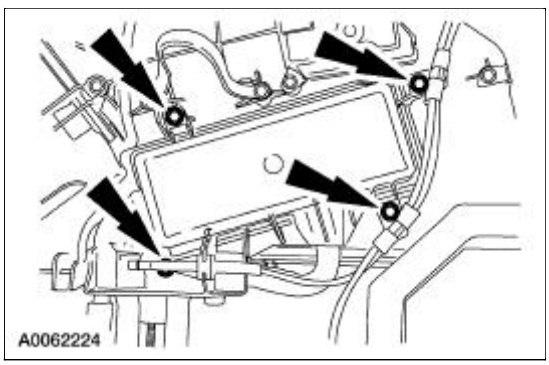
5. Remove the screws and detach the blower resistor or blower motor speed control and wire harness from the plenum chamber.



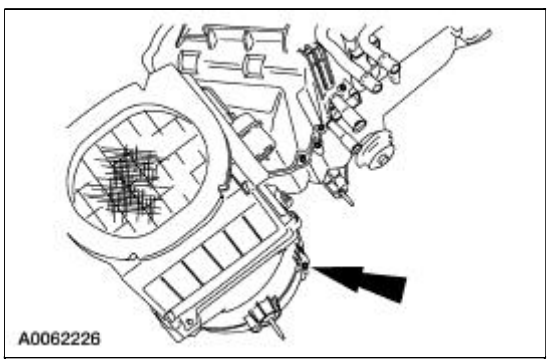
6. Remove the four bottom evaporator core cover screws.



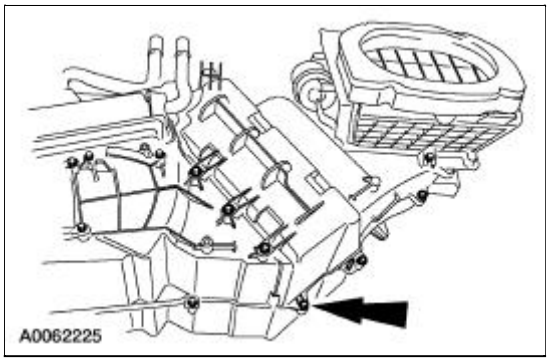
7. Remove the screws and position the heater core cover aside.



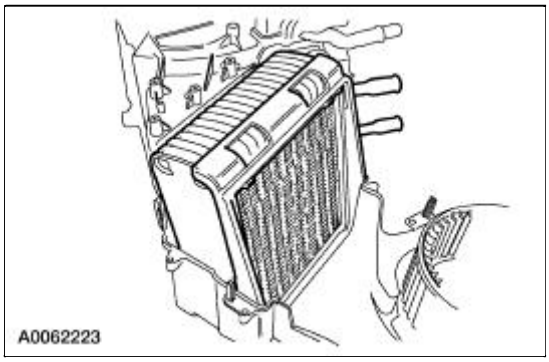
8. Remove the five upper evaporator core cover screws.



9. Remove the remaining upper evaporator core cover screws and the evaporator core cover.



10. Remove the evaporator core.



11. To install, reverse the removal procedure.

Condenser Core

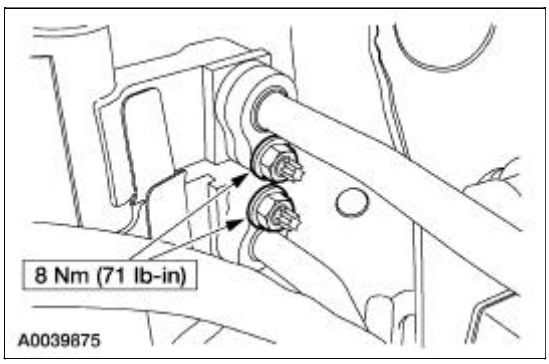
Material

Item	Specification
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B

Removal and Installation

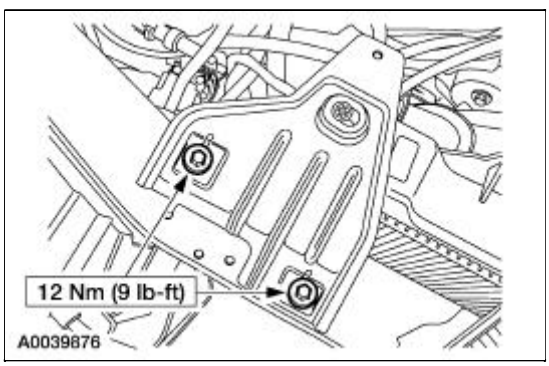
NOTE: Installation of a new receiver/drier is not required when repairing the air conditioning system except when there is physical evidence of contamination from a failed A/C compressor or damage to the receiver/drier.

1. Recover the refrigerant. For additional information, refer to Section 412-00 .
2. Remove the upper radiator sight shield.
3. Remove the nuts and disconnect the condenser line fittings.
   - Discard the O-ring seals.



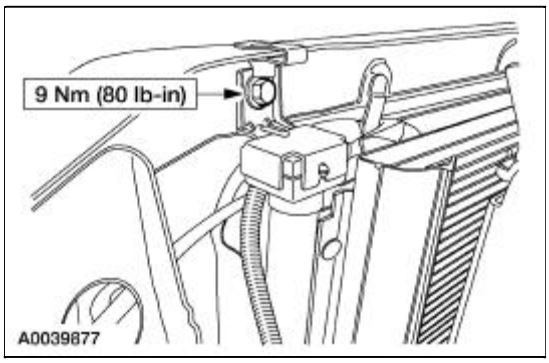
4. **NOTE:** LH radiator bracket shown, RH similar.

   Remove the bolts and the RH and LH radiator brackets.



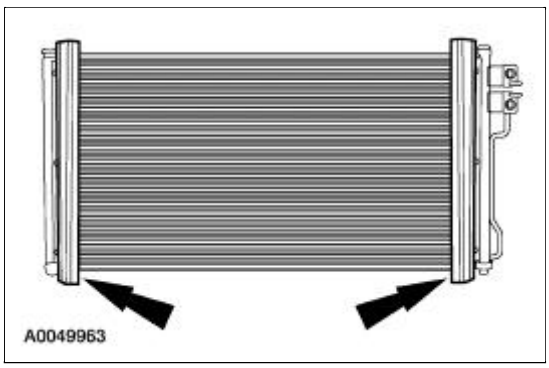
5. **NOTE:** RH condenser core bracket shown, LH similar.

   Remove the bolt and the RH and LH condenser core brackets.



6. Remove the condenser core.

7. If a new condenser core is to be installed, transfer the air deflectors from the old unit to the new unit.



8. To install, reverse the removal procedure.
   - Install new O-ring seals lubricated in clean PAG oil.
   - Lubricate the refrigerant system with the correct amount of clean PAG oil. For additional information, refer to Section 412-00 .

9. Evacuate, charge, and leak test the refrigerant system. For additional information, refer to Section 412-00 .

Compressor Manifold and Tube Assembly

Material

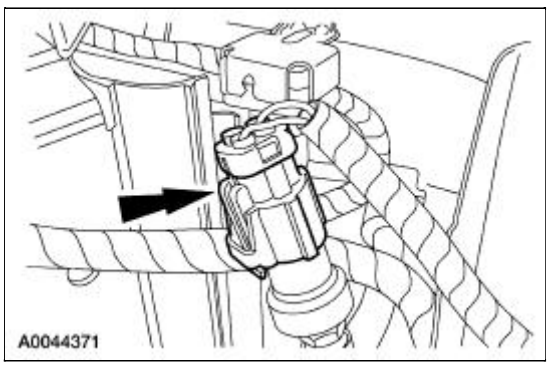
Item	Specification
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B

Removal and Installation

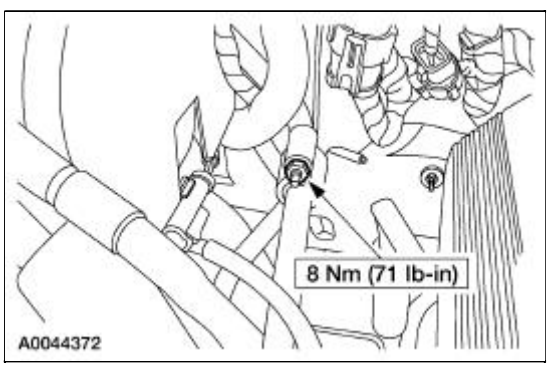
NOTE: Installation of a new receiver/drier is not required when repairing the air conditioning system except when there is physical evidence of contamination from a failed A/C compressor or damage to the receiver/drier.

All vehicles

1. Recover the refrigerant. For additional information, refer to Section 412-00 .
2. Disconnect the pressure cutoff switch electrical connector.

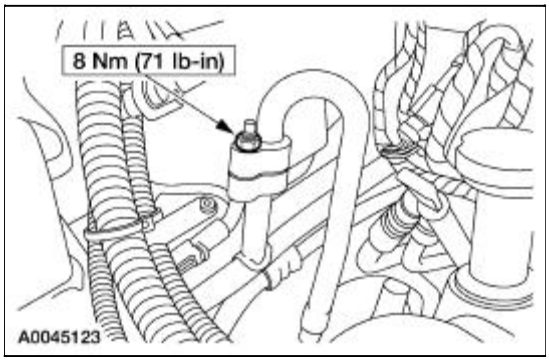


3. Remove the nut and disconnect the A/C fitting.
   - Discard the O-ring seal.



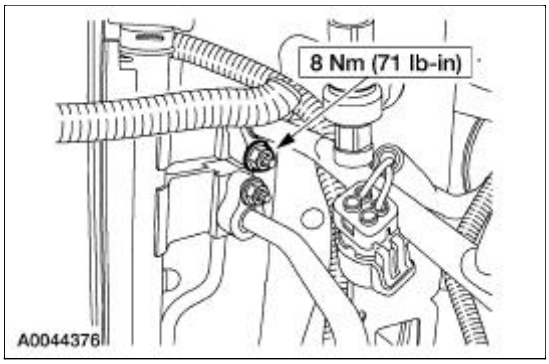
Vehicles with auxiliary A/C

4. Remove the nut and disconnect the auxiliary A/C line fitting.
    - Discard the O-ring seal.

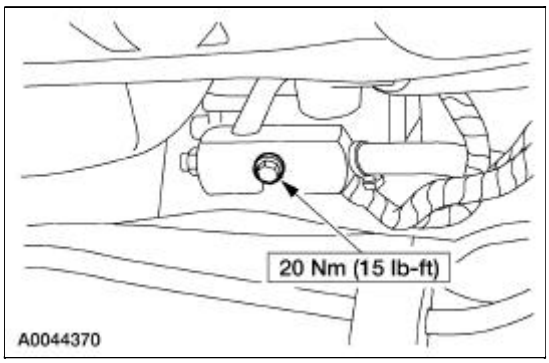


All vehicles

5. Remove the nut and disconnect the A/C fitting.
    - Discard the O-ring seal.



6. Loosen the bolt and remove the compressor manifold and tube assembly.
    - Discard the O-ring seals.



7. To install, reverse the removal procedure.
    - Install new O-ring seals, lubricated in clean PAG oil.
    - Lubricate the refrigerant system with the correct amount of clean PAG oil. For additional information, refer to Section 412-00 .

8. Evacuate, leak test and charge the refrigerant system. For additional information, refer to Section 412-00 .

Thermostatic Expansion Valve Manifold and Tube Assembly

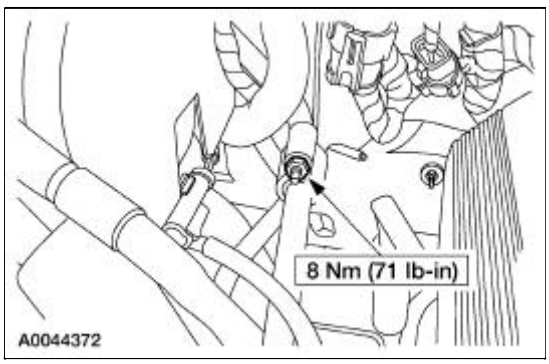
Material

Item	Specification
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B

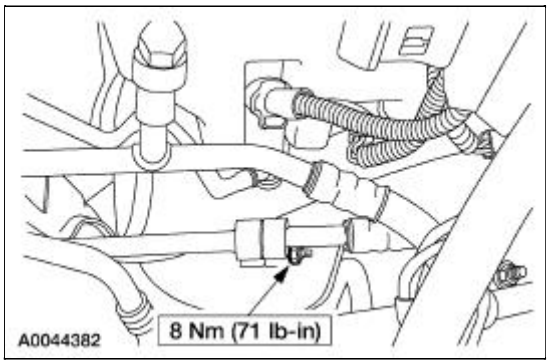
Removal and Installation

NOTE: Installation of a new receiver/drier is not required when repairing the air conditioning system except when there is physical evidence of contamination from a failed A/C compressor or damage to the receiver/drier.

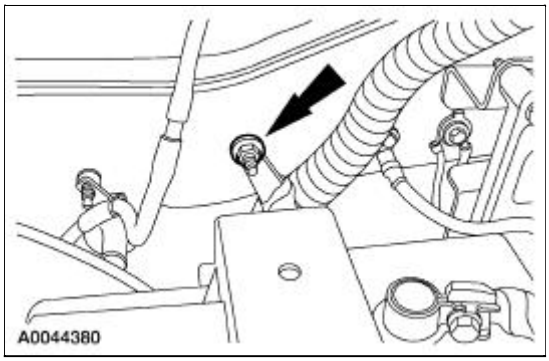
1. Recover the refrigerant. For additional information, refer to Section 412-00 .
2. Remove the nut and disconnect the A/C fitting.
   - Discard the O-ring seal.



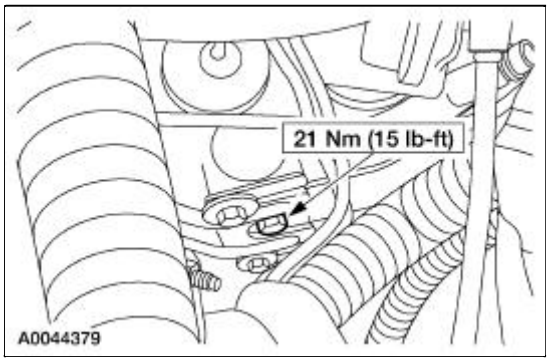
3. Remove the nut and disconnect the A/C fitting.
   - Discard the O-ring seal.



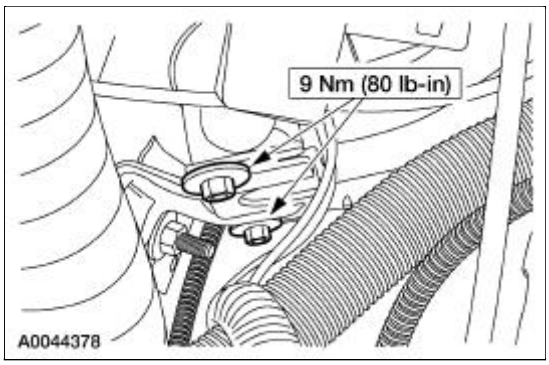
4. Remove the nut and position the wiring harness aside.



5. Remove the bolt.



6. Loosen the bolts and remove the thermostatic expansion valve manifold and tube assembly.
   - Discard the O-ring seals.



7. To install, reverse the removal procedure.
   - Install new O-ring seals, lubricated in clean PAG oil.
   - Lubricate the refrigerant system with the correct amount of clean PAG oil. For additional information, refer to Section 412-00 .

8. Evacuate, leak test and charge the refrigerant system. For additional information, refer to Section 412-00 .

Receiver Drier

Material

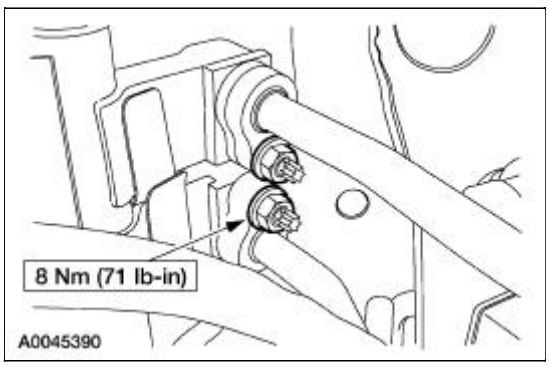
Item	Specification
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B

Removal and Installation

NOTE: Installation of a new receiver/drier is not required when repairing the air conditioning system except when there is physical evidence of contamination from a failed A/C compressor or damage to the receiver/drier.

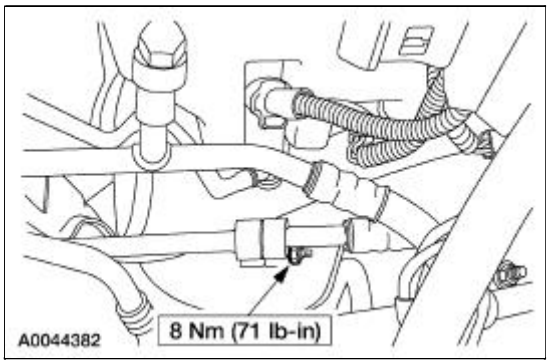
All vehicles

1. Recover the refrigerant. For additional information, refer to Section 412-00 .
2. Disconnect the A/C fitting.
   - Discard the O-ring seal.



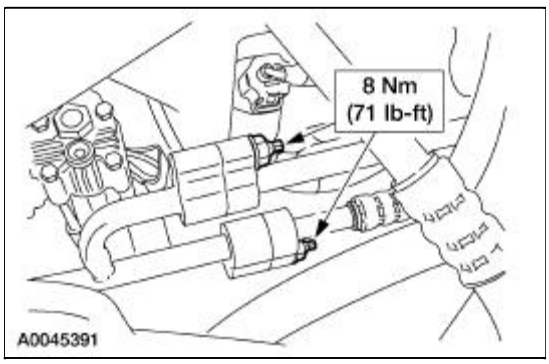
Vehicles without auxiliary A/C

3. Disconnect the A/C fitting.
   - Discard the O-ring seal.



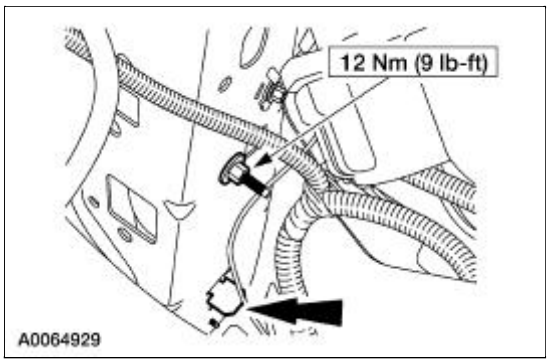
Vehicles with auxiliary A/C

4. Remove the nuts and disconnect the A/C fittings.
    - Discard the O-ring seal.



All vehicles

5. Remove the nut, detach the bracket and remove the receiver/drier.



6. To install, reverse the removal procedure.
    - Install new O-ring seals lubricated in clean PAG oil.
    - Lubricate the refrigerant system with the correct amount of clean PAG oil. For additional information, refer to Section 412-00 .

7. Evacuate, leak test and charge the refrigerant system. For additional information, refer to Section 412-00 .

General Specifications

Item	Specification
Lubricants	
MERPOL® (coolant hose lubricant)	ESE-M99B144-B
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B

Torque Specifications

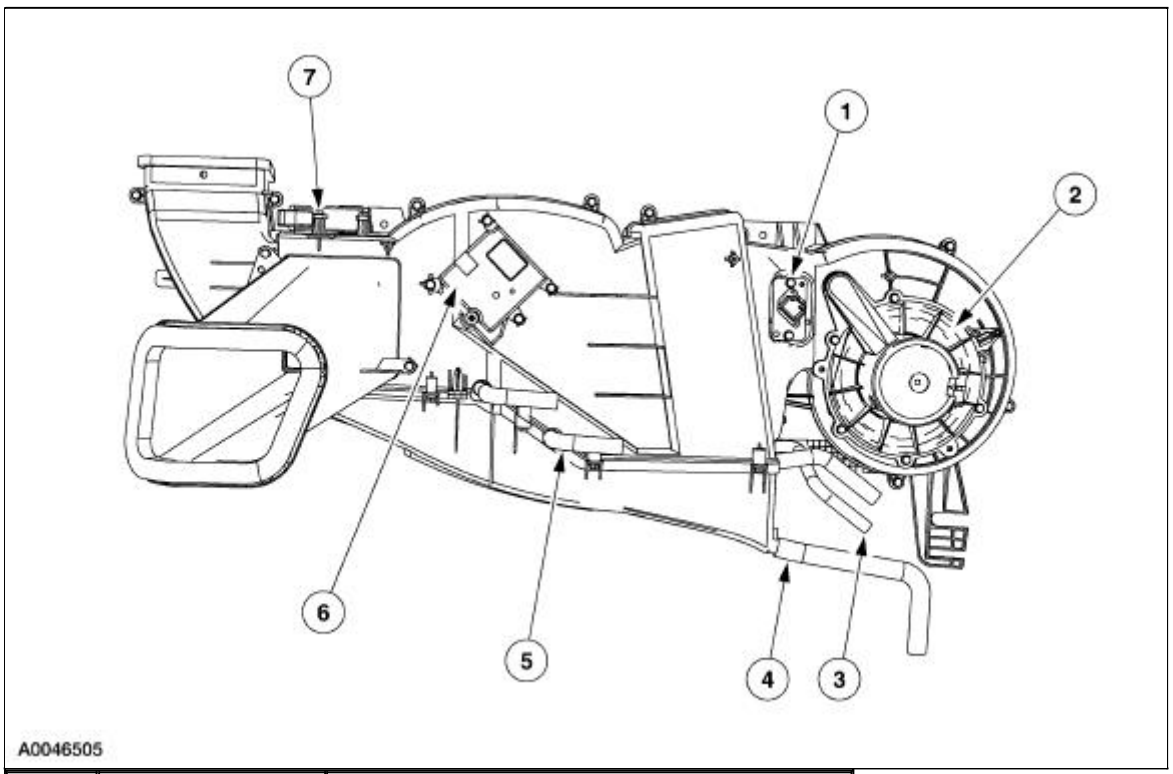
Description	Nm	lb-ft	lb-in
A/C (peanut) fitting nuts	8	—	71
Thermostatic expansion valve fittings	15	11	—
Auxiliary line bracket nuts	5	—	44
Exhaust heat shield bolts	15	11	—

Auxiliary Climate Control

An optional auxiliary air conditioning and heating system is available. The system is a one-piece unit that is located on the RH side of the vehicle between the side windows and the floorpan, behind the rear wheel well. The driver has primary control of the auxiliary air conditioning and heating system or can transfer control to a rear passenger control panel.

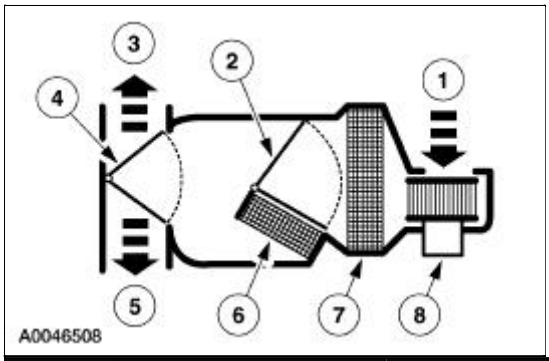
All of the auxiliary A/C-heater system components are serviceable from the inside of the vehicle except the lines.

Auxiliary Climate Control Housing



Item	Part Number	Description
1	19A706	Blower motor resistor
2	19805	Blower motor
3	19860	Evaporator core
4	18472	Drain tube
5	18476	Heater core
6	19E616	Temperature blend door actuator
7	19E616	Auxiliary mode door actuator

System Airflow



Item	Part Number	Description
1	—	Air inlet door
2	—	Temperature blend door
3	—	Headliner airflow
4	—	Auxiliary mode door
5	—	Floor airflow
6	18476	Heater core
7	19860	Evaporator core
8	19805	Blower motor

The auxiliary A/C and heating system has the following features:

- The auxiliary A/C and heating system is functional whenever the instrument panel mounted A/C control is in any position except OFF.
- The auxiliary blower motor recirculates the air inside the vehicle. Outside air is not available to the auxiliary system.
- Air is cooled and dehumidified by the auxiliary A/C evaporator core only if the instrument panel mounted A/C control is adjusted to a position that requires A/C compressor operation.
- The temperature blend door and the auxiliary mode door are controlled by electric actuator motors.
- Movement of the auxiliary temperature control between COOL and WARM causes a corresponding movement of the temperature blend door to mix air flowing through and around the auxiliary heater core.
- Movement of the auxiliary mode control between PANEL and FLOOR causes a corresponding movement of the auxiliary mode door to direct air flow between the panel (headliner) registers and the floor duct.

Blower Motor

The auxiliary air conditioning system contains a blower motor which is controlled by the heater blower motor switch on the front or rear auxiliary A/C control.

Control Assembly

The auxiliary A/C system has dual controls for the front and rear passengers consisting of temperature, blower speed, and mode. The front auxiliary A/C control is mounted in the overhead console. The rear auxiliary A/C control is mounted in the rear finish panel of the front floor console.

Heater Core

The heater core consists of fins and tubes arranged to extract heat from the engine coolant and transfer the heat to air passing through the auxiliary climate control housing.

Evaporator Core

NOTE: If an evaporator core leak is suspected, the evaporator core must be vacuum leak tested before it is removed from the vehicle. For additional information, refer to Section 412-00 .

NOTE: Installation of a new receiver/drier is not required when repairing the air conditioning system except when there is physical evidence of system contamination from a failed A/C compressor or damage to the receiver/drier.

The evaporator core is an aluminum plate/fin type and is located in the auxiliary climate control housing. A mixture of refrigerant and oil enters the bottom of the evaporator core through the evaporator core inlet tube and then moves out of the evaporator core through the evaporator core outlet tube. When the A/C compressor is operating, air from the blower motor is cooled and dehumidified as it flows through the evaporator core fins.

Thermostatic Expansion Valve

The thermostatic expansion valve (TXV) restricts the flow of refrigerant from the high pressure side of the refrigerant system and separates the low pressure and high pressure sides of the auxiliary refrigerant system. Refrigerant entering and exiting the auxiliary evaporator core passes through the TXV through two separate flow paths. An internal temperature sensing bulb senses the temperature of the refrigerant flowing out of the evaporator core and adjusts an internal pin-type valve to meter the refrigerant flow into the evaporator core. The internal pin-type valve decreases the amount of refrigerant entering the evaporator core at lower temperatures, and increases the amount of refrigerant entering the evaporator core at higher temperatures.

Auxiliary A/C-Heater Lines

The auxiliary lines are secured to the underbody of the vehicle. Each auxiliary line is only available as a multiple-piece kit for ease of installation.

Air Conditioning

Refer to Section 412-00 .

Auxiliary Climate Control Housing

Material

Item	Specification
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B

Removal and Installation

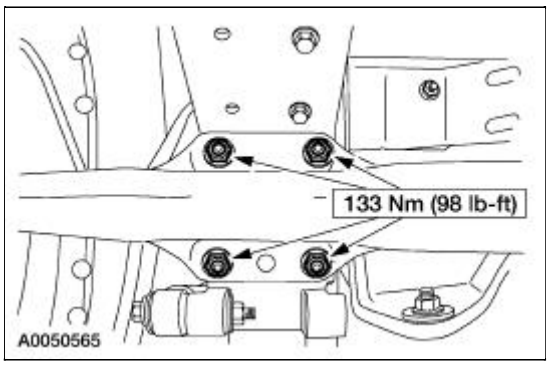
1. **WARNING: Do not open the cooling system while it is hot or while the engine is running. Failure to follow these instructions can result in personal injury.**

   Recover the refrigerant. For additional information, refer to Section 412-00 .

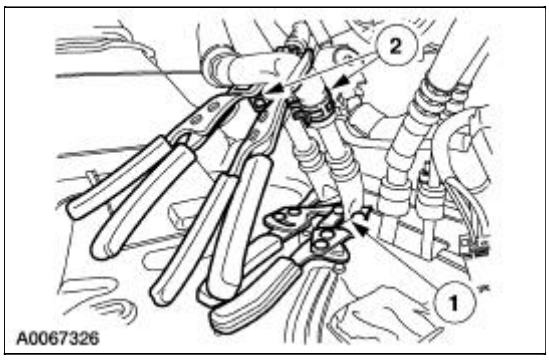
2. Remove the RH quarter trim panel. For additional information, refer to Section 501-05 .

3. Detach the upper air duct from the auxiliary housing.

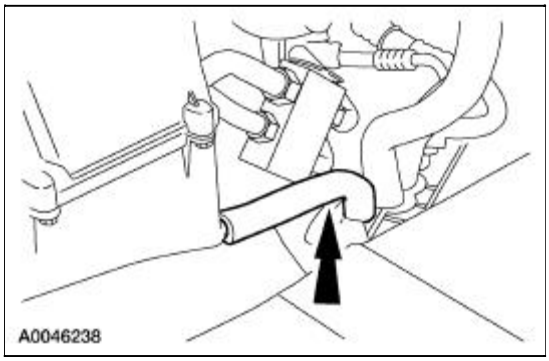
4. Remove the bolts and the auxiliary line bracket.



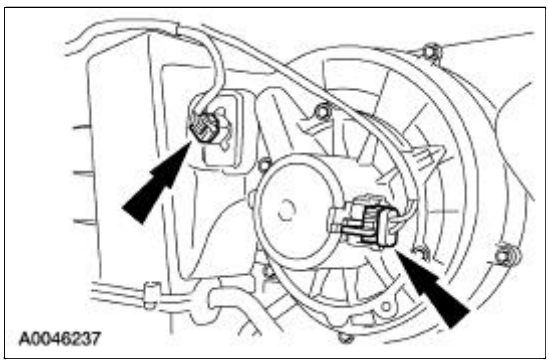
5. Disconnect the heater hoses.
   1. Using suitable tools, clamp off the heater hoses.
   2. Disconnect the heater hoses.



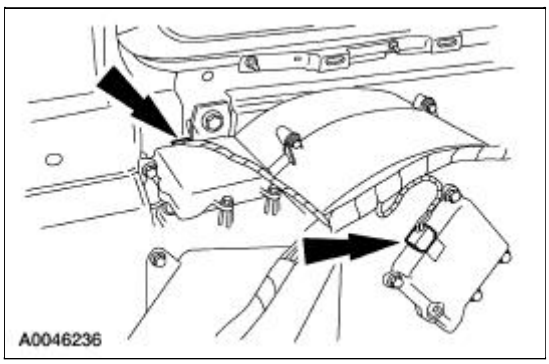
6. Disconnect the drain hose.



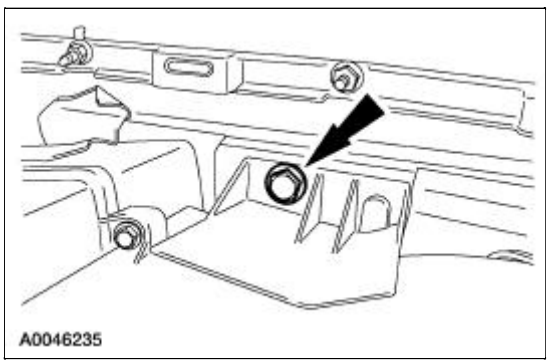
7. Disconnect the blower motor and blower motor resistor electrical connectors.



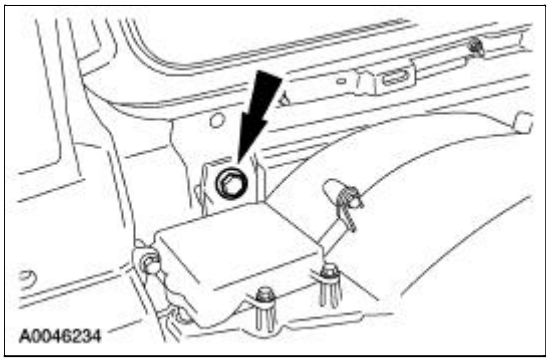
8. Disconnect the electrical actuator electrical connectors.



9. Remove the bolt.



10. Remove the bolt and the auxiliary climate control housing.



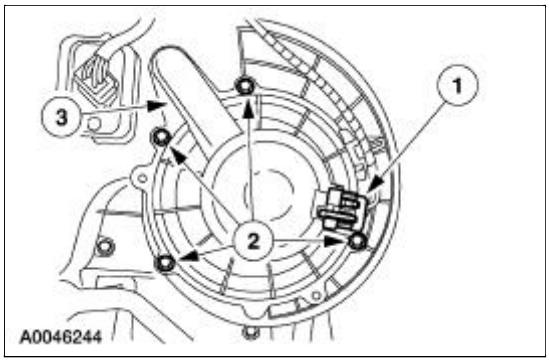
11. To install, reverse the removal procedure.
    - Install new O-ring seals with the correct amount of clean PAG oil.
    - Clean and lubricate the coolant hoses with plain water only if needed.
    - Lubricate the refrigerant system with the correct amount of clean PAG oil. For additional information, refer to Section 412-00 .
12. Fill the engine coolant level. For additional information, refer to Section 303-03 .
13. Evacuate, leak test and charge the refrigerant system. For additional information, refer to Section 412-00 .

Blower Motor

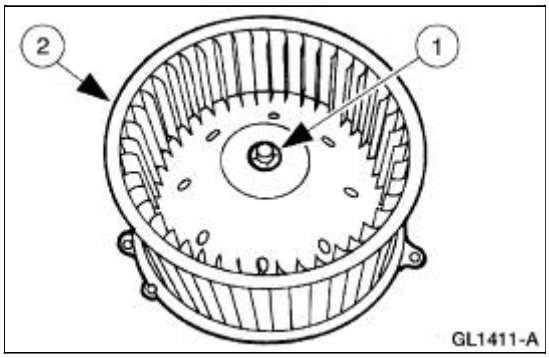
Removal and Installation

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

2. Remove the blower motor.
   1. Disconnect the blower motor electrical connector.
   2. Remove the screws.
   3. Remove the blower motor.



3. Remove the wheel from the blower motor.
   1. Remove the push clip.
   2. Remove the wheel.



4. To install, reverse the removal procedure.

Evaporator Core

Material

Item	Specification
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B

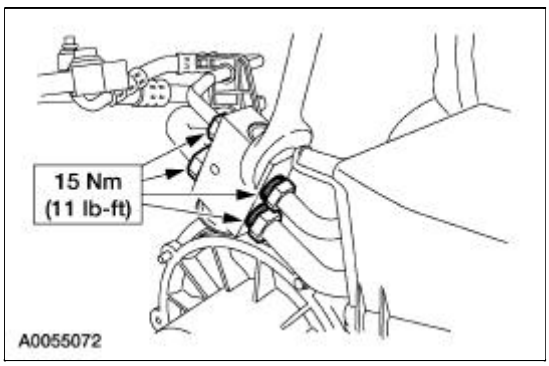
Removal and Installation

NOTE: If an evaporator core leak is suspected, the evaporator core must be vacuum leak tested before it is removed from the vehicle.

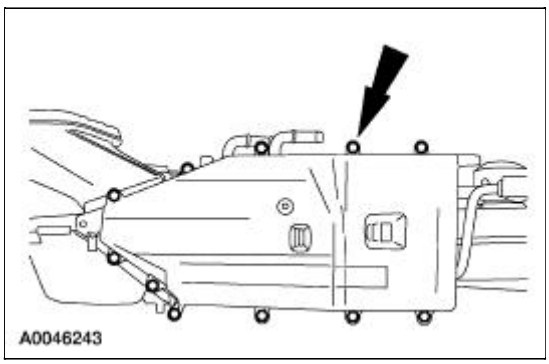
NOTE: Installation of a new receiver/drier is not required when repairing the air conditioning system except when there is physical evidence of contamination from a failed A/C compressor or damage to the receiver/drier.

1. Remove the auxiliary climate control housing. For additional information, refer to Auxiliary Climate Control Housing in this section.

2. Disconnect the A/C fittings and remove the thermostatic expansion valve (TXV).
   - Discard the O-ring seals.



3. Remove the screws and the evaporator/heater core access cover.



4. Remove the A/C evaporator core (19860).

5. To install, reverse the removal procedure.
    - Install new O-ring seals lubricated in clean PAG oil.

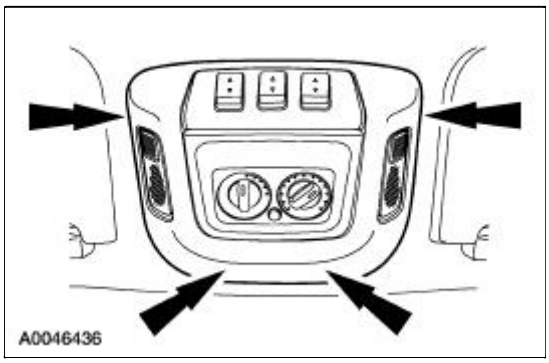
Auxiliary Climate Control Assembly —Front

Removal and Installation

All vehicles

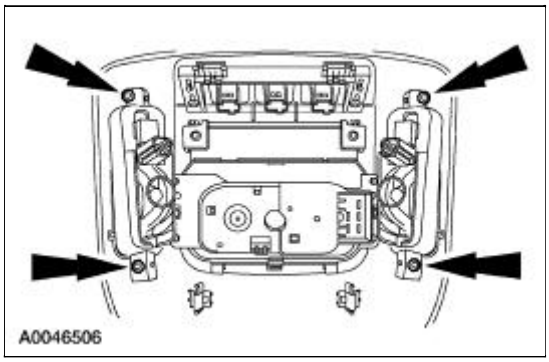
1. **NOTE:** Vehicle with moonroof shown, vehicle without moonroof similar.

   Disengage the clips and remove the overhead console.
   - Disconnect the electrical connectors.



Vehicles with moonroof

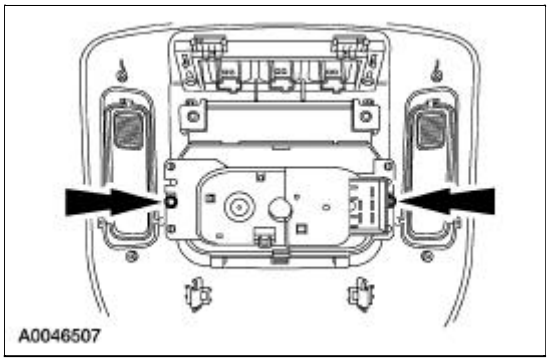
2. Remove the screws and the map lights.



All vehicles

3. **NOTE:** Vehicle with moonroof shown, vehicle without moonroof similar.

   Remove the screws and the front auxiliary climate control assembly.



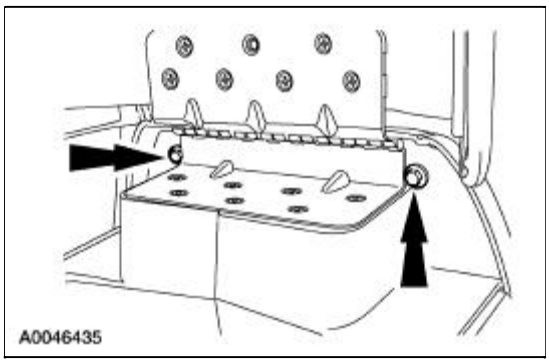
4. To install, reverse the removal procedure.

Auxiliary Climate Control Assembly —Rear

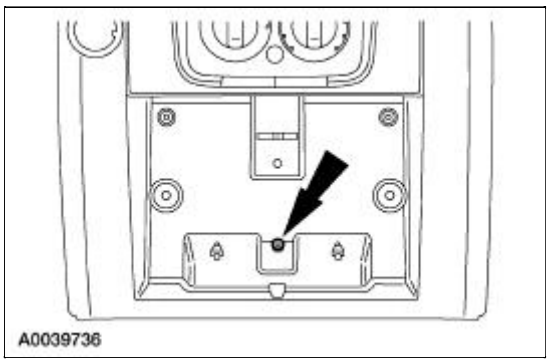
Removal and Installation

Navigator

1. Open the front floor console cover and remove the screws.



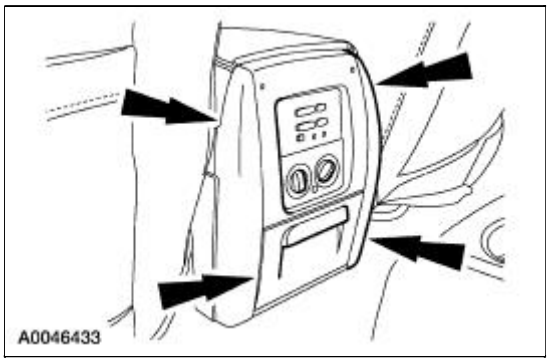
2. Open the cup holder and remove the screw.



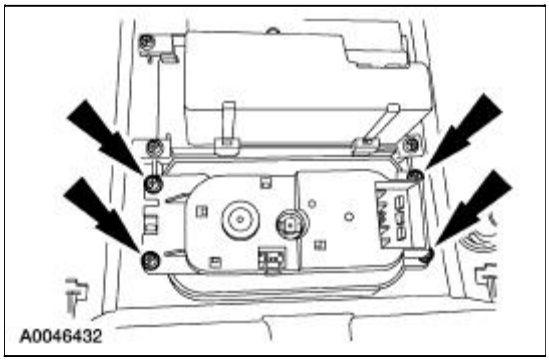
All vehicles

3. **NOTE:** Navigator shown, Expedition similar.

   Disengage the clips and remove the floor console rear finish panel.
   - Disconnect the electrical connectors.



4. Remove the screws and the rear auxiliary climate control assembly.

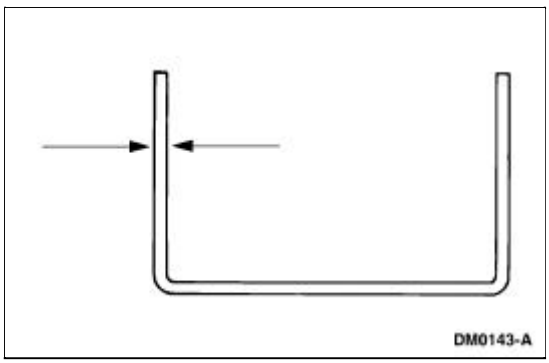


5. To install, reverse the removal procedure.

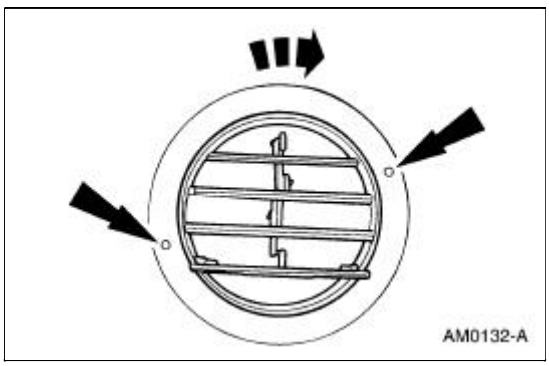
Register

Removal and Installation

1. Fabricate a removal tool from a 1/8-inch diameter rod.



2. Rotate the A/C register with the removal tool to align the retaining ears with the clearance openings and remove the A/C register.



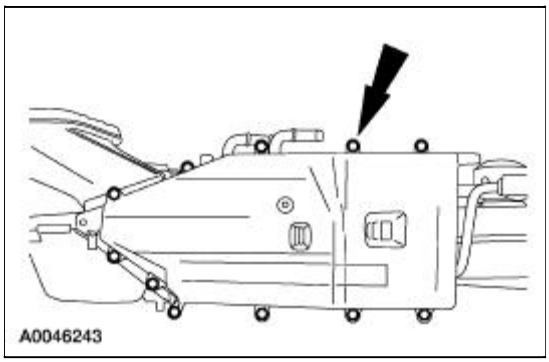
3. To install, reverse the removal procedure.

Heater Core

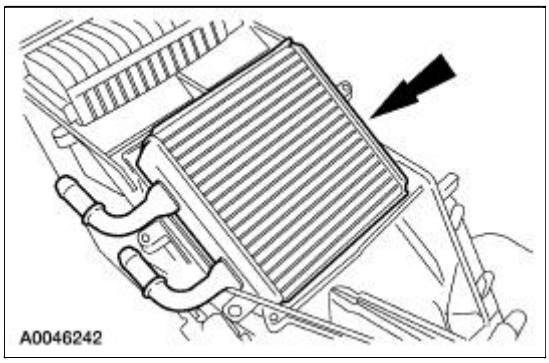
Removal and Installation

1. Remove the auxiliary climate control housing. For additional information, refer to Auxiliary Climate Control Housing in this section.

2. Remove the screws and the evaporator/heater core access cover.



3. Remove the heater core.



4. To install, reverse the removal procedure.

Auxiliary Heater Outlet and Inlet Line

Material

Item	Specification
MERPOL® Coolant Hose Lubricant	ESE-M99B144-B

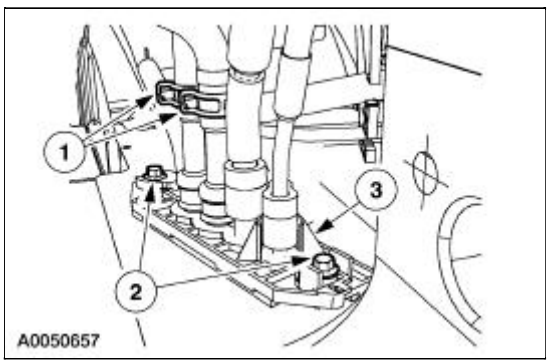
Removal

CAUTION: To avoid refrigerant loss, clearly differentiate the auxiliary heater lines from the auxiliary refrigerant lines before beginning this procedure.

NOTE: The auxiliary heater inlet and outlet lines are not supplied together as an assembly. The auxiliary heater inlet line and outlet line are each installed from the factory as one piece assemblies. The replacement parts are supplied as separate kits containing multiple piece lines for ease of installation.

NOTE: The following procedure can be used to remove and install one of, or both the auxiliary heater inlet line and auxiliary heater outlet line. If only one auxiliary heater line is to be removed and installed, cut or disconnect only the desired line at the specified points within the procedure.

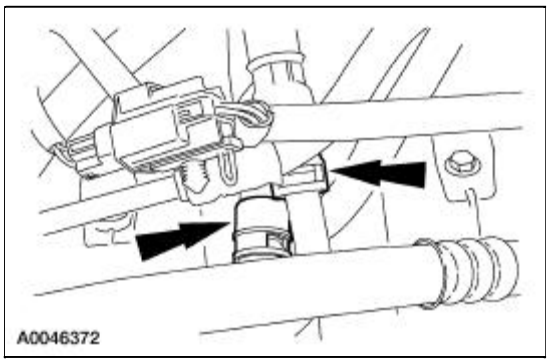
1. Drain the engine coolant. For additional information, refer to Section 303-03 .
2. Remove the RH quarter trim panel. For additional information, refer to Section 501-05 .
3. Detach the auxiliary heater lines.
    1. Disconnect the heater hose(s).
    2. Remove the bolts.
    3. Remove the line bracket.



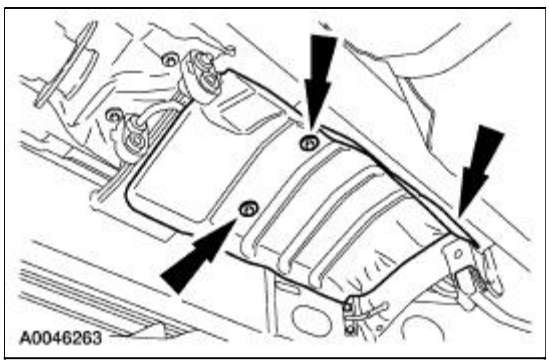
4. Remove the spare tire.
5. Raise the vehicle. For additional information, refer to Section 100-02 .
6. Remove the RH front wheel.
7. Remove the RH fender splash shield.

8. **NOTE:** If installing only one auxiliary heater line, disconnect only the desired line.

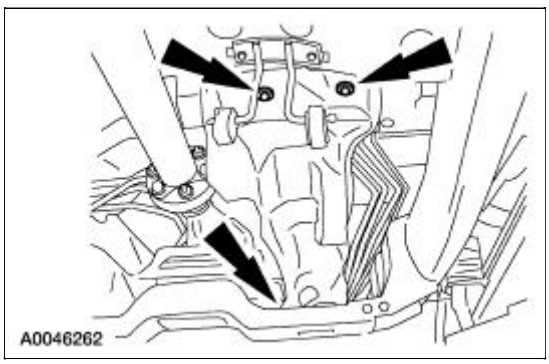
   Disconnect the heater hose(s).



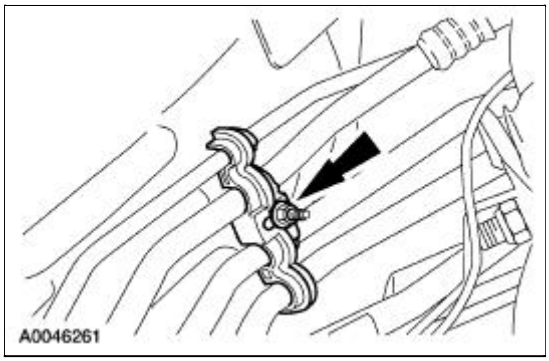
9. Remove the muffler. For additional information, refer to Section 309-00 .
10. Remove the RH catalytic converter. For additional information, refer to Section 309-00 .
11. Remove the three bolts and the heat shield.



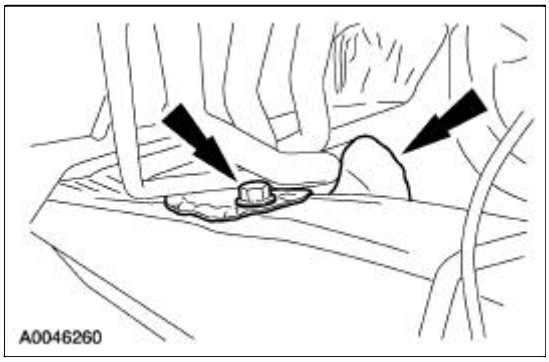
12. Remove the bolts.



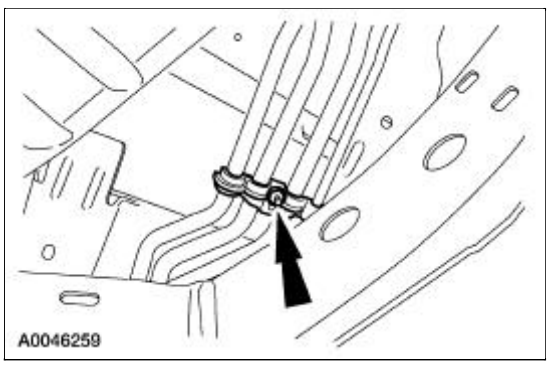
13. Remove the nut and the line bracket.



14. Remove the bolt and the heat shield.



15. Remove the nuts and the remaining line brackets.



16. **NOTE:** If installing only one auxiliary heater line, cut only the desired line.

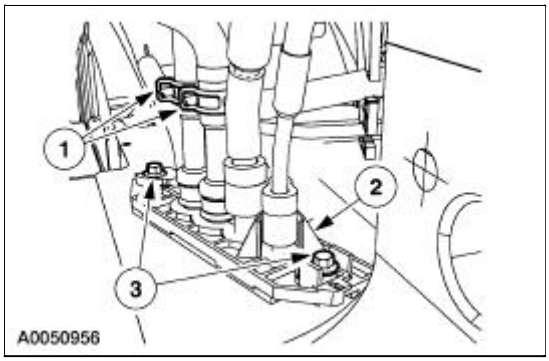
    Assemble and lay out the replacement line(s) in the same position as the existing line(s) and, using a suitable tool, cut the auxiliary heater line(s) in the same position as the fittings on the new line(s).

17. Remove the auxiliary heater line(s) in three separate pieces.

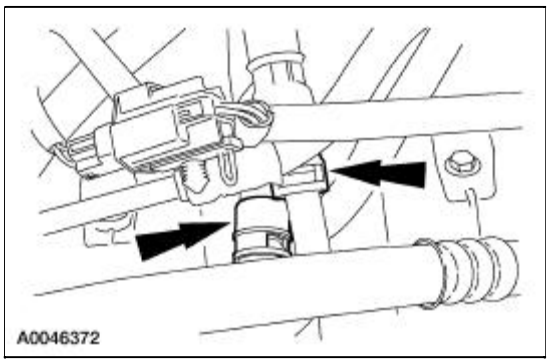
Installation

1. Partially lower the vehicle.

2. Attach the rear portion of the auxiliary heater lines.
    1. Connect the heater hoses.
    2. Install the line bracket.
    3. Install the bolts.



3. Install the front auxiliary heater line(s) and connect the heater hose(s).
    - Clean and lubricate the heater hoses with Coolant Hose Lubricant or plain water only if needed.

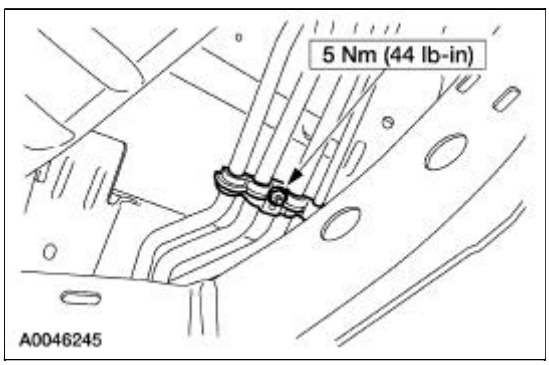


4. Raise the vehicle.

5. **NOTE:** Loosely connect, but do not tighten, the fittings.

   Install the middle auxiliary heater line(s).

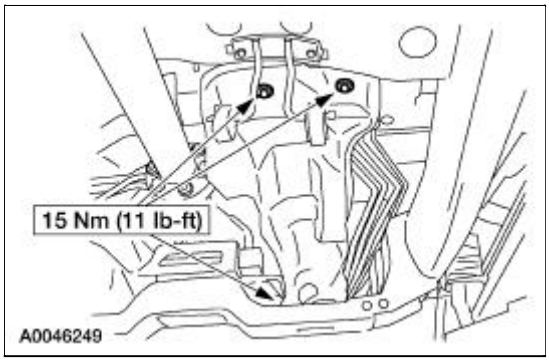
6. Starting from the rear of the vehicle, install the first three line brackets.



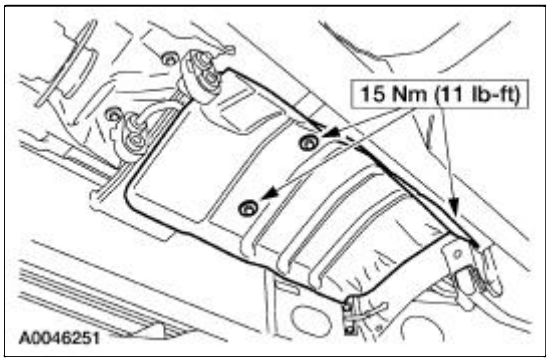
7. Tighten the middle auxiliary heater line fittings.

8. Inspect the auxiliary heater lines for correct installation. Loosen, reposition and tighten as needed.

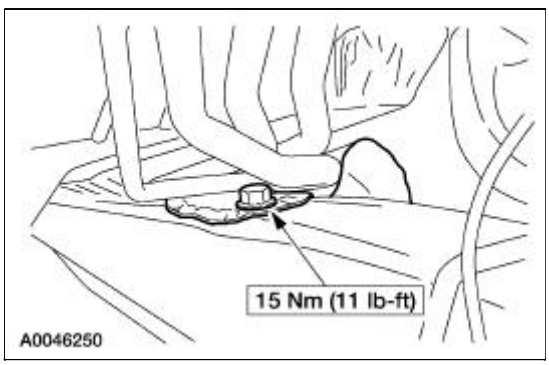
9. Install the heat shield and the bolts.



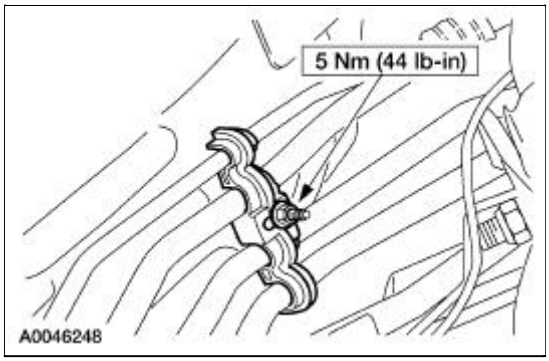
10. Install the heat shield and the bolts.



11. Install the RH catalytic converter. For additional information, refer to Section 309-00 .
12. Install the muffler. For additional information, refer to Section 309-00 .
13. Partially lower the vehicle.
14. Install the heat shield bolt.



15. Install the line bracket.



16. Lower the vehicle.
17. Install the spare tire.
18. Install the RH quarter trim panel. For additional information, refer to Section 501-05 .
19. Fill the engine coolant level. For additional information, refer to Section 303-03 .

Auxiliary Evaporator Outlet and Inlet Line

Material

Item	Specification
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B

Removal

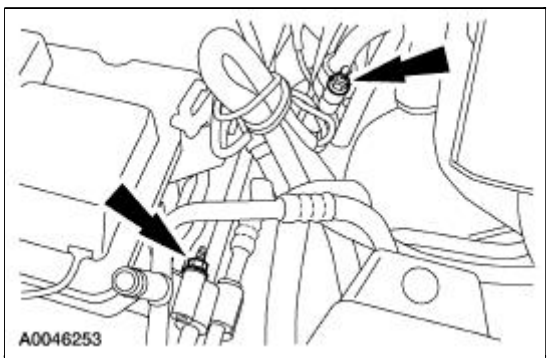
NOTE: The auxiliary evaporator inlet and outlet lines are not supplied together as an assembly. The auxiliary evaporator inlet line and outlet line are each installed from the factory as one piece assemblies. The replacement parts are supplied as separate kits containing multiple piece lines for ease of installation.

NOTE: The following procedure can be used to remove and install one of, or both the auxiliary evaporator inlet line and auxiliary evaporator outlet line. If only one auxiliary evaporator line is to be removed and installed, cut or disconnect only the desired line at the specified points within the procedure.

NOTE: Installation of a new receiver/drier is not required when repairing the air conditioning system except when there is physical evidence of contamination from a failed A/C compressor or damage to the receiver/drier.

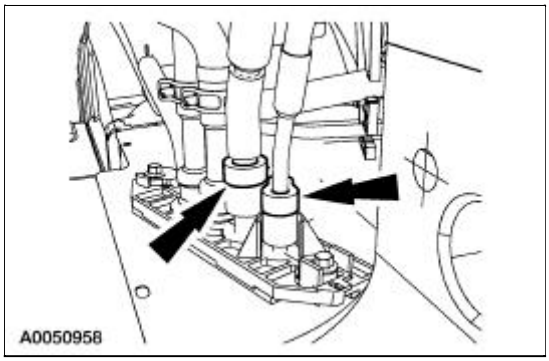
1. Recover the refrigerant. For additional information, refer to Section 412-00 .
2. **NOTE:** If only one auxiliary evaporator line is to be removed, disconnect only the desired line.

   Remove the nut(s) and disconnect the A/C fitting(s).

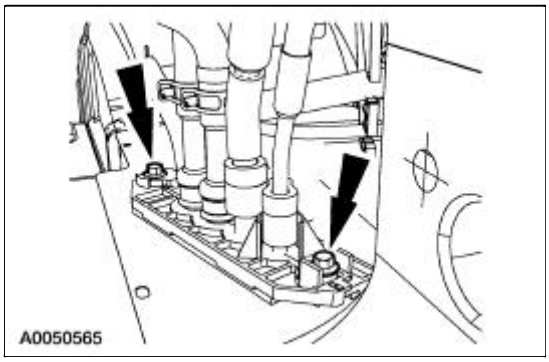


3. Remove the RH quarter trim panel. For additional information, refer to Section 501-05 .
4. Remove the spare tire and spare tire carrier splash shield.
5. **NOTE:** Both A/C fittings must be disconnected even if only one line is to be removed.

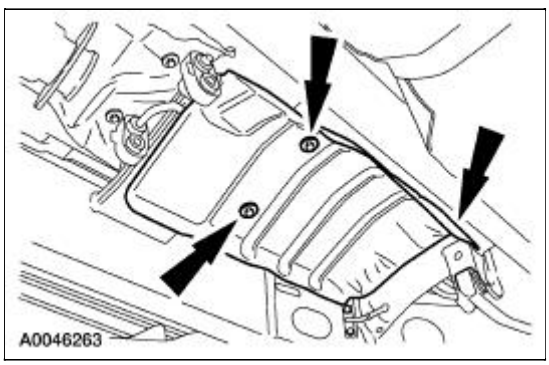
   Disconnect the A/C fittings.
   - Install new O-rings lubricated in clean PAG oil.



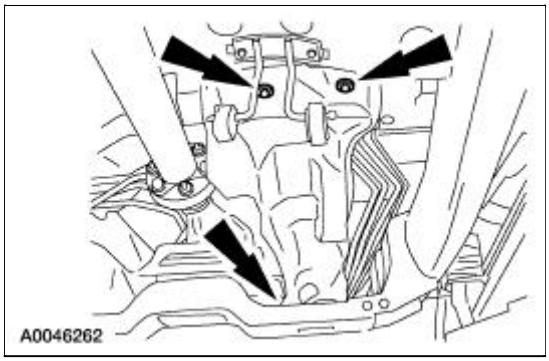
6. Remove the bolts and the line bracket.



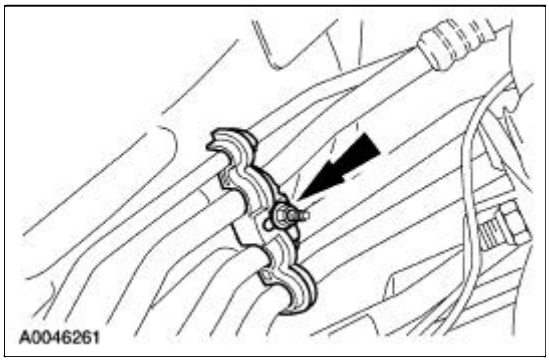
7. Raise the vehicle. For additional information, refer to Section 100-02 .
8. Remove the RH front wheel.
9. Remove the RH fender splash shield.
10. Remove the muffler. For additional information, refer to Section 309-00 .
11. Remove the RH catalytic converter. For additional information, refer to Section 309-00 .
12. Remove the three bolts and the heat shield.



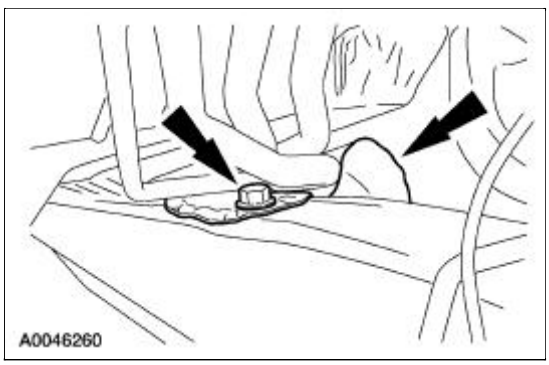
13. Remove the bolts.



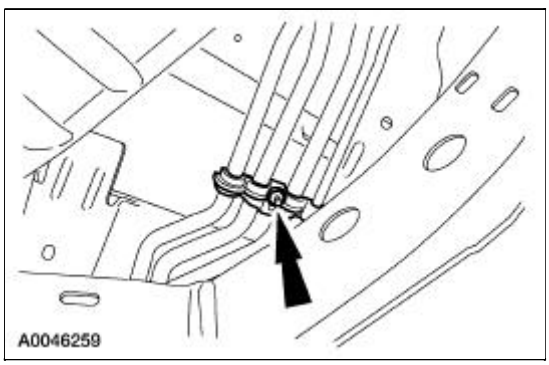
14. Remove the nut and the line bracket.



15. Remove the bolt and the heat shield.



16. Remove the nuts and the remaining line brackets.



17. **NOTE:** If installing only one auxiliary evaporator line, cut only the desired line.

    Assemble and lay out the replacement line(s) in the same position as the existing line(s) and, using a suitable tool, cut the auxiliary evaporator line(s) in the same position as the fittings on

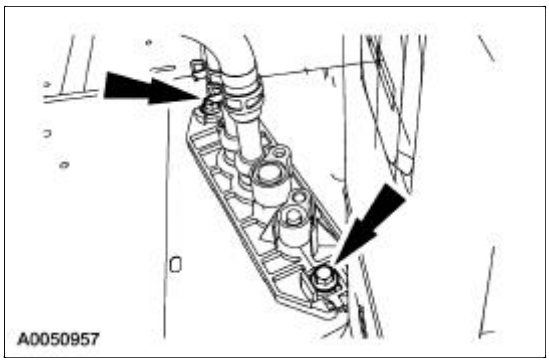
the new line(s).

18. Remove the auxiliary evaporator line(s) in three separate pieces.

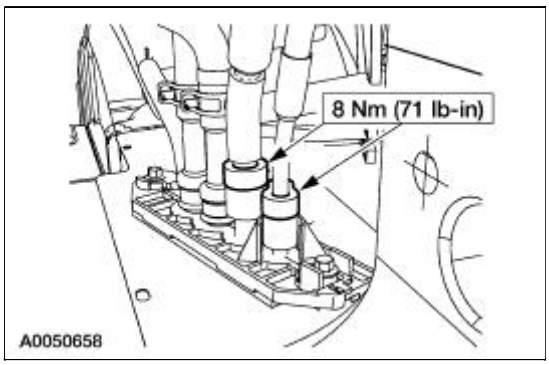
Installation

1. Partially lower the vehicle to allow access to both the rear auxiliary line fittings and the underside of the vehicle.

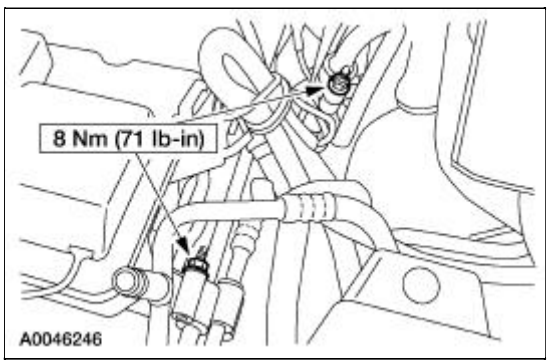
2. Position the rear portion of the auxiliary evaporator line(s) and install the line bracket and bolts.



3. Connect the A/C fittings.



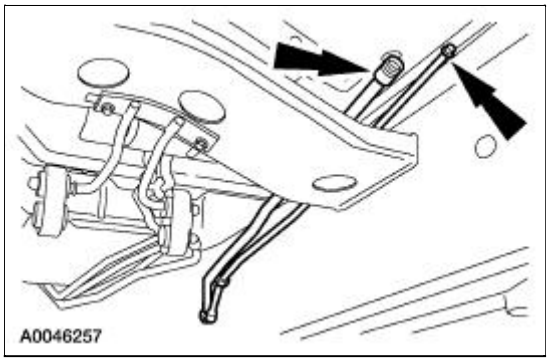
4. Install the front auxiliary evaporator line(s) and connect the A/C fittings.
    - Install new O-ring seals lubricated in clean PAG oil.



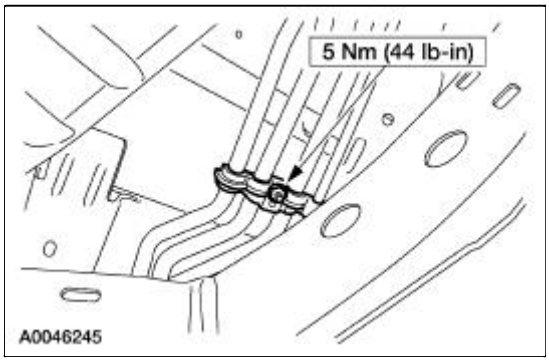
5. Raise the vehicle.

6. **NOTE:** Loosely connect, but do not tighten, the fittings.

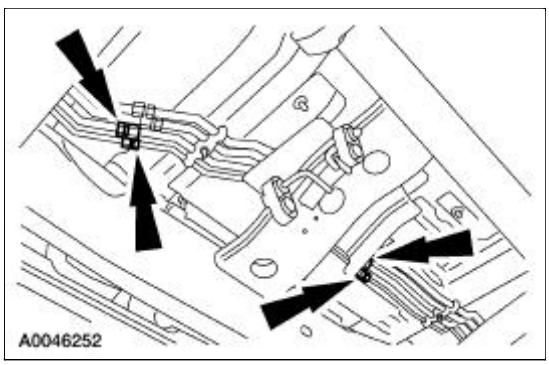
   Install the middle auxiliary evaporator line(s).



7. Starting from the rear of the vehicle, install the first three line brackets.

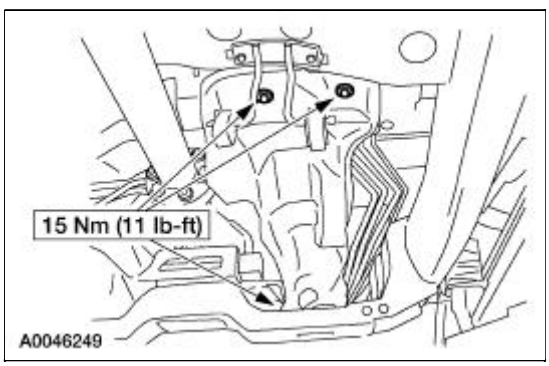


8. Tighten the middle auxiliary evaporator line fittings.

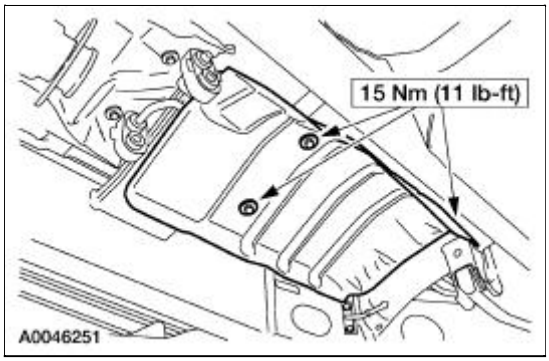


9. Inspect the auxiliary evaporator lines for correct installation. Loosen, reposition and tighten as needed.

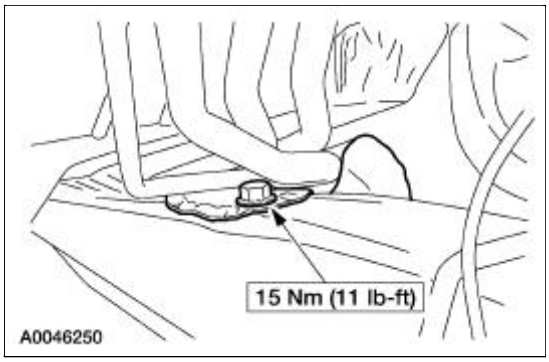
10. Install the heat shield and the bolts.



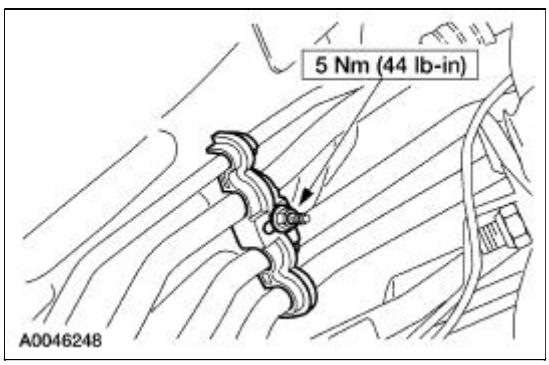
11. Install the heat shield and the bolts.



12. Install the RH catalytic converter. For additional information, refer to Section 309-00 .
13. Install the muffler. For additional information, refer to Section 309-00 .
14. Partially lower the vehicle.
15. Install the heat shield bolt.



16. Install the line bracket.



17. Lower the vehicle.
18. Install the spare tire.
19. Install the RH quarter trim panel. For additional information, refer to Section 501-05 .
20. Install the RH front fender splash shield.
21. Install the RH front wheel.
22. Install the spare tire and spare tire carrier splash shield.

23. Lubricate the refrigerant system with the correct amount of clean PAG oil. For additional information, refer to Section 412-00 .

24. Evacuate, leak test and charge the refrigerant system. For additional information, refer to Section 412-00 .

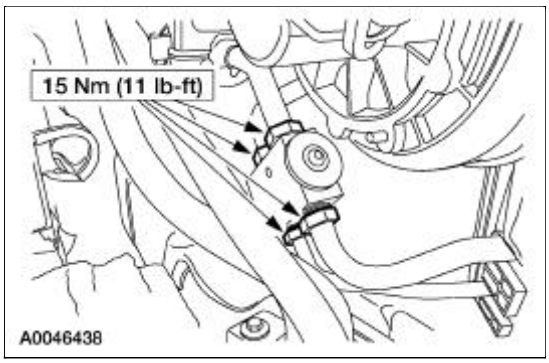
Thermostatic Expansion Valve

Material

Item	Specification
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B

Removal and Installation

1. Recover the refrigerant. For additional information, refer to Section 412-00 .
2. Remove the RH quarter trim panel. For additional information, refer to Section 501-05 .
3. Disconnect the fittings and remove the thermostatic expansion valve.
   - Discard the O-ring seals.

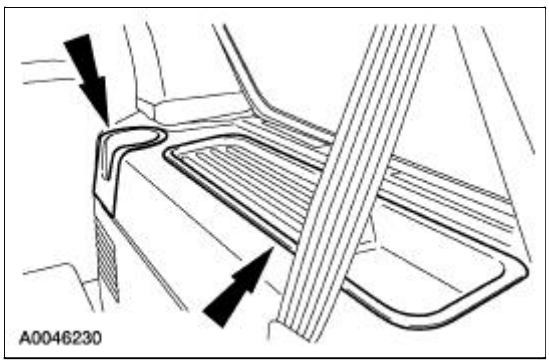


4. To install, reverse the removal procedure.
   - Install new O-ring seals lubricated in clean PAG oil.
   - Lubricate the refrigerant system with the correct amount of clean PAG oil. For additional information, refer to Section 412-00 .
5. Evacuate, leak test and charge the refrigerant system. For additional information, refer to Section 412-00 .

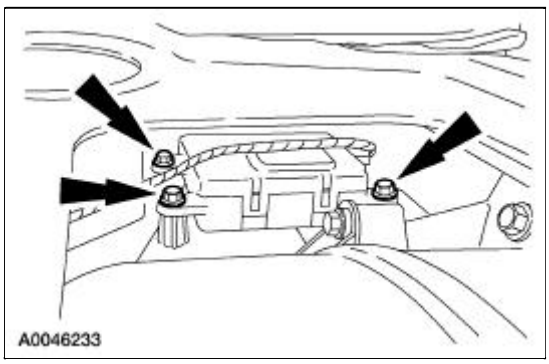
Auxiliary Blend Door Actuator —Air Distribution

Removal and Installation

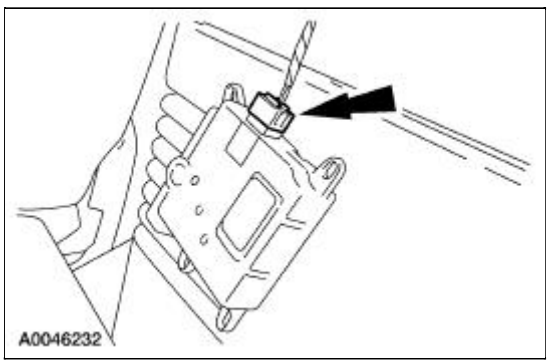
1. Remove the RH quarter trim panel cup holder and access panel.



2. Remove the screws.



3. Disconnect the blend door actuator electrical connector.

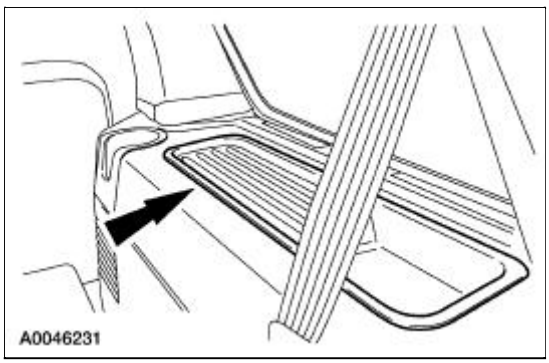


4. To install, reverse the removal procedure.

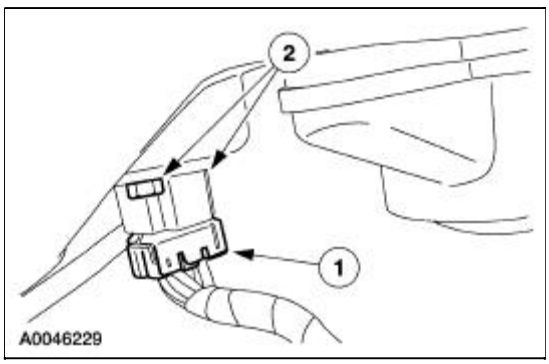
Blower Motor Resistor

Removal and Installation

1. Remove the RH quarter trim panel access panel.



2. Remove the blower motor resistor.
    1. Disconnect the blower motor resistor electrical connector.
    2. Remove the screws and the blower motor resistor.



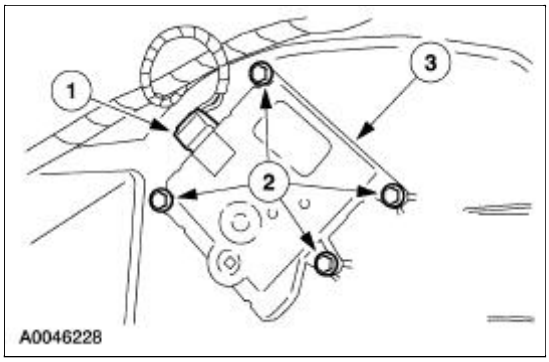
3. To install, reverse the removal procedure.

Auxiliary Blend Door Actuator —Temperature

Removal and Installation

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

2. Remove the auxiliary temperature blend door actuator.
    1. Disconnect the temperature blend door actuator electrical connector.
    2. Remove the screws.
    3. Remove the auxiliary temperature blend door actuator.



3. To install, reverse the removal procedure.

Control Components

Three climate control systems are available:

- manual climate control (Expedition only)
- electronic automatic temperature control
- dual automatic temperature control

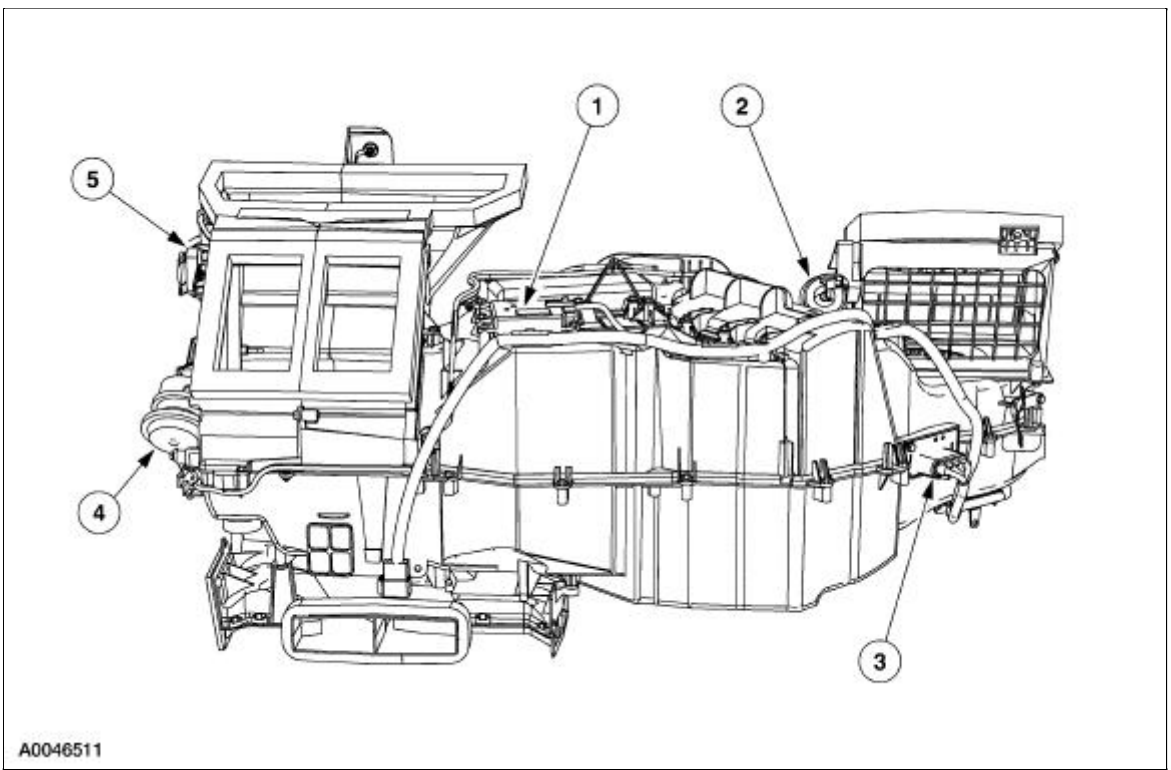
Refer to the appropriate heading below for information concerning each system.

Manual Climate Control

The manual climate control components are used to select:

- air inlet source (outside or recirculated).
- blower motor speed.
- discharge air temperature (temperature blend).
- discharge air location (defrost, panel, floor).
- A/C compressor operation.

Plenum Chamber Control Components — Manual



Item	Part Number	Description
1	19E616	Temperature blend door actuator

2	18A318	Air inlet door vacuum control motor
3	19A706	Blower motor resistor
4	18A318	Panel door vacuum control motor
5	18A318	Floor/defrost door vacuum control motor

Control System Inputs — Manual Climate Control

Function Selector Switch

The function selector switch combines a vacuum selector valve that determines air distribution and an electrical switch to supply battery voltage to the A/C compressor circuit and the blower motor circuit. When the function selector switch is in the MAX A/C, DEFROST or FLOOR/DEFROST positions, the A/C compressor will be operational regardless of the A/C request switch status.

Climate Control Assembly

The climate control assembly integrates the temperature control switch, A/C request button and rear defog switch into a single unit.

The temperature control switch setting determines air temperature. Temperature selection is accomplished with a potentiometer (temperature control switch) connected to the temperature blend door actuator. Movement of the temperature control switch from COOL (blue) to WARM (red) causes a corresponding movement of the temperature blend door and determines the air discharge temperature that the air distribution system will maintain. The temperature control switch is an integral part of the manual climate control assembly and cannot be installed separately.

The A/C request switch determines A/C compressor operation, except when the function selector switch is in the OFF, MAX A/C, DEFROST or FLOOR/DEFROST positions. The A/C request switch is an integral part of the manual climate control assembly and cannot be installed separately.

The rear defog button signals activation of the heated backlight and heated mirrors. The rear defog button is an integral part of the manual climate control assembly and cannot be installed separately.

Blower Motor Switch

The blower motor switch controls blower motor speed by supplying voltage to the blower resistor circuits.

Control System Outputs — Manual Climate Control

Blower Motor Resistor

The blower motor resistor:

- is located on the plenum chamber near the blower motor.
- has three resistor elements mounted on the resistor board to provide four blower motor speeds.
- has an overheating device (thermal limiter) that will open the resistor coil when the temperature reaches approximately 184°C (363°F), interrupting the blower motor operation in all speeds except high.
- is serviced as an assembly. The thermal limiter cannot be reset and is not serviceable.

Depending on the blower motor switch position, series resistance is added or bypassed in the blower motor circuit to decrease or increase blower motor speed.

Temperature Blend Door Actuator

The temperature blend door actuator:

- is located on the plenum chamber.
- moves the temperature blend door on command of the temperature control switch.
- contains a reversible electric motor.

Vacuum Control Motors

The three vacuum control motors have the following characteristics:

- They are actuated by the function selector switch.
- They position the plenum doors to direct system airflow to the vehicle interior as determined by the function selector switch settings.
- The air inlet door vacuum control motor is a single-diaphragm actuator with a single vacuum source.
- The airflow mode door vacuum control motors are double-diaphragm actuators with two separate vacuum sources to allow the actuator to fully retract or partially retract.
- When vacuum is applied to both vacuum sources, the actuator will fully retract.
- When vacuum is applied only to the partial stage vacuum source, the actuator will partially retract.

Coolant Control Valve

The coolant control valve is actuated by the air inlet vacuum circuit. When the air inlet vacuum circuit is closed (at full vacuum), coolant flow through the heater core is shut off and A/C cooling efficiency is increased.

Electronic Automatic Temperature Control

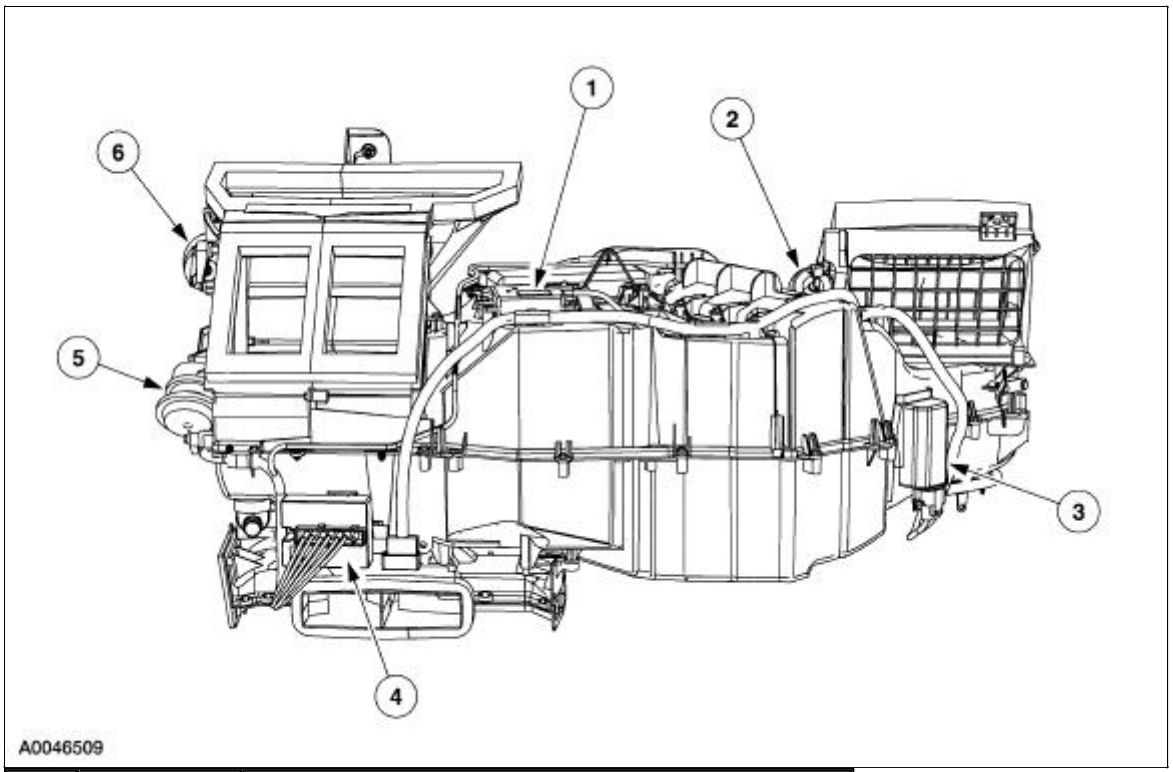
The electronic automatic temperature control (EATC) module analyzes input from the following major sources:

- temperature, function and blower selection (made by the vehicle occupants)
- in-vehicle temperature
- ambient temperature
- sunload
- vehicle speed
- engine coolant temperature

Using these inputs, the EATC module determines the correct conditions for the following outputs:

- A/C compressor operation
- blower speed
- temperature blend door position
- airflow door position
- coolant control valve

Plenum Chamber Control Components — EATC



Item	Part Number	Description
1	19E616	Temperature blend door actuator
2	18A318	Air inlet door vacuum control motor
3	19E624	Blower motor speed control
4	19D611	Automatic temperature control (ATC) solenoid and manifold
5	18A318	Floor/defrost door vacuum control motor
6	18A318	Panel door vacuum control motor

Control System Inputs—EATC

EATC Module (Climate Control Assembly)

The EATC module:

- is located in the instrument panel.
- has a vacuum fluorescent display for displaying set temperature, function and diagnostic trouble codes (DTCs).
- utilizes an on-board diagnostic (OBD) feature to supply the technician with diagnostic trouble codes (DTCs). These DTCs direct the technician to the inoperative component.

Steering Wheel Audio/Climate Control Switch

The steering wheel audio/climate control switch:

- is located on the right side of the steering wheel.

- allows the driver to adjust the passenger compartment temperature setting and manually override the blower motor speed setting.

For removal and installation of the steering wheel audio/climate control switch, refer to Section 415-01 .

Ambient Air Temperature Sensor

The ambient air temperature sensor:

- is located in front of the condenser core.
- provides a resistance value to a reference voltage from the EATC module that is proportional to the outside ambient temperature. The resulting voltage is then returned to the EATC module where it is interpreted as a temperature reading.

In-Vehicle Temperature Sensor

The in-vehicle temperature sensor operates in the following manner:

- A thermistor in the in-vehicle temperature sensor measures air temperature inside the passenger compartment.
- A hose and elbow is connected between the plenum chamber and the in-vehicle temperature sensor.
- Airflow through the plenum chamber creates a venturi-type suction through the hose which draws passenger compartment air through the in-vehicle temperature sensor and across the thermistor.

Solar Amplifier (Sunload Sensor)

The solar amplifier supplies sunload information to the EATC module. For information on the location and service of the solar amplifier, refer to Section 417-01 .

Control System Outputs—EATC

Automatic Temperature Control (ATC) Solenoid and Manifold

The ATC solenoid and manifold:

- is located on the plenum chamber in front of the front floor console.
- is controlled by the EATC module.
- uses solenoid-type valves to distribute vacuum to the vacuum control motors based on the settings of the EATC module.

Blower Motor Speed Control

The blower speed control:

- is located on the heater core and evaporator core housing near the blower motor.
- converts low power signals from the EATC module to a high current, variable ground feed for the blower motor.
- varies the blower motor speed and is controlled by the EATC module software.

- has a delay function to provide a gradual increase or decrease in blower motor speed under all conditions.
- controls the integral high blower speed relay which is engaged when maximum fan speed is selected.

Temperature Blend Door Actuator

The EATC system utilizes a temperature blend door actuator to control the temperature blend door. The temperature blend door actuator:

- is located on the plenum chamber.
- moves the temperature blend door on command from the EATC module.
- contains a reversible electric motor and a potentiometer. The potentiometer wiper is connected to the actuator output shaft and moves with the output shaft to indicate the position of the temperature blend door.
- receives a reference voltage to one end of the potentiometer. The voltage available at the wiper indicates the position of the potentiometer. The expressed value of the actuator wiper voltage is sent to the EATC module and is matched with an expected wiper voltage value. The EATC module then drives the actuator motor in whichever direction is necessary to make the actuator wiper voltage match the expected EATC module wiper voltage value.

Vacuum Control Motors

The three vacuum control motors have the following characteristics:

- They are actuated by the ATC solenoid and manifold based on input from the EATC module.
- They position the mode doors to direct system airflow to the vehicle interior as determined by the EATC module settings.
- The air inlet door vacuum control motor is a single-diaphragm actuator with a single vacuum source.
- The airflow mode door vacuum control motors are double-diaphragm actuators with two separate vacuum sources to allow the actuator to fully retract or partially retract.
- When vacuum is applied to both vacuum sources, the actuator will fully retract.
- When vacuum is applied only to the partial stage vacuum source, the actuator will partially retract.

Coolant Control Valve

The coolant control valve is actuated by the coolant control valve vacuum circuit. When the coolant control valve is closed (at full vacuum), coolant flow through the heater core is shut off and A/C cooling efficiency is increased.

Dual Automatic Temperature Control

The dual automatic temperature control (DATC) module analyzes input from the following major sources:

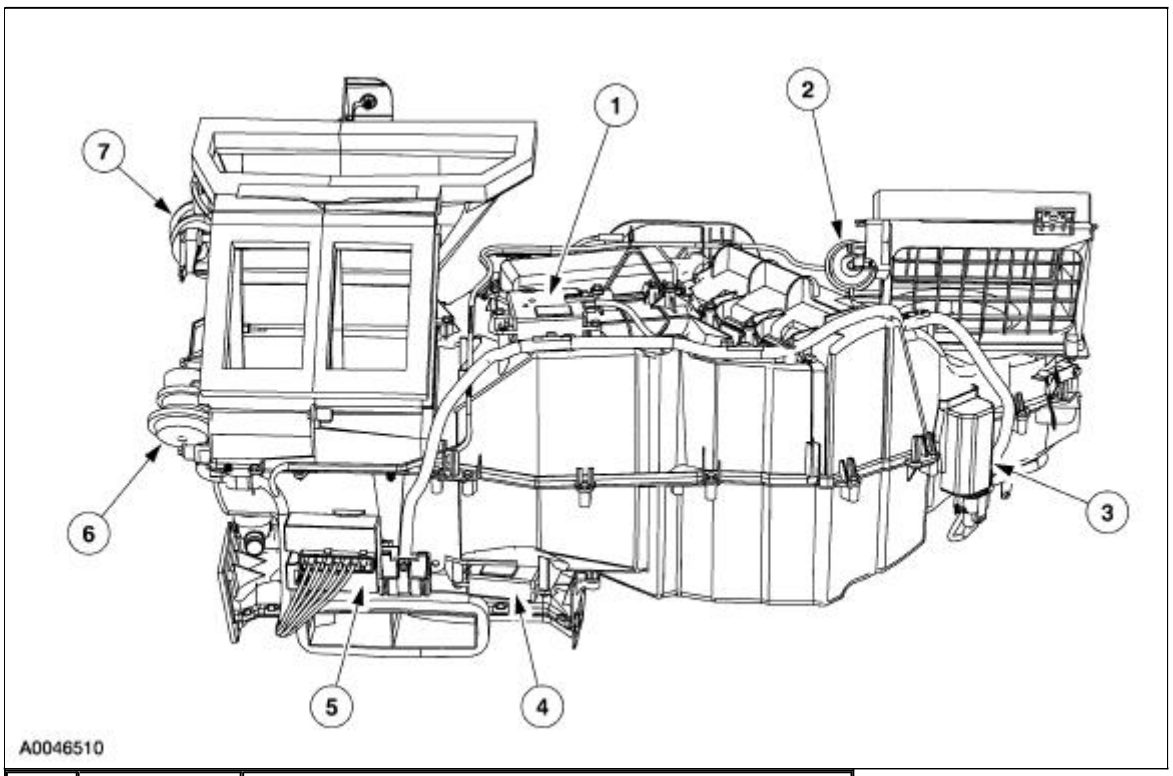
- temperature, function and blower selection (made by the vehicle occupants)
- in-vehicle temperature
- in-vehicle humidity (Navigator only)

- ambient temperature
- sunload
- vehicle speed
- engine coolant temperature

Using these inputs, the DATC module determines the correct conditions for the following outputs:

- A/C compressor operation
- blower speed
- LH side temperature blend door position
- RH side temperature blend door position
- panel airflow door position
- airflow door positions
- coolant control valve

Plenum Chamber Control Components — DATC



Item	Part Number	Description
1	19E616	Temperature blend door actuator — RH
2	18A318	Air inlet door vacuum control motor
3	19E624	Blower motor speed control
4	19E616	Temperature blend door actuator — LH
5	19D611	Automatic temperature control (ATC) solenoid and manifold
6	18A318	Floor/defrost door vacuum control motor

7	18A318	Panel door vacuum control motor

Control System Inputs—DATC

DATC Module (Climate Control Assembly)

The DATC module:

- is located in the instrument panel.
- has a vacuum fluorescent display for displaying set temperature, function and diagnostic trouble codes (DTCs).
- utilizes an on-board diagnostic (OBD) feature to supply the technician with diagnostic trouble codes (DTCs). These DTCs direct the technician to the inoperative component.

Steering Wheel Audio/Climate Control Switch

The steering wheel audio/climate control switch:

- is located on the right side of the steering wheel.
- allows the driver to adjust the passenger compartment temperature setting and manually override the blower motor speed setting.

For removal and installation of the steering wheel audio/climate control switch, refer to Section 415-01 .

Ambient Air Temperature Sensor

The ambient air temperature sensor:

- is located in front of the condenser core.
- provides a resistance value to a reference voltage from the DATC module that is proportional to the outside ambient temperature. The resulting voltage is then returned to the DATC module where it is interpreted as a temperature reading.

In-Vehicle Temperature/Humidity Sensor — Navigator

The in-vehicle temperature/humidity sensor operates in the following manner:

- A thermistor in the in-vehicle temperature/humidity sensor measures air temperature inside the passenger compartment.
- A humidity transducer in the in-vehicle temperature/humidity sensor measures in-vehicle humidity.
- A hose and elbow is connected between the plenum chamber and the in-car temperature/humidity sensor.
- Airflow through the plenum chamber creates a venturi-type suction through the hose which draws passenger compartment air through the in-vehicle temperature/humidity sensor and across the thermistor and humidity transducer.

In-Vehicle Temperature Sensor — Expedition

The in-vehicle temperature sensor operates in the following manner:

- A thermistor in the in-vehicle temperature sensor measures air temperature inside the passenger compartment.
- A hose and elbow is connected between the plenum chamber and the in-vehicle temperature sensor.
- Airflow through the plenum chamber creates a venturi-type suction through the hose which draws passenger compartment air through the in-vehicle temperature sensor and across the thermistor.

Dual Zone Solar Amplifier (Sunload Sensor) — Navigator

The solar amplifier is a dual zone type that supplies separate information to the DATC module indicating LH side and RH side sunload. For information on the location and service of the solar amplifier, refer to Section 417-01 .

Single Zone Solar Amplifier (Sunload Sensor) — Expedition

The solar amplifier supplies information to the DATC module indicating sunload. For information on the location and service of the solar amplifier, refer to Section 417-01 .

Control System Outputs—DATC

Automatic Temperature Control (ATC) Solenoid and Manifold

The ATC solenoid and manifold:

- is located on the plenum chamber in front of the front floor console.
- is controlled by the DATC module.
- uses solenoid-type valves to distribute manifold vacuum to the vacuum control motors based on the settings of the DATC module.

Blower Motor Speed Control

The motor blower speed control:

- is located on the heater core and evaporator core housing near the blower motor.
- converts low power signals from the DATC module to a high current, variable ground feed for the blower motor.
- varies the blower motor speed and is controlled by the DATC module software.
- has a delay function to provide a gradual increase or decrease in blower motor speed under all conditions.
- controls the integral high blower speed relay which is engaged when maximum fan speed is selected.

Temperature Blend Door Actuators

The DATC system utilizes two temperature blend door actuators to control two separate temperature blend doors that independently vary the LH and RH side temperature settings, as desired. The temperature blend door actuators:

- are located on the plenum chamber.
- move the temperature blend doors on command from the DATC module.
- contain a reversible electric motor and a potentiometer. The potentiometer wiper is connected to the actuator output shaft and moves with the output shaft to indicate the position of the temperature blend door.
- receive a reference voltage to one end of the potentiometer. The voltage available at the wiper indicates the position of the potentiometer. The expressed value of the actuator wiper voltage is sent to the DATC module and is matched with an expected wiper voltage value. The DATC module then drives the actuator motor in whichever direction is necessary to make the actuator wiper voltage match the expected DATC module wiper voltage value.

Vacuum Control Motors

The three vacuum control motors have the following characteristics:

- They are actuated by the ATC solenoid and manifold based on input from the DATC module.
- They position the mode doors to direct system airflow to the vehicle interior as determined by the DATC module settings.
- The air inlet door vacuum control motor is a single-diaphragm actuator with a single vacuum source.
- The airflow mode door vacuum control motors are double-diaphragm actuators with two separate vacuum sources to allow the actuator to fully retract or partially retract.
- When vacuum is applied to both vacuum sources, the actuator will fully retract.
- When vacuum is applied only to the partial stage vacuum source, the actuator will partially retract.

Coolant Control Valve

The coolant control valve is actuated by the coolant control valve vacuum circuit. When the coolant control valve is closed (at full vacuum), coolant flow through the heater core is shut off and A/C cooling efficiency is increased.

Control Components

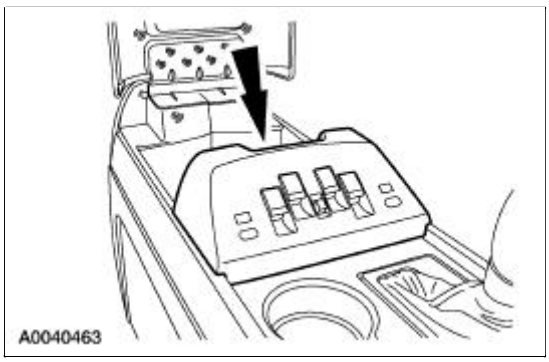
Refer to Section 412-00 .

Climate Control Assembly —EATC, DATC

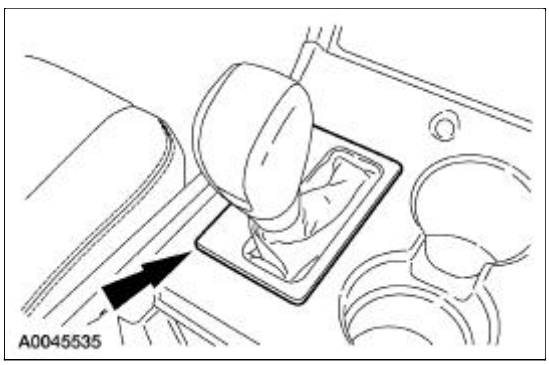
Removal and Installation

Navigator

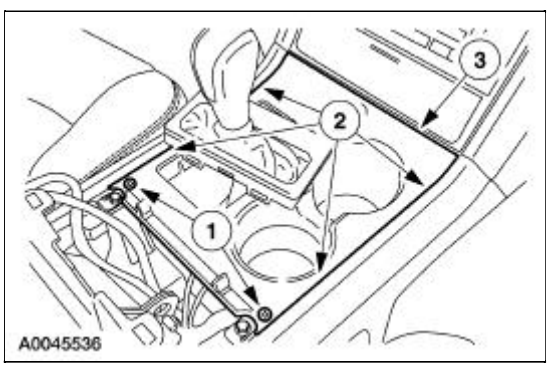
1. Disconnect the negative battery cable. For additional information, refer to Section 414-00 .
2. Detach and position aside the switch housing.



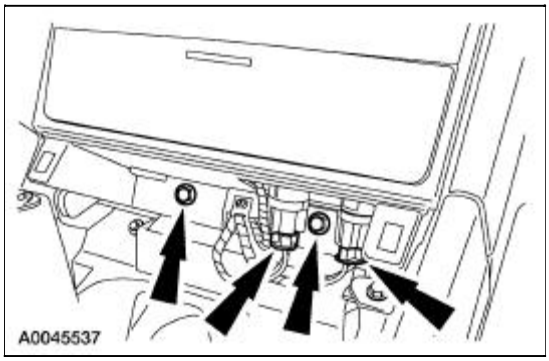
3. Detach the shift lever cover.
   - Disconnect the electrical connector.



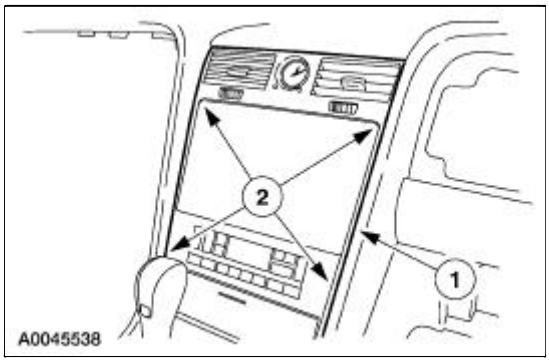
4. Remove the center console trim panel.
   1. Remove the screws.
   2. Disengage the four clips.
   3. Remove the center console trim panel.



5. Disconnect the electrical connectors and remove the screws.



6. Remove the center instrument panel finish panel.
    1. Open the audio unit cover to the full open position.
    2. Disengage the four clips.
    - Disconnect the electrical connectors.

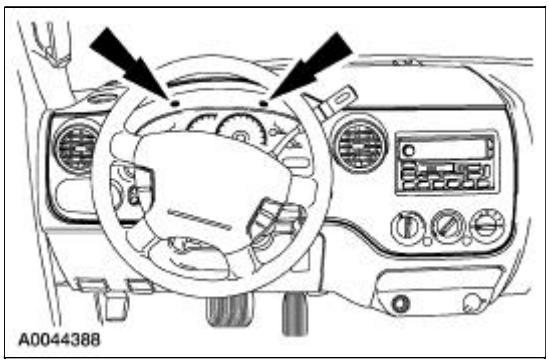


Expedition

7. Apply the parking brake and place the gear selector in (1).

8. Disconnect the negative battery cable. For additional information, refer to Section 414-00 .

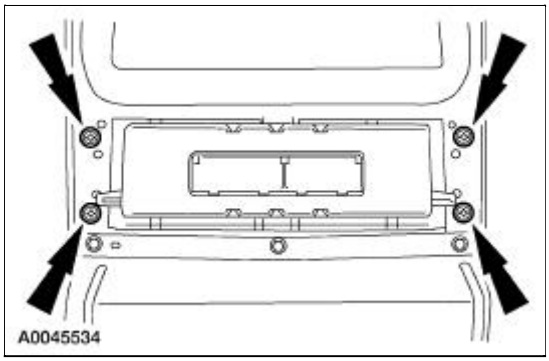
9. Remove the screws and the instrument cluster finish panel.
    - Disconnect the electrical connectors.



All vehicles

10. **NOTE:** Navigator shown, Expedition similar.

    Remove the screws and the climate control assembly.

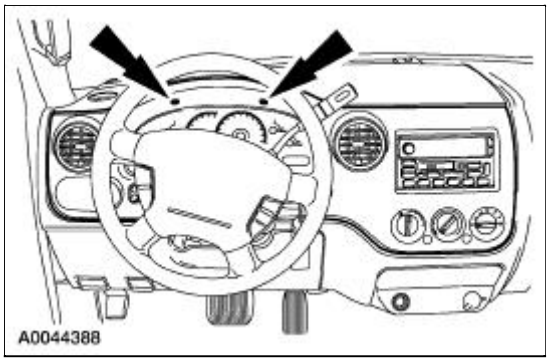


11. To install, reverse the removal procedure.

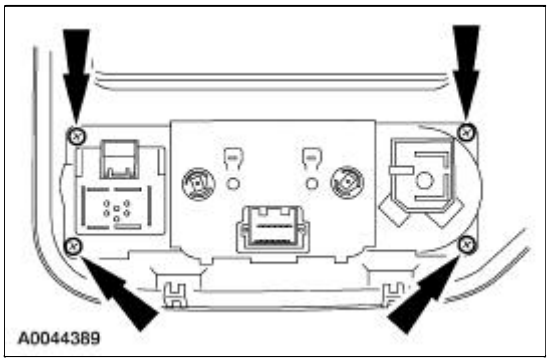
Climate Control Assembly —Manual

Removal and Installation

1. Remove the screws and the instrument cluster finish panel.
   - Disconnect the electrical connectors.



2. Remove the screws and the climate control assembly.

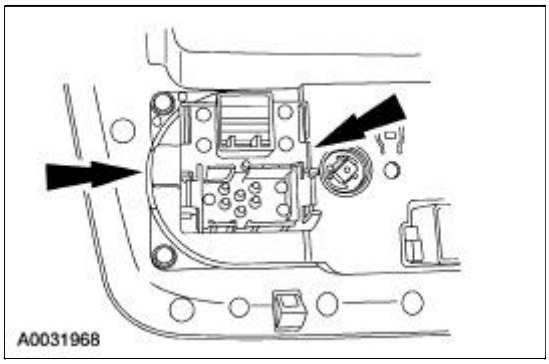


3. To install, reverse the removal procedure.

Function Selector Switch

Removal and Installation

1. Remove the manual climate control assembly. For additional information, refer to Climate Control Assembly—Manual in this section.
2. Pull and remove the function selector knob.
3. Release the clips and remove the function selector switch.

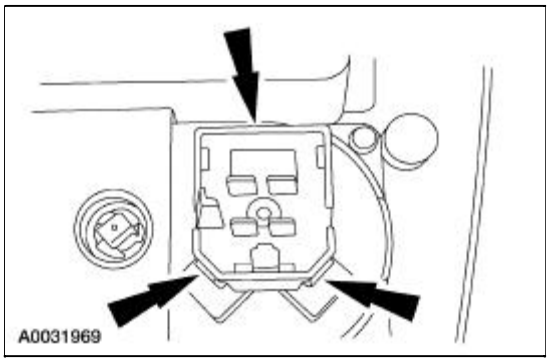


4. To install, reverse the removal procedure.

Blower Motor Switch

Removal and Installation

1. Remove the climate control assembly. For additional information, refer to Climate Control Assembly—Manual in this section.
2. Pull and remove the blower motor switch knob.
3. Release the clips and remove the blower motor switch.



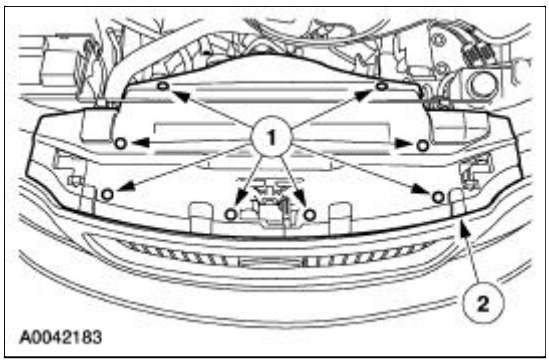
4. To install, reverse the removal procedure.

Ambient Air Temperature Sensor

Removal and Installation

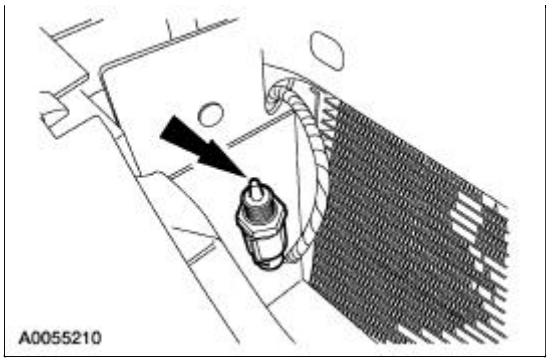
Expedition

1. Remove the radiator sight shield.
    1. Remove the pin-type retainers.
    2. Remove the radiator sight shield.

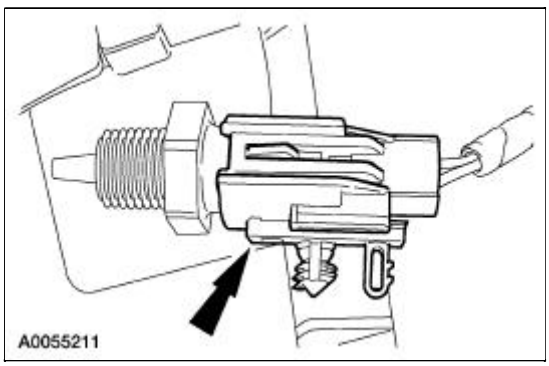


All vehicles

2. Detach the ambient temperature sensor pin-type retainer.



3. Disconnect the electrical connector and remove the ambient temperature sensor.

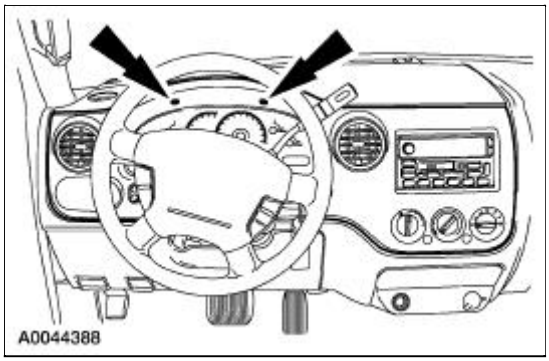


4. To install, reverse the removal procedure.

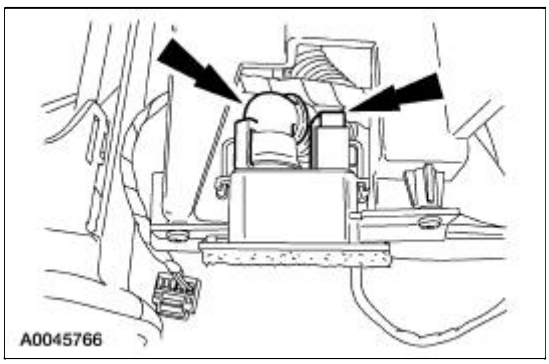
In-Vehicle Temperature Sensor

Removal and Installation

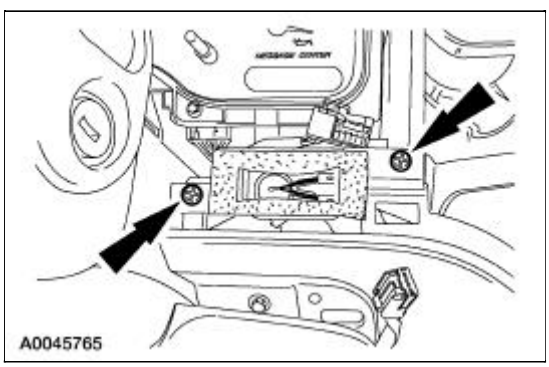
1. Remove the screws and the instrument cluster finish panel.
   - Disconnect the electrical connectors.



2. Disconnect the aspirator hose and the in-vehicle temperature sensor electrical connector.



3. Remove the screws and the in-vehicle temperature sensor.

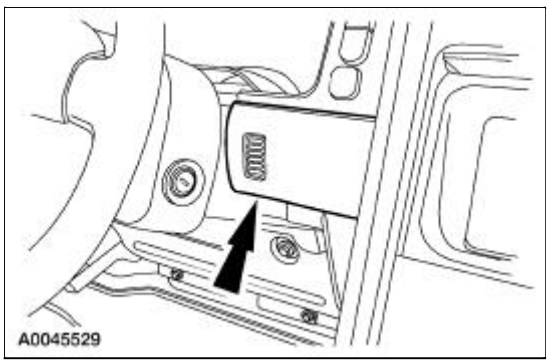


4. To install, reverse the removal procedure.

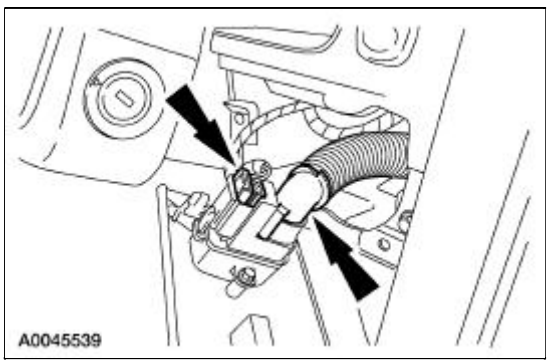
In-Vehicle Temperature and Humidity Sensor

Removal and Installation

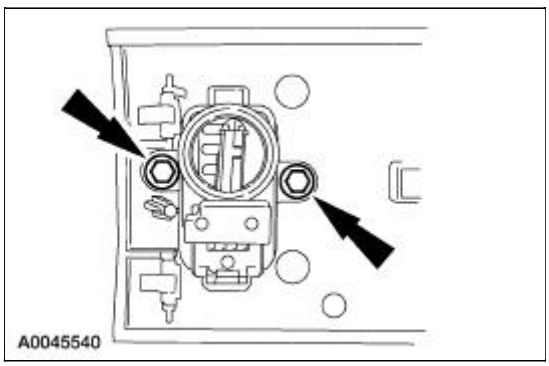
1. Remove the in-vehicle temperature and humidity sensor trim cover.



2. Disconnect the aspirator hose and the in-vehicle temperature and humidity sensor electrical connector.



3. Remove the screws and the in-vehicle temperature and humidity sensor.



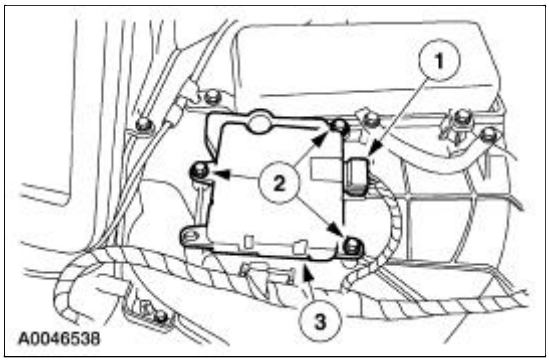
4. To install, reverse the removal procedure.

Temperature Blend Door Actuator —RH

Removal and Installation

1. Remove the instrument panel. For additional information, refer to Section 501-12 .

2. Remove the temperature blend door actuator.
    1. Disconnect the temperature blend door actuator electrical connector.
    2. Remove the screws.
    3. Remove the temperature blend door actuator.

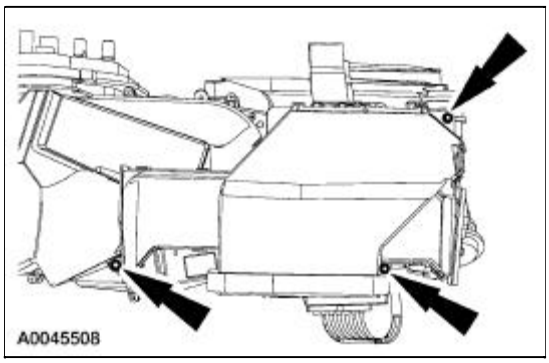


3. To install, reverse the removal procedure.

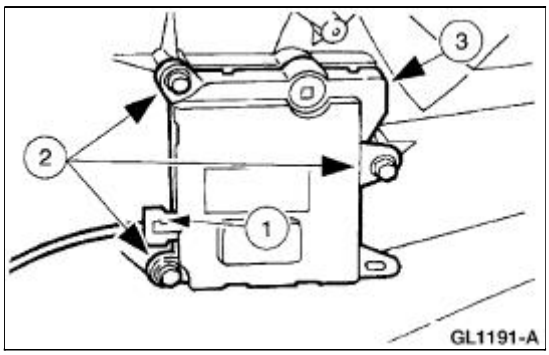
Temperature Blend Door Actuator —LH

Removal and Installation

1. Remove the plenum chamber. For additional information, refer to Section 412-01 .
2. Remove the screws and the floor duct.



3. Remove the temperature blend door actuator.
    1. Disconnect the temperature blend door actuator electrical connector.
    2. Remove the screws.
    3. Remove the temperature blend door actuator.



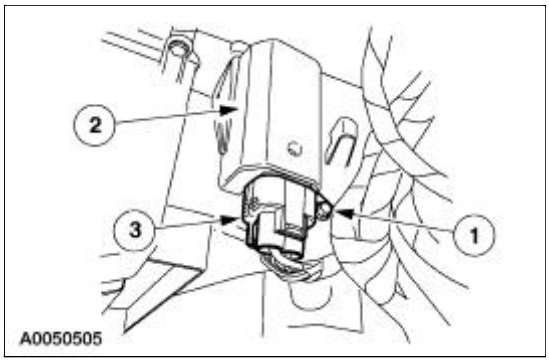
4. To install, reverse the removal procedure.

Blower Motor Speed Control

Removal and Installation

1. Remove the RH lower instrument panel insulator.

2. Remove the blower motor speed control.
    1. Remove the screw.
    2. Remove the blower motor speed control.
    3. Disconnect the blower motor speed control electrical connector.

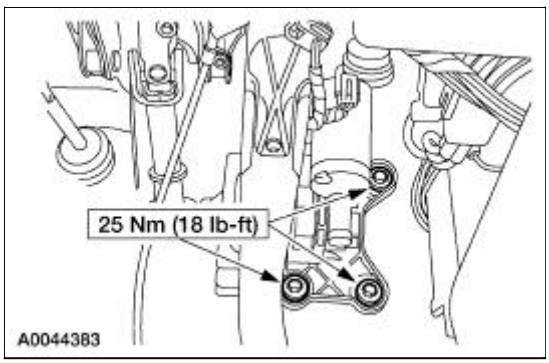


3. To install, reverse the removal procedure.

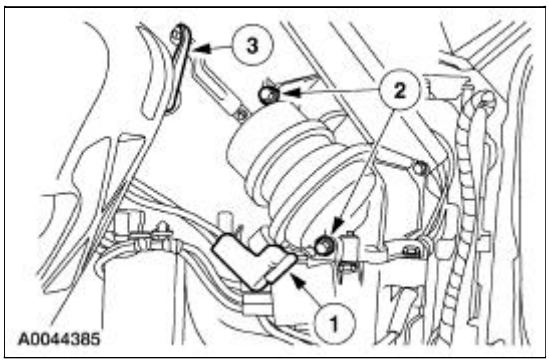
Vacuum Control Motor —Floor/Defrost Door

Removal and Installation

1. Remove the bolts and position aside the accelerator pedal.



2. Remove the floor/defrost door vacuum control motor.
    1. Disconnect the vacuum connector.
    2. Remove the screws.
    3. Rotate the floor/defrost door vacuum control motor to clear the retaining arm.



3. Remove the floor/defrost door vacuum control motor.

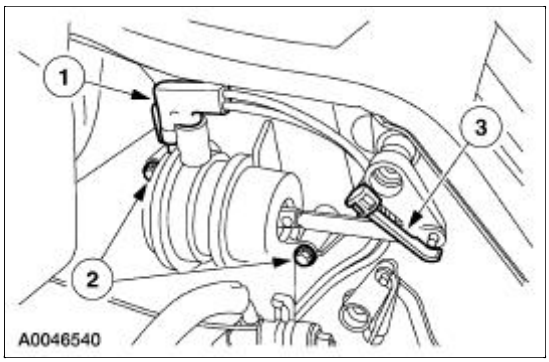
4. To install, reverse the removal procedure.

Vacuum Control Motor —Panel Door

Removal and Installation

1. Remove the instrument panel. For additional information, refer to Section 501-12 .

2. Remove the panel door vacuum control motor.
    1. Disconnect the vacuum connector.
    2. Remove the screws.
    3. Rotate the panel door vacuum control motor to clear the retaining arm.
    - Remove the panel door vacuum control motor.

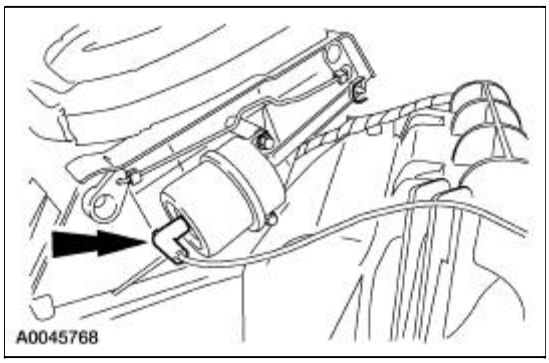


3. To install, reverse the removal procedure.

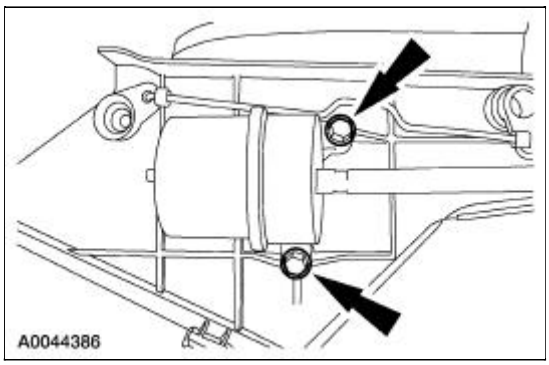
Vacuum Control Motor —Air Inlet Door

Removal and Installation

1. Remove the instrument panel. For additional information, refer to Section 501-12 .
2. Disconnect the vacuum connector.



3. Remove the screws and the air inlet door vacuum control motor.

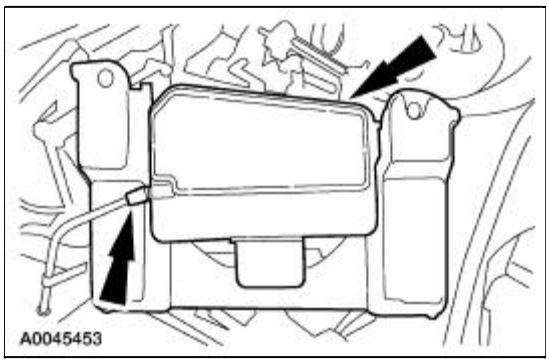


4. To install, reverse the removal procedure.

Vacuum Reservoir

Removal and Installation

1. Remove the battery and battery tray. For additional information, refer to Section 414-01 .
2. Disconnect the vacuum hose and remove the vacuum reservoir.



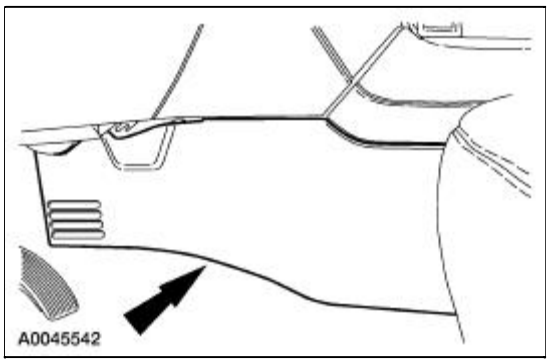
3. To install, reverse the removal procedure.

Automatic Temperature Control Solenoid and Manifold

Removal and Installation

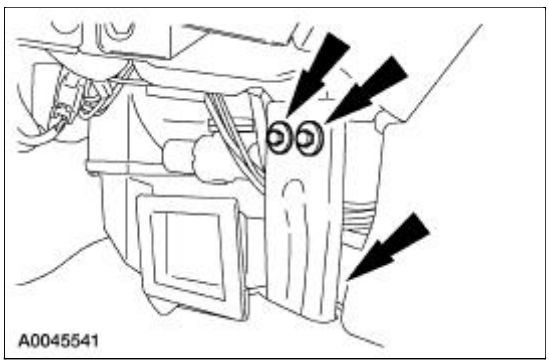
Navigator

1. Remove the floor console trim panel.



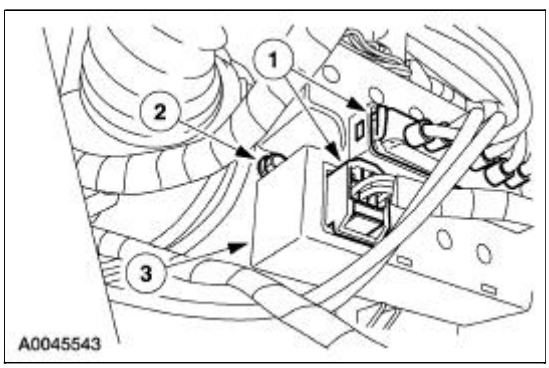
Expedition

2. Remove the bolts and the instrument panel brace.



All vehicles

3. Remove the automatic temperature control (ATC) solenoid and manifold.
    1. Disconnect the vacuum and electrical connectors.
    2. Remove the screw.
    3. Remove the ATC solenoid and manifold.



4. To install, reverse the removal procedure.

Instrument Cluster and Panel Illumination

The instrument cluster and panel lighting system illuminates the following components:

- A4WD mode switch
- adjustable pedal switch
- ash receptacle
- cigar lighter
- manual A/C control assembly
- electronic automatic temperature control (EATC)
- auxiliary climate control (front, rear)
- electric clock (Navigator only)
- headlamp switch
- heated back window switch and light
- instrument cluster
- message center switch
- exterior rear view mirror control
- power door lock switches (front left, front right)
- power window switches
- power rear quarter window switches
- sliding roof panel switch
- audio unit
- radio and A/C rear integral control panel (RICP)
- steering wheel switches

Instrument Cluster and Panel Illumination

Refer to Wiring Diagrams Cell 71 , Instrument Illumination for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent

Inspection and Verification

NOTE: Upon installation of a new instrument cluster, the module must be reconfigured. For additional information, refer to Section 418-01 .

1. Verify the customer concern by operating the instrument illumination.
2. Visually inspect for obvious signs of electrical damage; refer to the following chart.

Visual Inspection Chart

Electrical
● Central junction box (CJB) fuse(s): ■ 6 (15A) ■ 22 (10A) ● Wiring harness ● Headlamp switch ● Dimmer module (Navigator only)

3. If the fault is not visually evident, determine the symptom and proceed to the Symptom Chart.

Symptom Chart

Symptom Chart

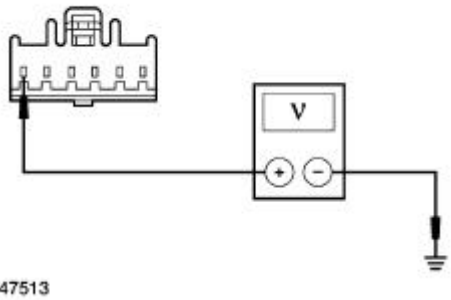
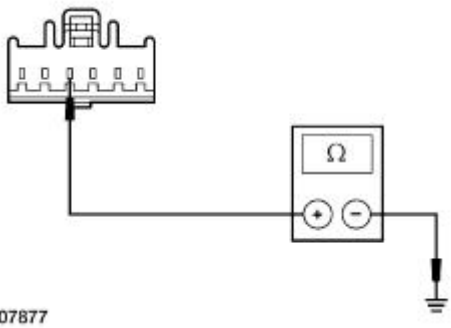
Condition	Possible Sources	Action
● The control illumination is inoperative	● Central Junction Box (CJB) Fuse 6 (15A). ● Circuitry. ● Headlamp switch.	● Go To Pinpoint Test A .
● The instrument cluster illumination is inoperative	● Bulb(s). ● Circuitry. ● Instrument cluster. ● Headlamp switch	● Go To Pinpoint Test B .
● The climate control illumination is inoperative	● Circuitry. ● Bulb(s).	● Go To Pinpoint

	• Electronic automatic temperature control (EATC).	Test C .
• The audio system illumination is inoperative	• Circuitry. • Audio unit.	• Go To Pinpoint Test D .
• A single illumination source is inoperative	• Bulb. • Circuitry. • Switch.	• Go To Pinpoint Test E .
• The power window switch(es) illumination source is inoperative — Expedition only	• Circuitry. • Switch.	• Go To Pinpoint Test F .
• The steering wheel control (SWC) switches illumination source is inoperative	• Circuitry. • SWC. • Clockspring.	• Go To Pinpoint Test G .
• One or more module controlled illumination source is inoperative — Navigator only	• Circuitry. • Dimmer module.	• Go To Pinpoint Test H .

Pinpoint Tests

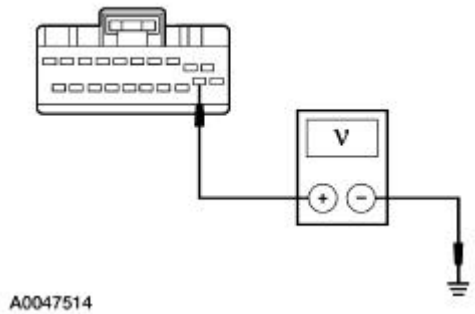
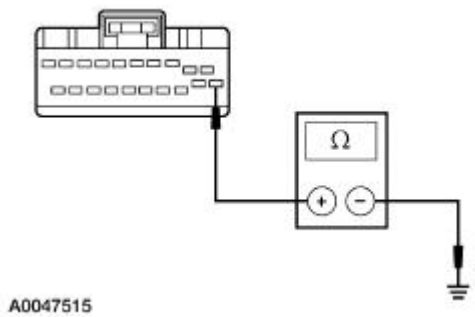
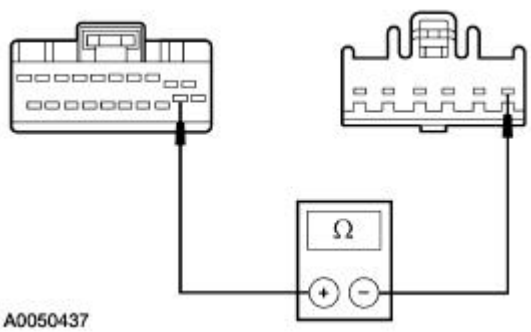
PINPOINT TEST A: THE CONTROL ILLUMINATION IS INOPERATIVE

Test Step	Result / Action to Take
A1 CHECK EXTERIOR LAMPS	
• Place the headlamp switch in the ON position. • **Are the exterior lamps on?**	**Yes** GO to A2 . **No** REFER to Section 417-01 .
A2 CHECK HEADLAMP SWITCH	
• Place the headlamp switch in the OFF position. • Disconnect: Headlamp Switch C205a and C205b. • Carry out the headlamp switch component test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. • **Is the headlamp switch OK?**	**Yes** RECONNECT the headlamp switch C205a. GO to A3 . **No** INSTALL a new headlamp switch; REFER to Section 417-01 . TEST the system for normal operation.
A3 CHECK CIRCUIT 14 (BN) FOR AN OPEN	
• Turn the headlamp switch to the parking lamps ON position. • Measure the voltage between the headlamp switch C205b pin 6, circuit 14 (BN), harness side and ground, while the headlamp switch is in the parking lamps ON position.	**Yes** GO to A4 . **No** REPAIR the circuit. TEST the system for normal operation.

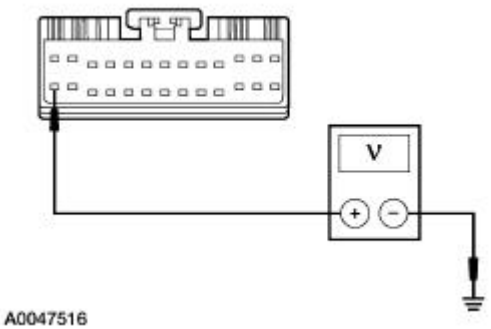
 A0047513 ● **Is the voltage greater than 10 volts?**	
A4 CHECK CIRCUIT 57 (BK) FOR AN OPEN	**Yes** For Expedition, REPAIR circuit 19 (LB/RD). For Navigator, REPAIR circuit 505 (GY/YE). TEST the system for normal operation. **No** REPAIR circuit 57 (BK). TEST the system for normal operation.
● Turn the headlamp switch off. ● Measure the resistance between the headlamp switch C205b pin 4, circuit 57 (BK), harness side and ground.  A0007877 ● **Is the resistance less than 5 ohms?**	

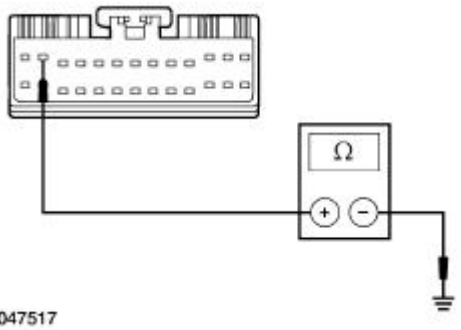
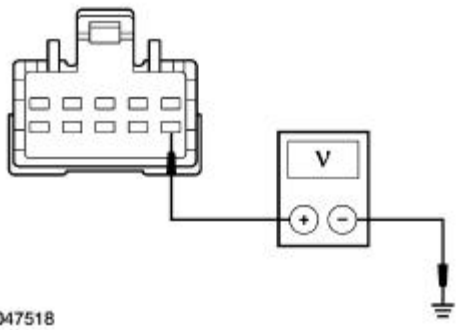
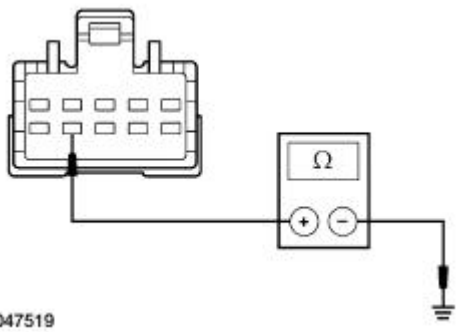
PINPOINT TEST B: THE INSTRUMENT CLUSTER ILLUMINATION IS INOPERATIVE

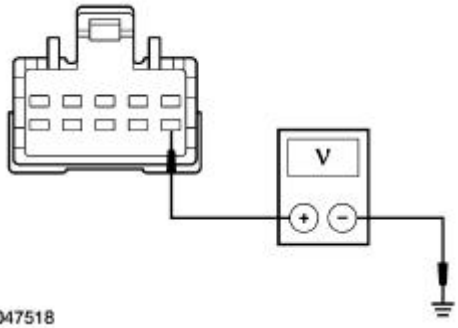
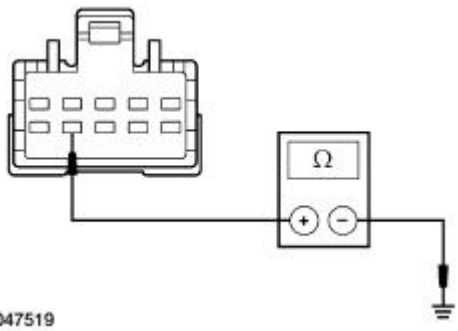
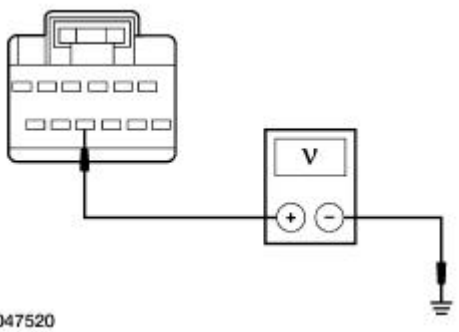
Test Step	Result / Action to Take
B1 MONITOR THE INSTRUMENT PANEL DIMMER SWITCH INPUT TO THE INSTRUMENT CLUSTER	
● Carry out the instrument cluster self-diagnostic mode. Refer to Section 413-01 . ● Advance the self-diagnostic mode until PWM_DIM_INPUT is displayed on the message center (Expedition/Navigator with message center) or rhO is displayed on the odometer (Expedition with base cluster). ● Turn the headlamp switch to the parking lamps ON position. ● Rotate the instrument panel dimmer switch from the full dim to the full illumination positions while observing the odometer display. ● **Does the value displayed vary from 1 in the full dim position to 22 in the full illumination position?**	**Yes** INSTALL a new instrument cluster. REFER to Section 413-01 . TEST the system for normal operation. **No** GO to B2 .
B2 CHECK VOLTAGE TO INSTRUMENT CLUSTER ILLUMINATION	
● Key in OFF position. ● Turn the headlamp switch off. ● Disconnect: Instrument Cluster C220a. ● Turn the headlamp switch to the parking lamps ON position. ● Rotate the instrument panel dimmer switch to the full illumination position. ● Measure the voltage between the instrument cluster C220a pin 12,	**Yes** GO to B3 . **No** GO to B4 .

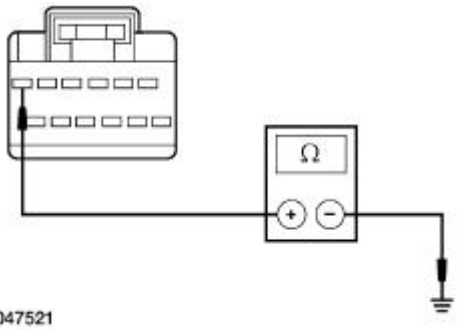
circuit 505 (GY/YE) (Navigator), harness side and ground; or between the instrument cluster C220a pin 12, circuit 19 (LB/RD) (Expedition), harness side and ground.  A0047514 • **Is the voltage greater than 10 volts?**	
B3 CHECK GROUND CIRCUIT TO INSTRUMENT CLUSTER	
• Turn the headlamp switch off. • Measure the resistance between the instrument cluster C220a pin 11, circuit 57 (BK), harness side and ground.  A0047515 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new instrument cluster. REFER to Section 413-01 . TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
B4 CHECK CIRCUIT 505 (GY/YE) (NAVIGATOR) OR CIRCUIT 19 (LB/RD) (EXPEDITION)	
• Disconnect: Headlamp/Instrument Panel Dimmer Switch C205b. • Measure the resistance between the instrument cluster C220a pin 12, circuit 505 (GY/YE) (Navigator) or circuit 19 (LB/RD) (Expedition) harness side and headlamp switch C205b pin 1, circuit 505 (GY/YE) (Navigator) or circuit 505 (GY/YE) (Navigator) or circuit 19 (LB/RD) (Expedition), harness side.  A0050437 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new instrument panel dimmer switch. REFER to Instrument Panel Dimmer Switch in this section. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.

PINPOINT TEST C: THE CLIMATE CONTROL ILLUMINATION IS INOPERATIVE

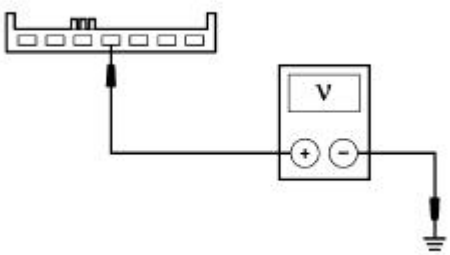
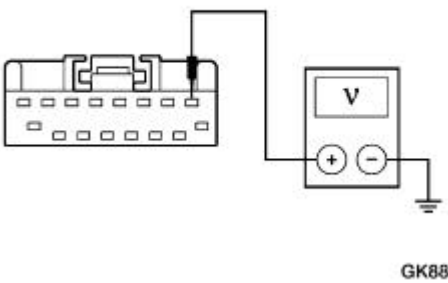
Test Step	Result / Action to Take
C1 VERIFY THE CLIMATE CONTROL ILLUMINATION OPERATION	
• Turn the headlamp switch to the parking lamps ON position. • Rotate the instrument panel dimmer switch to the full illumination position. • **Does the climate control illumination operate correctly?**	**Yes** System is OK. **No** If the EATC illumination does not operate correctly, GO to C2 . If the front auxiliary climate control illumination does not operate correctly, GO to C4 . If the rear auxiliary climate control illumination does not operate correctly, GO to C6 . If the manual climate control illumination does not operate correctly, GO to C8 .
C2 CHECK VOLTAGE TO THE EATC ILLUMINATION	
• Disconnect: EATC C228a. • Measure the voltage between the EATC C228a pin 14, circuit 235 (RD/BK) (Navigator), harness side and ground; or between the EATC C228a pin 14, circuit 19 (LB/RD) (Expedition), harness side and ground.  A0047516 • **Are the voltages greater than 10 volts?**	**Yes** GO to C3 . **No** REPAIR the circuit. TEST the system for normal operation.
C3 CHECK EATC GROUND	
• Measure the resistance between the EATC C228a pin 2, circuit 875 (BK/LB), harness side and ground.	**Yes** INSTALL a new EATC. REFER to Section 412-04 . TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.

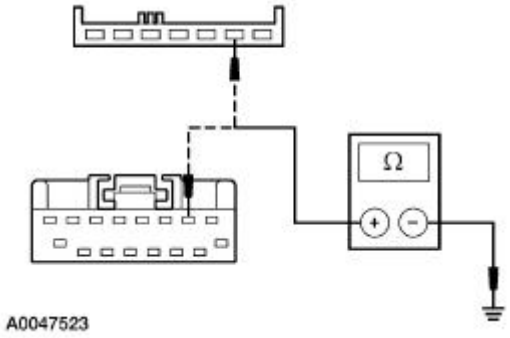
 A0047517 ● **Is the resistance less than 5 ohms?**	
C4 CHECK THE VOLTAGE TO THE FRONT AUXILIARY CLIMATE CONTROL	
● Disconnect: Front Auxiliary Climate Control C989b. ● Measure the voltage between the front auxiliary climate control C989b pin 6, circuit 19 (LB/RD), harness side and ground.  A0047518 ● **Is the voltage greater than 10 volts?**	**Yes** GO to C5 . **No** REPAIR the circuit. TEST the system for normal operation.
C5 CHECK THE GROUND CIRCUIT TO THE FRONT AUXILIARY CLIMATE CONTROL	
● Measure the resistance between the front auxiliary climate control C989b pin 9, circuit 57 (BK), harness side and ground.  A0047519 ● **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new front auxiliary climate control assembly. REFER to Section 412-04 . TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
C6 CHECK THE VOLTAGE TO THE REAR AUXILIARY CLIMATE CONTROL	
● Disconnect: Rear Auxiliary Climate Control C3198b. ● Measure the voltage between the rear auxiliary climate control C3198b pin 6, circuit 1417 (LG/RD) (Navigator), harness side and ground; or between the rear auxiliary climate control C3198b pin 6, circuit 19 (LB/RD) (Expedition), harness side and ground.	**Yes** GO to C7 . **No** REPAIR the circuit. TEST the system for normal operation.

 A0047518 ● **Is the voltage greater than 10 volts?**	
C7 CHECK THE GROUND CIRCUIT TO THE REAR AUXILIARY CLIMATE CONTROL	
● Measure the resistance between the rear auxiliary climate control C3198b pin 9, circuit 57 (BK), harness side and ground.  A0047519 ● **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new rear auxiliary climate control assembly. REFER to Section 412-04 . TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
C8 CHECK THE VOLTAGE TO THE MANUAL CLIMATE CONTROL	
● Disconnect: Function Selector Switch C294c. ● Measure the voltage between the function selector switch C294c pin 10, circuit 19 (LB/RD), harness side and ground.  A0047520 ● **Is the voltage greater than 10 volts?**	**Yes** GO to C9 . **No** REPAIR the circuit. TEST the system for normal operation.
C9 CHECK THE GROUND CIRCUIT TO THE MANUAL CLIMATE CONTROL	
● Measure the resistance between the function selector switch C294c pin 6, circuit 57 (BK), harness side and ground.	**Yes** INSTALL a new manual climate control assembly. REFER to Section 412-04 . TEST the system for normal operation. **No** REPAIR the circuit.

 ● **Is the resistance less than 5 ohms?**	TEST the system for normal operation.

PINPOINT TEST D: THE AUDIO SYSTEM ILLUMINATION IS INOPERATIVE

Test Step	Result / Action to Take
D1 CHECK VOLTAGE TO AUDIO UNIT	
● Disconnect: Audio Unit C2188a (with Navigation system) or C290a (without Navigation system). ● Turn the headlamp switch to the parking lamps ON position. ● Rotate the instrument panel dimmer switch to the full illumination position. ● Measure the voltage between the audio unit C2188a pin 4, circuit 235 (RD/BK) (Navigator with navigation system), harness side and ground; or between the audio unit C2188a pin 4, circuit 19 (LB/RD) (Expedition with navigation system), harness side and ground.  ● Measure the voltage between the audio unit C290a pin 1, circuit 235 (RD/BK) (Navigator without navigation system), harness side and ground; or between the audio unit C290a pin 1, circuit 19 (LB/RD) (Expedition without navigation system), harness side and ground.  ● **Is the voltage greater than 10 volts?**	**Yes** GO to D2 . **No** REPAIR circuit 235 (RD/BK) (Navigator) or circuit 19 (LB/RD) (Expedition). TEST the system for normal operation.

D2 CHECK GROUND TO AUDIO UNIT	
• Measure the resistance between the audio unit C2188a (with navigation system) pin 2, circuit 57 (BK) or between the audio unit C290a (without navigation system) pin 2, circuit 57 (BK), harness side and ground.  • **Is the resistance less than 5 ohms?**	**Yes** REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.

PINPOINT TEST E: A SINGLE ILLUMINATION SOURCE IS INOPERATIVE

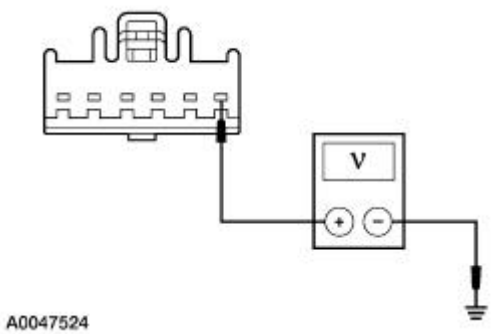
Test Step	Result / Action to Take
E1 CHECK VOLTAGE TO THE INOPERATIVE ILLUMINATION SOURCE	
• Disconnect: Inoperative Illumination Source. • Turn the headlamp switch to the parking lamps ON position. • Rotate the instrument panel dimmer switch to the full illumination position. • Measure the voltage between the inoperative illumination source, circuit 19 (LB/RD), circuit 194 (PK) (Expedition only), circuit 235 (RD/BK) (Navigator only), or circuit 1417 (LG/RD) (Navigator only), harness side and ground. • **Is the voltage greater than 10 volts?**	**Yes** GO to E2 . **No** REPAIR circuit 19 (LB/RD), circuit 194, (PK), circuit 235 (RD/BK), or circuit 1417 (RD/BK). TEST the system for normal operation.
E2 CHECK INOPERATIVE ILLUMINATION SOURCE GROUND	
• Measure the resistance between the inoperative illumination source, circuit 57 (BK), harness side and ground. • **Is the resistance less than 5 ohms?**	**Yes** If the bulb(s) are damaged, INSTALL new bulb(s). Otherwise, INSTALL a new component. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.

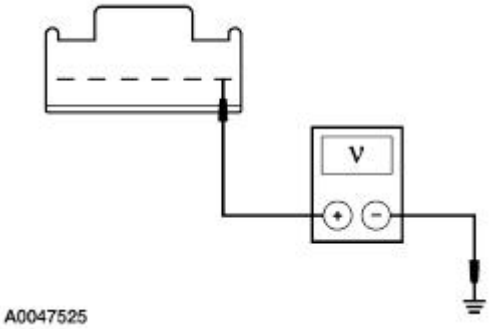
PINPOINT TEST F: THE POWER WINDOW SWITCH(ES) ILLUMINATION SOURCE IS INOPERATIVE — EXPEDITION ONLY

Test Step	Result / Action to Take
F1 CHECK POWER WINDOW OPERATION	
• Key in ON position.	**Yes**

• Turn the headlamp switch to the parking lamps ON position. • Rotate the instrument panel dimmer switch to the full illumination position. • Operate the power window switch in both up and down directions. • **Does the power window operate in both up and down directions?**	INSTALL a new power window switch assembly. REFER to Section 501-11 **No** REFER to Section 501-11 .

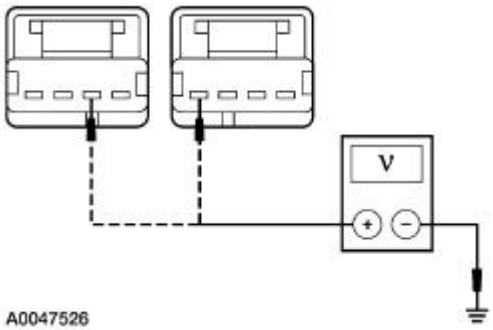
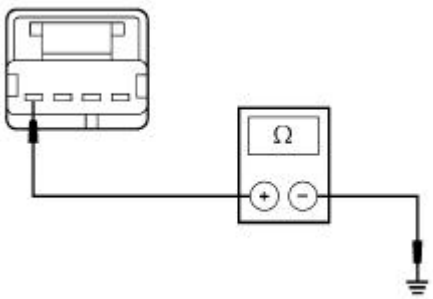
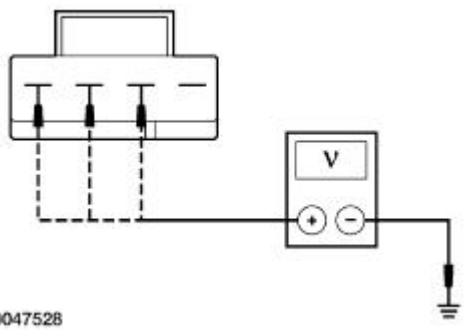
PINPOINT TEST G: THE STEERING WHEEL CONTROL (SWC) SWITCHES ILLUMINATION SOURCE IS INOPERATIVE

Test Step	Result / Action to Take
G1 CHECK SPEED CONTROL SYSTEM	
• Operate the speed control system. • **Does the speed control system operate correctly?**	**Yes** GO to G2 . **No** REFER to Section 310-03 .
G2 CHECK VOLTAGE TO THE CLOCKSPRING CONNECTOR	
• Key in OFF position. • Disconnect: Clockspring C218b. • Turn the headlamp switch to the parking lamps ON position. • Rotate the instrument panel dimmer switch to the full illumination position. • Measure the voltage between the clockspring C218b pin 1, circuit 19 (LB/RD), harness side and ground.  A0047524 • **Is the voltage greater than 10 volts?**	**Yes** GO to G3 . **No** REPAIR the circuit. TEST the system for normal operation.
G3 CHECK THE CLOCKSPRING	
• Connect: Clockspring C218b. • Deactivate the air bag system; refer to Section 501-20B . • Disconnect: Steering Wheel Connector(s). • Measure the voltage between the top of the clockspring connector pin 1, circuit 19 (LB/RD), harness side and ground.	**Yes** GO to G4 . **No** INSTALL a new clockspring. REFER to Section 501-20B . TEST the system for normal operation.

 ● **Is the voltage greater than 10 volts?**	
G4 CHECK STEERING WHEEL CONTROL SWITCH HARNESS	
● Inspect the steering wheel control switch harness for shorts, opens, or any damage. ● **Is the steering wheel control switch harness OK?**	**Yes** INSTALL new steering wheel control switch(es). REFER to Section 415-01 . TEST the system for normal operation. **No** INSTALL a new steering wheel control switch harness. TEST the system for normal operation.

PINPOINT TEST H: ONE OR MORE MODULE CONTROLLED ILLUMINATION SOURCE IS INOPERATIVE — NAVIGATOR ONLY

Test Step	Result / Action to Take
H1 CHECK THE MODULE CONTROLLED ILLUMINATION OPERATION	
● Turn the headlamp switch to the parking lamps ON position. ● Rotate the panel dimmer switch to the full illumination position. ● **Are all of the module controlled illumination sources inoperative?**	**Yes** GO to H2 . **No** GO to H4 .
H2 CHECK FOR VOLTAGE AT THE DIMMER MODULE	
● Turn the headlamp switch off. ● Disconnect: Dimmer Module C2065a and C2065b. ● Turn the headlamp switch to the parking lamps ON position. ● Rotate the instrument panel dimmer switch to the full illumination position. ● Measure the voltage between the dimmer module C2065b pin 2, circuit 14 (BN), harness side and ground; and between the dimmer module C2065a pin 4, circuit 505 (GY/YE), harness side and ground.	**Yes** GO to H3 . **No** REPAIR the circuit in question. TEST the system for normal operation.

 A0047526 ● **Are the voltages greater than 10 volts?**	
H3 CHECK THE DIMMER MODULE GROUND	
● Measure the resistance between the dimmer module C2065b pin 4, circuit 57 (BK), harness side and ground.  A0047527 ● **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new dimmer module. REFER to Dimmer Module in this section. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
H4 CHECK VOLTAGE OUTPUT FROM THE DIMMER MODULE	
● Turn the headlamp switch off. ● Disconnect: Dimmer Module C2065a. ● Turn the headlamp switch to the parking lamps ON position. ● Rotate the instrument panel dimmer switch to the full illumination position. ● Measure the voltage between the dimmer module C2065a pin 1, circuit 19 (LB/RD), component side and ground; or between the dimmer module C2065a pin 2, circuit 1417 (LG/RD), component side and ground; or between the dimmer module C2065a pin 3, circuit 235 (RD/BK), component side and ground.  A0047528 ● **Are the voltages greater than 10 volts?**	**Yes** REPAIR the circuit in question. TEST the system for normal operation. **No** INSTALL a new dimmer module. REFER to Dimmer Module in this section. TEST the system for normal operation.

Climate Control Assembly Bulb

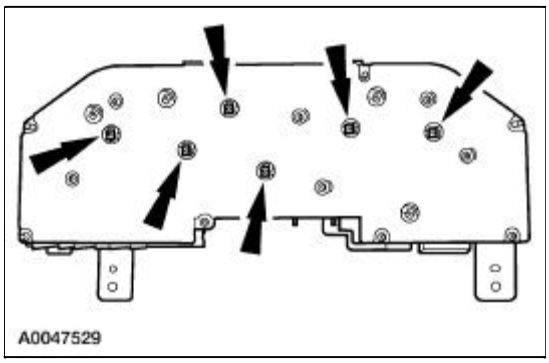
Removal and Installation

For additional information, refer to Section 412-04 .

Instrument Cluster Bulb

Removal and Installation

1. Remove the instrument cluster. For additional information, refer to Section 413-01 .
2. Remove the instrument cluster illumination bulbs.

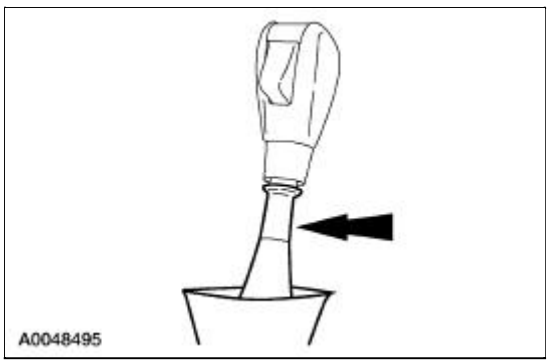


3. To install, reverse the removal procedure.

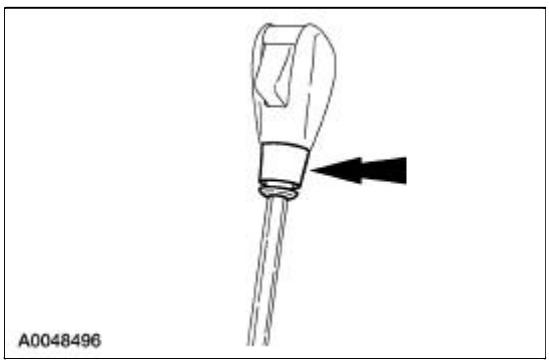
Selector Lever Indicator Bulb

Removal and Installation

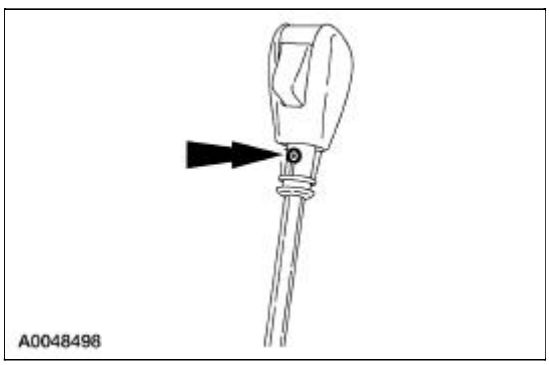
1. Push down the selector lever boot.



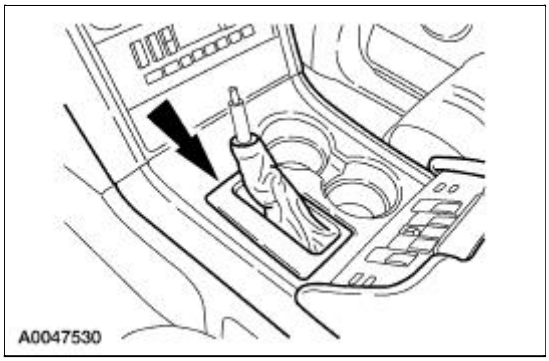
2. Push down the selector lever collar.



3. Remove the selector lever knob screw.
   - Remove the selector lever knob.



4. Detach the selector lever indicator bezel.
   - Disconnect the electrical connector.



5. To install, reverse the removal procedure.

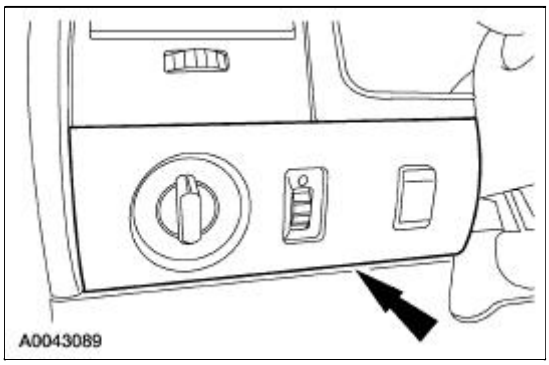
Instrument Panel Dimmer Switch

Removal and Installation

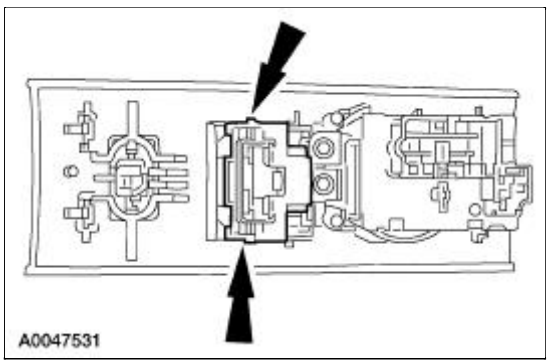
1. **NOTE:** For Expedition headlamp and dimmer switch removal, refer to Section 417-01 .

   Remove the instrument panel finish panel.

   - Disconnect the electrical connectors.



2. Depress the tabs and remove the instrument panel dimmer switch.

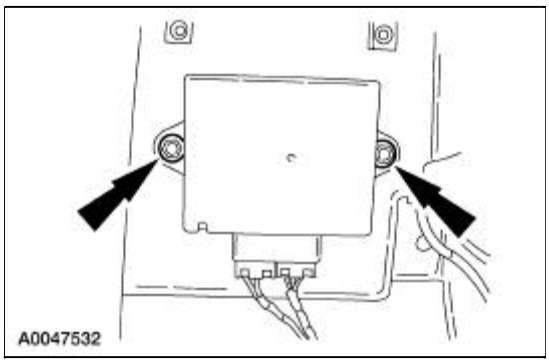


3. To install, reverse the removal procedure.

Dimmer Module

Removal and Installation

1. Remove the instrument panel glove compartment. Refer to Section 501-12 .
2. Remove the screws.
   - Disconnect the electrical connectors.



3. To install, reverse the removal procedure.

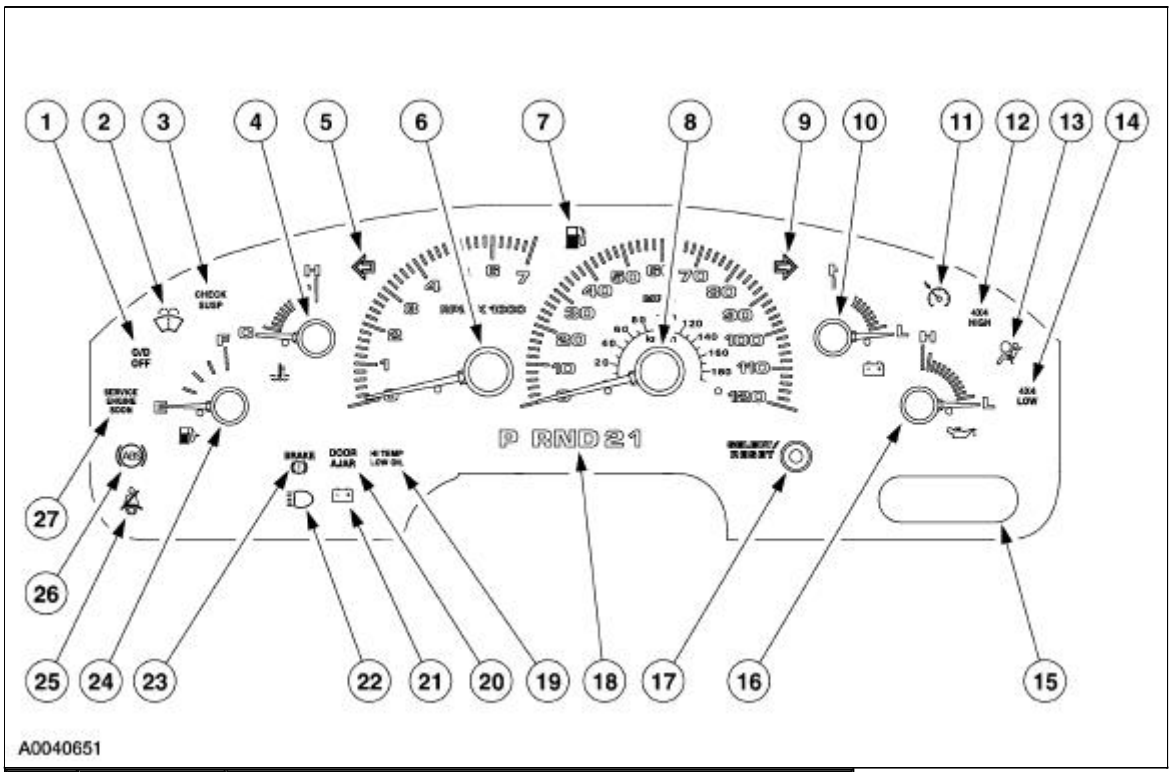
Instrument Cluster

The Navigator utilizes a virtual instrument cluster. The Expedition utilizes two instrument clusters, a base cluster and a message center cluster. The Navigator and Expedition base and message center clusters utilize a vacuum fluorescent tube display, located in the lower RH corner of the instrument cluster. The base cluster display contains the odometer, trip odometer, compass and outside air temperature information. The message center clusters contain an expanded vehicle information system in addition to the odometer, trip odometer, compass and outside air temperature information. For additional information regarding the message center displays and functions, refer to Section 413-08.

The Expedition instrument clusters consist of the following gauges and indicators:

NOTE: The English cluster is shown, the metric cluster is similar.

Instrument Cluster — Expedition



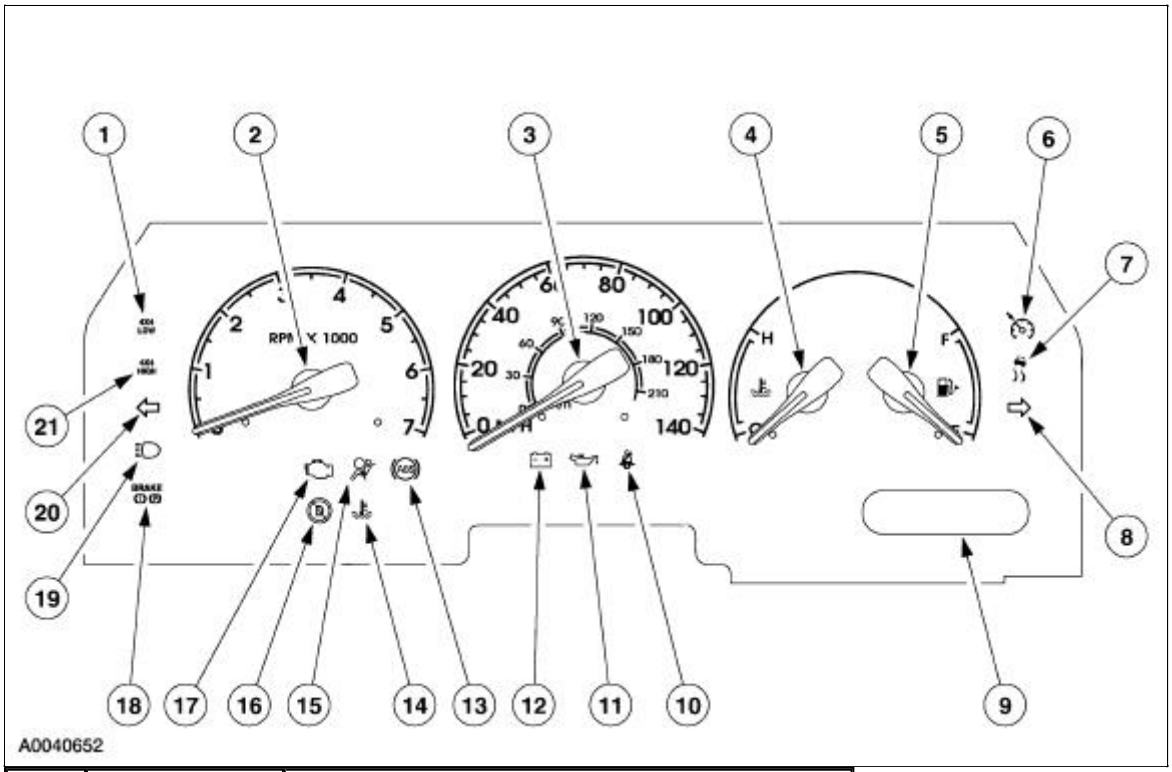
Item	Part Number	Description
1	—	O/D OFF indicator
2	—	Low washer indicator (base cluster only)
3	—	CHECK SUSP indicator (base cluster only)
4	—	Engine coolant temperature gauge
5	—	LH turn indicator
6	—	Tachometer
7	—	Low fuel warning indicator

8	—	Speedometer
9	—	RH turn indicator
10	—	Voltage gauge
11	—	Speed control indicator
12	—	4X4 HIGH indicator
13	—	Air bag warning indicator
14	—	4X4 LOW indicator
15	—	Integrated circuit display (base cluster) or message center (message center cluster)
16	—	Oil pressure gauge
17	—	SELECT/RESET button
18	—	PRNDL
19	—	HI TEMP/LOW OIL warning indicator
20	—	DOOR AJAR indicator
21	—	Charging system warning indicator
22	—	High beam indicator
23	—	BRAKE warning indicator
24	—	Fuel gauge
25	—	Safety belt warning indicator
26	—	ABS warning indicator
27	—	SERVICE ENGINE SOON indicator

The Navigator instrument cluster consists of the following gauges and indicators:

NOTE: The English cluster is shown, the metric cluster is similar.

Instrument Cluster — Navigator



Item	Part Number	Description
1	—	4X4 LOW indicator
2	—	Tachometer
3	—	Speedometer
4	—	Engine temperature gauge
5	—	Fuel gauge
6	—	Speed control indicator
7	—	Traction control indicator
8	—	RH turn indicator
9	—	Message center
10	—	Safety belt warning indicator
11	—	Low oil pressure warning indicator
12	—	Charging system warning indicator
13	—	ABS warning indicator
14	—	Temperature warning indicator
15	—	Air bag warning indicator
16	—	Overdrive off indicator
17	—	Malfunction indicator lamp (MIL) indicator
18	—	BRAKE warning indicator
19	—	High beam indicator
20	—	LH turn indicator
21	—	4X4 HIGH indicator

Instrument Cluster

Refer to Wiring Diagrams Cell 60 , Instrument Cluster for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST1473-A	Instrument Gauge System Tester 014-R1063 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418–F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool

Principles of Operation

The Expedition and Navigator instrument clusters are configurable, hybrid electronic clusters (HEC) that contain a microprocessor, gauges, indicator lamps, and internal circuitry. The instrument cluster is non-repairable at the dealership level with the exception of the warning indicator bulbs on the Expedition only and the instrument cluster lens on both the Expedition and Navigator clusters. The instrument cluster utilizes hardwired circuitry, the standard corporate protocol (SCP), and UART based protocol (UBP) communication networks. Communication using the SCP network transmits and receives data between the instrument cluster, the PCM, and the anti-lock brake system/traction control/integrated vehicle dynamics (ABS/TC/IVD) module. Communication using the UBP network utilizes data transmitted and received by the instrument cluster and the four-wheel drive control module, power liftgate module (Navigator only), parking aid module, air suspension module, vehicle security module, driver seat module and the electronic air temperature control (EATC). For additional information regarding the SCP and UBP communication networks, refer to Section 418-00 .

It is very important to understand:

- where the input originates from.
- all the information necessary in order for a feature to operate.
- which module(s) receive(s) the input or command message.
- does the module which received the input control the output of the feature, or does it output a message over the SCP or UBP network to another module?

- which module controls the output of the feature.

The instrument cluster carries out a display prove-out to verify that the warning/indicator lamps and monitored systems are operating correctly. When the ignition switch is turned to the ON position with the engine off, the following indicators will illuminate:

- 4x4 HIGH indicator
- 4x4 LOW indicator
- ABS warning indicator
- air bag warning indicator
- BRAKE warning indicator
- oil pressure warning indicator
- coolant temperature warning indicator
- low fuel warning indicator
- HI TEMP/LOW OIL warning indicator
- low washer fluid indicator
- traction control indicator
- CHECK SUSP indicator
- door ajar indicator

Gauge Indication Systems

Instrument Cluster Replacement

CAUTION: When installing a new instrument cluster, the instrument cluster must be re-configured. For additional information, refer to Section 418-01 .

When installing a new instrument cluster, contact the Instrument Cluster Program.

Integrated Circuit Display

The integrated circuit display is a vacuum fluorescent tube display that contains the odometer, trip odometer, outside air temperature and compass display on base clusters and the message center display on message center clusters. For additional information on the message center, refer to Section 413-08 . The compass module and outside air temperature sensor are hardwired to the instrument cluster. The odometer information is transmitted from the PCM through the SCP communication network to the instrument cluster. The instrument cluster microprocessor displays the appropriate message(s) upon receipt of the outside air temperature, compass heading and odometer data received.

Speedometer

The instrument cluster receives the vehicle speed sensor (VSS) signal from the powertrain control module (PCM) through the standard corporate protocol (SCP) communication network. The instrument cluster micro-processor monitors the VSS input from the PCM and commands the speedometer with a corresponding movement of the pointer.

Odometer

The odometer and trip odometer are viewed through the message center in the integrated circuit display on message center clusters or in the integrated circuit display on base clusters. The odometer is tamper resistant and accumulates and registers up to one million miles in English mode or one million kilometers in metric mode, based upon rolling count data sent from the PCM through the SCP network. The trip odometer is resettable and accumulates and registers up to 1,000 miles or 1,000 kilometers.

Fuel Gauge

The instrument cluster is hardwired to the fuel sending unit, which is a variable resistor controlled by the action of a float arm. When the fuel level is low, resistance in the unit is low (15 ohms ± 1 ohm). When the fuel level is high, the resistance is high (160 ohms ± 2 ohms). The instrument cluster micro-processor monitors the input from the fuel sender and commands the fuel gauge indication according to the fuel level data.

Temperature Gauge

The PCM receives the engine coolant temperature status through hardwired circuitry to the engine coolant temperature (ECT) sensor. The instrument cluster receives the engine coolant temperature data from the PCM through the SCP communication network. The instrument cluster microprocessor monitors the engine coolant temperature data received from the PCM and commands the temperature gauge indication with a corresponding movement of the pointer.

Oil Pressure Gauge

The instrument cluster is hardwired to the oil pressure sender unit. The oil pressure sender unit consists of a diaphragm and contact points, which are normally open. When there is low or no oil pressure, the oil pressure switch remains open and removes the ground to the instrument cluster and when sufficient oil pressure exists, the oil pressure switch closes providing a ground signal to the instrument cluster. The instrument cluster microprocessor monitors the oil pressure and commands the oil pressure gauge indication with a corresponding pointer movement.

Voltage Gauge

The voltage gauge displays the system battery voltage as measured at the instrument cluster run input.

Tachometer

The instrument cluster receives the tachometer data from the PCM through the SCP network and commands the tachometer according to the data.

Warning Indicators

Charging System Warning Indicator

The instrument cluster receives the charging system status from the PCM through the SCP communication network. Charging system data is monitored by the instrument cluster microprocessor and when charging system voltage is low, turns on the charging system indicator by providing a ground.

BRAKE Warning Indicator

The parking brake switch is hardwired to the instrument cluster and the brake fluid level switch is hardwired to the ABS module. The instrument cluster BRAKE warning indicator utilizes two inputs. The first input is provided by the parking brake switch and when applied, provides a ground to the instrument cluster turning on the BRAKE warning indicator. The second input is controlled by the ABS module. The ABS module, upon receipt of a low brake fluid level signal, ABS concern, or base brake

system concern, provides a brake signal to the instrument cluster through the SCP communication network. The instrument cluster microprocessor upon receipt of the brake signal, controls the BRAKE warning indicator according to the monitored signal.

ABS Warning Indicator

The ABS warning indicator is used to indicate an ABS concern or deactivation of the ABS. The instrument cluster receives the ABS message from the ABS module through the SCP communication network.

Malfunction Indicator Lamp (MIL)

The malfunction indicator lamp (MIL) is illuminated when a diagnostic trouble code (DTC) is detected by the powertrain control module (PCM). The instrument cluster receives the MIL data from the PCM through the SCP network.

Air Bag Warning Indicator

The instrument cluster is hardwired to the restraint control module. If an air bag system concern is detected, a DTC is logged and the restraint control module provides a ground path to the instrument cluster turning on the air bag indicator.

Safety Belt Warning Indicator

The restraint control module monitors the safety belt position through the safety belt buckle switch. When the safety belt is buckled, the restraint control module receives a ground signal and sends a SCP message to the instrument cluster to turn off the safety belt warning indicator. When the safety belt is unbuckled, the ground to the restraint control module is removed and the restraint control module sends a SCP safety belt warning message to the instrument cluster to turn on the indicator.

Low Fuel Warning Indicator (if equipped)

The low fuel warning indicator is controlled by the instrument cluster microprocessor and utilizes hardwired fuel level data from the fuel pump module. When the fuel level drops below approximately one-sixteenth of a tank, the instrument cluster microprocessor turns on the low fuel warning indicator.

Coolant Temperature Warning Indicator (if equipped)

The PCM receives the engine coolant temperature status through hardwired circuitry from the engine coolant temperature (ECT) sensor. Engine coolant temperature status is subsequently transmitted to the instrument cluster from the PCM through the SCP communication network. The instrument cluster microprocessor monitors the engine coolant temperature data received from the PCM and commands the coolant temperature warning indicator on when coolant temperature reaches 244°-250°F (118°-121°C).

Low Oil Pressure Warning Indicator (if equipped)

The instrument cluster is hardwired to the oil pressure sender unit. The oil pressure sender unit consists of a diaphragm and contact points, which are normally open. When there is low (under 6 psi [41 kPa]) or no oil pressure, the oil pressure switch remains open, removing the ground to the instrument cluster. When sufficient oil pressure exists, the oil pressure switch closes providing a ground signal to the instrument cluster. The instrument cluster microprocessor monitors the oil pressure ground signal and commands the low oil pressure warning indicator on or off according to engine oil pressure.

Door Ajar Indicator

The door ajar switches provide a ground signal to the vehicle security module. The vehicle security module, upon receipt of the door ajar ground data, supplies a door ajar status message to the instrument cluster through the UBP communication network. The instrument cluster microprocessor

monitors the door ajar status and commands the door ajar indicator on or off according to the door ajar status message.

Traction Control Indicator - Navigator

The traction control indicator flashes when the vehicle traction control is in active mode or is being controlled by the ABS/TC/IVD module. The instrument cluster receives the traction control signal from the anti-lock brake system/traction control/integrated vehicle dynamics (ABS/TC/IVD) module through the UBP communication network. The instrument cluster monitors the traction control signal and when the ABS/TC/IVD module detects a traction control concern, the instrument cluster microprocessor will turn on the traction control indicator.

RH and LH Turn Indicators

The instrument cluster provides a ground for the RH and LH turn indicators. When the multifunction switch is in the RH or LH turn position, power is supplied to the instrument cluster through hardwired circuitry and the RH or LH turn indicators flash on and off.

High Beam Indicator

The instrument cluster provides a ground for the high beam indicator. When the high beams are turned on, the multifunction switch provides a power signal to the instrument cluster through hardwired circuitry and illuminates the high beam indicator.

Speed Control Indicator

The instrument cluster receives the speed control signal from the PCM through the SCP communication network. When the speed control is engaged, the PCM provides a ground to the instrument cluster and turns on the speed control indicator.

HI TEMP/LOW OIL Warning Indicator - Expedition

The HIGH TEMP/LOW OIL warning indicator will illuminate when either of the following conditions exist:

- if the engine oil pressure drops below approximately 42 kPa (6 psi)
- if the engine temperature exceeds approximately 118° C (244° F)

Low Washer Fluid Indicator - Expedition

The instrument cluster is hardwired to the low washer fluid switch. The low washer fluid switch closes when the washer fluid level indicated is approximately 1/3 full, providing a ground to the instrument cluster and turning on the low washer fluid indicator. When the washer fluid is above the low level, the low washer fluid switch opens and removes the ground to the instrument cluster and the low washer fluid indicator turns off.

CHECK SUSP Indicator - Expedition

The instrument cluster is hardwired to the suspension control module. The CHECK SUSP indicator is powered through the instrument cluster, and when the air suspension is activated, the suspension control module provides the ground to the instrument cluster and illuminates the CHECK SUSP indicator.

Overdrive Off Indicator

The instrument cluster receives the overdrive off signal from the PCM through the SCP communication network. The overdrive off switch is hardwired to the PCM. When the transmission overdrive is selected off, the overdrive off switch provides a ground signal to the PCM. The PCM upon receipt of

the overdrive off ground signal, provides an SCP overdrive off signal to the instrument cluster and the instrument cluster microprocessor will turn on the overdrive off indicator.

4x4 HIGH and 4x4 LOW Indicators

The instrument cluster receives the 4x4 HIGH and 4x4 LOW information from the four-wheel drive control module through the UPB communication network. When either 4x4 high or 4x4 low are selected, the four-wheel drive control module will provide a 4x4 status signal to the instrument cluster microprocessor and turn on the appropriate indicator.

Inspection and Verification

1. Verify the customer concern by operating the system.

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

Visual Inspection Chart

Mechanical	Electrical
● Low washer fluid level ● Engine oil filter ● Engine oil level ● Oil pump ● Door adjustment ● Engine coolant level ● Water thermostat ● Fuel tank ● Fuel evaporative system	● Central junction box (CJB) fuses: ■ 1 (10A) ■ 21 (15A) ■ 15 (5A) ● Miniature bulb(s) ● Circuitry ● Instrument cluster

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

4. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
   - check that the program card or disk is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

5. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool operating manual.

6. Carry out the DATA LINK DIAGNOSTICS TEST. If the diagnostic tool responds with:
   - CKT1906, CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for the instrument cluster, Go To Pinpoint Test A . For vehicle security module, refer to Section 419-10 ; for anti-lock brake system (ABS), refer to Section 206-09A or Section 206-09B ; or for restraint control module, refer to Section 501-20B .
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the instrument cluster.

7. If the DTCs retrieved are related to the concern, go to the Instrument Cluster Diagnostic Trouble Code (DTC) Index, or Restraint Control Module Diagnostic Trouble Code (DTC) Index to continue diagnostics.

8. If no DTCs related to the concern are retrieved, proceed to the Symptom Chart to continue diagnostics.

Instrument Cluster Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1201	Fuel Sender Circuit Failure	Instrument Cluster	Go To Pinpoint Test B .
B1204	Fuel Sender Circuit Short to Ground	Instrument Cluster	Go To Pinpoint Test B .
B1205	EIC Switch-1 Assembly Circuit Failure	Instrument Cluster	INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation.
B1209	EIC Switch-2 Assembly Circuit Failure	Instrument Cluster	INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation.
B1255	Air Temperature External Sensor Circuit Open	Instrument Cluster	Go To Pinpoint Test AC .
B1257	Air Temperature External Sensor Circuit Short to Ground	Instrument Cluster	Go To Pinpoint Test AC .
B1317	Battery Voltage High	Instrument Cluster	Go To Pinpoint Test C .
B1318	Battery Voltage Low	Instrument Cluster	Go To Pinpoint Test C .
B1342	ECU is Defective	Instrument Cluster	INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation.
B1360	Ignition Run/Acc Circuit Open	Instrument Cluster	Go To Pinpoint Test A .
B2143	NVM Memory Failure	Instrument Cluster	Go To Pinpoint Test AC .
C1284	Oil Pressure Switch Failure	Instrument Cluster	For Expedition, Go To Pinpoint Test D . For Navigator, Go To Pinpoint Test X .
U1073	Invalid or Missing Data for Engine Coolant	Instrument Cluster	For temperature gauge, Go To Pinpoint Test E . For temperature warning indicator, Go To Pinpoint Test Y .
U1123	Invalid or Missing Data for Odometer	Instrument Cluster	Go To Pinpoint Test G .
U2013	Compass Module is not responding	Instrument Cluster	Go To Pinpoint Test AC .

For a complete list of instrument cluster DTCs, refer to Section 419-10 .

Instrument Cluster Self-Test Mode

To enter the instrument cluster self-test mode with the engine off, depress and hold the odometer reset

button (base cluster) or simultaneously depress and hold the message center reset and setup buttons (message center cluster). Turn the ignition switch to the RUN position and hold until the display indicates tESt (base cluster) or TEST (message center cluster) usually within three to five seconds. Depress the reset button once to advance to each stage of the self-test.

To exit the instrument cluster self-test mode, turn the ignition to the OFF position. If no DTCs related to the concern are retrieved, proceed to the Symptom Chart to continue diagnostics.

Instrument Cluster Self-Test Mode

Base cluster display	Message center cluster display	Description
tESt	TEST	Initial entry display into self-test mode.
GAGE	GAUGES SWEEP	Carries out gauge sweep of all gauges, then displays the present gauge values. Also carries out the checksum test on ROM and EEPROM.
All segments illuminated	All segments illuminated	Illuminates all odometer segments.
bulb	TEST TELLTALES	Illuminates all micro-controlled lamps and LEDs.
—	PART NUMBER, 2L#F-10849-##	Displays alpha-numeric part number.
2L1F	—	Display alpha-numeric part number prefix (first four digits).
####	—	Suffix (last two digits of the part number are displayed as tow byte hexadecimal number).
######	SERIAL NUMBER ######	Display serial number in decimal.
i9nin#	IGNITION KEY, #	Display key-in-ignition status.
r ####	ROM LEVEL ####, CHKSUM ####	Returns to normal operation of all micro-controlled lamps and LEDs and displays hexadecimal value for read-only memory (ROM) level (used when requesting assistance from the hotline).
nr####	NVM LEVEL ##, CHKSUM ####	Displays hexadecimal ROM level and type as stored in non-volatile memory (NVM).
EE ##	—	Displays hexadecimal value for EE level (used when requesting assistance from the hotline).
dt ####	FINAL DATE, ####	Displays hexadecimal coding of final manufacturing test date.
CF1-CF4	MODULE CONFIG, BYTE1-BYTE4=##	Displays hexadecimal of bytes 1-4 of module configuration settings.
dtc ####	DIAG TROUBLE, CODE: ####	Displays a 16 bit DTC in hexadecimal format. DTCs displayed are those detected in continuous operation, not during self-test.
E ###.#	VEHICLE SPEED, ###.# MPH	Displays English speed value being input, speedometer will indicate present speed.
###.#	VEHICLE SPEED, ###.# KPH	Displays metric speed value being input, speedometer will indicate present speed.
t ####	TACH VALUE, ####RPM	Displays the tachometer value being input to the instrument cluster. Tachometer will indicate present rpm.
F ###	FUEL LEVEL A/D,	Displays present fuel level analog/digital ratio input in

	###	decimal. The instrument cluster will indicate present fuel level.
FP ###	FUEL LEVEL %, ###	Displays present fuel level percent status in decimal.
### C	COOLANT TEMP, ###	Displays last temperature gauge input value from SCP, temperature gauge will indicate present temperature.
odo###	ODO SCP INPUT, ###	Displays the odometer input received through SCP in decimal.
OIL###	OIL PRESSURE, ###	Displays the last analog/digital reading of the oil pressure switch contact resistance, oil gauge will indicate present level.
br #	BRAKE FLUID AD, #	Displays the brake fluid level received from the ABS module.
bAt ##.#	BATTERY VOLTS, ##.#	Displays present SBATT reading in 10th of volt.
—	PWM DIM STEP, ##	Displays dimming step in decimal.
rhO ###	PWM DIM INPUT , ###	Displays present hexadecimal pulse width modulation (PWM) dimming input.
Prnd##	PRNDL, ##	Displays hexadecimal value of PRNDL inputs packed into a single byte.
Par-#	PARK BRAKE, #	Displays input status of the park brake switch.
door1-#	DOOR AJAR, #	Displays input status of any/all door ajar input (U222 only).
door2-#	LIFTGATE AJAR, #	Displays input status of liftgate ajar input.
Stbt-#	SEATBELT, #	Displays input status of safety belt switch.
—	RUN/START, #	RUN/START sense circuit check.
—	RUN/ACC, #	RUN/ACC sense circuit check.
CHE ##	CHECK ENGINE, ###	Displays 8 bit hexadecimal value of SCP service engine soon (MIL) telltale command.
PA, Pb, PE, PG ##	PORT A, B, E and J, ##	Displays 8-bit hexadecimal value for the ports A, b, E and G (base clusters) or J (message center clusters) readings (used when requesting information from the hotline).
PP, PS, PT, PCAn, PAD0 and PAD1 ##	PORT H, IB, P, S and T, ##	Displays 8-bit hexadecimal value for the ports P, S, T, CAn, AD0 and AD1 (base clusters) or H, IB, P, S, and T (message center clusters) in analog/digital readings (used when requesting information from the hotline).
AD00-AD17 ##	PORT AD00-AD17	Displays 8-bit hexadecimal value for the ports AD00-AD17 in analog/digital readings (used when requesting information from the hotline).

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
● No communication with the instrument cluster	● Central junction box (CJB) fuse(s): ■ 1 (11A).	● Go To Pinpoint Test A .

	■ 21 (15A). ■ 15 (5A). ● Circuitry. ● J1850 standard corporate protocol (SCP) communication network. ● UART based protocol (UBP) communication network. ● Instrument cluster.	
● Incorrect fuel gauge indication	● Circuitry. ● Fuel sender. ● Fuel tank. ● Instrument cluster.	● Go To Pinpoint Test B.
● Incorrect voltage gauge indication (Expedition only)	● Circuitry. ● Charging system. ● Powertrain control module (PCM). ● Instrument cluster.	● Go To Pinpoint Test C.
● Incorrect oil pressure gauge indication (Expedition only)	● Circuitry. ● Oil pressure switch. ● Instrument cluster.	● Go To Pinpoint Test D.
● Incorrect temperature gauge indication	● Circuitry. ● Cylinder head temperature sensor. ● Powertrain control module (PCM). ● Instrument cluster.	● Go To Pinpoint Test E.
● The low fuel warning indicator is never/always on	● Instrument cluster.	● Go To Pinpoint Test F.
● The speedometer/odometer is inoperative	● Circuitry. ● Powertrain control module (PCM). ● Instrument cluster.	● Go To Pinpoint Test G.
● The tachometer is inoperative	● Circuitry. ● Powertrain control module (PCM). ● Instrument cluster.	● Go To Pinpoint Test H.
● The door ajar indicator is inoperative (chime is operative)/does not operate correctly	● Circuitry. ● Instrument cluster. ● Vehicle security module.	● Go To Pinpoint Test I.
● The safety belt warning indicator is inoperative (chime is operative)/does	● Circuitry. ● Restraint control module (RCM).	● Go To Pinpoint Test J.

not operate correctly	• Safety belt switch (part of the driver belt buckle). • Instrument cluster.	
• Inaccurate speedometer reading	• Instrument cluster. • Anti-lock brake system (ABS) module. • Tires.	• Go To Pinpoint Test G .
• The ABS warning indicator is never on	• Circuitry. • Instrument cluster. • Anti-lock brake system (ABS) module.	• Go To Pinpoint Test K .
• The ABS warning indicator is always on	• Instrument cluster. • Anti-lock brake system (ABS) module.	• Section 501-20B .
• The brake warning indicator is never/always on	• Circuitry. • Brake fluid level switch. • Parking brake switch. • Anti-lock brake system (ABS) module. • Instrument cluster.	• Go To Pinpoint Test L .
• Malfunction indicator lamp (MIL) is never on	• Powertrain control module (PCM). • Instrument cluster.	• Go To Pinpoint Test M .
• Malfunction indicator lamp (MIL) is always on	• Diagnostic trouble code (DTC) related concern (s).	• REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
• The charging system warning indicator is never on	• Charging system. • Circuitry. • Powertrain control module (PCM). • Instrument cluster.	• Go To Pinpoint Test N .
• The charging system warning indicator is always on	• Circuitry. • Generator (charging system). • Powertrain control module (PCM). • Instrument cluster.	• REFER to Section 414-00 .
• The air bag indicator warning is never/always on	• Circuitry. • Restraint control module (RCM).	• Go To Pinpoint Test O .

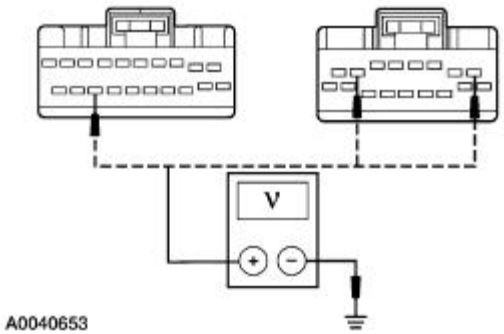
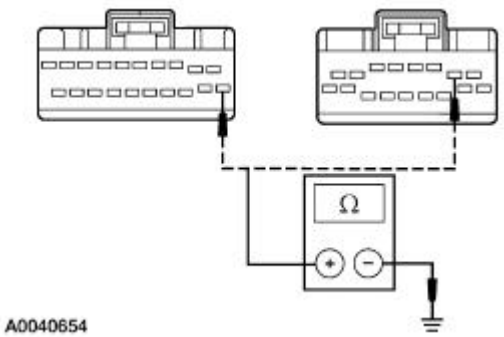
	• Instrument cluster.	
• The high beam indicator is never on	• High beam indicator bulb. • Circuitry. • Instrument cluster.	• Go To Pinpoint Test P.
• The LH turn indicator is never on	• LH turn indicator bulb. • Circuitry. • Instrument cluster.	• Go To Pinpoint Test Q.
• The RH turn indicator is never on	• RH turn indicator bulb. • Circuitry. • Instrument cluster.	• Go To Pinpoint Test R.
• The 4X4 HIGH range indicator is never/always on	• Circuitry. • Four-wheel drive (4WD) control module. • Instrument cluster.	• Go To Pinpoint Test S.
• The 4X4 LOW range indicator is never/always on	• Circuitry. • Four-wheel drive (4WD) control module. • Instrument cluster.	• Go To Pinpoint Test T.
• The speed control indicator is never/always on	• Speed control indicator bulb. • Circuitry. • Speed control servo. • Powertrain control module (PCM). • Instrument cluster.	• Go To Pinpoint Test U.
• The HI TEMP/LOW OIL warning indicator is never/always on - Expedition	• Circuitry. • Powertrain control module (PCM). • Instrument cluster.	• Go To Pinpoint Test V.
• The CHECK SUSP indicator is never/always on - Expedition	• Circuitry. • Air suspension module. • Instrument cluster.	• Go To Pinpoint Test W.
• The oil pressure warning indicator is never/always on - Navigator	• Circuitry. • Oil pressure switch. • Powertrain control module (PCM). • Instrument cluster.	• Go To Pinpoint Test X.
• The temperature warning indicator is never/always on - Navigator	• Circuitry. • Cylinder head temperature	• Go To Pinpoint Test Y.

	sensor. ● Powertrain control module (PCM). ● Instrument cluster.	
● The low washer fluid indicator is never/always on - Expedition	● Circuitry. ● Low washer fluid switch. ● Instrument cluster.	● Go To Pinpoint Test Z .
● The traction control indicator is never/always on - Navigator	● Anti-lock brake system (ABS) module. ● Instrument cluster.	● Go To Pinpoint Test AA .
● The O/D OFF indicator is never/always on	● Circuitry. ● Powertrain control module (PCM). ● Instrument cluster.	● Go To Pinpoint Test AB .
● The integrated circuit display is inoperative	● Central junction box (CJB) fuse(s): ■ 1 (11A). ■ 21 (15A). ■ 15 (5A). ● Circuitry. ● Instrument cluster	● If the integrated circuit display is inoperative, Go To Pinpoint Test AD . ● If the temperature display is inoperative, Go To Pinpoint Test AC . ● If the compass is inoperative, REFER to Section 413-08 .
● The instrument cluster is inoperative	● Central junction box (CJB) fuse(s): ■ 1 (11A). ■ 21 (15A). ■ 15 (5A). ● Circuitry. ● Instrument cluster.	● Go To Pinpoint Test AD .

Pinpoint Tests

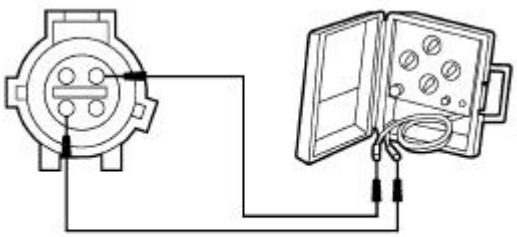
PINPOINT TEST A: NO COMMUNICATION WITH THE INSTRUMENT CLUSTER

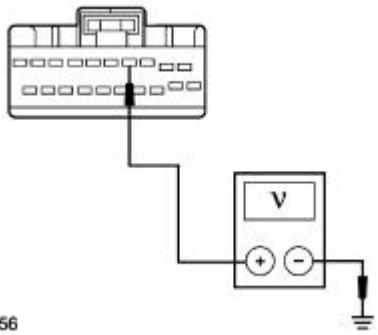
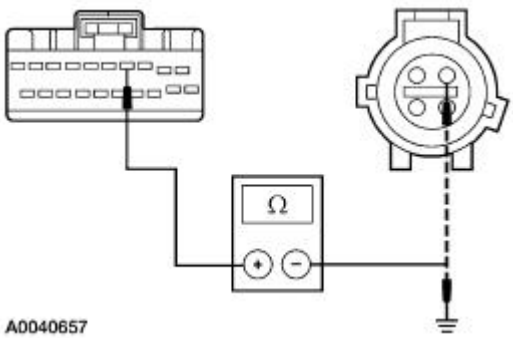
Test Step	Result / Action to Take
CAUTION: Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.	
A1 CHECK THE INSTRUMENT CLUSTER POWER SUPPLY	
● Key in OFF position. ● Disconnect: Instrument Cluster C220a.	**Yes** GO to A2 .

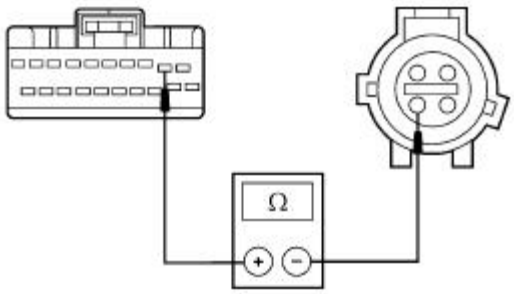
• Disconnect: Instrument Cluster C220b. • Key in ON position. • Using the following table, measure the voltage between the instrument cluster, harness side and ground. **Connector / Pin / Circuit** C220a / 18 / 1002 (BK/PK) C220b / 1 / 3049 (BK/LG) C220b / 7 / 640 (RD/YE)  A0040653 • **Are the voltages greater than 10 volts?**	**No** REPAIR the circuit (s) in question. TEST the system for normal operation.
A2 CHECK INSTRUMENT CLUSTER GROUND CIRCUITS 57 (BK) AND 676 (PK/OG)	
• Key in OFF position. • Measure the resistance between the instrument cluster C220a pin 11, circuit 57 (BK), harness side and ground; and between the instrument cluster C220b pin 2, circuit 676 (PK/OG), harness side and ground.  A0040654 • **Are the resistances less than 5 ohms?**	**Yes** REFER to Section 418-00 . **No** REPAIR the circuit (s) in question. TEST the system for normal operation.

PINPOINT TEST B: INCORRECT FUEL GAUGE INDICATION

Test Step	Result / Action to Take
CAUTION: Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.	
B1 RETRIEVE THE RECORDED DTCS FROM BOTH CONTINUOUS AND ON-DEMAND INSTRUMENT CLUSTER SELF-TESTS	
• Use the recorded instrument cluster DTCs from the continuous and on-demand self-tests.	**Yes** If instrument cluster

• **Are any instrument cluster DTCs recorded?**	DTC B1201 or B1204 is retrieved, GO to B6 . For all other instrument cluster DTCs REFER to the Instrument Cluster Diagnostic Trouble Code (DTC) Index. **No** GO to B2 .
B2 CARRY OUT THE INSTRUMENT CLUSTER FUEL GAUGE ACTIVE COMMAND USING THE DIAGNOSTIC TOOL	
• Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster. • Select the instrument cluster FUEL LEVEL CONTROL active command. Trigger, monitor, and scroll FUELLEVEL at: 0% , 50%, and 100%. • **Does the fuel gauge display: below E with 0%, half with 50%, and full stop with 100%?**	**Yes** GO to B3 . **No** GO to B9 .
B3 CHECK THE FUEL GAUGE OPERATION	
• Key in OFF position. • Disconnect: Fuel Pump Assembly C433. • Connect one lead of the Instrument Gauge System Tester to the fuel pump assembly C433 pin 1, circuit 29 (YE/WH), harness side and the other lead to the fuel pump assembly C433 pin 4, circuit 396 (BK/OG), harness side.  A0040655 • Set the Instrument Gauge System Tester to 160 ohms. • Key in ON position. • Wait one minute for the gauge to respond. • Key in OFF position. • Set the tester to 15 ohms. • Key in ON position. • **NOTE:** The fuel gauge should read below E (empty mark) when carrying out this test step. • Wait one minute and read the fuel gauge. • Key in OFF position. • Set the tester to 160 ohms. • Key in ON position. • **NOTE:** The fuel gauge should read F (full) or above when carrying out this test step. • Wait one minute and read the fuel gauge. • Key in OFF position. • **Does the fuel gauge operate correctly?**	**Yes** GO to B4 . **No** GO to B6 .
B4 CHECK THE FUEL TANK	

• Check the fuel tank for any damage or deformation. • **Is the fuel tank OK?**	**Yes** GO to B5 . **No** INSTALL a new fuel tank. REFER to Section 310-01 . TEST the system for normal operation.
B5 INSPECT THE FUEL PUMP ASSEMBLY • Check the fuel pump assembly in-tank mounting, float, float rod, wiring and connections for damage or obstruction. • **Are the fuel pump assembly and wiring OK?**	**Yes** INSTALL a new fuel sender. TEST the system for normal operation. **No** REPAIR or INSTALL a new fuel pump assembly as necessary. TEST the system for normal operation.
B6 CHECK CIRCUIT 29 (YE/WH) FOR SHORT TO POWER • Disconnect: Instrument Cluster C220a. • Key in ON position. • Measure the voltage between the instrument cluster C220a pin 4, circuit 29 (YE/WH), harness side and ground.  A0040656 • **Is any voltage present?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** GO to B7 .
B7 CHECK CIRCUIT 29 (YE/WH) FOR AN OPEN OR SHORT TO GROUND • Measure the resistance between the instrument cluster C220a pin 4, circuit 29 (YE/WH), harness side and the fuel pump assembly C433 pin 1, circuit 29 (YE/WH), harness side; and between the instrument cluster C220a pin 4, circuit 29 (YE/WH), harness side and ground.  A0040657	**Yes** GO to B8 . **No** REPAIR the circuit. TEST the system for normal operation.

• **Is the resistance less than 5 ohms between the instrument cluster and the fuel pump assembly; and greater than 10,000 ohms between the instrument cluster and ground?**	
B8 CHECK FUEL SENDING UNIT GROUND CIRCUIT 396 (BK/OG) FOR AN OPEN	
• Measure the resistance between the instrument cluster C220a pin 2, circuit 396 (BK/OG), harness side and the fuel pump assembly C433 pin 4, circuit 396 (BK/OG), harness side.  A0040658 • **Is the resistance less than 5 ohms?**	**Yes** GO to B9 . **No** REPAIR the circuit. TEST the system for normal operation.
B9 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
• Disconnect all instrument cluster connectors. • Check for: • corrosion • pushed-out pins • Connect all instrument cluster connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

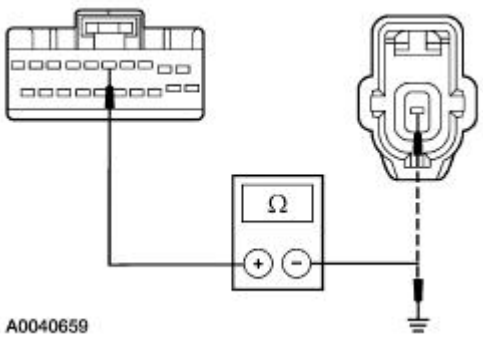
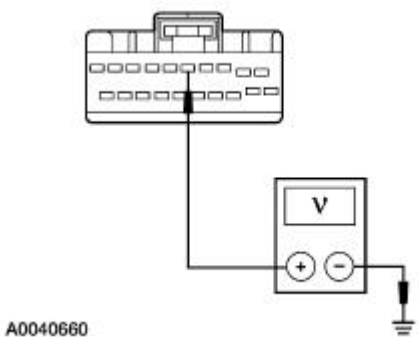
PINPOINT TEST C: INCORRECT VOLTAGE GAUGE INDICATION (EXPEDITION ONLY)

Test Step	Result / Action to Take
C1 RETRIEVE THE RECORDED DTCS FROM BOTH CONTINUOUS AND ON-DEMAND INSTRUMENT CLUSTER SELF-TESTS	
• Use the recorded instrument cluster DTCs from the continuous and on-demand self-tests. • **Are any instrument cluster DTCs recorded?**	**Yes** If instrument cluster DTC B1317 or B1318 is retrieved, REFER to Section 414-00 . For all other instrument cluster DTCs, REFER to the Instrument Cluster Diagnostic Trouble Code (DTC) Index. **No**

	GO to C2 .
C2 CARRY OUT THE VOLTMETER ACTIVE COMMAND USING THE DIAGNOSTIC TOOL ● Connect the diagnostic tool. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster Active Command. ● Select the instrument cluster voltmeter active command. ● Trigger the voltmeter active command. Scroll in three increments 0%, 50% and 100%. ● **Did the voltmeter start at L (low) when at 0%, move to half at 50% and H (high) at 100%?**	**Yes** REFER to Section 414-00 . **No** GO to C3 .
C3 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION ● Disconnect all instrument cluster connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all instrument cluster connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST D: INCORRECT OIL PRESSURE GAUGE INDICATION (EXPEDITION ONLY)

Test Step	Result / Action to Take
CAUTION: Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.	
D1 RETRIEVE THE RECORDED DTCS FROM BOTH CONTINUOUS AND ON-DEMAND INSTRUMENT CLUSTER SELF-TESTS ● Use the recorded instrument cluster DTCs from the continuous and on-demand self-tests. ● **Are any instrument cluster DTCs recorded?**	**Yes** If instrument cluster DTC C1284 is retrieved, INSTALL a new oil pressure switch. TEST the system for normal operation. For all other instrument cluster DTCs, REFER to the Instrument Cluster Diagnostic Trouble Code (DTC) Index. **No** GO to D2 .

D2 CARRY OUT THE OIL PRESSURE GAUGE ACTIVE COMMAND USING THE DIAGNOSTIC TOOL	
• Connect the diagnostic tool. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster Active Command. • Select the instrument cluster oil pressure gauge active command. • Trigger the oil pressure gauge active command. Scroll in three increments 0%, 50% and 100%. • **Did the engine oil pressure gauge start at L (low) when at 0%, move to half at 50% and H (high) at 100%?**	**Yes** GO to D3 . **No** GO to D6 .
D3 CHECK THE ENGINE OIL PRESSURE	
• Carry out the engine oil pressure test. Refer to Section 303-00 . • Key in ON position. • **Is the oil pressure within specification?**	**Yes** GO to D4 . **No** REFER to Section 303-00 .
D4 CHECK CIRCUIT 31 (WH/RD) FOR AN OPEN OR SHORT TO GROUND	
• Key in OFF position. • Disconnect: Instrument Cluster C220a. • Disconnect: Oil Pressure Switch C135. • Measure the resistance between the instrument cluster C220a pin 5, circuit 31 (WH/RD), harness side and the oil pressure switch C135, circuit 31 (WH/RD), harness side; and between the instrument cluster C220a pin 5, harness side and ground.  A0040659 • **Is the resistance less than 5 ohms between the instrument cluster and the oil pressure switch; and greater than 10,000 ohms between the instrument cluster and ground?**	**Yes** GO to D5 . **No** REPAIR the circuit. TEST the system for normal operation.
D5 CHECK CIRCUIT 31 (WH/RD) FOR SHORT TO POWER	
• Key in ON position. • Measure the voltage between the instrument cluster C220a pin 5, circuit 31 (WH/RD), harness side and ground.  A0040660 • **Is any voltage indicated?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** INSTALL a new oil pressure switch. TEST the system for normal operation.

D6 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
• Disconnect all instrument cluster connectors. • Check for: • corrosion • pushed-out pins • Connect all instrument cluster connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST E: INCORRECT TEMPERATURE GAUGE INDICATION

Test Step	Result / Action to Take
E1 RETRIEVE THE RECORDED DTCS FROM BOTH CONTINUOUS AND ON-DEMAND INSTRUMENT CLUSTER SELF-TESTS	
• Use the recorded instrument cluster DTCs from the continuous and on-demand self-tests. • **Are any instrument cluster DTCs recorded?**	**Yes** If instrument cluster DTC U1073 is retrieved, REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual to continue diagnosis. For all other instrument cluster DTCs REFER to the Instrument Cluster Diagnostic Trouble Code (DTC) Index. **No** GO to E2.
E2 CARRY OUT THE COOLANT TEMPERATURE GAUGE ACTIVE COMMAND USING THE DIAGNOSTIC TOOL	
• Connect the diagnostic tool. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster Active Command. • Select the instrument cluster engine coolant active command. • Trigger the engine coolant active command. Scroll in three increments 0%, 50% and 100%. • **Did the temperature gauge start at cold when at 0%, move to half at 50% and full hot at 100%?**	**Yes** REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual to continue diagnosis. **No** GO to E3.
E3 CHECK FOR CORRECT INSTRUMENT	

CLUSTER OPERATION • Disconnect all instrument cluster connectors. • Check for: • corrosion • pushed-out pins • Connect all instrument cluster connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST F: THE LOW FUEL WARNING INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
F1 CARRY OUT THE INSTRUMENT CLUSTER WARNING LAMPS AND CHIME ACTIVE COMMAND USING THE DIAGNOSTIC TOOL • Key in OFF position. • Connect the diagnostic tool. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster Active Command. • Select the instrument cluster warning lamps and chime active command. Trigger the all lamps active command on and off. Observe the low fuel warning indicator. • **Does the low fuel warning indicator illuminate when commanded on and turn off when commanded off?**	**Yes** GO to F2 . **No** GO to F3 .
F2 CHECK THE FUEL GAUGE • Key in ON position. • Check the fuel gauge. • **Does the fuel gauge operate correctly?**	**Yes** GO to F3 . **No** Go To Pinpoint Test B .
F3 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION • Disconnect all instrument cluster connectors. • Check for: • corrosion • pushed-out pins • Connect all instrument cluster connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST G: THE SPEEDOMETER/ODOMETER IS

INOPERATIVE

Test Step	Result / Action to Take
G1 RETRIEVE THE RECORDED DTCS FROM BOTH CONTINUOUS AND ON-DEMAND INSTRUMENT CLUSTER SELF-TESTS	
• Use the recorded instrument cluster DTCs from the continuous and on-demand self-tests. • **Are any instrument cluster DTCs recorded?**	**Yes** If instrument cluster U1123 is retrieved, REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual to continue diagnosis. For all other instrument cluster DTCs REFER to the Instrument Cluster Diagnostic Trouble Code (DTC) Index. **No** For inoperative speedometer, GO to G2 . For inoperative odometer, GO to G3 .
G2 CARRY OUT THE SPEEDOMETER ACTIVE COMMAND USING THE DIAGNOSTIC TOOL	
• Connect the diagnostic tool. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster Active Command. • Select the instrument cluster speedometer active command. • Trigger the speedometer and scroll in increments of 10% while monitoring the speedometer. The speedometer should increase in increments of approximately 20 km/h (12 mph) on the Expedition and approximately 23 km/h (14 mph) on the Navigator for each 10% change. • **Does the speedometer increase within specifications?**	**Yes** REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual to continue diagnosis. **No** GO to G4 .
G3 MONITOR THE INTEGRATED CIRCUIT DISPLAYS	
• Key in ON position. • Monitor the compass, air temperature and message center functions of the integrated circuit display. • **Do the compass, air temperature or message center displays operate correctly?**	**Yes** GO to G4 . **No** Go To Pinpoint Test AC .
G4 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
• Disconnect all instrument cluster connectors. • Check for: ◦ corrosion ◦ pushed-out pins • Connect all instrument cluster connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been

	caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST H: THE TACHOMETER IS INOPERATIVE

Test Step	Result / Action to Take
H1 CARRY OUT THE TACHOMETER ACTIVE COMMAND USING THE DIAGNOSTIC TOOL	**Yes** REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual to continue diagnosis. **No** GO to H2 .
● Connect the diagnostic tool. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster Active Command. ● Select the instrument cluster tachometer active command. ● Trigger the tachometer and scroll in increments of 10%. Monitor the tachometer gauge. The tachometer should increase in increments of approximately 700 rpm for each 10% change. ● **Does the tachometer gauge increase within specifications?**	
H2 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	**Yes** INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
● Disconnect all instrument cluster connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all instrument cluster connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	

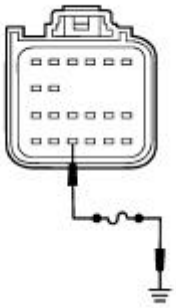
PINPOINT TEST I: THE DOOR AJAR INDICATOR IS INOPERATIVE (CHIME IS OPERATIVE)/DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
I1 CHECK THE INTERIOR LAMPS OPERATION	**Yes** GO to I2 . **No** REFER to Section 417-02 .
● Open and close each door while monitoring the interior lamps. ● **Do the interior lamps operate correctly?**	
I2 CARRY OUT THE INSTRUMENT CLUSTER WARNING LAMPS AND CHIME ACTIVE COMMAND USING THE DIAGNOSTIC TOOL	**Yes** GO to I3 .
● Key in OFF position. ● Connect the diagnostic tool. ● Key in ON position.	

• Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster Active Command. • Select the instrument cluster indicator lamp control active command. Trigger the door ajar active command. Observe the door ajar indicator. • **Is the door ajar indicator illuminated?**	**No** GO to I4 .
I3 CHECK FOR CORRECT VEHICLE SECURITY MODULE OPERATION	
• Disconnect all vehicle security module connectors. • Check for: • corrosion • pushed-out pins • Connect all vehicle security module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new vehicle security module. REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
I4 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
• Disconnect all instrument cluster connectors. • Check for: • corrosion • pushed-out pins • Connect all instrument cluster connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

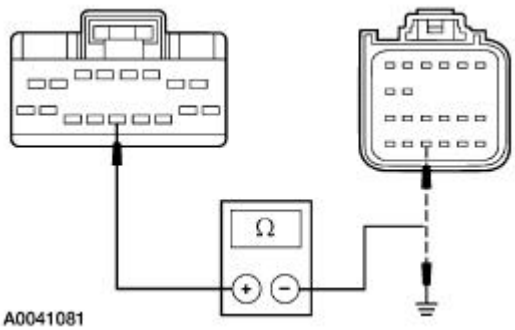
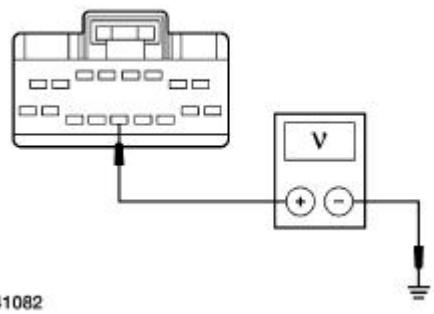
PINPOINT TEST J: THE SAFETY BELT WARNING INDICATOR IS INOPERATIVE (CHIME IS OPERATIVE)/DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
J1 CHECK THE SAFETY BELT WARNING INDICATOR OPERATION	
• Deactivate the restraint control supplemental air bag system. Refer to Section 501-20B . • Key in OFF position. • Disconnect: Restraint Control Module C310a. • Connect a fused (10A) jumper wire between the restraint control module C310a pin 22, circuit 1083 (LB/BK), harness side and ground.	**Yes** REFER to Section 501-20B to continue diagnosis. **No** GO to J2 .



A0041080

- Observe the safety belt warning indicator with the jumper wire connected and disconnected.
- Key in ON position.
- **Does the safety belt warning indicator lamp illuminate with the jumper wire connected and turn off when disconnected?**

J2 CHECK CIRCUIT 1083 (LB/BK) FOR AN OPEN OR SHORT TO GROUND	
• Key in OFF position. • Disconnect: Instrument Cluster C220b. • Measure the resistance between the instrument cluster C220b pin 13, circuit 1083 (LB/BK), harness side and the restraint control module C310a pin 22, circuit 1083 (LB/BK), harness side; and between the instrument cluster C220b pin 13, circuit 1083 (LB/BK), harness side and ground.  A0041081 • **Is the resistance less than 5 ohms between the instrument cluster and the restraint control module; and greater than 10,000 ohms between the instrument cluster and ground?**	**Yes** GO to J3 . **No** REPAIR the circuit. TEST the system for normal operation.
J3 CHECK CIRCUIT 1083 (LB/BK) FOR SHORT TO POWER	
• Key in ON position. • Measure the voltage between the instrument cluster C220b pin 13, circuit 1083 (LB/BK), harness side and ground.  A0041082 • **Is any voltage present?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** GO to J4 .
J4 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
• Disconnect all instrument cluster connectors.	**Yes**

• Check for: • corrosion • pushed-out pins • Connect all instrument cluster connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. TEST the system for normal operation.

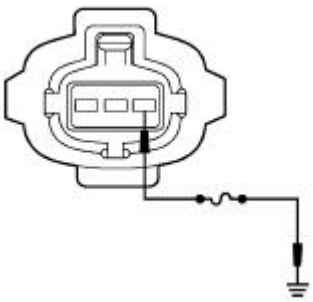
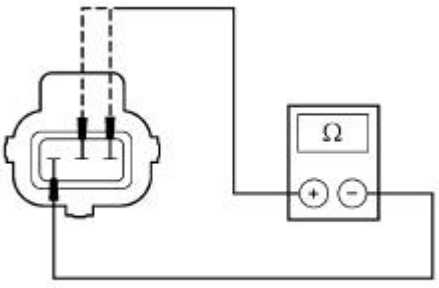
PINPOINT TEST K: THE ABS WARNING INDICATOR IS NEVER ON

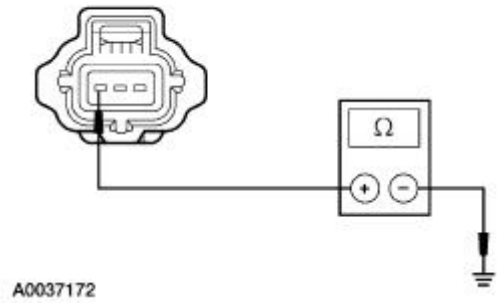
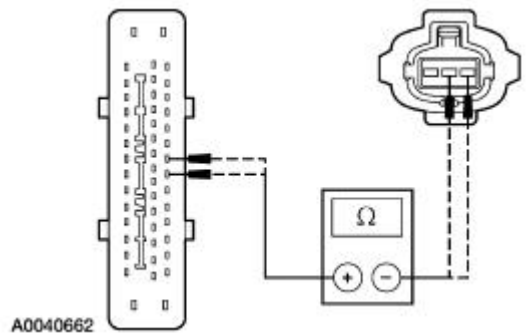
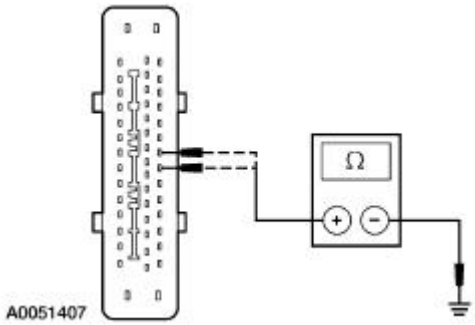
Test Step	Result / Action to Take
K1 CARRY OUT THE INSTRUMENT CLUSTER WARNING LAMPS AND CHIME ACTIVE COMMAND USING THE DIAGNOSTIC TOOL	
• Key in OFF position. • Connect the diagnostic tool. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster Active Command. • Select the instrument cluster warning lamps and chime active command. Trigger the all lamps active command. Observe the ABS warning indicator. • **Is the ABS warning indicator illuminated?**	**Yes** REFER to Section 501-20B to continue the diagnosis. **No** GO to K2.
K2 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
• Disconnect all instrument cluster connectors. • Check for: • corrosion • pushed-out pins • Connect all instrument cluster connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

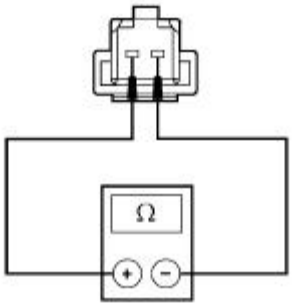
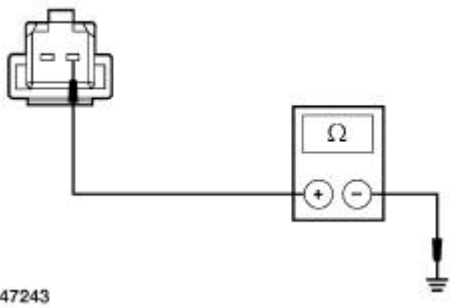
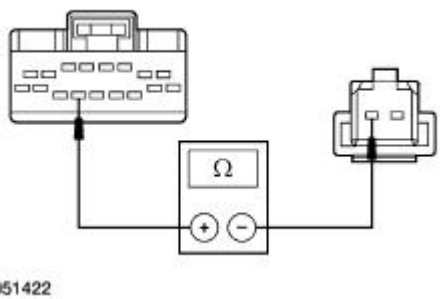
PINPOINT TEST L: THE BRAKE WARNING INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take

CAUTION: Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.

L1 CARRY OUT THE INSTRUMENT CLUSTER WARNING LAMPS AND CHIME ACTIVE COMMAND USING THE DIAGNOSTIC TOOL	
• Key in OFF position. • Connect the diagnostic tool. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster Active Command. • Select the instrument cluster warning lamps and chime active command. Trigger the all lamps active command on then off. Observe the brake warning indicator. • **Does the brake warning indicator illuminate when commanded on and turn off when commanded off?**	**Yes** GO to L2 . **No** GO to L11 .
L2 CHECK THE ABS MODULE OPERATION	
• Disconnect: Brake Fluid Level Switch C124. • Key in ON position. • Observe the brake warning indicator. • Key in OFF position. • Connect a fused (10A) jumper wire between the brake fluid level switch C124 pin 3, circuit 531 (DG/YE), harness side and ground.  A0045316 • Key in ON position. • Observe the brake warning indicator. • **Does the brake warning indicator illuminate with the brake fluid level switch disconnected; and turn off with the jumper wire connected?**	**Yes** GO to L3 . **No** GO to L5 .
L3 CHECK BRAKE FLUID LEVEL SWITCH	
NOTE: Verify that the brake fluid level is full. • Measure the resistances between the brake fluid level switch pin 3, circuit 531 (DG/YE), component side and the brake fluid level switch pin 1, circuit 1205 (BK), component side; and between the brake fluid level switch pin 3, circuit 531 (DG/YE), component side and the brake fluid level switch pin 2, circuit 512 (TN/LG), component side.  A0037169 • **Is the resistance greater than 10,000 ohms between the brake**	**Yes** GO to L4 . **No** INSTALL a new brake fluid level switch. TEST the system for normal operation.

fluid level switch pin 3 and the brake fluid level switch pin 1; and less than 5 ohms between the brake fluid level switch pin 3 and the brake fluid level switch pin 2?	
L4 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
• Measure the resistance between the brake fluid level switch C124 pin 1, circuit 57 (BK), harness side and ground.  • **Is the resistance less than 5 ohms?**	**Yes** GO to L7 . **No** REPAIR the circuit. TEST the system for normal operation.
L5 CHECK CIRCUIT 531 (DG/YE) AND CIRCUIT 512 (TN/LG) FOR AN OPEN	
• Key in OFF position. • Disconnect: ABS Module C135. • Measure the resistance between the ABS module C135 pin 8, circuit 512 (TN/LG), harness side and the brake fluid level switch C124 pin 2, circuit 512 (TN/LG), harness side; and between the ABS module C135 pin 9, circuit 531 (DG/YE), harness side and the brake fluid level switch C124 pin 3, circuit 531 (DG/YE), harness side.  • **Are the resistances less than 5 ohms?**	**Yes** GO to L6 . **No** REPAIR the circuit(s) in question. TEST the system for normal operation.
L6 CHECK CIRCUIT 531 (DG/YE) AMD CIRCUIT 512 (TN/LG) FOR SHORT TO GROUND	
• Measure the resistance between the ABS module C135 pin 8, circuit 512 (TN/LG), harness side and ground; and between the ABS module C135 pin 9, circuit 531 (DG/YE), harness side and ground.  	**Yes** GO to L10 . **No** REPAIR the circuit(s) in question. TEST the system for normal operation.

• **Are the resistances greater than 10,000 ohms?**	
L7 CHECK PARKING BRAKE SWITCH	
• Key in OFF position. • Disconnect: Parking Brake Switch C2015. • Measure the resistance between the parking brake switch C2015 pin 1, circuit 57 (BK), component side and the parking brake switch C2015 pin 2, circuit 162 (LG/RD), component side while engaging and fully disengaging the parking brake control.  A0047247 • **Is the resistance less than 5 ohms with the parking brake engaged and greater than 10,000 ohms with the parking brake fully disengaged?**	**Yes** GO to L9 . **No** GO to L8 .
L8 CHECK CIRCUIT 57 (BK) FOR OPEN	
• Measure the resistance between the parking brake switch C2105 pin 1, circuit 57 (BK), harness side and ground.  A0047243 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new parking brake switch. REFER to Section 206-00 . TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
L9 CHECK CIRCUIT 162 (LG/RD) FOR AN OPEN OR SHORT TO GROUND	
• Key in OFF position. • Disconnect: Instrument Cluster C220b. • Measure the resistance between the instrument cluster C220b pin 14, circuit 162 (LG/RD), harness side and the parking brake switch C2015 pin 2, circuit 162 (LG/RD), harness side; and between the instrument cluster C220b pin 14, circuit 162 (LG/RD), harness side and ground.  A0051422	**Yes** GO to L11 . **No** REPAIR the circuit. TEST the system for normal operation.

• **Is the resistance less than 5 ohms between the instrument cluster and the parking brake switch; and greater than 10,000 ohms between the instrument cluster and ground?**	
L10 CHECK FOR CORRECT ABS MODULE OPERATION	
• Disconnect all ABS module connectors. • Check for: • corrosion • pushed-out pins • Connect all ABS module connectors and make sure they seat correctly. • Operate the system and verify that concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ABS module. REFER to Section 206-09A or Section 206-09B. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. TEST the system for normal operation.
L11 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
• Disconnect all instrument cluster connectors. • Check for: • corrosion • pushed-out pins • Connect all instrument cluster connectors and make sure they seat correctly. • Operate the system and verify that concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused be a loose or corroded connector. TEST the system for normal operation.

PINPOINT TEST M: MALFUNCTION INDICATOR LAMP (MIL) IS NEVER ON

Test Step	Result / Action to Take
M1 CARRY OUT THE INSTRUMENT CLUSTER WARNING LAMPS AND CHIME ACTIVE COMMAND USING THE DIAGNOSTIC TOOL	
• Key in OFF position. • Connect the diagnostic tool. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster Active Command. • Select the instrument cluster warning lamps and chime active command. Trigger the all lamps active command. Observe the	**Yes** REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual. **No** GO to M2.

SERVICE ENGINE SOON indicator. ● **Is the SERVICE ENGINE SOON indicator illuminating?**	
M2 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION ● Disconnect all instrument cluster connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all instrument cluster connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

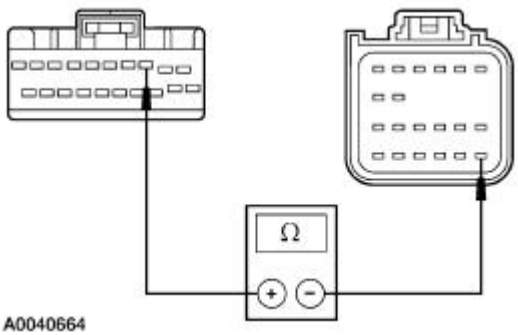
PINPOINT TEST N: THE CHARGING SYSTEM WARNING INDICATOR IS NEVER ON

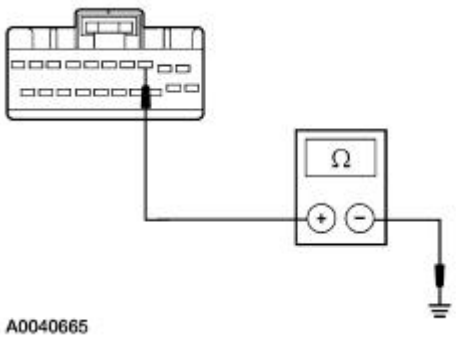
Test Step	Result / Action to Take
N1 CARRY OUT THE INSTRUMENT CLUSTER WARNING LAMPS AND CHIME ACTIVE COMMAND USING THE DIAGNOSTIC TOOL ● Key in OFF position. ● Connect the diagnostic tool. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster Active Command. ● Select the instrument cluster warning lamps and chime active command. Trigger the all lamps active command. Observe the charging system warning indicator. ● **Is the charging system warning indicator illuminating?**	**Yes** REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual. **No** GO to N2 .
N2 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION ● Disconnect all instrument cluster connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all instrument cluster connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST O: THE AIR BAG WARNING INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take

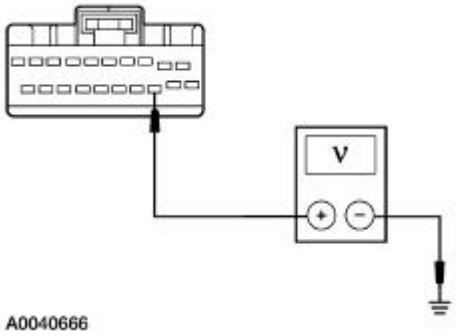
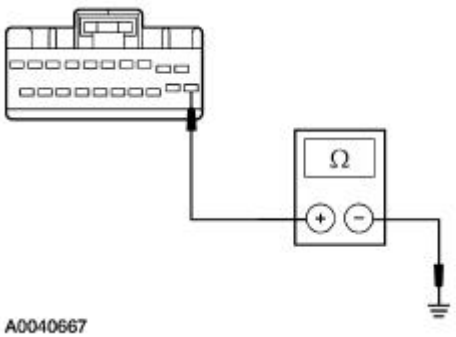
CAUTION: Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.

O1 CARRY OUT THE INSTRUMENT CLUSTER WARNING LAMPS AND CHIME ACTIVE COMMAND USING THE DIAGNOSTIC TOOL	
• Key in OFF position. • Connect the diagnostic tool. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster Active Command. • Select the instrument cluster warning lamps and chime active command. Trigger the all lamps active command on then off. Observe the charging system warning indicator. • **Does the airbag warning indicator turn on when commanded on and turn off when commanded off?**	**Yes** If the air bag indicator is never on, GO to O2 . If the air bag indicator is always on, GO to O4 . **No** GO to O6 .
O2 CHECK CIRCUIT 608 (BK/YE)	
• Deactivate the restraint control supplemental air bag system. Refer to Section 501-20B . • Key in OFF position. • Disconnect: Restraint Control Module C310a. • Connect a fused (10A) jumper wire between the restraint control module C310a pin 19, circuit 608 (BK/YE), harness side and ground.  A0040663 • Key in ON position. • **Does the air bag indicator lamp illuminate?**	**Yes** REFER to Section 501-20B . **No** GO to O3 .
O3 CHECK CIRCUIT 608 (BK/YE) FOR AN OPEN	
• Key in OFF position. • Disconnect: Instrument Cluster C220a. • Measure the resistance between the instrument cluster C220a pin 3, circuit 608 (BK/YE), harness side and the restraint control module C310a pin 19, circuit 608 (BK/YE), harness side.  A0040664 • **Is the resistance less than 5 ohms?**	**Yes** GO to O6 . **No** REPAIR the circuit. TEST the system for normal operation.
O4 ISOLATE RESTRAINT CONTROL MODULE	

• Key in OFF position. • Deactivate the restraint control supplemental air bag system. Refer to Section 501-20B . • Disconnect: Restraint Control Module C223a. • Observe the air bag warning indicator. • Key in ON position. • **Does the air bag warning indicator illuminate?**	**Yes** GO to O5 . **No** REFER to Section 501-20B .
O5 CHECK CIRCUIT 608 (BK/YE) FOR SHORT TO GROUND	
• Key in OFF position. • Disconnect: Instrument Cluster C220a. • Measure the resistance between the instrument cluster C220a pin 3, circuit 608 (BK/YE), harness side and ground.  A0040665 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to O6 . **No** REPAIR the circuit. TEST the system for normal operation.
O6 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
• Disconnect all instrument cluster connectors. • Check for: ◦ corrosion ◦ pushed-out pins • Connect all instrument cluster connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

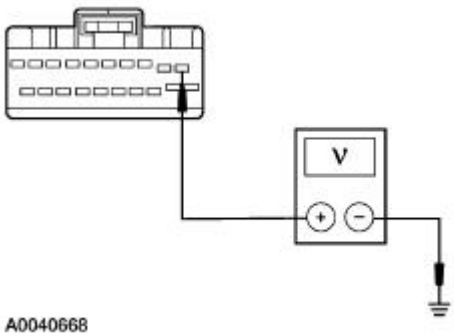
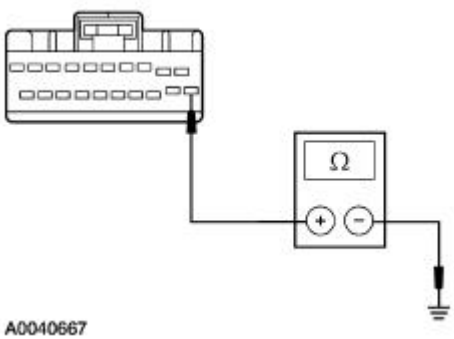
PINPOINT TEST P: THE HIGH BEAM INDICATOR IS NEVER ON

Test Step	Result / Action to Take
CAUTION: Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.	
P1 VERIFY HIGH BEAM OPERATION	
• Verify the high beam headlamps operation. • **Do the high beam headlamps operate correctly?**	**Yes** GO to P2 . **No** REFER to Section 417-01 .
P2 CHECK CIRCUITS 1718 (RD/PK) AND 12 (LG/BK) FOR AN OPEN	

• Disconnect: Instrument Cluster C220a. • **NOTE:** Headlamps must be on for this test. • Place the multifunction switch in the high beam position. • Measure the voltage between the instrument cluster C220a pin 13, circuit 1718 (RD/PK), harness side and ground.  A0040666 • **Is the voltage greater than 10 volts?**	**Yes** GO to P3 . **No** REPAIR the circuit(s) in question. TEST the system for normal operation.
P3 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
• Measure the resistance between the instrument cluster C220a pin 11, circuit 57 (BK), harness side and ground.  A0040667 • **Is the resistance less than 5 ohms?**	**Yes** GO to P4 . **No** REPAIR the circuit. TEST the system for normal operation.
P4 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
• Disconnect all instrument cluster connectors. • Check for: ◦ corrosion ◦ pushed-out pins • Connect all instrument cluster connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

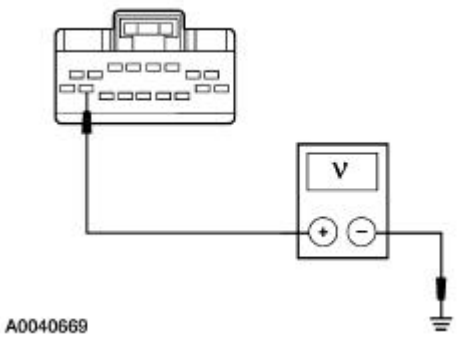
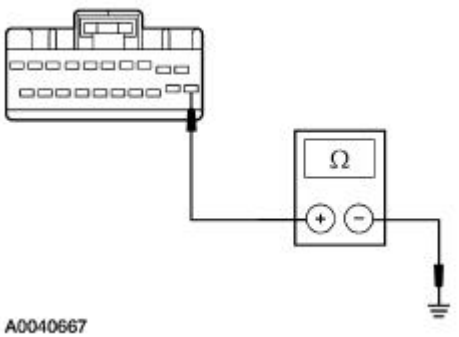
PINPOINT TEST Q: THE LH TURN INDICATOR IS NEVER ON

Test Step	Result / Action to Take
CAUTION: Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.	

Q1 VERIFY TURN SIGNAL OPERATION • Verify the turn signal operation. • **Do the turn signals operate correctly?**	**Yes** GO to Q2 . **No** REFER to Section 417-01 .
Q2 CHECK CIRCUIT 3 (LG/WH) FOR VOLTAGE • Disconnect: Instrument Cluster C220a. • Key in ON position. • Place the multifunction switch in the LH turn signal position. • Measure the voltage between the instrument cluster C220a pin 1, circuit 3 (LG/WH), harness side and ground.  A0040668 • **Does the voltage fluctuate between 0 and greater than 10 volts?**	**Yes** GO to Q3 . **No** REPAIR the circuit. TEST the system for normal operation.
Q3 CHECK CIRCUIT 57 (BK) FOR AN OPEN • Key in OFF position. • Disconnect: Instrument Cluster C220a. • Measure the resistance between the instrument cluster C220a pin 11, circuit 57 (BK), harness side and ground.  A0040667 • **Is the resistance less than 5 ohms?**	**Yes** GO to Q4 . **No** REPAIR the circuit. TEST the system for normal operation.
Q4 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION • Disconnect all instrument cluster connectors. • Check for: • corrosion • pushed-out pins • Connect all instrument cluster connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector.

	CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST R: THE RH TURN INDICATOR IS NEVER ON

Test Step	Result / Action to Take
CAUTION: Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.	
R1 VERIFY TURN SIGNAL OPERATION ● Verify the turn signal operation. ● **Do the turn signals operate correctly?**	**Yes** GO to R2 . **No** REFER to Section 417-01 .
R2 CHECK CIRCUIT 2 (WH/LB) FOR VOLTAGE ● Disconnect: Instrument Cluster C220b. ● Key in ON position. ● Place the multifunction switch in the RH turn signal position. ● Measure the voltage between the instrument cluster C220b pin 16, circuit 2 (WH/LB), harness side and ground.  A0040669 ● **Does the voltage fluctuate between 0 and greater than 10 volts?**	**Yes** GO to R3 . **No** REPAIR the circuit. TEST the system for normal operation.
R3 CHECK CIRCUIT 57 (BK) FOR AN OPEN ● Key in OFF position. ● Disconnect: Instrument Cluster C220a. ● Measure the resistance between the instrument cluster C220a pin 11, circuit 57 (BK), harness side and ground.  A0040667 ● **Is the resistance less than 5 ohms?**	**Yes** GO to R4 . **No** REPAIR the circuit. TEST the system for normal operation.
R4 CHECK FOR CORRECT INSTRUMENT CLUSTER	

OPERATION	
• Disconnect all instrument cluster connectors. • Check for: • corrosion • pushed-out pins • Connect all instrument cluster connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST S: THE 4X4 HIGH INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
S1 VERIFY THE FOUR WHEEL DRIVE OPERATION	
• Test drive the vehicle and verify that the vehicle is in two wheel drive when the 4x4 HIGH is switched off and that the four wheel drive high operates when switched to the 4x4 HIGH range. • **Does the 4x4 HIGH range operate correctly?**	**Yes** GO to S2. **No** REFER to Section 308-07A.
S2 CARRY OUT THE INSTRUMENT CLUSTER WARNING LAMPS AND CHIME ACTIVE COMMAND USING THE DIAGNOSTIC TOOL	
• Key in OFF position. • Connect the diagnostic tool. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster Active Command. • Select the instrument cluster warning lamps and chime active command. Trigger the all lamps active command on and off. Observe the 4x4 HIGH indicator. • **Does the 4x4 HIGH indicator illuminate when triggered on and turn off when triggered off?**	**Yes** GO to S3. **No** GO to S4.
S3 CHECK FOR CORRECT FOUR-WHEEL DRIVE MODULE OPERATION	
• Disconnect all four-wheel drive module connectors. • Check for: • corrosion • pushed-out pins • Connect all four-wheel drive module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new four-wheel drive module. REFER to Section 308-07A. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. TEST the system for normal operation.

S4 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
• Disconnect all instrument cluster connectors. • Check for: • corrosion • pushed-out pins • Connect all instrument cluster connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST T: THE 4X4 LOW INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
T1 VERIFY THE FOUR WHEEL DRIVE OPERATION	
• Test drive the vehicle and verify that the vehicle is in two wheel drive when the 4x4 LOW is switched off and that the four wheel drive low operates when switched to the 4x4 LOW range. • **Does the 4x4 LOW range operate correctly?**	**Yes** GO to T2. **No** REFER to Section 308-07A.
T2 CARRY OUT THE INSTRUMENT CLUSTER WARNING LAMPS AND CHIME ACTIVE COMMAND USING THE DIAGNOSTIC TOOL	
• Key in OFF position. • Connect the diagnostic tool. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster Active Command. • Select the instrument cluster warning lamps and chime active command. Trigger the all lamps active command on and off. Observe the 4x4 LOW indicator. • **Does the 4x4 LOW indicator illuminate when triggered on and turn off when triggered off?**	**Yes** GO to T3. **No** GO to T4.
T3 CHECK FOR CORRECT FOUR-WHEEL DRIVE MODULE OPERATION	
• Disconnect all four-wheel drive module connectors. • Check for: • corrosion • pushed-out pins • Connect all four-wheel drive module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new four-wheel drive module. REFER to Section 308-07A. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. TEST the system for normal operation.
T4 CHECK FOR CORRECT INSTRUMENT	

CLUSTER OPERATION	
• Disconnect all instrument cluster connectors. • Check for: • corrosion • pushed-out pins • Connect all instrument cluster connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST U: THE SPEED CONTROL INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
U1 CHECK SPEED CONTROL OPERATION	
• Test drive the vehicle and operate the speed control. • **Does the speed control operate correctly?**	**Yes** GO to U2. **No** REFER to Section 310-03.
U2 CARRY OUT THE INSTRUMENT CLUSTER SELF-TEST	
• Key in ON position. • Carry out the instrument cluster self-test and observe the speed control indicator. Refer to Instrument Cluster Self-Test Mode in this section. • **Does the speed control indicator illuminate during the self-test mode and turn off when not in the self-test mode?**	**Yes** GO to U3. **No** GO to U4.
U3 CHECK FOR CORRECT PCM OPERATION	
• Disconnect all PCM connectors. • Check for: • corrosion • pushed-out pins • Connect all PCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PCM. REFER to Section 303-14. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. TEST the system for normal operation.
U4 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
• Disconnect all instrument cluster connectors. • Check for: • corrosion • pushed-out pins • Connect all instrument cluster connectors and make sure they seat correctly. • Operate the system and verify the concern	**Yes** INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs.

is still present. • **Is the concern still present?**	TEST the system for normal operation.

PINPOINT TEST V: THE HI TEMP/LOW OIL WARNING INDICATOR IS NEVER/ALWAYS ON - EXPEDITION

Test Step	Result / Action to Take
V1 CARRY OUT THE INSTRUMENT CLUSTER INDICATOR LAMP CONTROL ACTIVE COMMAND USING THE DIAGNOSTIC TOOL	
• Key in OFF position. • Connect the diagnostic tool. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster Active Command. • Select the instrument cluster indicator lamp control active command. Trigger the check gauges indicator active command. Observe the HI TEMP/LOW OIL indicator. • **Is the HI TEMP/LOW OIL indicator illuminating?**	**Yes** GO to V2 . **No** GO to V3 .
V2 CHECK THE GAUGES	
• Key in START position. • Verify the fuel gauge, voltmeter and the oil pressure gauge operation. • **Are the gauges operating correctly?**	**Yes** GO to V3 . **No** RETURN to the Symptom Chart.
V3 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
• Disconnect all instrument cluster connectors. • Check for: ◦ corrosion ◦ pushed-out pins • Connect all instrument cluster connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

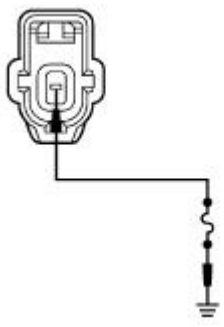
PINPOINT TEST W: THE CHECK SUSP INDICATOR IS NEVER/ALWAYS ON - EXPEDITION

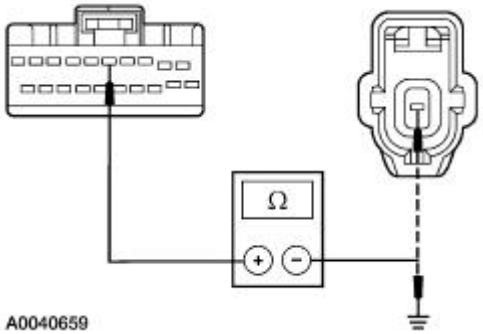
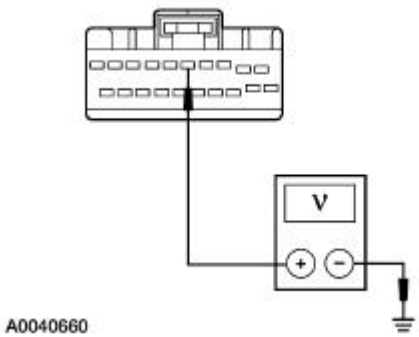
Test Step	Result / Action to Take
W1 VERIFY AIR SUSPENSION SYSTEM OPERATION	
• Check the air suspension system operation. • **Does the air suspension system operate correctly?**	**Yes** GO to W2 . **No** REFER to Section 204-05 .

W2 CARRY OUT THE INSTRUMENT CLUSTER WARNING LAMPS AND CHIME ACTIVE COMMAND USING THE DIAGNOSTIC TOOL	
• Key in OFF position. • Connect the diagnostic tool. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster Active Command. • Select the instrument cluster warning lamps and chime active command. Trigger the all lamps active command on and off. Observe the CHECK SUSP indicator. • **Does the CHECK SUSP indicator illuminate when triggered on and turn off when triggered off?**	**Yes** GO to W3 . **No** GO to W4 .
W3 CHECK FOR CORRECT SUSPENSION CONTROL MODULE OPERATION	
• Disconnect all suspension control module connectors. • Check for: ◦ corrosion ◦ pushed-out pins • Connect all suspension control module connectors and make sure they seat correctly. • Make sure all other system connectors are fully seated. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new suspension control module. REFER to Section 204-05 . TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
W4 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
• Disconnect all instrument cluster connectors. • Check for: ◦ corrosion ◦ pushed-out pins • Connect all instrument cluster connectors and make sure they seat correctly. • Make sure all other system connectors are fully seated. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST X: THE OIL PRESSURE WARNING INDICATOR IS NEVER/ALWAYS ON - NAVIGATOR

Test Step	Result / Action to Take
CAUTION: Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.	
X1 RETRIEVE THE RECORDED DTCS FROM BOTH CONTINUOUS AND ON-DEMAND INSTRUMENT CLUSTER SELF-TESTS	
• Use the recorded instrument cluster DTCs from the continuous and on-demand self-tests.	**Yes** If instrument cluster

• **Are any instrument cluster DTCs recorded?**	DTC C1284 is retrieved, INSTALL a new oil pressure switch. TEST the system for normal operation. For all other instrument cluster DTCs, REFER to the Instrument Cluster Diagnostic Trouble Code (DTC) Index. **No** GO to X2.
X2 CARRY OUT THE INSTRUMENT CLUSTER INDICATOR LAMP CONTROL ACTIVE COMMAND USING THE DIAGNOSTIC TOOL	
• Key in OFF position. • Connect the diagnostic tool. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster Active Command. • Select the instrument cluster indicator lamp control active command. Trigger the oil pressure low indicator active command. Observe the oil pressure warning indicator. • **Is the oil pressure warning indicator illuminating?**	**Yes** GO to X3. **No** GO to X7.
X3 CHECK THE OIL PRESSURE WARNING INDICATOR	
• Key in OFF position. • Disconnect: Oil Pressure Switch C135. • Key in ON position. • Connect a fused (10A) jumper wire between the engine oil pressure switch C103, circuit 31 (WH/RD), harness side and ground.  A0014311 • **Does the oil pressure warning indicator illuminate?**	**Yes** GO to X4. **No** GO to X5.
X4 CHECK THE ENGINE OIL PRESSURE	
• Carry out the engine oil pressure test. Refer to Section 303-00. • Key in ON position. • **Is the oil pressure within specification?**	**Yes** INSTALL a new oil pressure switch. TEST the system for normal operation. **No** REFER to Section 303-00.
X5 CHECK CIRCUIT 31 (WH/RD) FOR AN OPEN OR SHORT TO GROUND	

• Key in OFF position. • Disconnect: Instrument Cluster C220a. • Measure the resistance between the instrument cluster C220a pin 5, circuit 31 (WH/RD), harness side and the oil pressure switch C103, circuit 31 (WH/RD), harness side; and between the instrument cluster C220a pin 5, circuit 31 (WH/RD), harness side and ground.  • **Is the resistance less than 5 ohms between the instrument cluster and the oil pressure switch; and greater than 10,000 ohms between the instrument cluster and ground?**	**Yes** GO to X6 . **No** REPAIR the circuit. TEST the system for normal operation.
X6 CHECK CIRCUIT 31 (WH/RD) FOR SHORT TO POWER	
• Key in ON position. • Measure the voltage between the instrument cluster C220a pin 5, circuit 31 (WH/RD), harness side and ground.  • **Is any voltage present?**	**Yes** GO to X7 . **No** REPAIR the circuit. TEST the system for normal operation.
X7 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
• Disconnect all instrument cluster connectors. • Check for: ◦ corrosion ◦ pushed-out pins • Connect all instrument cluster connectors and make sure they seat correctly. • Make sure all other system connectors are fully seated. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

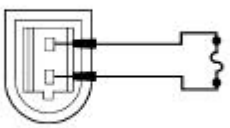
PINPOINT TEST Y: THE TEMPERATURE WARNING INDICATOR IS

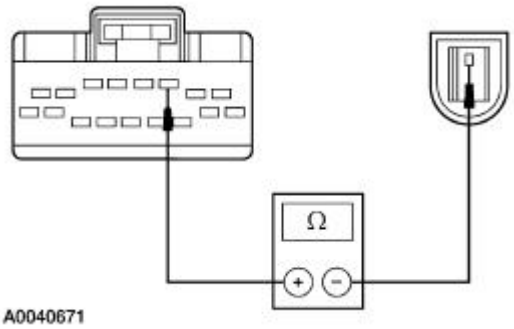
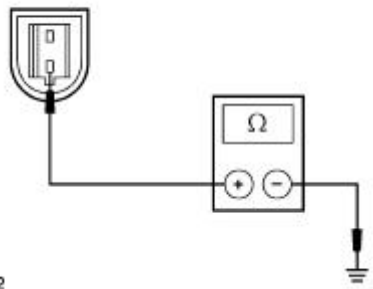
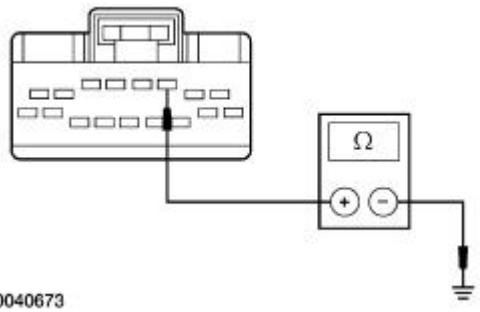
NEVER/ALWAYS ON - NAVIGATOR

Test Step	Result / Action to Take
Y1 RETRIEVE THE RECORDED DTCS FROM BOTH CONTINUOUS AND ON-DEMAND INSTRUMENT CLUSTER SELF-TESTS	
• Use the recorded instrument cluster DTCs from the continuous and on-demand self-tests. • **Are any instrument cluster DTCs recorded?**	**Yes** If instrument cluster DTC U1073 is retrieved, REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual to continue diagnosis. For all other instrument cluster DTCs REFER to the Instrument Cluster Diagnostic Trouble Code (DTC) Index. **No** GO to Y2 .
Y2 CARRY OUT THE INSTRUMENT CLUSTER INDICATOR LAMP CONTROL ACTIVE COMMAND USING THE DIAGNOSTIC TOOL	
• Key in OFF position. • Connect the diagnostic tool. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster Active Command. • Select the instrument cluster indicator lamp control active command. Trigger the engine over-temperature indicator active command on and off. Observe the temperature warning indicator. • **Does the temperature warning indicator illuminate when triggered on and turn off when triggered off?**	**Yes** GO to Y3 . **No** GO to Y4 .
Y3 CHECK FOR CORRECT PCM OPERATION	
• Disconnect all PCM connectors. • Check for: ◦ corrosion ◦ pushed-out pins • Connect all PCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. TEST the system for normal operation.
Y4 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
• Disconnect all instrument cluster connectors. • Check for: ◦ corrosion ◦ pushed-out pins • Connect all instrument cluster connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the

	DTCs. REPEAT the self-test.

PINPOINT TEST Z: THE LOW WASHER FLUID INDICATOR IS NEVER/ALWAYS ON - EXPEDITION

Test Step	Result / Action to Take
NOTE: Verify that the low washer fluid is full and that the key has been cycled at least once prior to carrying out the pinpoint test.	
Z1 CARRY OUT THE INSTRUMENT CLUSTER WARNING LAMPS AND CHIME ACTIVE COMMAND USING THE DIAGNOSTIC TOOL	
• Key in OFF position. • Connect the diagnostic tool. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster Active Command. • Select the instrument cluster warning lamps and chime active command. Trigger the all lamps active command on and off. Observe the low washer fluid indicator. • **Does the low washer fluid indicator illuminate when triggered on and turn off when triggered off?**	**Yes** If the low washer fluid indicator is inoperative, GO to Z2 . If the low washer fluid indicator is always on, GO to Z5 . **No** GO to Z6 .
Z2 CHECK THE LOW WASHER FLUID SWITCH	
• Key in OFF position. • Disconnect: Low Washer Fluid Switch C138. • Connect a fused (10A) jumper wire between the low washer fluid switch C138 pin 1, circuit 81 (RD/LG), harness side and the low washer fluid switch C138 pin 2, circuit 57 (BK), harness side.  A0040670 • Key in ON position. • **Does the low washer fluid indicator illuminate?**	**Yes** INSTALL a new low washer fluid switch. TEST the system for normal operation. **No** GO to Z3 .
Z3 CHECK CIRCUIT 81 (RD/LG) FOR AN OPEN	
• Disconnect: Instrument Cluster C220b. • Measure the resistance between the instrument cluster C220b pin 3, circuit 81 (RD/LG), harness side and the low washer fluid switch C138 pin 1, circuit 81 (RD/LG), harness side.	**Yes** GO to Z4 . **No** REPAIR the circuit. TEST the system for normal operation.

 A0040671 ● **Is the resistance less than 5 ohms?**	
Z4 CHECK CIRCUIT 57 (BK) FOR AN OPEN	**Yes** GO to Z6 . **No** REPAIR the circuit. TEST the system for normal operation.
● Measure the resistance between the low washer fluid switch C138 pin 2, circuit 57 (BK), harness side and ground.  A0040672 ● **Is the resistance less than 5 ohms?**	
Z5 CHECK CIRCUIT 81 (RD/LG) FOR SHORT TO GROUND	**Yes** GO to Z6 . **No** REPAIR the circuit. TEST the system for normal operation.
● Key in OFF position. ● Disconnect: Low Washer Fluid Switch C138. ● Disconnect: Instrument Cluster C220b. ● Measure the resistance between the instrument cluster C220b pin 3, circuit 81 (RD/LG), harness side and ground.  A0040673 ● **Is the resistance greater than 10,000 ohms?**	
Z6 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	**Yes** INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation. **No** The system is operating correctly at this time.
● Disconnect all instrument cluster connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all instrument cluster connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	

	Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST AA: THE TRACTION CONTROL INDICATOR IS NEVER/ALWAYS ON - NAVIGATOR

Test Step	Result / Action to Take
AA1 CARRY OUT THE INSTRUMENT CLUSTER INDICATOR LAMP CONTROL ACTIVE COMMAND USING THE DIAGNOSTIC TOOL	
• Key in OFF position. • Connect the diagnostic tool. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster Active Command. • Select the instrument cluster indicator lamp control active command. Trigger the traction assist active indicator active command on and off. Observe the traction control indicator. • **Does the traction control indicator illuminate when triggered on and turn off when triggered off?**	**Yes** REFER to Section 206-09A or Section 206-09B . **No** GO to AA2 .
AA2 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
• Disconnect all instrument cluster connectors. • Check for: ◦ corrosion ◦ pushed-out pins • Connect all instrument cluster connectors and make sure they seat correctly. • Make sure all other system connectors are fully seated. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

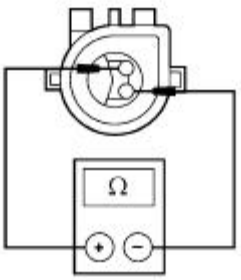
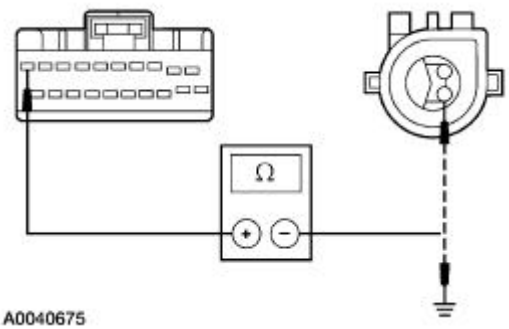
PINPOINT TEST AB: THE O/D OFF INDICATOR IS NEVER/ALWAYS ON

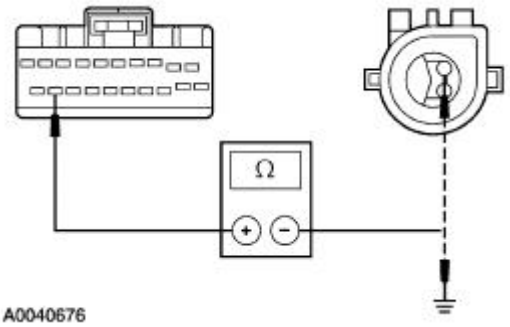
Test Step	Result / Action to Take
AB1 CARRY OUT THE INSTRUMENT CLUSTER WARNING LAMPS AND CHIME ACTIVE COMMAND USING THE DIAGNOSTIC TOOL	
• Key in OFF position. • Connect the diagnostic tool. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster	**Yes** REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual to continue the diagnosis.

Active Command. ● Select the instrument cluster warning lamps and chime active command. Trigger the all lamps active command off and then on. Observe the O/D OFF indicator. ● **Does the O/D OFF indicator illuminate when commanded on and turn off when commanded off?**	**No** GO to AB2 .
AB2 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
● Disconnect all instrument cluster connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all instrument cluster connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST AC: THE INTEGRATED CIRCUIT DISPLAY IS INOPERATIVE

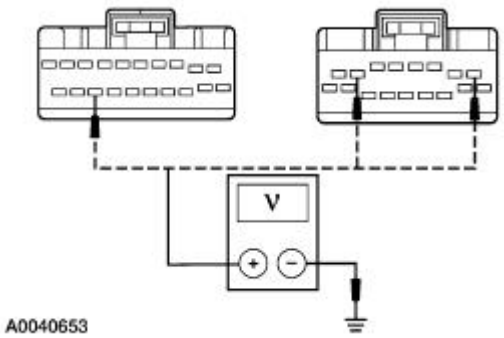
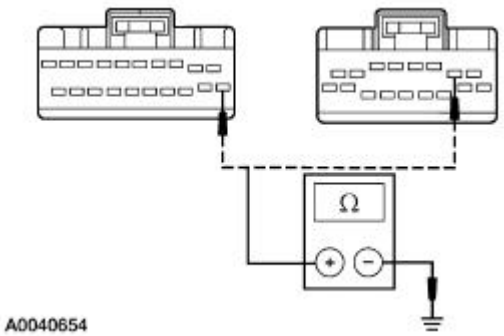
Test Step	Result / Action to Take
AC1 RETRIEVE AND RECORD DTCS FROM BOTH CONTINUOUS AND ON-DEMAND SELF-TESTS—INSTRUMENT CLUSTER	
● Connect the diagnostic tool. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Continuous DTCs. ● Retrieve and document the continuous DTCs. ● **Are DTCs B1255, B1257, B2143 or U2013 retrieved?**	**Yes** If DTC B2143 is present, GO to AC7 . If DTC B1255 or B1257 are present, GO to AC4 . **No** If DTC U2013 is present, GO to AC2 .
AC2 VERIFY THE INTEGRATED CIRCUIT DISPLAY OPERATION	
● Key in ON position. ● Monitor the compass, air temperature and odometer/trip odometer functions of the integrated circuit display. ● **Does the integrated circuit display operate correctly?**	**Yes** The system is operating correctly at this time. **No** If the compass is inoperative, REFER to Section 413-08 . If the odometer/trip odometer are inoperative, GO to AC3 . If the air temperature display is inoperative,

	GO to AC4 .
AC3 VERIFY THE SPEEDOMETER OPERATION ● Operate the vehicle and verify the speedometer operation. ● **Does the speedometer operate correctly?**	**Yes** GO to AC7 . **No** Go To Pinpoint Test G .
AC4 CHECK THE AMBIENT AIR TEMPERATURE SENSOR FUNCTION ● Disconnect: Ambient Air Temperature Sensor C132. ● Measure the resistance between the ambient air temperature sensor C132 pin 1, circuit 470 (PK/BK), component side and the ambient air temperature sensor C132 pin 2, circuit 767 (LB/OG), component side at ambient temperature of 18°-29°C (65°-85°F).  A0040677 ● **Is the resistance between 8,000 ohms and 14,000 ohms?**	**Yes** GO to AC5 . **No** INSTALL a new ambient air temperature sensor. TEST the system for normal operation.
AC5 CHECK CIRCUIT 767 (LB/OG) FOR AN OPEN OR SHORT TO GROUND ● Disconnect: Instrument Cluster C220a. ● Measure the resistance between the instrument cluster C220a pin 10, circuit 767 (LB/OG), harness side and the ambient air temperature sensor C132 pin 2, circuit 767 (LB/OG), harness side; and between the instrument cluster C220a pin 10, circuit 767 (LB/OG), harness side and ground.  A0040675 ● **Is the resistance less than 5 ohms between the instrument cluster and the ambient air temperature sensor; and greater than 10,000 ohms between the instrument cluster and ground?**	**Yes** GO to AC6 . **No** REPAIR the circuit. TEST the system for normal operation.
AC6 CHECK CIRCUIT 470 (PK/BK) FOR AN OPEN OR SHORT TO GROUND ● Measure the resistance between the instrument cluster C220a pin 19, circuit 470 (PK/BK), harness side and the ambient air temperature sensor C132 pin 1, circuit 470 (PK/BK), harness side; and between the instrument cluster C220a pin 19, circuit 470 (PK/BK), harness side and ground.	**Yes** GO to AC7 . **No** REPAIR the circuit.

 ● **Is the resistance less than 5 ohms between the instrument cluster and the ambient air temperature sensor; and greater than 10,000 ohms between the instrument cluster and ground?**	TEST the system for normal operation.
AC7 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION ● Disconnect all instrument cluster connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all instrument cluster connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST AD: THE INSTRUMENT CLUSTER IS INOPERATIVE

Test Step	Result / Action to Take
CAUTION: Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.	
AD1 CHECK THE INSTRUMENT CLUSTER POWER SUPPLY ● Key in OFF position. ● Disconnect: Instrument Cluster C220a. ● Disconnect: Instrument Cluster C220b. ● Key in ON position. ● Using the following table, measure the voltage between the instrument cluster, harness side and ground. **Connector** / **Pin** / **Circuit** C220a / 18 / 1002 (BK/PK) C220b / 1 / 3049 (BK/LG) C220b / 7 / 640 (RD/YE)	**Yes** GO to AD2 . **No** REPAIR the circuit(s) in question. TEST the system for normal operation.

 A0040653 ● **Are the voltages greater than 10 volts?**	
AD2 CHECK INSTRUMENT CLUSTER GROUND CIRCUITS 57 (BK) AND 676 (PK/OG)	**Yes** GO to AD3 . **No** REPAIR the circuit(s) in question. TEST the system for normal operation.
● Key in OFF position. ● Measure the resistance between the instrument cluster C220a pin 11, circuit 57 (BK), harness side and ground; and between the instrument cluster C220b pin 2, circuit 676 (PK/OG), harness side and ground.  A0040654 ● **Are the resistances less than 5 ohms?**	
AD3 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	**Yes** INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
● Disconnect all instrument cluster connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all instrument cluster connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	

Instrument Cluster

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418–F224 New Generation STAR (NGS) Tester 418-F052 or equivalent diagnostic tool

Removal and Installation

All vehicles

1. **CAUTION: Prior to removal of the module, it is necessary to upload module configuration information to the diagnostic tool. This information needs to be downloaded into the new module once installed. For additional information, refer to Section 418-01 .**

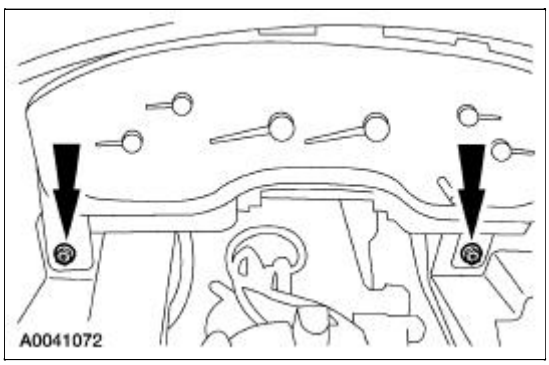
   Disconnect the battery. For additional information, refer to Section 414-01 .

2. Remove the instrument panel finish panel. For additional information, refer to Section 501-12 .

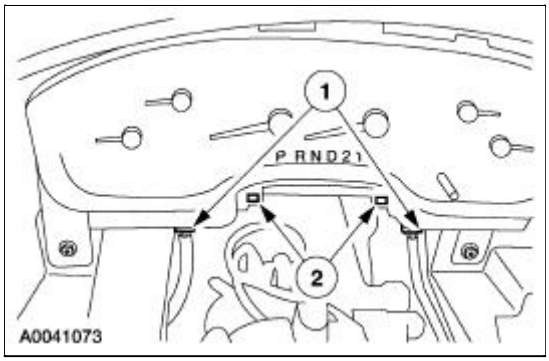
Expedition

3. **CAUTION: Electronic modules are sensitive to electrical charges. If exposed to these charges, damage may result.**

   Remove the instrument cluster screws and pull the instrument cluster out from the instrument panel.



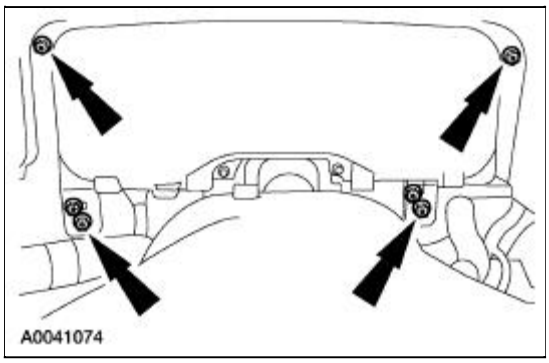
4. Remove the instrument cluster.
   1. Disconnect the electrical connectors.
   2. Depress the retaining tabs to remove the PRNDL and remove the instrument cluster.



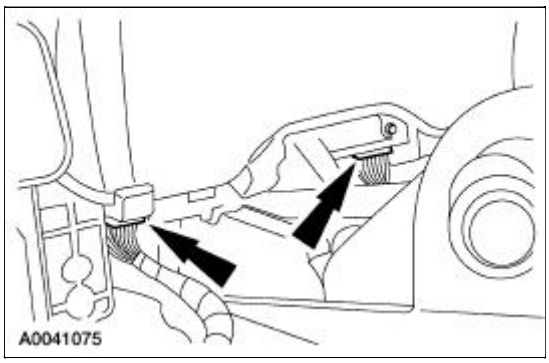
Navigator

5. **CAUTION: Electronic modules are sensitive to electrical charges. If exposed to these charges, damage may result.**

   Remove the instrument cluster screws and pull the instrument cluster out from the instrument panel.



6. Disconnect the electrical connectors and remove the instrument cluster.



All vehicles

7. **CAUTION: Once the new module is installed, it is necessary to download the module configuration information from the diagnostic tool into the new module. For additional information, refer to Section 418-01**

   To install, reverse the removal procedure.

Instrument Cluster Lens

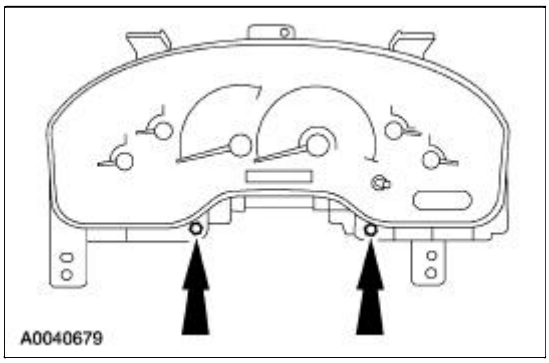
Removal and Installation

All Vehicles

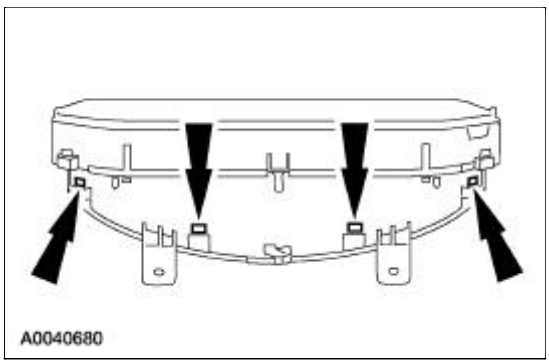
1. Remove the instrument cluster. For additional information, refer to Instrument Cluster in this section.

Expedition

2. Remove the screws.

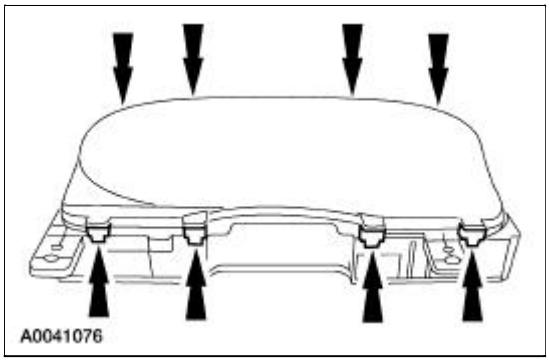


3. Release the clips and remove the cluster lens.



Navigator

4. Release the retaining tabs and remove the cluster lens.



All vehicles

5. To install, reverse the removal procedure.

Warning Indicator Bulb

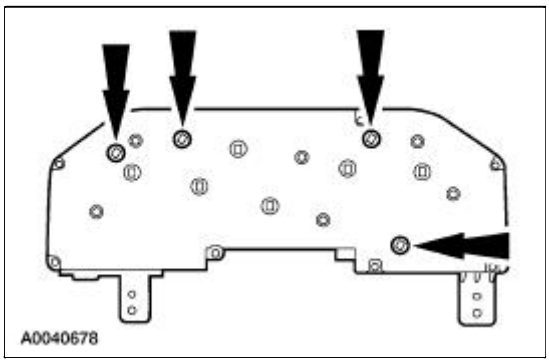
Removal and Installation

All vehicles

1. Remove the instrument cluster. For additional information, refer to Instrument Cluster in this section.

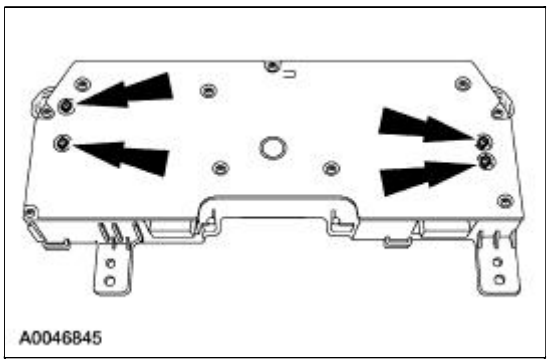
Expedition

2. Turn the warning indicator bulb one quarter turn counterclockwise and remove the bulb.



Navigator

3. Turn the warning indicator bulb one quarter turn counterclockwise and remove the bulb.



All vehicles

4. To install, reverse the removal procedure.

Horn

Horn components include the following items:

- clockspring
- horn relay
- horns
- steering wheel pad horn switch

Horn switches

The horn switch is incorporated into the driver side air bag module in the steering wheel. The switch is powered through the clockspring and grounded through the steering column. For removal and installation of the horn switch, refer to Section 501-20B .

Horn relay

The horn relay is incorperated into the central junction box (CJB). The central junction box is located behind the passenger lower kick panel.

Horn

Refer to Wiring Diagrams Cell 44 for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool

Inspection and Verification

1. Verify the customer concern by operating the horn system.
2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
● Central junction box (CJB) ● Horn ● Horn switch	● Central junction box (CJB) ● Central junction box (CJB) fuse 26 (20A) ● Circuitry ● Clockspring ● Powertrain control module (PCM) ● Tire pressure monitor (TPM) module ● Vehicle security module

3. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel, and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.
4. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool manual.

5. Carry out the DATA LINK DIAGNOSTICS TEST. If the diagnostic tool responds with:
    - CKT914, CKT915, CKT693 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
    - NO RESP/NOT EQUIP for vehicle security module, refer to Section 419-10 .
    - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the vehicle security module.
6. If the DTCs retrieved are related to the concern, go to the vehicle security module (DTC) Index to continue diagnostics.
7. If no DTCs related to the concern are retrieved, proceed to the Symptom Chart to continue diagnostics.

Vehicle Security Module Diagnostic Trouble Code (DTC) Index

DTC	Description	Source By	Action
B1217	Horn Relay Output	Body security module	Go To Pinpoint Test B .

Symptom Chart

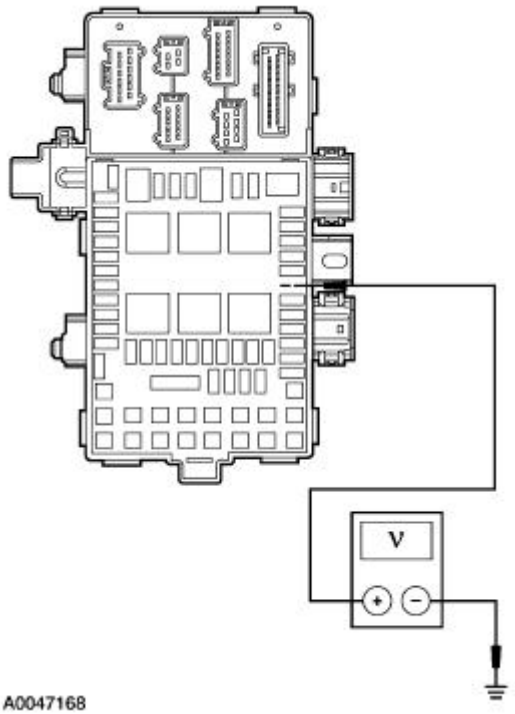
Symptom Chart

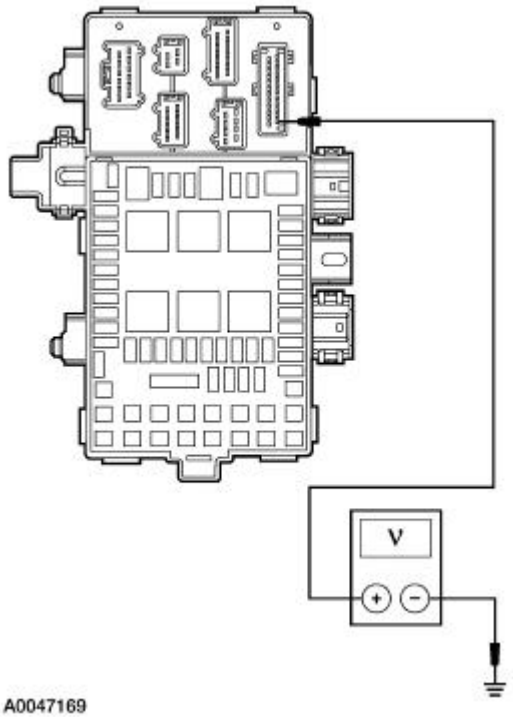
Condition	Possible Sources	Action
● The horn does not sound	● Central junction box (CJB). ● CJB fuse 26 (20A). ● Circuitry. ● Horn switch. ● Horn. ● Clockspring. ● Powertrain control module (PCM).	● Go To Pinpoint Test A .
● The horn sounds continuously	● Central junction box (CJB). ● Circuitry. ● Horn switch. ● Horn. ● Vehicle security module. ● Tire pressure monitor (TPM) module. ● Clockspring	● Go To Pinpoint Test B .

Pinpoint Tests

PINPOINT TEST A: THE HORN DOES NOT SOUND

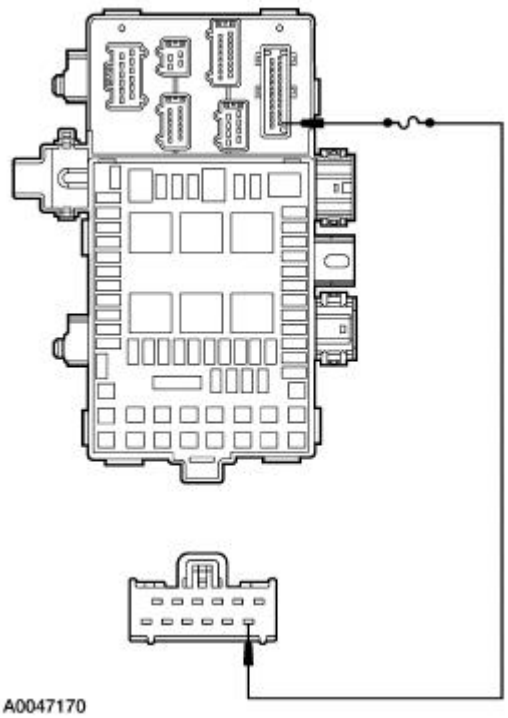
Test Step	Result / Action to Take
A1 TRIGGER THE HORN CONTROL COMMAND	

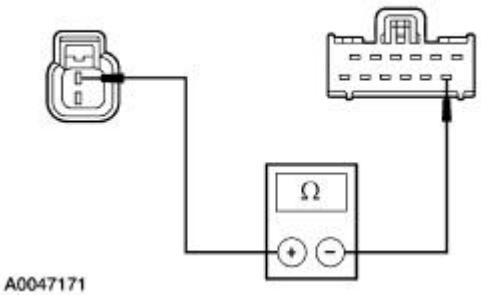
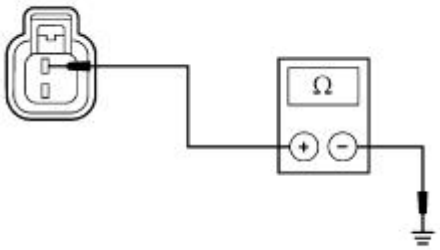
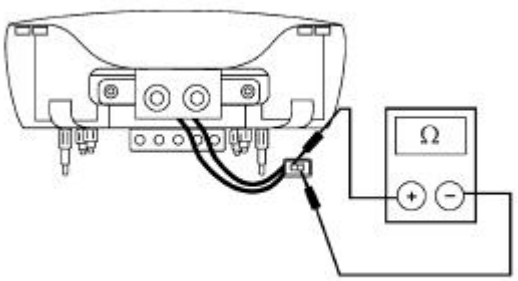
• Connect the diagnostic tool. • Trigger the horn control command. • **Does the horn sound?**	**Yes** GO to A7 . **No** GO to A2 .
A2 CHECK POWER SUPPLY TO THE CENTRAL JUNCTION BOX (CJB) HORN RELAY	
• Key in OFF position. • Disconnect: Fuse 26 (20A). • Measure the voltage between the CJB fuse 26 (20A) input side and ground.  A0047168 • **Is the voltage greater than 10 volts?**	**Yes** GO to A3 . **No** INSTALL or REPAIR a new CJB as necessary. TEST the system for normal operation.
A3 CHECK THE CJB HORN RELAY OUTPUT	
• Disconnect: CJB C270e. • Measure the voltage between CJB C270e pin 12, circuit 1 (DB), component side and ground.	**Yes** GO to A4 . **No** INSTALL or REPAIR a new CJB as necessary. TEST the system for normal operation.

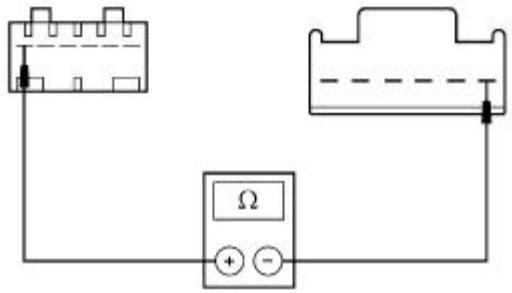
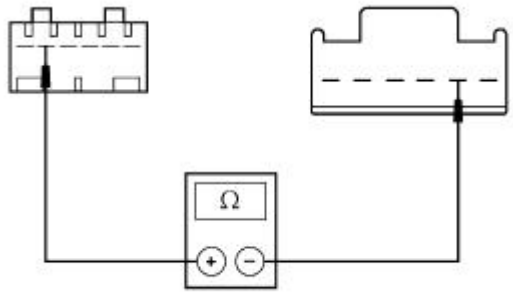
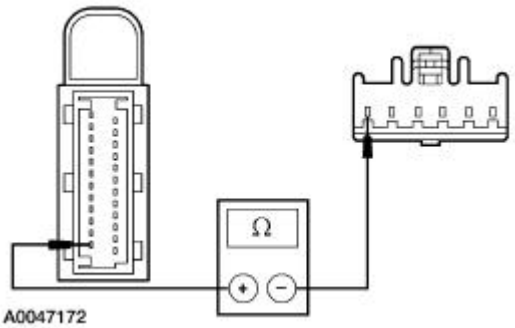


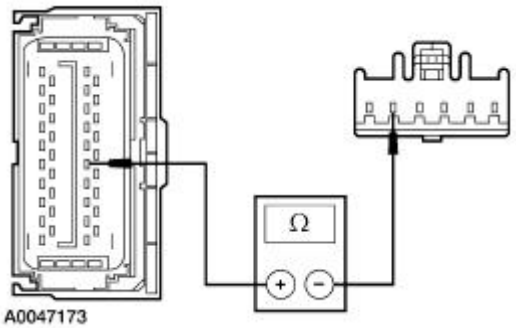
A0047169

- **Is the voltage greater than 10 volts?**

A4 CHECK THE HORNS OUTPUT CIRCUIT	
• Disconnect: CJB C270a. • Connect a 15A fused jumper wire between the CJB C270e pin 12, circuit 1 (DB), component side and the CJB C270a pin 7, circuit 6 (YE/LG), harness side.  A0047170 • **Does the horn sound?**	**Yes** GO to A7 . **No** GO to A5 .
A5 CHECK CIRCUIT 6 (YE/LG) FOR AN OPEN	
• Disconnect: Horn C131. • Measure the resistance between the CJB C270a pin 7, circuit 6 (YE/LG) harness side and horn C131 pin 1, circuit 6	**Yes** GO to A6 .

(YE/LG), harness side.  A0047171 ● **Is the resistance less than 5 ohms?**	**No** REPAIR the circuit. TEST the system for normal operation.
A6 CHECK CIRCUIT 57 (BK) BETWEEN HORN AND GROUND	
● Measure the resistance between right horn connector C131 pin 2, circuit 57 (BK), harness side and ground.  A0032815 ● **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new horn. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
A7 CHECK THE HORN SWITCH CIRCUITRY	
● Deactivate the air bag system. Refer to Section 501-20B . ● Measure the resistance between the horn pad switch connector pins under the following conditions: **Steering Wheel Pad Horn Switch Position** / **Resistance** Pressed / Less than 5 ohms Released / Greater than 10,000 ohms  K26006-A ● **Are the resistances correct?**	**Yes** GO to A8 . **No** INSTALL a new driver side air bag module. REFER to Section 501-20B . TEST the system for normal operation.
A8 CHECK THE CLOCKSPRING	
● Disconnect: Clockspring C218b. ● Measure the resistance between upper clockspring	**Yes** GO to A9 .

connector pin 6, (component side), and lower clockspring C218b pin 6, (component side).  A0024225 • Measure the resistance between upper clockspring connector pin 5, (component side), and lower clockspring C218b pin 5, (component side).  A0024226 • **Are the resistances less than 5 ohms?**	**No** INSTALL a new clockspring. TEST the system for normal operation.
A9 CHECK CIRCUIT 1 (DB) FOR AN OPEN	
• Measure the resistance between the CJB C270e pin 12, circuit 1 (DB), harness side and clockspring C218b pin 6, circuit 1 (DB), harness side.  A0047172 • **Is the resistance less than 5 ohms?**	**Yes** GO to A10 . **No** REPAIR the circuit. TEST the system for normal operation.
A10 CHECK CIRCUIT 848 (DG/OG) BETWEEN CLOCKSPRING AND POWERTRAIN CONTROL MODULE	
• Measure the resistance between the clockspring C218b pin 5, circuit 848 (DG/OG), harness side and the powertrain control module C175a pin 17, circuit 848 (DG/OG), harness side.	**Yes** GO to A11 . **No** REPAIR the circuit. TEST the system for normal operation.

 ● **Is the resistance less than 5 ohms?**	
A11 CHECK FOR CORRECT PCM OPERATION	
● Disconnect all PCM connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all PCM connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new PCM. REFER to Section 303-14 . CLEAR the DTCs. REPEAT the PCM self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST B: THE HORN SOUNDS CONTINUOUSLY

Test Step	Result / Action to Take
B1 CHECK THE CJB TO HORN	
● Key in OFF position. ● Disconnect: C270a. ● **Does the horn continue to sound?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** GO to B2 .
B2 CHECK THE HORN SWITCH CIRCUIT	
● Disconnect: CJB C270e. ● Connect: CJB C270a. ● **Does the horn continue to sound?**	**Yes** REPAIR or INSTALL a new CJB as necessary. TEST the system for normal operation. **No** GO to B3 .
B3 CHECK THE HORN SWITCH	
● Connect: CJB C270e. ● Disconnect: Upper Clockspring. ● **Does the horn continue to sound?**	**Yes** GO to B4 . **No** INSTALL a new driver side air bag module. REFER to Section 501-20B . TEST the system for normal operation.

B4 CHECK THE CLOCKSPRING ● Disconnect: Lower Clockspring C218b. ● **Does the horn continue to sound?**	**Yes** GO to B5 . **No** INSTALL a new clockspring. TEST the system for normal operation.
B5 CHECK VEHICLE SECURITY MODULE ● Disconnect: Vehicle Security Module C2113b. ● **Does the horn continue to sound?**	**Yes** GO to B6 . **No** GO to B7 .
B6 CHECK TIRE PRESSURE MODULE ● Disconnect: Tire Pressure Module C3813. ● **Does the horn continue to sound?**	**Yes** REPAIR circuit 1 (DB). TEST the system for normal operation. **No** GO to B8 .
B7 CHECK THE VEHICLE SECURITY MODULE FOR CORRECT OPERATION ● Disconnect all vehicle security module connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all vehicle security module connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new vehicle security module. REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
B8 CHECK THE TIRE PRESSURE MONITOR (TPM) MODULE FOR CORRECT OPERATION ● Disconnect all TPM connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all TPM connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new TPM. REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Clock

The stand-alone electric analog clock, available in the Navigator only, is centrally located on the instrument panel and displays time in a 12 hour format. The clock is backlit when the headlamps and parking lamps are on. The Expedition clock is integrated into the radio.

Clock

Refer to Wiring Diagrams Cell 44 , Horn/Cigar Lighter/Digital Clock for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent

Inspection and Verification

1. Verify the customer concern by operating the electric clock.
2. Visually inspect for obvious signs of mechanical and/or electrical damage using the following chart:

Visual Inspection Chart

Mechanical	Electrical
● Electric clock	● Central junction box (CJB) fuse 5 (7.5A) ● Circuitry

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the concern is not visually evident, proceed to the Symptom Chart.

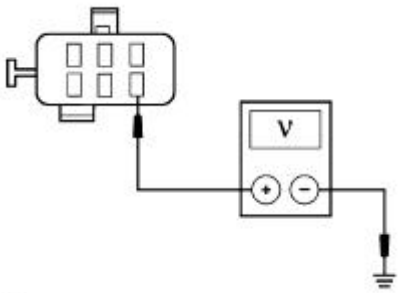
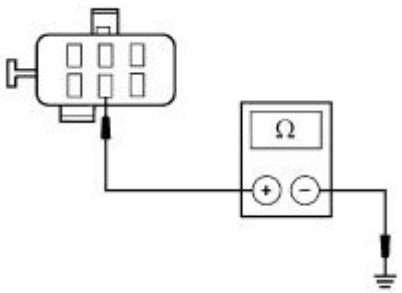
Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
● The clock operation is erratic/inoperative	● Central junction box (CJB) fuse 5 (7.5A). ● Circuitry. ● Electric clock.	● GO to Pinpoint Test A .

Pinpoint Tests

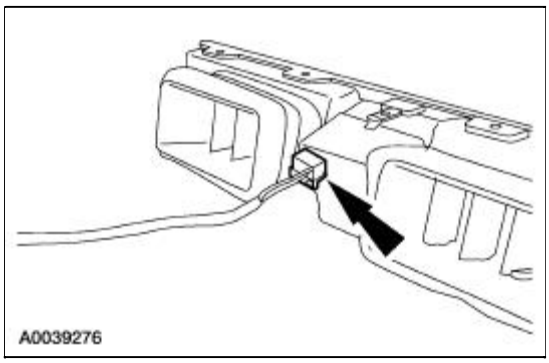
PINPOINT TEST A: THE CLOCK OPERATION IS ERRATIC/INOPERATIVE

Test Step	Result / Action to Take
A1 CHECK POWER SUPPLY TO THE ELECTRIC CLOCK	**Yes** GO to A2 . **No** REPAIR the circuit. TEST the system for normal operation.
● Key in OFF position. ● Measure the voltage between the electric clock C2016 pin 6, circuit 729 (RD/WT), harness side and ground.  A0039279 ● **Is the voltage greater than 10 volts?**	
A2 CHECK ELECTRIC CLOCK GROUND CIRCUIT	**Yes** INSTALL a new clock. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
● Measure the resistance between electric clock C2016 pin 5, circuit 57 (BK), harness side and ground.  A0039280 ● **Is the resistance less than 5 ohms?**	

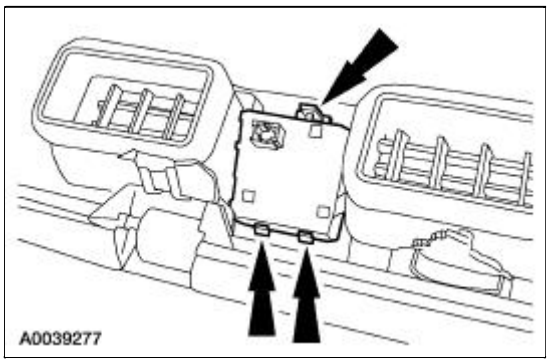
Clock

Removal and Installation

1. Remove the instrument cluster center finish panel. Refer to Section 501-12 .
2. Disconnect the electrical connector.



3. Pry the retaining clips away from the clock and remove the clock from the instrument cluster center finish panel.



4. To install, reverse the removal procedure.

Information And Message Center

The message center display is a green vacuum fluorescent, fixed format display. The message center is a two-line display integrated into the right side of the instrument cluster and is controlled by the message center switches. Refer to the owner literature for operating instructions.

Information And Message Center

Refer to Wiring Diagrams Cell 60 , Overhead Console for schematic and connector information.

Special Tool(s)

 ST1137-A	73 III Automotive Meter 105-R0057 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052 or equivalent diagnostic tool

Principles of Operation

The message center is a vacuum fluorescent display, part of the instrument cluster. The message center electronic functions use both hardwired, standard corporate protocol (SCP), and UART based protocol (UBP) communication networks to transmit and receive information. As a technician it is very important to understand:

- where the input (command) originates from.
- all the information (messages) necessary in order for a feature to operate.
- which module(s) receive(s) the input or command message.
- does the module which received the input (message) control the output of the feature, or does it output a message over the SCP communication network to another module?
- which module controls the output of the feature.

The message center provides the following features:

- information displays
- setup displays
- warning messages
- system check messages

The message center information can be selected through a set of three buttons:

- INFO
- SETUP

- RESET

Information Displays

The information displays are non-timed modes. The selected mode remains on until the driver depresses a message center button to change the mode or it is overridden by another mode. The information display modes are:

- odometer
- trip odometer
- compass
- distance to empty
- average fuel economy

For additional information regarding the odometer and trip odometer, refer to Section 413-01 .

Setup Displays

The setup displays are timed modes and terminate after a finite interval. The setup display modes are:

- language
- English/metric units
- system check
- charge system status
- oil pressure status
- engine temp status
- washer fluid status
- brake fluid status
- fuel level status
- distance to empty
- tire warning

Every 180 days or 8,000 km (5,000 miles) the OIL LIFE display in the message center SYSTEM CHECK will decrease gradually from 100% to 0%. At 5% oil life, the CHANGE OIL SOON warning indicator will illuminate. At 0% oil life, the OIL CHANGE REQUIRED warning indicator will illuminate. OIL LIFE status is continually displayed in the SYSTEM CHECK portion of the message center and OIL LIFE warnings appear if OIL LIFE is low. For additional information, refer to the owner literature.

Warning Messages

The warning messages are single cycle, non-resettable and repetitive warning messages. The single cycle warning messages are:

- CHANGE OIL SOON
- OIL CHANGE REQUIRED
- LOW WASHER FLUID LEVEL
- LOW BRAKE FLUID LEVEL
- POWER LIFTGATE

- POWER RUNNING BOARDS

The single cycle warning messages will display once whenever the ignition switch is turned to ON or a fault occurs in a system and can be cleared by pressing the RESET button.

The repetitive warning messages are:

- CHECK CHARGING SYSTEM
- TRANSMISSION OVERHEATED
- CHECK TRANSMISSION
- LOW FUEL LEVEL
- LOW OIL PRESSURE
- CHECK ENGINE TEMPERATURE
- CHECK TIRES
- CHECK FUEL CAP

The repetitive warning messages are displayed at a fixed interval whenever the ignition switch is turned ON or is in the ACC position. To remove a repetitive warning message, press the RESET button. The message will only reoccur after 10 minutes or until the warning condition is corrected.

The non-resettable warning messages will display whenever the ignition switch is turned to ON and a fault occurs in a system. The fault must be corrected to clear the non-resettable warning messages.

The non-resettable warning messages are:

- DOOR AJAR
- BACKUP AID

Inspection and Verification

NOTE: A new instrument cluster must be reconfigured. For additional information, refer to Section 418-01.

NOTE: When installing a new instrument cluster, it is necessary to contact the Instrument Cluster Program.

1. Verify the customer concern by operating the system.

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

Visual Inspection Chart

Mechanical	Electrical
● Low washer fluid level ● Fuel tank ● Low engine coolant level ● Accessory drive belt ● Low engine oil level	● Central junction box (CJB) fuse(s): ■ 1 (10A) ■ 15 (5A) ■ 21 (15A) ● Instrument cluster

• Low brake fluid level • Low tire pressure	• Switches or sensors • Loose or corroded connectors • Circuitry

3. If the inspection reveals obvious concern(s) that can be readily identified, repair as necessary.

4. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

5. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool manual.

6. Carry out the DATA LINK DIAGNOSTICS TEST. If the diagnostic tool responds with:
   - CKT1906, CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for the instrument cluster, refer to Section 413-01 .
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the instrument cluster.

7. If the DTCs retrieved are related to the concern, refer to the Instrument Cluster Diagnostic Trouble Code (DTC) Index to continue diagnostics.

8. If no DTCs related to the concern are retrieved, proceed to the Symptom Chart to continue diagnostics.

Instrument Cluster Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1205	IC Switch 1 Assembly Circuit Failure (Open or Short to Battery)	Instrument cluster	Go To Pinpoint Test D .
B1209	IC Switch 2 Assembly Circuit Failure (Open or Short to Battery)	Instrument cluster	Go To Pinpoint Test D .
U2013	Compass Module — No Response	Instrument cluster	Go To Pinpoint Test B .

Note: For a complete master list of all instrument cluster DTCs, refer to Section 419-10 .

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• No communication with the instrument cluster	• Central junction box (CJB) fuse (s):	• REFER to Section 413-01 .

	■ 1 (10A). ■ 15 (5A). ■ 21 (15A). ● Circuitry. ● Standard corporate protocol (SCP) network. ● Instrument cluster.	
● The message center is not operating correctly	● Instrument cluster. ● Message center switch. ● Circuitry.	● Go To Pinpoint Test A .
● The compass is inoperative	● Compass sensor module. ● Instrument cluster. ● Circuitry.	● Go To Pinpoint Test B .
● The compass is inaccurate	● Zone setting. ● Calibration. ● Vehicle magnetization. ● Compass sensor module. ● Circuitry.	● Go To Pinpoint Test C .
● The message center display is blank	● Instrument cluster.	● INSTALL a new instrument cluster. REFER to Section 413-01 .
● The message center switch does not operate correctly	● Message center switch. ● Instrument cluster. ● Circuitry.	● Go To Pinpoint Test D .
● The indicator does not operate correctly — charge system display	● Generator. ● Powertrain control module (PCM). ● Instrument cluster. ● Circuitry.	● REFER to Section 413-01 .
● The indicator does not operate correctly — low washer fluid level display	● Washer fluid level switch. ● Instrument cluster. ● Circuitry.	● Go To Pinpoint Test E .
● The indicator does not operate correctly — door ajar display	● Door ajar switch (es). ● Vehicle security module. ● Instrument cluster. ● Circuitry.	● Go To Pinpoint Test F .
● The indicator does not operate correctly — low fuel level display	● Fuel pump module. ● Instrument	● Go To Pinpoint Test G .

	cluster. • Circuitry.	
• The indicator does not operate correctly — distance to empty, average fuel economy	• Instrument cluster. • Powertrain control module (PCM). • Anti-lock brake system (ABS) module. • Circuitry.	• CHECK the operation of the speedometer, the fuel gauge and the odometer. If inoperative, REFER to Section 413-01 .
• The indicator does not operate correctly — distance to empty, average fuel economy	• Instrument cluster. • Powertrain control module (PCM). • Anti-lock brake system (ABS) module. • Circuitry.	• CHECK the operation of the speedometer, the fuel gauge and the odometer. If inoperative, REFER to Section 413-01 .
• The indicator does not operate correctly — low brake fluid level display	• Brake fluid level switch. • Instrument cluster. • Circuitry.	• Go To Pinpoint Test H .
• The indicator does not operate correctly — low oil pressure display	• Oil pressure switch. • Instrument cluster. • Circuitry.	• Go To Pinpoint Test I .
• The indicator does not operate correctly — check engine temperature	• Engine temperature sensor. • Powertrain control module (PCM). • Instrument cluster. • Circuitry.	• Go To Pinpoint Test J .
• The indicator does not operate correctly — check tire pressure	• Low tire pressure module. • Instrument cluster. • Circuitry.	• Go To Pinpoint Test K .
• The indicator does not operate correctly — power liftgate	• Power liftgate module. • Instrument cluster. • Circuitry.	• Go To Pinpoint Test L .
• The indicator does not operate correctly — power running boards	• Power liftgate module. • Instrument cluster. • Circuitry.	• Go To Pinpoint Test M .
• The indicator does not operate correctly — backup aid	• Parking aid module. • Instrument cluster.	• Go To Pinpoint Test N .

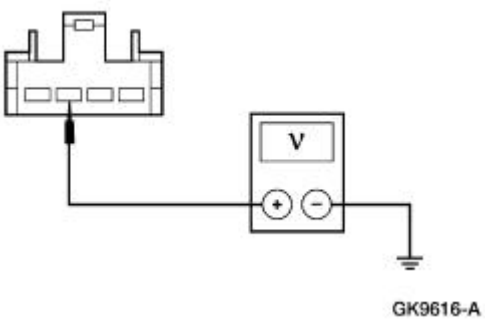
	• Circuitry.	
• The outside air temperature sensor does not operate correctly	• Outside air temperature sensor. • Circuitry.	• For vehicles equipped with EATC, REFER to Section 412-00 . Without EATC, REFER to Section 413-01 .

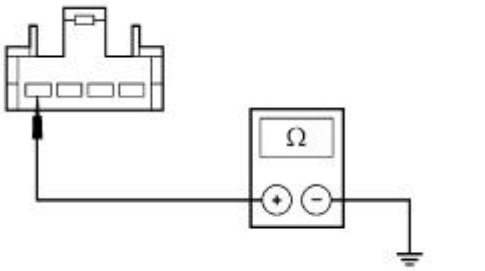
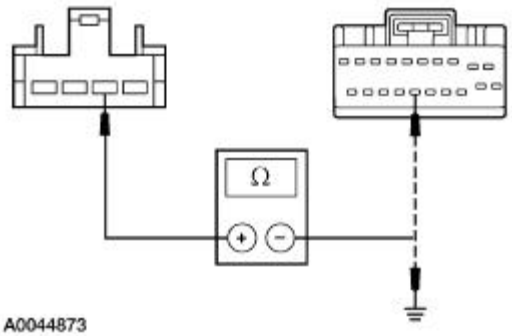
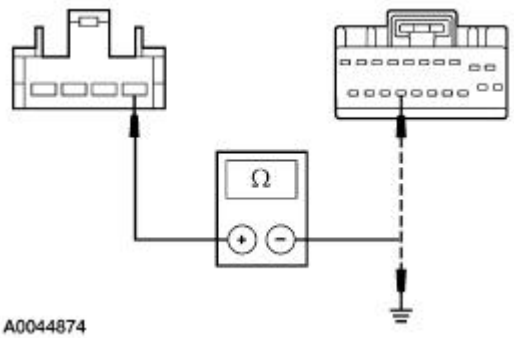
Pinpoint Tests

PINPOINT TEST A: THE MESSAGE CENTER IS NOT OPERATING CORRECTLY

Test Step	Result / Action to Take
A1 CHECK THE INSTRUMENT CLUSTER ODOMETER OPERATION	
• Key in ON position. • Observe the odometer display in the instrument cluster. • **Is the odometer displayed?**	**Yes** The system is OK. If the INFO, SETUP or RESET buttons are inoperative, Go To Pinpoint Test D . **No** REFER to the instrument cluster self-diagnostic mode in Section 413-01 .

PINPOINT TEST B: THE COMPASS IS INOPERATIVE

Test Step	Result / Action to Take
CAUTION: Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.	
B1 CHECK CIRCUIT 1003 (GY/YE) FOR BATTERY VOLTAGE	
• Key in OFF position. • Disconnect: Compass Sensor Module C909. • Key in ON position. • Measure the voltage between the compass sensor module C909 pin 3, circuit 1003 (GY/YE), harness side and ground.  GK9616-A • **Is the voltage greater than 10 volts?**	**Yes** GO to B2 . **No** REPAIR the circuit. TEST the system for normal operation.
B2 CHECK CIRCUIT 875 (BK/LB) FOR AN OPEN	

• Key in OFF position. • Measure the resistance between the compass sensor module C909 pin 4, circuit 875 (BK/LB), harness side and ground.  GK9617-A • **Is the resistance less than 5 ohms?**	**Yes** GO to B3 . **No** REPAIR the circuit. TEST the system for normal operation.
B3 CHECK CIRCUIT 702 (WH/BK) AND CIRCUIT 703 (WH/OG) FOR OPEN AND SHORT TO GROUND	
• Disconnect: Instrument Cluster C220a. • Measure the resistance between the compass sensor module C909 pin 2, circuit 703 (WH/OG), harness side and the instrument cluster C220a pin 16, circuit 703 (WH/OG), harness side; and between the compass sensor module C909 pin 2, circuit 703 (WH/OG), harness side and ground.  A0044873 • Measure the resistance between the compass sensor module C909 pin 1, circuit 702 (WH/BK), harness side and the instrument cluster C220a pin 17, circuit 702 (WH/BK), harness side; and between the compass sensor module C909 pin 1, circuit 702 (WH/BK), harness side and ground.  A0044874 • **Are the resistances less than 5 ohms between the compass sensor module and the instrument cluster; and greater than 10,000 ohms between the compass sensor module and ground?**	**Yes** INSTALL a new compass sensor module. SET the zone. REFER to Compass Zone Adjustment—With Message Center or Compass Zone Adjustment—Without Message Center in this section. CALIBRATE the compass. REFER to Compass Calibration—With Message Center or Compass Calibration—Without Message Center in this section. TEST the system for normal operation. **No** REPAIR the circuit(s) in question. TEST the system for normal operation.

PINPOINT TEST C: THE COMPASS IS INACCURATE

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>C1 CHECK THE COMPASS ZONE SETTING AND CALIBRATION
• Set the zone. Refer to Compass Zone Adjustment—With Message Center or Compass Zone Adjustment—Without Message Center in this section.
• Calibrate the compass. Refer to Compass Calibration—With Message Center or Compass Calibration—Without Message Center in this section.
• Does the compass calibrate correctly?</td><td>Yes
GO to C3 .

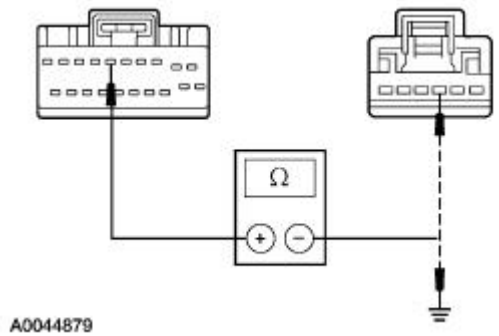
No
GO to C2 .</td></tr>
<tr><td>C2 DEMAGNETIZE THE VEHICLE
• Demagnetize the vehicle. Refer to Vehicle Demagnetizing in this section.
• Does the compass calibrate correctly?</td><td>Yes
GO to C3 .

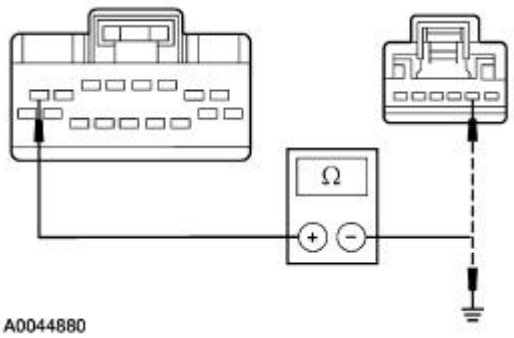
No
INSTALL a new compass sensor module. SET the zone. REFER to Compass Zone Adjustment—With Message Center or Compass Zone Adjustment—Without Message Center in this section. CALIBRATE the compass. REFER to Compass Calibration—With Message Center or Compass Calibration—Without Message Center in this section. TEST the system for normal operation.</td></tr>
<tr><td>C3 CHECK COMPASS ACCURACY
• Position the vehicle and observe the compass display as follows:
<table><tr><th>Direction</th><th>Compass Display</th></tr><tr><td>North</td><td>N</td></tr><tr><td>Northeast</td><td>NE</td></tr><tr><td>East</td><td>E</td></tr><tr><td>Southeast</td><td>SE</td></tr><tr><td>South</td><td>S</td></tr><tr><td>Southwest</td><td>SW</td></tr><tr><td>West</td><td>W</td></tr><tr><td>Northwest</td><td>NW</td></tr></table>• Does the compass display as indicated?</td><td>Yes
Compass is OK.

No
INSTALL a new compass sensor module. SET the zone. REFER to Compass Zone Adjustment—With Message Center or Compass Zone Adjustment—Without Message Center in this section. CALIBRATE the compass. REFER to Compass Calibration—With Message Center or Compass Calibration—Without Message Center in this section. TEST the system for normal operation.</td></tr>
</table>

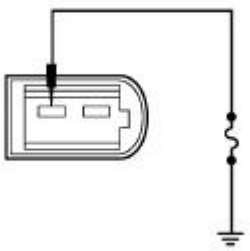
PINPOINT TEST D: THE MESSAGE CENTER SWITCH DOES NOT OPERATE CORRECTLY

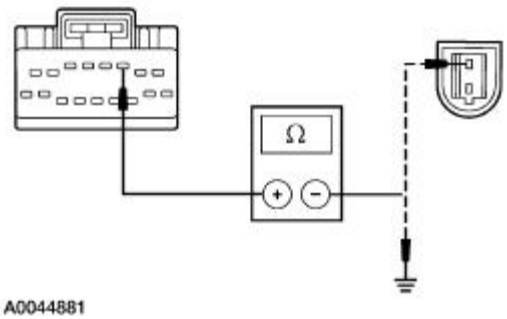
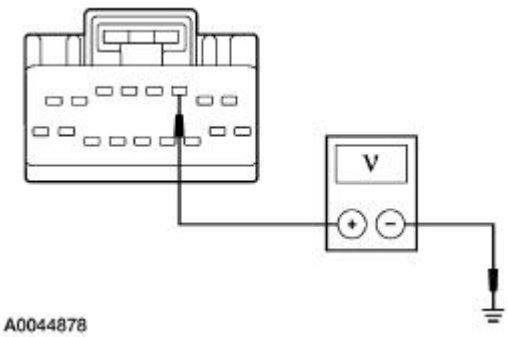
Test Step	Result / Action to

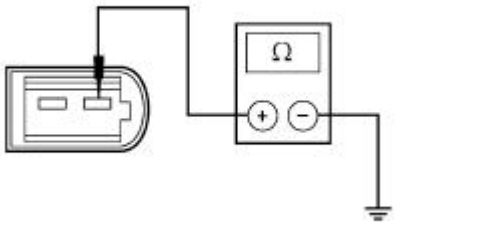
	Take
CAUTION: Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.	
D1 RETRIEVE THE RECORDED DTCS FROM BOTH CONTINUOUS AND ON-DEMAND SELF-TESTS — INSTRUMENT CLUSTER • Key in OFF position. • Connect the diagnostic tool. • Key in ON position. • Use the recorded instrument cluster DTCs from the continuous and on-demand self-test. • **Are any instrument cluster DTCs recorded?**	**Yes** If instrument cluster DTC B1205 or DTC B1209, GO to D3 . For all other instrument cluster DTCs, REFER to Section 419-10 . **No** GO to D2 .
D2 CHECK THE INSTRUMENT CLUSTER PID FOR THE MESSAGE CENTER SWITCH • Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster PID. • Select and monitor the instrument cluster PID RESETSW, INFOSW, and SETUPSW while pressing each message center button (INFO, SETUP and RESET). • **Does the PID agree with the button position?**	**Yes** GO to D5 . **No** GO to D3 .
D3 CHECK THE MESSAGE CENTER SWITCH CIRCUIT 1411 (GY/OG) FOR OPEN AND SHORT TO GROUND • Key in OFF position. • Disconnect: Instrument Cluster C220a. • Disconnect: Message Center Switch C253. • Measure the resistance between the instrument cluster C220a pin 6, circuit 1411 (GY/OG), harness side and the message center switch C253 pin 3, circuit 1411 (GY/OG), harness side; and between the instrument cluster C220a pin 6, circuit 1411 (GY/OG), harness side and ground.  A0044879 • **Are the resistances less than 5 ohms between the instrument cluster and the message center switch; and greater than 10,000 ohms between the instrument cluster and ground?**	**Yes** GO to D4 . **No** REPAIR the circuit. TEST the system for normal operation.
D4 CHECK THE MESSAGE CENTER SWITCH CIRCUIT 1396 (VT/WH) FOR OPEN AND SHORT TO GROUND • Disconnect: Instrument Cluster C220b. • Measure the resistance between the instrument cluster C220b pin 8, circuit 1396 (VT/WH), harness side and the message center switch C253 pin 2, circuit 1396 (VT/WH), harness side; and between the instrument cluster C220b pin 8, circuit 1396 (VT/WH), harness side and ground.	**Yes** INSTALL a new message center switch. REFER to Message Center Switch in this

 A0044880 ● **Are the resistances less than 5 ohms between the instrument cluster and the message center switch; and greater than 10,000 ohms between the instrument cluster and ground?**	section. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
D5 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
● Disconnect all instrument cluster connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all instrument cluster connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Section 413-01 . **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector.

PINPOINT TEST E: THE INDICATOR DOES NOT OPERATE CORRECTLY — LOW WASHER FLUID LEVEL DISPLAY

Test Step	Result / Action to Take
CAUTION: Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.	
E1 CHECK THE LOW WASHER FLUID LEVEL DISPLAY OPERATION	
● Key in OFF position. ● Disconnect: Washer Fluid Level Switch C138. ● Key in ON position. ● Connect a fused (10A) jumper wire between the washer fluid level switch C138 pin 1, circuit 81 (RD/LG), harness side and ground.  GK9178-A ● **Does the LOW WASHER FLUID message display in the message center?**	**Yes** GO to E5 . **No** GO to E2 .

E2 CHECK CIRCUIT 81 (RD/LG) FOR OPEN AND SHORT TO GROUND	
• Key in OFF position. • Disconnect: Instrument Cluster C220b. • Measure the resistance between the instrument cluster C220b pin 3, circuit 81 (RD/LG), harness side and the washer fluid level switch C138 pin 1, circuit 81 (RD/LG), harness side; and between the instrument cluster C220b pin 3, circuit 81 (RD/LG), harness side and ground.  A0044881 • **Are the resistances less than 5 ohms between the instrument cluster and the washer fluid level switch and greater than 10,000 ohms between the instrument cluster and ground?**	**Yes** GO to E3 . **No** REPAIR the circuit. TEST the system for normal operation.
E3 CHECK CIRCUIT 81 (RD/LG) FOR SHORT TO POWER	
• Key in ON position. • Measure the voltage between the instrument cluster C220b pin 3, circuit 81 (RD/LG), harness side and ground.  A0044878 • **Is there any voltage present?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** GO to E4 .
E4 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
• Disconnect all instrument cluster connectors. • Check for: ◦ corrosion ◦ pushed-out pins • Connect all instrument cluster connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Section 413-01 . **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector.
E5 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
• Key in OFF position. • Measure the resistance between the washer fluid level switch C138 pin 2, circuit 57 (BK), harness side and ground.	**Yes** INSTALL a new washer fluid level

 GK9179-A ● **Is the resistance less than 5 ohms?**	switch. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.

PINPOINT TEST F: THE INDICATOR DOES NOT OPERATE CORRECTLY—DOOR AJAR DISPLAY

Test Step	Result / Action to Take
F1 CHECK THE INTERIOR LAMPS OPERATION	
NOTE: The panel dimmer switch must be in the door position. ● Open and close each of the front doors. ● **Do the interior lamps operate correctly?**	**Yes** GO to F2 . **No** REFER to Section 417-02 .
F2 RETRIEVE THE RECORDED DTCS FROM BOTH THE CONTINUOUS AND ON-DEMAND SELF-TESTS — VEHICLE SECURITY MODULE	
● Key in OFF position. ● Connect the diagnostic tool. ● Key in ON position. ● Use the recorded vehicle security module DTCs from the continuous and on-demand self-test. ● **Are any DTCs recorded?**	**Yes** REFER to Section 419-10 . **No** GO to F3 .
F3 CHECK THE DOOR AJAR WARNING MESSAGE OPERATION	
● Enter the following diagnostic mode on the diagnostic tool: Vehicle Security Module Active Command. ● Trigger the door ajar active command. ● **Does the DOOR AJAR warning message display in the message center?**	**Yes** GO to F5 . **No** GO to F4 .
F4 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
● Disconnect all instrument cluster connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all instrument cluster connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Section 413-01 . **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
F5 CHECK FOR CORRECT VEHICLE SECURITY MODULE OPERATION	

• Disconnect all vehicle security module connectors. • Check for: • corrosion • pushed-out pins • Connect all vehicle security module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new vehicle security module. REFER to Section 419-10 . **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST G: THE INDICATOR DOES NOT OPERATE CORRECTLY — LOW FUEL LEVEL DISPLAY

Test Step	Result / Action to Take
G1 CHECK THE FUEL GAUGE OPERATION	
• Key in ON position. • Observe the fuel gauge operation. • **Does the fuel gauge operate correctly?**	**Yes** GO to G2 . **No** REFER to Section 413-01 .
G2 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
• Disconnect all instrument cluster connectors. • Check for: • corrosion • pushed-out pins • Connect all instrument cluster connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Section 413-01 . **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector.

PINPOINT TEST H: THE INDICATOR DOES NOT OPERATE CORRECTLY — LOW BRAKE FLUID LEVEL DISPLAY

Test Step	Result / Action to Take
H1 MONITOR THE BRAKE WARNING INDICATOR LAMP	
• Key in ON position. • Observe the brake warning indicator. The lamp should prove out for three seconds when the key is turned to the RUN position. • **Does the brake warning lamp illuminate for three seconds then go out?**	**Yes** GO to H2 . **No** REFER to Section 413-01 .
H2 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
• Disconnect all instrument cluster connectors. • Check for:	**Yes** INSTALL a new instrument cluster.

● corrosion ● pushed-out pins ● Connect all instrument cluster connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	REFER to Section 413-01 . **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector.

PINPOINT TEST I: THE INDICATOR DOES NOT OPERATE CORRECTLY — LOW OIL PRESSURE DISPLAY

Test Step	Result / Action to Take
I1 CHECK THE OIL PRESSURE GAUGE OPERATION	
● Key in ON position. ● Observe the oil pressure gauge operation. ● **Does the oil pressure gauge operate correctly?**	**Yes** GO to I2 . **No** REFER to Section 413-01 .
I2 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
● Disconnect all instrument cluster connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all instrument cluster connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Section 413-01 . **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector.

PINPOINT TEST J: THE INDICATOR DOES NOT OPERATE CORRECTLY — CHECK ENGINE TEMPERATURE

Test Step	Result / Action to Take
J1 CHECK THE TEMPERATURE GAUGE OPERATION	
● Key in ON position. ● Observe the temperature gauge operation. ● **Does the temperature gauge operate correctly?**	**Yes** GO to J2 . **No** REFER to Section 413-01 .
J2 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
● Disconnect all instrument cluster connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all instrument cluster connectors and make sure they seat	**Yes** INSTALL a new instrument cluster. REFER to Section 413-01 . **No** The system is operating correctly at this time. Concern may have been caused by a loose or

correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	corroded connector.

PINPOINT TEST K: THE INDICATOR DOES NOT OPERATE CORRECTLY — CHECK TIRE PRESSURE

Test Step	Result / Action to Take
K1 CHECK THE TIRE PRESSURE	
• Check the tire pressure on all tires. Refer to the safety certification sticker located on the driver door jamb for tire inflation pressure specifications. • **Are the tire inflation pressures correct?**	**Yes** GO to K2 . **No** INFLATE the tire(s) to the correct tire inflation pressure specification listed on the safety certification sticker. TEST the system for normal operation.
K2 RETRIEVE THE RECORDED DTCS FROM BOTH THE CONTINUOUS AND ON-DEMAND SELF-TESTS — LOW TIRE PRESSURE MODULE	
• Key in OFF position. • Connect the diagnostic tool. • Key in ON position. • Use the recorded low tire pressure module DTCs from the continuous and on-demand self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 419-10 . **No** GO to K3 .
K3 CHECK THE TIRE PRESSURE WARNING MESSAGE OPERATION	
• Enter the following diagnostic mode on the diagnostic tool: Low Tire Pressure Module Active Command. • Trigger the low tire pressure active command. • **Does the CHECK TIRES warning message display in the message center?**	**Yes** GO to K5 . **No** GO to K4 .
K4 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
• Disconnect all instrument cluster connectors. • Check for: ◦ corrosion ◦ pushed-out pins • Connect all instrument cluster connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Section 413-01 . **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector.
K5 CHECK FOR CORRECT LOW TIRE PRESSURE MODULE OPERATION	
• Disconnect the low tire pressure module connector. • Check for: ◦ corrosion ◦ pushed-out pins	**Yes** INSTALL a new low tire pressure module. REFER to Section 413-09 . **No**

• Connect the low tire pressure module connector and make sure it seats correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector.

PINPOINT TEST L: THE INDICATOR DOES NOT OPERATE CORRECTLY—POWER LIFTGATE

Test Step	Result / Action to Take
L1 RETRIEVE THE RECORDED DTCS FROM BOTH THE CONTINUOUS AND ON-DEMAND SELF-TESTS — POWER LIFTGATE MODULE	
• Key in OFF position. • Connect the diagnostic tool. • Key in ON position. • Use the recorded power liftgate module DTCs from the continuous and on-demand self-test. • **Are any DTCs recorded?**	**Yes** REFER to Section 419-10 . **No** GO to L2 .
L2 CHECK THE POWER LIFTGATE WARNING MESSAGE OPERATION	
• Enter the following diagnostic mode on the diagnostic tool: Power Liftgate Module PID Access. • Monitor the power liftgate open or closed status PID. • **Does the actual position of the liftgate agree with the PID?**	**Yes** GO to L3 . **No** REFER to Section 501-03 .
L3 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
• Disconnect all instrument cluster connectors. • Check for: ◦ corrosion ◦ pushed-out pins • Connect all instrument cluster connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Section 413-01 . **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST M: THE INDICATOR DOES NOT OPERATE CORRECTLY—POWER RUNNING BOARDS

Test Step	Result / Action to Take
M1 RETRIEVE THE RECORDED DTCS FROM BOTH THE CONTINUOUS AND ON-DEMAND SELF-TESTS — POWER LIFTGATE MODULE	
• Key in OFF position. • Connect the diagnostic tool. • Key in ON position. • Use the recorded power liftgate module	**Yes** REFER to Section 419-10 . **No**

DTCs from the continuous and on-demand self-test. ● **Are any DTCs recorded?**	GO to M2 .
M2 CHECK THE POWER RUNNING BOARDS WARNING MESSAGE OPERATION ● Enter the following diagnostic mode on the diagnostic tool: Power Liftgate Module PID Access. ● Monitor the power running board(s) in or out status PID. ● **Does the actual position of the power running board(s) agree with the PID?**	**Yes** GO to M3 . **No** REFER to Section 501-03 .
M3 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION ● Disconnect all instrument cluster connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all instrument cluster connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Section 413-01 . **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST N: THE INDICATOR DOES NOT OPERATE CORRECTLY—BACKUP AID

Test Step	Result / Action to Take
N1 RETRIEVE THE RECORDED DTCS FROM BOTH THE CONTINUOUS AND ON-DEMAND SELF-TESTS — PARKING AID MODULE ● Key in OFF position. ● Connect the diagnostic tool. ● Key in ON position. ● Use the recorded parking aid module DTCs from the continuous and on-demand self-test. ● **Are any DTCs recorded?**	**Yes** REFER to Section 419-10 . **No** GO to N2 .
N2 CHECK THE BACKUP AID WARNING MESSAGE OPERATION ● Enter the following diagnostic mode on the diagnostic tool: Parking Aid Module PID Access. ● Monitor the parking aid module PRNDL range status PID. ● **Does the actual position of the PRNDL range agree with the PID?**	**Yes** GO to N3 . **No** REFER to Section 413-13 .
N3 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION ● Disconnect all instrument cluster connectors. ● Check for: ● corrosion ● pushed-out pins	**Yes** INSTALL a new instrument cluster. REFER to Section 413-01 . **No**

• Connect all instrument cluster connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Vehicle Demagnetizing

CAUTION: During demagnetizing, the demagnetizer coil will be pulled toward the vehicle. Place a cloth over the vehicle's roof to protect the vehicle's surface if contact occurs. Make sure the cloth covers the front third and the entire width of the roof.

NOTE: The demagnetizing process requires the use of a demagnetizing coil commonly used by television service technicians to demagnetize television tubes.

NOTE: To demagnetize, use a constant circular motion over the vehicle's roof. Do not turn off the demagnetizer while sweeping the vehicle's roof to prevent remagnetizing ferrous materials contained in the vehicle.

NOTE: During the demagnetizing process, make sure the phenolic surface of the tool (the side opposite the handle) is closest to the vehicle's surface.

1. Demagnetize the front third of the vehicle's roof.
    1. Turn on the demagnetizer at least 1 meter (3 ft) away from the vehicle.
    2. Holding the demagnetizer no more than 2.5 cm (1 in) from the roof and starting on the passenger side, demagnetize the front third of the roof closest to the windshield using a constant circular motion. Keep the circle's radius within 30 cm (12 in) while sweeping across the entire surface of the roof closest to the windshield. Continue the circular motion four times.
    3. After the fourth pass and without stopping, move the demagnetizer at least 1 meter (3 ft) away from the vehicle.
    4. Turn the demagnetizer off.

2. **NOTE:** The demagnetizer must be located over the outside of the windshield no greater than 2.5 cm (1 in).

   Demagnetize the inside rear view mirror mounting pad.
    1. Turn on the demagnetizer at least 1 meter (3 ft) away from the vehicle.
    2. Using a circular motion, pass the demagnetizer over the outside of the windshield near the inside rear view mirror mounting pad. Without stopping, move the demagnetizer at least 1 meter (3 ft) away from the vehicle.
    3. Turn the demagnetizer off.

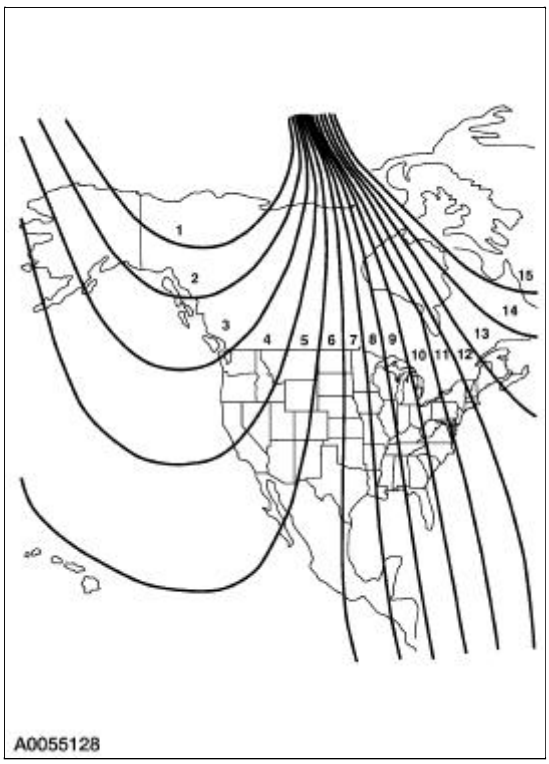
3. Carry out the Compass Zone Adjustment procedure. Refer to Compass Zone Adjustment—With Message Center or Compass Zone Adjustment—Without Message Center in this section.

4. Carry out the Calibration Adjustment procedure. Refer to Compass Calibration—With Message Center or Compass Calibration—Without Message Center in this section.

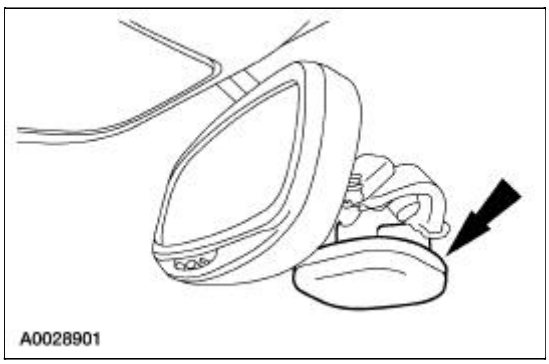
Compass Zone Adjustment —With Message Center

1. **NOTE:** The compass zone setting is preset from the factory to Zone 8.

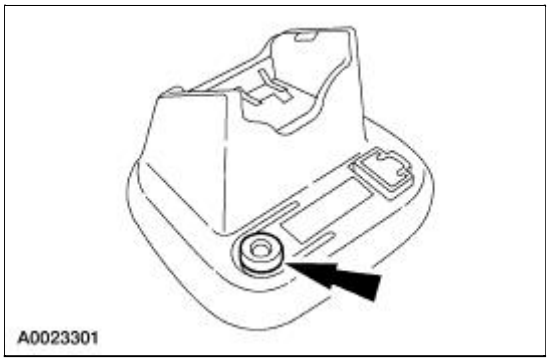
   Determine which magnetic zone you are in for your geographic location.



2. Start the engine.
3. Press the message center switch INFO button until the compass information is displayed.
4. Locate the compass module at the base of the mirror.



5. Press and hold the reset button on the LH top of the compass sensor module until RESET FOr ZONE appears in the message center display.



6. Press the message center RESET button until SETUP ZONE XX is displayed in the message center display.

7. **NOTE:** To exit the compass zone adjustment mode before carrying out a compass zone adjustment, press the INFO button.

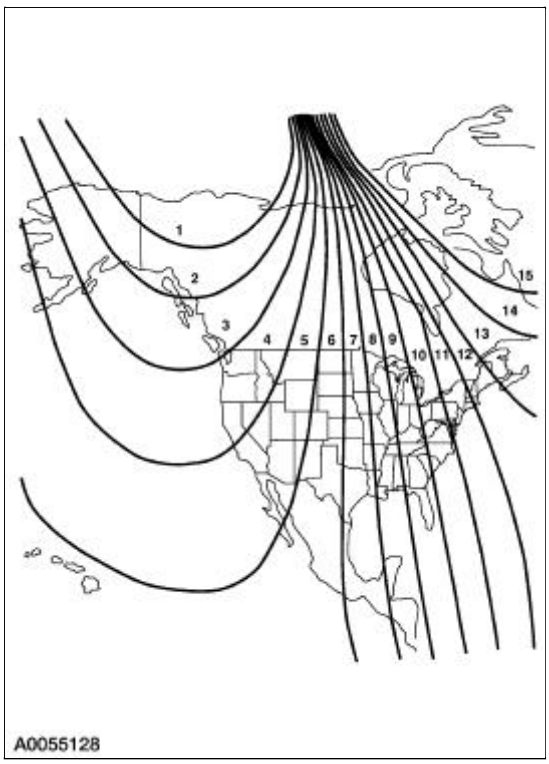
   Press the SETUP button repeatedly until the correct zone setting for your geographic location is displayed.

8. Press the RESET button to exit the zone setting mode and lock you individual zone.

Compass Zone Adjustment —Without Message Center

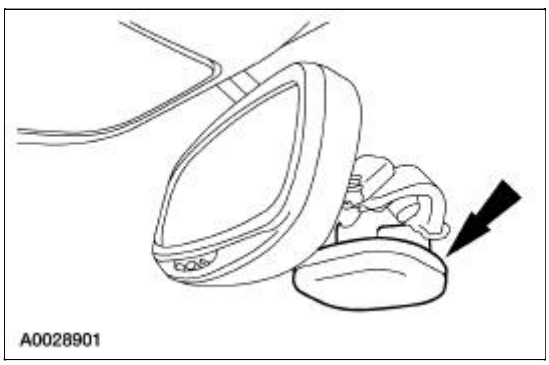
1. **NOTE:** The compass zone setting is preset from the factory to Zone 8.

   Determine which magnetic zone you are in for your geographic location.

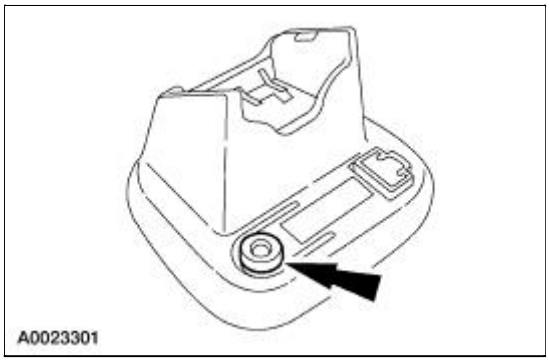


2. Turn the ignition key to the ON position.

3. Locate the compass module at the base of the mirror.



4. Press and hold the reset button on the LH top of the compass sensor module. Press and hold until ZONE and the current zone setting (1-15) appear in the instrument cluster display, and release.



5. Press the reset button repeatedly to cycle through the possible zone settings until the setting for your geographic location is displayed.

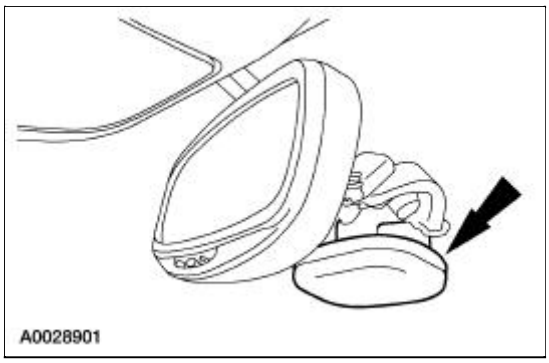
6. Release the button to exit the zone setting mode. After approximately five seconds the display will report the direction and the zone will be set.

Compass Calibration —With Message Center

1. **NOTE:** For optimum calibration, drive to an open, level location away from large metallic objects or structures. Switch off all non-essential electrical accessories (rear window defrost, heater A/C, map lamps, wiper, etc.) and make sure all the doors are closed.

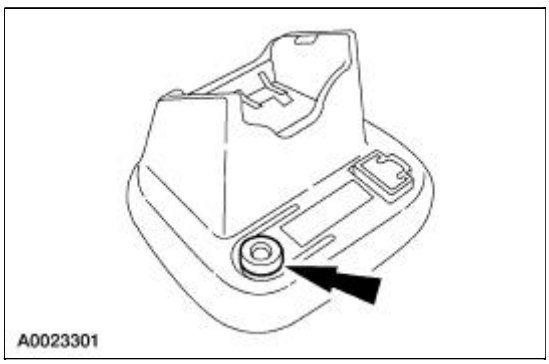
   Start the vehicle.

2. Locate the compass module at the base of the mirror.



3. **NOTE:** To exit CAL mode before carrying out a compass adjustment, turn thw ignition switch to the OFF position.

   Press the RESET button located on top LH side of the compass module until ZONE appears. Continue to hold the button down until CIRCLE SLOWLY TO CAL is displayed in the message center display.



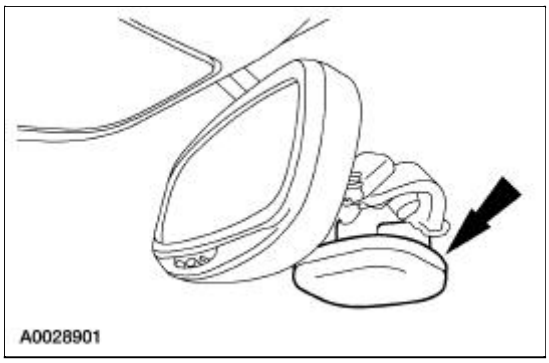
4. Slowly drive the vehicle in a circle at no more than five times at no more than 5 km/h (3 mph) until CIRCLE SLOWLY TO CAL changes to CALIBRATION COMPLETED in the message center.

Compass Calibration —Without Message Center

1. **NOTE:** For optimum calibration, drive to an open, level location away from large metallic objects or structures. Switch off all non-essential electrical accessories (rear window defrost, heater A/C, map lamps, wiper, etc.) and make sure all the doors are closed.

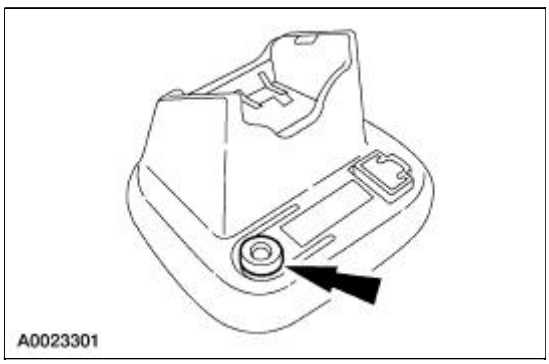
   Start the vehicle.

2. Locate the compass module at the base of the mirror.



3. **NOTE:** To exit CAL mode before carrying out a compass adjustment, turn thw ignition switch to the OFF position.

   Press the RESET button located on top LH side of the compass module until ZONE appears. Continue to hold the button down until CAL is displayed in the instrument cluster compass display and release the button.



4. Slowly drive the vehicle in a circle at no more than 5 km/h (3 mph) until CAL turns off (approximately four to five circles).

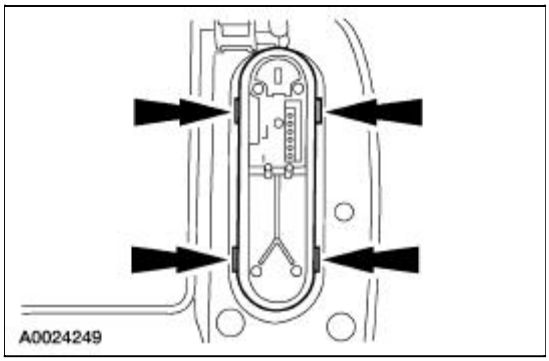
Message Center Switch

Removal and Installation

1. Remove the instrument cluster center finish panel. For additional information refer to Section 501-12 .

2. **NOTE:** Navigator shown, Expedition similar.

   Disconnect the message center switch electrical connector.
   Depress the tabs and remove the message center switch.



3. To install, reverse the removal procedure.

Warning Devices

The warning device system consists of the following:

- safety belt warning lamp switch
- door ajar switch
- liftgate ajar switch
- instrument cluster
- key-in-ignition warning switch
- headlamp on warning
- low washer fluid warning
- tire pressure monitor (TPM)
- low oil pressure
- backup aid
- air suspension
- advance traction control

Warning Devices

Refer to Wiring Diagrams Cell 21 for schematic and connector information.

Refer to Wiring Diagrams Cell 59 for schematic and connector information.

Refer to Wiring Diagrams Cell 60 for schematic and connector information.

Refer to Wiring Diagrams Cell 66 for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418–F224 New Generation STAR (NGS) Tester 418-F052 or equivalent diagnostic tool

Principles of Operation

Safety Belt Warning Chime

The safety belt warning chime warns that the safety belt is not fastened. The safety belt warning chime will sound when the driver safety belt is not fastened and the ignition switch is turned to RUN or START.

The safety belt warning chime will stop sounding when:

- the safety belt is fastened.
- the ignition switch is switched to the OFF/LOCK or ACC position.
- the chime has sounded for six seconds.

The safety belt warning chime inputs are:

- ignition switch RUN/START position
- ignition switch RUN/ACC position
- driver safety belt switch
- restraint control module

Output is the instrument cluster chime.

Belt Minder

The belt minder feature is configurable. For additional information, refer to Section 418-01 . To configure without using a diagnostic tool, refer to Belt Minder Deactivating/Activating in this section.

The belt minder feature supplements the current safety belt warning function. The belt minder feature is enabled after the current safety belt warning is complete. The belt minder reminds the driver that their safety belt is unbuckled by intermittently sounding a chime and illuminating the safety belt warning lamp in the instrument cluster once the vehicle speed has exceeded three mph. While activated, the belt minder alternates the chime and indicator from ON for 6 seconds to OFF for 30 seconds.

The belt minder reminder stops when:

- the driver safety belt is buckled.
- the ignition is turned to OFF or ACC.
- five minutes have elapsed since the belt minder has started.

Door Ajar Warning Chime

The door ajar warning chime warns that a door is ajar. The door ajar warning chime is a single chime with a one-second duration. The door ajar chime will sound when the driver or passenger door, liftgate or liftgate glass becomes ajar while the ignition switch is in the RUN position.

The door ajar warning chime inputs are:

- ignition switch RUN position
- door ajar switches
- liftgate/liftgate glass ajar switches

The output is the instrument cluster chime.

Key-In-Ignition Warning Chime

The key-in-ignition chime warns that the key is in the ignition when the driver door is ajar. The key-in-ignition warning chime will sound when all the following conditions are met:

- The driver door is ajar.
- The key is in the ignition.
- The ignition switch is in the OFF/LOCK or ACC position.

The key-in-ignition warning chime will stop sounding when:

- The driver door is closed.
- The key is removed from the ignition.
- The ignition switch is switched to the RUN position.

The key-in-ignition warning chime inputs are:

- ignition switch RUN/START position
- ignition switch RUN/ACC position
- key-in-ignition switch
- LH door ajar switch

Output is the instrument cluster chime.

Headlamp On Warning Chime

The headlamp on warning chime warns that the headlamps are on while the driver door is ajar. The headlamp on warning chime will sound when all the following conditions are met:

- The driver door is ajar.
- The headlamp switch is in the PARK or HEAD position.
- The ignition switch is in the OFF/LOCK position.
- The key is out of the ignition switch.

The headlamp on warning chime will stop sounding when any one of the conditions above are removed.

The headlamp on warning chime inputs are:

- ignition switch not indicating OFF
- headlamp switch is OFF
- driver door ajar switch is closed
- key-in-ignition switch is closed

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Key-in-ignition warning switch • Door open warning lamp switch • Safety belt warning indicator switch • Headlamp switch	• Central junction box (CJB) fuses: ▪ 1 (10A) ▪ 15 (5A) ▪ 21 (15A) • Damaged wiring harness • Loose or corroded connections • Instrument cluster

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

4. If the cause is not visually evident,, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
    - check that the program card is correctly installed.
    - check the connections to the vehicle.
    - check the ignition switch position.

5. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool operating manual.

6. Carry out the DATA LINK DIAGNOSTICS TEST. If the diagnostic tool responds with:
    - CKT914, CKT915 or CKT693 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
    - NO RESP/NOT EQUIP for INSTRUMENT CLUSTER, go to Section 413-01 .
    - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs, and carry out the self-test diagnostics for the instrument cluster.

7. If the DTCs retrieved are related to the concern, go to the Instrument Cluster Diagnostic Trouble Code (DTC) Index to continue diagnostics.

8. If no DTCs related to the concern are retrieved, proceed to the Symptom Chart.

Instrument Cluster Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1352	Ignition Key-In Circuit Failure	Instrument Cluster	Go To Pinpoint Test B .
—	All Other DTCs	Instrument Cluster	REFER to Section 419-10 .

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• No communication with the instrument cluster module	• CJB fuses: ■ 1 (10A). ■ 15 (5A). ■ 21 (15A). • Circuitry. • Instrument cluster.	• REFER to Section 413-01 .
• All chimes are inoperative	• Instrument cluster.	• REFER to Section 413-01 .
• The safety belt warning chime is inoperative	• Circuitry. • Safety belt switch. • Instrument cluster.	• Go To Pinpoint Test A .
• The belt minder feature is not operating correctly	• Circuitry. • Safety belt	• Go To Pinpoint Test

	switch. ● Instrument cluster.	A .
● A chime is inoperative — key in ignition (with door ajar)	● Circuitry. ● Headlamp switch. ● Instrument cluster.	● Go To Pinpoint Test B .
● A chime is inoperative—head/parking lamps ON (with door ajar)	● Circuitry. ● Headlamp switch. ● Instrument cluster.	● Go To Pinpoint Test C .
● The chime sounds when the driver door is ajar (no key in the ignition and headlights off)	● Circuitry. ● Key-in-ignition switch. ● Instrument cluster.	● Go To Pinpoint Test D .
● A chime does not operate correctly — the air bag warning tone	● Instrument cluster. ● Circuitry.	● Go To Pinpoint Test D .

Pinpoint Tests

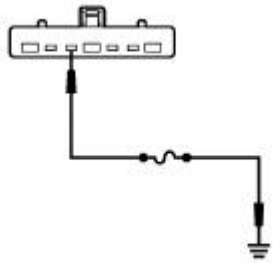
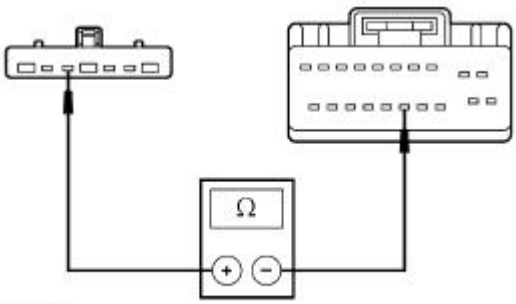
PINPOINT TEST A: THE SAFETY BELT WARNING CHIME IS INOPERATIVE

Test Step	Result / Action to Take
A1 CHECK THE CHIME	
NOTE: Verify if the belt minder is in the deactivated or activated mode. ● Connect the diagnostic tool. ● Key in ON position. ● In the active command mode select Warning Lamps and Chime. ● Request chime ON. ● **Did the chime sound?**	**Yes** GO to A2 . **No** GO to A3 .
A2 CHECK THE DRIVER SAFETY BELT SWITCH	
● Key in OFF position. ● Make sure the safety belt is unlatched. ● Key in ON position. ● **Does the safety belt warning lamp illuminate?**	**Yes** GO to A3 . **No** DIAGNOSE safety belt warning indicator. REFER to Section 413-01 .
A3 VERIFY THE SYMPTOM	
● Key in OFF position. ● Key in ON position. ● **Is the symptom still present?**	**Yes** GO to A4 . **No**

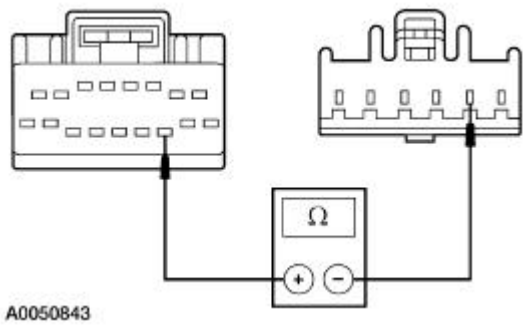
	The system is working correctly.
A4 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
• Disconnect all instrument cluster connectors. • Check for: • corrosion • pushed-out pins • Connect all instrument cluster connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Section 413-01 . TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST B: A CHIME IS INOPERATIVE—KEY IN IGNITION (WITH DOOR AJAR)

Test Step	Result / Action to Take
B1 CHECK FOR FAULTY INSTRUMENT CLUSTER CHIME FUNCTION	
• Key in ON position. • Connect the diagnostic tool. • Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster ACM. • In the Active Command Mode select Warning Lamps and Chime. • Select Chime ON. • **Did the chime sound?**	**Yes** GO to B2 . **No** GO to B6 .
B2 MONITOR INSTRUMENT CLUSTER PID IGN_KEY	
• Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster PID. • Monitor the instrument cluster PID IGN_KEY while inserting and removing the key from the ignition switch. • **Does the instrument cluster PID IGN_KEY values agree with the key positions?**	**Yes** GO to B3 . **No** GO to B4 .
B3 CHECK THE DRIVER DOOR AJAR PID	
• Key in ON position. • Monitor the instrument cluster PID D_DR_SW while opening and closing the driver front door. • **Does the PID agree with the door position?**	**Yes** GO to B6 . **No** DIAGNOSE the door ajar switches. REFER to Section 417-02 .
B4 CHECK FOR A FAULTY KEY-IN-IGNITION SWITCH	
• Disconnect: Ignition Switch C250. • While monitoring instrument cluster PID IGN_KEY, connect a fused (10A) jumper from ignition switch C250 pin 5, circuit 158 (BK/PK) harness side to ground.	**Yes** INSTALL a new key-in-ignition switch. TEST the system for normal operation. **No** GO to B5 .

 A0050841 ● **Does PID IGN_KEY read OUT then IN when the circuit was jumpered to ground?**	
B5 CHECK CIRCUIT 158 (BK/PK) FOR AN OPEN	
● Key in OFF position. ● Disconnect: Instrument Cluster C220a. ● Measure the resistance between ignition switch C250 pin 5, circuit 158 (BK/PK) harness side and instrument cluster C220a pin 15, circuit 158 (BK/PK) harness side.  A0050842 ● **Is the resistance less than 5 ohms?**	**Yes** GO to B6 . **No** REPAIR the circuit. TEST the system for normal operation.
B6 VERIFY THE SYMPTOM	
● Key in OFF position. ● Connect: Instrument Cluster 220a. ● Connect: Ignition Switch C250. ● Key in ON position. ● **Is the symptom still present?**	**Yes** GO to B7 . **No** The system is working correctly.
B7 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
● Disconnect all instrument cluster connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all instrument cluster connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Section 413-01 . TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. TEST the system for normal operation.

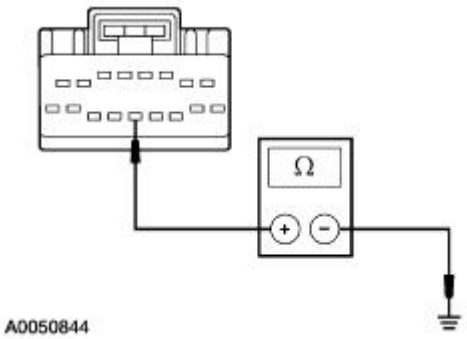
PINPOINT TEST C: A CHIME IS INOPERATIVE-HEAD/PARKING LAMPS ON (WITH DOOR AJAR)

Test Step	Result / Action to Take
C1 CHECK THE CHIME FUNCTION	
• Key in ON position. • Connect the diagnostic tool. • Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster ACM. • In the Active Command Mode, select Warning Lamps and Chime. • Select Chime ON. • **Does the chime sound?**	**Yes** GO to C2 . **No** GO to C6 .
C2 CHECK THE DRIVER DOOR AJAR PID D_DR_SW	
• Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster PID. • Monitor the instrument cluster PID D_DR_SW while opening and closing the driver door. • **Does the instrument cluster PID D_DR_SW agree with the door position?**	**Yes** GO to C3 . **No** REFER to Section 417-02 .
C3 CHECK THE HEADLAMP SWITCH PID PARK_SW	
• Monitor the instrument cluster PID PARK_SW while turning the headlamps on and off. • **Do the instrument cluster PID PARK_SW values agree with the headlamp switch positions?**	**Yes** GO to C4 . **No** GO to C5 .
C4 CHECK THE HEADLAMP SWITCH	
• Carry out the headlamp switch component test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. • **Is the headlamp switch OK?**	**Yes** GO to C5 . **No** INSTALL a new headlamp switch. REFER to Section 417-01 . TEST the system for normal operation.
C5 CHECK CIRCUIT 402 (OG/LG) FOR AN OPEN	
• Key in OFF position. • Disconnect: Headlamp Switch C205b. • Disconnect: Instrument Cluster C220b. • Measure the resistance between headlamp switch C205b pin 2, circuit 402 (OG/LG), harness side and instrument cluster C220b pin 11, circuit 402 (OG/LG), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** GO to C6 . **No** REPAIR the circuit. TEST the system for normal operation.
C6 VERIFY THE SYMPTOM	
• Key in OFF position. • Connect: Instrument Cluster C220b. • Connect: Headlamp Switch C205b. • Key in ON position.	**Yes** GO to C7 . **No**

• **Is the symptom still present?**	The system is working correctly.
C7 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
• Disconnect all instrument cluster connectors. • Check for: • corrosion • pushed-out pins • Connect all instrument cluster connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Section 413-01 . TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST D: A CHIME DOES NOT OPERATE CORRECTLY—AIR BAG WARNING TONE

Test Step	Result / Action to Take
D1 CHECK THE AIR BAG WARNING LAMP OPERATION	
• Key in OFF position. • Key in ON position. • **Does the air bag warning lamp illuminate?**	**Yes** GO to D2 . **No** DIAGNOSE the air bag warning lamp. REFER to Section 413-01 .
D2 CHECK EXTERNAL CHIME REQUEST PID IPCHIME	
• Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster PID. • Monitor the instrument cluster PID IPCHIME. • **Does instrument cluster PID IPCHIME indicate ON?**	**Yes** GO to D3 . **No** GO to D5 .
D3 CHECK FOR A FAULTY RESTRAINT CONTROL MODULE (RCM)	
• Disconnect: RCM C310a. • **Does the instrument cluster PID IPCHIME still read ON?**	**Yes** GO to D4 . **No** DIAGNOSE the RCM module. REFER to Section 501-20B .
D4 CHECK CIRCUIT 1083 (LB/BK) FOR SHORT TO GROUND	
• Disconnect: Instrument Cluster C220b. • Measure the resistance between instrument cluster C220b pin 13, circuit 1083 (LB/BK), harness side and ground.	**Yes** GO to D5 . **No** REPAIR the circuit. TEST the system for normal operation.

 A0050844 ● **Is the resistance greater than 10,000 ohms?**	
D5 VERIFY THE SYMPTOM	**Yes** GO to D6 . **No** The system is working correctly.
● Key in OFF position. ● Connect: Instrument Cluster C220b. ● Connect: RCM C2041. ● Key in ON position. ● **Is the symptom still present?**	
D6 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	**Yes** INSTALL a new instrument cluster. REFER to Section 413-01 . TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. TEST the system for normal operation.
● Disconnect all instrument cluster connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all instrument cluster connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	

Switch —Door Ajar

Removal and Installation

For additional information, refer to Section 501-14 .

Switch —Key In Ignition Warning

Removal and Installation

1. The key-in-ignition switch is part of the ignition switch. Refer to Section 211-05 .

General Specifications

Item	Specification
Azimuth system check object position 1 (P1) and position 5 (P5), distance from sensor	160 cm (63 in)
Azimuth system check object position 2 (P2), 3 (3P3), and position 4 (P4), distance from sensor	5 m (16.4 ft)

Parking Aid —Reverse Sensing System

The parking aid system consists of the following:

- one radar sensor (located in the center of the rear bumper)
- two ultrasonic parking aid sensors (located on the left and right side of the rear bumper)
- parking aid module (PAM) (located behind the LH C-pillar trim panel)
- parking aid speaker—audible warning tone (located in the parking aid module)
- reverse gear select input (to the parking aid module from reverse lamp circuit)

Parking Aid —Reverse Sensing System

Refer to Wiring Diagrams Cell 66 , Warning Chimes for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418–F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

Principles of Operation

NOTE: The liftgate must be closed for correct operation of the parking aid system.

The parking aid system detects objects behind the vehicle when the vehicle is in reverse gear. The parking aid module (PAM) does this by calculating the distance to an object by the use of two ultrasonic sensors and one radar sensor mounted in the rear bumper. The ultrasonic field is emitted in a semicircular area around the rear of the vehicle. The parking aid sensors can detect objects approximately 5 m (16.4 ft) when the vehicle is moving and 3 m (9.8 ft) when the vehicle is stationary to the rear of the vehicle, 50 cm (1.6 ft) to the rear side of the vehicle, and 16 cm (6 in) above ground. A 750 Hz variable warning tone is generated from a parking aid speaker attached to the PAM. The parking aid speaker increases its warning tone rate as the vehicle gets closer to an obstacle. When an object is detected within 45 cm (18 inches) of the sensors, the warning tone becomes continuous.

The parking aid system is enabled when the vehicle ignition is in RUN and reverse (R) gear is selected. The system can be disabled by pressing the menu button on the message center. The parking aid system will indicate it is disabled by illuminating the park assist off located in the message center. The system will always enable when the ignition is transitioned to RUN, or upon entry into REVERSE (R) gear is selected.

The parking aid system will be disabled if a fault is detected in one of the three sensors, the parking aid speaker or the PAM. This will be indicated by the parking assist off in the message center. The PAM is on the International Standards Organization (ISO) 9141 network and can be diagnosed with a diagnostic tool.

Inspection and Verification

1. Verify the customer concern.

2. Visually inspect the following for obvious signs of electrical damage.

Visual Inspection Chart

Electrical
• Central junction box (CJB) fuse 27 (5A) • Circuitry • Parking aid module (PAM) • Relays • Parking aid sensors

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

4. If the cause is not visually evident, connect the diagnostic tool to the data link connector and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

5. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool operating manual.

6. Carry out the DATA LINK DIAGNOSTICS test. If the diagnostic tool responds with:
   - CKT 914, CKT 915 or CKT 70 — ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for PAM, go to Pinpoint Test A.
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the parking aid (PAM) module.

7. If the DTCs retrieved are related to the concern, go to the PAM Diagnostic Trouble Code (DTC) Index.

8. If no DTCs related to the concern are retrieved, proceed to the Symptom Chart.

Park Aid Calibration and Self-Test Diagnostics

9. Connect the diagnostic tool.

10. Clear the DTCs.

11. Transmit the Radar Calibration Command ($8905). This will pre-condition the module for the park aid self-test.

12. RUN the park aid self-test.

13. RETRIEVE the stored DTCs. REFER to DTC index.

14. Diagnose and repair the vehicle. RERUN the Park Aid Calibration and Self-Test if required.

PAM Diagnostic Trouble Code (DTC) Index

PAM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1299	Power supply sensor circuit short to ground	PAM	Go To Pinpoint Test A .
B1342	ECU is defective	PAM	CLEAR the DTCs. REPEAT the PAM self-test. If DTC B1342 is retrieved again, INSTALL a new PAM; REFER to Parking Aid Module . CLEAR all DTCs. REPEAT the self-test.
C1700	Left rear sensor circuit failure	PAM	Go To Pinpoint Test B .
C1701	Left rear sensor fault	PAM	Go To Pinpoint Test B .
C1703	Right rear sensor circuit failure	PAM	Go To Pinpoint Test B .
C1704	Right rear sensor fault	PAM	Go To Pinpoint Test B .
C1983	Radar sensor fault	PAM	Go To Pinpoint Test B .
C1984	Radar sensor circuit failure	PAM	Go To Pinpoint Test B .
U2306	Transmission PRNDL Range Selected Status Invalid	PAM	Refer to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1628	Ignition Voltage Out of Range	PAM	REFER to Section 414-00 .
P0725	Speed input stuck low/high	PAM	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Symptom Chart

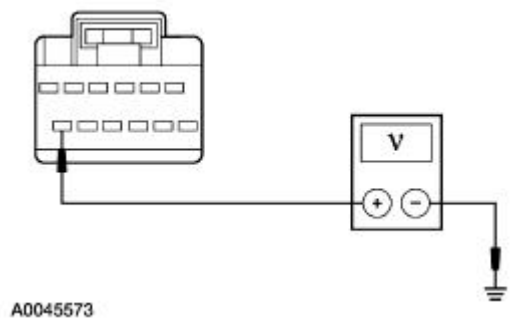
Symptom Chart

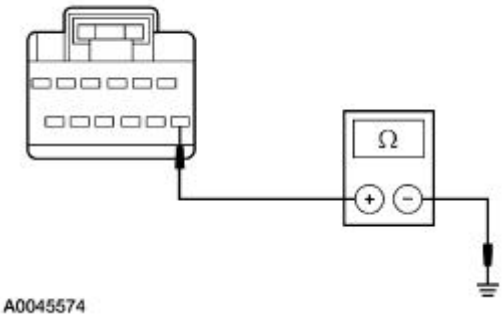
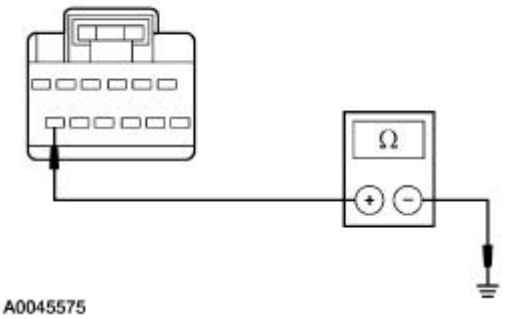
Condition	Possible Sources	Action
● No communication with the parking aid module (PAM)	● Circuitry. ● Fuse junction panel Fuse 27 (5A). ● PAM.	● Go To Pinpoint Test A .
● Parking aid is inoperative	● Circuitry. ● Parking aid sensor. ● Parking aid speaker. ● Parking aid module (PAM).	● Go To Pinpoint Test B .
● Continuous or intermittent tone when no obstacles or fault codes are present (certain obstacles may appear "stealthy" to the system, depending on geometric shape, size and material).	● Dirty or iced over parking aid sensor(s).	● CLEAN the rear bumper and sensors with high-pressure water.

	• Parking aid sensor bezel(s) or parking aid sensor(s) locked into the rear bumper incorrectly. • Parking aid sensors are not aligned correctly.	• INSTALL the parking aid sensor bezel(s) into the rear bumper correctly. INSTALL the parking aid sensor(s) into the parking aid sensor bezel(s) correctly. • CARRY OUT the azimuth check. REFER to Azimuth System Check Minimum Detectable Object Verification in this section.

Pinpoint Tests

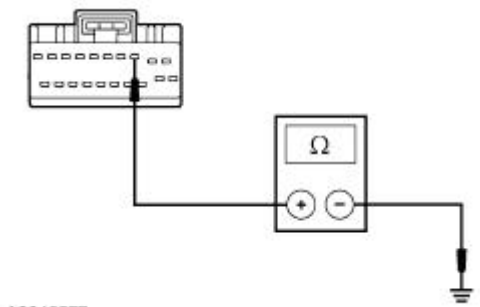
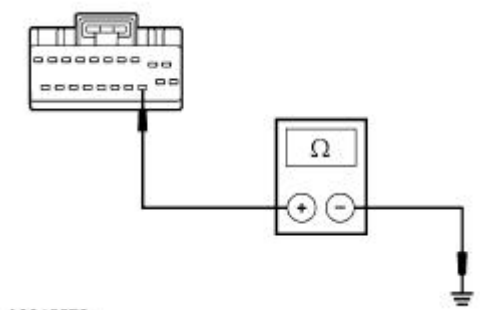
PINPOINT TEST A: NO COMMUNICATION WITH THE PARKING AID MODULE (PAM)

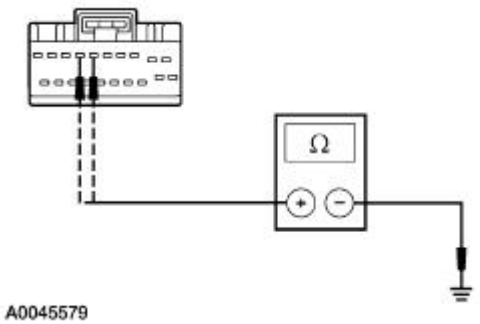
Test Step	Result / Action to Take
A1 USE DIAGNOSTIC TROUBLE CODES (DTCS) FROM PAM MODULE SELF-TEST	
• Use the recorded results from PAM self-test. • **Is DTC B1299 retrieved?**	**Yes** GO to A4 . **No** GO to A2 .
A2 CHECK PAM CIRCUIT 1003 (GY/WH) FOR VOLTAGE	
• Key in OFF position. • Disconnect: PAM C4014b. • Key in ON position. • Measure the voltage between PAM C4014b pin 12, circuit 1003 (GY/WH), harness side and ground.  A0045573 • **Is the voltage greater than 10 volts?**	**Yes** GO to A3 . **No** REPAIR the circuit. TEST the system for normal operation.
A3 CHECK CIRCUIT 875 (BK/LB) FOR AN OPEN	
• Key in OFF position. • Measure the resistance between PAM C4014b pin 7, circuit 875 (BK/LB), harness side and ground.	**Yes** GO to A5 . **No** REPAIR the circuit. TEST the

 A0045574 ● **Is the resistance less than 5 ohms?**	system for normal operation.
A4 CHECK CIRCUIT 1003 (GY/WH)	
● Key in OFF position. ● Disconnect: PAM C4014b. ● Measure the resistance between PAM C4014b pin 12, circuit 1003 (GY/WH), harness side and ground.  A0045575 ● **Is the resistance greater than 10,000 ohms?**	**Yes** GO to A2 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
A5 CHECK FOR CORRECT PARKING AID MODULE OPERATION	
● Disconnect all parking aid module connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all parking aid module connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new parking aid module. REFER to Parking Aid Module in this section. REPEAT the parking aid module self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST B: PARKING AID IS INOPERATIVE

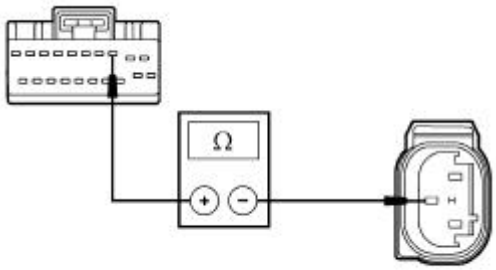
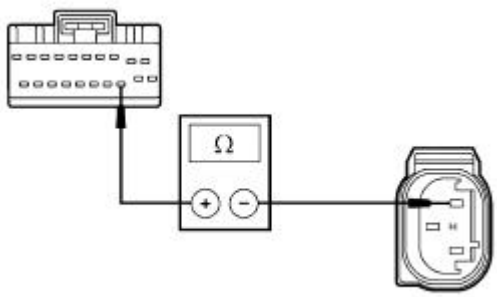
Test Step	Result / Action to Take
B1 USE THE RECORDED DIAGNOSTIC TROUBLE CODES (DTCS) FROM PAM SELF-TEST	
● Use the recorded results from PAM self-test. ● **Are any DTCs recorded?**	**Yes** If DTC C1700 or C1703, GO to B2 . If DTC C1701 or C1704, GO to B8

	If DTC C1983 or C1984, GO to B11 . If DTC C2644, GO to B20 . **No** GO to B23 .
B2 CHECK CIRCUIT 1440 (DG/YE) FOR A SHORT TO GROUND ● Disconnect the parking aid ultrasonic sensor in question. ● Disconnect: PAM C4014a. ● Measure the resistance between PAM C4014a pin 3, circuit 1440 (DG/YE), harness side and ground.  A0045577 ● **Is the resistance greater than 10,000 ohms?**	**Yes** GO to B3 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
B3 CHECK CIRCUIT 1439 (BN/PK) FOR A SHORT TO GROUND ● Measure the resistance between PAM C4014a pin 13, circuit 1439 (BN/PK), harness side and ground.  A0045578 ● **Is the resistance greater than 10,000 ohms?**	**Yes** GO to B4 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
B4 CHECK THE CIRCUIT IN QUESTION FOR SHORT TO GROUND ● Measure the resistance between PAM C4014a pin, harness side and ground; refer to the following chart. **Connector Pin** / **Circuit** C4014a pin 6 / 1441 (WH/LG) C4014a pin 7 / 1444 (DB/YE)	**Yes** GO to B5 . **No** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.

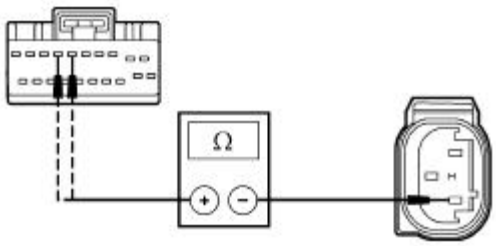
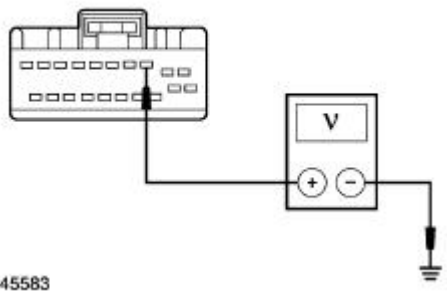
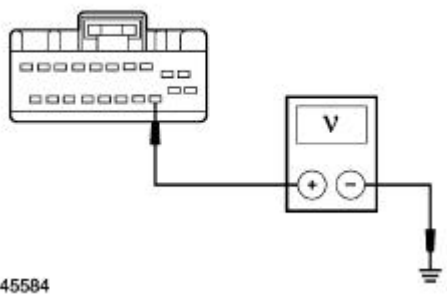


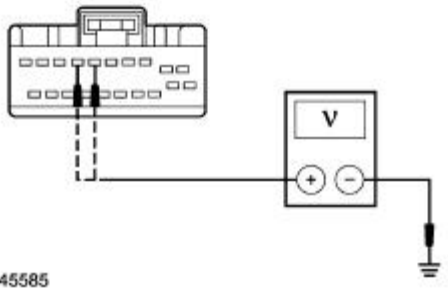
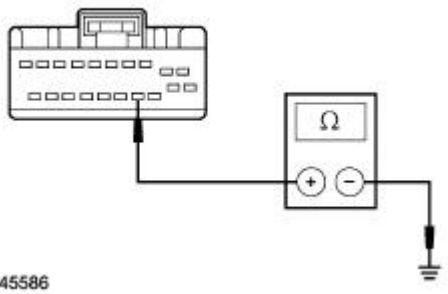
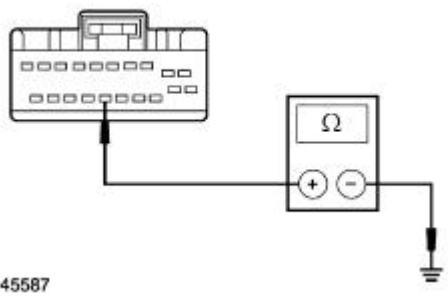
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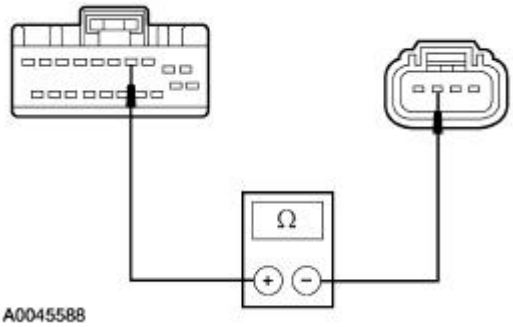
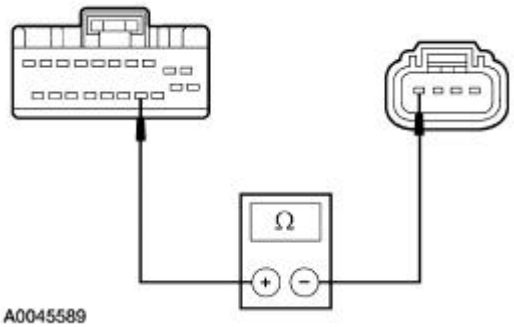
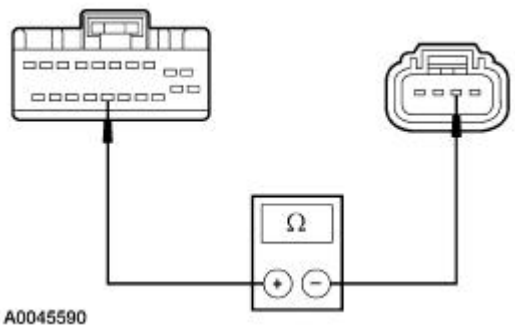
- **Are the resistances greater than 10,000 ohms?**

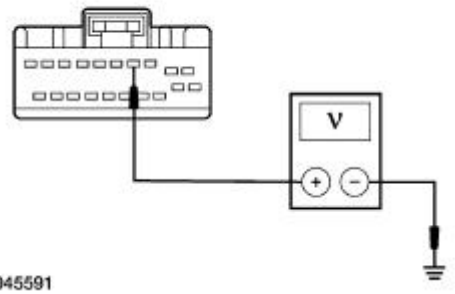
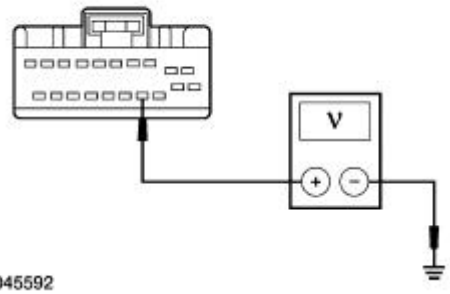
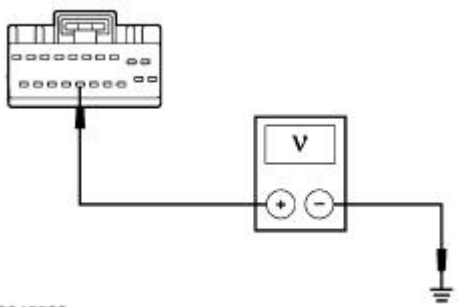
B5 CHECK CIRCUIT 1440 (DG/YE) FOR AN OPEN - Measure the resistance between PAM C4014a pin 3, circuit 1440 (DG/YE), harness side and parking aid sensor pin 2, circuit 1440 (DG/YE), harness side.  A0045580 - **Is the resistance less than 5 ohms?**	**Yes** GO to B6 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
B6 CHECK CIRCUIT 1439 (BN/PK) FOR AN OPEN - Measure the resistance between PAM C4014a pin 13, circuit 1439 (BN/PK), harness side and parking aid sensor pin 3, circuit 1439 (BN/PK), harness side.  A0045581 - **Is the resistance less than 5 ohms?**	**Yes** GO to B7 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
B7 CHECK CIRCUIT IN QUESTION FOR AN OPEN - Measure the resistance between PAM C4014a pin, harness side and parking aid sensor pin, harness side; refer to the following chart.	**Yes** If both parking aid sensors recorded DTCs, GO to B24 . If both parking aid sensors did not record DTCs, INSTALL a new sensor(s) for the one in question. REFER to Parking Aid Sensor in this section. CLEAR the DTCs. REPEAT the self-test.

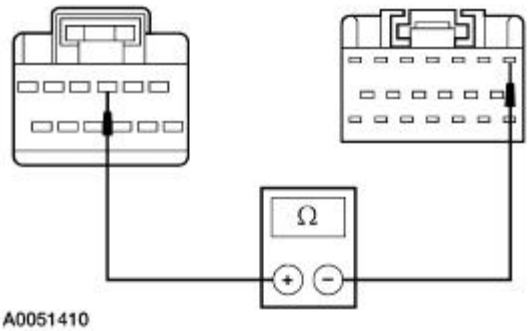
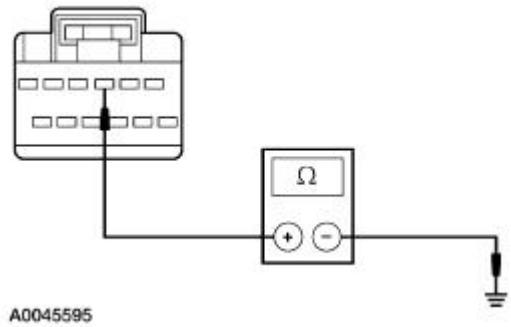
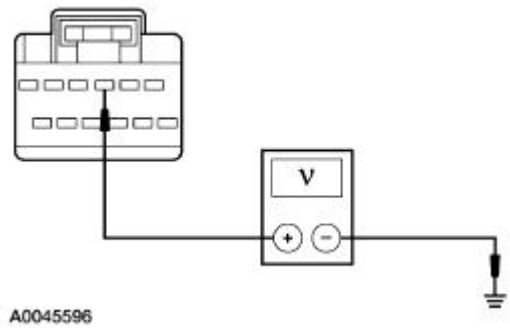
PAM Connector Pin	Parking Aid Sensor Connector Pin	Circuit
C4014a pin 6	C4192 pin 1	1441 (WH/LG)
C4014a pin 7	C4193 pin 1	1444 (DB/YE)

 A0045582 ● **Are the resistances less than 5 ohms?**	**No** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.
B8 CHECK CIRCUIT 1440 (DG/YE) FOR A SHORT TO VOLTAGE	
● Disconnect the parking aid sensor in question. ● Disconnect: PAM C4014a. ● Key in ON position. ● Measure the voltage between PAM C4014a pin 3, circuit 1440 (DG/YE), harness side and ground.  A0045583 ● **Is any voltage indicated?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. **No** GO to B9 .
B9 CHECK CIRCUIT 1439 (BN/PK) FOR A SHORT TO VOLTAGE	
● Measure the voltage between PAM C4014a pin 13, circuit 1439 (BN/PK), harness side and ground.  A0045584 ● **Is any voltage indicated?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. **No** GO to B10 .
B10 CHECK CIRCUIT IN QUESTION FOR SHORT TO VOLTAGE	
● Measure the voltage between PAM C4014a pin, harness side and ground; refer to the following chart. **Connector Pin** / **Circuit** C4014a pin 7 / 1444 (DB/YE)	**Yes** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test. **No**

C4014a pin 6 | 1441 (WH/LG)  A0045585 • **Is any voltage indicated?**	If both parking aid sensors recorded DTCs, GO to B24 . If both parking aid sensors did not record DTCs, INSTALL a new sensor(s) for the one in question. REFER to Parking Aid Sensor in this section. CLEAR the DTCs. REPEAT the self-test.
B11 CHECK CIRCUIT 1959 (RD/WH) FOR A SHORT TO GROUND • Measure the resistance between PAM C4014a pin 14, circuit 1959 (RD/WH), harness side and ground.  A0045586 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to B12 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
B12 CHECK CIRCUIT 1443 (WH/LB) FOR SHORT TO GROUND • Measure the resistance between PAM C4014a pin 16, circuit 1443 (WH/LB), harness side and ground.  A0045587 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to B13 . **No** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.
B13 CHECK CIRCUIT 1960 (PK/YE) FOR AN OPEN • Measure the resistance between PAM C4014a pin 4, circuit 1960 (PK/YE), harness side and parking aid radar sensor C4191 pin 3, circuit 1960 (PK/YE), harness side.	**Yes** GO to B14 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

 A0045588 ● **Is the resistance less than 5 ohms?**	
B14 CHECK CIRCUIT 1959 (RD/WH) FOR AN OPEN ● Measure the resistance between PAM C4014a pin 14, circuit 1959 (RD/WH), harness side and parking aid radar sensor C4191 pin 4, circuit 1959 (RD/WH), harness side.  A0045589 ● **Is the resistance less than 5 ohms?**	**Yes** GO to B15 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
B15 CHECK CIRCUIT IN QUESTION FOR AN OPEN ● Measure the resistance between PAM C4014a pin 16, circuit 1443 (WH/LB), harness side and parking aid radar sensor C4191 pin 2,circuit 1443 (WH/LB), harness side.  A0045590 ● **Is the resistance less than 5 ohms?**	**Yes** GO to B16 . **No** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.
B16 CHECK CIRCUIT 1960 (PK/YE) FOR A SHORT TO VOLTAGE ● Measure the voltage between PAM C4014a pin 4, circuit 1960 (PK/YE), harness side and ground.	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. **No** GO to B17 .

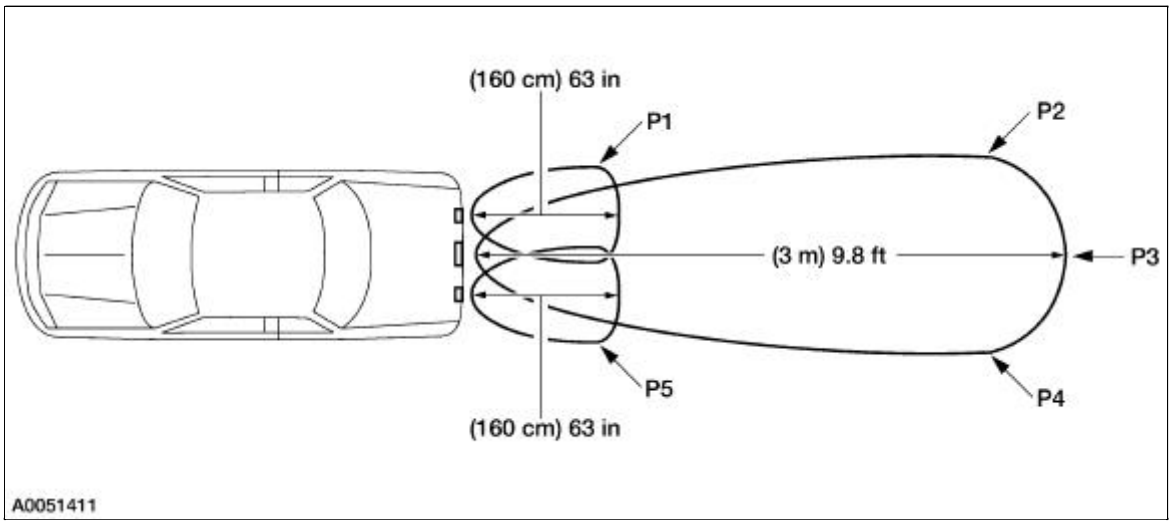
 A0045591 ● **Is any voltage indicated?**	
B17 CHECK CIRCUIT 1959 (RD/WH) FOR A SHORT TO VOLTAGE	
● Measure the voltage between PAM C4014a pin 14, circuit 1959 (RD/WH), harness side and ground.  A0045592 ● **Is any voltage indicated?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. **No** GO to B18 .
B18 CHECK CIRCUIT 1443 (WH/LB) FOR SHORT TO VOLTAGE	
● Measure the voltage between PAM C4014a pin 16, circuit 1443 (WH/LB), harness side and ground.  A0045593 ● **Is any voltage indicated?**	**Yes** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test. **No** GO to B19 .
B19 CHECK THE RADAR SENSOR	
● Install a new radar sensor. Refer to Parking Aid Sensor in this section. ● Restore the system and RUN the PAM self-test. ● **Does the system pass the self test?**	**Yes** The system is operating normally at this time. **No** INSTALL the original radar sensor and GO to B24 .
B20 CHECK CIRCUIT 689 (DB) FOR AN OPEN	
● Disconnect: Radio C290b. ● Disconnect: PAM C4014b. ● Measure the resistance between PAM C4014b pin 3,	**Yes** GO to B21 .

circuit 689 (DB), harness side and radio C290b pin 1, circuit 689 (DB), harness side.  A0051410 • **Is the resistance less than 5 ohms?**	**No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
B21 CHECK CIRCUIT 689 (DB) FOR A SHORT TO GROUND	
• Measure the resistance between PAM C4014b pin 3, circuit 689 (DB), harness side and ground.  A0045595 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to B22 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
B22 CHECK CIRCUIT 689 (DB) FOR A SHORT TO VOLTAGE	
• Measure the voltage between PAM C4014b pin 3, circuit 689 (DB), harness side and ground.  A0045596 • **Is the voltage greater than 10 volts?**	**Yes** REPAIR circuit 689 (DB). CLEAR the DTCs. REPEAT the self-test. **No** GO to B24 .
B23 CHECK PARKING AID SENSORS FOR CORRECT ALIGNMENT	
NOTE: If the vehicle has been in an accident, the PAM sensors may not be aligned correctly. • Check the sensors for correct alignment. Refer to Azimuth System Check and Elevation System Check in this section. • **Are the bumper and parking aid sensors correctly aligned?**	**Yes** GO to B24 . **No** Correctly INSTALL the sensors. REFER to Parking Aid Sensor in this section. If the vehicle has been in an accident, further body work may be necessary to bring the parking aid sensors into

	correct alignment.
B24 CHECK FOR CORRECT PARKING AID MODULE OPERATION	
• Disconnect all parking aid module connectors. • Check for: • corrosion • pushed-out pins • Connect all parking aid module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new parking aid module. REFER to Parking Aid Module in this section. REPEAT the parking aid module self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Azimuth System Check

Minimum Detectable Object Locations



1. **NOTE:** The detectable object used in this system check can be fabricated using a 7.62 cm (3 inches) diameter plastic pipe, 99.06 cm (39 inches) in length (available as PVC pipe, or similar from a hardware or plumbing supply).

   NOTE: The following system check should be carried out with the vehicle on a level surface.

   NOTE: The parking aid module (PAM) system will default to on when the ignition key is cycled from the OFF position to the ON position.

   Turn the ignition to the ON position, engine off.

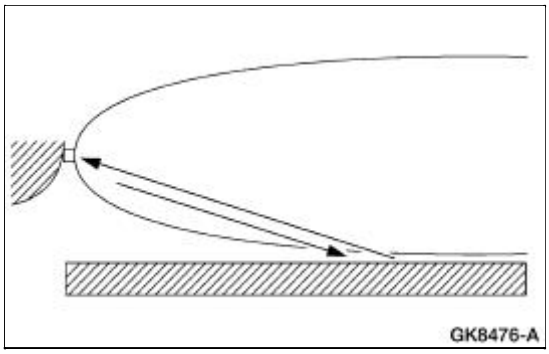
2. Set the parking brake on.

3. Place the gearshift in REVERSE (R).

4. Verify that the PAM detects the detectable object when it is placed within the five specified locations (P1, P2, P3, P4 and P5). These zones are shown ideally and are not absolute. Pipe should be inside of locations.

Elevation System Check

1. Check the parking aid system to make sure that the system **does not** see signals caused by ground reflections.



2. The following system check should be carried out with the vehicle on a 4.57 m (15 feet) wide by 3.05 m (10 feet) deep smooth concrete surface, free of all obstacles. The area should also be free of noise from fans and pneumatic tools.

3. Turn the ignition to the ON position, engine off.

4. Set the parking brake on.

5. Place the gearshift in REVERSE (R).

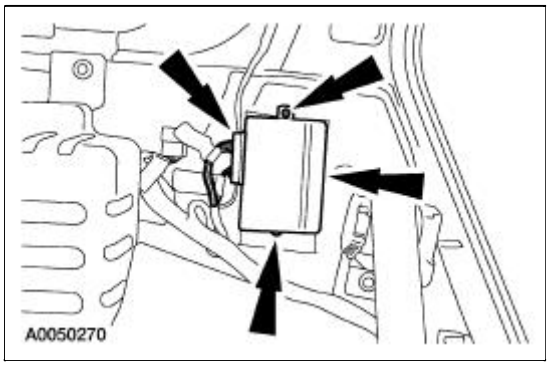
6. **NOTE:** No audible warning tones should be heard. If audible warning tones are heard, check to make sure the bumper is installed correctly and not tilted downward so that the sensor is pointing towards the ground.

   Verify that **no** audible warning tones are heard.

Parking Aid Module

Removal and Installation

1. Remove the LH quarter trim panel. For additional information, refer to Section 501-05 .
2. Remove the parking aid module (PAM).
   - Disconnect the electrical connectors.
   - Remove the screws.



3. To install, reverse the removal procedure.
4. Perform the Park Aid Calibration and Self-Test Diagnostics located in Inspection and Verification.

Parking Aid Sensor

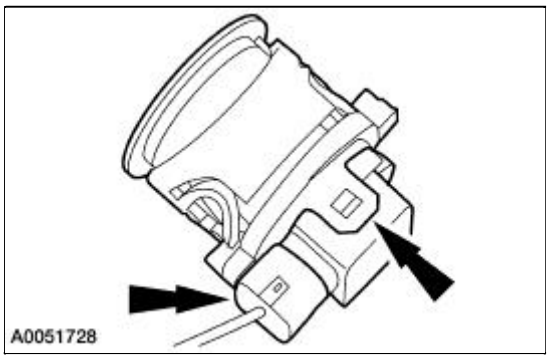
Removal and Installation

All Vehicles

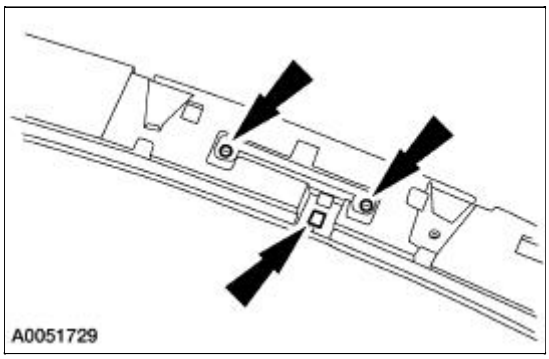
1. Remove the rear bumper cover. For additional information, refer to Section 501-19 .

Navigator, Early Build Expedition

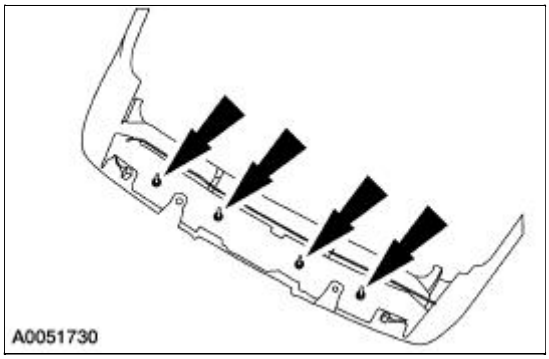
2. Remove the parking aid ultrasonic sensor.
   - Disconnect the electrical connector.
   - Release the locking tabs.



3. Remove the foam absorber from the bumper cover.

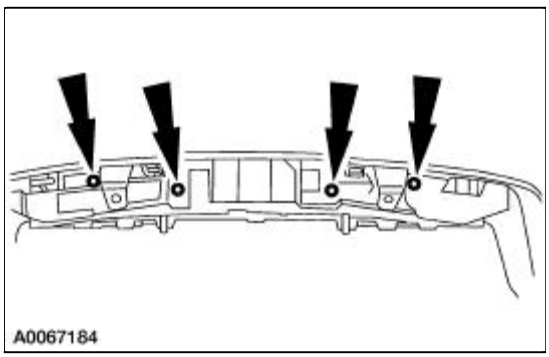


4. Remove the radar sensor.
   - Remove the fasteners.
   - Disconnect the electrical connector.

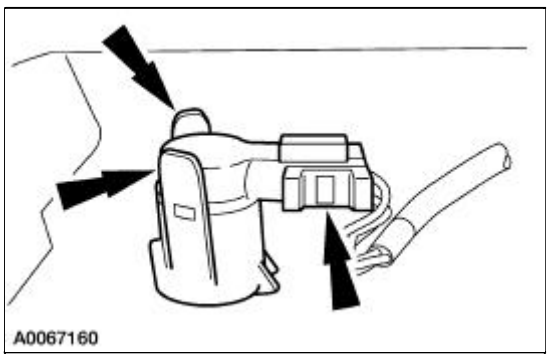


Late Build Expedition

5. Remove the four nuts and the foam absorber from the bumper cover.



6. Remove the sonar sensor.
    - Disconnect the electrical connector.
    - Release the locking tabs.



All vehicles

7. To install, reverse the removal procedure.

8. Perform Park Aid Calibration and Self-Test Diagnostics located in Inspection and Verification in this section.

Charging System

Charging System

The charging system is a negative ground system consisting of the following components:

- generator
- internal voltage regulator
- charging system warning indicator
- voltage gauge
- battery
- circuitry and cables
- powertrain control module

The generator is belt-driven by the engine accessory drive system.

Battery

The battery is a 12 volt direct current (DC) source connected in a negative ground system. The battery case is sealed and includes two vent holes to release gases. The battery has three major functions:

- engine cranking power source
- voltage stabilizer for the electrical system
- temporary power when electrical loads exceed the generator output current

Charging System

Refer to Wiring Diagrams Cell 12 for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST2173-A	SABRE Premium Battery and Electrical System Tester 010-00736 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052 or equivalent diagnostic tool

Principles of Operation

Charging System

After the engine is started, voltage is applied through the I circuit 1931 (BN/PK) from the powertrain control module (PCM) to the generator. This turns the regulator on, allowing current to flow from the battery sense A circuit 35 (OG/LB) to the generator field coil. When the engine is started, the generator begins to generate alternating current (AC) which is internally converted to direct current (DC). This current is then supplied to the vehicle electrical system through the output (B+) terminal of the generator. Once the generator begins generating current, a voltage signal is taken from the generator stator and fed back to the regulator internally. This voltage feedback signal (typically half the battery voltage) is used to turn off the warning indicator.

With the system functioning normally, the generator output current is determined by the voltage of the A circuit 25 (OG/LB) which is compared to a set voltage internal to the regulator. The regulator controls the generator field current to maintain the current generator output.

The set voltage will vary with temperature and is typically higher in cold temperatures and lower in warm temperatures. This allows improved battery recharge in the winter and reduces the chance of overcharging in the summer.

Circuit Description

B+ Output Terminal Circuit 38 (BK/OG)

Generator output voltage is supplied through the battery positive (B+) output terminal on the rear of the generator to the battery and the electrical system.

Circuit 35 (OG/LB)

This is the A-line battery voltage sense circuit and is used to sense battery voltage.

Circuit 1930 (TN/LG)

The PCM determines the optimal voltage setpoint for the charging system and communicates the information to the voltage regulator via the Alternator Load Feed Forward (ALFF) circuit. This is a communication line only and can only be measured with an ohmeter.

Circuit 1931 (BN/PK)

The I-line circuit is used to turn on the voltage regulator. This circuit is powered by the PCM with the engine running. This circuit is also used by the PCM to determine if and when to send a message to the instrument cluster to turn the charging system warning indicator on if there is a fault in the charging system.

Inspection and Verification

WARNING: Batteries normally produce explosive gases. Therefore, do not allow flames, sparks or lighted substances to come near the battery. When charging or working near a battery, always shield your face and protect your eyes. Always provide ventilation. Failure to follow these instructions may result in personal injury.

WARNING: When lifting a plastic-cased battery, excessive pressure on the end walls could cause acid to spew through the vent caps, resulting in personal injury, damage to the vehicle or battery. Lift with a battery carrier or with your hands on opposite corners. Failure to follow these instructions may result in personal injury.

WARNING: Keep batteries out of the reach of children. Batteries contain sulfuric acid. Avoid contact with skin, eyes, or clothing. Also, shield your eyes when working near the battery to protect against possible splashing of the acid solution. In case of acid contact with skin or eyes, flush immediately with water for a minimum of 15 minutes and get prompt medical attention. If acid is swallowed, call a physician immediately. Failure to follow these instructions may result in personal injury.

1. Verify the customer concern by operating the engine to duplicate the concern.

2. Visually inspect for signs of mechanical and electrical damage; refer to the following chart:

Visual Inspection Chart

Mechanical	Electrical
• Battery • Generator drive belt • Generator pulley	• Central junction box (CJB) fuse 9 (10A) • Circuitry • Cables

3. If the inspection reveals obvious concerns that can be readily identified, repair as necessary. Check the generator sense fuse 9 (10A) located in the CJB.

4. Measure the open circuit battery voltage. (Battery is located in the engine compartment.) If the battery voltage is less than 12.0 volts, test and recharge the battery before continuing with diagnosis. Refer to Section 414-01 .

5. Check the operation of the charging system warning indicator lamp (instrument cluster). Normal operation is as follows:
   - With the ignition switch OFF, the charging system warning indicator should be off.
   - With the ignition switch in RUN and the engine off, the charging system warning indicator light should be on.
   - With the engine running, the charging system warning indicator light should be off.

6. Turn off the headlamps and the A/C system. Turn blower to low/off. Check the battery voltage before and after starting the engine to determine if the battery voltage increases. Refer to the Normal Charging System Voltages chart.

Normal Charging System Voltages and Charging System Warning Indicator Operation

Key Position	A-line 35 (OG/LB)	I-line 1931 (BN/PK)	Generator B+ 38 (BK/OG)	Battery	Engine to Battery Ground	Charging System Warning Indicator Operation
Key OFF	12 volts	0 V	12 volts	12 volts	0 volts	Off
RUN — engine OFF	12 volts	0 V	12 volts	12 volts	0 volts	Illuminated
RUN — engine running	13- 15V	8- 12V	13- 15V	13- 15V	0V	Off

7. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located under the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the vehicle selection cannot be entered:
   - check that the diagnostic card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position. If the diagnostic tool still does not allow the vehicle selection to be entered, refer to the diagnostic tool manual.

8. If any PCM DTCs are retrieved, go to the PCM Index below to check if the codes retrieved are related to the charging system and continue diagnosis.

9. If no DTCs related to the charging system are retrieved, go to the Symptom Chart to continue diagnosis.

NOTE: DTC P1246 can be set by the loss of the I-line circuit 1931 (BN/PK). The generator warning indicator will illuminate and the generator will operate in back-up mode (13.5 volts).

Powertrain Control Module Diagnostic Trouble Code (DTC) Index

DTC	Description	Action
P1246	System Voltage	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED)

	Failure	manual.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• Battery is discharged or battery voltage is low	• Circuitry. • High key-off current drain(s). • Battery. • Generator.	• Go To Pinpoint Test A .
• The charging system warning indicator is on with the engine running (the charging system voltage does not increase)	• Generator. • Central junction box (CJB) fuse (10A) • Circuitry.	• Go To Pinpoint Test B .
• The charging system overcharges (battery voltage greater than 15.5 volts)	• Central junction box (CJB) fuse (10A). • Circuitry. • Generator.	• Go To Pinpoint Test C .
• The charging system warning indicator is on with the engine running and the battery increases voltage	• CJB fuse 9 (10A). • Generator. • Instrument cluster. • Powertrain Control Module (PCM). • Circuitry.	• Go To Pinpoint Test D .
• The charging system warning indicator is off with the ignition switch in the RUN position and the engine off	• Generator connector unplugged (C102a). • Battery. • Circuitry. • Instrument cluster. • Powertrain Control Module (PCM).	• Go To Pinpoint Test E .
• The charging system warning indicator flickers or is intermittent	• CJB fuse 9 (10A). • Generator connector unplugged (C102a). • Circuitry. • Generator.	• Go To Pinpoint Test F .
• The generator is noisy	• Loose bolts/brackets. • Drive belt. • Generator/pulley.	• Go To Pinpoint Test G .
• Radio interference	• Generator. • Wiring/routing. • In-vehicle entertainment system.	• Go To Pinpoint Test H .

Pinpoint Tests

CAUTION: Do not make jumper connections except as directed. Incorrect connections may damage the voltage regulator test terminals, fuses or fuse links.

CAUTION: Do not allow any metal object to come in contact with the generator housing

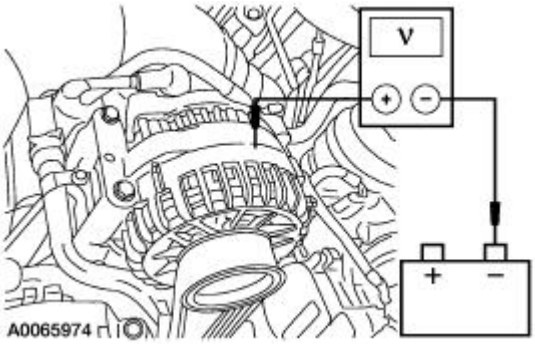
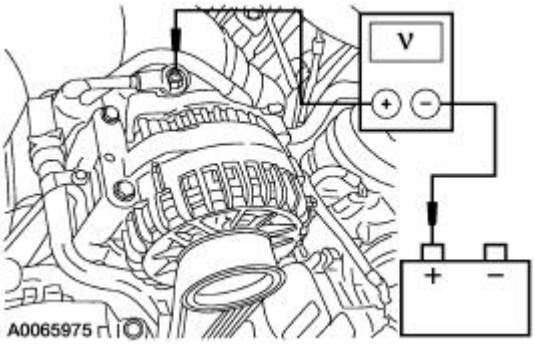
and internal diode cooling fins.

NOTE: While carrying out any pinpoint test, disregard any DTCs set while following any specific pinpoint test. After the completion of any test, be sure to clear all codes in the PCM.

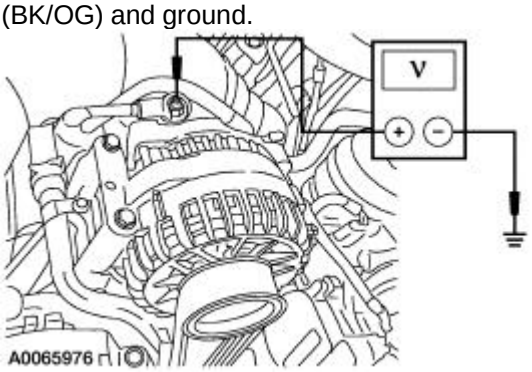
NOTE: All voltage measurements are referenced to the negative (-) battery post unless otherwise specified.

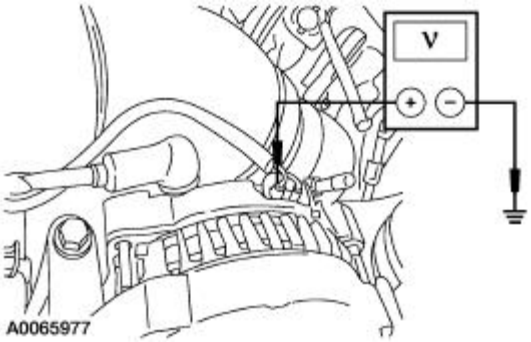
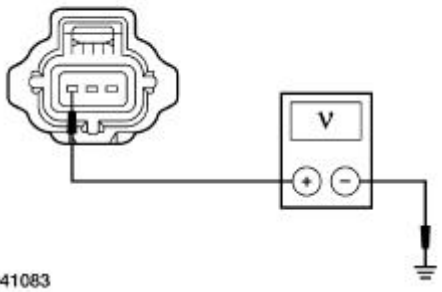
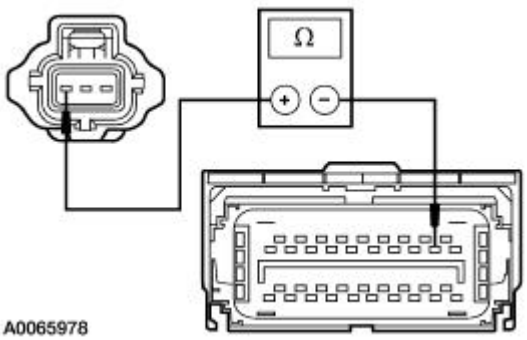
PINPOINT TEST A: BATTERY IS DISCHARGED OR BATTERY VOLTAGE IS LOW

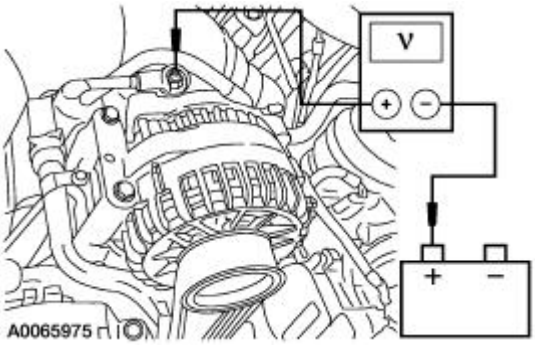
Test Step	Result / Action to Take
A1 CHECK BATTERY CONDITION	
• Carry out the Battery — Condition Test to determine if the battery can hold a charge and is OK for use. Refer to Section 414-01 . • **Is the battery OK?**	**Yes** GO to A2 . **No** INSTALL a new battery. REFER to Section 414-01 . TEST the system for normal operation.
A2 CHECK THE GENERATOR OUTPUT	
• Carry out the Generator On-Vehicle Load Test and No Load Test. Refer to Component Tests in this section. • **Is the generator OK?**	**Yes** GO to A3 . **No** Go To Pinpoint Test B
A3 CHECK FOR CURRENT DRAINS	
• Carry out the Battery — Drain Testing. Refer to Component Tests in this section. • **Are there any excessive current drains?**	**Yes** REPAIR as necessary. TEST the system for normal operation. **No** GO to A4 .
A4 CHECK VEHICLE GROUNDS	
• Key in START position. • Measure the voltage drop between the generator housing and the negative battery terminal.	**Yes** GO to A5 . **No** CHECK the engine ground and the battery for corrosion. REPAIR as necessary.

 ● **Is the voltage drop less than 0.1 volt?**	
A5 CHECK VOLTAGE DROP IN B+ CIRCUIT 38 (BK/OG)	**Yes** Go To Pinpoint Test B . **No** REPAIR the high resistance in the B+ circuit 38 (BK/OG). TEST the system for normal operation.
● Turn the headlamps on high beam, the heated rear window ON (if applicable) and the blower motor to HIGH. With the engine at approximately 2000 rpm, measure the voltage drop between the generator C102b, circuit 38 (BK/OG) and the positive battery terminal.  ● **Is the voltage drop less than 0.5 volt?**	

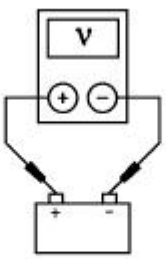
PINPOINT TEST B: THE CHARGING SYSTEM WARNING INDICATOR IS ON WITH THE ENGINE RUNNING (THE CHARGING SYSTEM VOLTAGE DOES NOT INCREASE)

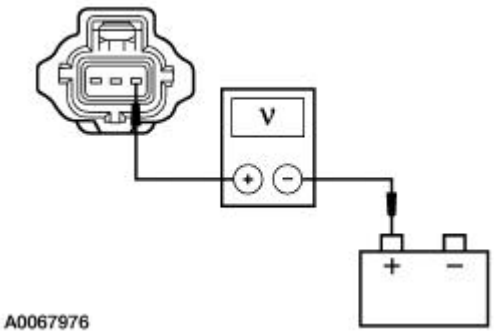
Test Step	Result / Action to Take
B1 CHECK THE GENERATOR B+ CIRCUIT 38 (BK/OG)	**Yes** GO to B2 . **No** REPAIR the circuit. TEST the system for normal operation.
● Key in OFF position. ● Measure the voltage between the generator C102b, circuit 38 (BK/OG) and ground.  ● **Is the voltage equal to battery positive voltage?**	
B2 CHECK THE GENERATOR A CIRCUIT 35 (OG/LB)	**Yes**

• Measure the voltage between the generator C102a pin 3, A circuit 35 (OG/LB), harness side and ground.  A0065977 • **Is the voltage equal to battery positive voltage?**	GO to B3 . **No** REPAIR the circuit. TEST the system for normal operation.
B3 CHECK CIRCUIT 1931 (BN/PK) FOR VOLTAGE	
• Disconnect: Generator C102a. • Key in START position. • Measure the voltage between the generator C102a pin 1, circuit 1931 (BN/PK), harness side and ground.  A0041083 • **Is the voltage 8-12 volts?**	**Yes** GO to B5 . **No** GO to B4 .
B4 CHECK CIRCUIT 1931 (BK/PK) FOR INTEGRITY	
• Key in OFF position. • Disconnect: PCM C175b. • Measure the resistance between the generator C102a pin 1, circuit 1931 (BN/PK) harness side and the PCM C175b pin 14, circuit 1931 (BN/PK) harness side; and between the generator C102a pin 1, circuit 1931 (BN/PK) harness side and ground.  A0065978 • **Is the resistance less than 5 ohms between the generator and the PCM; and greater than 10,000 ohms between the generator and ground?**	**Yes** INSTALL a new PCM. REFER to Section 303-14 . **No** REPAIR the circuit. TEST the system for normal operation.
B5 CHECK THE VOLTAGE DROP IN B+ CIRCUIT 38 (BK/OG)	
• Key in OFF position. • Connect: Generator C102a. • Key in START position. • Turn the headlamps on high beam, the heated rear window ON (if applicable) and the blower motor to HIGH. With the engine at	**Yes** INSTALL a new generator. REFER to Section 414-02 .

approximately 2000 rpm, measure the voltage drop between the generator B+ C102b, circuit 38 (BK/OG) and the positive battery terminal.  ● **Is the voltage drop less than 0.5 volt?**	**No** REPAIR the high resistance in the B+ circuit 38 (BK/OG). TEST the system for normal operation.

PINPOINT TEST C: THE CHARGING SYSTEM OVERCHARGES (BATTERY VOLTAGE GREATER THAN 15.5 VOLTS)

Test Step	Result / Action to Take
C1 CHECK THE FAULT CODES IN THE PCM	
● Connect the diagnostic tool. ● Key in ON position. ● Use the recorded PCM DTCs from the continuous and on-demand self-test. ● **Are any DTCs recorded?**	**Yes** REFER to PCM Diagnostic Trouble Code (DTC) Index. **No** GO to C2 .
C2 CHECK THE BATTERY VOLTAGE	
● Key in OFF position. ● Disconnect the diagnostic tool. ● Key in START position. ● With the engine running and all accessories turned off, measure the voltage at the battery while varying the engine rpm.  ● **Is the voltage greater than 15.5 volts?**	**Yes** GO to C3 . **No** GO to C4 .
C3 CHECK FOR VOLTAGE DROP IN CIRCUIT 35 (OG/LB)	
● Key in OFF position. ● Disconnect: Generator C102a. ● Measure the voltage drop between the generator C102a, pin 3 circuit 35 (OG/LB), harness side and the positive battery terminal.	**Yes** GO to C4 . **No** REPAIR the circuit. TEST the system for normal operation.

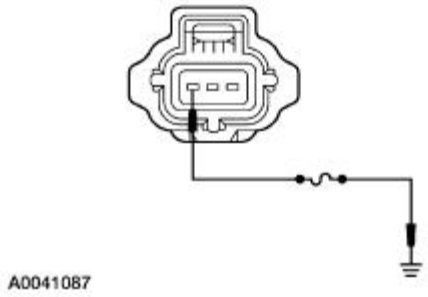
 ● **Is the resistance drop less than 0.5 volt?**	
C4 CHECK THE GENERATOR AND BATTERY GROUND CONNECTIONS	
● Key in OFF position. ● Check the ground connections between the generator and the engine, and the battery and the engine. ● **Are all ground connections clean and tight?**	**Yes** INSTALL a new generator. REFER to Section 414-02 . CLEAR the DTCs. TEST the system for normal operation. **No** REPAIR the ground connections as necessary. CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST D: THE CHARGING SYSTEM WARNING INDICATOR IS ON WITH THE ENGINE RUNNING AND THE BATTERY INCREASES VOLTAGE

Test Step	Result / Action to Take
D1 CHECK THE FAULT CODES IN THE PCM	
● Connect the diagnostic tool. ● Key in ON position. ● Use the recorded PCM DTCs from the continuous and on-demand self-test. ● **Are any DTCs recorded?**	**Yes** REFER to PCM Diagnostic Trouble Code (DTC) Index. **No** REFER to Section 413-01 .

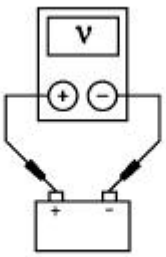
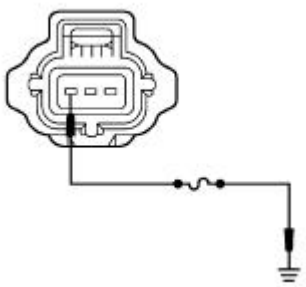
PINPOINT TEST E: THE CHARGING SYSTEM WARNING INDICATOR IS OFF WITH THE IGNITION SWITCH IN THE RUN POSITION AND THE ENGINE IS OFF

Test Step	Result / Action to Take
E1 CHECK THE FAULT CODES IN THE PCM	
● Connect the diagnostic tool. ● Key in ON position. ● Use the recorded PCM DTCs from the continuous and on-demand self-test. ● **Are any DTCs recorded?**	**Yes** REFER to PCM Diagnostic Trouble Code (DTC) Index. **No** GO to E2 .

E2 CHECK THE CHARGING SYSTEM WARNING INDICATOR OPERATION	
• Key in OFF position. • Disconnect the diagnostic tool. • Disconnect: Generator C102a. • Key in ON position. • With the engine off, connect a fused (15A), jumper wire between the generator C102a pin 1, circuit 1931 (BN/PK), harness side and ground.  A0041087 • **Does the charging system warning indicator illuminate?**	**Yes** INSTALL a new generator. REFER to Section 414-02 . TEST the system for normal operation. **No** GO to E3 .
E3 CHECK FOR CORRECT PCM OPERATION	
• Disconnect all PCM connectors. • Check for: • corrosion • pushed-out pins • Connect all PCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PCM. REFER to Section 303-14 . REPEAT the PCM self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST F: THE CHARGING SYSTEM WARNING INDICATOR LAMP FLICKERS OR IS INTERMITTENT

Test Step	Result / Action to Take
F1 CHECK THE FAULT CODES IN THE PCM	
• Connect the diagnostic tool. • Key in ON position. • Use the recorded PCM DTCs from the continuous and on-demand self-test. • **Are any DTCs recorded?**	**Yes** REFER to PCM Diagnostic Trouble Code (DTC) Index. **No** GO to F2 .
F2 CHECK FOR LOOSE CONNECTIONS	
• Disconnect: Generator C102a. • Check all generator, battery, and power distribution connections for looseness, corrosion, loose or bent terminals, or loose eyelets. • Connect: Generator C102a. • **Are all connections clean and tight?**	**Yes** GO to F3 . **No** REPAIR as necessary. TEST the system for normal operation.

F3 CHECK FUSE CONNECTION	
• Key in START position. • With the engine running, check CJB fuse 9 (10A) in circuit 35 (OG/LB) for looseness by wiggling the fuse and noting the charging system warning indicator lamp operation. • **Does the charging system warning indicator lamp flicker?**	**Yes** REPAIR loose fuse connections as necessary. TEST the system for normal operation. **No** GO to F4 .
F4 CHECK THE BATTERY VOLTAGE	
• Key in START position. • With the engine running, and all accessories turned off, measure the voltage at the battery while varying the engine rpm.  AJ0210-A • **Is the voltage greater than 15.5 volts?**	**Yes** Go To Pinpoint Test C . **No** GO to F5 .
F5 CHECK THE WARNING SYSTEM INDICATOR OPERATION	
• Key in OFF position. • Disconnect: Generator C102a. • Key in ON position. • Connect a fused jumper wire between generator C102a pin 1, circuit 1931 (BN/PK), harness side and ground.  A0041087 • **Does the charging system warning indicator illuminate?**	**Yes** GO to F6 . **No** REPAIR the circuit. TEST the system for normal operation.
F6 CHECK THE PCM OPERATION	
• Key in OFF position. • Connect: Generator C102a. • Key in ON position. • Monitor the charging system warning indicator operation. • **Is the charging system warning indicator illuminated?**	**Yes** The PCM is operating correctly. RECHECK the generator circuits (including the generator) for intermittent shorts or opens. TEST the system for normal operation. **No** GO to F7 .

F7 CHECK FOR CORRECT PCM OPERATION	
• Disconnect all PCM connectors. • Check for: • corrosion • pushed-out pins • Connect all PCM connectors and make sure they seat correctly • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PCM. REFER to Section 303-14 . REPEAT the PCM self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST G: THE GENERATOR IS NOISY

Test Step	Result / Action to Take
G1 CHECK FOR ACCESSORY DRIVE NOISE AND MOUNTING BRACKETS	
• Check the accessory drive belt for damage and correct installation; refer to Section 303-05 . • Check the accessory mounting brackets and generator pulley for looseness or misalignment. • **Is the accessory drive OK?**	**Yes** GO to G2 . **No** REPAIR as necessary. TEST the system for normal operation.
G2 CHECK GENERATOR FOR ELECTRICAL NOISE	
• Disconnect: Generator C102a. • Key in START position. • With the engine running, • **Is the noise still present?**	**Yes** GO to G3 . **No** INSTALL a new generator. REFER to Section 414-02 . TEST the system for normal operation.
G3 CHECK GENERATOR FOR MECHANICAL NOISE	
• Key in OFF position. • Key in START position. • Turn all accessories off. With the engine running, use a stethoscope or equivalent listening device to probe the generator for unusual mechanical noise. • **Is the generator the noise source?**	**Yes** INSTALL a new generator. REFER to Section 414-02 . TEST the system for normal operation. **No** REFER to Section 303-00 to diagnose the source of the engine noise.

PINPOINT TEST H: RADIO INTERFERENCE

Test Step	Result / Action to Take
H1 VERIFY GENERATOR IS SOURCE OF RADIO INTERFERENCE	
• Key in START position. • Start and run the engine. • Tune the radio to a station where the	**Yes** REFER to Section 415-00 for diagnosis and testing of the in-vehicle entertainment system.

interference is present. • Key in OFF position. • Disconnect: Generator C102a. • Key in START position. • **Is the interference present with the generator disconnected?**	**No** INSTALL a new generator. REFER to Section 414-02 . TEST the system for normal operation.

Component Tests

Battery — Drain Testing

Check for current drains on the battery in excess of 24-26 milliamps (0.024-0.026 amp) with all the electrical accessories off and the vehicle at rest for at least 40 minutes. Current drains can be tested with the following procedure:

WARNING: Do not attempt this test on a lead-acid battery that has recently been recharged. Explosive gases can cause personal injury.

CAUTION: To prevent damage to the meter, do not crank the engine or operate accessories that draw more than 10A.

NOTE: Many electronic modules draw 5 mA or more continuously.

NOTE: Use an in-line digital ammeter between the battery negative post and its respective cable.

1. Make sure the central junction box is accessible without turning on interior or underhood lights.
2. Drive the vehicle at least five minutes and over 48 km/h (30 mph) to turn on and activate vehicle systems.
3. Allow the vehicle to sit with the key off for at least 40 minutes to allow modules to time out/power down.
4. Connect a jumper wire between the negative battery cable and the negative battery post to prevent modules from resetting and to catch capacitive drains.
5. Disconnect the negative battery cable from the negative battery post without breaking the connection of the jumper wire.
6. Connect the battery tester between the negative battery cable and post. The meter must be capable of reading milliamps and should have a 10 amp capacity.

NOTE: It is very important that continuity is not broken between the battery post and the negative cable when connecting the meter. If this happens, the entire procedure must be repeated.

7. Remove the jumper wire.

NOTE: If the meter settings need to be switched or the test leads need to be moved to another jack, the jumper wire must be reinstalled to avoid breaking continuity.

8. Note the amperage draw. Draw will vary from vehicle to vehicle depending on the equipment package. Compare to a similar vehicle for reference. No factory equipped vehicle should have more than a 24-26 mA draw (0.024-0.026 amp).
9. If the draw is found to be excessive, pull fuses from the central junction box one at a time and note the current reading. Do not reinstall fuses until you have finished testing.

10. If the current draw is still excessive, remove the remaining fuses from the junction box one at a time and note the current drop. Do not reinstall fuses until you have finished testing. When the current level drops after pulling a fuse, the circuit containing the excessive draw has been located.

11. Check the Wiring Diagrams for any circuits that run from the battery without passing through the junction box. If the current draw is still excessive, disconnect these circuits until the draw is found. Also disconnect the generator electrical connections if the draw cannot be located. The generator may be internally shorted, causing current drain.

Generator On-Vehicle Tests

CAUTION: To prevent damage to the generator, do not make jumper wire connections except as directed.

CAUTION: Do not allow any metal object to come in contact with the housing and the internal diode cooling fins with key on or off. A short circuit will result and burn out the diodes.

NOTE: Battery posts and cable clamps must be clean and tight for accurate meter indications.

1. Turn off all lamps and electrical components.

2. Place the vehicle in transmission range NEUTRAL and apply the parking brake.

3. Carry out the Load Test and No Load Test according to the following component tests:

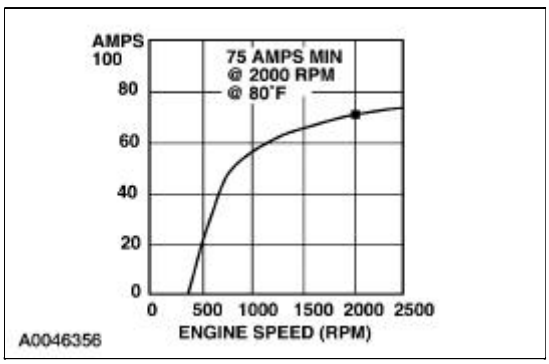
Generator On-Vehicle Tests — Load Test

1. Switch the tester to the ammeter function.

2. Connect the positive and negative leads of the tester to the corresponding battery terminals.

3. Connect the current probe to the generator B+ output terminal, circuit 38 (BK/OG).

4. With the engine running at 2,000 rpm, adjust the tester load bank to determine the output of the generator. Generator output should be greater than the applicable graphs shown below. If not, refer back to the pinpoint test or to the Symptom Chart.



Generator On-Vehicle Tests — No Load Test

1. Switch the tester to the voltmeter function.

2. Connect the voltmeter positive lead to the generator B+ terminal and the negative lead to ground.

3. Turn all electrical accessories off.

4. With the engine running at 2,000 rpm, check the generator output voltage. The voltage should be between 13.0 and 15.0 volts. If not, refer back to the pinpoint test or to the Symptom Chart.

5. Turn the A/C on, the blower motor on high speed and the headlamps on high beam.

6. The voltage should increase a minimum of 0.5 volt above the base voltage.
    - If the voltage does not increase as specified, refer back to the pinpoint test or to the Symptom Chart.
    - If the voltage increases as specified, the charging system is operating normally.

Torque Specifications

Description	Nm	lb-ft	lb-in
Battery hold-down bolt	10	—	89
Battery tray bolts	30	22	—
Negative battery cable to cowl panel ground bolt	12	9	—
Negative battery cable to frame bolt	12	9	—
Battery ground terminal bolt	7	—	62
Positive battery terminal cable junction nut	9	—	80
Starter motor negative cable nut	22	16	—
Starter solenoid cable nut	5	—	44
Starter motor positive cable nut	12	9	—
Positive battery terminal nut	9	—	80

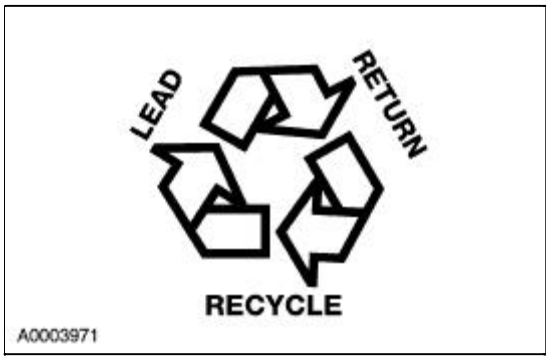
Battery and Cables

Vehicles are equipped with a 12 volt maintenance-free battery.

The battery and cable system consists of the following components:

- battery
- battery cable assembly
- battery tray

Ford Motor Company strongly recommends that lead-acid batteries be returned to an authorized recycling facility for disposal.



Battery

Special Tool(s)

 ST2442-A	Micro 490 Digital Battery Analyzer 162-00004

Inspection and Verification

1. Verify the customer concern by operating the system.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
● Battery ● Battery mounting	● Battery cables ● Battery posts

3. If an obvious cause for a concern is found, correct the cause before proceeding to the next step.
4. If the fault is not visually evident, proceed to the pinpoint test.

Pinpoint Tests

PINPOINT TEST A: BATTERY CONDITION TEST

Test Step	Result / Action to Take
A1 TEST BATTERY CONDITION	
NOTE: No battery with a red test-eye should be replaced. The red eye only means the battery is discharged, not necessarily defective. **NOTE:** Failure to fully charge the battery before retesting may cause false readings. ● Verify the battery condition using the Battery Analyzer. ● **Is the battery OK?**	**Yes** Does the meter read, GOOD BATTERY? RETURN the battery to service. REFER to Section 414-00 . Does the meter read, GOOD-RECHARGE? CHARGE the battery and RETURN to service. REFER to Section 414-00 . Does the meter read, CHARGE & RETEST? Fully CHARGE the battery and RETEST.

	No Does the meter read, REPLACE BATTERY? INSTALL a new battery. Does the meter read, BAD CELL-REPLACE? INSTALL a new battery.

Battery Disconnect

WARNING: Batteries normally produce explosive gases which can cause personal injury. Therefore, do not allow flames, sparks or lighted substances to come near the battery, always shield your face and protect your eyes. Always provide ventilation. Failure to follow these instructions may result in personal injury.

WARNING: To avoid accidental deployment and possible injury, the backup power supply must be depleted before repairing or installing any front or side air bag supplemental restraint system (SRS) components and before repairing, installing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches. Failure to follow these procedures may result in personal injury.

Refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

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

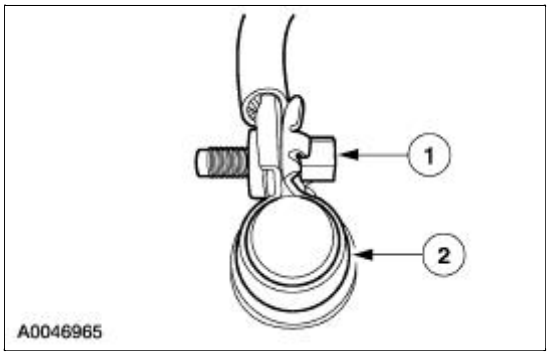
WARNING: When lifting a battery, excessive pressure on the end walls could cause acid to spew through the vent caps, resulting in personal injury. Lift with a battery carrier or with your hands on opposite corners. Failure to follow these instructions may result in personal injury.

WARNING: Keep out of the reach of children. Batteries contain sulfuric acid. Avoid contact with skin, eyes or clothing. Also, shield your eyes when working near the battery to protect against possible splashing of the acid solution. In case of acid contact with the skin or eyes, flush immediately with water for a minimum of 15 minutes and get prompt medical attention. If acid is swallowed, call a physician immediately. Failure to follow these instructions may result in personal injury.

1. **CAUTION: Do not lift the battery terminal by grabbing onto the wire.**

   NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven to relearn its strategy.

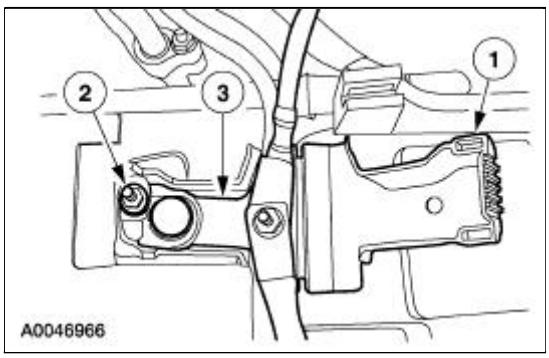
   Disconnect the battery ground cable.
   1. Loosen the battery terminal bolt.
   2. Slightly rotate and lift the battery terminal assembly.



2. **CAUTION: Do not lift the battery terminal by grabbing onto the wire or lifting underneath the terminal cover.**

Disconnect the positive battery cable.

1. Open the battery terminal cover.
2. Loosen the battery terminal nut.
3. Slightly rotate and lift the battery terminal and cover assembly.

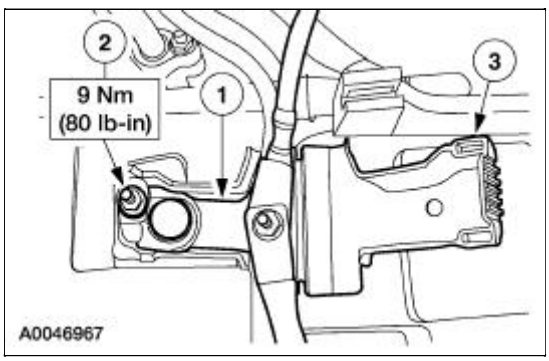


3. **CAUTION: Do not tap, press or excessively push on the battery terminal.**

NOTE: Make sure the battery terminal slides all of the way down the battery post and is not tilted.

Connect the positive battery cable.

1. Install the battery cable.
2. Tighten the nut.
3. Close the terminal cover.

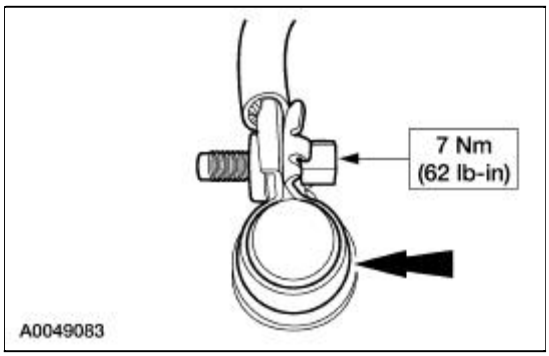


4. **CAUTION: Do not tap, press or excessively push on the battery terminal.**

NOTE: Make sure the battery terminal slides all of the way down the battery post and is not

tilted.

Connect the battery ground cable and tighten the bolt.

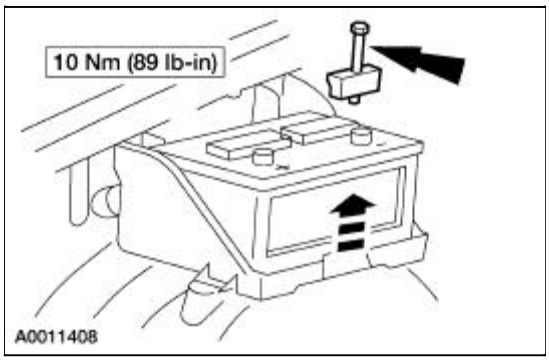


Battery

Removal and Installation

1. Disconnect the battery cables. For additional information, refer to Battery Disconnect in this section.

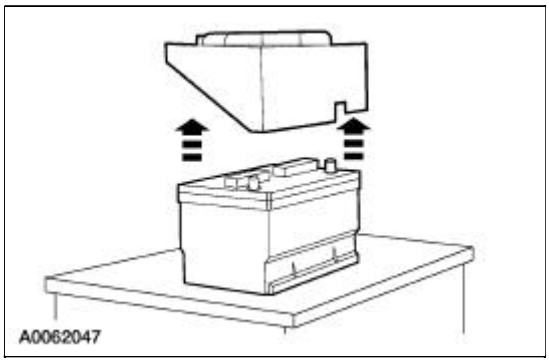
2. Remove the battery hold-down bolt and the battery hold-down clamp.



3. **WARNING: When lifting a battery, excessive pressure on the end walls could cause acid to leak out through the vent caps, resulting in personal injury, or damage to the vehicle or battery. Lift with battery carrier.**

   Remove the battery.

4. With the battery on a workbench, remove the battery heat shield, if necessary.

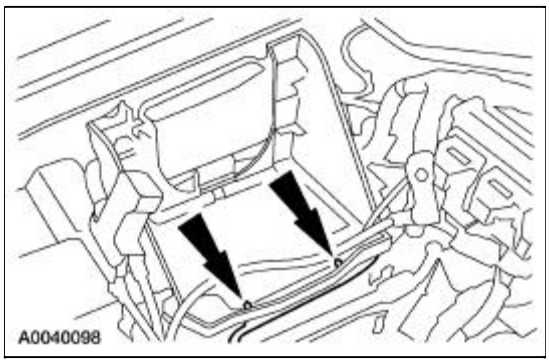


5. To install, reverse the removal procedure.

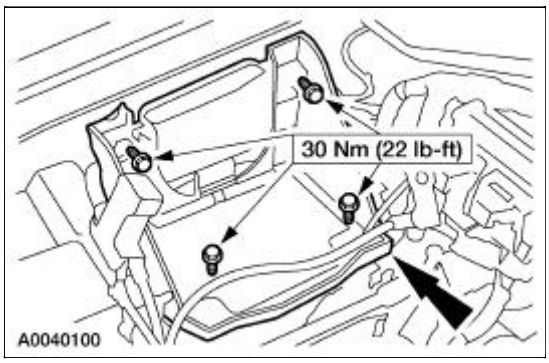
Battery Tray

Removal and Installation

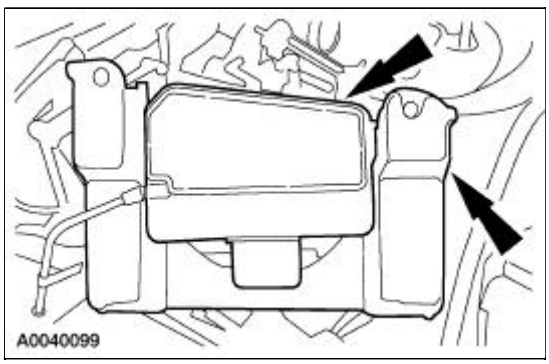
1. Remove the battery. For additional information, refer to Battery in this section.
2. Disconnect the wiring harness locators from the battery tray.



3. Remove the bolts and position the battery tray aside.



4. Remove the battery tray.
   - Disconnect the vacuum reservoir.

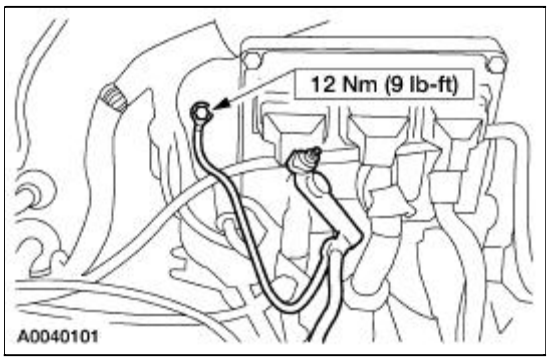


5. To install, reverse the removal procedure.

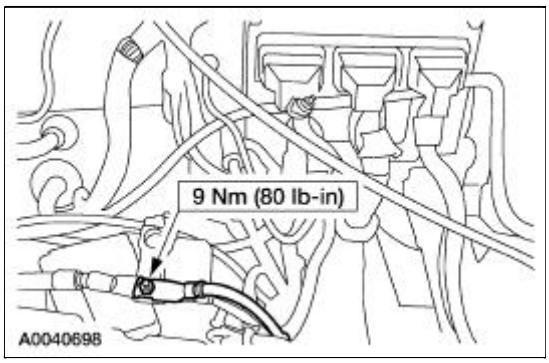
Battery Cables

Removal and Installation

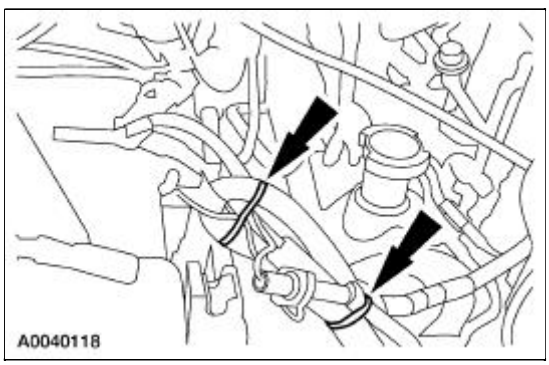
1. Disconnect the battery. For additional information, refer to Battery Disconnect in this section.
2. Remove the negative battery cable ground bolt at the cowl panel.



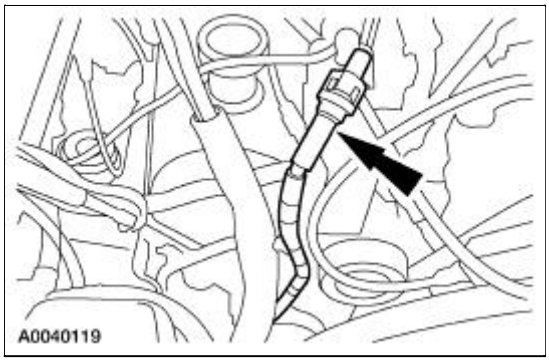
3. Remove the nut and disconnect the positive battery cable at the positive battery terminal junction.



4. Remove the engine cover.
   - Remove the bolts.
5. Remove the two tiestraps from the battery cable harness.

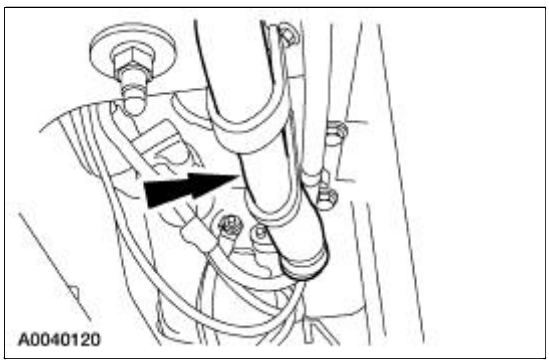


6. Disconnect the electrical connector from the battery cable harness.

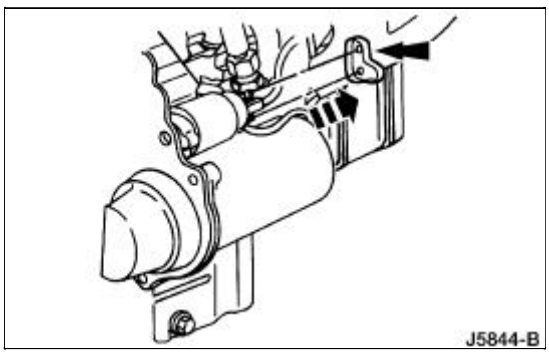


7. Raise the vehicle. For additional information, refer to Section 100-02 .

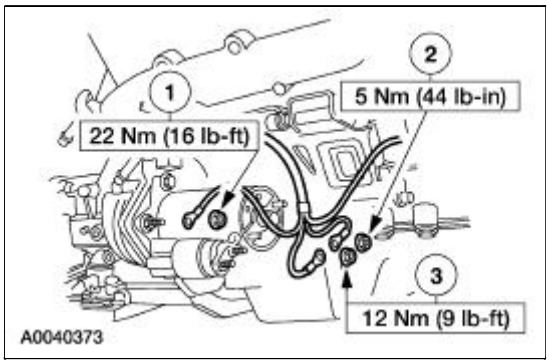
8. Release the battery cable harness from the two support brackets.



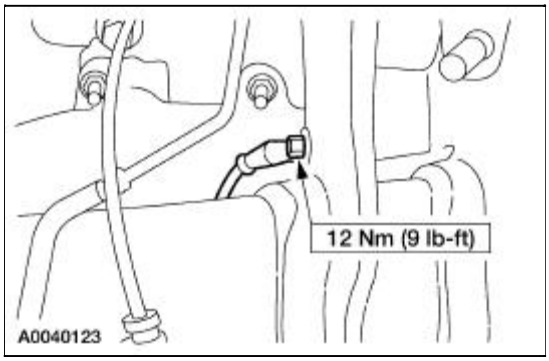
9. Remove the starter motor solenoid terminal cover.



10. Disconnect the starter motor connections.
    1. Remove the nut and disconnect the starter motor negative cable.
    2. Remove the nut and disconnect the starter solenoid cable.
    3. Remove the nut and disconnect the starter motor positive cable.



11. Remove the negative battery cable to frame bolt.



12. Remove the battery cable harness.

13. To install, reverse the removal procedure.

General Specifications

Item	Specification
Generator	110 amp

Torque Specifications

Description	Nm	lb-ft	lb-in
Generator B+ cable nut	8	—	71
Generator bolts	25	18	—
Generator bracket bolts	10	—	89

Generator

The charging system consists of the following components:

- battery
- generator with internal voltage regulator

Generator

Refer to Section 414-00 .

Generator —4.6L and 5.4L (2V)

Removal and Installation

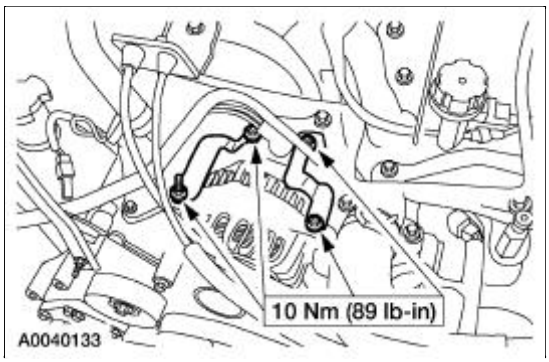
1. **NOTE:** The 4.6L (2V) is shown. The 5.4L (2V) procedure is similar.

   Disconnect the battery . For additional information, refer to Section 414-01 .

2. Remove the air cleaner outlet pipe assembly. For additional information, refer to Section 303-12 .

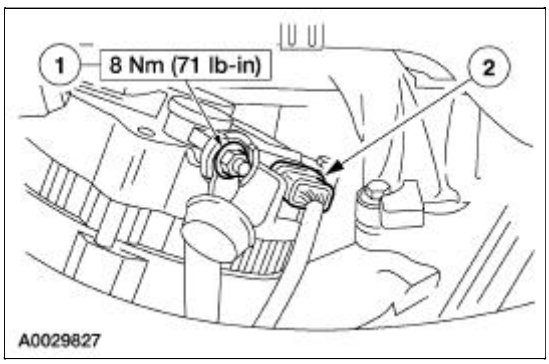
3. Relieve the accessory drive belt tension and remove the belt from the generator pulley.

4. Remove the bolts and remove the generator bracket.

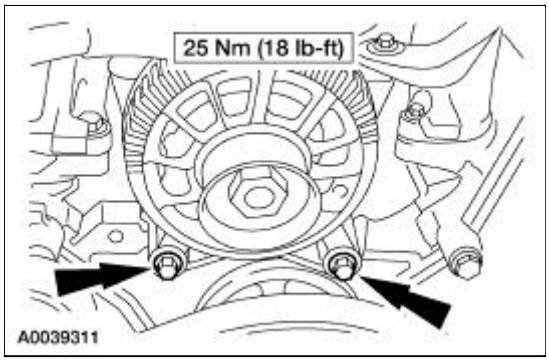


5. **CAUTION: This is a new style connector that has a press-to-release tab. Pulling on the tab could result in damage to the connector or harness.**

   Disconnect the generator electrical connections.
   1. Remove the B + cable nut and cable.
   2. Disconnect the electrical connector.



6. Loosen the lower bolts and remove the generator.

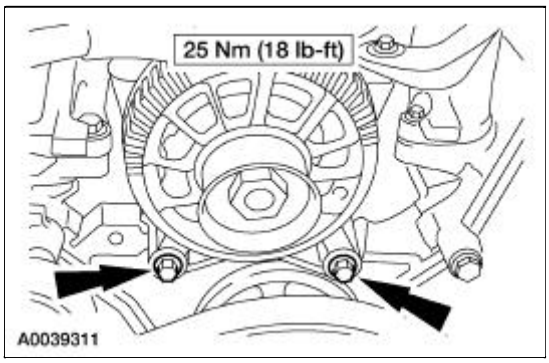


7. To install, reverse the removal procedure.

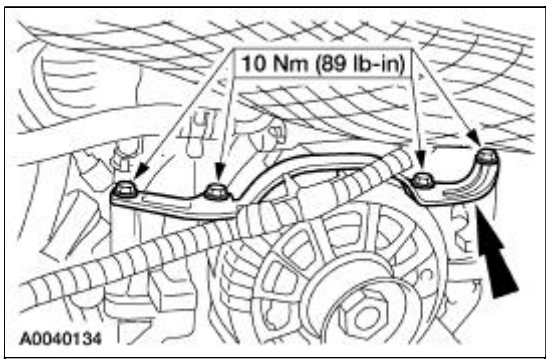
Generator —5.4L (4V)

Removal and Installation

1. Disconnect the battery. For additional information, refer to Section 414-01 .
2. Remove the radiator shroud and cooling fan. For additional information, refer to Section 303-03 .
3. Relieve the accessory drive belt tension and remove the belt from the generator pulley.
4. Loosen the lower generator bolts.

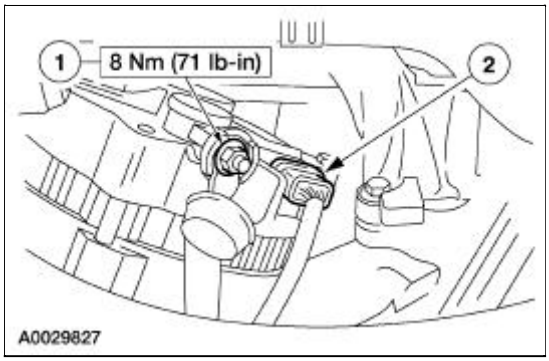


5. Disconnect the harness pin-type retainer from the water-neck housing.
6. Remove the bolts and the generator bracket.



7. Position the generator aside.
8. **CAUTION: This is a new style connector that has a press-to-release tab. Pulling on the tab could result in damage to the connector or harness.**

   Disconnect the electrical connections and remove the generator.
   1. Remove the B+ cable nut and cable.
   2. Disconnect the electrical connector.



9. To install, reverse the removal procedure.

Audio System

Refer to Wiring Diagrams Cell 130 , Audio for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent

Inspection and Verification

1. Verify the customer concern by operating the audio system and the video system (if equipped) with the engine running and the vehicle in and out of motion.

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

Visual Inspection Chart

Mechanical	Electrical
● Audio unit ● Digital audio compact disc changer ● Antenna, wire assembly, or antenna cable ● Radio speakers or mountings ● Radio ignition interference capacitor, radio frequency interference suppression bond and radio receiver hood bonding strap misaligned, corroded or loose	● Central junction box (CJB) fuse(s): ■ 4 (15A) ■ 7 (7.5A) ■ 22 (10A) ■ 31 (25A) ● Ignition switch ● Circuitry ● Audio unit ● Video system ● Rear seat controller (RSC) ● Compact disc/disc jockey (CD/DJ)

3. If the fault is visually evident, proceed to the symptom chart.

4. If the fault is not visually evident, proceed to the speaker walk-around test and audio unit self-diagnostic mode.

Speaker Walk-Around Test—Vehicle Navigation Radio (VNR) Only

NOTE: To enter the speaker walk-around test or audio unit self-diagnostic mode, the audio unit must

be turned on and in radio tuner mode (AM/FM).

5. To enter the speaker walk-around test, simultaneously press the audio unit preset buttons 3 and 6.

6. The speaker walk-around test stops at each speaker and applies sound to each speaker for about one to two seconds. Each speaker is tested and displayed on the audio unit in the following sequence: RF, LF, LR, RR.

7. The speaker walk-around test automatically continues and tests for the operation of the AM/FM antenna. If the antenna is inoperative, NOT FOUND will be displayed. If the vehicle is not equipped with CD/DJ, or if the CD/DJ is not responding, NO DJ will be displayed.

Speaker Walk-Around Test—Navigator with Navigation System (late build only)

NOTE: To enter the speaker walk-around test or audio unit self-diagnostic mode, the audio unit must be turned on and in radio tuner mode (AM/FM).

1. To enter the speaker walk-around test, simultaneously press and hold for five seconds the audio unit preset buttons MAP and DEST.

2. The speaker walk-around test stops at each speaker and applies sound to each speaker for about one to two seconds. Each speaker is tested and displayed on the audio unit in the following sequence: RF, LF, LR, RR, Subwoofer.

Speaker Walk-Around Test—All Audio Units Except VNR

NOTE: To enter the speaker walk-around test or audio unit self-diagnostic mode, the audio unit must be turned on and in radio tuner mode (AM/FM).

1. To enter the speaker walk-around test, simultaneously press the audio unit preset buttons 3 and 6.

2. The speaker walk-around test stops at each speaker and applies sound to each speaker for about one to two seconds. Each speaker is tested and displayed on the audio unit in the following sequence: RF, LF, LR, RR.

3. The speaker walk-around test automatically continues and tests Subwoofer I and Subwoofer II for a speaker short and CD/DJ. If a speaker short exists, SPKR SHORT will be displayed. If the vehicle is not equipped with CD/DJ or if the CD/DJ is not responding, NO DJ will be displayed.

Audio Unit Self-Diagnostic Mode—All Audio Units Except Navigation Audio Units

NOTE: To enter the speaker walk-around test or audio unit self-diagnostic mode, the audio unit must be turned on and in radio tuner mode (AM/FM).

1. To enter the following tests, depress the desired preset button while in the speaker walk-around test or while in the audio unit self-diagnostic mode.

2. To exit the audio unit self-diagnostic mode, turn the ignition switch or the audio unit off.

3. If the concern remains and the fault is not detected, proceed to the Symptom Chart to continue diagnostics.

4. The audio unit self-diagnostic mode has five tests available:
    - Preset Button 1 = Audio internal/external SELF TEST. This test is an on-demand self-test. If SELF FAIL is displayed, press TUNE > to scroll view the DTCs stored. Refer to the audio unit Diagnostic Trouble Code (DTC) Index. If the system is OK, SELF PASS will be displayed.
    - Preset Button 2 = View/Clear continuous DTCs. NO DTCS is displayed if no DTCs are retrieved. If DTCS FOUND is displayed, press TUNE > to view the DTCs retrieved. Refer to the Audio Unit Diagnostic Trouble Code (DTC) Index. To clear all DTCs, press the EJECT button. DTCS CLEAR will be displayed.
    - Preset Button 3 = SIGNAL TEST. This test measures the average strength at the current tuner setting.
    - **NOTE:** Always document, clear, and carry out the audio unit on-demand self-test again.

      Preset Button 4 = Software configuration level. This test queries each audio system controller for its software configuration level. SOFT LEVELS will be displayed upon completion of the query. Press TUNE > to scroll view the software configuration version level.
    - Preset Button 5 = DISPLAY TEST. This test will light all the audio unit display segments for five seconds. When the test is complete, DISPLAY TEST is displayed on the bezel.

Audio Unit Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1342	ECU is Defective	Audio Unit	For early build vehicles CLEAR and DOCUMENT the DTCs. CARRY OUT the self-test. REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility if DTC B1342 is retrieved again. TEST the system for normal operation. For Navigator with navigation audio unit, REFER to Section 419-07 .
B2103	Antenna Not Connected	Audio Unit	Verify that the radio antenna is connected. CLEAR and DOCUMENT the DTCs. CARRY OUT the self-test. If DTC B2406 is retrieved again, REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation after the repair.
B2139	Data Mismatch	Audio Unit	REFER to Section 419-07 .
B2204	GPS Antenna Open or Short	Audio Unit	REFER to Section 419-07 .
B2208	Navigation To Head Unit Communication Error	Audio Unit	REFER to Section 419-07 .
B2401	Audio Tape Deck Mechanism Fault	Audio Unit	VERIFY that no cassette is inserted in the audio unit. CLEAR and DOCUMENT the DTCs. CARRY OUT the self-test. If DTC B2401 is retrieved again, REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.
B2402	Audio CD/DJ Thermal Shutdown Fault	Audio Unit	Go To Pinpoint Test B .
B2403	Audio CD/DJ Internal Fault	Audio Unit	Go To Pinpoint Test B .
B2404	Audio Steering Wheel Switch Circuit Fault	Audio Unit	Go To Pinpoint Test K .

B2405	Audio Single-Disc CD Player Thermal Shutdown Fault	Audio Unit	CLEAR and DOCUMENT the DTCs. CARRY OUT the self-test. If DTC B2405 is retrieved again, REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation after the repair.
B2406	Audio Single-Disc CD Player Internal Fault	Audio Unit	CLEAR and DOCUMENT the DTCs. CARRY OUT the self-test. If DTC B2406 is retrieved again, REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation after the repair.
B2633	Driver-front Microphone Circuit Failure	Audio Unit	REFER to Section 419-07 .
B2858	H/U is Defective	Audio Unit	REFER to Section 419-07 .
B2913	Audio Subwoofer Not Connected	Audio Unit	Go To Pinpoint Test H .
U2003	Audio Compact Disc/Disc Jockey is Not Responding	Audio Unit	If equipped with CD/DJ, Go To Pinpoint Test B .
U2005	Audio Rear Seat Controller (RSC) Unit is Not Responding	Audio Unit	**NOTE:** U2005 is retrieved if RSC Unit is not present, disconnected or inoperative. If equipped with RSC, Go To Pinpoint Test I .
U2014	Audio Subwoofer Unit is Not Responding	Audio Unit	Go To Pinpoint Test H .
U2026	Family Entertainment System is Not Responding	Audio Unit	Go To Pinpoint Test H .
A477	Audio Unit Configuration	Audio Unit	CLEAR and DOCUMENT the DTCs. CARRY OUT the self-test. If DTC A477 is retrieved again, REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation after the repair.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
● The audio unit is inoperative—except Navigator with navigation audio unit	● Central junction box (CJB) fuse (s): ■ 31 (25A). ■ 7 (7.5A). ● Circuitry. ● Audio unit. ● Ignition switch.	● Go To Pinpoint Test A .
● The audio unit is inoperative—Navigator with navigation audio unit only	● Central junction box (CJB) fuse (s): ■ 4 (15A). ■ 7 (7.5A). ■ 31 (25A).	● For Navigator with navigation audio unit, REFER to Section 419-07 .

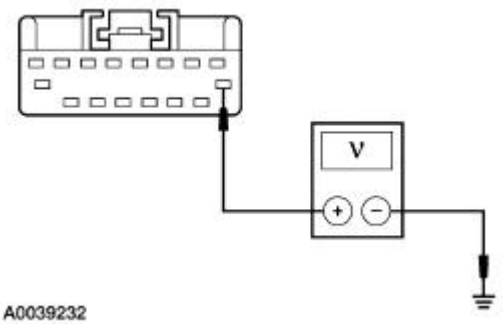
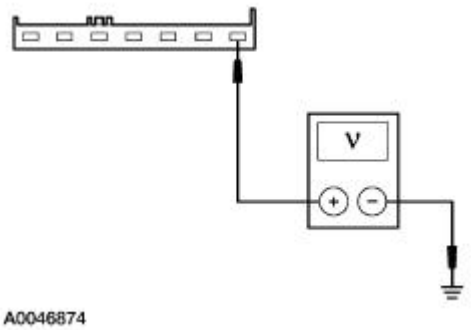
	• Circuitry. • Audio unit. • Navigation system module. • Ignition switch.	
• The cassette player is inoperative/does not operate correctly	• Audio unit.	• REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.
• The audio unit does not operate correctly — display is blank	• Audio unit. • Navigation control module.	• Late build Navigator with navigation, REFER to Section 419-07 , all others, REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.
• The CD changer is inoperative/does not operate correctly	• Central junction box (CJB) fuse 4 (15A). • Circuitry. • Audio unit. • CD changer.	• Go To Pinpoint Test B .
• The audio unit does not display CD changer information—vehicle navigation radio (VNR) only	• Central junction box (CJB) fuse (s): ■ 31 (25A). ■ 7 (7.5A). ■ 4 (15A). • Circuitry. • Audio unit. • CD changer.	• Go To Pinpoint Test C .
• Poor reception	• Antenna. • Antenna connections. • Noise suppression equipment. • Audio unit. • Cellular phone coaxial cable. • Connections at battery, antenna, speaker leads or audio unit. • Antenna isolator module.	• Go To Pinpoint Test D .
• Continuous SEEK/SCAN in AM/FM	• Antenna. • Antenna connections. • Audio unit. • Antenna isolator module.	• Go To Pinpoint Test E .
• Poor sound quality/distorted sound from one or more	• Speaker(s). • Wiring to speaker (s).	• Go To Pinpoint Test F .

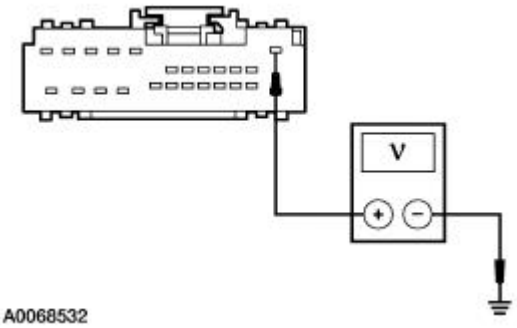
speakers—not all speakers	• Audio cable. • Audio unit.	
• Poor sound quality/distorted sound from all speakers	• Speaker(s). • Wiring to speaker (s). • Audio unit.	• Go To Pinpoint Test G .
• No sound from one or more of the speakers — not all speakers	• Speaker(s). • Wiring to speaker (s). • Audio unit. • Audio amplifier.	• Go To Pinpoint Test F .
• No sound from all speakers	• Audio unit. • Audio amplifier. • Circuitry.	• Go To Pinpoint Test G .
• The subwoofer is inoperative — except Navigator with navigation audio unit	• Central junction box (CJB) fuse 31 (25A). • Circuitry. • Subwoofer. • Subwoofer amplifier.	• For the Navigator with navigation audio unit, Go To Pinpoint Test M . For all others, Go To Pinpoint Test H .
• No auxiliary headphone audio	• Rear seat entertainment unit.	• If the rear radio speakers operate correctly, INSTALL a new RSC unit. REFER to Section 415-01 . TEST the system for normal operation.
• The auxiliary audio control is inoperative—rear seat controller (RSC) unit	• Central junction box (CJB) fuse 4 (15A). • Circuitry. • RSC unit. • Headphone set.	• Go To Pinpoint Test I .
• Loud popping sound when cycling the ignition switch	• Amplifier enable line shorted. • Amplifier.	• Go To Pinpoint Test J .
• The auxiliary audio control is inoperative—steering wheel control	• Battery junction box (BJB) fuse (s): ■ 31 (25A). ■ 7 (7.5A). • Circuitry. • Clockspring. • Steering wheel control switch. • Audio unit.	• Go To Pinpoint Test K .
• Audio unit illumination inoperative	• Circuitry. • Audio unit.	• REFER to Section 413-00 .
• The video system is inoperative/does not operate correctly	• Battery junction box fuse 4 (15A). • Circuitry. • Video system.	• Go To Pinpoint Test L .
• The video display is inoperative	• Circuitry. • Video system.	• Go To Pinpoint Test L .
• The video system does not operate correctly — no audio	• Circuitry. • Video system.	• Go To Pinpoint Test L .

• The video system does not operate correctly—remote control does not function correctly	• Video system.	• INSTALL new batteries in the remote control. If the concern is still present, CONTACT an authorized Ford audio repair facility for further diagnostic test procedures.

Pinpoint Tests

PINPOINT TEST A: THE AUDIO UNIT IS INOPERATIVE — EXCEPT NAVIGATOR WITH NAVIGATION AUDIO UNIT

Test Step	Result / Action to Take
A1 CHECK THE VOLTAGE TO THE AUDIO UNIT	
• Disconnect: Audio Unit C290a (late build CDX6 and all early build except VNR). • Disconnect: Audio Unit C2188a (VNR). • Disconnect: Audio Unit C240a (late build DM100i). • Key in ON position. • For all except VNR and late build DM100i, measure the voltage between the audio unit C290a pin 9, circuit 797 (LG/VT), harness side and ground.  A0039232 • For VNR, measure the voltage between the audio unit C2188a pin 1, circuit 797 (LG/VT), harness side and ground.  A0046874 • For late build DM100i, measure the voltage between the audio unit C240a pin 1, circuit 797 (LG/VT), harness side and ground	**Yes** GO to A2 . **No** REPAIR the circuit(s) in question. TEST the system for normal operation.

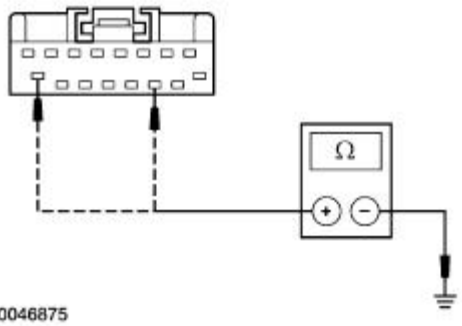


A0068532

- **Is the voltage greater than 10 volts?**

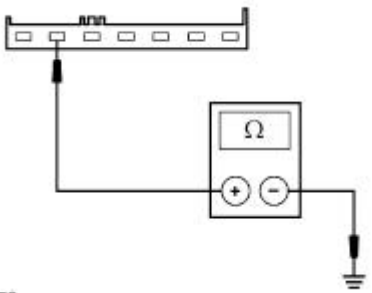
A2 CHECK CIRCUIT 694 (BK/LG) FOR AN OPEN

- Key in OFF position.
- For all except VNR and late build DM100i, measure the resistance between the audio unit C290a pin 11, circuit 694 (BK/LG), harness side and ground; and between the audio unit C290a pin 16, circuit 694 (BK/LG), harness side and ground.



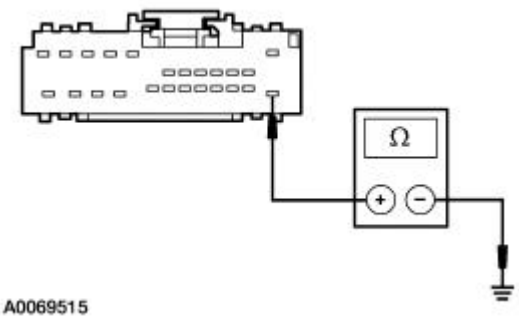
A0046875

- For VNR, measure the resistance between the audio unit C2188a pin 6, circuit 694 (BK/LG), harness side and ground.



A0046876

- For late build DM100i, measure the resistance between the audio unit C240a pin 13, circuit 694 (BK/LG), harness side and ground



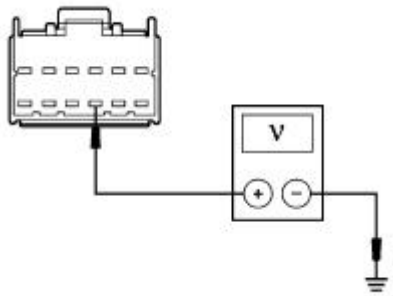
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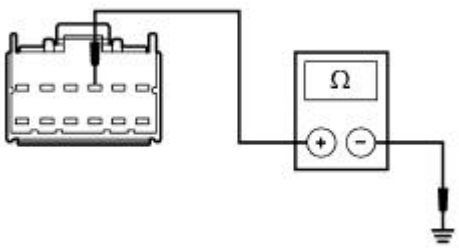
- **Are the resistances less than 5 ohms?**

Yes
REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.

No
REPAIR the circuit. TEST the system for normal operation.

PINPOINT TEST B: THE CD CHANGER IS INOPERATIVE/DOES NOT OPERATE CORRECTLY

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>B1 CHECK VOLTAGE TO THE CD CHANGER
● Key in OFF position.
● Disconnect: CD Changer C3028.
● Disconnect: CD Changer C243 (Navigator).
● Key in ON position.
● Measure the voltage between the CD changer C3028 (or C243) pin 9, circuit 720 (RD/YL), harness side and ground.

A0050791
● Is the voltage greater than 10 volts?</td><td>Yes
GO to B2 .

No
REPAIR the circuit. TEST the system for normal operation.</td></tr>
<tr><td>B2 CHECK CIRCUIT 694 (BK/LG) FOR AN OPEN
● Key in OFF position.
● Measure the resistance between the CD changer C3028 (or C243) pin 3, circuit 694 (BK/LG), harness side and ground.

A0072650
● Is the resistance less than 5 ohms?</td><td>Yes
GO to B3 .

No
REPAIR the circuit. TEST the system for normal operation.</td></tr>
<tr><td>B3 CHECK THE CIRCUITS BETWEEN THE COMPONENTS FOR AN OPEN
● Key in OFF position.
● Disconnect: Audio Unit C2188d.
● Disconnect: Rear Seat Controller Connector.
● Measure the resistance between the following groups of pins: CD changer C3028 (or C243) and the RSC unit C349b, CD changer C3028 (or C243) and the audio unit C2188d, and between RSC unit C349b and audio unit C2188d.
<table>
<tr><th>CD Changer Pin</th><th>RSC Unit Pin</th><th>Audio Unit Pin</th><th>Circuit</th></tr>
<tr><td>C3028 (or C243) pin 11</td><td>C349b pin 15</td><td>—</td><td>798 (LG/RD)</td></tr>
<tr><td>C3028 (or C243) pin 5</td><td>C349b pin 16</td><td>—</td><td>856 (VT)</td></tr>
</table></td><td>Yes
GO to B4 .

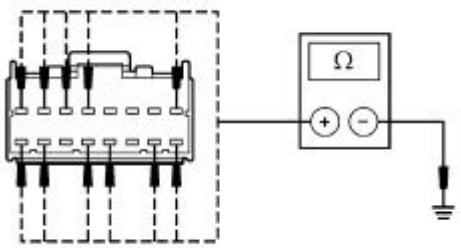
No
REPAIR the circuit in question. TEST the system for normal operation.</td></tr>
</table>

C3028 (or C243) pin 12	C349b pin 13	—	799 (OG/BK)
C3028 (or C243) pin 6	C349b pin 14	—	690 (GY)
C3028 (or C243) pin 8	C349a pin 10	C2188d pin 8	1068 (LB/BK)
C3028 (or C243) pin 7	C349a pin 12	C2188d pin 7	833 (TN)
C3028 (or C243) pin 1	C349a pin 13	C2188d pin 1	832 (LB/PK)
—	C349b pin 7	C2188d pin 11	1560 (WH)
—	C349b pin 8	C2188d pin 5	1559 (RD)
—	C349b pin 5	C2188d pin 12	1562 (YE)
—	C349b pin 6	C2188d pin 6	1561 (OG)

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

B4 CHECK THE CIRCUITS BETWEEN THE COMPONENTS FOR A SHORT

- Measure the resistance between the following RSC unit C349a pins, harness side and ground:
  - 1, circuit 19 (LB/RD)
  - 5, circuit 802 (OG/RD)
  - 6, circuit 803 (BN/PK)
  - 7, circuit 800 (GY/LB)
  - 8, circuit 801 (TN/YL)
  - 9, circuit 720 (RD/YL)
  - 10, circuit 1068 (LG/BK)
  - 12, circuit 833 (TN)
  - 13, circuit 832 (LB/PK)
  - 15, circuit 827 (TN/WH)
  - 16, circuit 825 (TN/LG)

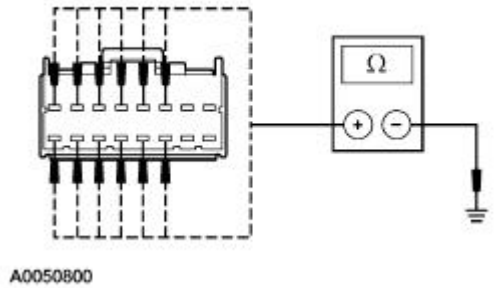


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- Measure the resistance between the following RSC unit C349b pins, harness side and ground:
  - 3, circuit 1806 (BK)
  - 4, circuit 1804 (LG)
  - 5, circuit 1562 (YE)
  - 6, circuit 1561 (OG)
  - 7, circuit 1560 (WH)
  - 8, circuit 1559 (RD)
  - 11, circuit 1805 (RD)
  - 12, circuit 1803 (WH)
  - 13, circuit 799 (OG/BK)

Yes
REMOVE the CD changer and SEND it to an authorized Ford audio repair facility. TEST the system for normal operation.

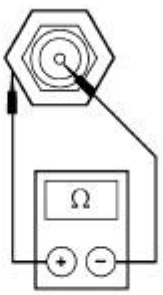
No
REPAIR the circuit in question. TEST the system for normal operation.

■ 14, circuit 690 (GY) ■ 15, circuit 798 (LG/RD) ■ 16, circuit 856 (VT)  A0050800 ● **Are the resistances greater than 10,000 ohms?**	

PINPOINT TEST C: THE AUDIO UNIT DOES NOT DISPLAY CD CHANGER INFORMATION—VNR ONLY

Test Step	Result / Action to Take
C1 CHECK OPERATION OF THE CD CHANGER ● Key in ON position. ● Turn on the audio unit. ● Verify the audio unit is operating correctly. Refer to the owner literature. ● Verify that the CD changer power loading function is operating correctly. Refer to the owner literature for CD loading instructions. ● **Is the CD changer information displayed on the audio unit display?**	**Yes** Go To Pinpoint Test B . **No** GO to C2 .
C2 CHECK FOR SOUND COMING FROM THE SPEAKERS ● Load a known good CD and press the CD button. ● **Is sound coming from the speakers?**	**Yes** GO to C3 . **No** Go To Pinpoint Test G .
C3 CHECK AUDIO UNIT DISPLAY ● Press the AM/FM button. ● Verify that the audio unit display is illuminated. ● **Is the audio unit display illuminated?**	**Yes** GO to C4 . **No** Go To Pinpoint Test A .
C4 CHECK CIRCUIT CONNECTIONS ● Key in OFF position. ● Disconnect: CD Changer C3028. ● Disconnect: CD Changer C243 (Navigator). ● Check circuit connectors and circuits for damage, corrosion or an open circuit at CD changer C243. ● **Are the circuits and connectors OK?**	**Yes** REMOVE the CD changer and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation. **No** REPAIR the circuit or connector as necessary. TEST the system for normal operation.

PINPOINT TEST D: POOR RECEPTION

Test Step	Result / Action to Take
NOTE: If equipped with video system, refer to owner literature before diagnosis.	
D1 CHECK ANTENNA CABLE CONNECTIONS	
• Key in OFF position. • Check the antenna connections, bracket and ground screw. • **Are the connections clean, secure and in metal-to-metal contact?**	**Yes** GO to D2. **No** CLEAN and SECURE the antenna cable and ground connections as necessary. TEST the system for normal operation.
D2 CHECK AUDIO UNIT COAX CABLE CENTER CONDUCTOR FOR AN OPEN	
• Key in OFF position. • Disconnect: Audio Unit Antenna Cable. • Disconnect: Antenna Cable. • Measure the resistance between the audio unit antenna connector center conductor and the antenna connector center conductor of the antenna isolator module. • **Is the resistance less than 4 ohms?**	**Yes** GO to D3. **No** REPAIR or INSTALL a new antenna cable. REFER to Section 415-02. TEST the system for normal operation.
D3 CHECK AUDIO UNIT COAX CABLE FOR A SHORT	
• Measure the resistance between the audio unit cable center conductor and the cable outer shield.  A0004930 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to D4. **No** REPAIR or INSTALL a new antenna cable. REFER to Section 415-02. TEST the system for normal operation.
D4 CHECK AUDIO UNIT COAX CABLE FOR AN OPEN	
• Measure the resistance between the antenna cable shield at the audio unit connector to a known good body sheet metal ground. • **Is the resistance less than 5 ohms?**	**Yes** GO to D5. **No** REPAIR or INSTALL a new antenna cable. REFER to Section 415-02. TEST the system for normal operation.
D5 CHECK SUPPRESSION EQUIPMENT	
• Check all necessary suppression equipment, the radio frequency interference suppression bond and the radio strap for security, cleanliness and metal-to-metal contact. Refer to Section 415-01. • **Are the contacts clean, secure and in metal-to-metal**	**Yes** GO to D6. **No** INSTALL a new radio frequency

contact?	interference suppression bond and related equipment, or CLEAN and SECURE the connections as necessary. TEST the system for normal operation.
D6 CHECK MOUNTING AND CONNECTING CIRCUITS	
NOTE: The capacitor mounting points are used to complete the electrical circuit and must be mounted securely to clean surfaces. ● Check the mounting and connecting circuits of the radio ignition interference capacitor(s) for security, cleanliness and metal-to-metal contact. Refer to Section 415-01 . ● **Are the contacts clean, secure and in metal-to-metal contact?**	**Yes** GO to D7 . **No** CLEAN and SECURE the connections as necessary. TEST the system for normal operation.
D7 CHECK RADIO IGNITION INTERFERENCE CAPACITOR(S)	
● Check the operation of the radio ignition interference capacitor(s) by installing known good component(s). ● Key in START position. ● Turn on the radio and check the reception. ● **Is the noise eliminated?**	**Yes** INSTALL a new radio ignition interference capacitor(s) as necessary. TEST the system for normal operation. **No** GO to D8 .
D8 CHECK GENERATOR	
● Key in OFF position. ● Check the generator by disconnecting the wiring harness from the voltage regulator. ● Key in START position. ● Turn on the radio and check the reception. ● **Is the noise eliminated?**	**Yes** INSTALL a new generator. REFER to Section 414-02 . **No** GO to D9 .
D9 CHECK IGNITION CIRCUITS	
● Key in OFF position. ● Check the ignition circuits for correct routing, grounding and security of connections. ● **Are the circuits OK?**	**Yes** GO to D10 . **No** REPAIR the circuit in question.
D10 CHECK IGNITION SYSTEM	
● Check the ignition system. Refer to Powertrain Control/Emissions Diagnosis (PC/ED) manual. ● **Is the ignition system OK?**	**Yes** GO to D11 . **No** REPAIR the ignition system as necessary. TEST the system for normal operation.
D11 CHECK AUDIO UNIT MOUNTING POINTS	
● Check all of the audio unit mounting points for security. ● **Are the mounting points secure?**	**Yes** If equipped with VNR, GO to D12 . Without VNR, GO to D13 . **No** CLEAN and SECURE the connections as necessary.

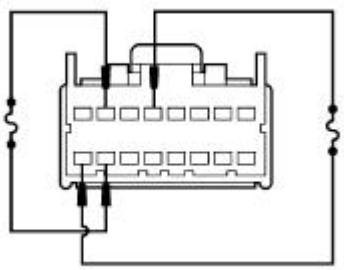
	TEST the system for normal operation.
D12 CHECK THE VOLTAGE TO THE ANTENNA ISOLATOR MODULE	
• Key in OFF position. • Disconnect: Antenna Isolator Module Connector. • Key in START position. • Measure the voltage between the antenna isolator module connector pin 1, circuit 194 (PK), harness side and ground. • **Is the voltage greater than 10 volts?**	**Yes** GO to D13 . **No** REPAIR the circuit in question. TEST the system for normal operation.
D13 SUBSTITUTE ANTENNA	
• **NOTE:** The in-glass antenna will have different reception characteristics than a whip antenna. • If the reception is poor in all speakers, substitute a known good antenna. • Key in START position. • Verify the operation of the audio unit. • **Is the noise eliminated?**	**Yes** REPAIR or INSTALL a new antenna cable. REFER to Section 415-02 . TEST the system for normal operation. **No** REINSTALL the original antenna. GO to D14 .
D14 SUBSTITUTE ANTENNA CABLE	
• Key in OFF position. • **NOTE:** The substitute rear cable must be grounded or poor reception will result. • Substitute a known good antenna cable(s). • Key in START position. • Verify the operation of the audio unit. • **Is the noise eliminated?**	**Yes** REPAIR or INSTALL a new antenna cable. REFER to Section 415-02 . TEST the system for normal operation. **No** REINSTALL the original antenna cable(s). GO to D15 .
D15 SUBSTITUTE AUDIO UNIT	
• Key in OFF position. • Substitute a known good audio unit. • Key in START position. • Verify the operation of the audio unit. • **Is the noise eliminated?**	**Yes** REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation. **No** REINSTALL the original audio unit. GROUND various parts of the vehicle (for example: engine, fenders, quarter panels, stone deflectors, engine air cleaner and body sheet metal) to the frame using a jumper cable. When the noise is eliminated, PROVIDE a permanent ground where necessary.

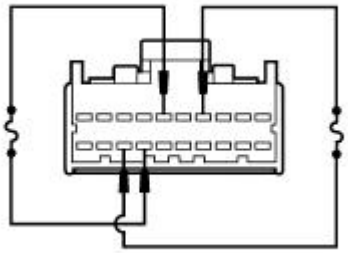
PINPOINT TEST E: CONTINUOUS SEEK/SCAN IN AM/FM

Test Step	Result / Action to Take
E1 CHECK OPERATION OF THE	

SEEK/SCAN FUNCTIONS ● Key in ON position. ● Operate the SEEK/SCAN functions with the audio unit in both AM and FM tuner modes. ● **Do the SEEK/SCAN functions search continuously?**	**Yes** GO to E2 . **No** The system is OK.
E2 CHECK ANTENNA FOR AN OPEN ● Key in OFF position. ● Disconnect: Antenna Cable. ● **NOTE:** The meter lead must be within 25mm (1 inch) of the tab. ● Measure the resistance between the antenna cable lead terminal and the antenna grid center printed line. ● **Is the resistance less than 1 ohm?**	**Yes** GO to E3 . **No** REPAIR or INSTALL a new antenna cable. REFER to Section 415-02 . TEST the system for normal operation.
E3 CHECK ANTENNA CENTER PRINTED LINE FOR AN OPEN ● Measure the resistance of the center printed line between the tab and the bottom of the line. ● **Is the resistance less than 1.4 ohms?**	**Yes** GO to E4 . **No** REPAIR or INSTALL a new antenna cable. REFER to Section 415-02 . TEST the system for normal operation.
E4 CHECK ANTENNA LOOP FOR AN OPEN ● Measure the resistance of the loop around the outside of the glass between the tab and the bottom of the antenna grid loop. ● **Is the resistance less than 1.4 ohms?**	**Yes** GO to E5 . **No** REPAIR or INSTALL a new antenna cable. REFER to Section 415-02 . TEST the system for normal operation.
E5 CHECK ANTENNA TAB FOR AN OPEN ● Measure the resistance between the tab and within one inch of the printed pattern. ● **Is the resistance less than 1 ohm?**	**Yes** GO to E6 . **No** REPAIR or INSTALL a new antenna cable. REFER to Section 415-02 . TEST the system for normal operation.
E6 SUBSTITUTE ANTENNA CABLE ● **NOTE:** The substitute rear cable must be grounded or poor reception will result. ● Substitute a known good antenna cable (s) between the audio unit and the antenna. ● Key in START position. ● Check the operation of the audio unit. ● **Is the noise eliminated?**	**Yes** INSTALL a new antenna cable(s). REFER to Section 415-02 . TEST the system for normal operation. **No** REINSTALL the original cable. REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.

PINPOINT TEST F: POOR SOUND QUALITY/DISTORTED SOUND FROM ONE OR MORE SPEAKERS — NOT ALL SPEAKERS

Test Step	Result / Action to Take
F1 CHECK FOR POOR/NO SOUND	
• Key in ON position. • Turn on the audio unit. • Carry out the speaker walk-around test by pressing preset buttons 3 and 6 simultaneously. For Navigator with navigation audio unit hold the MAP and the DEST buttons simultaneously for 5 seconds. • **Do all the speakers have poor sound quality or no sound?**	**Yes** Go To Pinpoint Test G . **No** If the subwoofer is inoperative, Go To Pinpoint Test M . All others GO to F2 .
F2 CHECK FOR SPEAKER CONCERNS	
• Check for loose trim panels or attachments that might cause rattles near the speaker in question. • Check for pinched or broken circuits at or near the audio unit or speakers in question. • Check for foreign material in the speaker(s) cone(s). • **Are there any visible speaker concerns?**	**Yes** REPAIR the concerns as necessary. TEST the system for normal operation. **No** GO to F3 .
F3 BYPASS RSC UNIT	
• Key in OFF position. • Disconnect: RSC Unit C349a (early build). • Disconnect: RSC Unit C388 (late build). • For all early build vehicles and for late build vehicles without a DVD player, connect a 10A fused jumper wire between RSC unit C349a pin 5, circuit 802 (OG/RD), harness side and pin 16, circuit 825 (TN/LG), harness side. Connect another 10A fused jumper wire between RSC unit C349a pin 7, circuit 800 (GY/LB), harness side and pin 15, circuit 827 (TN/WH), harness side.  A0050793 • For late build vehicles with a DVD player, connect a 10A fused jumper wire between RSC unit C388 pin 4, circuit 802 (OG/RD), harness side and pin 18, circuit 825 (TN/LG), harness side. Connect another 10A fused jumper wire between RSC unit C388 pin 6, circuit 800 (GY/LB), harness side and pin 17, circuit 827 (TN/WH), harness side.	**Yes** For all late build vehicles, GO to F5 . For all early build vehicles, GO to F4 . **No** INSTALL a new RSC unit. TEST system for normal operation.



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- Key in ON position.
- **Do the speakers in question still have poor sound quality or no sound?**

F4 CHECK SPEAKER RESISTANCE

- Key in OFF position.
- Disconnect: Audio Unit C290a (all except VNR) .
- Disconnect: Audio Unit C2188b (VNR).
- Measure the resistance between the audio unit C290a output and return circuits for the speaker that has poor sound quality or no sound.

Speaker	Output	Return
RF	pin 7, circuit 805 (WH/LG)	pin 8, circuit 811 (DG/OG)
LF	pin 14, circuit 804 (OG/LG)	pin 15, circuit 813 (LB/WH)
RR	pin 5, circuit 802 (OG/RD)	pin 6, circuit 803 (BN/PK)
LR	pin 12, circuit 800 (GY/LB)	pin 13, circuit 801 (TN/YL)

- For VNR, measure the resistance between the audio unit C2188b output and return circuits for the speaker that has poor sound quality or no sound.

Speaker	Output	Return
RF	pin 5, circuit 805 (WH/LG)	pin 6, circuit 811 (DG/OG)
LF	pin 1, circuit 804 (OG/LG)	pin 2, circuit 813 (LB/WH)
RR	pin 7, circuit 802 (OG/RD)	pin 8, circuit 803 (BN/PK)
LR	pin 3, circuit 800 (GY/LB)	pin 4, circuit 801 (TN/YL)

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

Yes
GO to F6 .

No
REPAIR the circuit or INSTALL a new speaker as needed. REFER to Section 415-03 . TEST the system for normal operation.

F5 CHECK THE SPEAKER CIRCUITRY

- Key in OFF position.
- Remove the door panel to gain access to the suspect speaker. REFER to Section 501-05 .
- Remove the speaker that has poor sound quality or no sound. REFER to Section 415-03 .
- Disconnect: Speaker Connector.
- Measure the A/C voltage to the speaker that has poor sound quality or no sound as follows:

All Late Build Vehicles

Speaker	Connector	Output	Return
RF (and tweeter)	C612	pin 1, circuit 805 (WH/LG)	pin 2, circuit 811 (GN/OG)

Yes
GO to F7 .

No
REPAIR the circuit or INSTALL a new speaker as needed. REFER to Section 415-03 . TEST the system for normal operation.

LF (and tweeter)	C523	pin 1, circuit 804 (OG/LG)	pin 2, circuit 813 (LB/WH)
RR	802	pin 1, circuit 827 (TN/WH)	pin 2, circuit 801 (TN/YE)
LR	702	pin 1, circuit 827 (TN/WH)	pin 2, circuit 801 (TN/YE)

- **Is the value approximately 2 A/C volts?**

F6 SUBSTITUTE SPEAKER

- Connect: Audio Unit Connector.
- Substitute a known good speaker for each speaker with poor sound quality or no sound.
- Key in ON position.
- Turn on the audio unit.
- **Does the known good speaker(s) have poor sound quality or no sound?**

Yes
REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.

No
INSTALL a new speaker(s) as necessary. REFER to Section 415-03 . TEST the system for normal operation.

F7 CHECK SPEAKER SIGNAL CIRCUITS FOR SHORTS AND OPENS

- Disconnect: Audio Amplifier C4208a.
- Disconnect: Audio Unit C2253d.
- Measure the resistance between the audio amplifier C4211a and the audio unit C2253d; and amplifier C4208a harness side and ground for the speaker that has poor sound quality or no sound as follows.

Speaker	Audio Unit C2253d	Amplifier C4208a
RF	pin 2, circuit 279 (WH/RD)	pin 14, circuit 279 (WH/RD)
RF	pin 11, circuit 858 (BN)	pin 15, circuit 858 (BN)
LF	pin 1, circuit 280 (LG/WH)	pin 2, circuit 280 (LG/WH)
LF	pin 10, circuit 857 (WH/OG)	pin 3, circuit 857 (WH/OG)
RR	pin 4, circuit 278 (PK/WH)	pin 18, circuit 278 (PK/WH)
RR	pin 13, circuit 855 (LB)	pin 19, circuit 855 (LB)
LR	pin 3, circuit 277 (LB/BK)	pin 6, circuit 277 (LB/BK)
LR	pin 12, circuit 859 (YE)	pin 7, circuit 859 (YE)

- **Is the resistance less than 5 ohms between the audio unit and the amplifier and greater than 10,000 ohms between the amplifier and ground?**

Yes
GO to F8 .

No
REPAIR the circuit. TEST the system for normal operation.

F8 SUBSTITUTE SPEAKER

- Connect: Audio Unit Connector.
- Connect: Amplifier C4208a.
- Substitute a known good speaker for each speaker with poor sound quality or no sound.
- Key in ON position.
- Turn on the audio unit.

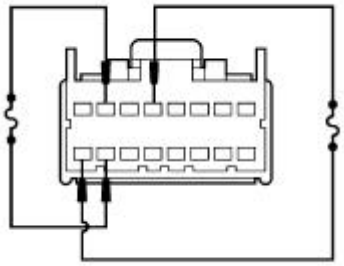
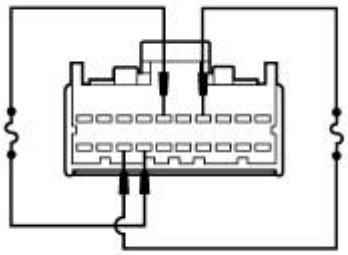
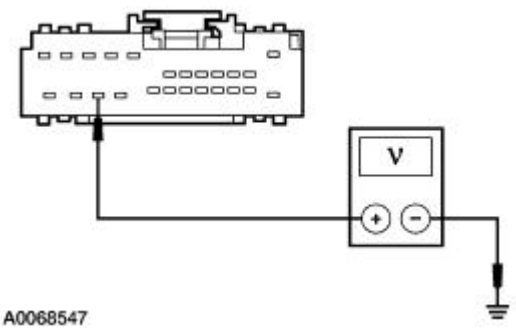
Yes
GO to F9 .

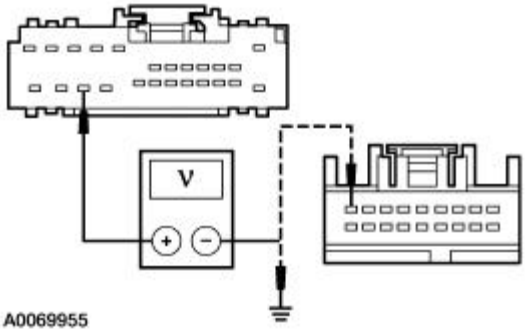
No
INSTALL a new speaker(s) as

• **Does the known good speaker(s) have poor sound quality or no sound?**	necessary. REFER to Section 415-03 . TEST the system for normal operation.
F9 SUBSTITUTE A KNOWN GOOD AUDIO UNIT	
• Substitute a known good audio unit. • **Does the speaker(s) still have poor quality/no sound?**	**Yes** INSTALL a new audio amplifier. REFER to audio amplifier in Section 415-01 . TEST the system for normal operation. **No** REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.

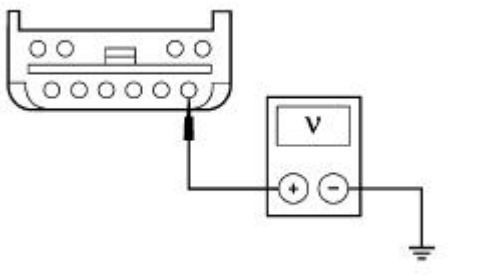
PINPOINT TEST G: POOR SOUND QUALITY/DISTORTED SOUND FROM ALL SPEAKERS

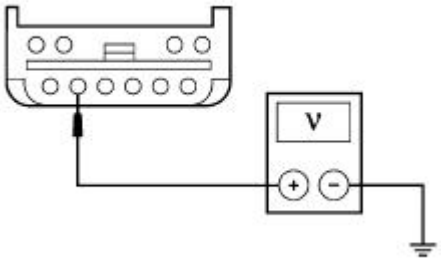
Test Step	Result / Action to Take
G1 CHECK FOR POOR SOUND QUALITY OR NO SOUND	
• Key in ON position. • Turn on the audio unit. • Carry out the speaker walk-around test by pressing the preset buttons 3 and 6 simultaneously. For Navigator with navigation audio unit hold the MAP and the DEST buttons simultaneously for 5 seconds. • **Do all the speakers have poor sound quality or no sound?**	**Yes** GO to G2 . **No** Go To Pinpoint Test F .
G2 BYPASS RSC UNIT	
• Key in OFF position. • Disconnect: RSC Unit C349a (all early build). • Disconnect: RSC Unit C388 (late build with DVD). • For all early build vehicles plus late build vehicles without a DVD player, connect a fused jumper between RSC unit C349a pin 5, circuit 802 (OG/RD) harness side and pin 16, circuit 825 (TN/LG) harness side. Connect another fused jumper between RSC unit C349a pin 7, circuit 800 (GY/LB) harness side and pin 15, circuit 827 (TN/WH) harness side.	**Yes** If all speakers have poor sound quality GO to G3 . If all speakers still have no sound, for Navigator with navigation audio unit GO to G4 . For all others REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation. **No** If all speakers now operate normally, INSTALL a new RSC unit. TEST system for normal operation. If one

 A0050793 ● For late build vehicles with a DVD player, connect a 10A fused jumper wire between RSC unit C388 pin 4, circuit 802 (OG/RD), harness side and pin 18, circuit 825 (TN/LG), harness side. Connect another 10A fused jumper wire between RSC unit C388 pin 6, circuit 800 (GY/LB), harness side and pin 17, circuit 827 (TN/WH), harness side.  A0068546 ● Key in ON position. ● **Do all speakers still have poor sound quality or no sound?**	or more speakers has poor sound quality or no sound, Go To Pinpoint Test F .
G3 CHECK THE VOLUME RANGE FOR DISTORTION ● Vary the volume level of the audio unit. ● **Is the distortion only at high volume levels?**	**Yes** The system is OK. **No** REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.
G4 CHECK CIRCUIT 173 (DG/PK) ● Key in OFF position. ● Disconnect: Audio Amplifier C4208a. ● Key in ON position. ● Measure the voltage between the audio amplifier C4208a pin 22, circuit 173 (DG/PK), harness side and ground.  A0068547 ● **Is the voltage 3.8 - 6.7 volts?**	**Yes** INSTALL a new audio amplifier. TEST the system for normal operation. **No** GO to G5 .

G5 CHECK CIRCUIT 173 (DG/PK) FOR AN OPEN OR A SHORT TO GROUND	
• Disconnect: Audio Unit C2253d. • Measure the resistance between the audio amplifier C4208a pin 22, circuit 173 (DG/PK), harness side and the audio unit C2253d pin 9, circuit 173 (DG/PK), harness side; and between audio amplifier C4208a pin 22, circuit 173 (DG/PK), harness side and ground.  A0069955 • **Is the resistance less than 5 ohms between the audio unit and the amplifier and greater than 10,000 ohms between the amplifier and ground?**	**Yes** REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation. **No** REPAIR the circuit, and TEST the system for normal operation.

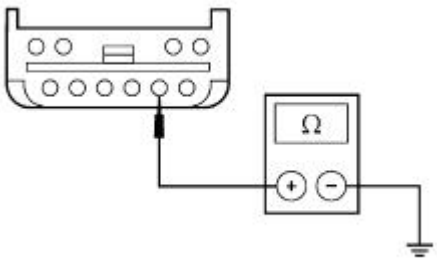
PINPOINT TEST H: THE SUBWOOFER IS INOPERATIVE—EXCEPT NAVIGATOR WITH NAVIGATION AUDIO UNIT

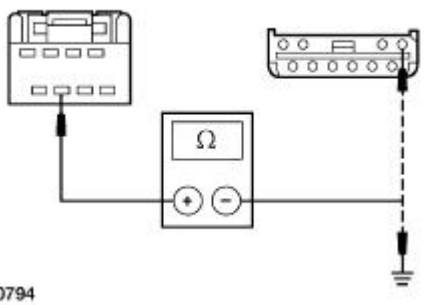
Test Step	Result / Action to Take
H1 CHECK CIRCUIT 173 (DG/VT) FOR VOLTAGE	
• Key in OFF position. • Disconnect: Subwoofer C466. • Key in ON position. • Measure the voltage between the subwoofer amplifier C466 pin 1, circuit 173 (DG/VT), harness side and ground.  GK8799-A • **Is voltage present?**	**Yes** GO to H2 . **No** GO to H6 .
H2 CHECK CIRCUIT 797 (LG/VT) FOR VOLTAGE	
• Key in ON position. • Measure the voltage between the subwoofer amplifier C466 pin 5, circuit 797 (LG/VT), harness side and ground.	**Yes** GO to H3 . **No** REPAIR the circuit. TEST the system for normal operation.

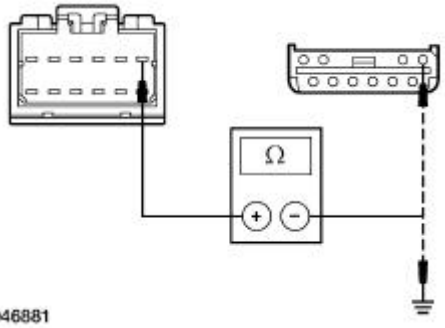


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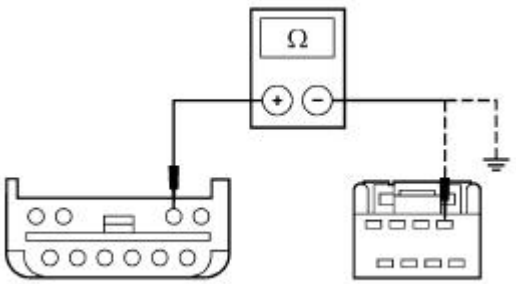
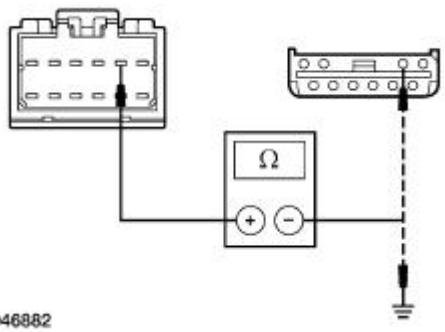
- **Is the voltage greater than 10 volts?**

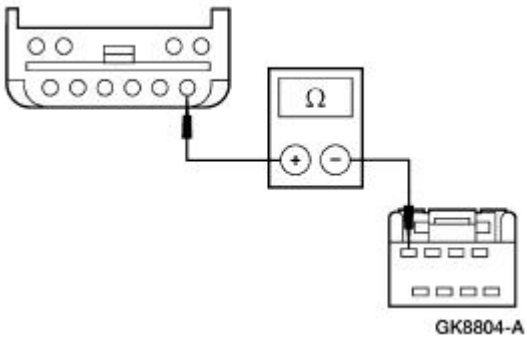
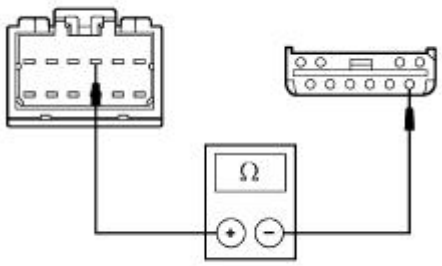
H3 CHECK CIRCUIT 1204 (BK/OG) FOR AN OPEN	
• Measure the resistance between the subwoofer amplifier C466 pin 2, circuit 1204 (BK/OG), harness side and ground.  GK8801-A • **Is the resistance less than 5 ohms?**	**Yes** GO to H4 . **No** REPAIR the circuit. TEST the system for normal operation.

H4 CHECK CIRCUIT 167 (BN/OG) FOR OPEN OR SHORT TO GROUND	
• Key in OFF position. • Disconnect: Audio Unit. • Measure the resistance between the subwoofer amplifier C466 pin 7, circuit 167 (BN/OG), harness side and the audio unit C290c pin 2, circuit 167 (BN/OG), harness side; and between the subwoofer amplifier C466 pin 7, circuit 167 (BN/OG), harness side and ground.  A0050794 • For VNR, measure the resistance between the subwoofer amplifier C466 pin 7, circuit 167 (BN/OG), harness side and the audio unit C2188e pin 1, circuit 167 (BN/OG), harness side; and between the subwoofer amplifier C466 pin 7, circuit 167 (BN/OG), harness side and ground.	**Yes** GO to H5 . **No** REPAIR the circuit. TEST the system for normal operation.

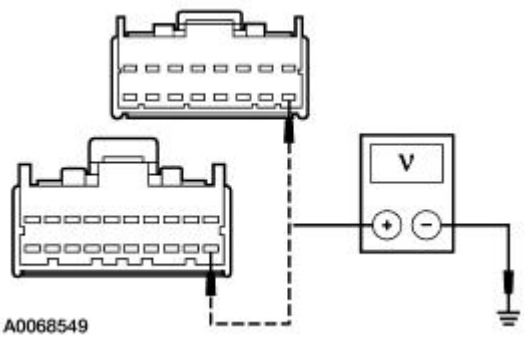


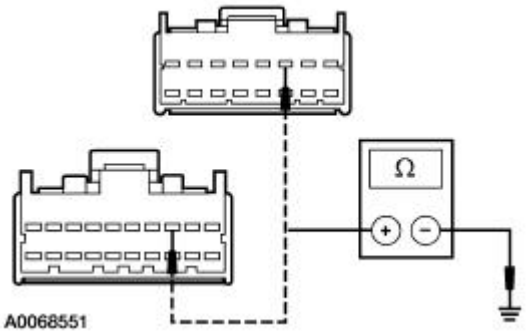
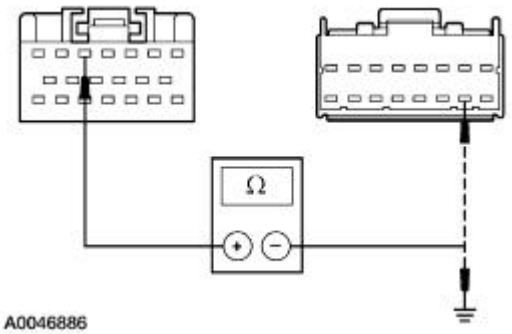
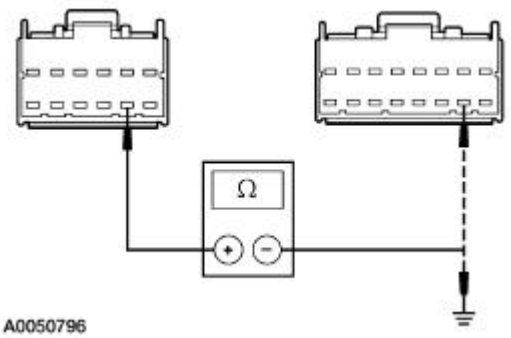
- **Is the resistance less than 5 ohms between the subwoofer amplifier and the audio unit and greater than 10,000 ohms between the subwoofer amplifier and ground?**

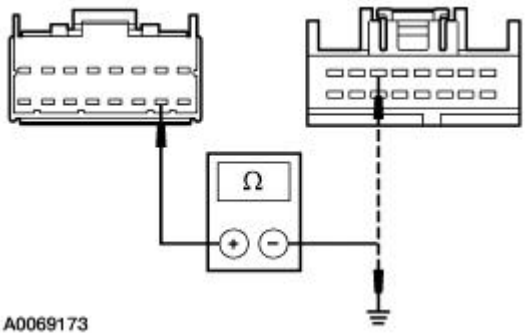
H5 CHECK CIRCUIT 168 (RD/BK) FPR AN OPEN OR A SHORT TO GROUND	
• Measure the resistance between the subwoofer amplifier C466 pin 8, circuit 168 (RD/BK), harness side and the audio unit C290c pin 1, circuit 168 (RD/BK), harness side; and between the subwoofer amplifier C466 pin 8, circuit 168 (RD/BK), harness side and ground.  GK8803-A • For VNR, measure the resistance between the subwoofer amplifier C466 pin 8, circuit 168 (RD/BK), harness side and the audio unit C2188e pin 2, circuit 168 (RD/BK), harness side; and between the subwoofer amplifier C466 pin 8, circuit 168 (RD/BK), harness side and ground.  A0046882 • **Is the resistance less than 5 ohms between the subwoofer amplifier and the audio unit, and greater than 10,000 ohms between the subwoofer amplifier and ground?**	**Yes** REMOVE the subwoofer amplifier and SEND it to an authorized audio system repair facility. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
H6 CHECK CIRCUIT 173 (DG/VT) FOR AN OPEN	
• Measure the resistance between the subwoofer amplifier C466 pin 1, circuit 173 (DG/VT), harness side and the audio unit C290c pin 4, circuit 173 (DG/VT), harness side.	**Yes** REMOVE the subwoofer amplifier and SEND it to an authorized Ford audio system repair facility. TEST the system for

 GK8804-A ● For VNR, measure the resistance between the subwoofer amplifier C466 pin 1, circuit 173 (DG/VT), harness side and the audio unit C2188e pin 3, circuit 173 (DG/VT), harness side.  A0050795 ● **Is the resistance less than 5 ohms?**	normal operation. **No** REPAIR the circuit. TEST the system for normal operation.

PINPOINT TEST I: THE AUXILIARY AUDIO CONTROL IS INOPERATIVE — REAR SEAT CONTROLLER (RSC) UNIT

Test Step	Result / Action to Take
I1 CHECK CIRCUIT 720 (RD/YL) FOR AN OPEN	
● Key in OFF position. ● Disconnect: RSC Unit. ● Key in ON position. ● Measure the voltage between the RSC unit C388 pin 11, circuit 720 (RD/YL), harness side and ground (late build with DVD, except VNR). For all others, measure the voltage between the RSC unit C349a pin 9, circuit 720 (RD/YL), harness side and ground.  A0068549 ● **Is the voltage greater than 10 volts?**	**Yes** GO to I2 . **No** REPAIR the circuit. TEST the system for normal operation.
I2 CHECK CIRCUIT 694 (BK/LG) FOR AN OPEN	
● Measure the resistance between C388, pin 3, circuit 694 (BK/LG), harness side and ground (late build with DVD); or between C349a, pin 3,	**Yes** If late build

circuit 694 (BK/LG), harness side and ground (all others).  ● **Is the resistance less than 5 ohms?**	with DVD (except VNR) GO to I6 . All others GO to I3 . **No** REPAIR the circuit. TEST the system for normal operation.
I3 CHECK CIRCUIT 1068 (LG/BK) FOR AN OPEN AND A SHORT TO GROUND — WITHOUT DVD	
● Disconnect: Audio Unit C290b (CDX6). ● Disconnect: Audio Unit C2188d (VNR). ● Disconnect: Audio Unit C2253b (Navigator with navigation audio unit). ● Disconnect: Audio Unit C240b (late build DM100i). ● Measure the resistance between the audio unit C290b pin 5, circuit 1068 (LG/BK), harness side and the RSC unit C349a pin 10, circuit 1068 (LG/BK), harness side; and between the audio unit C290b pin 5, circuit 1068 (LG/BK), harness side and ground.  ● For VNR, measure the resistance between the audio unit C2188d pin 8, circuit 1068 (LG/BK), harness side and the RSC unit C349a pin 10, circuit 1068 (LG/BK), harness side; and between the audio unit C2188d pin 8, circuit 1068 (LG/BK), harness side and ground.  ● Measure the resistance between the audio unit C240b pin 6, circuit 1068 (LG/BK), harness side and the RSC unit C349a pin 10, circuit 1068 (LG/BK), harness side; and between the audio unit C349a pin 10, circuit 1068 (LG/BK), harness side and ground (late build DM100i). Measure the resistance between the audio unit C2253b pin 6, circuit 1068 (LG/BK), harness side and the RSC unit C349a pin 10, circuit 1068 (LG/BK), harness side; and between the RSC unit C349a pin 10, circuit 1068 (LG/BK), harness side and ground (Navigator with navigation audio unit).	**Yes** GO to I4 . **No** REPAIR the circuit. TEST the system for normal operation.

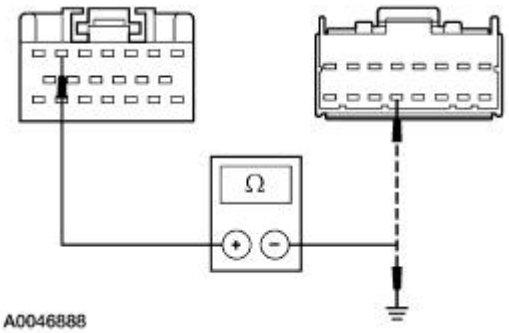


A0069173

- **Is the resistance less than 5 ohms between the audio unit and RSC unit, and greater than 10,000 ohms between the audio unit and ground?**

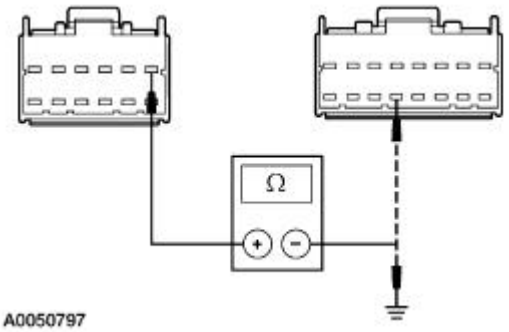
I4 CHECK CIRCUIT 832 (LB/PK) FOR AN OPEN AND SHORT TO GROUND—WITHOUT DVD

- Measure the resistance between the audio unit C290b pin 6, circuit 832 (LB/PK), harness side and the RSC unit C349a pin 13, circuit 832 (LB/PK), harness side and between the audio unit C290b pin 6, circuit 832 (LB/PK), harness side and ground.



A0046888

- For VNR, measure the resistance between the audio unit C2188d pin 1, circuit 832 (LB/PK), harness side and the RSC unit C349a pin 13, circuit 832 (LB/PK), harness side and between the audio unit C2188d pin 1, circuit 832 (LB/PK), harness side and ground.

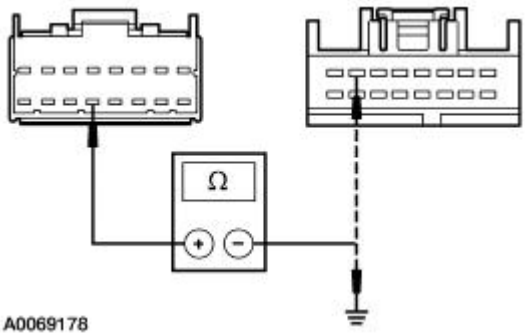


A0050797

- For late build DM100i, measure the resistance between the audio unit C240b pin 7, circuit 832 (LB/PK), harness side and the RSC unit C349a pin 13, circuit 832 (LB/PK), harness side; and between the audio unit C349a pin 13, circuit 832 (LB/PK), harness side and ground. Navigator with navigation audio unit, measure the resistance between the audio unit C2253b pin 7, circuit 832 (LB/PK), harness side and the RSC unit C349a pin 13, circuit 832 (LB/PK), harness side; and between the RSCo unit C349a pin 13, circuit 832 (LB/PK), harness side and ground.

Yes
GO to I5 .

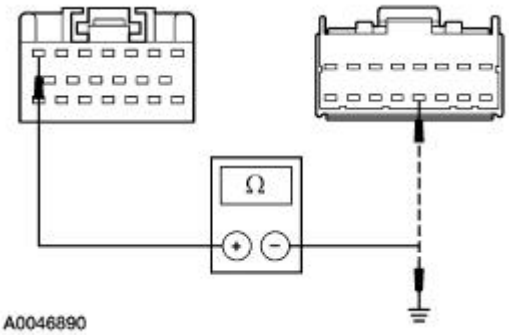
No
REPAIR the circuit. TEST the system for normal operation.



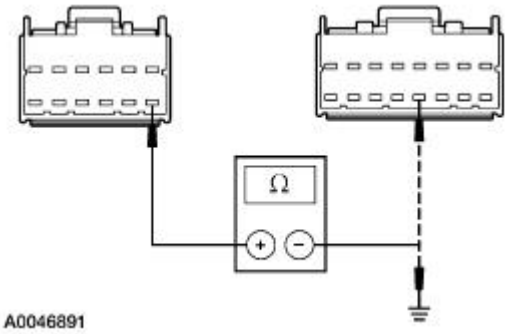
- **Is the resistance less than 5 ohms between the audio unit and the RSC unit, and greater than 10,000 ohms between the audio unit and ground?**

I5 CHECK CIRCUIT 833 (TN) FOR AN OPEN OR SHORT TO GROUND—WITHOUT DVD

- Measure the resistance between the audio unit C290b pin 7, circuit 833 (TN), harness side and the RSC unit C349a pin 12, circuit 833 (TN), harness side; and between the audio unit C290b pin 7, circuit 833 (TN), harness side and ground.



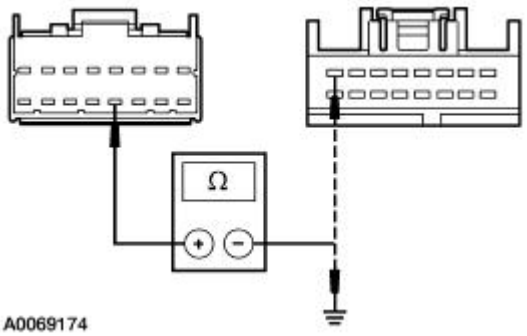
- For VNR, measure the resistance between the audio unit C2188d pin 7, circuit 833 (TN), harness side and the RSC unit C349a pin 12, circuit 833 (TN), harness side; and between the audio unit C2188d pin 7, circuit 833 (TN), harness side and ground.



- For late build DM100i, measure the resistance between the audio unit C240b pin 8, circuit 833 (TN), harness side and the RSC unit C349a pin 11, circuit 833 (TN), harness side; and between the audio unit C240b pin 8, circuit 833 (TN), harness side and ground. Navigator with navigation audio unit, measure the resistance between the audio unit C2253b pin 8, circuit 833 (TN), harness side and the RSC unit C349a pin 11, circuit 833 (TN), harness side; and between the audio unit C2253b pin 8, circuit 833 (TN), harness side and ground.

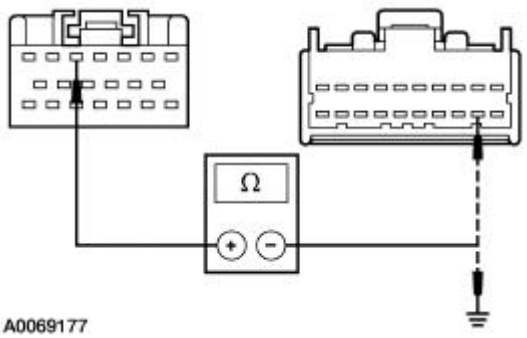
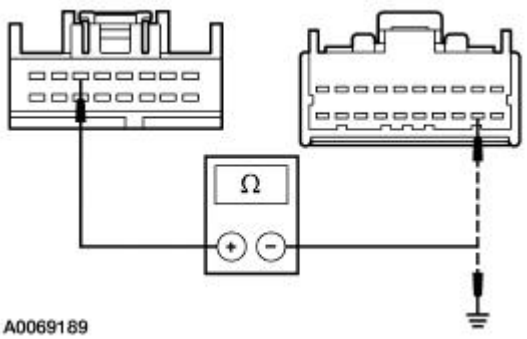
Yes
INSTALL a new RSC unit. REFER to Section 415-01 . TEST the system for normal operation.

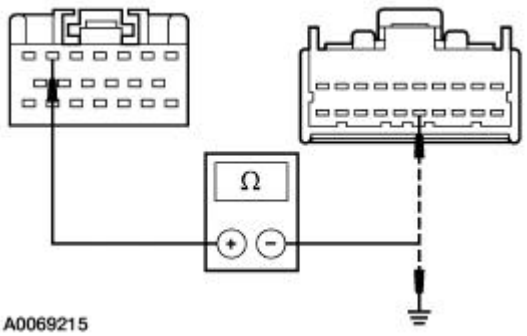
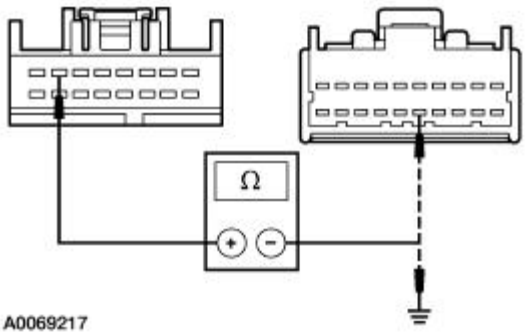
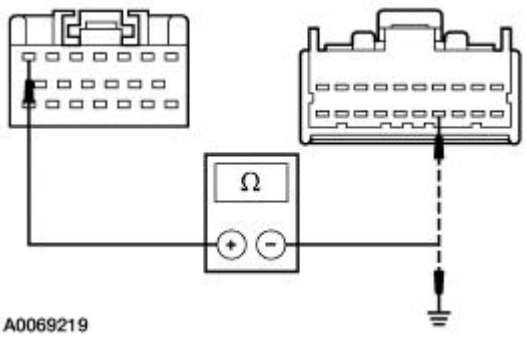
No
REPAIR the circuit. TEST the system for normal operation.

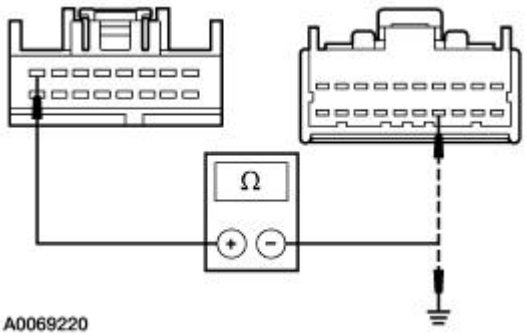


A0069174

- **Is the resistance less than 5 ohms between the audio unit and the RSC unit, and greater than 10,000 ohms between the audio unit and ground?**

I6 CHECK CIRCUIT 1068 (LG/BK) FOR AN OPEN AND A SHORT TO GROUND—WITH DVD	
• Disconnect: Audio Unit Connector. • For CDX6, measure the resistance between the audio unit C290b pin 5, circuit 1068 (LG/BK), harness side and the RSC unit C388 pin 12, circuit 1068 (LG/BK), harness side; and between the audio unit C290b pin 5, circuit 1068 (LG/BK), harness side and ground.  A0069177 • Measure the resistance between the audio unit C2253b (Navigator with navigation audio unit) or C240b (DM100i) pin 6, circuit 1068 (LG/BK), harness side and the RSC unit C388 pin 12, circuit 1068 (LG/BK), harness side; and between the audio unit C290b pin 6, circuit 1068 (LG/BK), harness side and ground .  A0069189 • **Is the resistance less than 5 ohms between the audio unit and RSC unit, and greater than 10,000 ohms between the audio unit and ground?**	**Yes** GO to I7 . **No** REPAIR the circuit. TEST the system for normal operation.
I7 CHECK CIRCUIT 832 (LB/PK) FOR AN OPEN AND SHORT TO GROUND—WITH DVD	
• For CDX6, measure the resistance between the audio unit C290b pin 6, circuit 832 (LB/PK), harness side and the RSC unit C388 pin 15, circuit 832 (LB/PK), harness side and between the audio unit C290b pin 6, circuit 832 (LB/PK), harness side and ground.	**Yes** GO to I8 . **No** REPAIR the circuit. TEST

 A0069215 ● Measure the resistance between the audio unit C2253b (Navigator with navigation audio unit) or C240b (DM100i) pin 7, circuit 832 (LB/PK), harness side and the RSC unit C388 pin 15, circuit 832 (LB/PK), harness side and between the audio unit C2253b pin 7, circuit 832 (LB/PK), harness side and ground.  A0069217 ● **Is the resistance less than 5 ohms between the audio unit and the RSC unit, and greater than 10,000 ohms between the audio unit and ground?**	the system for normal operation.
I8 CHECK CIRCUIT 833 (TN) FOR AN OPEN OR SHORT TO GROUND—WITH DVD ● For CDX6 measure the resistance between the audio unit C290b pin 7, circuit 833 (TN), harness side and the RSC unit C388 pin 14, circuit 833 (TN), harness side; and between the audio unit C290b pin 7, circuit 833 (TN), harness side and ground.  A0069219 ● Measure the resistance between the audio unit C2253b (Navigator with navigation audio unit) or C240b (DM100i) pin 8, circuit 833 (TN), harness side and the RSC unit C388 pin 14, circuit 833 (TN), harness side and between the audio unit C2253b pin 8, circuit 833 (TN), harness side and ground.	**Yes** INSTALL a new RSC unit. REFER to Section 415-01 . TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.

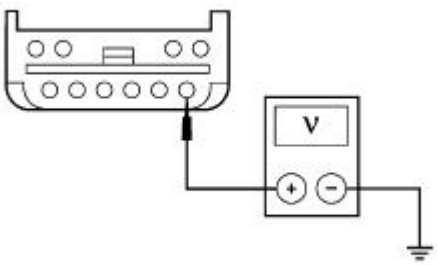


A0069220

- **Is the resistance less than 5 ohms between the audio unit and the RSC unit, and greater than 10,000 ohms between the audio unit and ground?**

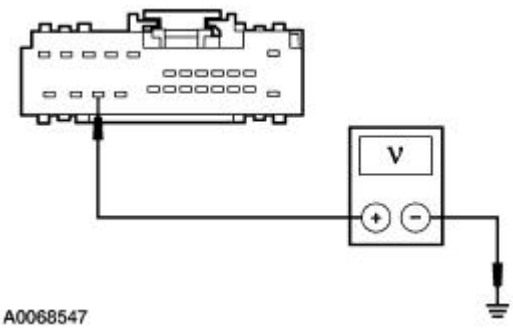
PINPOINT TEST J: LOUD POPPING SOUND WHEN CYCLING THE IGNITION SWITCH

Test Step	Result / Action to Take
J1 CHECK CIRCUIT 173 (DG/VT) FOR A SHORT TO BATTERY	
• Key in OFF position. • Disconnect: Subwoofer Amplifier C466. • Disconnect: Audio Amplifier C4208. • For all early build and CDX6, measure the voltage between the subwoofer amplifier C466 pin 1, circuit 173 (DG/VT), harness side and ground.	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** REMOVE the subwoofer amplifier and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.



GK8799-A

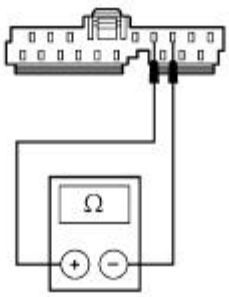
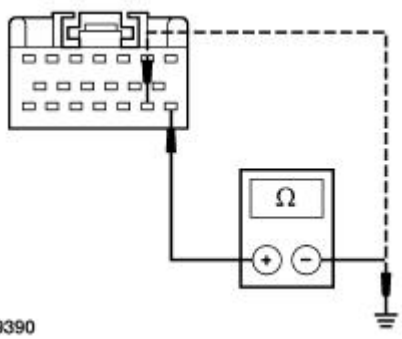
- For Navigator with navigation audio unit, measure the voltage between the audio amplifier C4208a pin 22, circuit 173 (DG/VT), harness side and ground.



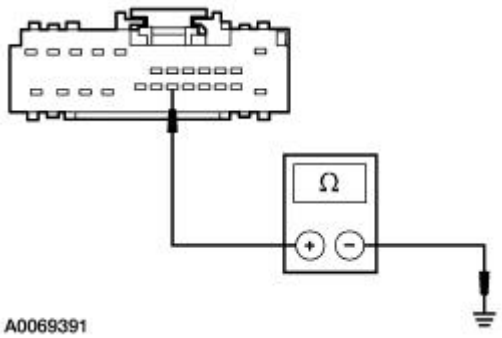
A0068547

- **Is voltage present?**

PINPOINT TEST K: THE AUXILIARY AUDIO CONTROL IS INOPERATIVE — STEERING WHEEL CONTROL

Test Step	Result / Action to Take
K1 CHECK THE STEERING WHEEL CONTROL SWITCH CIRCUITS ● Key in OFF position. ● Disconnect: Audio Unit Connector. ● For VNR, measure the resistance between the audio unit C2188c pin 11, circuit 595 (LB/RD), harness side and audio unit C2188c pin 12, circuit 848 (DG/OG), harness side while pressing the steering wheel control switches as follows:  A0046892 ● For all early build vehicles except VNR, measure the resistance between the audio unit C290b pin 14, circuit 595 (LB/RD), harness side and audio unit C290b pin 15, circuit 848 (DG/OG), harness side; for late build CDX6, measure the resistance between the audio unit C290b pin 14, circuit 595 (LB/RD), harness side and ground while pressing the steering wheel control switches as follows: **Switch** / **Resistance Range** VOL Down — 69.3-77.4 ohms VOL Up — 198.5-217.7 ohms NEXT — 419.4-467.5 ohms MEDIA — 851.4-941.1 ohms No Buttons Pressed — 4,560-5,080 ohms  A0069390 ● For late build DM100i, measure the resistance between the audio unit C240a pin 18, circuit 595 (LB/RD), harness side and ground; or for Navigator with navigation audio unit measure the resistance between the audio unit C2253a pin 18, circuit 595 (LB/RD), harness side and ground as follows: **Switch** / **Resistance Range** MEDIA — 52.4-54.8 ohms NEXT — 143.4-150.0 ohms	**Yes** REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation. **No** For all late build vehicles, GO to K4 . For all others GO to K2 .

VOL UP	293.9-307.4 ohms
VOL DOWN	549.0-574.3 ohms
REPEAT	1,013.4-1,060.0 ohms
VOICE	1,990.9-2,082.5 ohms
No Buttons Pressed	4,933.1-5,160 ohms

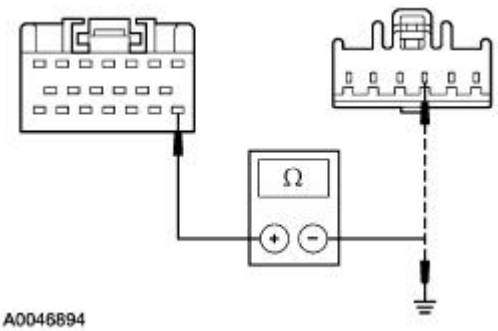


A0069391

- **Are the resistances within specifications?**

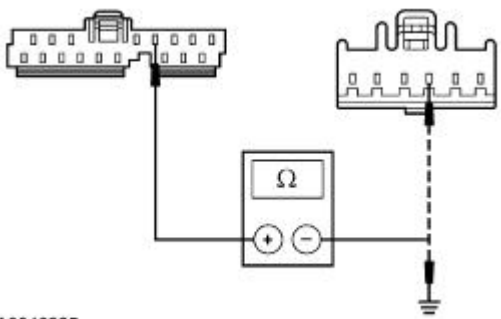
K2 CHECK CIRCUIT 595 (LB/RD) FOR OPEN OR SHORT TO GROUND

- Disconnect: Clockspring C218b.
- For all except VNR, measure the resistance between the audio unit C290b pin 14, circuit 595 (LB/RD), harness side and the clockspring C218b pin 3, circuit 595 (LB/RD), harness side; and between the audio unit C290b pin 14, circuit 595 (LB/RD), harness side and ground.



A0046894

- For VNR, measure the resistance between the audio unit C2188c pin 11, circuit 595 (LB/RD), harness side and the clockspring C218b pin 3, circuit 595 (LB/RD), harness side; and between the audio unit C2188c pin 11, circuit 595 (LB/RD), harness side and ground.



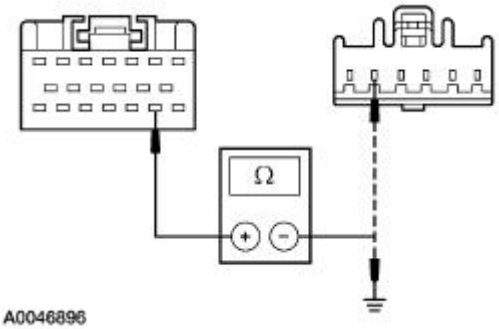
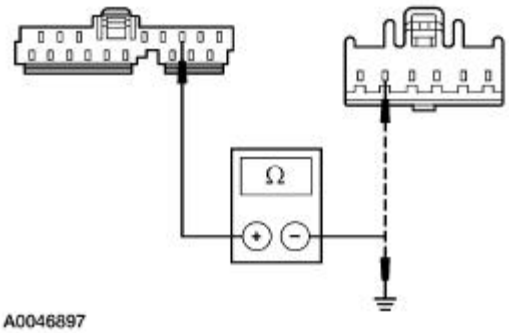
A0046895

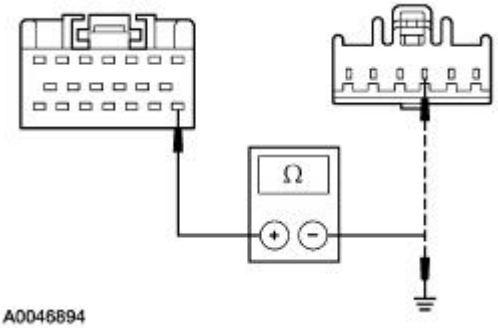
- **Is the resistance less than 5 ohms between the audio unit and the clockspring, and greater than 10,000 ohms between the audio unit and ground?**

Yes
GO to K3 .

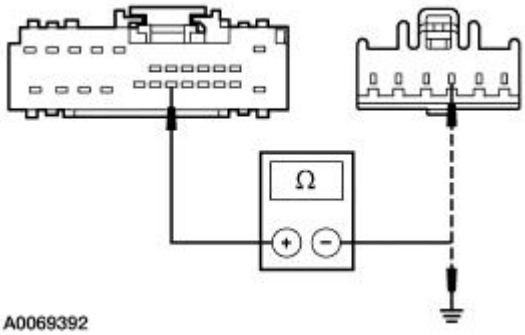
No
REPAIR the circuit. TEST the system for normal operation.

K3 CHECK CIRCUIT 848 (DG/OG) FOR AN OPEN OR A SHORT TO

GROUND ● For all except VNR, measure the resistance between the audio unit C290b pin 15, circuit 848 (DG/OG), harness side, and the clockspring C218b pin 5, circuit 848 (DG/OG), harness side; and between the audio unit C290b pin 15, circuit 848 (DG/OG), harness side and ground.  A0046896 ● For VNR, measure the resistance between the audio unit C2188c pin 12, circuit 848 (DG/OG), harness side and the clockspring C218b pin 5, circuit 848 (DG/OG), harness side; and between the audio unit C2188c pin 12, circuit 848 (DG/OG), harness side and ground.  A0046897 ● **Is the resistance less than 5 ohms between the audio unit and the clockspring, and greater than 10,000 ohms between the audio unit and ground?**	**Yes** INSTALL new steering wheel control switches. REFER to Section 211-05 . TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
K4 CHECK THE SPEED CONTROL — LATE BUILD ● Verify the correct operation of the speed control. ● **Does the speed control operate correctly?**	**Yes** GO to K5 . **No** REFER to Section 310-03 .
K5 CHECK CIRCUIT 595 (LB/RD) FOR OPEN OR SHORT TO GROUND — LATE BUILD ● Disconnect: Clockspring C218b. ● For CDX6, measure the resistance between the audio unit C290b pin 14, circuit 595 (LB/RD), harness side and the clockspring C218b pin 3, circuit 595 (LB/RD), harness side; and between the audio unit C290b pin 14, circuit 595 (LB/RD), harness side and ground.	**Yes** GO to K6 . **No** REPAIR the circuit. TEST the system for normal operation.



- For DM100i, measure the resistance between the audio unit C240a pin 18, circuit 595 (LB/RD), harness side and the clockspring C218b pin 3, circuit 595 (LB/RD), harness side; and between the audio unit C240a pin 18, circuit 595 (LB/RD), harness side and ground; or for Navigator with navigation audio unit, measure the resistance between the audio unit C2253a pin 18, circuit 595 (LB/RD), harness side and the clockspring C218b pin 3, circuit 595 (LB/RD), harness side; and between the audio unit C2253a pin 18, circuit 595 (LB/RD), harness side and ground.



- **Is the resistance less than 5 ohms between the audio unit and the clockspring, and greater than 10,000 ohms between the audio unit and ground?**

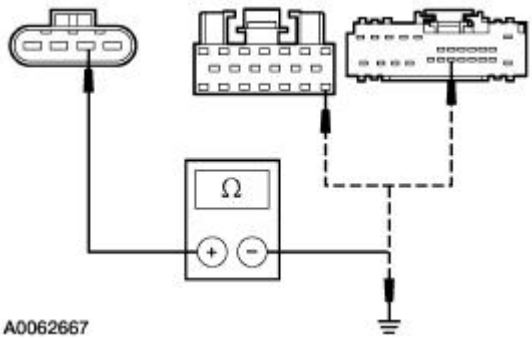
K6 CHECK CIRCUIT 595 (LB/RD) FOR OPEN OR SHORT TO GROUND — LATE BUILD

- Connect: Clockspring C218b.
- Disconnect: Steering Wheel Audio Control Switch Connector.
- Measure the resistance between the steering wheel audio control switch connector pin 2, circuit 595 (LB/RD), harness side and ground; and between the steering wheel audio control switch connector pin 2, circuit 595 (LB/RD), harness side and the audio unit as follows.

Audio Unit	Connector-Pin	Circuit
CDX6	C240c-14	595
DM100i	C240a-18	595
Navigator with navigation audio unit	C2253a-18	595

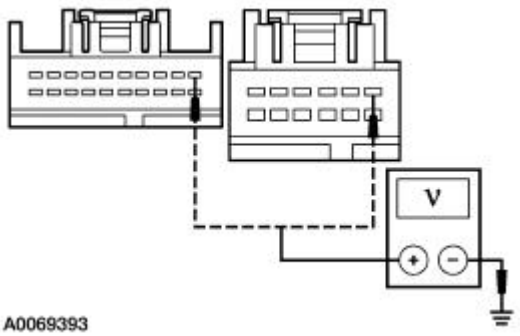
Yes
INSTALL new steering wheel audio control switches. REFER to Steering Wheel Audio Controls in this section. TEST the system for normal operation.

No
GO to K7

 ● **Is the resistance greater than 10,000 ohms between the steering wheel audio control switch and ground; and less than 5 ohms between the steering wheel audio control switch and the audio unit?**	
K7 CHECK THE HORN SWITCH HARNESS FOR AN OPEN OR SHORT TO GROUND — LATE BUILD	
● Inspect the horn switch harness for opens and shorts to ground. ● **Is the horn switch harness OK?**	**Yes** INSTALL a new clockspring. REFER to Section 501-20B . TEST the system for normal operation. **No** REPAIR the circuit and TEST the system for normal operation.

PINPOINT TEST L: THE VIDEO SYSTEM IS INOPERATIVE/DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
L1 VERIFY OPERATION OF THE DVD PLAYER	
● Key in ON position. ● Insert a known good DVD disc into the DVD player. ● **Is there an image displayed on the screen?**	**Yes** If the DVD player turns on and there is no audio, GO to L4 . **No** GO to L2 .
L2 CHECK VOLTAGE TO THE DVD PLAYER	
● Key in OFF position. ● Disconnect: DVD C949 (early build). ● Disconnect: DVD C9020 (late build). ● Key in ON position. ● Measure the voltage between the DVD player C949 (early build) pin 1, circuit 720 (RD/YL), harness side and ground; or C9020 pin 1 (late build), circuit 720 (RD/YL), harness side and ground.	**Yes** GO to L3 . **No** REPAIR the circuit. TEST the system for normal operation.

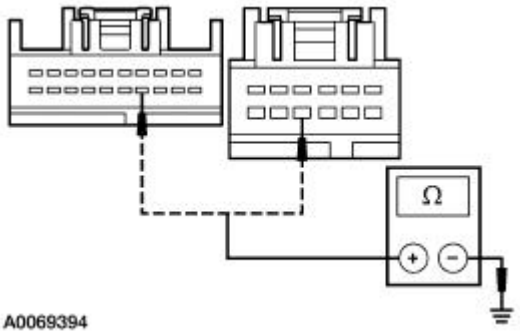


A0069393

- **Is voltage greater than 10 volts?**

L3 CHECK GROUND CIRCUIT 694 (BK/LG) FOR AN OPEN

- Key in OFF position.
- Measure the resistance between the DVD player C949 (early build) pin 10, circuit 694 (BK/LG), harness side and ground; or C9020 pin 14 (late build), circuit 694 (BK/LG), harness side and ground.



A0069394

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

Yes
GO to L4 .

No
REPAIR the circuit. TEST the system for normal operation.

L4 CHECK AUDIO AND ACP CIRCUITS FOR AN OPEN

- Key in OFF position.
- Disconnect: Audio Unit Connector.
- Disconnect: RSC Unit connector(s).
- Disconnect: DVD Connector.
- Measure the resistance between the audio unit and the DVD player and between the RSC unit and the DVD player in the following groups:

VNR Unit Pin	All CDX6 Audio Unit Pin	Navigator Navigation Audio Unit Pin	RSC Unit Pin	DVD Pin	Circuit
C2188d pin 8	C290b pin 5	C2253b pin 6	C349a pin 10 (early build), or C388 pin 12 (late build)	C949 pin 2 (early build), or C9020 pin 2 (late build)	1068 (LG/BK)
C2188d pin 1	C290b pin 6	C2253b pin 7	C349a pin 13 (early build), or C388 pin 15 (late build)	C949 pin 7 (early build), or C9020 pin 11 (late build)	832 (LB/PK)
C2188d pin 7	C290b pin 7	C2253b pin 8	C349a pin 12 (early	C949 pin 8 (early	833 (TN)

Yes
CONTACT an authorized Ford audio repair facility for further diagnostic test procedures.

No
REPAIR the circuit. TEST the system for normal operation.

			build), or C388 pin 14 (late build)	build), or C9020 pin 12 (late build)	
—	C290b pin 17	C2253b pin 9	C349b pin 11 (VNR)	C949 pin 6 (early build), or C9020 pin 6 (late build)	1805 (RD)

VNR Unit Pin	All CDX6 Audio Unit Pin	Navigator Navigation Audio Unit Pin	RSC Unit Pin	DVD Pin	Circuit
—	C290b pin 18	C2253b pin 10	C349b pin 3 (VNR)	C949 pin 12 (early build), or C9020 pin 16 (late build)	1806 (BK)
—	C290b pin 19	C2253b pin 1	C349b pin 12 (VNR)	C949 pin 5 (early build), or C9020 pin 5 (late build)	1803 (WH)
—	C290b pin 20	C2253b pin 2	C349b pin 4 (VNR)	C949 pin 11 (early build), or C9020 pin 15 (late build)	1804 (LG)

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

PINPOINT TEST M: THE SUBWOOFER IS INOPERATIVE—NAVIGATOR WITH NAVIGATION AUDIO UNIT ONLY

Test Step	Result / Action to Take
M1 CHECK THE AMPLIFIER OUTPUT CIRCUITS	
• Key in OFF position. • Disconnect: Subwoofer C4212. • Disconnect: Audio Amplifier C4208b. • Measure the resistance between the audio amplifier and the subwoofer; and between the audio amplifier and ground as follows.	**Yes** GO to M2 . **No** REPAIR the circuit and TEST the system for normal operation.

Audio Amplifier C4208b	Subwoofer C4212
pin 13, circuit 287 (BK/WH)	pin 3, circuit 287 (BK/WH)
pin 15, circuit 288 (VT)	pin 1, circuit 288 (VT)
pin 14, circuit 822 (BK/LG)	pin 4, circuit 287 (BK/LG)

pin 16, circuit 823 (LG)	pin 2, circuit 823 (LG)

- **Is the resistance less than 5 ohms between the amplifier and the subwoofer and greater than 10,000 ohms between the amplifier and ground?**

M2 CHECK THE AMPLIFIER INPUT CIRCUITS	
• Key in OFF position. • Disconnect: Audio Amplifier C4208a. • Disconnect: Audio Unit C2253d. • Measure the resistance between the audio amplifier and the audio unit; and between the audio amplifier and ground as follows. **Audio Amplifier C4208b** / **Audio Unit C2253d** pin 5, circuit 167 (BN/OG) / pin 16, circuit 167 (BN/OG) pin 4, circuit 168 (RD/BK) / pin 7, circuit 168 (RD/BK) • **Is the resistance less than 5 ohms between the amplifier and the subwoofer and greater than 10,000 ohms between the amplifier and ground?**	**Yes** GO to M3 . **No** REPAIR the circuit. TEST the system for normal operation.
M3 SUBSTITUTE A KNOWN GOOD AUDIO UNIT	
• Substitute a known good audio unit. • **Does the subwoofer operate correctly?**	**Yes** REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation. **No** REMOVE the audio amplifier and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.

Torque Specifications

Description	Nm	lb-ft	lb-in
Radio frequency interference suppression bond to bulkhead screw	12	9	—
Radio frequency interference suppression bond to engine nut	11	8	—
Radio frequency interference suppression bond frame to floorpan screws	12	9	—
Air bag module plate bolts	8	—	71
Steering wheel controls fasteners	2	—	18

Audio System

Two audio systems are available:

- DM100 premium AM/FM/Cassette/CD (standard on Expedition)
- CDX6 AM/FM/6 disc CD in-dash (premium)
- audiophile CDX6 AM/FM/6 disc CD in-dash (standard on Navigator)
- optional Vehicle Navigation Radio (VNR) with remote 6 disc CDDJ

The following options are available:

- rear passenger controls
- steering wheel integrated audio controls (Expedition Eddie Bauer and Navigator)
- the dual media and premium CDX6 systems include four door-mounted speakers
- audiophile and VNR systems include premium front door speakers, rear door speakers and rear mounted subwoofer assembly.
- an optional video system is available (Eddie Bauer only). For additional information, refer to Section 415-07 .

Rear Auxiliary Audio Controls

The rear audio unit control panel controls allow the rear passengers to control volume, station, AM/FM band, memory presets, and speaker or headphone selection. The mini-headphone jacks are also located on the panel.

The rear audio unit control panel is located at the rear of the center console.

Steering Wheel Integrated Audio Controls

The audio controls on the steering wheel allow the driver to control volume, AM/FM band, CD and memory presets.

Audio System —Radio Frequency Interference Suppression Equipment

The radio frequency suppression equipment consists of the following components:

- radio frequency interference suppression bond to bulkhead screw
- radio frequency interference suppression bond straps
- radio frequency interference suppression bond to engine nut
- radio ignition interference capacitors
- radio frequency interference suppression bond frame to floorpan screws

The radio suppression equipment reduces interference transmitted through the speakers by the engine ignition and electrical systems. When installing any radio suppression equipment components, make sure that a good contact is made at all connections. Remove any paint or dirt from between a component and its ground. Tighten all connectors and screws securely according to torque specifications. Refer to Specifications in this section.

Audio System —Radio Frequency Interference Suppression Equipment

Refer to Section 415-00 .

Audio Unit

Removal and Installation

Vehicles with column shift

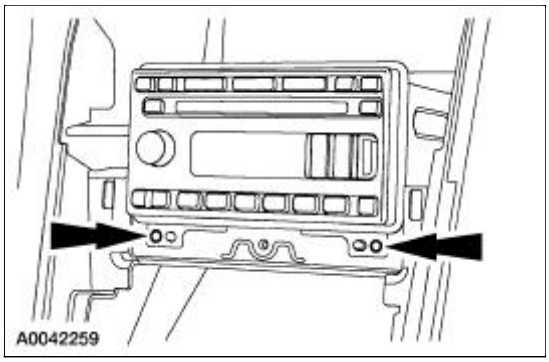
1. Remove the instrument cluster finish panel. For additional information, refer to Section 501-12 .

Vehicles with floor shift

2. Remove the instrument cluster center finish panel. For additional information, refer to Section 501-12 .

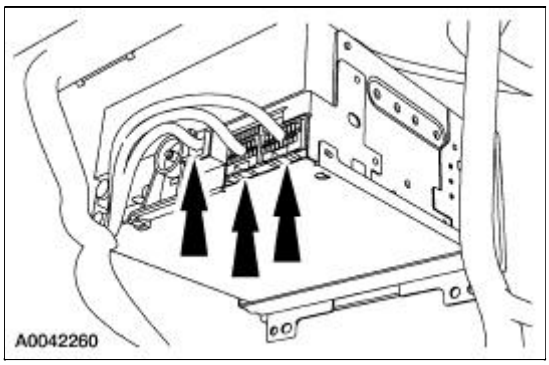
All vehicles

3. Remove the bolts.



NOTE: Standard audio is shown, others are similar

4. Disconnect the audio unit antenna lead-in cable and the audio unit electrical connectors.

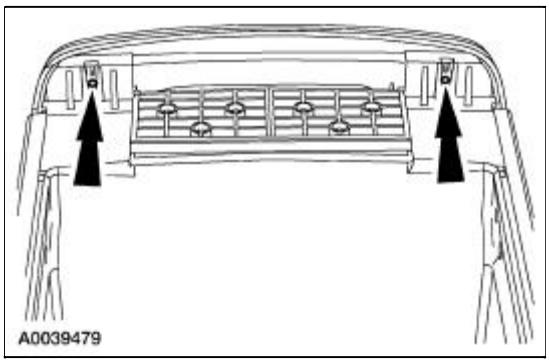


5. To install, reverse the removal procedure.

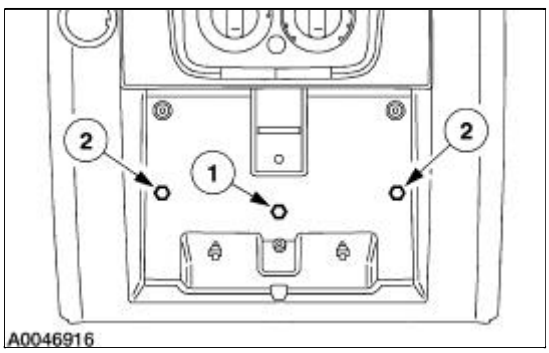
Rear Auxiliary Audio Controls

Removal and Installation

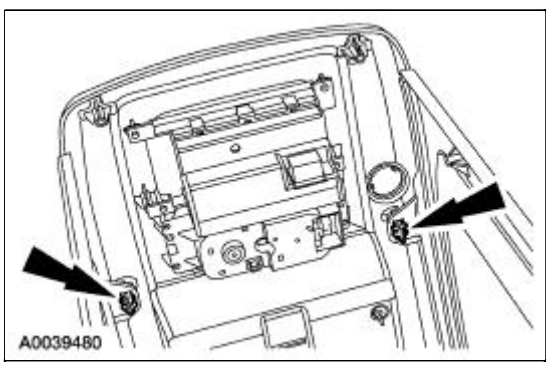
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the screws underneath the armrest cover.



3. Open the rear cup holder and remove the bolt(s).
    1. Navigator
    2. Expedition



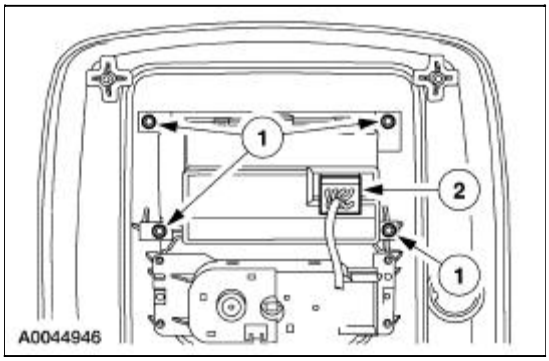
4. Detach the pin-type retainers.



NOTE: Standard audio is shown, others are similar

5. Remove the rear auxiliary audio control unit.
    1. Remove the screws.

2. Disconnect the electrical connector.



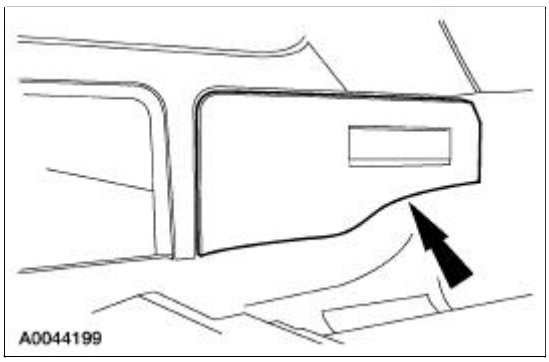
6. To install, reverse the removal procedure.

Compact Disc (CD) Changer —Navigator

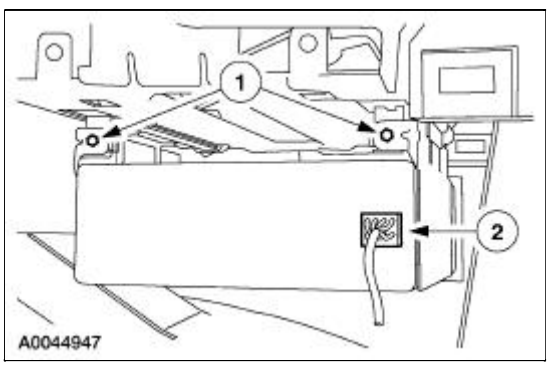
Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. **NOTE:** Right side shown, left side similar.

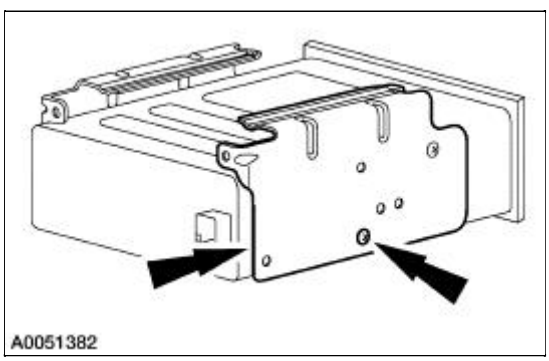
   Remove the right and left side lower kick panels.



3. Remove the CD changer.
   1. Remove the screws on the rear of the CD changer.
   2. Disconnect electrical connectors.
   3. Slide the CD changer out by pulling back until the tangs slide out of the retaining slots.



4. Remove the brackets from the CD changer.
   - Remove the screws.

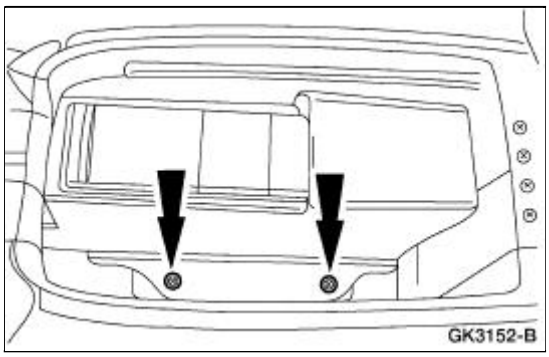


5. To install, reverse the removal procedure.

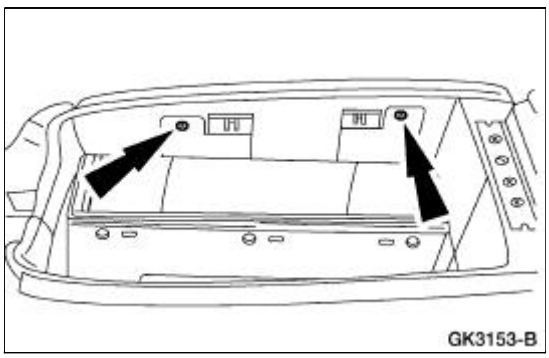
Compact Disc (CD) Changer —Expedition

Removal and Installation

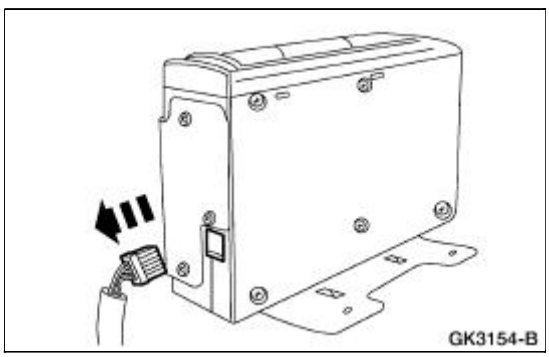
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the mat at the bottom of the console bin and remove the screws.
   - To ease removal of the trim panel, pull the front edge back and lift out.



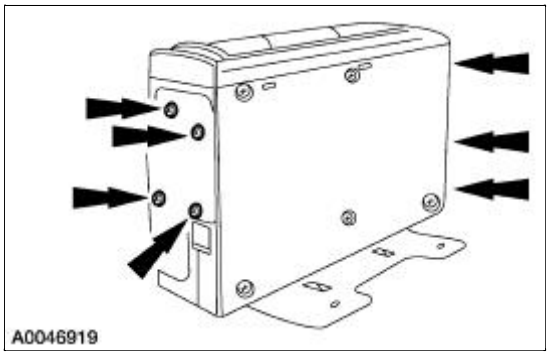
3. Remove the screws and pull out the CD changer and the bracket.



4. Disconnect the electrical connector.



5. Remove the screws.



6. To install, reverse the removal procedure.

Steering Wheel Audio Controls

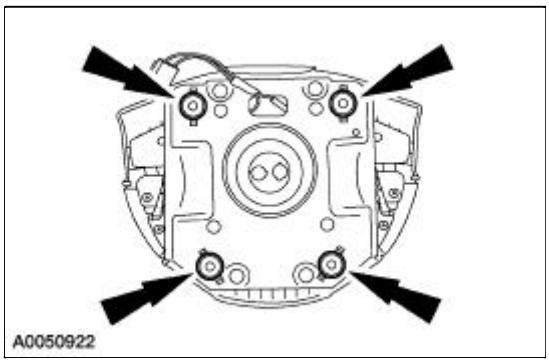
Removal

All Vehicles

1. For Navigator the steering wheel audio controls are integral to the air bag module. Remove the drivers side air bag module. For additional information, refer to Section 501-20B .

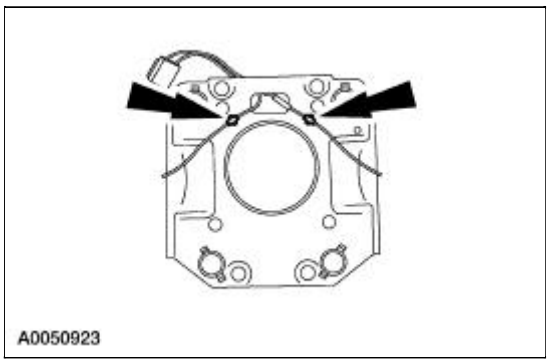
Expedition Only

2. Remove the bolts and springs and position the module plate aside.

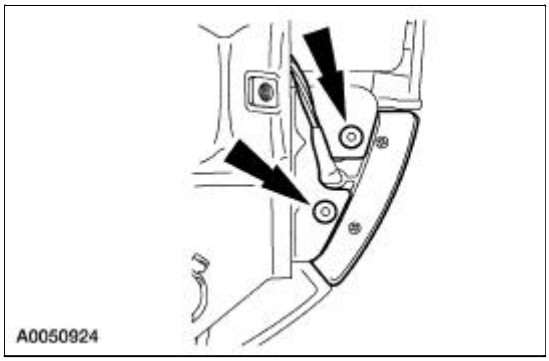


3. **NOTE:** Note the routing of the steering wheel audio controls harness wire on the module plate for installation of the new steering wheel audio controls.

   Disconnect the steering wheel audio controls harness from the clips.

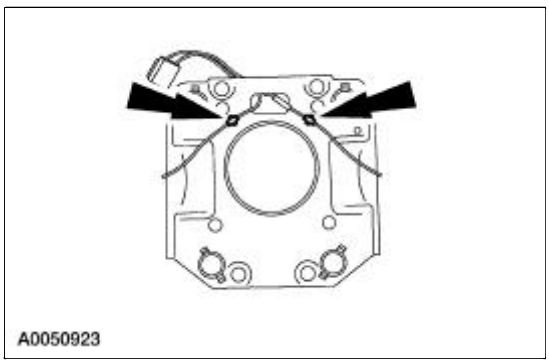


4. Remove the screws and steering wheel audio controls.

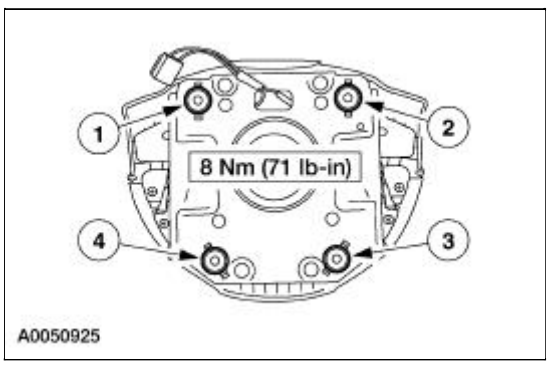


Installation

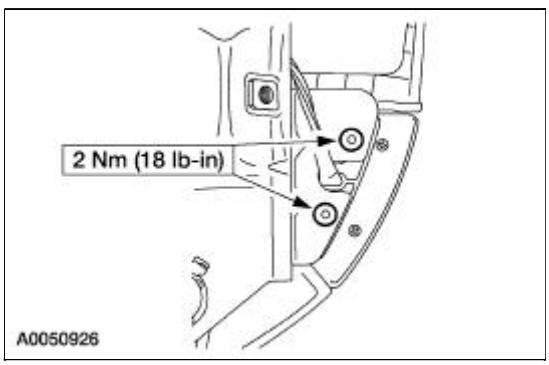
1. Install the steering wheel audio controls wire harness into the clips on the module plate.



2. Install the module plate-to-driver air bag module.
    - Install the plate, springs and bolts and tighten in the sequence shown.

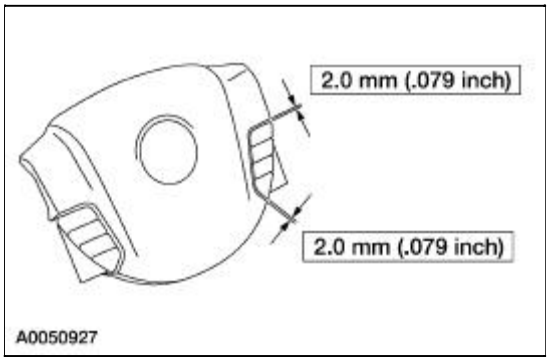


3. Install the steering wheel audio controls.



4. Check the gap between driver air bag module and steering wheel audio controls and adjust as

necessary.

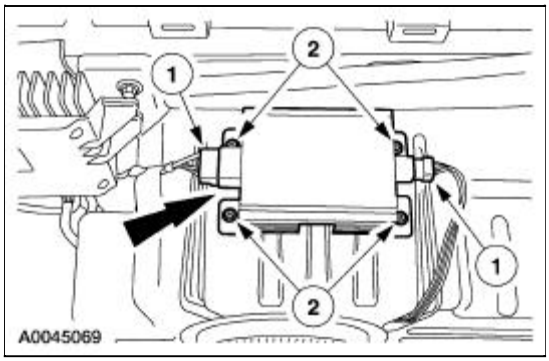


5. Install the driver airbag module. For additional information, refer to Section 501-20B .

Subwoofer Amplifier

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the rear quarter trim. Refer to Section 501-05 .
3. Remove the subwoofer amplifier.
    1. Disconnect the electrical connectors.
    2. Remove the screws.



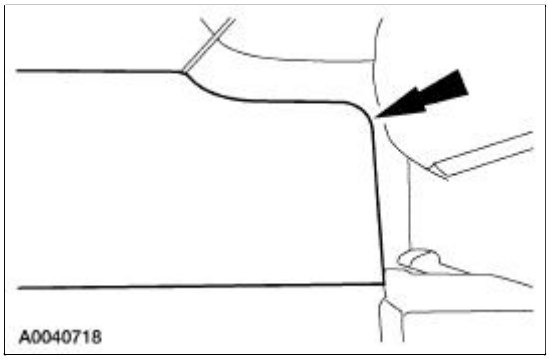
4. To install, reverse the removal procedure.

Audio Amplifier

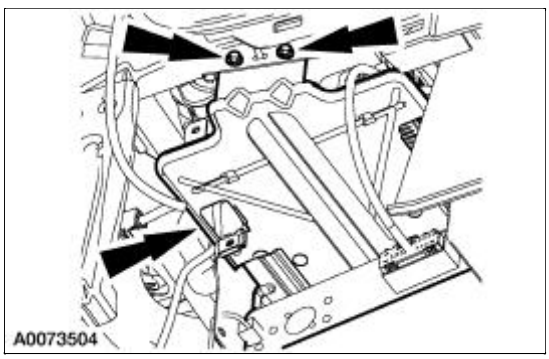
Removal

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. **NOTE:** RH side is shown, LH side is similar.

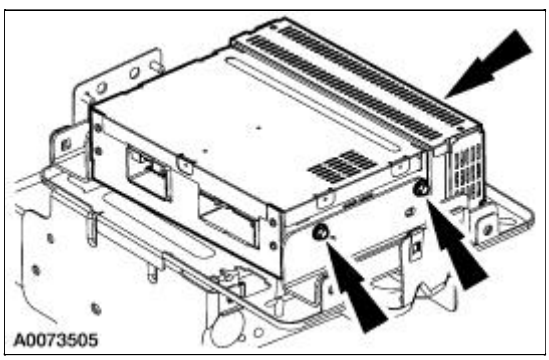
   Remove the LH and RH front floor console side finish panels



3. Remove the bolts and audio amplifier/navigation DVD assembly.
   - Disconnect the electrical connectors.



4. Remove the four bolts and the audio amplifier.



5. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-ft	lb-in
Antenna rear lead-in cable mounting bolt	9	—	80
Antenna isolator module bolt to body	9	—	80

General Specifications

Item	Specification
Rear Window Defroster Repair D8A2-19562-AA	WSB-MYJ58-B

Antenna

The antenna system consists of the following components:

- antenna grid and quarter glass assembly
- antenna lead-in, front cable
- antenna lead-in, rear cable
- antenna isolator module [vehicle navigation radio (VNR) only]

The antenna receives AM and FM radio waves. The waves are sent to the audio unit through the radio antenna lead-in cable.

The antenna is located on the inside of the right rear quarter glass and can be repaired, but not replaced separately from the glass. For additional information, refer to Antenna Grid Wire Repair in this section.

If the antenna cannot be repaired, install a new rear quarter window glass. For additional information, refer to Section 501-11 .

Antenna Grid Wire Repair

Special Tool(s)

 ST1171-A	Heat Gun 107-R0300 or equivalent

NOTE: Any breaks longer than 25.4 mm (1 in) in one grid cannot be repaired. The right quarter window glass must be replaced. Breaks equal to or shorter than 25.4 mm (1 in) in the antenna grid wire can be successfully repaired by using the following procedure:

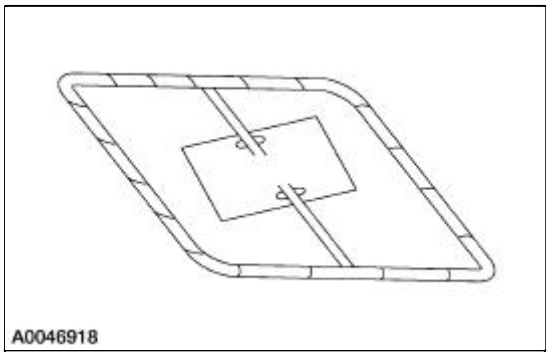
1. Obtain a grid wire repair repair kit meeting Ford specification WSB-M4J58-B.

2. The vehicle should be brought inside and allowed to reach 16°C (60°F) or above.

NOTE: The grid line is very close to the interior trim/headliner. It is recommended to remove the trim (or drop the headliner) in the vicinity of the repair area to allow full access to the grid lind and to prevent any damage to trim/headliner while following the repair procedure.

3. Clean the repair area with denatured alcohol.

4. Place the grid line mask over the break, aligning the cut out slots on either side of the repair area.



5. Apply the epoxy to the repair area.

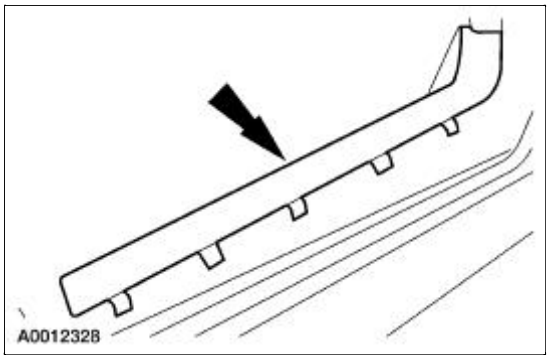
6. Remove the mask without disturbing the epoxy.

7. Use the heat gun to heat the repair area for one to two minutes at a distance of about 25-50 mm (1-2 in). This procedure should heat the repair area to approximately 149°C (300°F).

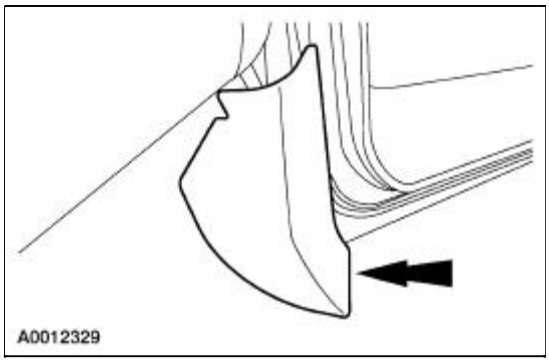
8. Optimum hardness and adhesion will occur after 24 hours. Do not disturb the repaired area until that time.

Antenna Lead-In Cable —Front

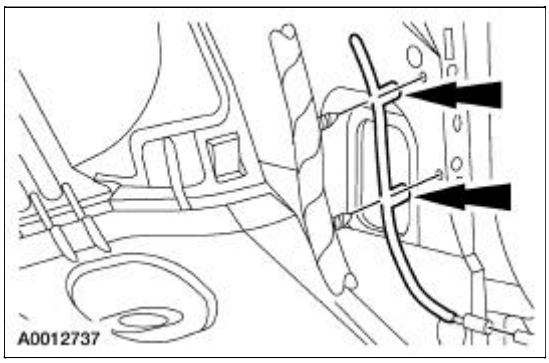
1. Remove the RH scuff plate.



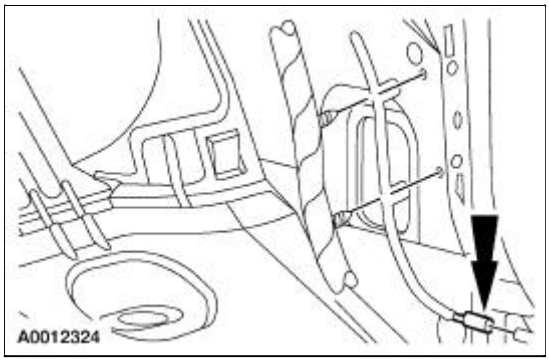
2. Remove the RH A-pillar lower trim panel.



3. Disconnect the two pin-type retainers from the lower A-pillar.



4. Disconnect the rear antenna lead-in cable from the front antenna lead-in cable.



5. **NOTE:** The antenna is an integral part of the wiring harness and cannot be replaced separately from the harness. Cut the ends off of the old antenna cable and tape the remainder to the wiring harness to prevent noise.

   Remove the ground plate and remove the antenna cable ends.

6. **NOTE:** When installing the new cable, tape or wire-tie the new cable to the wiring harness to prevent noise.

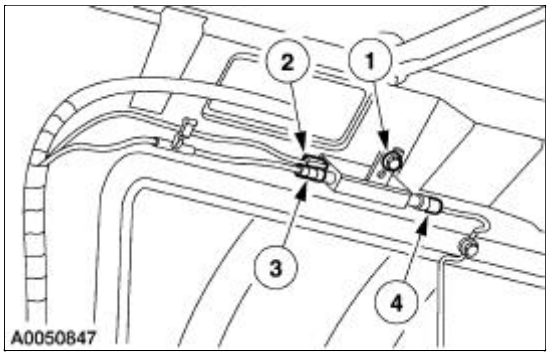
   To install, reverse the removal procedure.

Antenna Isolator Module

1. Remove the RH coat hanger clips.

2. Lower the right rear of the headliner enough to gain access to the isolator module.

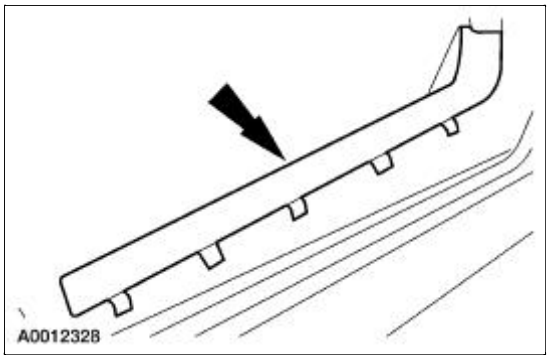
3. Remove the isolator module.
    1. Remove the bolt.
    2. Disconnect the electrical connector.
    3. Disconnect the antenna cable.
    4. Disconnect the antenna glass-to-module connector.



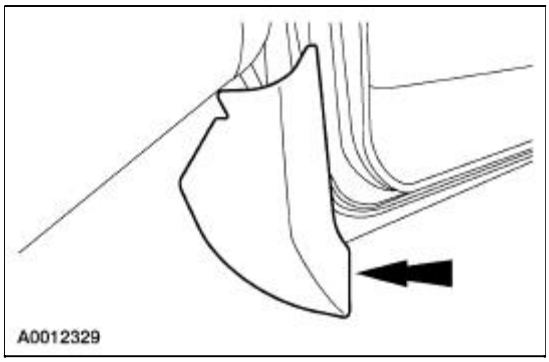
4. To install, reverse the removal procedure.

Antenna Lead-In Cable —Rear

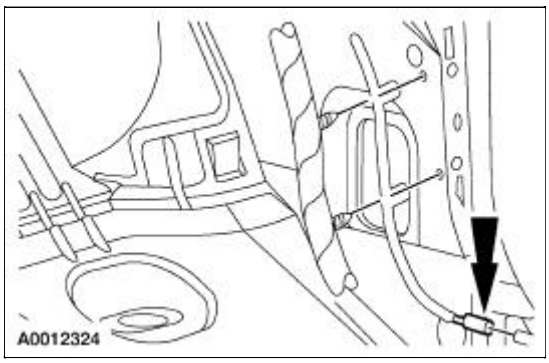
1. Remove the RH scuff plate.



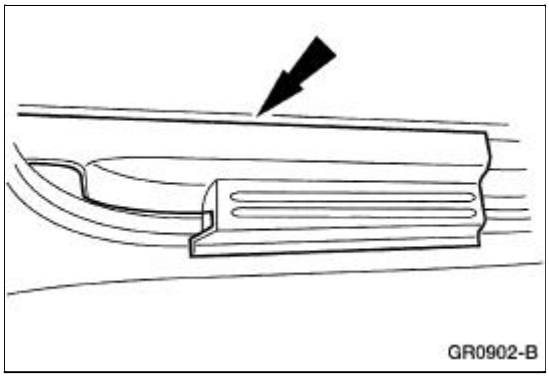
2. Remove the RH A-pillar lower trim panel.



3. Disconnect the rear antenna lead-in cable from the front antenna lead-in cable.



4. Remove the RH rear door scuff plate.

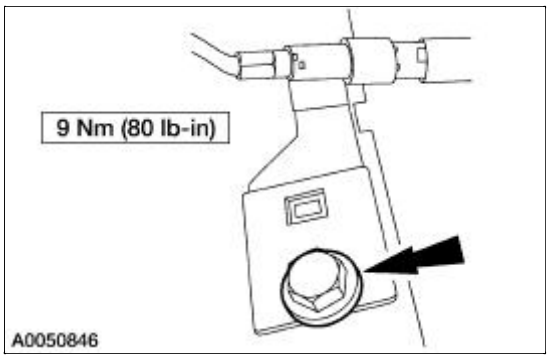


5. Remove the RH rear quarter trim. For additional information, refer to Section 501-05 .

6. Lower the headliner enough to gain access to the rear antenna cable connection.

7. Disconnect the rear lead-in cable from the antenna cable.

8. Remove the bolt from the ground plate.



9. **NOTE:** The antenna is an integral part of the wiring harness and can not be replaced separately from the harness. Cut the ends off of the old antenna cable and tape the remainder to the wiring harness to prevent noise.

   Remove the ground plate and remove the antenna cable ends.

10. **NOTE:** When installing the new cable, tape or wire tie the new cable to the wiring harness to prevent noise.

    To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-in
Speaker screws	2	22
Subwoofer enclosure screws	4	35

Speakers

The speaker system consists of the following components:

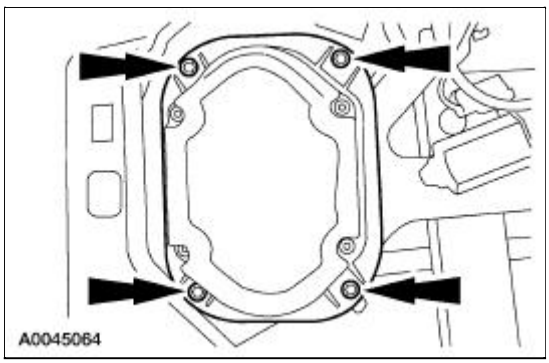
- subwoofer
- speakers

On all vehicles:

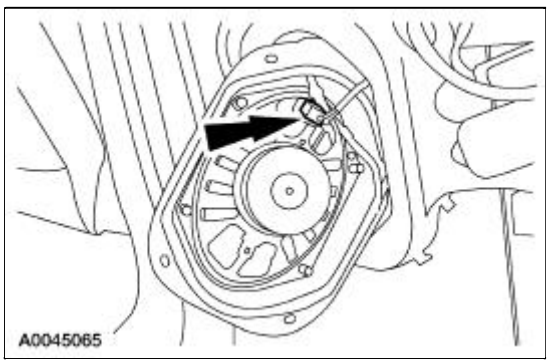
- The rear speakers are located behind the rear door trim panels.
- The front speakers are located behind the front door trim panels (23942)
- The subwoofer is located behind the LH quarter trim panel.

Door Speaker

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



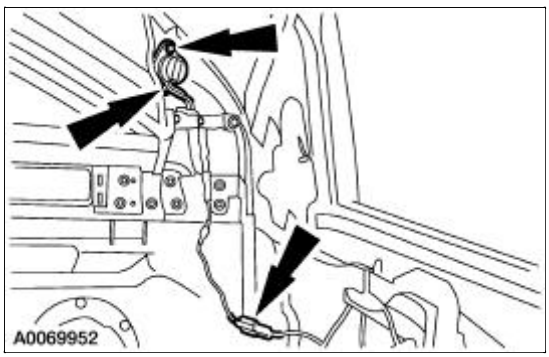
3. Disconnect the electrical connector.



4. To install, reverse the removal procedure.

Front Door Tweeter Speaker

1. Remove the door trim panel. For additional information, refer to Section 501-05 .
2. Disconnect the electrical connector and remove the bolts.

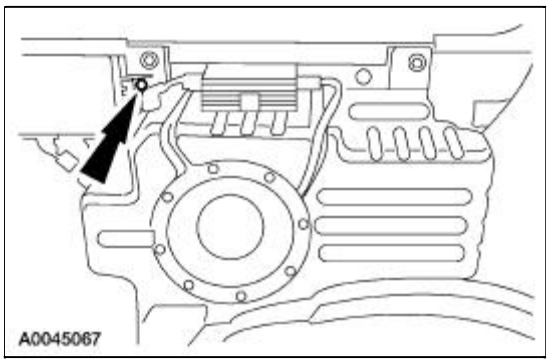


3. To install, reverse the removal procedure.

Subwoofer Speaker

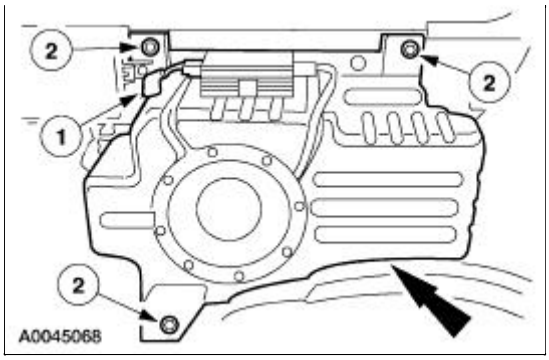
Removal and Installation

1. Remove the rear quarter trim panel. Refer to Section 501-05 .
2. Remove liftgate module bolt (if equipped) and remove liftgate module.



NOTE: Early build is shown, late build is similar

3. Remove the subwoofer assembly.
    1. Disconnect the subwoofer amplifier electrical connector.
    2. Remove the bolts.



4. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-ft	lb-in
DVD assembly screws	1.9	—	8.9

Video System

The video system consists of the following components:

- an overhead assembly containing the video display screen and the digital versatile disc (DVD) player
- remote control

The components of the assembly are not repairable. For diagnosis and testing, refer to Section 415-00 .

Video System

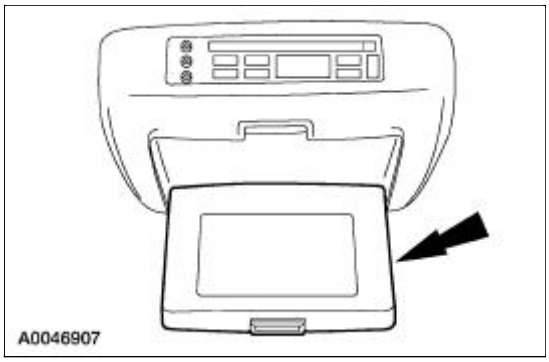
Refer to Section 415-00 .

Digital Versatile Disc (DVD) Player

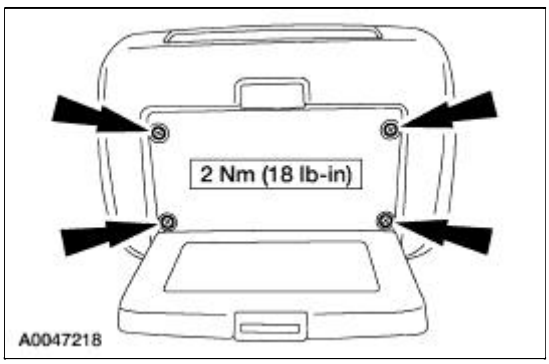
Removal and Installation

CAUTION: When removing the DVD unit do not pull on the display. This may cause damage to the unit and void the warranty.

1. Disconnect the battery ground cable. Refer to Section 414-01 .
2. Open the video display door.

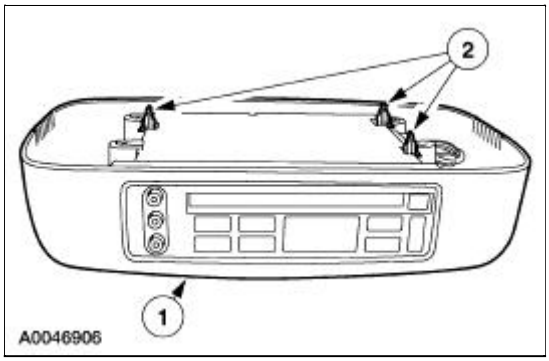


3. Remove the screws.

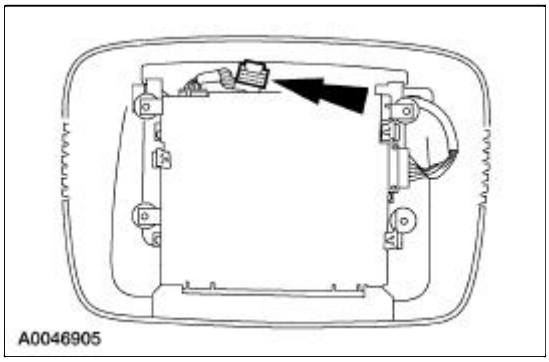


4. **NOTE:** The DVD assembly must be supported while disengaging the clips.

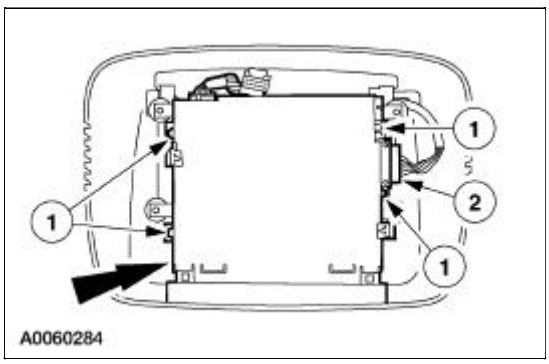
   Remove the DVD assembly.
   1. Close the video display door.
   2. Disengage the clips.



5. Disconnect the electrical connector.



6. Remove the DVD player.
    1. Remove the four screws.
    2. Disconnect the electrical connector.



7. To install, reverse the removal procedure.

Exterior Lighting

The exterior lighting system components include:

- headlamps
- ballast (if equipped with high intensity discharge [HID] headlamps)
- rear lamps
- reversing lamps (integral to the rear lamps for Expedition)(located in the liftgate for Navigator)
- turn signal lamps
- fog lamps (if equipped)
- signal mirror lamp (if equipped)
- parking lamps
- high mounted stoplamp
- headlamp switch
- fog lamp switch (integral to the headlamp switch)
- multifunction switch
- photocell and amplifier (if equipped with autolamps)
- vehicle security module
- brake pedal position (BPP) switch
- headlamp relay
- fog lamp relay (if equipped)
- trailer tow relays

The fog lamp switch is integral to the headlamp switch.

Headlamps

Refer to Wiring Diagrams Cell 87 , Headlamps for schematic and connector information.

Refer to Wiring Diagrams Cell 13 , Power Distribution for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect the following for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
● Headlamp switch ● Multifunction switch	● Central junction box (CJB) fuse(s): ■ 17 (15A) ■ 23 (10A) ■ 25 (10A) ■ 35 (20A) ■ 40 (20A) ● Circuitry ● Headlamp bulbs ● Daytime running lamp (DRL) relay

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the concern is not visually evident, verify the symptom and refer to the Symptom Chart.

Symptom Chart

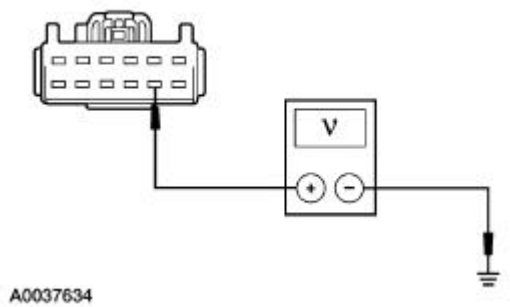
Symptom Chart

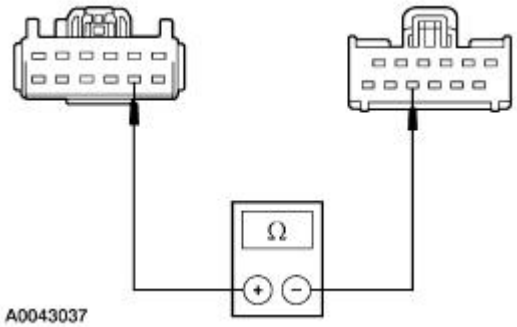
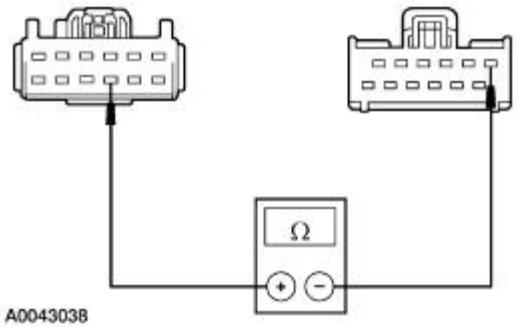
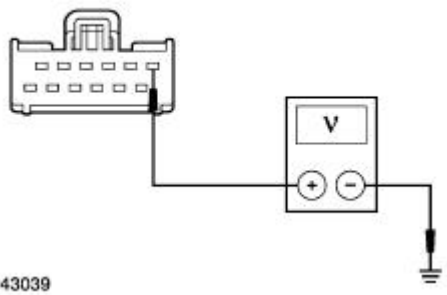
Condition	Possible Sources	Action
● The low beams are inoperative	● Circuitry. ● Headlamp switch. ● Central junction box (CJB).	● Go To Pinpoint Test A .
● The high beams are	● Central junction box (CJB)	● Go To

inoperative	fuse 35 (20A). ● Circuitry. ● High beam relay. ● Multifunction switch. ● CJB.	Pinpoint Test B .
● One low beam headlamp is inoperative	● Central junction box (CJB) fuse 23 (10A) (RH headlamp). ● CJB fuse 25 (10A) (LH headlamp). ● Circuitry. ● CJB.	● Go To Pinpoint Test C .
● One high beam headlamp is inoperative	● Circuitry. ● Headlamp assembly.	● Go To Pinpoint Test D .
● The headlamps are on continuously	● Circuitry. ● Headlamp switch. ● Multifunction switch. ● Central junction box (CJB). ● Vehicle security module.	● Go To Pinpoint Test E .
● The high and low beam headlamp is inoperative on one side	● Circuitry.	● REPAIR circuit 57 (BK).
● The flash-to-pass feature is inoperative	● Multifunction switch. ● Circuitry.	● Go To Pinpoint Test F .

Pinpoint Tests

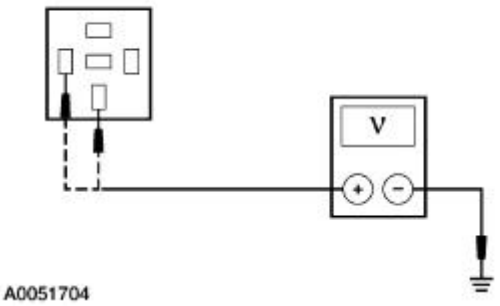
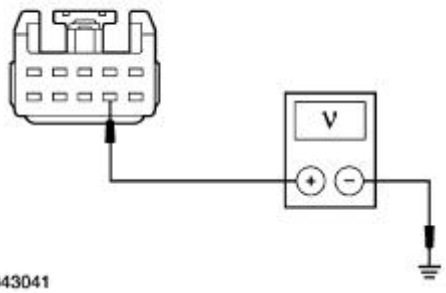
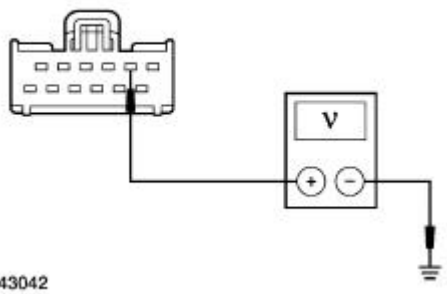
PINPOINT TEST A: THE LOW BEAMS ARE INOPERATIVE

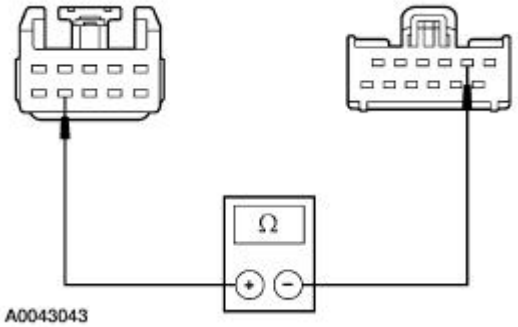
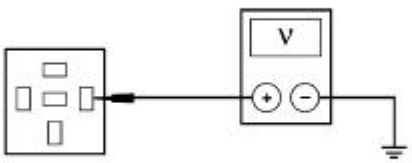
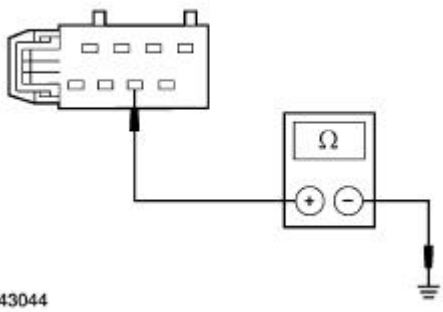
Test Step	Result / Action to Take
A1 CHECK CIRCUIT 196 (DB/OG) FOR VOLTAGE	
● Key in OFF position. ● Disconnect: Headlamp Switch C205a. ● Measure the voltage between the headlamp switch C205a pin 8, circuit 196 (DB/OG), harness side and ground.  A0037634 ● **Is the voltage greater than 10 volts?**	**Yes** GO to A3 . **No** GO to A2 .
A2 CHECK CIRCUIT 196 (DB/OG) FOR AN OPEN	
● Disconnect: Central Junction Box (CJB) C270h.	**Yes**

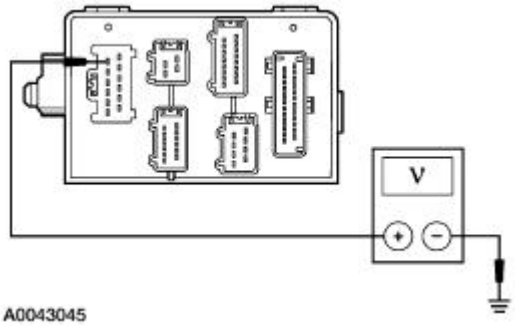
• Measure the resistance between the headlamp switch C205a pin 8, circuit 196 (DB/OG), harness side and the CJB C270h pin 10, circuit 196 (DB/OG), harness side.  A0043037 • **Is the resistance less than 5 ohms?**	INSTALL a new CJB. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
A3 CHECK CIRCUIT 15 (RD/YE) FOR AN OPEN	
• Disconnect: CJB C270h. • Measure the resistance between the headlamp switch C205a pin 9, circuit 15 (RD/YE), harness side and the CJB C270h pin 1, circuit 15 (RD/YE), harness side.  A0043038 • **Is the resistance less than 5 ohms?**	**Yes** RECONNECT the headlamp switch. GO to A4 . **No** REPAIR the circuit. TEST the system for normal operation.
A4 CHECK FOR VOLTAGE TO THE CJB	
• Turn the headlamp switch to the headlamps ON position. • Measure the voltage between the CJB C270h pin 1 circuit 15 (RD/YE), harness side and ground.  A0043039 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new CJB. TEST the system for normal operation. **No** INSTALL a new headlamp switch. REFER to Headlamp Switch in this section. TEST the system for normal operation.

PINPOINT TEST B: THE HIGH BEAMS ARE INOPERATIVE

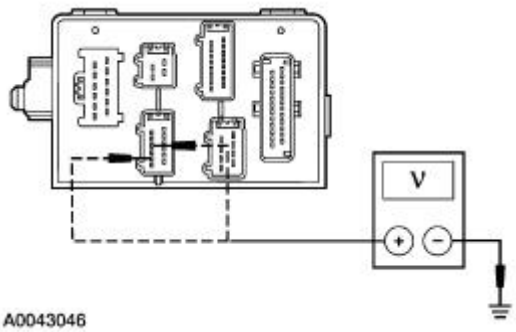
Test Step	Result / Action to Take
B1 CHECK FOR VOLTAGE TO THE HIGH BEAM RELAY	
• Key in OFF position. • Disconnect: High Beam Relay C2242.	**Yes** TURN the headlamp

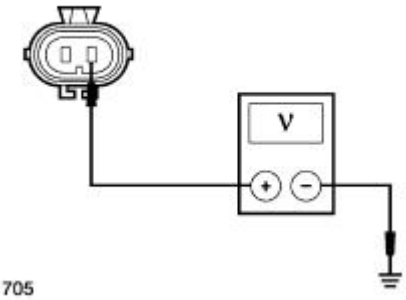
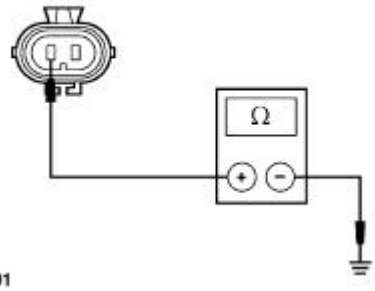
• Turn the headlamp switch to the headlamps ON position. • Place the multifunction switch in the high beam position. • Measure the voltage between the high beam relay C2242 pin 85, harness side and ground; and between the high beam relay C2242 pin 30, harness side and ground.  A0051704 • **Are the voltages greater than 10 volts?**	switch off. GO to B5 . **No** If no voltage at pin 85, TURN the headlamp switch off. GO to B2 . If no voltage at pin 30, INSTALL a new central junction box (CJB). TEST the system for normal operation.
B2 CHECK CIRCUIT 15 (RD/YE) FOR AN OPEN	
• Disconnect: Multifunction Switch C202c. • Measure the voltage between the multifunction switch C202c pin 7, circuit 15 (RD/YE), harness side and ground.  A0043041 • **Is the voltage greater than 10 volts?**	**Yes** GO to B3 . **No** REPAIR the circuit. TEST the system for normal operation.
B3 CHECK FOR VOLTAGE TO THE CENTRAL JUNCTION BOX (CJB)	
• Connect: Multifunction Switch C202c. • Disconnect: CJB C270h. • Turn the headlamp switch to the headlamps ON position. • Measure the voltage between the CJB C270h pin 2, circuit 275 (YE), harness side and ground.  A0043042 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new CJB. TEST the system for normal operation. **No** TURN the headlamp switch off. GO to B4 .
B4 CHECK CIRCUIT 275 FOR AN OPEN	
• Disconnect: Multifunction Switch C202c. • Measure the resistance between the multifunction switch C202c pin 9, circuit 275 (YE), harness side and the CJB C270h pin 2, circuit 275 (YE), harness side.	**Yes** INSTALL a new multifunction switch. REFER to Section 211-

 A0043043 ● **Is the resistance less than 5 ohms?**	05 . TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
B5 CHECK THE HIGH BEAM RELAY ● Carry out the high beam relay component test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. ● **Is the high beam relay OK?**	**Yes** GO to B6 . **No** INSTALL a new high beam relay. TEST the system for normal operation.
B6 CHECK THE HIGH BEAM RELAY GROUND ● Measure the resistance between the high beam relay C2242 pin 86, harness side and ground.  GN1438-A ● **Is the resistance less than 5 ohms?**	**Yes** GO to B8 . **No** GO to B7 .
B7 CHECK CIRCUIT 57 (BK) FOR AN OPEN ● Disconnect: Central Junction Box (CJB) C270f. ● Measure the resistance between the CJB C270f pin 6, harness side and ground.  A0043044 ● **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new CJB. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
B8 CHECK THE CENTRAL JUNCTION BOX (CJB) ● Connect: High Beam Relay C2242. ● Disconnect: CJB C270a. ● Turn the headlamp switch to the headlamps ON position.	**Yes** REPAIR circuit 12 (LG/BK). TEST the

• Place the multifunction switch in the high beam position. • Measure the voltage between the CJB C270a pin 6, component side and ground.  A0043045 • **Is the voltage greater than 10 volts?**	system for normal operation. **No** INSTALL a new CJB. TEST the system for normal operation.

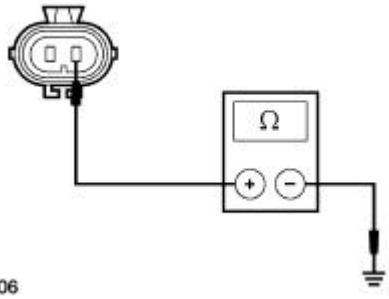
PINPOINT TEST C: ONE LOW BEAM HEADLAMP IS INOPERATIVE

Test Step	Result / Action to Take
C1 CHECK THE CENTRAL JUNCTION BOX (CJB)	
• Key in OFF position. • Disconnect: CJB C270b. • Turn the headlamp switch to the headlamps ON position. • Place the multifunction switch in the low beam position. • Measure the voltage between the CJB C270b pin 5, circuit 160 (DB/WH) (LH headlamp), component side and ground; or between the CJB C270b pin 9, circuit 161 (DG/OG) (RH headlamp), component side and ground.  A0043046 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new CJB. TEST the system for normal operation. **No** TURN the headlamp switch off. GO to C2 .
C2 CHECK CIRCUIT 160 (DB/WH) OR 161 (DG/OG) FOR AN OPEN	
• Connect: CJB C270b. • Disconnect: Inoperative Headlamp. • Turn the headlamp switch to the headlamps ON position. • Measure the voltage between the LH headlamp C1111 pin 2, circuit 160 (DB/WH), harness side and ground; or between the RH headlamp C1112 pin 2, circuit 160 (DB/WH), harness side and ground.	**Yes** If not equipped with HID headlamp, REPAIR circuit 57 (BK). TEST the system for normal operation. If equipped with HID headlamp, TURN the headlamp switch off. GO to C3 **No** REPAIR circuit 160

 A0051705 ● **Is the voltage greater than 10 volts?**	(DB/WH) or 161 (DG/OG) as necessary. TEST the system for normal operation.
C3 CHECK CIRCUIT 57 FOR AN OPEN	
● Measure the resistance between the headlamp C1111 (LH lamp) or C1112 (RH lamp) pin 1, circuit 57 (BK), harness side and ground.  A0044891 ● **Is the resistance less than 5 ohms?**	**Yes** GO to C4 . **No** REPAIR the circuit. TEST the system for normal operation.
C4 CHECK THE HID BALLAST	
● Substitute a known good HID ballast. ● Turn the headlamp switch to the headlamps ON position. ● **Does the headlamp illuminate?**	**Yes** INSTALL a new HID ballast. REFER to Headlamp Bulb in this section. **No** INSTALL a new HID bulb. REFER to Headlamp Bulb in this section.

PINPOINT TEST D: ONE HIGH BEAM HEADLAMP IS INOPERATIVE

Test Step	Result / Action to Take
D1 CHECK THE VOLTAGE TO THE INOPERATIVE HEADLAMP BULB	
● Key in OFF position. ● Disconnect the inoperative headlamp. ● Turn the headlamp switch to the headlamps ON position. ● Place the multifunction switch in the high beam position. ● Measure the resistance between the LH high beam lamp C1020 pin 2, circuit 12 (LG/BK), harness side or the RH high beam lamp C1040 pin 2, circuit 12 (LG/BK), harness side and ground.	**Yes** REPAIR circuit 12 (LG/BK). TEST the system for normal operation. **No** REPAIR circuit 57 (BK). TEST the system for normal

 ● **Is the resistance less than 5 ohms?**	operation.

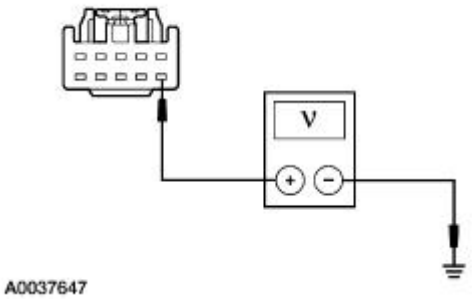
PINPOINT TEST E: THE HEADLAMPS ARE ON CONTINUOUSLY

Test Step	Result / Action to Take
E1 CHECK THE HIGH BEAM CIRCUIT FOR SHORT TO POWER	
● Key in OFF position. ● Place the multifunction switch in the low beam position. ● **Is the high beam indicator illuminated?**	**Yes** GO to E2 . **No** GO to E7 .
E2 CHECK CIRCUIT 12 (LG/BK) TO THE HEADLAMPS FOR SHORT TO POWER	
● Disconnect: Central Junction Box (CJB) C270a. ● **Do the headlamps continue to illuminate?**	**Yes** REPAIR circuit 12 (LG/BK). TEST the system for normal operation. **No** GO to E3 .
E3 CHECK THE CJB FOR SHORT TO POWER	
● Connect: CJB C270a. ● Disconnect: High Beam Relay C2242. ● **Do the headlamps continue to illuminate?**	**Yes** INSTALL a new CJB. TEST the system for normal operation. **No** GO to E4 .
E4 CHECK THE HIGH BEAM RELAY	
● Carry out the high beam relay component test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. ● **Is the high beam relay OK?**	**Yes** GO to E5 . **No** INSTALL a new high beam relay. TEST the system for normal operation.
E5 CHECK THE HIGH BEAM RELAY POWER SUPPLY CIRCUIT FOR SHORT TO POWER	
● Connect: High Beam Relay C2242. ● Disconnect: CJB C270h. ● **Do the headlamps continue to illuminate?**	**Yes** INSTALL a new CJB. TEST the system for normal operation.

	No GO to E6 .
E6 CHECK CIRCUIT 275 (YE) FOR SHORT TO POWER ● Connect: CJB C270h. ● Disconnect: Multifunction Switch C202c. ● **Do the headlamps continue to illuminate?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** INSTALL a new multifunction switch. REFER to Section 211-05 . TEST the system for normal operation.
E7 CHECK THE AUTOLAMP SYSTEM ● Disconnect: Vehicle Security Module C2113b. ● **Do the headlamps continue to illuminate?**	**Yes** GO to E8 . **No** REFER to Autolamps in this section.
E8 CHECK CIRCUITS 160 (DB/WH) AND 161 (DB/OG) FOR SHORT TO POWER ● Disconnect: Central Junction Box (CJB) C270b. ● **Do the headlamps continue to illuminate?**	**Yes** REPAIR circuit 160 (DB/WH) or 161 (DG/OG) as necessary. TEST the system for normal operation. **No** GO to E9 .
E9 CHECK THE CJB ● Connect: CJB C270b. ● Disconnect: CJB C270h. ● **Do the headlamps continue to illuminate?**	**Yes** INSTALL a new CJB. TEST the system for normal operation. **No** RECONNECT the CJB C270h. GO to E10 .
E10 CHECK THE MULTIFUNCTION SWITCH ● Disconnect: Multifunction Switch C202c. ● **Do the headlamps continue to illuminate?**	**Yes** GO to E11 . **No** INSTALL a new multifunction switch. REFER to Section 211-05 . TEST the system for normal operation.
E11 CHECK CIRCUIT 15 (RD/YE) FOR SHORT TO POWER ● Disconnect: Headlamp Switch C205a. ● **Do the headlamps continue to illuminate?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** INSTALL a new headlamp switch. REFER to Headlamp Switch in this section. TEST the system for normal operation.

PINPOINT TEST F: THE FLASH TO PASS FEATURE IS

INOPERATIVE

Test Step	Result / Action to Take
F1 CHECK CIRCUIT 196 (DB/OG) FOR AN OPEN	
• Disconnect: Multifunction Switch C202c. • Measure the voltage between the multifunction switch C202c pin 8, circuit 196 (DB/OG), harness side and ground.  A0037647 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new multifunction switch. REFER to Section 211-05 . TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.

Autolamps

Refer to Wiring Diagrams Cell 87 , Autolamps for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool

Principles of Operation

The autolamp system provides light-sensitive automatic on/off control of the headlamps and parking lamps controlled by the vehicle security module when the headlamp switch is in the autolamps position. When the ignition switch is turned to the RUN or START position with the autolamps feature already enabled and the ambient light level is dark, the vehicle security module will request the headlamps and parking lamps be turned on. When the autolamps are disabled, the vehicle security module will request the headlamps and parking lamps to be turned off, regardless of the ignition switch position. When the vehicle security module has turned on the exterior lamps and the ignition is turned to the OFF or ACCY position, the exterior lamps will remain on for an additional time specified by the customer or the headlamp switch is turned off.

When the autolamps have been enabled and the ignition switch is in the RUN/START position, the vehicle security module will request that the exterior lamps be turned on or off based on ambient light level. If the vehicle enters darkness for at least 15 seconds, the vehicle security module will request the exterior lamps on. If the vehicle enters light for at least 15 seconds, the vehicle security module will request the exterior lamps off. By delaying turning on and off the exterior lamps during short periods of darkness and light, the vehicle security module prevents the exterior lamps from flashing on and off.

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect the following for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
● Headlamp switch	● Central junction box (CJB) fuse(s): ■ 5 (7.5A)

	■ 30 (30A) ● Circuitry ● Headlamp bulb ● Vehicle security module ● Photocell

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

4. If the concern is not visually evident, determine the symptom and refer to the Symptom Chart.

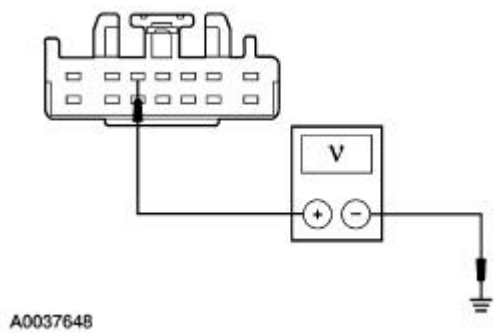
Symptom Chart

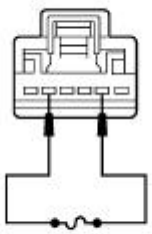
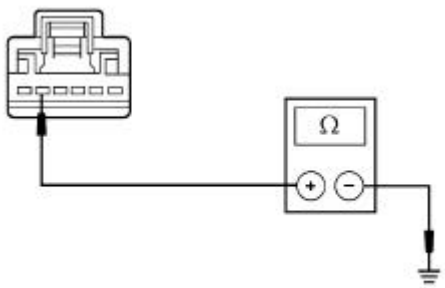
Symptom Chart

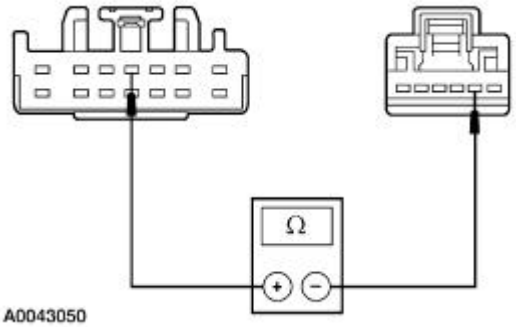
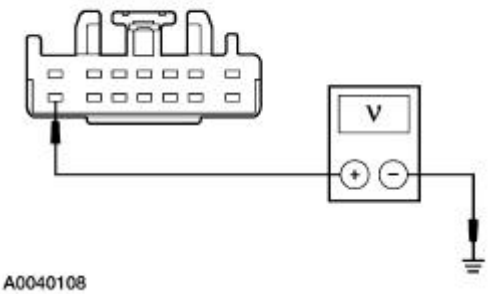
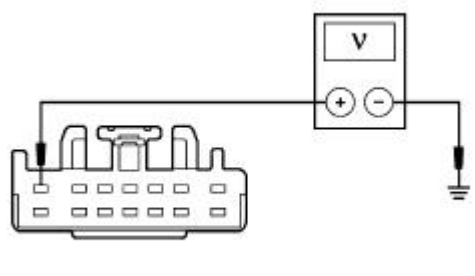
Condition	Possible Sources	Action
● No communication with the vehicle security module	● Central junction box (CJB) fuse(s): ■ 5 (7.5A). ■ 30 (30A). ● Circuitry. ● Vehicle security module.	● REFER to Section 419-10 .
● The autolamps are inoperative — do not operate correctly	● Circuitry. ● Photocell. ● Headlamp switch. ● Vehicle security module.	● Go To Pinpoint Test G .
● The autolamps are on continuously	● Photocell covered by opaque material/obstructed. ● Photocell incorrectly installed. ● Circuitry. ● Photocell. ● Vehicle security module.	● REMOVE opaque material/obstruction. ● INSTALL the photocell correctly. ● Go To Pinpoint Test G .
● The autolamp time delay is inoperative	● Vehicle security module.	● INSTALL a new vehicle security module. REFER to Section 419-10 .
● The headlamps are inoperative with autolamps on	● Circuitry. ● Vehicle security module.	● Go To Pinpoint Test G .
● The autolamps operate, but parking, rear or license lamps are inoperative	● Circuitry. ● Vehicle security module.	● Go To Pinpoint Test G .

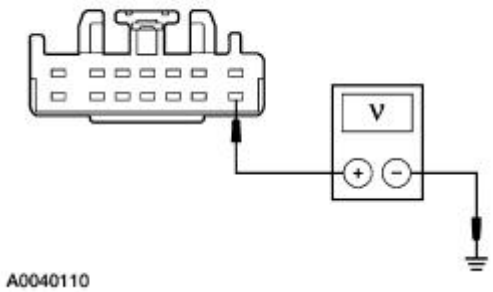
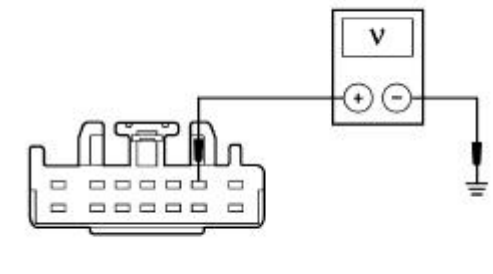
Pinpoint Tests

PINPOINT TEST G: THE AUTOLAMPS ARE INOPERATIVE — DO NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
G1 CHECK THE HEADLAMPS AND PARKING LAMPS	
• Key in OFF position. • Turn the headlamp switch to the headlamps ON position. • **Did the headlamps and parking lamps turn on?**	**Yes** Turn the headlamp switch off. GO to G2 . **No** REFER to Headlamps or Parking, Rear and License Lamps in this section.
G2 MONITOR THE AUTOLAMP PID	
• Key in ON position. • Connect the diagnostic tool. • Enter the following diagnostic mode on the diagnostic tool: Autolamp PID. • Place the headlamp switch in the autolamp position. • Monitor the autolamp PID. • **Does the autolamp PID indicate ON?**	**Yes** Turn the headlamp switch off. GO to G5 . **No** Turn the headlamp switch off. GO to G3 .
G3 CHECK THE INPUT FROM THE HEADLAMP SWITCH	
• Key in OFF position. • Disconnect: Vehicle Security Module C2113b. • Measure the voltage between the vehicle security module C2113b pin 5, circuit 219 (DG/YE), harness side and ground while placing the headlamp switch in the autolamp and off positions.  • **Is the voltage greater than 10 volts with the headlamp switch in the autolamp position and less than 5 volts with the headlamp switch in the off position?**	**Yes** Turn the headlamp switch off. GO to G15 . **No** Turn the headlamp switch off. GO to G4 .
G4 CHECK THE HEADLAMP SWITCH	
• Carry out the headlamp switch component test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. • **Is the headlamp switch OK?**	**Yes** REPAIR circuit 219 (DG/YE). TEST the system for normal operation. **No** INSTALL a new headlamp switch. REFER to Headlamp Switch in this section. TEST the system for

	normal operation.
G5 CHECK THE PHOTOCELL INPUT — MONITOR THE VEHICLE SECURITY MODULE LIGHT SENSOR PID	
• Enter the following diagnostic mode on the diagnostic tool: Light Sensor PID. • Monitor the vehicle security module photocell sensor PID while illuminating the photocell, then remove the light source. • **Does the PID indicate NO with the light source applied and YES with the light removed?**	**Yes** GO to G9 . **No** GO to G6 .
G6 CHECK THE PHOTOCELL	
• Key in OFF position. • Disconnect: Photocell C286. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Light Sensor PID. • Monitor the photocell PID while connecting a fused jumper wire (5A) between the photocell C286 pin 2, circuit 218 (WH/VT), harness side and the photocell C286 pin 5, circuit 875 (BK/LB), harness side.  A0043049 • **Does the photocell sensor PID indicate YES?**	**Yes** INSTALL a new photocell. REFER to Photocell and Amplifier in this section. TEST the system for normal operation. **No** GO to G7 .
G7 CHECK CIRCUIT 875 (BK/LB) FOR AN OPEN	
• Key in OFF position. • Measure the resistance between the photocell C286 pin 5, circuit 875 (BK/LB), harness side and ground.  A0008729 • **Is the resistance less than 5 ohms?**	**Yes** GO to G8 . **No** REPAIR the circuit. TEST the system for normal operation.
G8 CHECK THE CIRCUIT 218 (WH/VT) FOR AN OPEN	
• Disconnect: Vehicle Security Module C2113b. • Measure the resistance between the photocell C286 pin 2, circuit 218 (WH/VT), harness side and the vehicle security module C2113b pin 4, circuit 218 (WH/VT), harness side.	**Yes** GO to G15 . **No** REPAIR the circuit. TEST the system for normal operation.

 A0043050 ● **Is the resistance less than 5 ohms?**	
G9 CHECK THE HEADLAMP CIRCUITS	
● Enter the following diagnostic mode on the diagnostic tool: Headlamps Active Command. ● Activate the active command for the headlamps. ● **Do the headlamps operate with the active command?**	**Yes** GO to G12 . **No** GO to G10 .
G10 CHECK CIRCUIT 196 (DB/OG) FOR AN OPEN	
● Key in OFF position. ● Disconnect: Vehicle Security Module C2113b. ● Measure the voltage between the vehicle security module C2113b pin 14, circuit 196 (DB/OG), harness side and ground.  A0040108 ● **Is the voltage greater than 10 volts?**	**Yes** GO to G11 . **No** REPAIR the circuit. TEST the system for normal operation.
G11 CHECK CIRCUIT 15 (RD/YE) FOR AN OPEN	
● Turn the headlamp switch to the headlamps ON position. ● Measure the voltage between the vehicle security module C2113b pin 7, circuit 15 (RD/YE), harness side and ground.  A0040109 ● **Is the voltage greater than 10 volts?**	**Yes** GO to G15 . **No** REPAIR the circuit. TEST the system for normal operation.
G12 CHECK THE PARKING LAMP CIRCUITS	
● Enter the following diagnostic mode on the diagnostic tool: Parking Lamps Active Command. ● Activate the active command for the parking lamps. ● **Do the parking lamps operate with the active command?**	**Yes** GO to G15 . **No**

	GO to G13 .
G13 CHECK CIRCUIT 195 (TN/WH) FOR AN OPEN	
• Key in OFF position. • Disconnect: Vehicle Security Module C2113b. • Measure the voltage between the vehicle security module C2113b pin 8, circuit 195 (TN/WH), harness side and ground.  A0040110 • **Is the voltage greater than 10 volts?**	**Yes** GO to G14 . **No** REPAIR the circuit. TEST the system for normal operation.
G14 CHECK CIRCUIT 14 (BN) FOR AN OPEN	
• Turn the headlamp switch to the headlamps ON position. • Measure the voltage between the vehicle security module C2113b pin 2, circuit 14 (BN), harness side and ground.  A0040111 • **Is the voltage greater than 10 volts?**	**Yes** GO to G15 . **No** REPAIR the circuit. TEST the system for normal operation.
G15 CHECK FOR VEHICLE SECURITY MODULE OPERATION	
• Key in OFF position. • Disconnect all vehicle security module connectors. • Check for: ◦ corrosion ◦ pushed-out pins • Connect all vehicle security module connectors and make sure they are seated correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new vehicle security module. REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector.

Stoplamps

Refer to Wiring Diagrams Cell 90 , Turn/Stop/Hazard Lamps for schematic and connector information.

Refer to Wiring Diagrams Cell 13 , Power Distribution for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect the following for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
● Central junction box (CJB) ● Brake pedal position (BPP) switch ● Multifunction switch	● CJB fuse 2 (20A) ● Circuitry ● Stoplamp bulbs

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the concern is not visually evident, verify the symptom and refer to the Symptom Chart.

Symptom Chart

NOTE:

Refer to Wiring Diagrams Cell 90 for schematic and connector information.

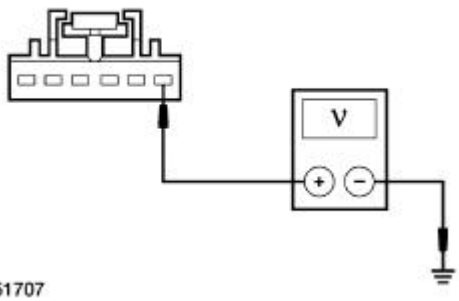
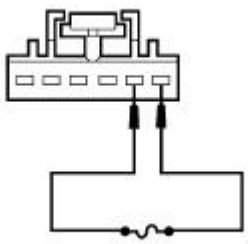
Symptom Chart

Condition	Possible Sources	Action
● The stoplamps are inoperative	● Central junction box (CJB) fuse 2 (20A). ● Circuitry. ● Brake pedal position (BPP) switch.	● Go To Pinpoint Test H .
● One or more stoplamps	● Stoplamp bulb.	● Go To Pinpoint

are inoperative	• Circuitry. • Multifunction switch. • Central junction box (CJB).	Test I .
• The stoplamps are on continuously	• Brake pedal position (BPP) switch. • Circuitry. • Multifunction switch. • Central junction box (CJB).	• Go To Pinpoint Test J .

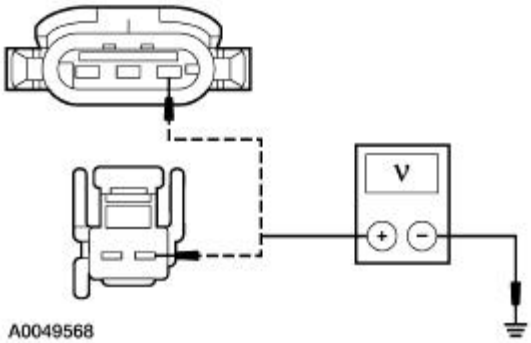
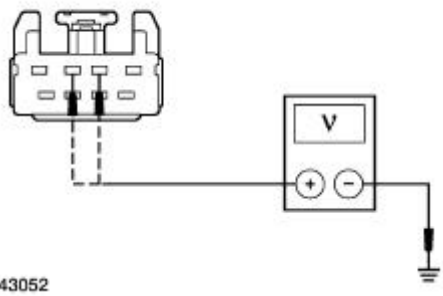
Pinpoint Tests

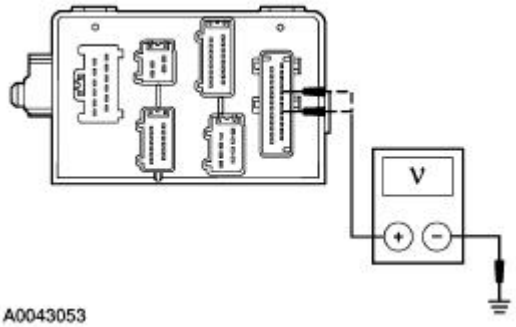
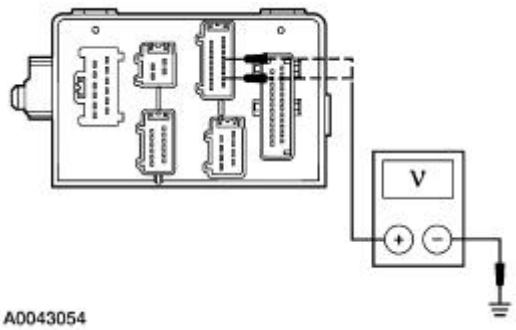
PINPOINT TEST H: THE STOPLAMPS ARE INOPERATIVE

Test Step	Result / Action to Take
H1 CHECK CIRCUIT 10 (LG/RD) FOR AN OPEN • Disconnect: BPP Switch C278. • Measure the voltage between BPP switch C278 pin 1, circuit 10 (LG/RD), harness side and ground.  A0051707 • **Is the voltage greater than 10 volts?**	**Yes** GO to H2 . **No** REPAIR the circuit. TEST the system for normal operation.
H2 CHECK THE BPP SWITCH • Connect a fused jumper wire (20A) between BPP C278 pin 1, circuit 10 (LG/RD), harness side and BPP C278 pin 2, circuit 511 (LG), harness side.  A0051708 • **Do the stoplamps operate?**	**Yes** INSTALL a new BPP switch. REFER to Brake Pedal Position (BPP) Switch in this section. **No** REPAIR circuit 511 (LG). TEST the system for normal operation.

PINPOINT TEST I: ONE OR MORE STOPLAMPS ARE INOPERATIVE

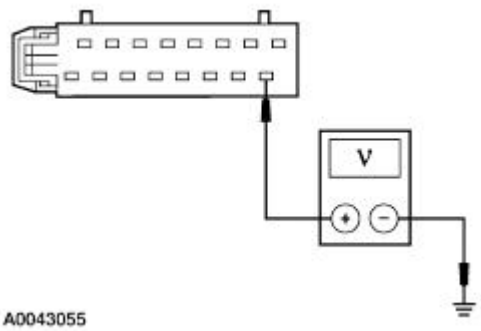
	Result / Action to

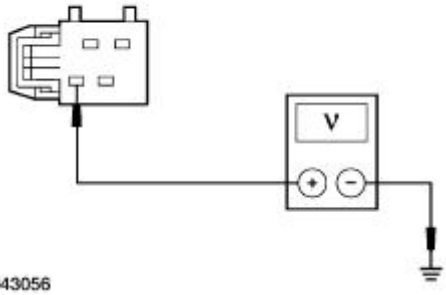
Test Step	Take
I1 CHECK THE VOLTAGE TO THE STOPLAMP	
• Disconnect: Inoperative Stoplamp. • Depress the brake pedal. • Measure the voltage between the inoperative stoplamp connector pin 3, circuit 9 (LG/OG) (LH) or circuit 5 (OG/LB) (RH), harness side and ground; or between the inoperative high mounted stoplamp C475 pin 1, circuit 511 (LG), harness side and ground.  A0049568 • **Is the voltage greater than 10 volts?**	**Yes** REPAIR circuit 57 (BK). TEST the system for normal operation. **No** If high mounted stoplamp, REPAIR circuit 511 (LG). TEST the system for normal operation. If both stoplamps are inoperative, INSTALL a new multifunction switch. REFER to Section 211-05 . TEST the system for normal operation. If a single stoplamp is inoperative, GO to I2 .
I2 CHECK CIRCUIT 511 (LG) FOR VOLTAGE	
• Disconnect: Multifunction Switch C202b. • Depress the brake pedal. • Measure the voltage between the multifunction switch C202b pin 2, circuit 511 (LG) (RH stoplamp), harness side and ground; or between the multifunction switch C202b pin 3, circuit 511 (LG) (LH stoplamp), harness side and ground.  A0043052 • **Is the voltage greater than 10 volts?**	**Yes** GO to I3 . **No** REPAIR the circuit. TEST the system for normal operation.
I3 CHECK THE MULTIFUNCTION SWITCH	
• Carry out the multifunction switch component test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. • **Is the multifunction switch OK?**	**Yes** GO to I4 . **No** INSTALL a new multifunction switch. REFER to Section 211-05 . TEST the system for normal operation.
I4 CHECK FOR VOLTAGE TO THE CENTRAL JUNCTION BOX (CJB)	
• Connect: Multifunction Switch C202b. • Disconnect: CJB C270e. • Depress the brake pedal.	**Yes** GO to I5 .

• Measure the voltage between the CJB C270e pin 15, circuit 9 (LG/OG) (LH stoplamp), component side and ground; or between the CJB C270e pin 18, circuit 5 (OG/LB) (RH stoplamp), component side and ground.  A0043053 • **Is the voltage greater than 10 volts?**	**No** REPAIR circuit 9 (LG/OG) or circuit 5 (OG/LB) as necessary. TEST the system for normal operation.
I5 CHECK THE CJB	
• Connect: CJB C270e. • Disconnect: CJB C270j. • Depress the brake pedal. • Measure the voltage between the CJB C270j pin 8, circuit 9 (LG/OG) (LH stoplamp), component side and ground; or between the CJB C270j pin 14, circuit 5 (OG/LB) (RH stoplamp), component side and ground.  A0043054 • **Is the voltage greater than 10 volts?**	**Yes** REPAIR circuit 9 (LG/OG) or circuit 5 (OG/LB) as necessary. TEST the system for normal operation. **No** INSTALL a new CJB. TEST the system for normal operation.

PINPOINT TEST J: THE STOPLAMPS ARE ON CONTINUOUSLY

Test Step	Result / Action to Take
J1 CHECK THE BRAKE PEDAL POSITION (BPP) SWITCH	
• Disconnect: BPP Switch C278. • **Are the stoplamps illuminated?**	**Yes** GO to J2 . **No** INSTALL a new BPP switch. REFER to Brake Pedal Position (BPP) Switch in this section. TEST the system for normal operation.
J2 CHECK CIRCUIT 511 (LG) FOR SHORT TO POWER	
• Disconnect: Multifunction Switch C202b. • **Do the stoplamps continue to illuminate?**	**Yes** If center high mounted stoplamp, REPAIR circuit 511 (LG). TEST the system for normal operation.

	If rear stoplamp, GO to J3 . **No** INSTALL a new multifunction switch. REFER to Section 211-05 . TEST the system for normal operation.
J3 CHECK CIRCUIT TO CENTRAL JUNCTION BOX (CJB) FOR SHORT TO POWER ● Disconnect: CJB C270a. ● **Does the rear stoplamp continue to illuminate?**	**Yes** GO to J4 . **No** REPAIR circuit 5 (OG/LB) (RH stoplamp) or circuit 9 (LG/OG) (LH stoplamp) as necessary. TEST the system for normal operation.
J4 CHECK CIRCUIT 5 (OG/LB) OR CIRCUIT 9 (LG/OG) FOR AN OPEN ● Disconnect: CJB C270j. ● **Does the rear stoplamp continue to illuminate?**	**Yes** REPAIR circuit 5 (OG/LB) (RH stoplamp) or circuit 9 (LG/OG) (LH stoplamp) as necessary. TEST the system for normal operation. **No** If LH stoplamp, GO to J5 . If RH stoplamp, GO to J6 .
J5 CHECK CIRCUIT 64 (DG) FOR SHORT TO POWER ● Disconnect: Trailer Tow C4098 (4-pin). ● Disconnect: Trailer Tow C4099 (7-pin). ● Measure the voltage between the CJB C270j pin 16, circuit 64 (DG), harness side and ground.  A0043055 ● **Is the voltage greater than 10 volts?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** INSTALL a new CJB. TEST the system for normal operation.
J6 CHECK CIRCUIT 52 (YE) FOR SHORT TO POWER ● Disconnect: CJB C270k. ● Disconnect: Trailer Tow C4098 (4-pin). ● Disconnect: Trailer Tow C4099 (7-pin). ● Measure the voltage between the CJB C270k pin 2, circuit 52 (YE), harness side and ground.	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** INSTALL a new CJB. TEST the system for normal operation.



A0043056

- **Is the voltage greater than 10 volts?**

Turn Signal and Hazard Lamps

Refer to Wiring Diagrams Cell 90 , Turn/Stop/Hazard Lamps for schematic and connector information.

Refer to Wiring Diagrams Cell 13 , Power Distribution for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect the following for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
● Multifunction switch	● Central junction box (CJB) fuse(s): ■ 2 (20A) ■ 18 (10A) ● Circuitry ● Electronic flasher ● Signal/hazard lamp

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the concern is not visually evident, verify the symptom and refer to the Symptom Chart.

Symptom Chart

NOTE: Refer to Wiring Diagrams for the connector numbers stated in the pinpoint tests.

Symptom Chart

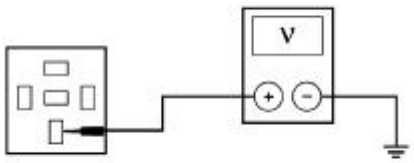
Condition	Possible Sources	Action
● The turn signal lamps are	● Central junction box (CJB) fuse 18	● Go To Pinpoint Test K .

inoperative	(10A). ● Circuitry. ● Electronic flasher. ● Multifunction switch. ● CJB.	
● The turn signal lamps are always on	● Multifunction switch.	● INSTALL a new multifunction switch. REFER to Section 211-05 . TEST the system for normal operation.
● One turn signal/hazard lamp is inoperative	● Turn signal/hazard flasher lamp. ● Multifunction switch. ● Circuitry.	● Go To Pinpoint Test L .
● The hazard lamps are inoperative	● Central junction box (CJB) fuse 2 (20A). ● Circuitry. ● Electronic flasher. ● Multifunction switch. ● CJB.	● Go To Pinpoint Test M .
● The hazard lamps are always on	● Multifunction switch.	● INSTALL a new multifunction switch. REFER to Section 211-05 . TEST the system for normal operation.
● The turn signal lamps are inoperative—signal mirror	● Circuitry. ● Signal mirror.	● Go To Pinpoint Test N .

Pinpoint Tests

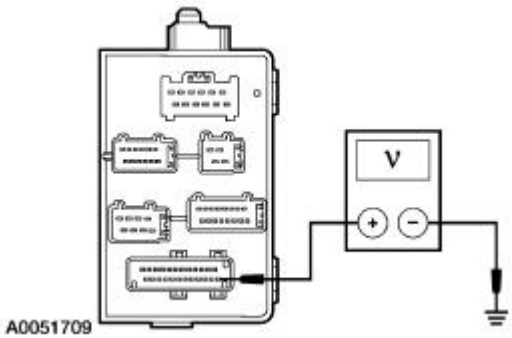
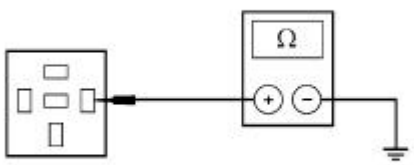
PINPOINT TEST K: THE TURN SIGNAL LAMPS ARE INOPERATIVE

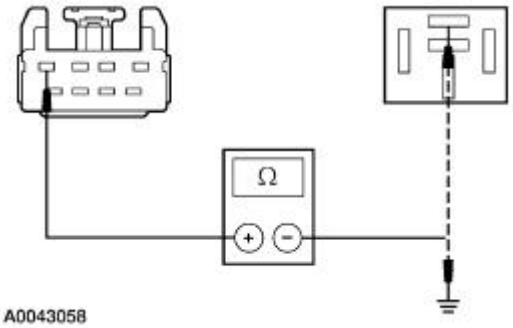
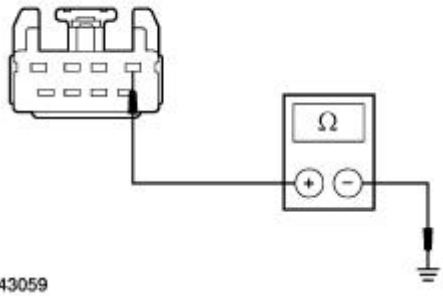
Test Step	Result / Action to Take
K1 CHECK THE VOLTAGE TO THE ELECTRONIC FLASHER	
● Key in OFF position. ● Disconnect: Electronic Flasher C2047. ● Key in ON position. ● Measure the voltage between the electronic flasher C2047 pin 30, circuit 294 (WH/LB), harness side and ground.	**Yes** GO to K3 . **No** GO to K2 .



GN1437-A

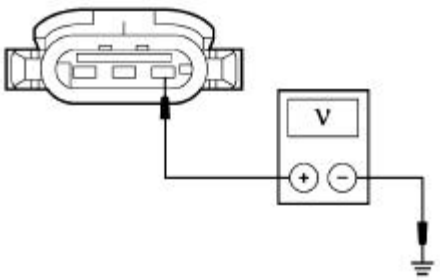
- **Is the voltage greater than 10 volts?**

K2 CHECK CIRCUIT 294 (WH/LB) FOR AN OPEN - Key in OFF position. - Disconnect: Central Junction Box (CJB) C270e. - Key in ON position. - Measure the voltage between the CJB C270e pin 1, circuit 294 (WH/LB), component side and ground.  A0051709 - **Is the voltage greater than 10 volts?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** INSTALL a new CJB. TEST the system for normal operation.
K3 CHECK CIRCUIT 57 (BK) FOR AN OPEN - Key in OFF position. - Measure the resistance between the electronic flasher C2047 pin 86, circuit 57 (BK), harness side and ground.  GN1433-A - **Is the resistance less than 5 ohms?**	**Yes** GO to K4 . **No** REPAIR the circuit. TEST the system for normal operation.
K4 CHECK CIRCUIT 44 (LB) FOR OPEN OR SHORT TO GROUND - Disconnect: Multifunction Switch C202b. - Measure the resistance between the multifunction switch C202b pin 4, circuit 44 (LB), harness side and the electronic flasher C2047 pin 87, circuit 44 (LB), harness side; and between the multifunction switch C202b pin 4, circuit 44 (LB), harness side and ground.	**Yes** GO to K5 . **No** REPAIR the circuit. TEST the system for normal operation.

 A0043058 ● **Is the resistance less than 5 ohms between the multifunction switch and the electronic flasher, and greater than 10,000 ohms between the multifunction switch and ground?**	
K5 CHECK CIRCUIT 385 (WH/RD) FOR SHORT TO GROUND	**Yes** GO to K6 . **No** REPAIR the circuit. TEST the system for normal operation.
● Measure the resistance between the multifunction switch C202b pin 1, circuit 385 (WH/RD), harness side and ground.  A0043059 ● **Is the resistance greater than 10,000 ohms?**	
K6 CHECK THE MULTIFUNCTION SWITCH	**Yes** INSTALL a new electronic flasher. TEST the system for normal operation. **No** INSTALL a new multifunction switch. REFER to Section 211-05 . TEST the system for normal operation.
● Carry out the multifunction switch component test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. ● **Is the multifunction switch OK?**	

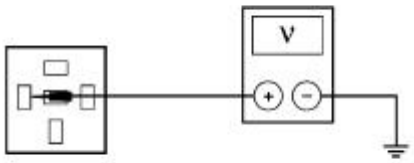
PINPOINT TEST L: ONE TURN SIGNAL/HAZARD LAMP IS INOPERATIVE

Test Step	Result / Action to Take
L1 CHECK THE STOPLAMPS FOR CORRECT OPERATION	
● Key in OFF position. ● Depress and release the brake pedal. ● **Doe the stoplamps operate correctly?**	**Yes** GO to L2 . **No** REFER to Stoplamps in this

	section.
L2 CHECK THE VOLTAGE TO THE INOPERATIVE LAMP	
• Key in OFF position. • Disconnect: Inoperative Turn Signal/Hazard Flasher Lamp. • Place the hazard flasher lamp switch in the ON position. • Measure the voltage between the inoperative lamp connector pin 3, harness side and ground: **Inoperative Lamp / Circuit** LF C1023 — 3 (LG/WH) RF C1043 — 2 (WH/LB) LR C4035 — 9 (LG/OG) RR C4032 — 5 (OG/LB)  A0039258 • **Does the voltage alternate between less than 1 volt and greater than 10 volts?**	**Yes** REPAIR circuit 57 (BK). TEST the system for normal operation. **No** If rear lamp is inoperative, INSTALL a new multifunction switch. REFER to Section 211-05 . TEST the system for normal operation. If front lamp is inoperative, GO to L3 .
L3 CHECK THE MULTIFUNCTION SWITCH	
• Carry out the multifunction switch component test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. • **Is the multifunction switch OK?**	**Yes** REPAIR circuit 3 (LG/WH) or 2 (WH/LB). TEST the system for normal operation. **No** INSTALL a new multifunction switch. REFER to Section 211-05 . TEST the system for normal operation.

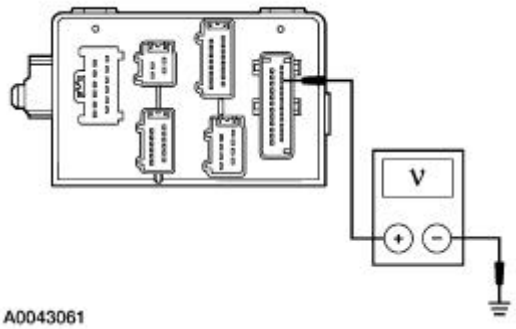
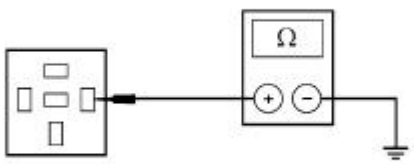
PINPOINT TEST M: THE HAZARD LAMPS ARE INOPERATIVE

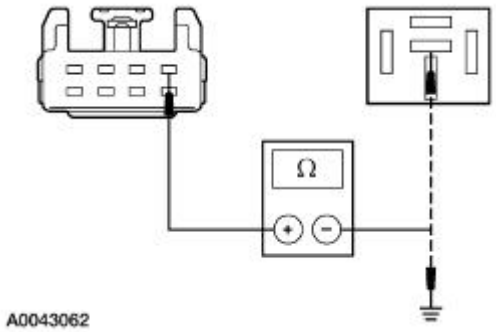
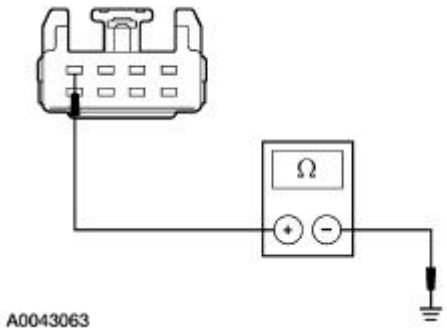
Test Step	Result / Action to Take
M1 CHECK THE VOLTAGE TO THE ELECTRONIC FLASHER	
• Disconnect: Electronic Flasher C2047. • Measure the voltage between the electronic flasher C2047 pin 85, circuit 383 (RD/WH), harness side and ground.	**Yes** GO to M3 . **No** GO to M2 .



GN1436-A

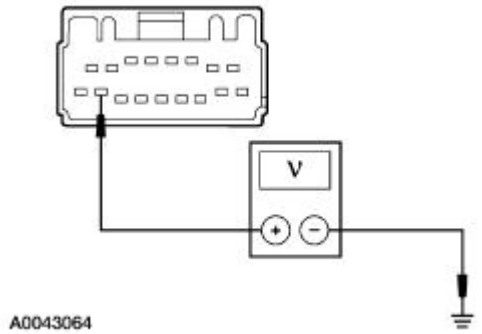
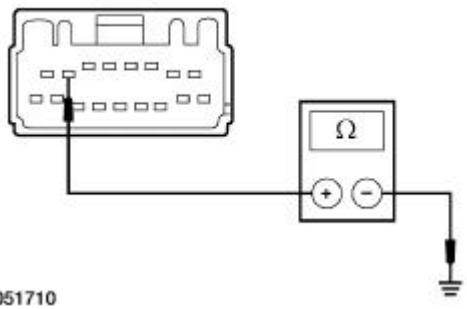
- **Is the voltage greater than 10 volts?**

M2 CHECK CIRCUIT 10 (LG/RD) AND 383 (RD/WH) FOR AN OPEN	
• Disconnect: Central Junction Box (CJB) C270f. • Measure the voltage between the CJB C270f pin 3, circuit 10 (LG/RD), component side and ground.  A0043061 • **Is the voltage greater than 10 volts?**	**Yes** REPAIR circuit 10 (LG/RD) or 383 (RD/WH) as necessary. TEST the system for normal operation. **No** INSTALL a new CJB. TEST the system for normal operation.
M3 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
• Measure the resistance between the electronic flasher C2047 pin 86, circuit 57 (BK), harness side and ground.  GN1433-A • **Is the resistance less than 5 ohms?**	**Yes** GO to M4 . **No** REPAIR the circuit. TEST the system for normal operation.
M4 CHECK CIRCUIT 385 (WH/RD) FOR OPEN OR SHORT TO GROUND	
• Disconnect: Multifunction Switch C202b. • Measure the resistance between the multifunction switch C202b pin 1, circuit 385 (WH/RD), harness side and the electronic flasher C2047 pin 87a, circuit 385 (WH/RD), harness side; and between the multifunction switch C202b pin 1, circuit 385 (WH/RD), harness side and ground.	**Yes** GO to M5 . **No** REPAIR the circuit. TEST the system for normal operation.

 A0043062 ● **Is the resistance less than 5 ohms between the multifunction switch and the electronic flasher, and greater than 10,000 ohms between the multifunction switch and ground?**	
M5 CHECK CIRCUIT 44 (LB) FOR SHORT TO GROUND	
● Measure the resistance between the multifunction switch C202b pin 4, circuit 44 (LB), harness side and ground.  A0043063 ● **Is the resistance greater than 10,000 ohms?**	**Yes** GO to M6 . **No** REPAIR the circuit. TEST the system for normal operation.
M6 CHECK THE MULTIFUNCTION SWITCH	
● Carry out the multifunction switch component test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. ● **Is the multifunction switch OK?**	**Yes** INSTALL a new electronic flasher. TEST the system for normal operation. **No** INSTALL a new multifunction switch. REFER to Section 211-05 . TEST the system for normal operation.

PINPOINT TEST N: THE TURN SIGNAL LAMPS ARE INOPERATIVE—SIGNAL MIRROR

Test Step	Result / Action to Take
N1 CHECK CIRCUIT 2 (WH/LB) OR CIRCUIT 3 (LG/WH) FOR AN OPEN	
● Key in OFF position. ● Disconnect: Inoperative Outside Rear View Mirror Connector. ● Place the hazard switch on. ● Measure the voltage between the LH outside rear view mirror	**Yes** GO to N2 . **No**

C516 pin 10, circuit 3 (LG/WH), harness side and ground; or between the RH outside rear view mirror C622 pin 10, circuit 2 (WH/LB), harness side and ground.  A0043064 • **Does the voltage vary between 0 and greater than 10 volts?**	REPAIR the circuit in question. TEST the system for normal operation.
N2 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
• Measure the resistance between the LH outside rear view mirror C516 pin 2, circuit 57 (BK), harness side and ground; or between the RH outside rear view mirror C622 pin 2, circuit 57 (BK), harness side and ground.  A0051710 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new outside rear view mirror. REFER to Section 501-09 . TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.

Parking, Rear and License Lamps

Refer to Wiring Diagrams Cell 92 , Exterior Lamps for schematic and connector information.

Refer to Wiring Diagrams Cell 13 , Power Distribution for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect the following for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
● Headlamp switch ● Vehicle security module	● Central junction box (CJB) fuse 6 (15A) ● Parking, rear or license lamp ● Circuitry ● CJB

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the concern is not visually evident, verify the symptom and refer to the Symptom Chart.

Symptom Chart

NOTE: Refer to Wiring Diagrams for the connector numbers stated in the pinpoint tests.

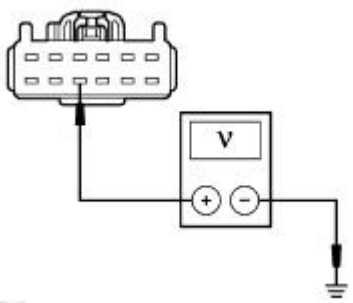
Symptom Chart

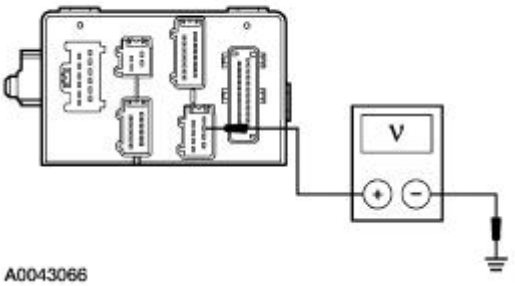
Condition	Possible Sources	Action
● The autolamps operate but parking, rear and license lamps are inoperative	● Central junction box (CJB) fuse 6 (15A). ● Circuitry. ● Vehicle security	● Go To Pinpoint Test G .

	module.	
• The exterior lamps are inoperative	• Central Junction Box (CJB) fuse 6 (15A). • Circuitry. • Headlamp switch. • CJB.	• Go To Pinpoint Test O .
• One or more parking, rear or license lamp is inoperative	• Parking, rear or license lamp. • Circuitry. • Central junction box (CJB).	• Go To Pinpoint Test P .
• The parking, rear or license lamps are on continuously	• Circuitry. • Headlamp switch. • Central junction box (CJB). • Vehicle security module.	• Go To Pinpoint Test O .

Pinpoint Tests

PINPOINT TEST O: THE PARKING, REAR OR LICENSE LAMPS ARE INOPERATIVE

Test Step	Result / Action to Take
O1 CHECK VOLTAGE TO THE HEADLAMP SWITCH	
• Key in OFF position. • Disconnect: Headlamp Switch C205a. • Measure the voltage between the headlamp switch C205a pin 10 , circuit 195 (TN/WH), harness side and ground.  A0037718 • **Is the voltage greater than 10 volts?**	**Yes** GO to O3 . **No** GO to O2 .
O2 CHECK CIRCUIT 195 (TN/WH) FOR AN OPEN	
• Disconnect: Central Junction Box (CJB) C270f. • Measure the voltage between the CJB C270f pin 4, circuit 195 (TN/WH), component side and ground.	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** INSTALL a new CJB. TEST the system for normal operation.



- **Is the voltage greater than 10 volts?**

O3 CHECK THE HEADLAMP SWITCH	
• Carry out the headlamp switch component test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. • **Is the headlamp switch OK?**	**Yes** REPAIR circuit 14 (BN). TEST the system for normal operation. **No** INSTALL a new headlamp switch. REFER to Headlamp Switch in this section. TEST the system for normal operation.

PINPOINT TEST P: ONE OR MORE PARKING, REAR OR LICENSE LAMP IS INOPERATIVE

Test Step	Result / Action to Take
P1 CHECK THE VOLTAGE TO THE INOPERATIVE LAMP (S)	
• Disconnect: Inoperative Lamp. • Measure the voltage between inoperative lamp connector, harness side and ground as follows: • **Is the voltage greater than 10 volts?**	**Yes** REPAIR circuit 57 (BK). TEST the system for normal operation. **No** REPAIR circuit 14 (BN). TEST the system for normal operation.

Inoperative Lamp	Pin	Circuit
LF park/turn C1023	2	14 (BN)
RF park/turn C1043	2	14 (BN)
LF side marker C151	1	14 (BN)
RF side marker C161	1	14 (BN)
LR turn/stop/park C4035	2	14 (BN)
RR turn/stop/park C4032	2	14 (BN)
LH license C452	2	14 (BN)
RH license C462	1	14 (BN)

PINPOINT TEST Q: THE PARKING, REAR OR LICENSE LAMPS ARE ON CONTINUOUSLY

Test Step	Result / Action to Take
Q1 CHECK THE HEADLAMP SWITCH ● Turn the headlamp switch off. ● Disconnect: Headlamp Switch C205a. ● **Do the parking, rear or license lamps continue to illuminate?**	**Yes** GO to Q2 . **No** INSTALL a new headlamp switch. REFER to Headlamp Switch in this section. TEST the system for normal operation.
Q2 CHECK THE VEHICLE SECURITY MODULE ● Disconnect: Vehicle Security Module C2113b. ● **Do the parking, rear or license lamps continue to illuminate?**	**Yes** GO to Q3 . **No** REFER to Autolamps in this section.
Q3 CHECK CIRCUIT 14 (BN) FOR AN OPEN ● Disconnect: Central Junction Box (CJB) C270a. ● **Do the parking, rear or license lamps continue to illuminate?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** INSTALL a new CJB. TEST the system for normal operation.

Fog Lamps

Refer to Wiring Diagrams Cell 86 , Fog Lamps for schematic and connector information.

Refer to Wiring Diagrams Cell 13 , Power Distribution for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent

Inspection and verification

1. Verify the customer concern.
2. Visually inspect the following for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
● Headlamp switch	● Central junction box (CJB) fuse 17 (15A) ● Circuitry ● Fog lamp relay ● Daytime running lamp (DRL) relay ● Fog lamp

3. If an obvious cause for an observed or reported concern is found, correct the cause before proceeding to the next step.
4. If the concern is not visually evident, verify the symptom and refer to the Symptom Chart.

Symptom Chart

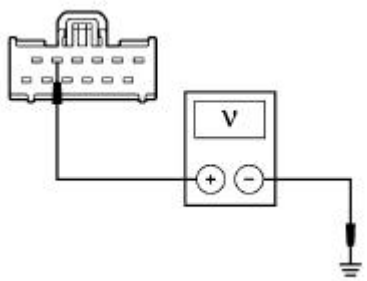
Symptom Chart

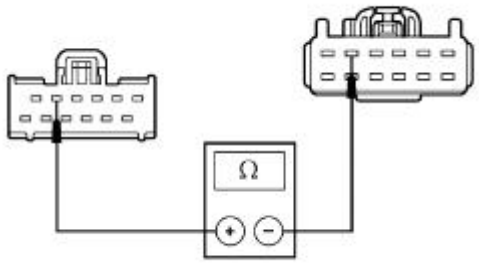
Condition	Possible Sources	Action
● The fog lamps are inoperative	● Central junction box (CJB) fuse 17 (15A). ● Circuitry. ● Headlamp switch. ● Fog lamp relay. ● CJB.	● Go To Pinpoint Test R .

• The individual fog lamp is inoperative	• Circuitry.	• Go To Pinpoint Test S .
• The fog lamps are on continuously	• Circuitry. • Fog lamp relay. • Headlamp switch. • Central junction box (CJB).	• Go To Pinpoint Test T .

Pinpoint Tests

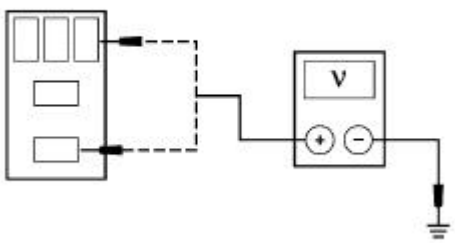
PINPOINT TEST R: THE FOG LAMPS ARE INOPERATIVE

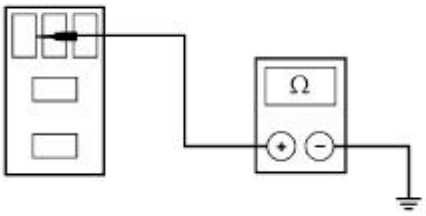
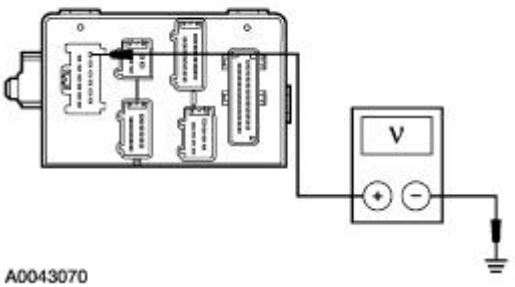
Test Step	Result / Action to Take
R1 CHECK HIGH BEAM HEADLAMPS	
• Inspect the high beam headlamp operation. • **Do the high beams operate correctly?**	**Yes** GO to R2 . **No** REFER to Headlamps in this section.
R2 CHECK HEADLAMP SWITCH OUTPUT	
• Key in OFF position. • Disconnect: Central Junction Box (CJB) C270h. • **NOTE:** Headlamps must be in the low beam position. • Turn the headlamp switch to the headlamps ON position and engage the fog lamp switch. • Measure the voltage between the CJB C270h pin 5, circuit 188 (WH/BK), harness side and ground.  A0043067 • **Is the voltage greater than 10 volts?**	**Yes** TURN the headlamp switch off. GO to R5 . **No** TURN the headlamp switch off. GO to R3 .
R3 CHECK CIRCUIT 188 (WH/BK) FOR AN OPEN	
• Disconnect: Headlamp Switch C205a. • Measure the resistance between the CJB C270h pin 5, circuit 188 (WH/BK), harness side and the headlamp switch C205a pin 5, circuit 188 (WH/BK), harness side.	**Yes** GO to R4 . **No** REPAIR the circuit. TEST the system for normal operation.



A0043068

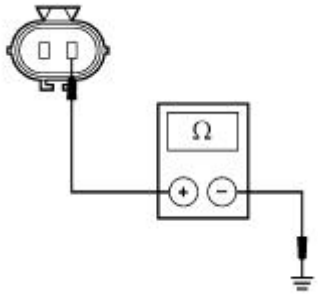
- **Is the resistance less than 5 ohms?**

R4 CHECK THE HEADLAMP SWITCH	
• Carry out the headlamp switch component test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. • **Is the headlamp switch OK?**	**Yes** REPAIR circuit 14 (BN). TEST the system for normal operation. **No** INSTALL a new headlamp switch. REFER to Headlamp Switch in this section. TEST the system for normal operation.
R5 CHECK FOR POWER TO THE FOG LAMP RELAY	
• Connect: Central Junction Box (CJB) C270h. • Disconnect: Fog Lamp Relay C2241. • **NOTE:** Headlamps must be in the low beam position. • Turn the headlamp switch to the headlamps ON position and engage the fog lamp switch. • Measure the voltage between the fog lamp relay C2241 pin 1, harness side and ground; and between the fog lamp relay C2241 pin 3, harness side and ground.  A0043069 • **Are the voltages greater than 10 volts?**	**Yes** TURN the headlamp switch off. GO to R6 . **No** INSTALL a new CJB. TEST the system for normal operation.
R6 CHECK FOG LAMP RELAY GROUND CIRCUIT	
• Measure the resistance between the fog lamp relay C2241 pin 2, harness side and ground.	**Yes** GO to R7 . **No** INSTALL a new CJB. TEST the system for normal operation.

 GN1455-A ● **Is the resistance less than 5 ohms?**	
R7 CHECK THE FOG LAMP RELAY	
● Carry out the fog lamp relay component test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. ● **Is the fog lamp relay OK?**	**Yes** GO to R8 . **No** INSTALL a new fog lamp relay. TEST the system for normal operation.
R8 CHECK CIRCUIT 478 (TN/OG) FOR AN OPEN	
● Connect: Fog Lamp Relay C2241. ● Disconnect: CJB C270a. ● **NOTE:** Headlamps must be in the low beam position. ● Turn the headlamp switch to the headlamps ON position and engage the fog lamp switch. ● Measure the voltage between the CJB C270a pin 12, component side and ground.  A0043070 ● **Is the voltage greater than 10 volts?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** INSTALL a new CJB. TEST the system for normal operation.

PINPOINT TEST S: THE INDIVIDUAL FOG LAMP IS INOPERATIVE

Test Step	Result / Action to Take
S1 CHECK FOG LAMP GROUND	
● Key in OFF position. ● Disconnect: Inoperative Fog Lamp. ● Measure the resistance between the fog lamp connector pin 2, circuit 57 (BK), harness side and ground.	**Yes** REPAIR circuit 478 (TN/OG). TEST the system for normal operation. **No** REPAIR circuit 57 (BK). TEST the system for normal operation.

 A0043071 ● **Is the resistance less than 5 ohms?**	

PINPOINT TEST T: THE FOG LAMPS ARE ON CONTINUOUSLY

Test Step	Result / Action to Take
T1 CHECK THE HEADLAMP SWITCH	**Yes** GO to T2 . **No** INSTALL a new headlamp switch. REFER to Headlamp Switch in this section. TEST the system for normal operation.
● Key in OFF position. ● Disconnect: Headlamp Switch C205a. ● **Do the fog lamps continue to illuminate?**	
T2 CHECK CIRCUIT 188 (WH/BK) FOR SHORT TO POWER	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** If equipped with daytime running lamps (DRL), GO to T3 . If not equipped with DRL, GO to T4 .
● Disconnect: Central Junction Box (CJB) C270h. ● **Do the fog lamps continue to illuminate?**	
T3 CHECK THE DRL SYSTEM	**Yes** GO to T4 . **No** REFER to Section 417-04 .
● Disconnect: DRL Headlamp Relay C1359. ● **Do the fog lamps continue to illuminate?**	
T4 CHECK CIRCUIT 478 (TN/OG) FOR SHORT TO POWER	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** GO to T5 .
● Disconnect: CJB C270a. ● **Do the fog lamps continue to illuminate?**	
T5 CHECK THE FOG LAMP RELAY	**Yes** INSTALL a new CJB. TEST the system for normal operation. **No**
● Carry out the fog lamp relay component test. Refer to Wiring Diagrams Cell 149	

for schematic and connector information. • **Is the fog lamp relay OK?**	INSTALL a new fog lamp relay. TEST the system for normal operation.

Reversing Lamps

Refer to Wiring Diagrams Cell 93 , Reversing Lamps for schematic and connector information.

Refer to Wiring Diagrams Cell 13 , Power Distribution for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect the following for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
● Digital transmission range (TR) sensor	● Central junction box (CJB) fuse(s): ■ 14 (10A) ■ 10 (20A) ● Circuitry ● Reversing lamp relay ● Reversing lamp ● Digital transmission range (TR) sensor

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the concern is not visually evident, verify the symptom and refer to the Symptom Chart.

Symptom Chart

NOTE: Refer to Wiring Diagrams for the connector numbers stated in the pinpoint tests.

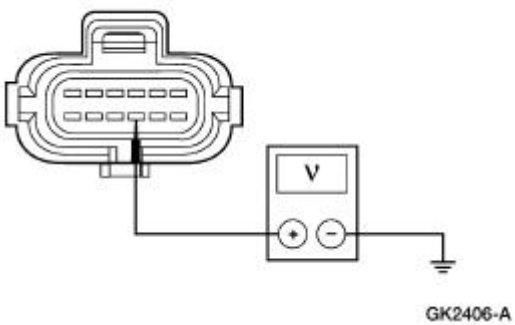
Symptom Chart

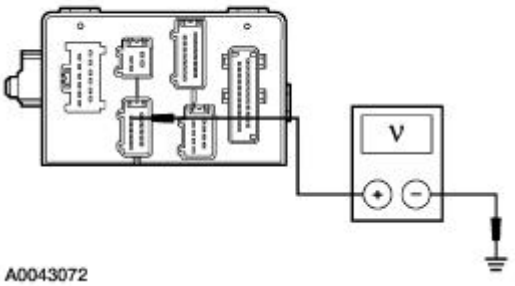
Condition	Possible Sources	Action
● The reversing lamps are	● Central junction box	● Go To Pinpoint

inoperative	(CJB) fuse(s): ■ 14 (10A). ■ 10 (20A). ● Reversing lamp relay ● Circuitry. ● Digital transmission range (TR) sensor. ● CJB.	Test U .
● The individual reversing lamp is inoperative	● Reversing lamp. ● Circuitry.	● Go To Pinpoint Test V .
● The reversing lamps are on continuously	● Reversing lamp relay ● Circuitry. ● Digital transmission range (TR) sensor. ● Central junction box (CJB).	● Go To Pinpoint Test W .

Pinpoint Tests

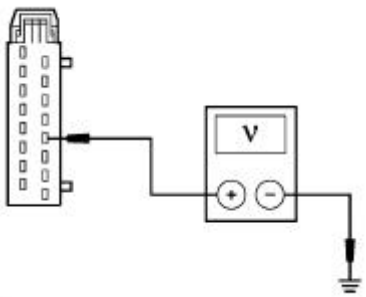
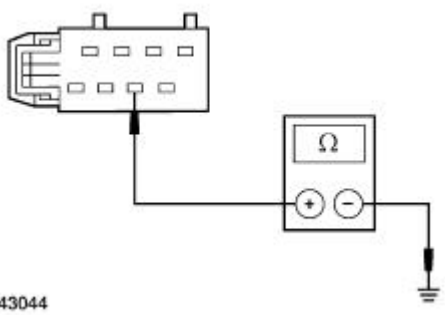
PINPOINT TEST U: THE REVERSING LAMPS ARE INOPERATIVE

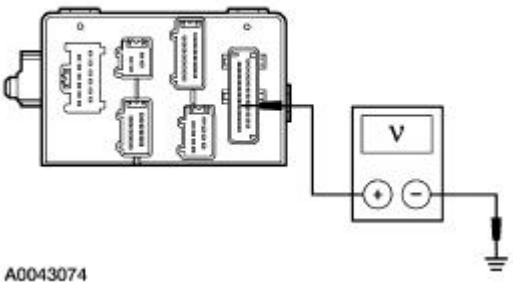
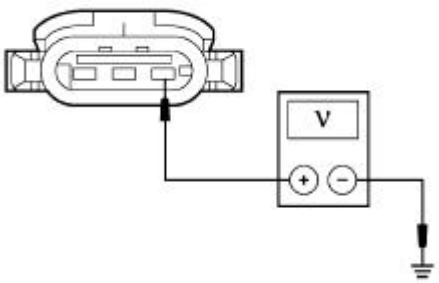
Test Step	Result / Action to Take
U1 CHECK THE VOLTAGE TO THE DIGITAL TR SENSOR	
● Key in OFF position. ● Disconnect: Digital TR Sensor C167. ● Key in ON position. ● Measure the voltage between the digital TR sensor C167 pin 9, circuit 295 (LB/PK), harness side and ground.  GK2406-A ● **Is the voltage greater than 10 volts?**	**Yes** GO to U3 . **No** GO to U2 .
U2 CHECK CIRCUIT 295 (LB/PK) FOR AN OPEN	
● Key in OFF position. ● Disconnect: Central Junction Box (CJB) C270b. ● Key in ON position. ● Measure the voltage between the CJB C270b pin 1, circuit 295 (LB/PK), component side and ground.	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** INSTALL a new CJB. TEST the system for normal operation.



A0043072

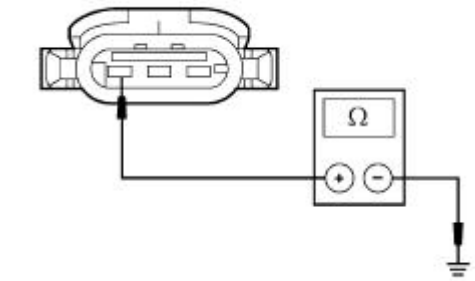
- **Is the voltage greater than 10 volts?**

U3 CHECK THE DIGITAL TR SENSOR	
• Carry out the digital TR sensor component test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. • **Is the digital TR sensor OK?**	**Yes** GO to U4 . **No** INSTALL a new digital TR sensor. TEST the system for normal operation.
U4 CHECK CIRCUIT 1789 (VT/WH) FOR AN OPEN	
• Key in OFF position. • Connect: Digital TR Sensor C167. • Disconnect: Central Junction Box (CJB) C270j. • Apply the parking brake. • Key in ON position. • Select REVERSE. • Measure the voltage between the CJB C270j pin 9, circuit 1789 (VT/WH), harness side and ground.  A0043073 • **Is the voltage greater than 10 volts?**	**Yes** GO to U5 . **No** REPAIR the circuit. TEST the system for normal operation.
U5 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
• Key in OFF position. • Disconnect: CJB C270f. • Measure the resistance between the CJB C270f pin 6, circuit 57 (BK), harness side and ground.  A0043044	**Yes** GO to U6 . **No** REPAIR the circuit. TEST the system for normal operation.

• **Is the resistance less than 5 ohms?**	
U6 CHECK THE CJB	
• Connect: CJB C270j. • Connect: CJB C270f. • Disconnect: CJB C270e. • Apply the parking brake. • Key in ON position. • Select REVERSE. • Measure the voltage between the CJB C270e pin 20, circuit 140 (BK/PK), component side and ground.  A0043074 • **Is the voltage greater than 10 volts?**	**Yes** GO to U7 . **No** INSTALL a new CJB. TEST the system for normal operation.
U7 CHECK CIRCUIT 140 (BK/PK) FOR AN OPEN	
• Key in OFF position. • Connect: CJB C270e. • Disconnect: RH Reversing Lamp C461. • Key in ON position. • Select REVERSE. • Measure the voltage between the RH reversing lamp C461 pin 3, circuit 140 (BK/PK), harness side and ground.  A0039258 • **Is the voltage greater than 10 volts?**	**Yes** REPAIR circuit 140 (BK/PK). TEST the system for normal operation. **No** REPAIR circuit 57 (BK). TEST the system for normal operation.

PINPOINT TEST V: THE INDIVIDUAL REVERSING LAMP IS INOPERATIVE

Test Step	Result / Action to Take
V1 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
• Key in OFF position. • Disconnect: Inoperative Reversing Lamp. • Measure the resistance between inoperative reversing lamp connector pin 1, circuit 57 (BK), harness side and ground.	**Yes** REPAIR circuit 140 (BK/PK). TEST the system for normal operation. **No**

 A0039259 ● **Is the resistance less than 5 ohms?**	REPAIR circuit 57 (BK). TEST the system for normal operation.

PINPOINT TEST W: THE REVERSING LAMPS ARE ON CONTINUOUSLY

Test Step	Result / Action to Take
W1 CHECK THE DIGITAL TR SENSOR	
● Key in OFF position. ● Disconnect: Digital TR Sensor C167. ● **Do the reversing lamps continue to illuminate?**	**Yes** GO to W2 . **No** INSTALL a new digital TR sensor. REFER to Section 307-01A or Section 307-01B . TEST the system for normal operation.
W2 CHECK CIRCUIT 3078 (LB/OG) FOR SHORT TO POWER	
● Disconnect: Central Junction Box (CJB) C270j. ● **Do the reversing lamps continue to illuminate?**	**Yes** GO to W3 . **No** REPAIR the circuit. TEST the system for normal operation.
W3 CHECK CIRCUIT 140 (BK/PK) FOR SHORT TO POWER	
● Disconnect: CJB C270e. ● **Do the reversing lamps continue to illuminate?**	**Yes** REPAIR circuit 140 (BK/PK) or circuit 963 (BK/LG). TEST the system for normal operation. **No** INSTALL a new CJB. TEST the system for normal operation.

Trailer Lamps

Refer to Wiring Diagrams Cell 95 , Trailer/Camper Lamps for schematic and connector information.

Refer to Wiring Diagrams Cell 13 , Power Distribution for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect the following for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Electrical
● Central junction box (CJB) fuse(s): ■ 10 (20A) ■ 13 (10A) ■ 29 (30A) ■ 36 (10A) ■ 42 (10A) ■ 106 (30A) ● Circuitry ● Lamps ● Trailer tow battery charge relay ● Trailer tow park lamp relay ● Trailer tow electric brake controller ● CJB

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the concern is not visually evident, verify the symptom and refer to the Symptom Chart.

Symptom Chart

NOTE: Refer to Wiring Diagrams for the connector numbers stated in the pinpoint tests.

Symptom Chart

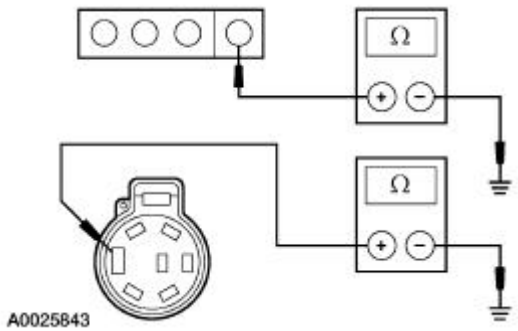
Condition	Possible Sources	Action

• The trailer lamps are inoperative	• Circuitry.	• Go To Pinpoint Test X .
• The individual trailer lamp is inoperative — RH trailer turn signal/stoplamp/hazard flasher lamp	• Central junction box (CJB) fuse 36 (10A). • Circuitry. • CJB.	• Go To Pinpoint Test Y .
• The individual trailer lamp is inoperative — LH trailer turn signal/stoplamp/hazard flasher lamp	• Central junction box (CJB) fuse 42 (10A). • Circuitry. • CJB.	• Go To Pinpoint Test Z .
• The trailer lamps are inoperative — trailer parking lamps	• Central junction box (CJB) fuse 10 (20A). • Trailer tow parking lamp relay. • Circuitry. • CJB.	• Go To Pinpoint Test AA .
• The trailer lamps are inoperative — trailer reversing lamps	• Circuitry.	• Go To Pinpoint Test AB .
• The trailer lamps are on continuously	• Trailer tow parking lamp relay. • Circuitry. • Central junction box (CJB).	• Go To Pinpoint Test AC .
• The trailer battery charging is inoperative	• Central junction box (CJB) fuse 106 (30A). • Circuitry. • CJB.	• Go To Pinpoint Test AD .
• The trailer electric brakes are inoperative	• Central junction box (CJB) fuse 29 (30A). • Circuitry. • Trailer tow electric brake controller. • CJB.	• Go To Pinpoint Test AE .

Pinpoint Tests

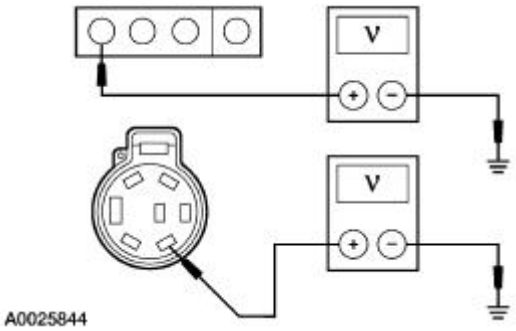
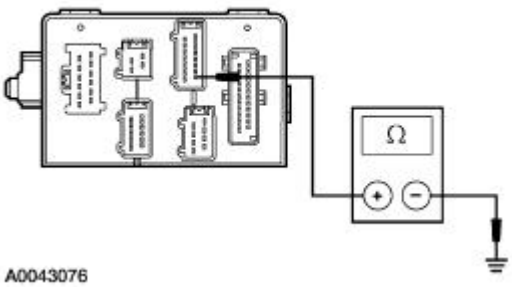
PINPOINT TEST X: THE TRAILER LAMPS ARE INOPERATIVE

Test Step	Result / Action to Take
X1 CHECK LIGHTING OPERATION	**Yes** GO to X2 .
• Key in OFF position. • Disconnect: Trailer Tow C4098 (4-pin). • Disconnect: Trailer Tow C4099 (7-pin) .	

• Disconnect the trailer from the vehicle. • Check the operation of the vehicle exterior lighting systems for any concerns. • **Does the exterior lighting system of the vehicle operate correctly?**	**No** REPAIR any vehicle exterior lighting concerns. TEST the system for normal operation.
X2 CHECK CIRCUIT 206 (WH) FOR AN OPEN	
• Measure the resistance between the trailer tow C4098 pin 1, circuit 206 (WH) (4–pin connector), or the trailer tow C4099 pin 2, circuit 206 (WH) (7–pin connector), harness side and ground.  • **Is the resistance less than 5 ohms?**	**Yes** Vehicle is operating correctly. HAVE the trailer repaired by an authorized camper/trailer repair center. **No** REPAIR the circuit. TEST the system for normal operation.

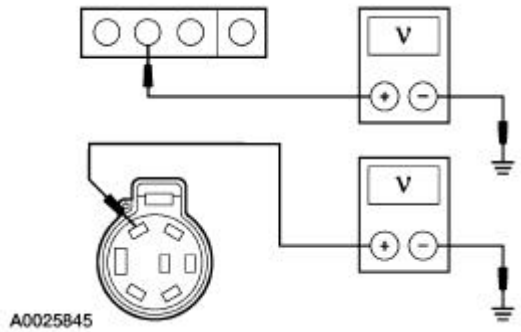
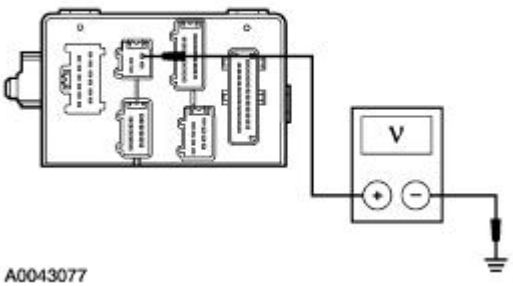
PINPOINT TEST Y: THE INDIVIDUAL TRAILER LAMP IS INOPERATIVE — RH TRAILER TURN SIGNAL/STOPLAMP/HAZARD FLASHER LAMP

Test Step	Result / Action to Take
Y1 CHECK TURN SIGNAL OPERATION	
• Key in OFF position. • Disconnect: Trailer Tow C4098 (4-pin). • Disconnect: Trailer Tow C4099 (7-pin) . • Disconnect the trailer from the vehicle. • Check the operation of the vehicle exterior lighting systems for any concerns. • **Does the exterior lighting system of the vehicle operate correctly?**	**Yes** GO to Y2 . **No** REPAIR any vehicle exterior lighting concerns. TEST the system for normal operation.
Y2 CHECK CIRCUIT 64 (DG) FOR POWER	
• Key in ON position. • Place the multifunction switch in the RH turn position. • Measure the voltage between the trailer tow C4098 pin 4, circuit 64 (DG) (4-pin connector), or the trailer tow C4099 pin 4, circuit 64 (DG) (7– pin connector), harness side and ground.	**Yes** Vehicle is operating correctly. HAVE the trailer repaired by an authorized camper/trailer repair center. **No** GO to Y3 .

 A0025844 ● **Does the voltage alternate between less than 1 volt and greater than 10 volts?**	
Y3 CHECK CIRCUIT 64 (DG) FOR AN OPEN	
● Key in OFF position. ● Disconnect: Central Junction Box (CJB) C270j. ● Key in ON position. ● Measure the resistance between the CJB C270j pin 16, circuit 64 (DG), component side and ground.  A0043076 ● **Does the voltage alternate between less than 1 volt and greater than 10 volts?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** INSTALL a new CJB. TEST the system for normal operation.

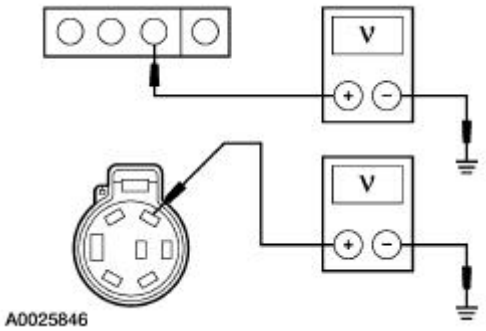
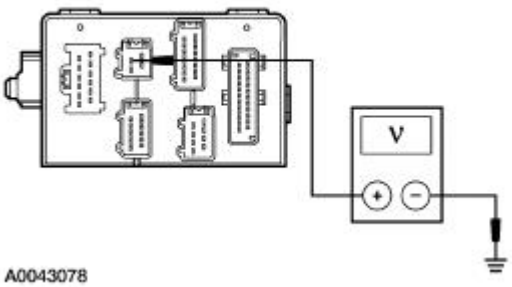
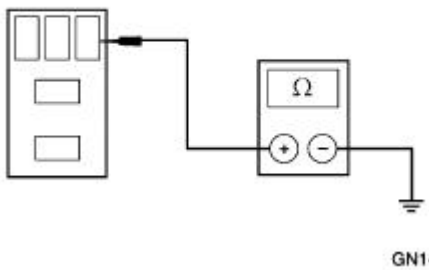
PINPOINT TEST Z: THE INDIVIDUAL TRAILER LAMP IS INOPERATIVE — LH TRAILER TURN SIGNAL/STOPLAMP/HAZARD FLASHER LAMP

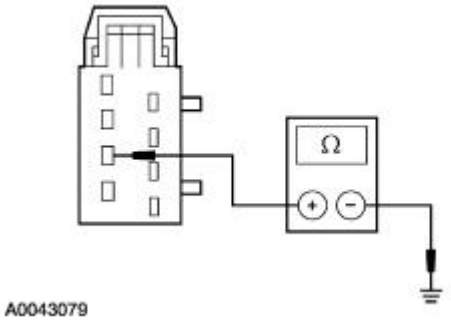
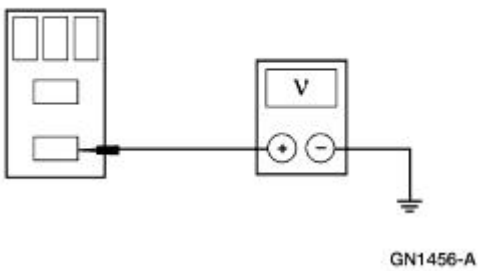
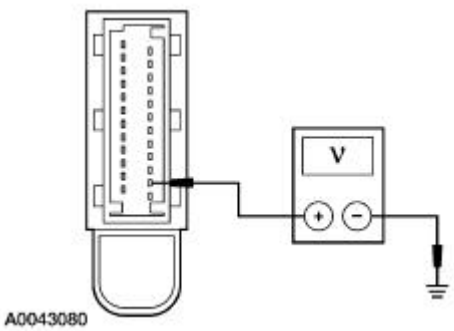
Test Step	Result / Action to Take
Z1 CHECK TURN SIGNAL OPERATION	
● Key in OFF position. ● Disconnect: Trailer Tow C4098 (4-pin). ● Disconnect: Trailer Tow C4099 (7-pin) . ● Disconnect the trailer from the vehicle. ● Check the operation of the vehicle exterior lighting systems for any concerns. ● **Does the exterior lighting system of the vehicle operate correctly?**	**Yes** GO to Z2 . **No** REPAIR any vehicle exterior lighting concerns. TEST the system for normal operation.
Z2 CHECK CIRCUIT 52 (YE) FOR POWER	
● Key in ON position. ● Place the multifunction switch in the LH turn position. ● Measure the voltage between the trailer tow C4098 pin 3, circuit 52 (YE) (4-pin connector), or the trailer tow C4099 pin 1, circuit 52 (YE) (7-pin connector), harness side and ground.	**Yes** Vehicle is operating correctly. HAVE the trailer repaired by an authorized camper/trailer repair center.

 ● **Does the voltage alternate between less than 1 volt and greater than 10 volts?**	**No** GO to Z3 .
Z3 CHECK CIRCUIT 52 (YE) FOR AN OPEN ● Key in OFF position. ● Disconnect: Central Junction Box (CJB) C270k. ● Key in ON position. ● Measure the voltage between the CJB C270k pin 2, circuit 52 (YE), component side and ground.  ● **Does the voltage alternate between less than 1 volt and greater than 10 volts?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** INSTALL a new CJB. TEST the system for normal operation.

PINPOINT TEST AA: THE TRAILER LAMPS ARE INOPERATIVE — TRAILER PARKING LAMPS

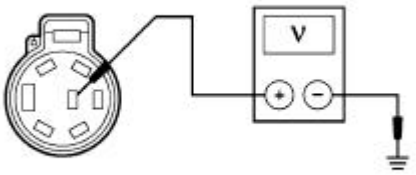
Test Step	Result / Action to Take
AA1 CHECK LIGHTING OPERATION ● Key in OFF position. ● Disconnect: Trailer Tow C4098 (4-pin). ● Disconnect: Trailer Tow C4099 (7-pin) . ● Disconnect the trailer from the vehicle. ● Check the operation of the vehicle exterior lighting systems for any concerns. ● **Does the exterior lighting system of the vehicle operate correctly?**	**Yes** GO to AA2 . **No** REPAIR any vehicle exterior lighting concerns. TEST the system for normal operation.
AA2 CHECK CIRCUIT 962 (BN/WH) FOR POWER ● Turn the headlamp switch to the parking lamps ON position. ● Measure the voltage between the trailer tow C4098 pin 2, circuit 962 (BN/WH) (4-pin connector) or the trailer tow C4099 pin 6, circuit 962 (BN/WH) (7-pin connector), harness side and ground.	**Yes** Vehicle is operating correctly. HAVE the trailer repaired by an authorized camper/trailer repair center.

 A0025846 ● **Is the voltage greater than 10 volts?**	**No** GO to AA3 .
AA3 CHECK CIRCUIT 962 (BN/WH) FOR AN OPEN	
● Turn the headlamp switch off. ● Disconnect: Central Junction Box (CJB) C270k. ● Turn the headlamp switch to the parking lamps ON position. ● Measure the voltage between the CJB C270k pin 1, circuit 962 (BN/WH), component side and ground.  A0043078 ● **Is the voltage greater than 10 volts?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** GO to AA4 .
AA4 CHECK THE TRAILER TOW PARKING LAMP RELAY	
● Turn the headlamp switch off. ● Carry out the trailer tow parking lamp relay component test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. ● **Is the trailer tow parking lamp relay OK?**	**Yes** GO to AA5 . **No** INSTALL a new trailer tow parking lamp relay. TEST the system for normal operation.
AA5 CHECK THE TRAILER TOW PARKING LAMP RELAY GROUND	
● Disconnect: Trailer Tow Parking Lamp Relay C2240. ● Measure the resistance between the trailer tow parking lamp relay C2240 pin 1, component side and ground.  GN1453-A ● **Is the resistance less than 5 ohms?**	**Yes** GO to AA7 . **No** GO to AA6 .
AA6 CHECK CIRCUIT 57 (BK) FOR AN OPEN	

• Disconnect: CJB C270f. • Measure the resistance between the CJB C270f pin 6, harness side and ground.  A0043079 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new CJB. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
AA7 CHECK THE TRAILER TOW PARKING LAMP RELAY POWER SUPPLY	
• Measure the voltage between the trailer tow parking lamp relay C2240 pin 3, harness side and ground.  GN1456-A • **Is the voltage greater than 10 volts?**	**Yes** GO to AA8 . **No** INSTALL a new CJB. TEST the system for normal operation.
AA8 CHECK CIRCUIT 14 (BN) FOR AN OPEN	
• Disconnect: CJB C270e. • Turn the headlamp switch to the parking lamps ON position. • Measure the voltage between the CJB C270e pin 2, circuit 14 (BN), harness side and ground.  A0043080 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new CJB. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.

PINPOINT TEST AB: THE TRAILER LAMPS ARE INOPERATIVE — TRAILER REVERSING LAMPS

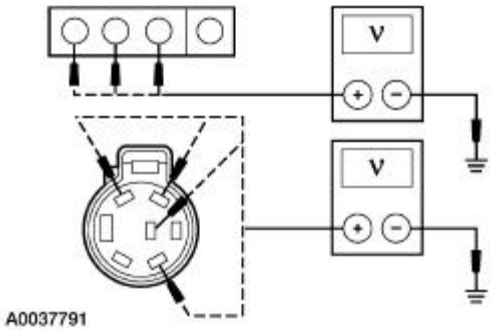
Test Step	Result / Action to Take
AB1 CHECK LIGHTING OPERATION	

• Key in OFF position. • Disconnect: Trailer Tow C4098 (4-pin). • Disconnect: Trailer Tow C4099 (7-pin) . • Disconnect the trailer from the vehicle. • Check the operation of the vehicle exterior lighting systems for any concerns. • **Does the exterior lighting system of the vehicle operate correctly?**	**Yes** GO to AB2 . **No** REPAIR any vehicle exterior lighting concerns. TEST the system for normal operation.
AB2 CHECK CIRCUIT 963 (BK/LG) FOR AN OPEN	
• Apply the parking brake. • Key in ON position. • Select REVERSE. • Measure the voltage between the trailer tow C4099 pin 7, circuit 963 (BK/LG), and ground.  A0025848 • **Is the voltage greater than 10 volts?**	**Yes** Vehicle is operating correctly. HAVE the trailer repaired by an authorized camper/trailer repair center. **No** REPAIR the circuit. TEST the system for normal operation.

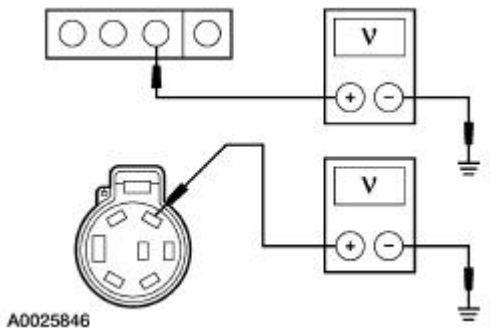
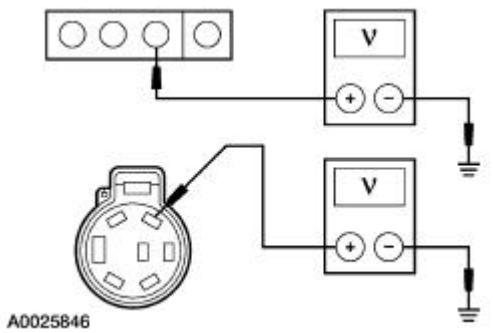
PINPOINT TEST AC: THE TRAILER LAMPS ARE ON CONTINUOUSLY

Test Step	Result / Action to Take
AC1 CHECK LIGHTING OPERATION	
• Key in OFF position. • Disconnect: Trailer Tow C4098 (4-pin). • Disconnect: Trailer Tow C4099 (7-pin) . • Disconnect the trailer from the vehicle. • Check the operation of the vehicle exterior lighting systems for any concerns. • **Does the exterior lighting system of the vehicle operate correctly?**	**Yes** GO to AC2 . **No** REPAIR any vehicle exterior lighting concerns. TEST the system for normal operation.
AC2 CHECK FOR VOLTAGE AT THE TRAILER TOW CONNECTOR	
• Disconnect the trailer from the vehicle. • Turn the headlamp switch off. • Measure the voltage between the trailer tow C4098 (4-pin connector) or trailer tow C4099 (7-pin connector) and ground as follows: **C4098 Pin** / **C4099 Pin** / **Circuit** 3 / 1 / 52 (YE) 4 / 4 / 64 (DG) 2 / 6 / 962 (BN/WH)	**Yes** GO to AC3 . **No** Vehicle is operating correctly. HAVE the trailer repaired by an authorized camper/trailer repair center.

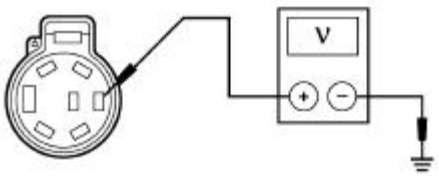
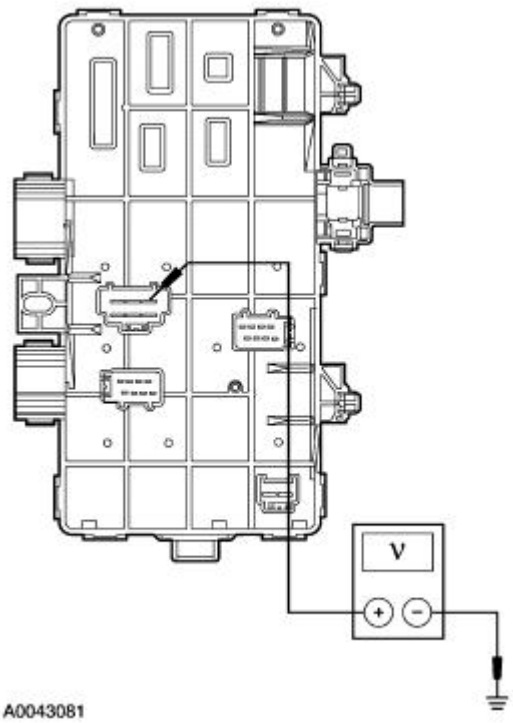
—	7	963 (BK/LG)

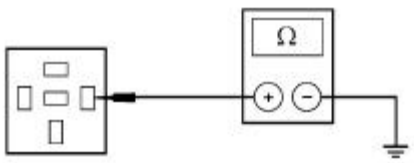
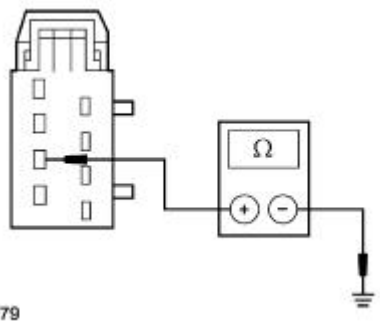


- **Are the voltages greater than 10 volts?**

AC3 CHECK THE TRAILER TOW PARKING LAMP RELAY	
• Disconnect: Trailer Tow Parking Lamp Relay C2240. • Measure the voltage between the trailer tow C4098 pin 2, circuit 962 (BN/WH) (4-pin connector) or the trailer tow C4099 pin 6, circuit 962 (BN/WH) (7-pin connector), harness side and ground.  • **Is the voltage greater than 10 volts?**	**Yes** GO to AC4 . **No** INSTALL a new trailer tow parking lamp relay. TEST the system for normal operation.
AC4 CHECK CIRCUIT 962 (BN/WH) FOR SHORT TO POWER	
• Disconnect: Central Junction Box (CJB) C270k. • Measure the voltage between the trailer tow C4098 pin 2, circuit 962 (BN/WH) (4-pin connector) or the trailer tow C4099 pin 6, circuit 962 (BN/WH) (7-pin connector), harness side and ground.  • **Is the voltage greater than 10 volts?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** INSTALL a new CJB. TEST the system for normal operation.

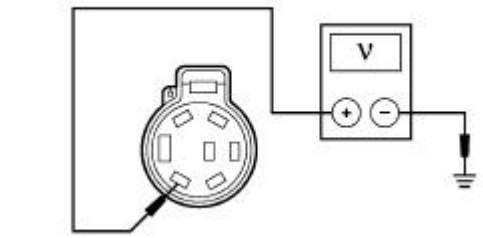
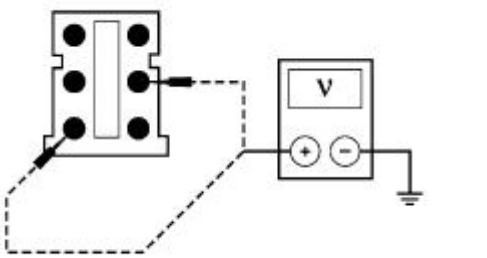
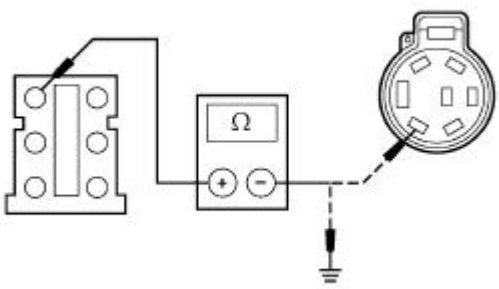
PINPOINT TEST AD: THE TRAILER BATTERY CHARGING IS INOPERATIVE

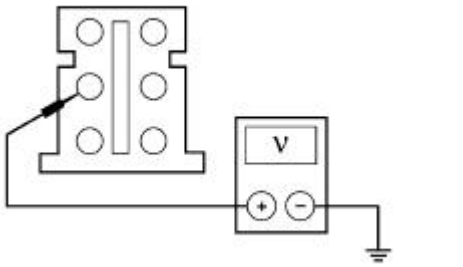
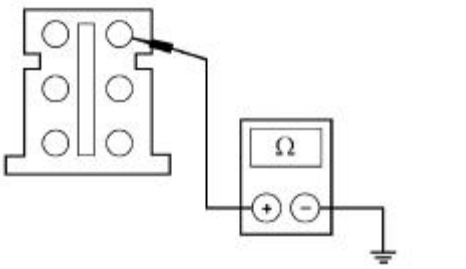
Test Step	Result / Action to Take
AD1 CHECK VOLTAGE FOR THE BATTERY CHARGE AT THE TRAILER TOW CONNECTOR	
• Key in OFF position. • Disconnect: Trailer Tow C4099 (7-pin) . • Disconnect the trailer from the vehicle. • Key in ON position. • Measure the voltage between the trailer tow C4099 pin 5, circuit 49 (OG) and ground.  A0025428 • **Is the voltage greater than 10 volts?**	**Yes** Vehicle is operating correctly. HAVE the trailer repaired by an authorized camper/trailer repair center. **No** GO to AD2 .
AD2 CHECK CIRCUIT 49 (OG) FOR AN OPEN	
• Key in OFF position. • Disconnect: Central Junction Box (CJB) C270n. • Key in ON position. • Measure the voltage between the CJB C270n pin 4, circuit 49 (OG), component side and ground.  A0043081 • **Is the voltage greater than 10 volts?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** GO to AD3 .
AD3 CHECK THE TRAILER TOW BATTERY CHARGE RELAY	
• Turn the headlamp switch off. • Disconnect: Trailer Tow Battery Charge Relay C2110. • Carry out the trailer tow battery charge relay component test.	**Yes** GO to AD4 . **No**

Refer to Wiring Diagrams Cell 149 for schematic and connector information. ● **Is the trailer tow battery charge relay OK?**	INSTALL a new trailer tow battery charge relay. TEST the system for normal operation.
AD4 CHECK THE TRAILER TOW BATTERY CHARGE RELAY GROUND	
● Key in OFF position. ● Disconnect: CJB C270f. ● Measure the resistance between the trailer tow battery charge relay C2110 pin 86, harness side and ground.  GN1433-A ● **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new CJB. TEST the system for normal operation. **No** GO to AD5 .
AD5 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
● Measure the resistance between the CJB C270f pin 6, harness side and ground.  A0043079 ● **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new CJB. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.

PINPOINT TEST AE: THE TRAILER ELECTRIC BRAKES ARE INOPERATIVE

Test Step	Result / Action to Take
AE1 CHECK LIGHTING OPERATION	
● Key in OFF position. ● Disconnect: Trailer Tow C4098 (4-pin). ● Disconnect: Trailer Tow C4099 (7-pin) . ● Disconnect the trailer from the vehicle. ● Check the operation of the vehicle exterior lighting systems for any concerns. ● **Does the exterior lighting system of the vehicle operate correctly?**	**Yes** GO to AE2 . **No** REPAIR any vehicle exterior lighting concerns. TEST the system for normal operation.
AE2 CHECK VOLTAGE FROM THE ELECTRIC BRAKE	

CONTROLLER AT THE TRAILER TOW CONNECTOR	
• Apply the brake. • Measure the voltage between the trailer tow C4099 pin 3, circuit 43 (DB), harness side and ground.  A0025430 • **Is the voltage greater than 10 volts?**	**Yes** The vehicle is operating correctly. HAVE the trailer repaired by an authorized camper/trailer repair center. **No** GO to AE3 .
AE3 CHECK THE VOLTAGE TO THE TRAILER TOW ELECTRIC BRAKE CONTROLLER	
• Disconnect: Trailer Tow Electric Brake Controller C2142. • Turn the headlamp switch to the parking lamps ON position. • Measure the voltage between the trailer tow electric brake controller C2142 pin 1, circuit 50 (RD), harness side and ground; and between the trailer tow electric brake controller C2142 pin 5, circuit 14 (BN), harness side and ground.  GK7573-A • **Are the voltages greater than 10 volts?**	**Yes** GO to AE4 . **No** REPAIR circuit 50 (RD) or circuit 14 (BN) as necessary. TEST the system for normal operation.
AE4 CHECK CIRCUIT 43 (DB) FOR AN OPEN	
• Measure the resistance between the trailer tow electric brake controller C2142 pin 3, circuit 43 (DB), harness side and the trailer tow C4099 pin 3, circuit 43 (DB), harness side; and between the trailer tow electric brake controller C2142 pin 3, circuit 43 (DB), harness side and ground.  A0025431 • **Is the resistance less than 5 ohms between the connectors and greater than 10,000 ohms between the trailer tow electric brake controller connector and ground?**	**Yes** GO to AE5 . **No** REPAIR the circuit. TEST the system for normal operation.
AE5 CHECK CIRCUIT 511 (LG) FOR AN OPEN	

• Apply the brake. • Measure the voltage between the trailer tow electric brake controller C2142 pin 2, circuit 511 (LG), harness side and ground.  GK2178-A • **Is the voltage greater than 10 volts?**	**Yes** GO to AE6 . **No** REPAIR the circuit. TEST the system for normal operation.
AE6 CHECK CIRCUIT 206 (WH) FOR AN OPEN	
• Measure the resistance between the trailer tow electric brake controller C2142 pin 6, circuit 206 (WH), harness side and ground.  GK2179-A • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new trailer tow electric brake controller. TEST the system for normal operation. **No** REPAIR circuit 206 (WH) or circuit 57 (BK) as necessary. TEST the system for normal operation.

Headlamp Adjustment

Headlamp Aiming

1. The headlamp aiming procedure depends on the type of beam pattern the headlamp is equipped with. Vehicles may come equipped with visual optical right (VOR), visual optical left (VOL), or SAE only (includes sealed beam type) headlamps. To identify the headlamp beam pattern, look on the headlamp lens. Molded in small letters on the headlamp lens is one of the following:
    - SAE
    - VOR or SAE
    - VOL or SAE
2. Once the headlamp beam pattern is identified, aim the headlamps using one of the following methods as applicable.
    - Photometric aimers can aim SAE, VOR and VOL type headlamps. This is the preferred method of headlamp aiming.
    - Visual or screen method aiming can be used to aim SAE, VOR and VOL type headlamps.
    - Mechanical aimers can be used only with SAE type headlamps. Lamps that can be aimed mechanically will have three nibs molded into the lens of the lamp.

Photometric Aiming

1. For the photometric aiming procedure, refer to the appropriate photometric headlamp aimer instruction manual.

Screen Method Aiming

All headlamp types

NOTE: Horizontal aim is not necessary for VOR or VOL headlamps.

NOTE: Consult your state vehicle inspection manual for recommended tolerance ranges for visual aiming.

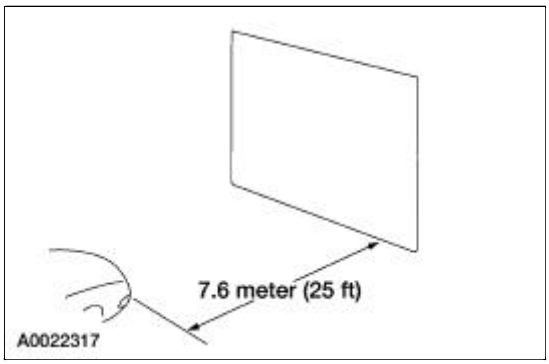
NOTE: The sight shield may need to be positioned or removed for access to the adjusters.

1. Before starting headlamp adjustment:
    - Check the tire inflation.
    - Check that no other load is in the vehicle other than a half tank of fuel.
    - Check that the headlamps are clean.
    - Check for correct headlamp operation.

- Check that the vehicle is on level ground.
- If the vehicle is equipped with air suspension, make sure that the switch is on.

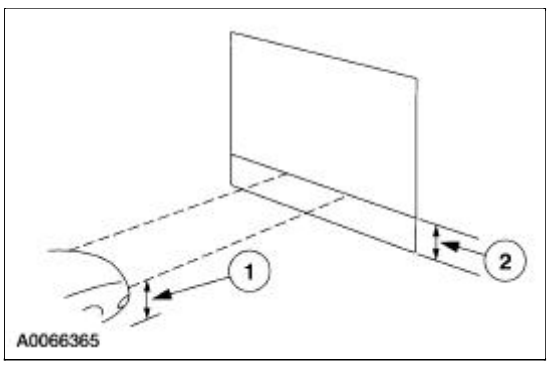
2. **NOTE:** The vertical wall or screen must be a minimum of 2.4 meters (8 feet) wide.

   Park the vehicle on a level surface approximately 7.6 meters (25 feet) from the vertical wall or screen directly in front of it.



3. **NOTE:** The center of the lamp is marked by a 3 mm (0.12 in) circle on the headlamp lens.

   Mark a horizontal reference line on the vertical wall or screen.
   1. Measure the center of the headlamp height to ground and record.
   2. Make a 2.4 meter (8 foot) horizontal mark (masking tape) on the vertical wall or screen at the same distance from the ground as previously recorded.



4. **NOTE:** This procedure should be done in a dark environment to effectively see the headlamp beam pattern.

   Turn on the low beam headlamps to illuminate the wall or screen and open the hood.

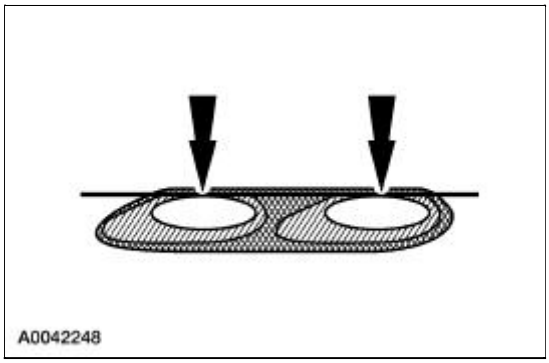
5. **NOTE:** For SAE type headlamps, the appearance of the beam pattern may vary between vehicles.

   On the wall or screen, locate the high intensity area of the beam pattern. Place the top edge of the high intensity zone even with the horizontal reference line.

VOR type headlamps

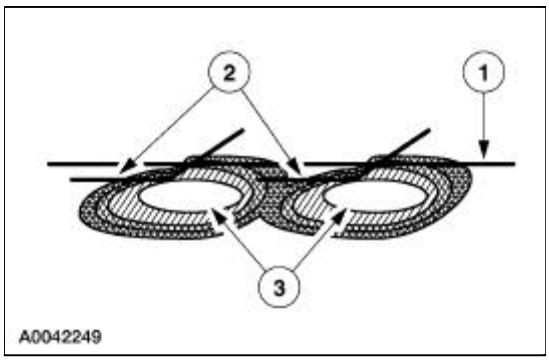
6. **NOTE:** The appearance of the VOR beam pattern may vary between vehicles.

   Identify at the top edge of this high intensity area a distinct horizontal cutoff in the beam pattern. If the top edge of this cutoff is not even with the horizontal reference line, the headlamp beam will need to be adjusted.



VOL type headlamps

7. For VOL type headlamps, there will be a distinct cutoff in the left portion of the beam pattern. The edge of this cutoff should be positioned 50.2 mm (2 in) below the horizontal reference line.
    1. Horizontal reference line.
    2. Top edge of the beam pattern.
    3. High intensity zone.



Mechanical Aiming

1. For the mechanical aiming procedure, refer to the appropriate mechanical headlamp aimer instruction manual.

Front Fog Lamp Adjustment

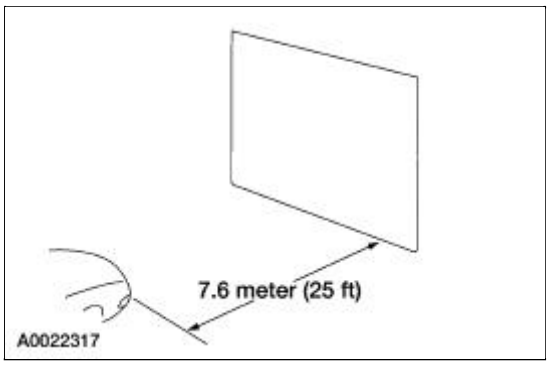
1. **NOTE:** Horizontal aim is not required for this vehicle and is not adjustable. Consult your state vehicle inspection center for recommended tolerance ranges for visual aiming.

   Before starting the fog lamp assembly adjustment:

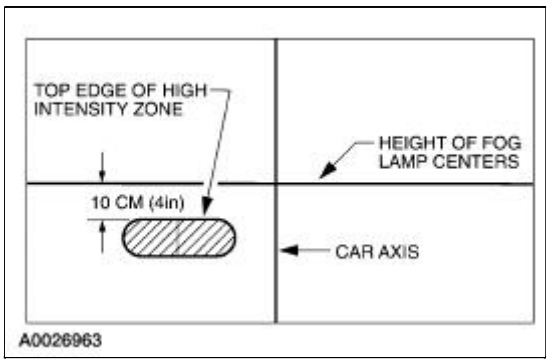
   - check the tire inflation.
   - make sure there are no other loads in the vehicle other than a half tank of fuel.
   - make sure the vehicle is on level ground.
   - make sure the fog lamps and headlamps are clean.
   - make sure the headlamps are operating and are correctly aimed.

2. **NOTE:** The vertical wall screen must be a minimum of 2.4 meters (8 ft) wide.

   Park the vehicle on a level surface approximately 7.6 meters (25 ft) from the vertical wall or screen directly in front of it.



3. The correct visual aim for the fog lamps is with the top edge of the high-intensity zone 10 cm (4 in) below the horizontal center of the fog lamps.



Headlamp Bulb

Removal and Installation

All vehicles

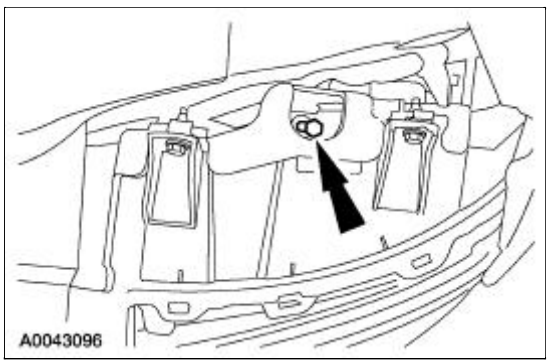
WARNING: The halogen bulb contains gas under pressure. The bulb may shatter if the glass envelope is scratched or if the bulb is dropped. Handle the bulb only by its base. Avoid touching the glass envelope. Failure to follow these instructions may result in personal injury.

NOTE: The headlamp bulb should not be removed from the headlamp until just before a new bulb is installed. Removing the bulb for an extended period of time may affect headlamp bulb performance. Contaminants may enter the headlamp where they can settle on the lens and reflector. Never turn on the headlamp with the bulb removed from the headlamp.

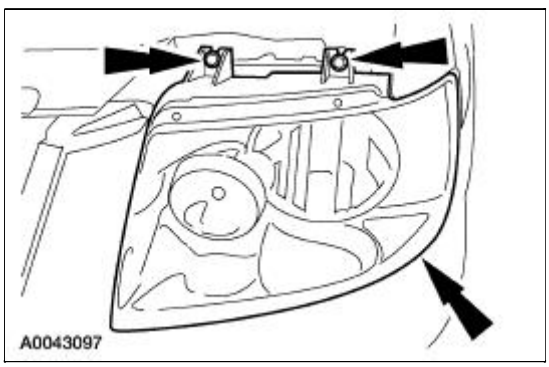
1. Make sure that the headlamp switch and the ignition switch are in the OFF position.

Expedition

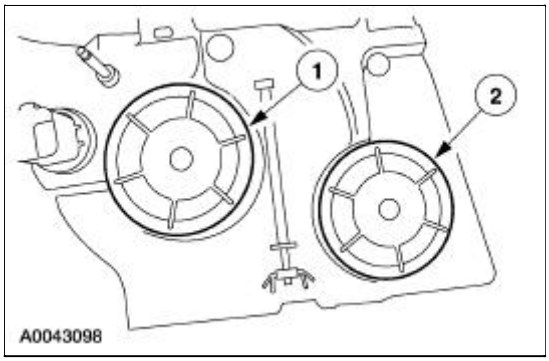
2. Loosen the headlamp retaining bolt.



3. Remove the bolts and the headlamp assembly.
   - Disconnect the electrical connectors.

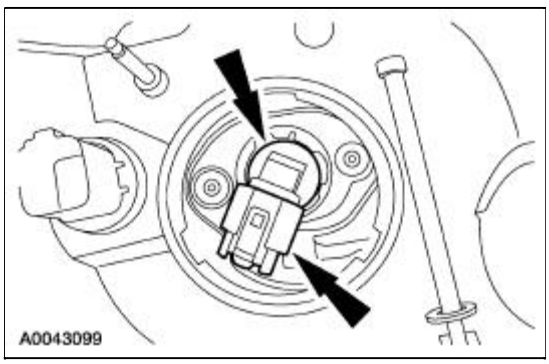


4. Remove the headlamp bulb protective cover(s).
   1. Remove the low beam cover.
   2. Remove the high beam cover.



5. **CAUTION: Bulbs 9004 and 9007 look similar, but are not interchangeable.**

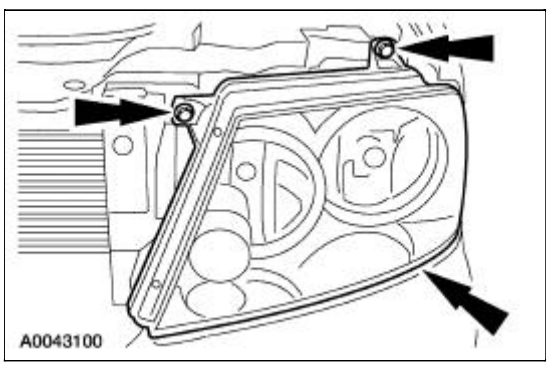
   Disconnect the electrical connector and remove the headlamp bulb.



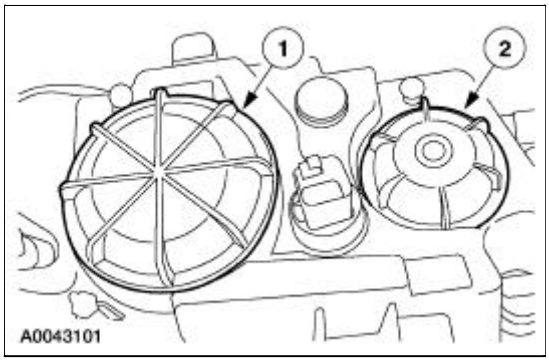
Navigator high intensity discharge (HID) headlamp

6. Remove the front radiator air deflector.

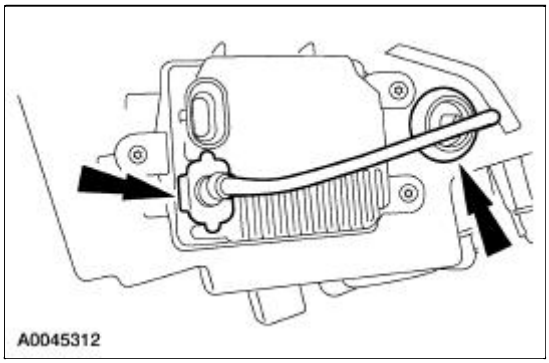
7. Remove the three bolts and the headlamp assembly.
   - Disconnect the electrical connectors.



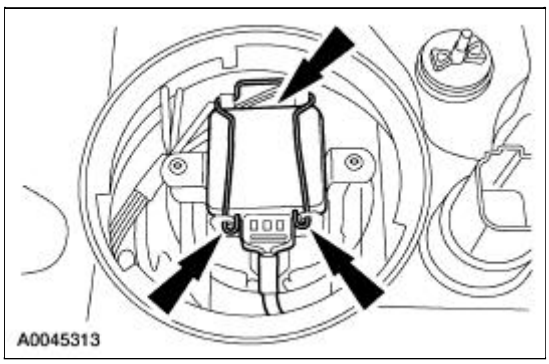
8. Remove the headlamp bulb protective cover(s).
   1. Remove the HID lamp cover.
   2. Remove the high beam cover.



9. Disconnect the electrical connector and push the grommet into the headlamp assembly.



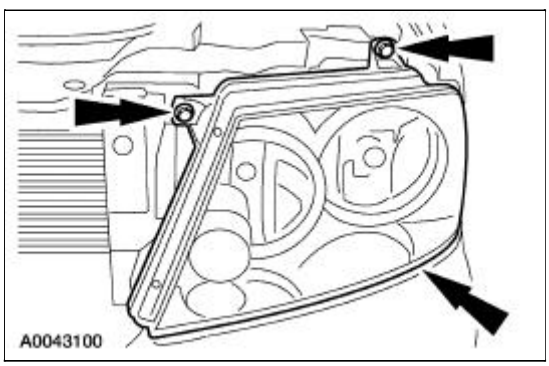
10. Release the spring tabs and remove the HID low beam bulb.



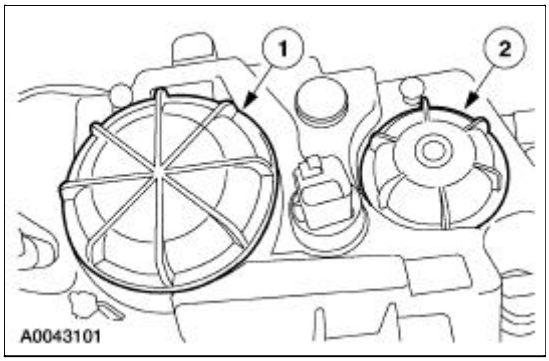
Navigator standard headlamp

11. Remove the front radiator air deflector.

12. Remove the three bolts and the headlamp assembly.
    - Disconnect the electrical connectors.

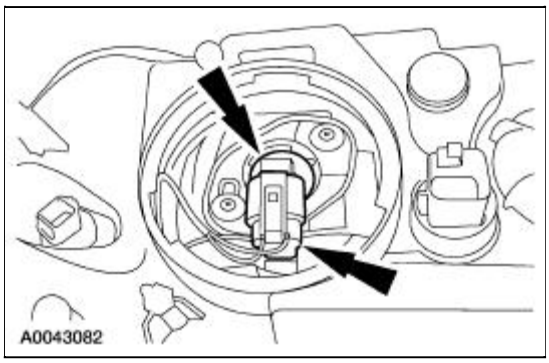


13. Remove the headlamp bulb protective cover.
    1. Low beam cover.
    2. High beam cover.



14. **CAUTION: Bulbs 9004 and 9007 look similar, but are not interchangeable.**

    Disconnect the electrical connector and remove the headlamp bulb.



All vehicles

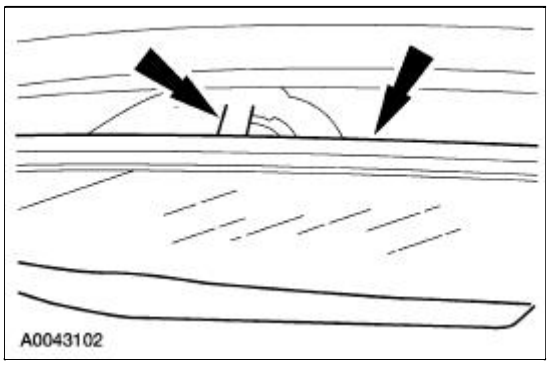
15. To install, reverse the removal procedure.

Side Turn Signal Lamp —Signal Mirror

Removal and Installation

NOTE: Navigator shown, Expedition similar.

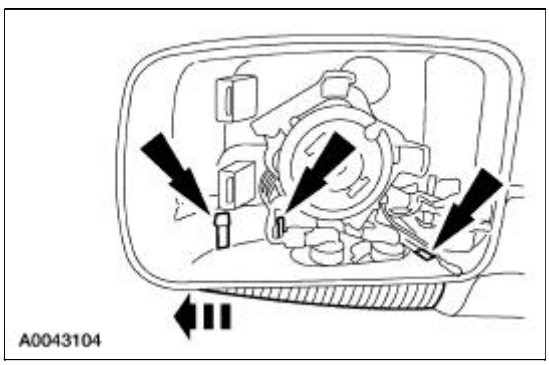
1. Release the two tabs and remove the mirror glass.



2. **CAUTION: Take care not to break the tabs.**

   Slide the lamp assembly away from the vehicle, release the tabs and remove the signal mirror lamp assembly.

   - Separate the bulb holders from the lamp assembly.



3. To install, reverse the removal procedure.

Fog Lamp Bulb

Removal and Installation

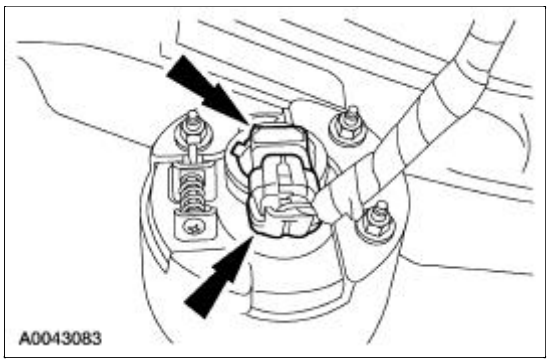
WARNING: The halogen bulb contains gas under pressure. The bulb may shatter if the glass envelope is scratched or if the bulb is dropped. Handle the bulb only by its base. Avoid touching the glass envelope. Failure to follow these instructions may result in personal injury.

NOTE: The fog lamp bulb should not be removed from the fog lamp until just before a new bulb is installed. Removing the bulb for an extended period of time may affect headlamp bulb performance. Contaminants may enter the headlamp where they can settle on the lens and reflector. Never turn on the fog lamp with the bulb removed from the fog lamp.

NOTE: Navigator shown, Expedition similar.

1. **NOTE:** Make sure the headlamp switch and the ignition switch are in the OFF position.

   Disconnect the electrical connector and remove the fog lamp bulb.



2. To install, reverse the removal procedure.

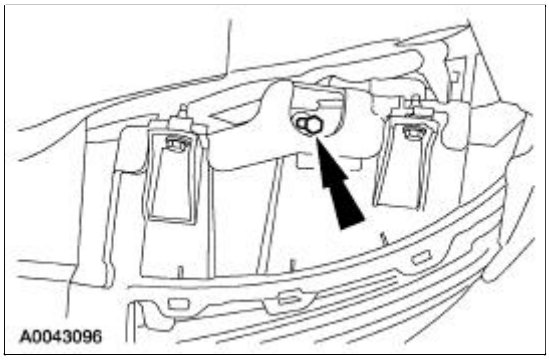
Headlamp Assembly

Removal and Installation

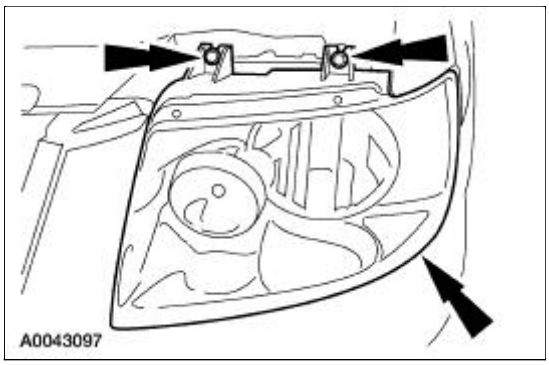
NOTE: Make sure the headlamp switch and the ignition switch are in the OFF position.

Expedition

1. Loosen the headlamp retaining bolt.

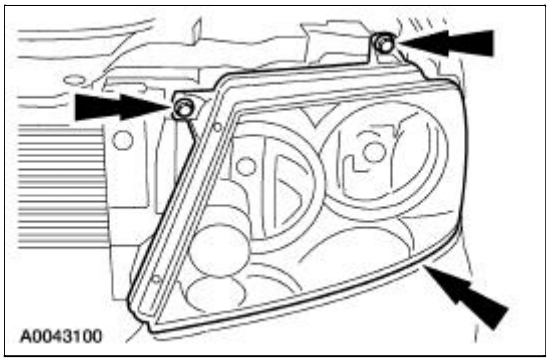


2. Remove the bolts and the headlamp assembly.
    - Disconnect the electrical connectors.



Navigator

3. Remove the front radiator air deflector.
4. Remove the three bolts and the headlamp assembly.
    - Disconnect the electrical connectors.



All vehicles

5. To install, reverse the removal procedure.
    - If necessary, adjust the headlamps. For additional information, refer to Headlamp Adjustment in this section.

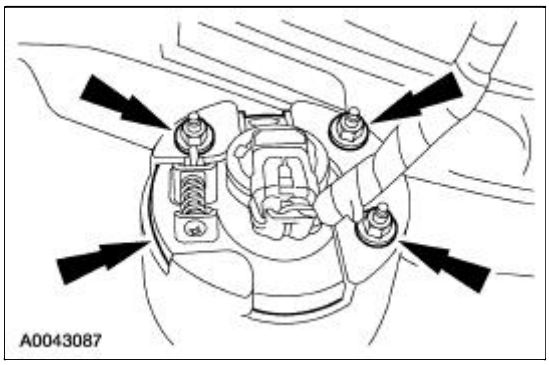
Fog Lamp

Removal and Installation

NOTE: Navigator shown, Expedition similar.

1. **NOTE:** Make sure that the headlamp switch and the ignition switch are in the OFF position.

   Remove the nuts and the fog lamp.
   - Disconnect the electrical connector.

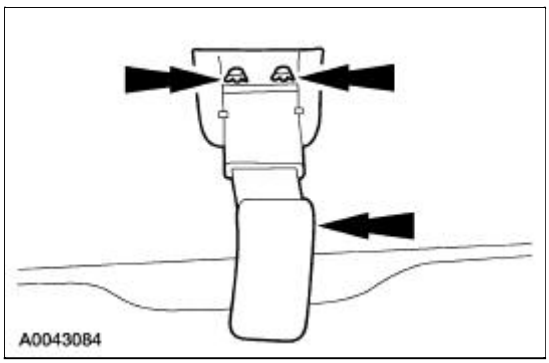


2. To install, reverse the removal procedure.
   - If necessary, adjust the fog lamps. Refer to Front Fog Lamp Adjustment in this section

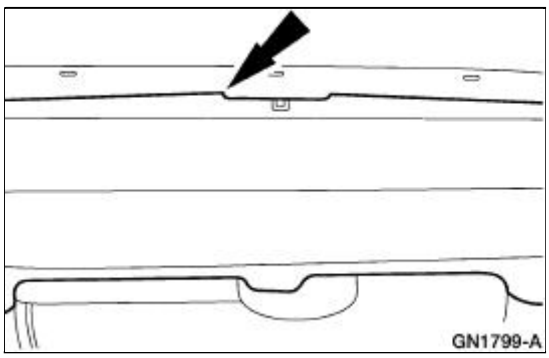
Reversing Lamp

Removal and Installation

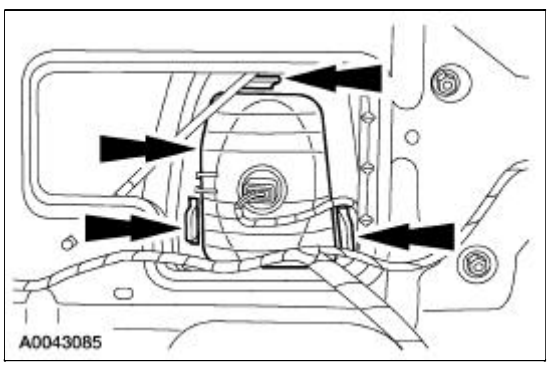
1. Remove the screws and the liftgate pull handle.



2. Remove the liftgate trim panel.
   - Remove the water shield.



3. Release the tabs and remove the reversing lamp.
   - Disconnect the reversing lamp.



4. To install, reverse the removal procedure.

Headlamp Switch

Removal and Installation

All vehicles

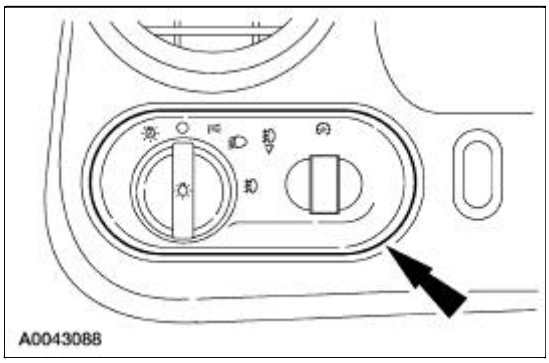
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

Expedition

2. **CAUTION: Cover the end of the tool with tape to prevent damage to the trim panel.**

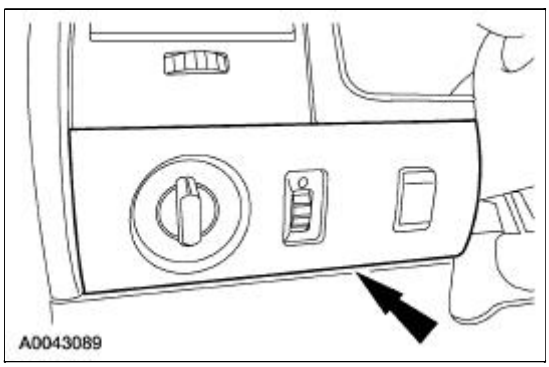
   NOTE: Use a thin-bladed tool to remove the headlamp switch bezel assembly.

   Remove the headlamp switch and bezel assembly.
   - Disconnect the electrical connectors.

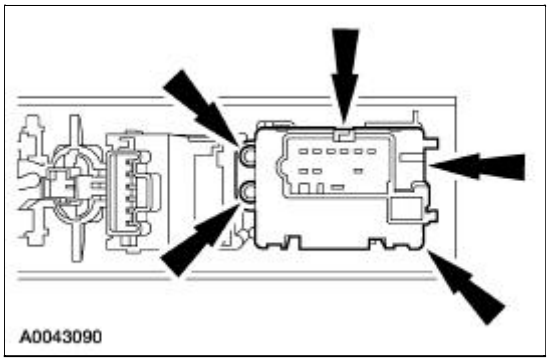


Navigator

3. Remove the headlamp switch and bezel assembly.
   - Disconnect the electrical connectors.



4. Remove the screws, release the tabs and remove the headlamp switch.



All vehicles

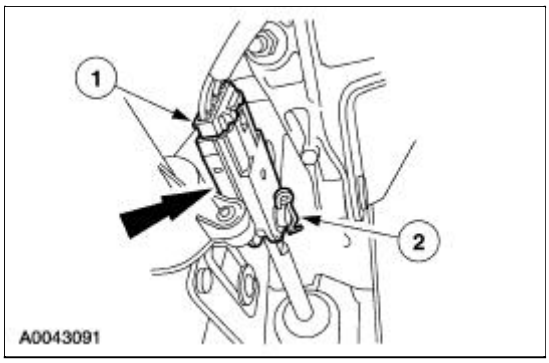
5. To install, reverse the removal procedure.

Brake Pedal Position (BPP) Switch

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

2. Remove the BPP switch.
    1. Disconnect the electrical connector.
    2. Remove the self-locking pin and the BPP switch.



3. To install, reverse the removal procedure.

Photocell and Amplifier

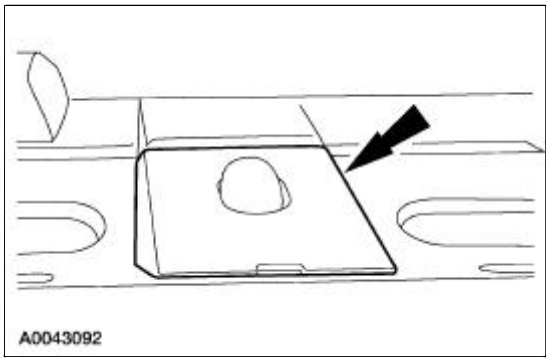
Removal and Installation

All vehicles

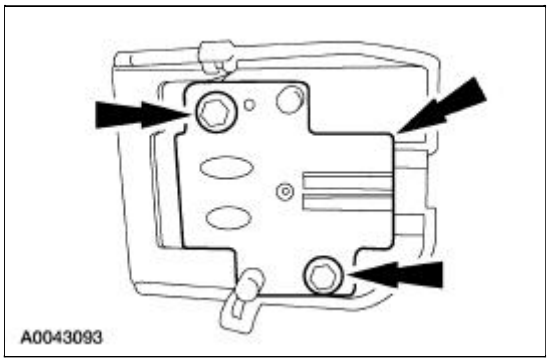
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

Expedition

2. Remove the photocell and bezel from the defroster grille.
   - Disconnect the electrical connector.

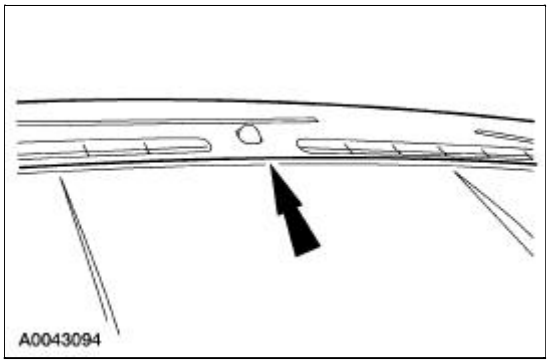


3. Remove the screws and the photocell and amplifier.

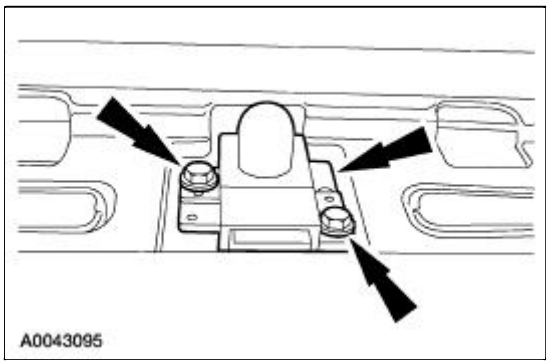


Navigator

4. Remove the defroster grille.



5. Remove the screws and the photocell.
    - Disconnect the electrical connector.



All vehicles

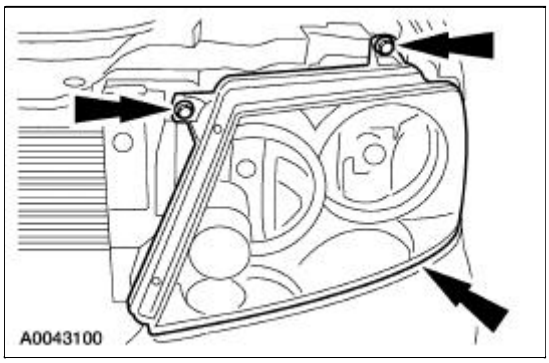
6. To install, reverse the removal procedure.

Ballast

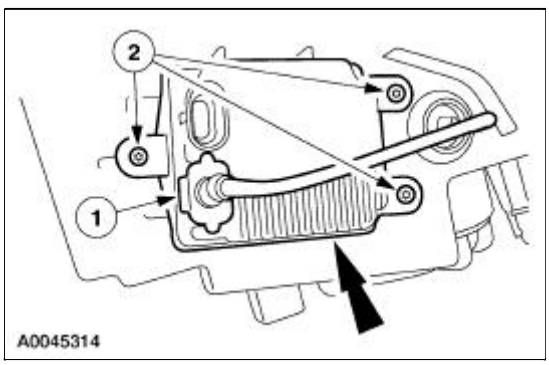
Removal and Installation

NOTE: Make sure that the headlamp switch and the ignition switch are in the OFF position.

1. Remove the front radiator air deflector.
2. Remove the three bolts and the headlamp assembly.
   - Disconnect the electrical connectors.



3. Remove the ballast.
   1. Disconnect the electrical connector.
   2. Remove the screws.



4. To install, reverse the removal procedure.

Interior Lighting

The interior lighting system consists of the following:

- front map lamp assembly
- front door courtesy lamp
- glove box lamp assembly
- instrument cluster
- vehicle security module
- interior lamp switch
- interior lamp relay
- illuminated vanity mirrors
- reading lamp assembly
- rear courtesy lamp
- puddle lamps
- underhood lamp assembly

Interior Lighting

Refer to Wiring Diagrams Cell 89 , Courtesy Lamps for schematic and connector information.

Refer to Wiring Diagrams Cell 117 , Remote Keyless Entry (RKE) for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418–F224 New Generation STAR (NGS) Tester 418–F052 or equivalent diagnostic tool

Principles of Operation

Vehicle Security Module

The vehicle security module receives inputs from the following:

- door ajar switches
- keyless entry keypad
- ignition switch
- remote keyless entry transmitter

The vehicle security module uses these inputs to control an output signal to the instrument cluster which controls the battery saver relay and courtesy lamp output.

Interior Lighting Systems

The instrument cluster grounds the battery saver relay and supplies the power for courtesy lamps when any door ajar switch is opened, or the interior lamp (headlamp) switch is closed. The instrument cluster then supplies voltage to the interior lamp circuit. Vehicle speed must be less than 24 kph (15 mph) for the instrument cluster module to keep courtesy lamps on. The interior lamps will remain illuminated for up to 25 seconds after all doors are closed unless the instrument cluster module receives an input from any of the following:

- voltage from the ignition switch
- a vehicle speed signal

- input from the keyless entry keypad through the vehicle security module
- input from the remote keyless entry transmitter lock or panic switch through the vehicle security module

Illuminated Entry

Illuminated entry is activated when a vehicle is unlocked using the keyless entry keypad or the remote keyless entry transmitter. The vehicle security module then requests that the instrument cluster module supply voltage to the interior lamps. Illuminated entry is deactivated when the vehicle security module receives a lock signal from the remote keyless entry transmitter. Illuminated entry will also be deactivated when the instrument cluster module receives a change in ignition switch pid status.

Battery Saver

The battery saver is activated when the instrument cluster module is not receiving voltage input from the ignition switch (OFF position). The instrument cluster module will then provide ground to the battery saver relay coil. This activates for a period of 10 minutes with the interior lamp (headlamp) switch in the OFF position, or a maximum period of 30 minutes with the interior lamp (headlamp) switch in the ON position, or a door is ajar, provided that the instrument cluster module does not receive any other input signals within the time-out period. The activated battery saver relay switches voltage to the demand lamp circuit . After time-out, the instrument cluster module disconnects ground from the battery saver relay coil, disabling the demand lamp circuit.

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect the following for obvious signs of electrical damage:

Visual Inspection Chart

Electrical
• Bulbs • Central junction box (CJB) fuse(s):   ▪ 21 (15A).   ▪ 24 (15A). • Circuitry • Vehicle security module • Instrument cluster module

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
   - check that the diagnostic card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.
5. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool

operating manual.

6. Carry out the DATA LINK DIAGNOSTICS test. If the diagnostic tool responds with:
   - CKT 70, CKT 914, CKT 915 or CKT 693 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESPONSE/NOT EQUIPPED for Instrument cluster, refer to Section 413-01 , or Vehicle Security Module, refer to Section 419-10 .
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs, and carry out self-test diagnostics.

7. If the DTCs retrieved are related to the concern, go to the Instrument Cluster Diagnostic Trouble Code (DTC) Index.

8. If no DTCs related to the concern are retrieved, proceed to the Symptom Chart.

Instrument Cluster Diagnostic Trouble Code Index

DTC	Description	Source	Action
B1342	ECU is Defective	Instrument Cluster	REFER to Section 413-01 .
B2499	Courtesy Lamp Output Failure	Instrument Cluster	Go To Pinpoint Test A .
B1320	Driver Door Ajar Circuit Open	Instrument Cluster	Go To Pinpoint Test A .
B1328	Passenger Door Ajar Circuit Open	Instrument Cluster	Go To Pinpoint Test A .
—	All Other DTCs	Instrument Cluster	REFER to Section 419-10 .

Symptom Chart

Symptom Chart

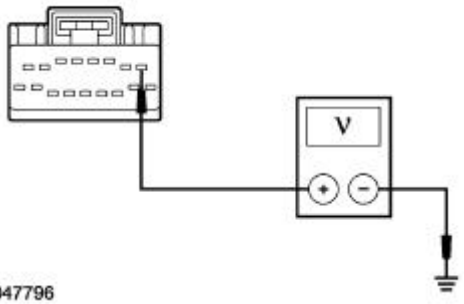
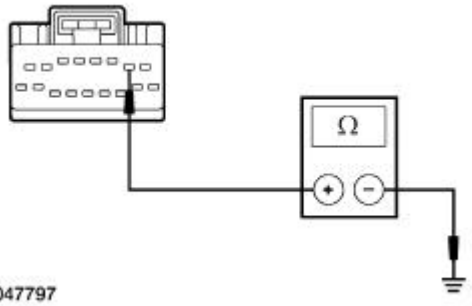
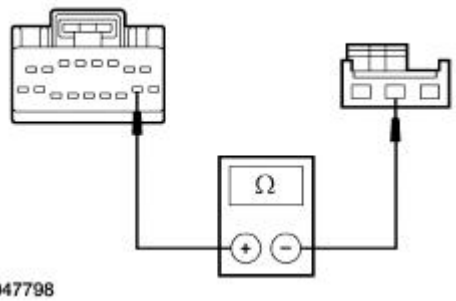
Condition	Possible Sources	Action
• The interior lamps are inoperative	• Instrument cluster module. • Vehicle security module	• Go To Pinpoint Test A .
• An individual interior lamp is inoperative	• Circuitry. • Lamp	• Go To Pinpoint Test B .
• The interior lamps stay on continuously	• Circuitry. • Instrument cluster module. • Door ajar switch. • Vehicle security module.	• Go To Pinpoint Test C .
• The interior lamps do not turn on with one door open	• Vehicle security module. • Door ajar switch. • Circuitry.	• GO to Section 419-10 .
• The illuminated entry is inoperative from one/both door handles	• Vehicle security module. • Door ajar	• GO to Section 419-10 .

	switches. ● Circuitry.	
● The illuminated entry is inoperative when using the remote transmitter/keypad	● Vehicle security module. ● Circuitry. ● Keyless entry keypad. ● Remote keyless entry transmitter.	● GO to Section 419-10 .
● The demand lighting is inoperative	● Circuitry. ● Instrument cluster module.	● Go To Pinpoint Test D .
● The individual demand lamp is inoperative	● Circuitry. ● Lamp	● Go To Pinpoint Test E .
● The interior lamps are inoperative—do not deactivate after time-out	● Instrument cluster module.	● Go To Pinpoint Test G .
● The battery saver does not deactivate after time-out	● Instrument cluster module.	● Go To Pinpoint Test F .
● All battery saver components do not operate	● Circuitry. ● Instrument cluster module.	● Go To Pinpoint Test G .
● No communication with the vehicle security module	● Circuity ● Vehicle security module	● REFER to Section 419-10 .
● No communication with the instrument cluster module	● Circuitry ● Instrument cluster module	● REFER to Section 413-01 .

Pinpoint Tests

PINPOINT TEST A: THE INTERIOR LAMPS ARE INOPERATIVE

Test Step	Result / Action to Take
A1 CHECK INTERIOR LAMP OPERATION AT DOOR AJAR SWITCHES	
● Key in OFF position. ● Operate the interior lamps by opening and closing the doors. ● **Do the interior lamps illuminate?**	**Yes** GO to the Symptom Chart. **No** GO to A2 .
A2 CHECK INTERIOR LAMP OPERATION AT THE HEADLAMP SWITCH	
● Operate the interior lamps by turning the interior lamp switch on. ● **Do any interior lamps illuminate?**	**Yes** CARRY OUT no communication test with suspect module. REFER to Section 413-01 for the instrument cluster module or Section 419-10 for the vehicle security module.

	No GO to A3 .
A3 CHECK CIRCUIT 3049 (BK/LG)	
• Key in OFF position. • Disconnect: Instrument Cluster C220b. • Key in ON position. • Measure the voltage between instrument cluster C220b, pin 1, circuit 3049 (BK/LG) and ground.  A0047796 • **Is the voltage greater than 10 volts?**	**Yes** GO to A4 . **No** REPAIR power supply circuit. CLEAR the DTCs. REPEAT the self-test.
A4 CHECK CIRCUIT 676 (PK/OG)	
• Key in OFF position. • Disconnect: Instrument Cluster C220b. • Measure the resistance between instrument cluster C220b, pin 2, circuit 676 (PK/OG) and ground.  A0047797 • **Is the resistance less than 5 ohms?**	**Yes** GO to A5 . **No** REPAIR circuit 676 (PK/OG). CLEAR the DTCs. REPEAT the self-test.
A5 CHECK CIRCUIT 53 (BK/LB)	
• Disconnect: LH Roof Rail Lamp C941. • Measure the resistance between instrument cluster C220b, pin 10, circuit 53 (BK/LB) and LH roof rail lamp C941, pin 2, circuit 53 (BK/LB).  A0047798 • **Is the resistance less than 5 ohms?**	**Yes** GO to A6 . **No** REPAIR circuit 53 (BK/LB). CLEAR the DTCs. REPEAT the self-test.
A6 CHECK FOR CORRECT INSTRUMENT CLUSTER MODULE OPERATION	

• Disconnect all instrument cluster module connectors. • Check for: • corrosion • pushed-out pins • Connect all instrument cluster module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new instrument cluster module. REFER to Section 413-01 . CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST B: AN INDIVIDUAL INTERIOR LAMP IS INOPERATIVE

<table>
<tr><th>Test Step</th><th>Result / Action to Take</th></tr>
<tr><td>B1 CHECK CIRCUIT 53 (BK/LB)</td><td rowspan="2">Yes
GO to B2 .

No
REPAIR circuit 53 (BK/LB). CLEAR the DTCs. REPEAT the self-test.</td></tr>
<tr><td>• Key in ON position.
• Operate the interior lamps by turning the interior lamps switch on.
• Disconnect the inoperative interior lamp connector.
• Measure the voltage from the inoperative interior lamp connector circuit 53 (BK/LB) to ground. Refer to the following table for connector and pin number.
<table>
<tr><th>Location</th><th>Connector</th><th>Pin</th></tr>
<tr><td>RH puddle lamp</td><td>C622</td><td>11</td></tr>
<tr><td>LH puddle lamp</td><td>C516</td><td>11</td></tr>
<tr><td>Driver door courtesy lamp</td><td>C520</td><td>1</td></tr>
<tr><td>Passenger door courtesy lamp</td><td>C606</td><td>1</td></tr>
<tr><td>RH roof rail lamp</td><td>C942</td><td>2</td></tr>
<tr><td>LH roof rail lamp</td><td>C941</td><td>2</td></tr>
<tr><td>Cargo lamp</td><td>C926</td><td>1</td></tr>
<tr><td>Front row dome/map lamp</td><td>C931</td><td>1 (without overhead console)
2 (with overhead console)</td></tr>
<tr><td>Second row dome/map lamp</td><td>C932</td><td>1 (without overhead console)
2 (with overhead console)</td></tr>
</table>
• Is the voltage greater than 10 volts?</td></tr>
<tr><td>B2 CHECK CIRCUIT 57 (BK)</td><td rowspan="2">Yes
INSTALL a new lamp. CLEAR the DTCs.</td></tr>
<tr><td>• Measure the resistance from the inoperative interior lamp connector circuit 57 (BK) to ground. Refer to the following table for connector and pin number.</td></tr>
</table>

Location	Connector	Pin
RH puddle lamp	C622	2
LH puddle lamp	C516	2
Driver door courtesy lamp	C520	3
Passenger door courtesy lamp	C606	3
RH roof rail lamp	C942	1
LH roof rail lamp	C941	3
Cargo lamp	C926	2
Front row dome/map lamp	C931	1 (with overhead console) 2 (without overhead console)
Second row dome/map lamp	C932	1 (with overhead console) 2 (without overhead console)

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

REPEAT the self-test.

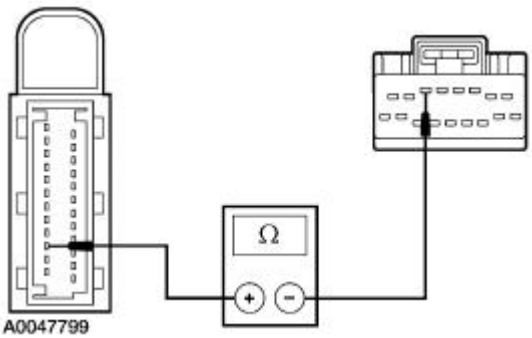
No
REPAIR circuit 57 (BK). CLEAR the DTCs. REPEAT the self-test.

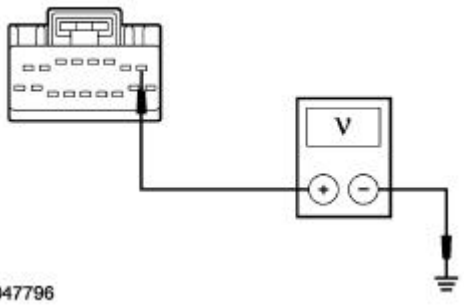
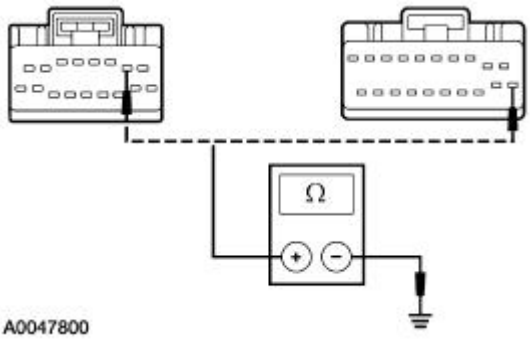
PINPOINT TEST C: THE INTERIOR LAMPS STAY ON CONTINUOUSLY

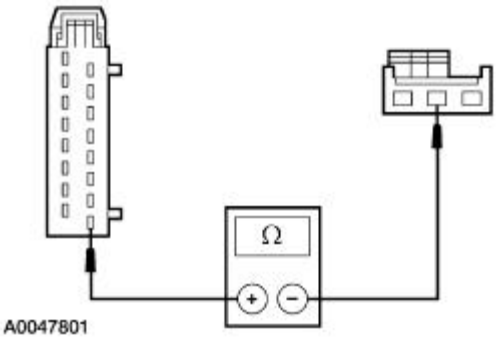
Test Step	Result / Action to Take
C1 CHECK THE DOOR AJAR PIDS ● Key in OFF position. ● Check the door ajar PIDs while opening and closing the doors. ● **Do the door ajar PID values agree with the door positions?**	**Yes** GO to C2 . **No** REFER to Section 501-14 for door ajar switch diagnosis.
C2 CHECK CIRCUIT 53 (BK/LB) ● Key in OFF position. ● Disconnect: Instrument Cluster C220b. ● **Are the interior lamps still illuminated?**	**Yes** REPAIR short to power in circuit 53 (BK/LB). CLEAR the DTCs. REPEAT the self-test. **No** GO to C3 .
C3 CHECK FOR CORRECT INSTRUMENT CLUSTER MODULE OPERATION ● Disconnect all instrument cluster module connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all instrument cluster module connectors and make sure they seat correctly. ● Operate the system and verify the	**Yes** INSTALL a new instrument cluster module. REFER to Section 413-01 . CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the

concern is still present. ● **Is the concern still present?**	self-test.

PINPOINT TEST D: THE DEMAND LIGHTING IS INOPERATIVE

Test Step	Result / Action to Take
D1 CHECK GLOVE COMPARTMENT LAMP	
● Key in OFF position. ● Open the glove compartment and observe lamp. ● **Is the glove compartment lamp illuminated?**	**Yes** GO to D9 . **No** GO to D2 .
D2 CHECK GLOVEBOX SWITCH ALIGNMENT	
● Check glovebox switch for correct operation during opening and closing of glove box compartment. ● **Is the glovebox switch correctly positioned for normal operation?**	**Yes** GO to D3 . **No** Adjust glovebox switch for correct operation.
D3 CHECK CIRCUIT 705 (LG/OG) FOR VOLTAGE	
● Measure the voltage between the glovebox lamp connector circuit 705 (LG/OG) and ground. ● **Is the voltage greater than 10 volts?**	**Yes** GO to D4 . **No** REPAIR the circuit. TEST the system for normal operation.
D4 CHECK CIRCUIT 1005 (VT/OG)	
● Key in OFF position. ● Disconnect: Instrument Cluster C220b. ● Disconnect: Battery Junction Box C270e. ● Measure the resistance between instrument cluster C220b, pin 6 circuit 1005 (VT/OG) and battery junction box C270e, pin 10, circuit 1005 (VT/OG).  ● **Is the resistance less than 5 ohms?**	**Yes** GO to D5 . **No** REPAIR circuit 1005 (VT/OG). CLEAR the DTCs. REPEAT the self-test.
D5 CHECK CIRCUIT 3049 (BK/LG)	
● Measure the voltage between instrument cluster C220b, pin 1, circuit 3049 (BK/LG) and ground.	**Yes** GO to D6 . **No** REPAIR power supply circuit. CLEAR the DTCs. REPEAT the self-test.

 A0047796 ● **Is the voltage greater than 10 volts?**	
D6 CHECK CIRCUITS 676 (PK/OG) AND 57 (BK) ● Disconnect: Instrument Cluster C220a. ● Measure the resistance between instrument cluster C220b, pin 2, circuit 676 (PK/OG) and ground and instrument cluster C220a, pin 11, circuit 57 (BK) and ground.  A0047800 ● **Is the resistance less than 5 ohms?**	**Yes** GO to D7 . **No** REPAIR circuit 676 (PK/OG) or circuit 57 (BK). CLEAR the DTCs. REPEAT the self-test.
D7 CHECK BATTERY SAVER RELAY ● Carry out the component testing. Refer to Wiring Diagrams Cell 149 for schematic and connector information. ● **Did the battery saver relay pass the component test?**	**Yes** GO to D8 . **No** INSTALL a new batter saver relay. CLEAR the DTCs. REPEAT the self-test.
D8 CHECK FOR CORRECT INSTRUMENT CLUSTER MODULE OPERATION ● Disconnect all instrument cluster module connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all instrument cluster module connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new instrument cluster module. REFER to Section 413-01 . CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
D9 CHECK CIRCUIT 705 (LG/OG) ● Disconnect: Battery Junction Box C270j. ● Disconnect: LH Roof Rail Lamp C941. ● Measure the resistance between connectors battery	**Yes** REPAIR circuit 57 (BK). CLEAR the DTCs. REPEAT

junction box C270j, pin 15, circuit 705 (LG/OG) and LH roof rail lamp C941, pin 1, circuit 705 (LG/OG).  ● **Is the resistance less than 5 ohms?**	the self-test. **No** REPAIR circuit 705 (LG/OG). CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST E: AN INDIVIDUAL DEMAND LAMP IS INOPERATIVE

Test Step	Result / Action to Take
E1 CHECK CIRCUIT 705 (LG/OG)	
● Key in OFF position. ● Measure the voltage from the inoperative demand lamp connector, circuit 705 (LG/OG) to ground. Refer to the following table for connector and pin number. **Location / Connector / Pin** Underhood lamp / C1159 / 2 Glove compartment lamp / C254 / 2 RH vanity lamp / C952 / 1 LH vanity lamp / C907 / 1 Front row dome/map lamp / C903 / 3 Second row dome/map lamp / C908 / 3 RH roof rail lamp / C942 / 3 LH roof rail lamp / C941 / 1 Cargo lamp / C926 / 3 ● **Is the voltage greater than 10 volts?**	**Yes** GO to E2 . **No** REPAIR circuit 705 (LG/OG). CLEAR the DTCs. REPEAT the self-test.
E2 CHECK CIRCUIT 57 (BK)	
● Measure the resistance from the inoperative demand lamp connector, circuit 57 (BK) to ground. Refer to the following table for connector and pin number. **Location / Connector / Pin** Underhood lamp / C1159 / 1 Glove compartment lamp / C254 / 1 RH vanity lamp / C906 / 2 LH vanity lamp / C907 / 2	**Yes** INSTALL a new lamp. CLEAR the DTCs. REPEAT the self-test. **No** REPAIR circuit 57 (BK). CLEAR the DTCs. REPEAT the self-test.

Front row dome/map lamp	C931	1 (with overhead console) 2 (without overhead console)
Second row dome/map lamp	C932	1
RH roof rail lamp	C942	1
LH roof rail lamp	C941	3
Cargo lamp	C926	2

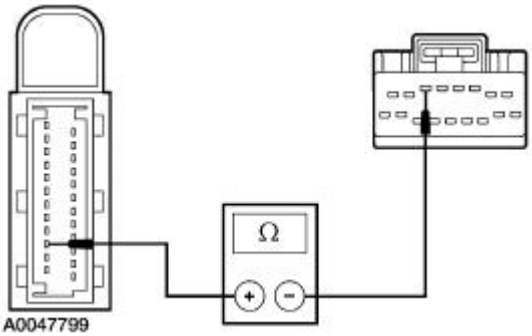
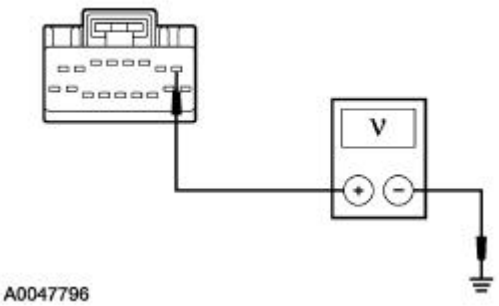
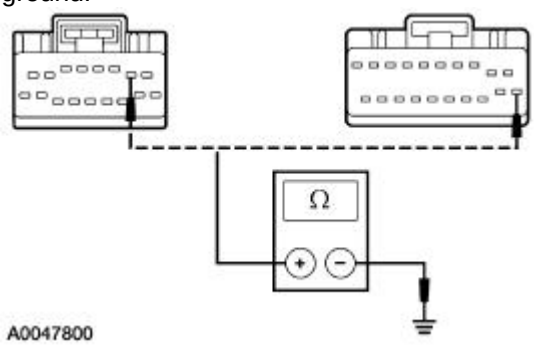
- **Is the resistance less than 5 ohms?**

PINPOINT TEST F: THE BATTERY SAVER DOES NOT DEACTIVATE AFTER TIME-OUT

Test Step	Result / Action to Take
F1 CHECK FOR CORRECT INSTRUMENT CLUSTER MODULE OPERATION	
• Disconnect all instrument cluster module connectors. • Check for: • corrosion • pushed-out pins • Connect all instrument cluster module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new instrument cluster module. REFER to Section 413-01 . CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST G: ALL BATTERY SAVER COMPONENTS DO NOT OPERATE

Test Step	Result / Action to Take
G1 CHECK CIRCUIT 1005 (VT/OG)	
• Key in OFF position. • Disconnect: Instrument Cluster C220b. • Disconnect: Battery Junction Box C270e. • Measure the resistance between instrument cluster C220b, pin 6 circuit 1005 (VT/OG) and battery junction box C270e, pin 10, circuit 1005 (VT/OG).	**Yes** GO to G2 . **No** REPAIR circuit 1005 (VT/OG). CLEAR the DTCs. REPEAT the self-test.

 ● **Is the resistance less than 5 ohms?**	
G2 CHECK CIRCUIT 3049 (BK/LG) ● Measure the voltage between instrument cluster C220b, pin 1, circuit 3049 (BK/LG) and ground.  ● **Is the voltage greater than 10 volts?**	**Yes** GO to G3 . **No** REPAIR power supply circuit. CLEAR the DTCs. REPEAT the self-test.
G3 CHECK CIRCUITS 676 (PK/OG) AND 57 (BK) ● Disconnect: Instrument Cluster C220a. ● Measure the resistance between instrument cluster C220b, pin 2, circuit 676 (PK/OG) and ground and instrument cluster C220a, pin 11, circuit 57 (BK) and ground.  ● **Is the resistance less than 5 ohms?**	**Yes** GO to G4 . **No** REPAIR circuit 676 (PK/OG) or circuit 57 (BK). CLEAR the DTCs. REPEAT the self-test.
G4 CHECK BATTERY SAVER RELAY ● Carry out the component testing. Refer to Wiring Diagrams Cell 149 for schematic and connector information. ● **Did the battery saver relay pass the component test?**	**Yes** GO to G5 . **No** INSTALL a new batter saver relay. CLEAR the DTCs. REPEAT the self-test.
G5 CHECK FOR CORRECT INSTRUMENT CLUSTER MODULE OPERATION ● Disconnect all instrument cluster module connectors. ● Check for:	**Yes** INSTALL a new instrument

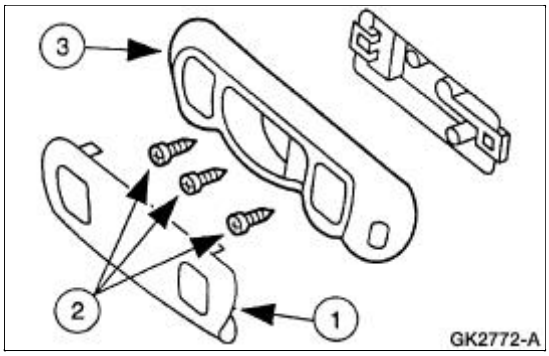
● corrosion ● pushed-out pins ● Connect all instrument cluster module connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	cluster module. REFER to Section 413-01 . CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Lamp Assembly —Map

Removal

1. Remove the map lamp assembly.
    1. Carefully release the lamp lens.
    2. **NOTE:** Identify the location of each screw to aid in the installation of the map lamp assembly.

       Remove interior lamp screws.
    3. Remove the map lamp assembly.

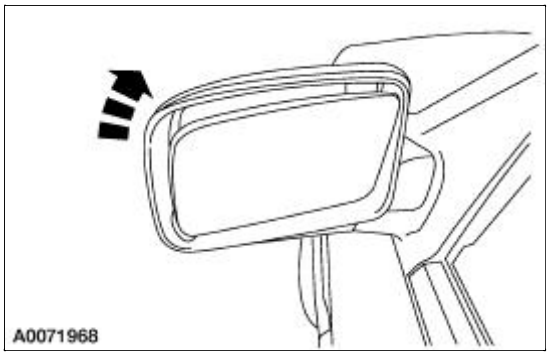


Installation

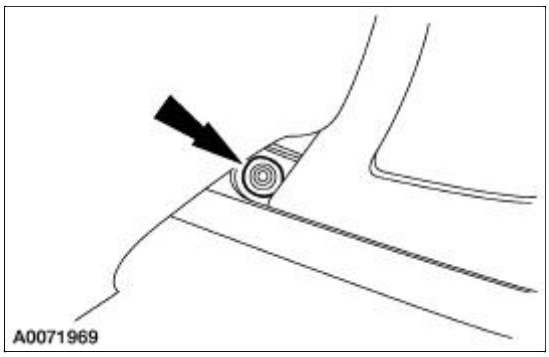
1. To install, reverse the removal procedure.

Approach Lamp

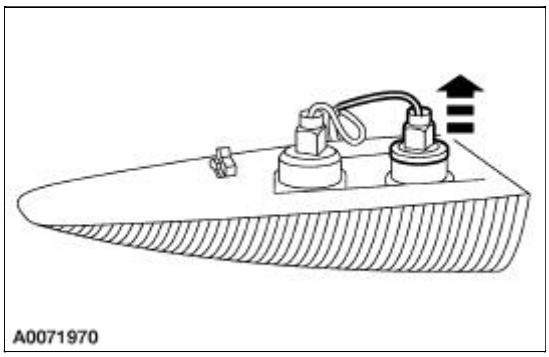
1. Fold the mirror assembly forward.



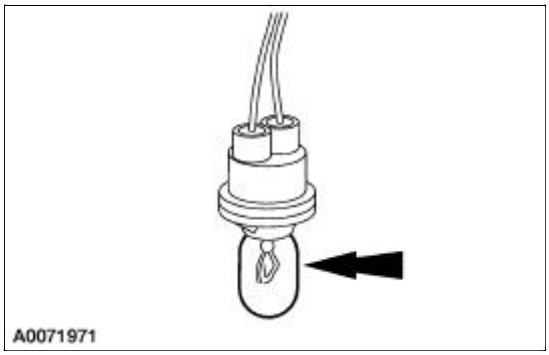
2. Remove the Torx®-head screw.



3. Remove the approach lamp connector from the turn signal assembly.



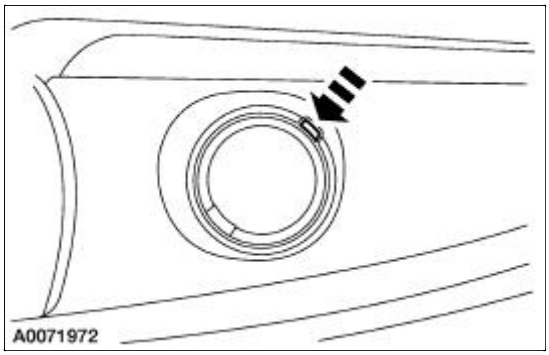
4. Remove the approach lamp bulb.



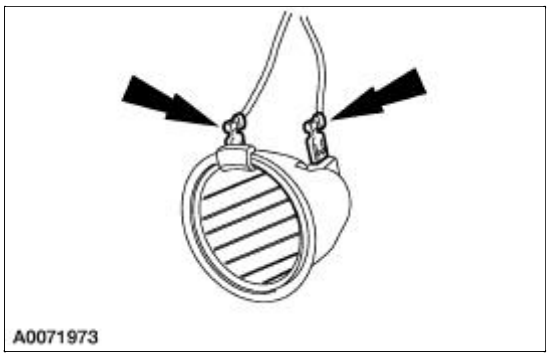
5. To install, reverse the removal procedure.

Approach Lamp Assembly

1. Squeeze the tab and lower the approach lamp assembly.



2. Disconnect the electrical connectors.



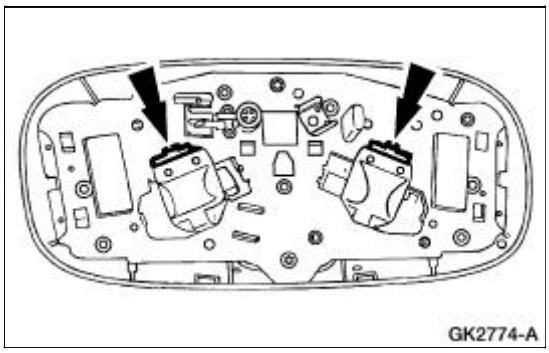
3. To install, reverse the removal procedure.

Bulb —Map Lamp

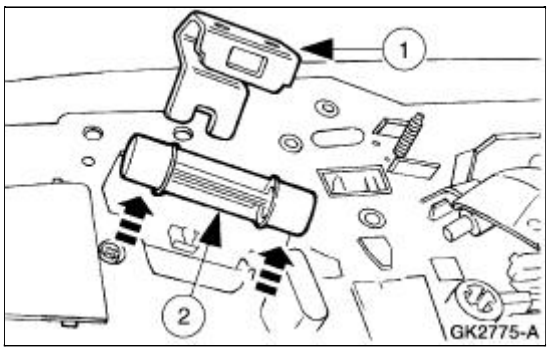
Removal

1. Remove the map lamp assembly. For additional information, refer to Lamp Assembly—Map in this section.

2. Release the clip on the bulb(s) to be replaced.



3. Remove the map lamp bulb.
    1. Remove the map lamp reflector.
    2. Remove the map lamp bulb from the clips.



Installation

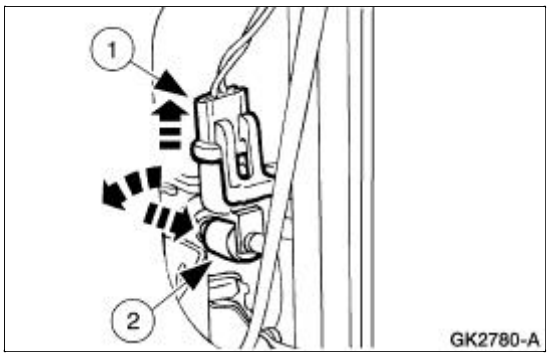
1. To install, reverse the removal procedure.

Switch —Interior Lamp

Removal

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

2. Remove the interior lamp switch.
    1. Disconnect the electrical connector.
    2. Rotate the interior lamp switch counterclockwise to remove.



Installation

1. To install, reverse the removal procedure.

Daytime Running Lamps (DRL)

The DRL system illuminates the fog lamps at full intensity.

The system operates when the following conditions are met:

- The high beam headlamps are disabled.
- The ignition switch is in the RUN position.
- The headlamp switch is in the OFF position.

The DRL system consists of the DRL relays (located in the engine compartment).

Daytime Running Lamps (DRL)

Refer to Wiring Diagrams Cell 97 , Daytime Running Lamps for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Digital Multimeter or equivalent 105-R0057

Principles of Operation

The daytime running lamps are implemented by using the fog lamps at 100% system voltage.

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Electrical
● Central junction box (CJB) fuse 14 (10A) ● DRL ignition relay ● DRL headlamp relay

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the concern is not visually evident, determine the symptom and refer to the Symptom Chart.

Symptom Chart

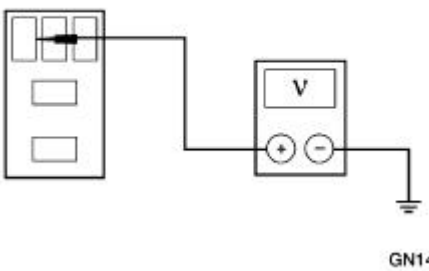
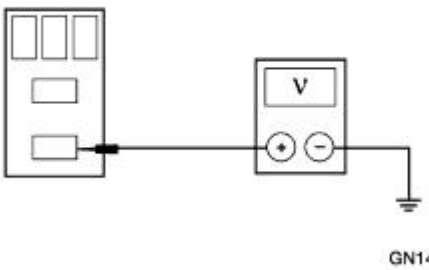
Symptom Chart

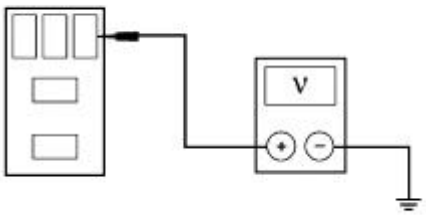
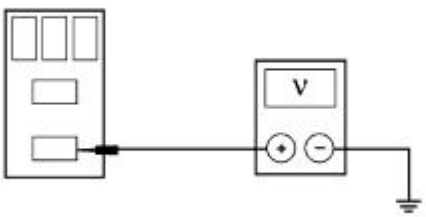
Condition	Possible Sources	Action
● The daytime running lamps (DRL) are inoperative	● Central junction box (CJB) Fuse 14 (10A). ● Circuitry.	● Go To Pinpoint Test A .

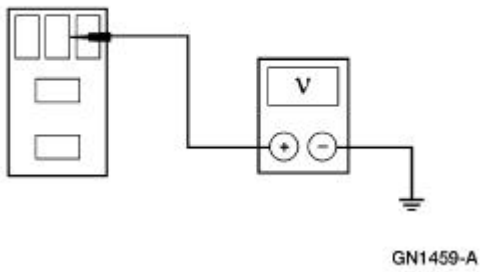
	• DRL ignition relay. • DRL headlamp relay.	
• The daytime running lamps (DRL) are on with the ignition switch OFF	• Circuitry. • DRL ignition relay.	• Go To Pinpoint Test B.

Pinpoint Tests

PINPOINT TEST A: THE DAYTIME RUNNING LAMPS (DRL) ARE INOPERATIVE

Test Step	Result / Action to Take
A1 VERIFY THE FOG LAMPS OPERATE CORRECTLY	
NOTE: Make sure the steering column multifunction switch is in the low beam position. • Key in OFF position. • Turn the headlamp switch to the headlamps ON position and engage the fog lamp switch. • **Do the fog lamps operate correctly?**	**Yes** TURN the headlamp switch OFF. GO to A2. **No** REFER to Section 417-01.
A2 CHECK CIRCUIT 295 (LB/PK) FOR AN OPEN	
• Disconnect: DRL Ignition Relay C1171. • Key in ON position. • Measure the voltage between the DRL ignition relay C1171 pin 1, circuit 295 (LB/PK), harness side and ground.  GN1460-A • **Is the voltage greater than 10 volts?**	**Yes** GO to A3. **No** REPAIR the circuit. TEST the system for normal operation.
A3 CHECK CIRCUIT 196 (DB/OG) FOR AN OPEN	
• Measure the voltage between the DRL ignition relay C1171 pin 3, circuit 196 (DB/OG), harness side and ground.  GN1456-A	**Yes** GO to A4. **No** REPAIR the circuit. TEST the system for normal operation.

• **Is the voltage greater than 10 volts?**	
A4 CHECK CIRCUIT 12 (LG/BK) FOR AN OPEN	
• Turn the headlamp switch to the headlamps ON position. • Place the multifunction switch in the high beam position • Measure the voltage between the DRL ignition relay C1171 pin 2, circuit 12 (LG/BK), harness side and ground.  GN1458-A • **Is the voltage greater than 10 volts?**	**Yes** TURN the headlamp switch OFF. PLACE the multifunction switch in the low beam position. GO to A5 . **No** REPAIR the circuit. TEST the system for normal operation.
A5 CHECK DRL IGNITION RELAY	
• Key in OFF position. • Carry out the DRL ignition relay component test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. • **Is the DRL ignition relay OK?**	**Yes** REINSTALL the DRL ignition relay. GO to A6 . **No** INSTALL a new DRL ignition relay. TEST the system for normal operation.
A6 CHECK CIRCUIT 2017 (WH/RD) FOR AN OPEN	
• Disconnect: DRL Headlamp Relay C1359. • Key in ON position. • Measure the voltage between the DRL headlamp relay C1359 pin 3, circuit 2017 (WH/RD), harness side and ground.  GN1456-A • **Is the voltage greater than 10 volts?**	**Yes** GO to A7 . **No** REPAIR the circuit. TEST the system for normal operation.
A7 CHECK THE DRL HEADLAMP RELAY	
• Key in OFF position. • Carry out the headlamp relay component test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. • **Is the DRL headlamp relay OK?**	**Yes** REINSTALL the DRL headlamp relay.GO to A8 . **No** INSTALL a new DRL headlamp relay. TEST the system for normal operation.
A8 CHECK CIRCUIT 478 (TN/OG) FOR AN OPEN	
• Turn the headlamp switch to the headlamps ON position	**Yes**

and engage the fog lamp switch. ● Measure the voltage between the DRL headlamp relay C1172 pin 4, circuit 478 (TN/OG), harness side and ground.  GN1459-A ● **Is the voltage greater than 10 volts?**	INSTALL a new DRL headlamp relay. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.

PINPOINT TEST B: THE DAYTIME RUNNING LAMPS (DRL) ARE ON WITH THE IGNITION SWITCH OFF

Test Step	Result / Action to Take
B1 CHECK FOR VOLTAGE FROM THE DRL IGNITION RELAY ● Key in OFF position. ● Disconnect: DRL Ignition Relay C1171. ● **Do the fog lamps continue to illuminate?**	**Yes** GO to B3 . **No** GO to B2 .
B2 CHECK CIRCUIT 295 (LB/PK) FOR SHORT TO POWER ● Carry out the DRL ignition relay component test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. ● **Is the DRL ignition relay OK?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** INSTALL a new DRL ignition relay. TEST the system for normal operation.
B3 CHECK CIRCUIT 2017 (WH/RD) FOR SHORT TO POWER (NAVIGATOR) ● Disconnect: DRL Headlamp Relay C1359. ● **Do the fog lamps continue to illuminate?**	**Yes** REFER to Section 417-01 . **No** REPAIR the circuit. TEST the system for normal operation.

General Specifications

Item	Specification
Heat shrink tube overlap mm (inch)	12.7 (0.5)
Wire insulation removal length (twist side) mm (inch)	37.2 (1.5)
Wire insulation removal length (receiving side) mm (inch)	19.5 (0.75)
Raychem SCT® Heat Shrink Tubing, Motorcraft part number WT-5627	ESB-M99D56-A2

Communications Network

Module Communications Network Components

- powertrain control module (PCM)
- restraint control module (RCM)
- instrument cluster
- driver seat module (DSM)
- climate controlled seat module
- parking aid module
- central junction box (CJB)
- vehicle security module
- air suspension control module
- 4-wheel anti-lock brake/traction control (ABS/TC) module or stability assist module
- electronic automatic temperature control (EATC) module
- four-wheel drive (4WD) control module
- power liftgate module
- tire pressure monitoring system module

Communications Network

Refer to Wiring Diagrams Cell 14 for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool

Principles of Operation

The vehicle has three module communication networks:

- the standard corporate protocol (SCP) communications network
- the international standards organization (ISO) 9141 communications network
- the UART based protocol (UBP) communications network

The diagnostic tool connects to all three networks through the data link connector (DLC). This makes diagnosis and testing of these systems easier by allowing one smart tester to be able to diagnose and control any module on the three networks from one connector. The DLC can be found under the instrument panel between the steering column and the radio.

The ISO 9141 communications network does not permit intermodule communication. When the diagnostic tool communicates to modules on the ISO 9141 communication network, the diagnostic tool must request all information, or initiate module commands.

The ISO 9141 communications network will not function if the wire is shorted to ground or battery voltage. Also, if one of the modules on the ISO 9141 communications network loses power or shorts internally, communications to that module will fail.

The SCP communications network will remain operational even with the severing of one of the bus wires. Communications will also continue if one of the bus wires is shorted to ground or voltage, or if some but not all termination resistors are lost. The SCP communications network allows inter-module communication.

The UBP communications network will not function if the wire is shorted to ground or voltage. The UBP is different from the ISO communication network in that it allows intermodule communication.

The powertrain control module (PCM) is on the SCP communication network. The PCM controls the engine for better fuel economy, emissions control, and failure mode detection and storage. For additional information, refer to Section 303-14 .

The restraint control module (RCM) is on the ISO 9141 network. The RCM controls the deployment of the air bags based on sensor input. For additional information, refer to Section 501-20B .

The tire pressure monitoring system module is on the SCP communications network. The module and sensors monitor tire pressure and alert the driver when a concern may exist. For additional information, refer to Section 204-04 .

The electronic automatic temperature control (EATC) module is on the UBP communication network. The EATC module controls automatic climate functions that maintain the vehicle interior temperature at a constant setting. For additional information, refer to Section 412-00 .

The driver and passenger climate controlled seat modules are on the UBP network. The climate controlled seat modules control the temperature of the driver and passenger seats. For additional information, refer to Section 501-10 .

The vehicle security module is on the UBP communication network. The vehicle security module controls a variety of systems:

- windshield wipers
- courtesy lamps
- warning chimes
- interior lamps
- exterior lamps
- power windows
- perimeter security
- RKE/keyless entry
- lock functions
- monitors the entry doors and radio

Refer to Section 419-10 .

The driver seat module (DSM) is on the UBP communication network. The DSM controls the positioning and programming of the driver seat, pedals and both outside mirrors. Refer to Section 501-10 .

The 4-wheel anti-lock brake/traction control (ABS/TC) module or stability assist module is on the ISO 9141 and the SCP communication network. The ABS/TC module or stability assist module controls the brake pressure to the four wheels to keep the vehicle under control while braking. Refer to Section 206-09A .

The air suspension control module is on the UBP communication network and controls the air compressor motor (through a solid state relay) and all system solenoids. The module also provides power to front and rear height sensors on four-wheel air suspension systems, or rear height sensors on the rear-wheel suspension systems. The module controls vehicle height adjustments by monitoring two height sensors, vehicle speed, a steering sensor, acceleration input, the door ajar signal, transfer case signals and the brake switch. The module also conducts all fail-safe and diagnostic strategies and contains self-test and communication software for testing the vehicle and module.

The control module is mounted in the passenger compartment inside the instrument panel above the radio and temperature controls.

The air suspension control module monitors and controls the system through a 32–pin two-way connector. It is keyed so that the control module cannot be plugged into an incorrect harness. There are two sides of the harness connection to the module. Each is uniquely colored and keyed to prevent reversal of connections.

For additional air suspension information, refer to Section 204-05 .

The instrument cluster is on the SCP and UBP communication network. It is an analog face cluster with a digital odometer. The instrument cluster displays a variety of information. For additional information, refer to Section 413-01 .

The parking aid module is connected to the UBP communication module. The module controls sensors in the rear bumper that detect close objects when the vehicle is in reverse. Refer to Section 413-13 .

The four-wheel drive (4WD) control module is on the UBP communication network. The 4WD control module controls the four-wheel drive functions for the vehicle. Refer to Section 308-07A .

The power liftgate module is on the UBP network. The module controls the motor that opens and closes the liftgate. Refer to Section 501-03 .

Inspection and Verification

1. Verify the customer concern by operating the system.

2. Visually inspect for obvious signs of electrical damage.

Visual Inspection Chart

Electrical
● Central junction box (CJB) fuse 41 (20 A) ● Wiring harness ● Connections

3. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
    - check that the program card is correctly installed.
    - check the connections to the vehicle.
    - check the ignition switch position.

If the diagnostic tool still does not communicate with the vehicle, Go To Pinpoint Test S .

4. Go To Pinpoint Test PC .

System Precheck

PINPOINT TEST PC: DATA LINK DIAGNOSTICS NETWORK TEST

Test Step	Result / Action to Take
PC1 RUN THE DATA LINK DIAGNOSTICS NETWORK TEST	
• Carry out the DATA LINK DIAGNOSTICS test. • **Is SYSTEM PASSED obtained?**	**Yes** Test passed. RETURN to the Symptom Chart of the section for the module in question. **No** If no response from the diagnostic tool, Go To Pinpoint Test S . If CKT70, CKT914 and/or CKT915 = SOME ECUS NO RESP/NOT EQUIP, REFER to the Symptom Chart. If CKT70 = ALL ECUS NO RESP/NOT EQUIP, Go To Pinpoint Test P . If CKT914 = ALL ECUS NO RESP/NOT EQUIP, Go To Pinpoint Test Q . If CKT915 = ALL ECUS NO RESP/NOT EQUIP, Go To Pinpoint Test Q . If the module in question is NO RESPONSE/NOT EQUIPPED, REFER to the Symptom Chart. If the module in question is NO RESPONSE ON CKT914 (BUS+), REFER to the Symptom Chart. If the module in question is NO RESPONSE ON CKT915 (BUS-), REFER to the Symptom Chart.

Symptom Chart

Symptom Chart

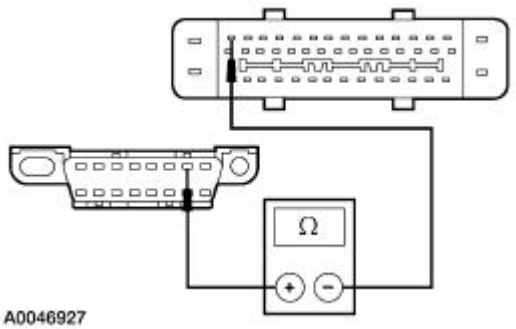
Condition	Possible Sources	Action
• The 4-wheel anti-lock brake/traction control (ABS/TC) module or stability assist module does not respond to the diagnostic tool (ISO)	• Circuit or connection in the international standards organization (ISO) 9141 network. • ABS/TC module.	• Go To Pinpoint Test A .
• The 4-wheel anti-lock brake/traction control (ABS/TC) module or stability assist module does not respond to the diagnostic tool (SCP)	• Circuit or connection in the standard corporate protocol (SCP) network. • ABS/TC module.	• Go To Pinpoint Test B .
• The restraint control module (RCM) does not respond to the diagnostic tool	• Circuit or connection in the ISO 9141 communication network. • RCM.	• Go To Pinpoint Test C .
• The vehicle security module does not respond to the diagnostic tool	• Circuit or connection in the UART based protocol (UBP) network. • Vehicle security module.	• Go To Pinpoint Test D .
• The powertrain control module (PCM) does not respond to the diagnostic tool	• Circuit or connection in the SCP communication network.	• Go To Pinpoint Test E .

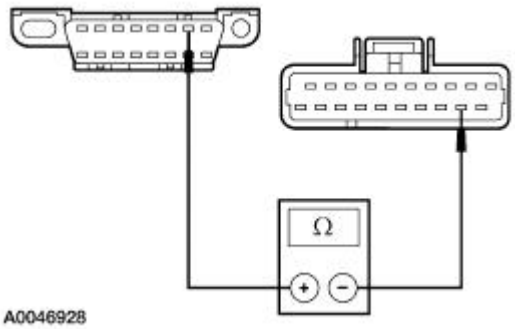
	• PCM.	
• The electronic automatic temperature control (EATC) module does not respond to the diagnostic tool	• Circuit or connection in the UBP network. • EATC module.	• Go To Pinpoint Test F .
• The driver seat module (DSM) does not respond to the diagnostic tool	• Circuit or connection in the UBP network. • DSM.	• Go To Pinpoint Test G .
• The parking aid module does not respond to the diagnostic tool	• Circuit or connection in the UBP network. • Parking aid module.	• Go To Pinpoint Test H .
• The four-wheel drive (4WD) control module does not respond to the diagnostic tool	• Circuit or connection in the UBP network. • 4WD control module.	• Go To Pinpoint Test I .
• The instrument cluster does not respond to the diagnostic tool (SCP)	• Circuit or connection in the SCP communication network. • Instrument cluster.	• Go To Pinpoint Test J .
• The instrument cluster does not respond to the diagnostic tool (UBP)	• Circuit or connection in the UBP communication network. • Instrument cluster.	• Go To Pinpoint Test K .
• The tire pressure monitor module does not respond to the diagnostic tool	• Circuit or connection in the SCP communication network. • Tire pressure monitor module.	• Go To Pinpoint Test L .
• The power liftgate module does not respond to the diagnostic tool	• Circuit or connection in the UBP communication network. • Power liftgate module.	• Go To Pinpoint Test M .
• The air suspension control module does not respond to the diagnostic tool	• Circuit or connection in the UBP communication network. • Air suspension control module.	• Go To Pinpoint Test N .
• The climate controlled seat module does not respond to the diagnostic tool	• Circuit or connection in the UBP communication network. • Climate controlled seat module.	• Go To Pinpoint Test O .
• No international standards organization (ISO 9141) network communication	• Circuit or connection in the ISO 9141 communication network. • ISO 9141 networked modules.	• Go To Pinpoint Test P .
• No standard corporate protocol (SCP) network communication	• Circuit or connection in the SCP communication network. • SCP networked modules.	• Go To Pinpoint Test Q .
• No UART based protocol (UBP) network communication	• Circuit or connection in the UBP communication network. • UBP networked modules.	• Go To Pinpoint Test R .

• No module/network communication — no power to the diagnostic tool	• Data link connector (DLC). • Central junction box (CJB) fuse 41 (20A). • Circuitry. • Diagnostic tool.	• Go To Pinpoint Test S .

Pinpoint Tests

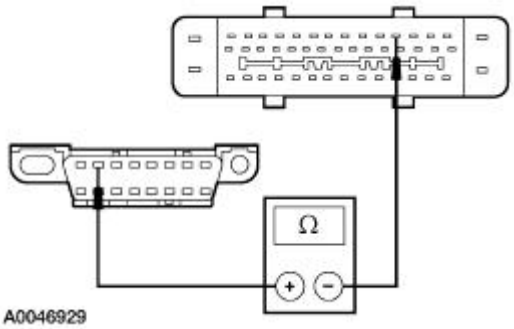
PINPOINT TEST A: THE 4-WHEEL ANTI-LOCK BRAKE/TRACTION CONTROL (ABS/TC) MODULE OR STABILITY ASSIST MODULE (IF EQUIPPED) DOES NOT RESPOND TO THE DIAGNOSTIC TOOL (ISO)

Test Step	Result / Action to Take
A1 CHECK THE ABS/TC MODULE C135 FOR DAMAGE	
• Key in OFF position. • Disconnect: ABS/TC Module C135. • Inspect the ABS/TC module C135 for damage. • **Is the ABS/TC module C135 OK?**	**Yes** GO to A2 . **No** REPAIR the ABS/TC module C135. CARRY OUT the DATA LINK DIAGNOSTICS test.
A2 CHECK CIRCUIT 70 (LB/WH) BETWEEN THE DLC C251 AND THE ABS/TC MODULE C135 FOR AN OPEN	
• Measure the resistance between the ABS/TC module C135 pin 2, circuit 70 (LB/WH), harness side and the DLC C251 pin 7, circuit 70 (LB/WH), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** GO to A5 . **No** GO to A3 .
A3 CHECK IN-LINE C213	
• Disconnect: In-Line C213. • Inspect in-lines C213M and C213F for damage. • **Are in-lines C213M and C213F OK?**	**Yes** GO to A4 . **No** REPAIR in-lines C213M and C213F. CARRY OUT the DATA LINK DIAGNOSTICS test.
A4 CHECK CIRCUIT 70 (LB/WH) BETWEEN IN-LINE C213F AND THE DLC C251 FOR AN OPEN	
• Measure the resistance between in-line C213F pin 12, circuit 70 (LB/WH), harness side and the DLC C251 pin 7,	**Yes** REPAIR circuit 70 (LB/WH)

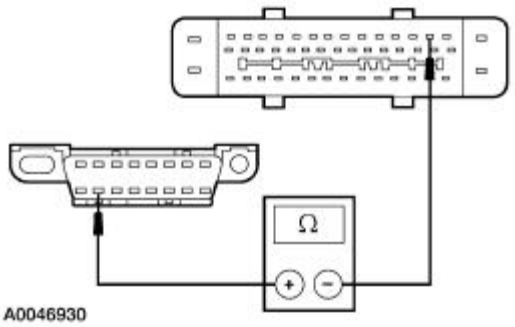
circuit 70 (LB/WH), harness side.  ● **Is the resistance less than 5 ohms?**	between in-line C213M and ABS/TC module C135. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** REPAIR circuit 70 (LB/WH) between DLC C251 and in-line C213F. CARRY OUT the DATA LINK DIAGNOSTICS test.
A5 CHECK FOR CORRECT ABS/TC MODULE OPERATION	
● Disconnect all the ABS/TC module connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all the ABS/TC module connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new ABS/TC module. REFER to Section 206-09A . TEST the system for normal operation. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST B: THE 4-WHEEL ANTI-LOCK BRAKE/TRACTION CONTROL (ABS/TC) MODULE OR STABILITY ASSIST MODULE (IF EQUIPPED) DOES NOT RESPOND TO THE DIAGNOSTIC TOOL (SCP)

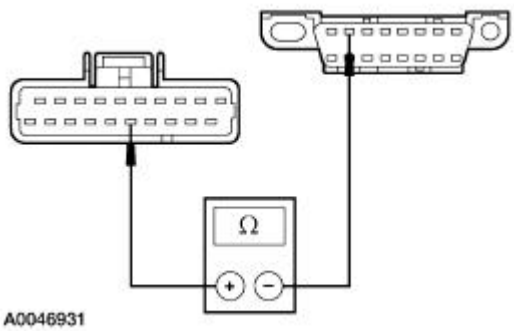
Test Step	Result / Action to Take
B1 CHECK THE ABS/TC MODULE C135	
● Key in OFF position. ● Disconnect: ABS/TC Module C135. ● Inspect the ABS/TC module C135 for damage. ● **Is the ABS/TC module C135 OK?**	**Yes** GO to B2 . **No** REPAIR the ABS/TC Module C135. CARRY OUT the DATA LINK DIAGNOSTICS test.
B2 CHECK CIRCUITS 914 (TN/OG) AND 915 (PK/LB) BETWEEN THE ABS/TC MODULE C135 AND THE DLC C251 FOR AN OPEN	
● Measure the resistance between the ABS/TC module C135 pin 12, circuit 914 (TN/OG), harness side and the DLC C251 pin 2, circuit 914 (TN/OG), harness side.	**Yes** GO to B5 . **No** GO to B3 .

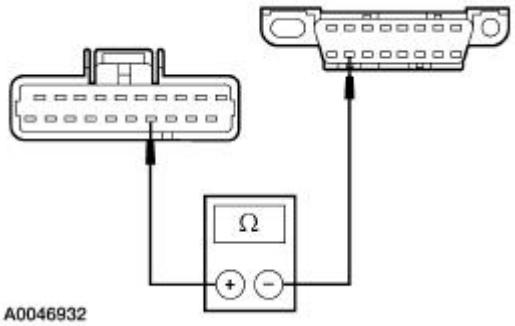


- Measure the resistance between the ABS/TC module C135 pin 14, circuit 915 (PK/LB), harness side and the DLC C251 pin 10, circuit 915 (PK/LB), harness side.



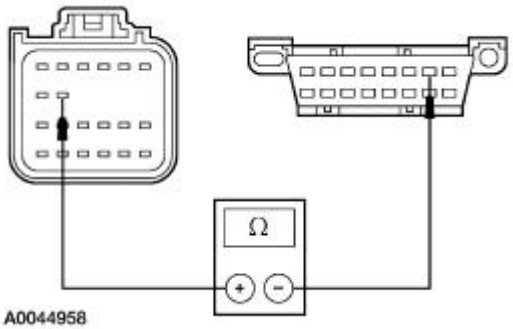
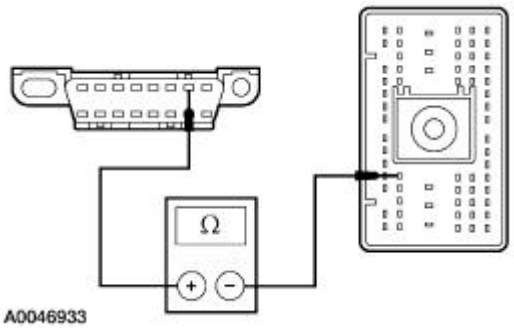
- **Are the resistances less than 5 ohms?**

B3 CHECK IN-LINE C210 FOR DAMAGE - Disconnect: In-Line C210. - Inspect in-lines C210M and C210F for damage. - **Are in-lines C210M and C210F OK?**	**Yes** GO to B4 . **No** REPAIR the in-lines C210M and C210F. CARRY OUT the DATA LINK DIAGNOSTICS test.
B4 CHECK CIRCUITS 914 (TN/OG) AND 915 (PK/LB) BETWEEN IN-LINE C210F AND THE DLC C251 FOR AN OPEN - Measure the resistance between in-line C210F pin 15, circuit 914 (TN/OG), harness side and the DLC C251 pin 2, circuit 914 (TN/OG), harness side.  - Measure the resistance between in-line C210F pin 14 circuit 915 (PK/LB), harness side and the DLC C251 pin 10, circuit 915 (PK/LB), harness side.	**Yes** REPAIR the circuit(s) in question between in-line C210M and the ABS/TC module C135. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** REPAIR the circuit(s) in question between in-line C210F and the DLC C251. CARRY OUT the DATA LINK DIAGNOSTICS test.

 ● **Are the resistances less than 5 ohms?**	
B5 CHECK FOR CORRECT ABS/TC MODULE OPERATION ● Disconnect all the ABS/TC module connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all the ABS/TC module connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new ABS/TC module. REFER to Section 206-09A . TEST the system for normal operation. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

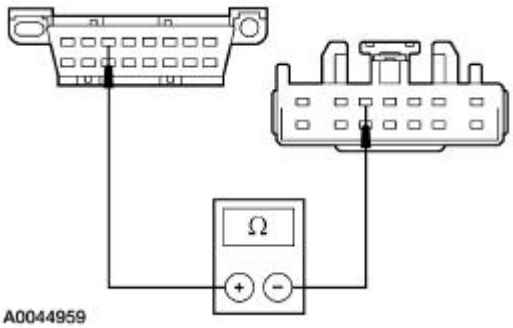
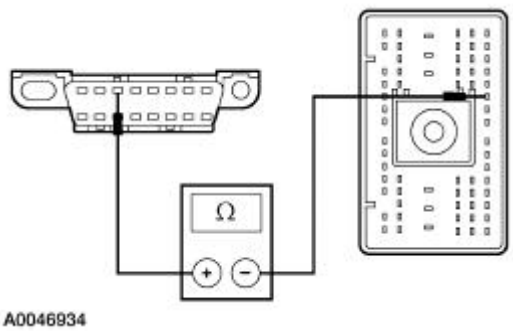
PINPOINT TEST C: THE RESTRAINT CONTROL MODULE (RCM) DOES NOT RESPOND TO THE DIAGNOSTIC TOOL

Test Step	Result / Action to Take
C1 CHECK THE RCM C310a FOR DAMAGE ● Key in OFF position. ● Deactivate the air bag system; refer to Section 501-20B . ● Disconnect: RCM C310a. ● Inspect the RCM C310a for damage. ● **Is the RCM C310a OK?**	**Yes** GO to C2 . **No** REPAIR the RCM C310a. CARRY OUT the DATA LINK DIAGNOSTICS test.
C2 CHECK CIRCUIT 70 (LB/WH) BETWEEN THE DLC C251 AND THE RCM C310a FOR AN OPEN ● Measure the resistance between the RCM C310a pin 11, circuit 70 (LB/WH), harness side and the DLC C251 pin 7, circuit 70 (LB/WH), harness side.	**Yes** GO to C4 . **No** GO to C3 .

 ● **Is the resistance less than 5 ohms?**	
C3 CHECK THE RESISTANCE BETWEEN IN-LINE C238M AND THE DLC C251	
● Measure the resistance between in-line C238M pin 48, circuit 70 (LB/WH), harness side and the DLC C251 pin 7, circuit 70 (LB/WH), harness side.  ● **Is the resistance less than 5 ohms?**	**Yes** REPAIR the circuit between in-line C238F and the RCM C310a. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** REPAIR the circuit between in-line C238M and the DLC C251. CARRY OUT the DATA LINK DIAGNOSTICS test.
C4 CHECK FOR CORRECT RCM OPERATION	
● Disconnect all the RCM connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all the RCM connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new RCM; REFER to Section 501-20B . TEST the system for normal operation. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

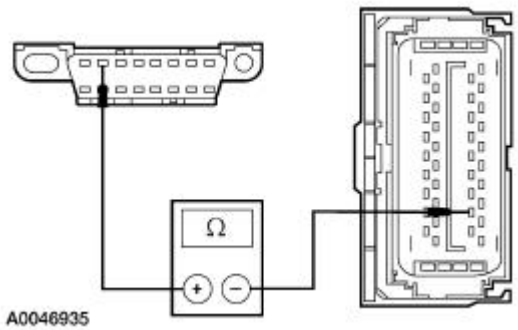
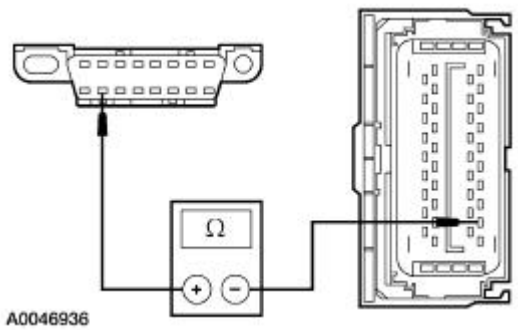
PINPOINT TEST D: THE VEHICLE SECURITY MODULE DOES NOT RESPOND TO THE DIAGNOSTIC TOOL

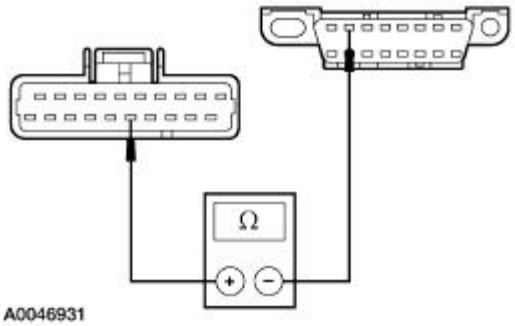
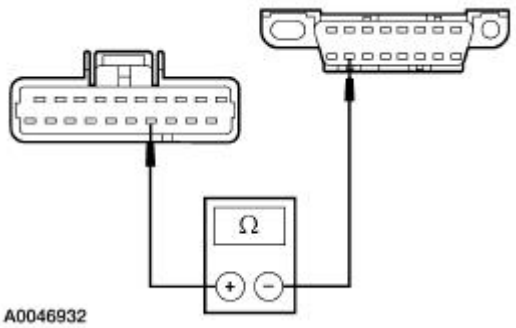
Test Step	Result / Action to Take
D1 CHECK THE VEHICLE SECURITY MODULE C2113c FOR DAMAGE	
● Key in OFF position. ● Disconnect the battery before removal of any vehicle security module connectors. Refer to Section 414-01 .	**Yes** GO to D2 .

• Disconnect: Vehicle Security Module C2113c. • Inspect the vehicle security module C2113c for damage. • **Is the vehicle security module C2113c OK?**	**No** REPAIR the vehicle security module C2113c. CARRY OUT the DATA LINK DIAGNOSTICS test.
D2 CHECK CIRCUIT 1906 (VT) BETWEEN THE DLC C251 AND THE VEHICLE SECURITY MODULE C2113c FOR AN OPEN	
• Measure the resistance between the vehicle security module C2113c pin 5, circuit 1906 (VT), harness side and the DLC C251 pin 3, circuit 1906 (VT), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** GO to D4 . **No** GO to D3 .
D3 CHECK CIRCUIT 1906 (VT) BETWEEN IN-LINE C238M AND THE DLC C251 FOR AN OPEN	
• Measure the resistance between in-line C238M pin 6, circuit 1906 (VT), harness side and the DLC C251 pin 3, circuit 1906 (VT), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** REPAIR the circuit between the vehicle security module and in-line C238F. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** REPAIR the circuit between the DLC C251 and in-line C238M. CARRY OUT the DATA LINK DIAGNOSTICS test.
D4 CHECK FOR CORRECT VEHICLE SECURITY MODULE OPERATION	
• Disconnect all the vehicle security module connectors. • Check for: • corrosion • pushed-out pins • Re-connect the battery. Refer to Section 414-01 . • Connect all the vehicle security module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new vehicle security module. REFER to Section 419-10 . TEST the system for normal operation. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the

	self-test. CARRY OUT the DATA LINK DIAGNOSTICS test.

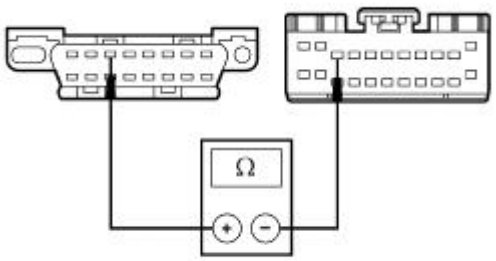
PINPOINT TEST E: THE POWERTRAIN CONTROL MODULE (PCM) DOES NOT RESPOND TO THE DIAGNOSTIC TOOL

Test Step	Result / Action to Take
E1 CHECK THE PCM C175a	
• Key in OFF position. • Disconnect: PCM C175a. • Inspect the PCM C175a for damage. • **Is the PCM C175a OK?**	**Yes** GO to E2 . **No** REPAIR the PCM C175a. CARRY OUT the DATA LINK DIAGNOSTICS test.
E2 CHECK CIRCUITS 914 (TN/OG) AND 915 (PK/LB) BETWEEN THE PCM C175a AND THE DLC C251 FOR AN OPEN	
• Measure the resistance between the PCM C175a pin 32, circuit 914 (TN/OG), harness side and the DLC C251 pin 2, circuit 914 (TN/OG), harness side.  • Measure the resistance between the PCM C175a pin 44, circuit 915 (PK/LB), harness side and the DLC C251 pin 10, circuit 915 (PK/LB), harness side.  • **Are the resistances less than 5 ohms?**	**Yes** GO to E5 . **No** GO to E3 .
E3 CHECK IN-LINE C210 FOR DAMAGE	
• Disconnect: In-Line C210. • Inspect in-lines C210M and C210F for damage. • **Are in-lines C210M and C210F OK?**	**Yes** GO to E4 . **No** REPAIR the in-lines C210M and C210F. CARRY OUT the

	DATA LINK DIAGNOSTICS test.
E4 CHECK CIRCUITS 914 (TN/OG) AND 915 (PK/LB) BETWEEN IN-LINE C210M AND THE DLC C251 FOR AN OPEN	
• Measure the resistance between in-line C210F pin 15, circuit 914 (TN/OG), harness side and the DLC C251 pin 2, circuit 914 (TN/OG), harness side.  • Measure the resistance between in-line C210F pin 14, circuit 915 (PK/LB), harness side and the DLC C251 pin 10, circuit 915 (PK/LB), harness side.  • **Are the resistances less than 5 ohms?**	**Yes** REPAIR the circuit(s) in question between in-line C210M and the PCM C175a. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** REPAIR the circuit(s) in question between in-line C210F and the DLC C251. CARRY OUT the DATA LINK DIAGNOSTICS test.
E5 CHECK FOR CORRECT PCM OPERATION	
• Disconnect all the PCM connectors. • Check for: • corrosion • pushed-out pins • Connect all the PCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

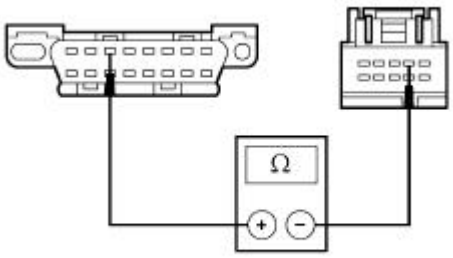
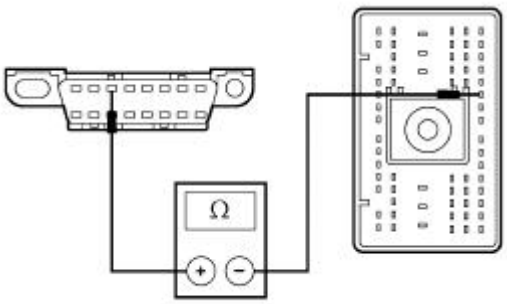
PINPOINT TEST F: THE ELECTRONIC AUTOMATIC TEMPERATURE CONTROL (EATC) MODULE DOES NOT RESPOND TO THE DIAGNOSTIC TOOL

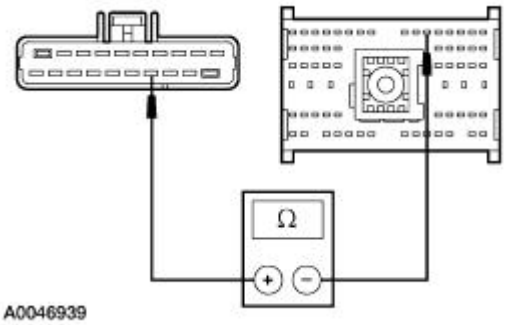
Test Step	Result / Action to Take

F1 CHECK THE EATC MODULE C228b FOR DAMAGE	
• Key in OFF position. • Disconnect: EATC Module C228b. • Inspect the EATC module C228b for damage. • **Is the EATC module C228b OK?**	**Yes** GO to F2 . **No** REPAIR the EATC module C228b. TEST the system for normal operation.
F2 CHECK CIRCUIT 1906 (VT) FOR AN OPEN	
• Measure the resistance between the DLC C251 pin 3, circuit 1906 (VT), harness side and the EATC module C228b pin 3, circuit 1906 (VT), harness side.  A0046937 • **Are the resistances less than 5 ohms?**	**Yes** GO to F3 . **No** REPAIR the circuit(s) in question. CARRY OUT the DATA LINK DIAGNOSTICS test.
F3 CHECK FOR CORRECT EATC OPERATION	
• Disconnect all the EATC connectors. • Check for: ◦ corrosion ◦ pushed-out pins • Connect all the EATC connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new EATC module. REFER to Section 412-00 . TEST the system for normal operation. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST G: THE DRIVER SEAT MODULE (DSM) DOES NOT RESPOND TO THE DIAGNOSTIC TOOL

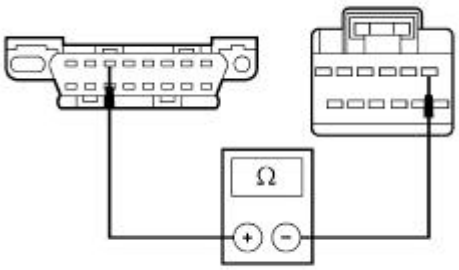
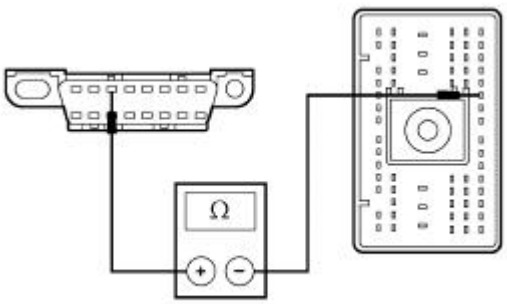
Test Step	Result / Action to Take
G1 CHECK THE DSM C341c FOR DAMAGE	
• Key in OFF position. • Disconnect: DSM C341c. • Inspect the DSM C341c for damage. • **Is the DSM C341c OK?**	**Yes** GO to G2 . **No** REPAIR the DSM C341c. CARRY OUT the DATA LINK DIAGNOSTICS test.
G2 CHECK CIRCUIT 1906 (VT) BETWEEN THE DLC C251	

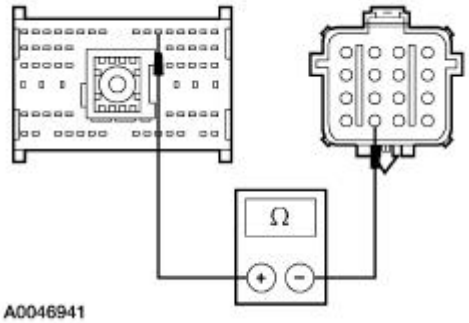
AND THE DSM C341c FOR AN OPEN	
• Measure the resistance between the DSM C341c pin 2, circuit 1906 (VT), harness side and the DLC C251 pin 3, circuit 1906 (VT), harness side.  A0046938 • **Is the resistance less than 5 ohms?**	**Yes** GO to G7 . **No** GO to G3 .
G3 CHECK IN-LINE C238 FOR DAMAGE	
• Disconnect: In-Line C238. • Inspect in-lines C238M and C238F for damage. • **Are in-lines C238M and C238F OK?**	**Yes** GO to G4 . **No** REPAIR in-lines C238M and C238F. CARRY OUT the DATA LINK DIAGNOSTICS test.
G4 CHECK CIRCUIT 1906 (VT) BETWEEN IN-LINE C238M AND THE DLC C251 FOR AN OPEN	
• Measure the resistance between the DLC C251 pin 3, circuit 1906 (VT), harness side and in-line C238M pin 6, circuit 1906 (VT), harness side.  A0046934 • **Is the resistance less than 5 ohms?**	**Yes** GO to G5 . **No** REPAIR the circuit between in-line C238M and the DLC C251. CARRY OUT the DATA LINK DIAGNOSTICS test.
G5 CHECK IN-LINE C312 FOR DAMAGE	
• Disconnect: In-Line C312. • Inspect in-lines C312M and C312F for damage. • **Are in-lines C312M and C312F OK?**	**Yes** GO to G6 . **No** REPAIR in-lines C312M and C312F. CARRY OUT the DATA LINK DIAGNOSTICS test.
G6 CHECK CIRCUIT 1906 (VT) BETWEEN IN-LINE C238F AND IN-LINE C312F FOR AN OPEN	
• Measure the resistance between in-line C238F pin 6, circuit 1906 (VT), harness side and in-line C312F pin 14, circuit 1906 (VT), harness side.	**Yes** REPAIR the circuit between in-line C312M and the DSM C341c. CARRY OUT the DATA

 ● **Is the resistance less than 5 ohms?**	LINK DIAGNOSTICS test. **No** REPAIR the circuit between in-lines C238F and C312F. CARRY OUT the DATA LINK DIAGNOSTICS test.
G7 CHECK FOR CORRECT DSM OPERATION	
● Disconnect all the DSM connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all the DSM connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new DSM. REFER to Section 501-10 . TEST the system for normal operation. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST H: THE PARKING AID MODULE DOES NOT RESPOND TO THE DIAGNOSTIC TOOL

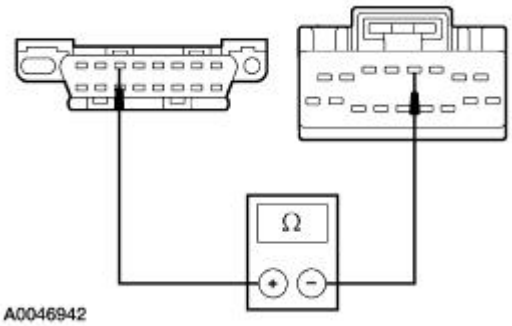
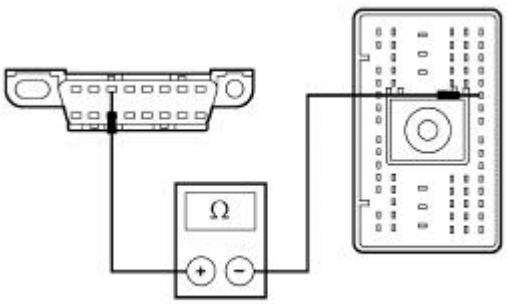
Test Step	Result / Action to Take
H1 CHECK THE PARKING AID MODULE C4014b FOR DAMAGE	
● Key in OFF position. ● Disconnect: Parking Aid Module C4014b. ● Inspect the parking aid module C4014b for damage. ● **Is the parking aid module C4014b OK?**	**Yes** GO to H2 . **No** REPAIR the parking aid module C4014b. CARRY OUT the DATA LINK DIAGNOSTICS test.
H2 CHECK CIRCUIT 1906 (VT) BETWEEN THE DLC C251 AND THE PARKING AID MODULE C4014b FOR AN OPEN	
● Measure the resistance between the parking aid module C4014b pin 1, circuit 1906 (VT), harness side and the DLC C251 pin 3, circuit 1906 (VT), harness side.	**Yes** GO to H7 . **No** GO to H3 .

 A0046940 ● **Is the resistance less than 5 ohms?**	
H3 CHECK IN-LINE C238 FOR DAMAGE ● Disconnect: In-Line C238. ● Inspect in-lines C238M and C238F for damage. ● **Are in-lines C238M and C238F OK?**	**Yes** GO to H4 . **No** REPAIR in-lines C238M and C238F. CARRY OUT the DATA LINK DIAGNOSTICS test.
H4 CHECK CIRCUIT 1906 (VT) BETWEEN IN-LINE C238M AND THE DLC C251 FOR AN OPEN ● Measure the resistance between the DLC C251 pin 3, circuit 1906 (VT), harness side and in-line C238M pin 6, circuit 1906 (VT), harness side.  A0046934 ● **Is the resistance less than 5 ohms?**	**Yes** GO to H5 . **No** REPAIR the circuit between in-line C238M and the DLC C251. CARRY OUT the DATA LINK DIAGNOSTICS test.
H5 CHECK IN-LINE C465 FOR DAMAGE ● Disconnect: In-Line C465. ● Inspect in-lines C465M and C465F for damage. ● **Are in-lines C465M and C465F OK?**	**Yes** GO to H6 . **No** REPAIR in-lines C465M and C465F. CARRY OUT the DATA LINK DIAGNOSTICS test.
H6 CHECK CIRCUIT 1906 (VT) BETWEEN IN-LINE C238F AND IN-LINE C465F FOR AN OPEN ● Measure the resistance between in-line C238F pin 6, circuit 1906 (VT), harness side and in-line C465F pin 15, circuit 1906 (VT), harness side.	**Yes** REPAIR the circuit between in-line C465M and the parking aid module C4014b. CARRY OUT the DATA LINK DIAGNOSTICS test. **No**

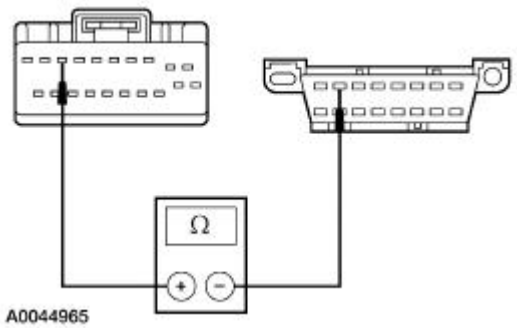
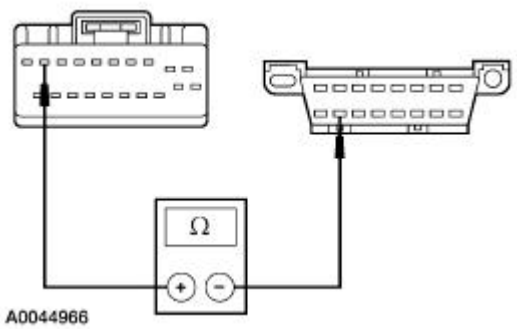
 ● **Is the resistance less than 5 ohms?**	REPAIR the circuit between in-line C238F and in-line C465F. CARRY OUT the DATA LINK DIAGNOSTICS test.
H7 CHECK FOR CORRECT PARKING AID MODULE OPERATION	
● Disconnect all the parking aid module connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all the parking aid module connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new parking aid module. REFER to Section 413-13 . TEST the system for normal operation. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST I: THE FOUR-WHEEL DRIVE (4WD) CONTROL MODULE DOES NOT RESPOND TO THE DIAGNOSTIC TOOL

Test Step	Result / Action to Take
I1 CHECK THE 4WD CONTROL MODULE C3184b FOR DAMAGE	
● Key in OFF position. ● Disconnect: 4WD Control Module C3184b. ● Inspect the 4WD control module C3184b for damage. ● **Is the 4WD control module C3184b OK?**	**Yes** GO to I2 . **No** REPAIR the 4WD control module C3184b. CARRY OUT the DATA LINK DIAGNOSTICS test.
I2 CHECK CIRCUIT 1906 (VT) BETWEEN THE DLC C251 AND THE 4WD CONTROL MODULE C3184b FOR AN OPEN	
● Measure the resistance between the 4WD control module C3184b pin 4, circuit 1906 (VT), harness side and the DLC C251 pin 3, circuit 1906 (VT), harness side.	**Yes** GO to I5 . **No** GO to I3 .

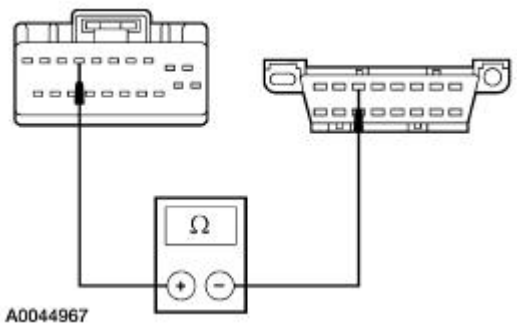
 A0046942 ● **Is the resistance less than 5 ohms?**	
I3 CHECK IN-LINE C238 FOR DAMAGE ● Disconnect: In-Line C238. ● Inspect in-lines C238M and C238F for damage. ● **Are in-lines C238M and C238F OK?**	**Yes** GO to I4 . **No** REPAIR in-lines C238M and C238F. CARRY OUT the DATA LINK DIAGNOSTICS test.
I4 CHECK CIRCUIT 1906 (VT) BETWEEN IN-LINE C238M AND THE DLC C251 FOR AN OPEN ● Measure the resistance between the DLC C251 pin 3, circuit 1906 (VT), harness side and in-line C238M pin 6, circuit 1906 (VT), harness side.  A0046934 ● **Is the resistance less than 5 ohms?**	**Yes** REPAIR the circuit between in-line C238F and the 4WD control module C3184b. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** REPAIR the circuit between in-line C238M and the DLC C251. CARRY OUT the DATA LINK DIAGNOSTICS test.
I5 CHECK FOR CORRECT 4WD CONTROL MODULE OPERATION ● Disconnect all the 4WD control module connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all the 4WD control module connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new 4WD control module. REFER to Section 308-07A . TEST the system for normal operation. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST J: THE INSTRUMENT CLUSTER DOES NOT RESPOND TO THE DIAGNOSTIC TOOL (SCP)

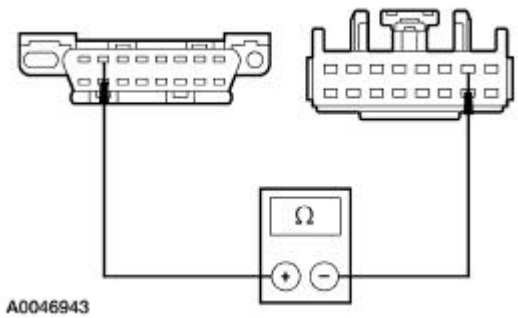
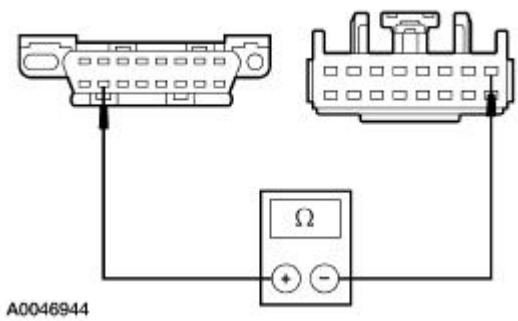
Test Step	Result / Action to Take
J1 CHECK THE INSTRUMENT CLUSTER C220a FOR DAMAGE	
• Key in OFF position. • Disconnect: Instrument Cluster C220a. • Inspect the instrument cluster C220a for damage. • **Is the instrument cluster C220a OK?**	**Yes** GO to J2. **No** REPAIR the instrument cluster C220a. CARRY OUT the DATA LINK DIAGNOSTICS test.
J2 CHECK CIRCUITS 914 (TN/OG) AND 915 (PK/LB) FOR AN OPEN	
• Measure the resistance between the DLC C251 pin 2, circuit 914 (TN/OG), harness side and the instrument cluster C220a pin 8, circuit 914 (TN/OG), harness side.  • Measure the resistance between the DLC C251 pin 10, circuit 915 (PK/LB), harness side and the instrument cluster C220a pin 9, circuit 915 (PK/LB), harness side.  • **Are the resistances less than 5 ohms?**	**Yes** GO to J3. **No** REPAIR the circuit(s) in question. CARRY OUT the DATA LINK DIAGNOSTICS test.
J3 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
• Disconnect all the instrument cluster connectors. • Check for: ◦ corrosion ◦ pushed-out pins • Connect all the instrument cluster connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Section 413-00. TEST the system for normal operation. CARRY OUT the DATA LINK DIAGNOSTICS test. **No**

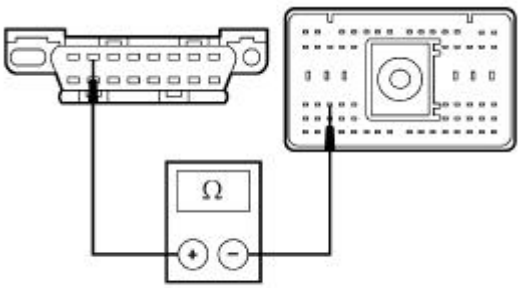
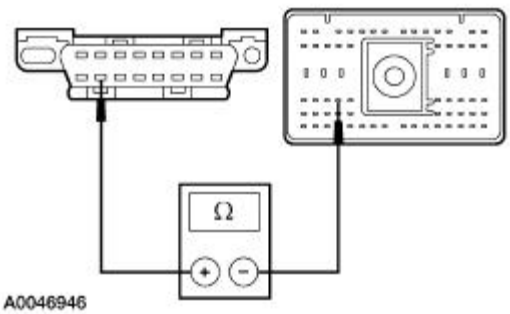
	The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST K: THE INSTRUMENT CLUSTER DOES NOT RESPOND TO THE DIAGNOSTIC TOOL (UBP)

Test Step	Result / Action to Take
K1 CHECK THE INSTRUMENT CLUSTER C220a FOR DAMAGE	
• Key in OFF position. • Disconnect: Instrument Cluster C220a. • Inspect the instrument cluster C220a for damage. • **Is the instrument cluster C220a OK?**	**Yes** GO to K2 . **No** REPAIR the instrument cluster C220a. CARRY OUT the DATA LINK DIAGNOSTICS test.
K2 CHECK CIRCUIT 1906 (VT) FOR AN OPEN	
• Measure the resistance between the DLC C251 pin 3, circuit 1906 (VT), harness side and the instrument cluster C220a pin 7, circuit 1906 (VT), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** GO to K3 . **No** REPAIR the circuit in question. CARRY OUT the DATA LINK DIAGNOSTICS test.
K3 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
• Disconnect all the instrument cluster connectors. • Check for: • corrosion • pushed-out pins • Connect all the instrument cluster connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Section 413-00 . TEST the system for normal operation. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

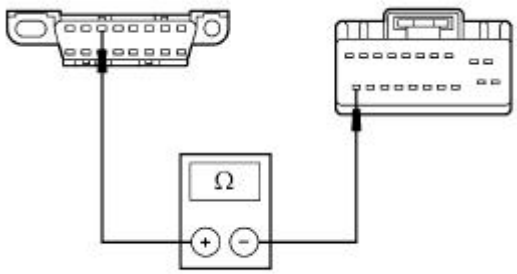
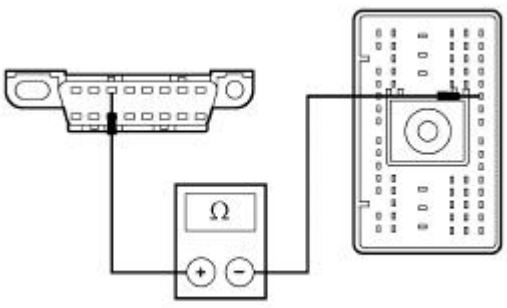
PINPOINT TEST L: THE TIRE PRESSURE MONITOR MODULE DOES NOT RESPOND TO THE DIAGNOSTIC TOOL

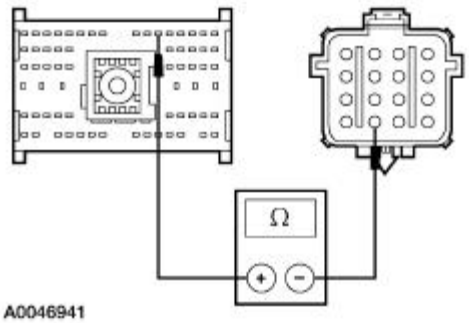
Test Step	Result / Action to Take
L1 CHECK THE TIRE PRESSURE MONITOR MODULE C3183	
• Key in OFF position. • Disconnect: Tire Pressure Monitor Module C3183. • Inspect the tire pressure monitor module C3183 for damage. • **Is the tire pressure monitor module C3183 OK?**	**Yes** GO to L2 . **No** REPAIR the tire pressure monitor module C3183 CARRY OUT the DATA LINK DIAGNOSTICS test.
L2 CHECK CIRCUITS 914 (TN/OG) AND 915 (PK/LB) BETWEEN THE TIRE PRESSURE MONITOR MODULE C3183 AND THE DLC C251 FOR AN OPEN	
• Measure the resistance between the tire pressure monitor module C3183 pin 2, circuit 914 (TN/OG), harness side and the DLC C251 pin 2, circuit 914 (TN/OG), harness side.  A0046943 • Measure the resistance between the tire pressure monitor module C3183 pin 1, circuit 915 (PK/LB), harness side and the DLC C251 pin 10, circuit 915 (PK/LB), harness side.  A0046944 • **Are the resistances less than 5 ohms?**	**Yes** GO to L5 . **No** GO to L3 .
L3 CHECK IN-LINE C238 FOR DAMAGE	
• Disconnect: In-Line C238. • Inspect in-lines C238M and C238F for damage. • **Are in-lines C238M and C238F OK?**	**Yes** GO to L4 . **No** REPAIR the in-lines C238M and C238F. CARRY OUT the DATA LINK DIAGNOSTICS test.
L4 CHECK CIRCUITS 914 (TN/OG) AND 915 (PK/LB) BETWEEN IN-LINE C238M AND THE DLC C251 FOR AN	

OPEN	
• Measure the resistance between in-line C238M pin 34, circuit 914 (TN/OG), harness side and the DLC C251 pin 2, circuit 914 (TN/OG), harness side.  A0049339 • Measure the resistance between in-line C238M pin 33, circuit 915 (PK/LB), harness side and the DLC C251 pin 10, circuit 915 (PK/LB), harness side.  A0046946 • **Are the resistances less than 5 ohms?**	**Yes** REPAIR the circuit(s) in question between in-line C238F and the tire pressure monitor module C3183 CARRY OUT the DATA LINK DIAGNOSTICS test. **No** REPAIR the circuit(s) in question between in-line C238M and the DLC C251. CARRY OUT the DATA LINK DIAGNOSTICS test.
L5 CHECK FOR CORRECT TIRE PRESSURE MONITOR MODULE OPERATION	
• Disconnect all the tire pressure monitor module connectors. • Check for: • corrosion • pushed-out pins • Connect all the tire pressure monitor module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new tire pressure monitor module. REFER to Section 413-08 . TEST the system for normal operation. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST M: THE POWER LIFTGATE MODULE DOES NOT RESPOND TO THE DIAGNOSTIC TOOL

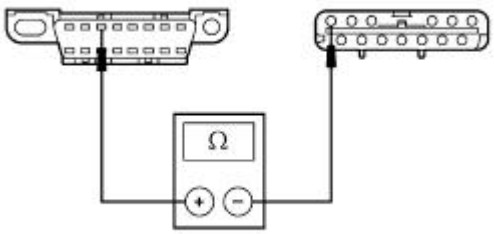
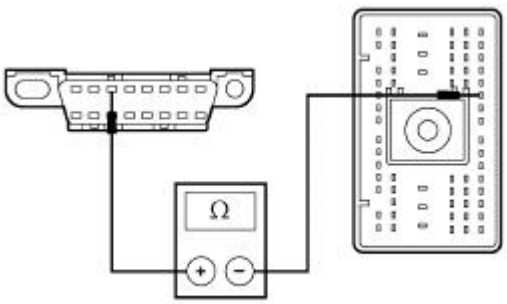
Test Step	Result / Action to Take
M1 CHECK THE POWER LIFTGATE MODULE C4174d FOR DAMAGE	
• Key in OFF position.	**Yes**

• Disconnect: Power Liftgate Module C4174d. • Inspect the power liftgate module C4174d for damage. • **Is the power liftgate module C4174d OK?**	GO to M2 . **No** REPAIR the power liftgate module C4174d. CARRY OUT the DATA LINK DIAGNOSTICS test.
M2 CHECK CIRCUIT 1906 (VT) BETWEEN THE DLC C251 AND THE POWER LIFTGATE MODULE C4174d FOR AN OPEN	
• Measure the resistance between the power liftgate module C4174d pin 20, circuit 1906 (VT), harness side and the DLC C251 pin 3, circuit 1906 (VT), harness side.  A0046947 • **Is the resistance less than 5 ohms?**	**Yes** GO to M7 . **No** GO to M3 .
M3 CHECK IN-LINE C238 FOR DAMAGE	
• Disconnect: In-Line C238. • Inspect in-lines C238M and C238F for damage. • **Are in-lines C238M and C238F OK?**	**Yes** GO to M4 . **No** REPAIR in-lines C238M and C238F. CARRY OUT the DATA LINK DIAGNOSTICS test.
M4 CHECK CIRCUIT 1906 (VT) BETWEEN IN-LINE C238M AND THE DLC C251 FOR AN OPEN	
• Measure the resistance between the DLC C251 pin 3, circuit 1906 (VT), harness side and in-line C238M pin 6, circuit 1906 (VT), harness side.  A0046934 • **Is the resistance less than 5 ohms?**	**Yes** GO to M5 . **No** REPAIR the circuit between in-line C238M and the DLC C251. CARRY OUT the DATA LINK DIAGNOSTICS test.
M5 CHECK IN-LINE C465 FOR DAMAGE	
• Disconnect: In-Line C465. • Inspect in-lines C465M and C465F for damage. • **Are in-lines C465M and C465F OK?**	**Yes** GO to M6 . **No** REPAIR in-lines C465M and

	C465F. CARRY OUT the DATA LINK DIAGNOSTICS test.
M6 CHECK CIRCUIT 1906 (VT) BETWEEN IN-LINE C238F AND IN-LINE C465F FOR AN OPEN	
• Measure the resistance between in-line C238F pin 6, circuit 1906 (VT), harness side and in-line C465F pin 15, circuit 1906 (VT), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** REPAIR the circuit between in-line C465M and the power liftgate module C4174d. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** REPAIR the circuit between in-line C238F and in-line C465F. CARRY OUT the DATA LINK DIAGNOSTICS test.
M7 CHECK FOR CORRECT PARKING AID MODULE OPERATION	
• Disconnect all the power liftgate module connectors. • Check for: • corrosion • pushed-out pins • Connect all the power liftgate module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new power liftgate module. REFER to Section 501-03 . TEST the system for normal operation. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

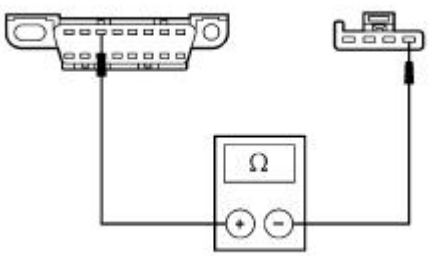
PINPOINT TEST N: THE AIR SUSPENSION CONTROL MODULE DOES NOT RESPOND TO THE DIAGNOSTIC TOOL

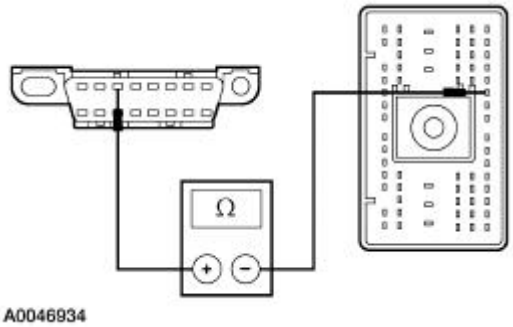
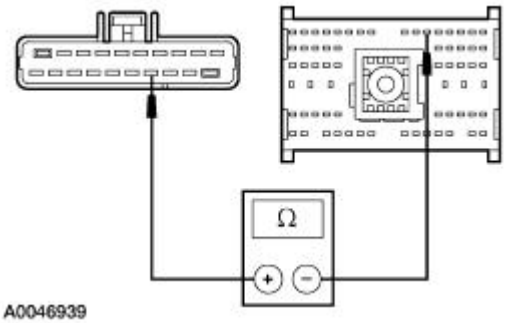
Test Step	Result / Action to Take
N1 CHECK THE AIR SUSPENSION CONTROL MODULE C2131b FOR DAMAGE	
• Key in OFF position. • Disconnect: Air Suspension Control Module C2131b. • Inspect the air suspension control module C2131b for damage. • **Is the air suspension control module C2131b OK?**	**Yes** GO to N2 . **No** REPAIR the air suspension control module C2131b. CARRY OUT the DATA LINK DIAGNOSTICS test.
N2 CHECK CIRCUIT 1906 (VT) BETWEEN THE DLC C251 AND THE AIR SUSPENSION CONTROL C2131b FOR AN OPEN	

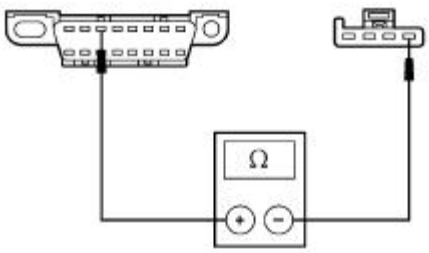
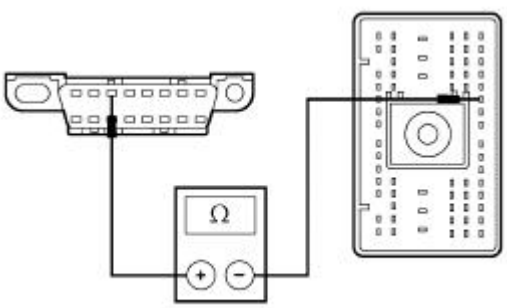
• Measure the resistance between the air suspension control module C2131b pin 26, circuit 1906 (VT), harness side and the DLC C251 pin 3, circuit 1906 (VT), harness side.  A0046948 • **Is the resistance less than 5 ohms?**	**Yes** GO to N5 . **No** GO to N3 .
N3 CHECK IN-LINE C238 FOR DAMAGE	
• Disconnect: In-Line C238. • Inspect in-lines C238M and C238F for damage. • **Are in-lines C238M and C238F OK?**	**Yes** GO to N4 . **No** REPAIR in-lines C238M and C238F. CARRY OUT the DATA LINK DIAGNOSTICS test.
N4 CHECK CIRCUIT 1906 (VT) BETWEEN IN-LINE C238M AND THE DLC C251 FOR AN OPEN	
• Measure the resistance between the DLC C251 pin 3, circuit 1906 (VT), harness side and in-line C238M pin 6, circuit 1906 (VT), harness side.  A0046934 • **Is the resistance less than 5 ohms?**	**Yes** REPAIR the circuit between in-line C238F and the air suspension control module C2131b. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** REPAIR the circuit between in-line C238M and the DLC C251. CARRY OUT the DATA LINK DIAGNOSTICS test.
N5 CHECK FOR CORRECT AIR SUSPENSION CONTROL MODULE OPERATION	
• Disconnect all the air suspension control module connectors. • Check for: ◦ corrosion ◦ pushed-out pins • Connect all the air suspension control module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new air suspension control module. REFER to Section 204-05 . TEST the system for normal operation. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a

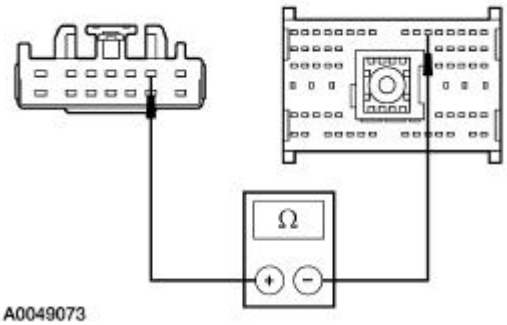
	loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST O: THE CLIMATE CONTROLLED SEAT MODULE DOES NOT RESPOND TO THE DIAGNOSTIC TOOL

Test Step	Result / Action to Take
O1 CHECK THE CLIMATE CONTROLLED SEAT MODULE C3031b FOR DAMAGE	
• Key in OFF position. • If the passenger seat module does not respond to the diagnostic tool, GO to O8. • Disconnect: Climate Controlled Seat Module C3031b. • Inspect the climate controlled seat module C3031b for damage. • **Is the climate controlled seat module C3031b OK?**	**Yes** GO to O2 . **No** REPAIR the climate controlled seat module C3031b. CARRY OUT the DATA LINK DIAGNOSTICS test.
O2 CHECK CIRCUIT 1906 (VT) BETWEEN THE DLC C251 AND THE CLIMATE CONTROLLED SEAT MODULE C3031b FOR AN OPEN	
• Measure the resistance between the climate controlled seat module C3031b pin 1, circuit 1906 (VT), harness side and the DLC C251 pin 3, circuit 1906 (VT), harness side.  A0046949 • **Is the resistance less than 5 ohms?**	**Yes** GO to O7 . **No** GO to O3 .
O3 CHECK IN-LINE C238 FOR DAMAGE	
• Disconnect: In-Line C238. • Inspect in-lines C238M and C238F for damage. • **Are in-lines C238M and C238F OK?**	**Yes** GO to O4 . **No** REPAIR in-lines C238M and C238F. CARRY OUT the DATA LINK DIAGNOSTICS test.
O4 CHECK CIRCUIT 1906 (VT) BETWEEN IN-LINE C238M AND THE DLC C251 FOR AN OPEN	
• Measure the resistance between the DLC C251 pin 3, circuit 1906 (VT), harness side and in-line C238M pin 6, circuit 1906 (VT), harness side.	**Yes** GO to O5 . **No** REPAIR the circuit between in-line C238M and the DLC C251. CARRY OUT the

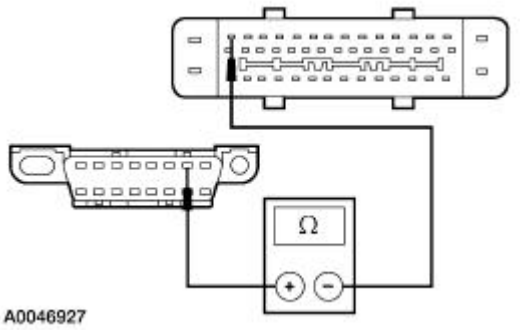
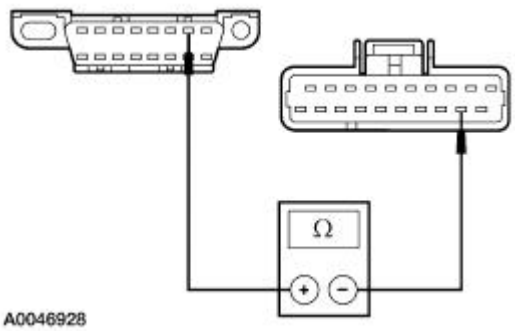
 A0046934 ● **Is the resistance less than 5 ohms?**	DATA LINK DIAGNOSTICS test.
O5 CHECK IN-LINE C312 FOR DAMAGE	
● Disconnect: In-Line C312. ● Inspect in-lines C312M and C312F for damage. ● **Are in-lines C312M and C312F OK?**	**Yes** GO to O6 . **No** REPAIR in-lines C312M and C312F. CARRY OUT the DATA LINK DIAGNOSTICS test.
O6 CHECK CIRCUIT 1906 (VT) BETWEEN IN-LINE C238F AND IN-LINE C312F FOR AN OPEN	
● Measure the resistance between in-line C238F pin 6, circuit 1906 (VT), harness side and in-line C312F pin 14, circuit 1906 (VT), harness side.  A0046939 ● **Is the resistance less than 5 ohms?**	**Yes** REPAIR the circuit between in-line C312M and the climate controlled seat module C3036b. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** REPAIR the circuit between in-lines C238F and C312F. CARRY OUT the DATA LINK DIAGNOSTICS test.
O7 CHECK FOR CORRECT CLIMATE CONTROLLED SEAT MODULE OPERATION	
● Disconnect all the climate controlled seat module connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all the climate controlled seat module connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new climate controlled seat module. REFER to Section 501-10 . TEST the system for normal operation. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
O8 CHECK THE CLIMATE CONTROLLED SEAT MODULE	

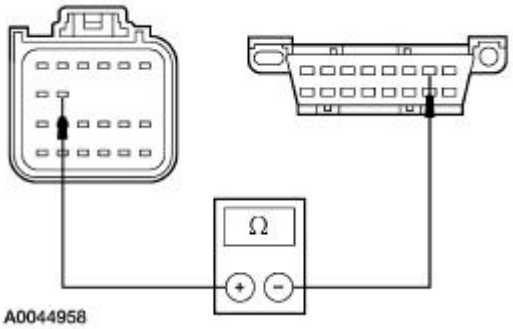
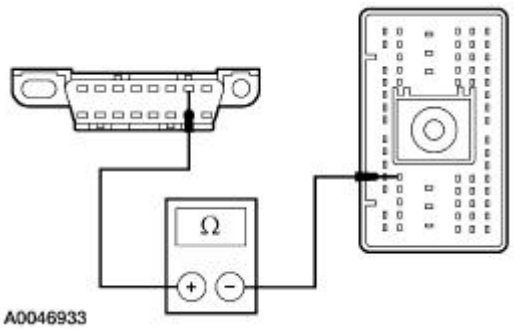
C3036B FOR DAMAGE	
• Key in OFF position. • Disconnect: Climate Controlled Seat Module C3036b. • Inspect the climate controlled seat module C3036b for damage. • **Is the climate controlled seat module C3036b OK?**	**Yes** GO to O9 . **No** REPAIR the climate controlled seat module C3036b. CARRY OUT the DATA LINK DIAGNOSTICS test.
O9 CHECK CIRCUIT 1906 (VT) BETWEEN THE DLC C251 AND THE CLIMATE CONTROLLED SEAT MODULE C3036B FOR AN OPEN	
• Measure the resistance between the climate controlled seat module C3036b pin 1, circuit 1906 (VT), harness side and the DLC C251 pin 3, circuit 1906 (VT), harness side.  A0046949 • **Is the resistance less than 5 ohms?**	**Yes** GO to O14 . **No** GO to O10 .
O10 CHECK IN-LINE C238 FOR DAMAGE	
• Disconnect: In-Line C238. • Inspect in-lines C238M and C238F for damage. • **Are lines C238M and C238F OK?**	**Yes** GO to O11 . **No** REPAIR in-lines C238M and C238F. CARRY OUT the DATA LINK DIAGNOSTICS test.
O11 CHECK CIRCUIT 1906 (VT) BETWEEN IN-LINE C238M AND THE DLC C251 FOR AND OPEN	
• Measure the resistance between the DLC C251 pin 3, circuit 1906 (VT), harness side and in-line C238M pin 6, circuit 1906 (VT), harness side.  A0046934 • **Is the resistance less than 5 ohms?**	**Yes** GO to O12 . **No** REPAIR the circuit between in-line C238M and the DLC C251. CARRY OUT the DATA LINK DIAGNOSTICS test.
O12 CHECK IN-LINE C313 FOR DAMAGE	
• Disconnect: In-Line C313. • Inspect in-lines C313M and C313F for damage.	**Yes** GO to O13 .

• **Are in-lines C313M and C313F OK?**	**No** REPAIR in-lines C313M and C313F. CARRY OUT the DATA LINK DIAGNOSTICS test.
O13 CHECK CIRCUIT 1906 (VT) BETWEEN IN-LINE C238F AND IN-LINE C313F FOR AN OPEN	
• Measure the resistance between in-line C238F pin 6, circuit 1906 (VT), harness side and in-line C313F pin 2, circuit 1906 (VT), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** REPAIR the circuit between in-line C313M and the climate controlled seat module C3036b. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** REPAIR the circuit between in-lines C238F and C313F. CARRY OUT the DATA LINK DIAGNOSTICS test.
O14 CHECK FOR CORRECT CLIMATE CONTROLLED SEAT MODULE OPERATION	
• Disconnect all the climate controlled seat module connectors. • Check for: • corrosion • pushed-out pins • Connect all the climate controlled seat module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new climate controlled seat module. REFER to Section 501-10 . TEST the system for normal operation. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST P: NO INTERNATIONAL STANDARDS ORGINIZATION (ISO) 9141 NETWORK COMMUNICATION

Test Step	Result / Action to Take
P1 CHECK THE DLC C251 FOR DAMAGE	
• Key in OFF position. • Inspect the DLC C251. • **Is the DLC C251 OK?**	**Yes** GO to P2 . **No** REPAIR the DLC C251. CARRY OUT the DATA LINK DIAGNOSTICS test.
P2 CHECK THE 4-WHEEL ANTI-LOCK BRAKE/TRACTION	

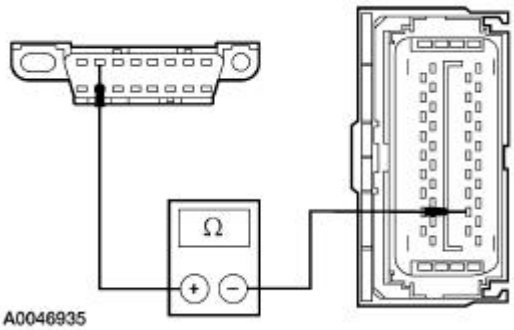
CONTROL (ABS/TC) MODULE OR STABILITY ASSIST MODULE (IF EQUIPPED) C135 FOR DAMAGE	
• Key in OFF position. • Disconnect: ABS/TC Module C135. • Inspect the ABS/TC module C135 for damage. • **Is the ABS/TC module C135 OK?**	**Yes** GO to P3 . **No** REPAIR the ABS/TC module C135. CARRY OUT the DATA LINK DIAGNOSTICS test.
P3 CHECK CIRCUIT 70 (LB/WH) BETWEEN THE DLC C251 AND THE ABS/TC MODULE C135 FOR AN OPEN	
• Measure the resistance between the ABS/TC module C135 pin 2, circuit 70 (LB/WH), harness side and the DLC C251 pin 7, circuit 70 (LB/WH), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** GO to P5 . **No** GO to P4 .
P4 CHECK CIRCUIT 70 (LB/WH) BETWEEN IN-LINE C213F AND THE DLC C251 FOR AN OPEN	
• Measure the resistance between in-line C213F pin 12, circuit 70 (LB/WH), harness side and the DLC C251 pin 7, circuit 70 (LB/WH), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** REPAIR circuit 70 (LB/WH) between in-line C213M and ABS module C135. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** REPAIR circuit 70 (LB/WH) between DLC C251 and in-line C213F. CARRY OUT the DATA LINK DIAGNOSTICS test.
P5 CHECK THE ISO 9141 NETWORK WITH THE ABS/TC MODULE C135 DISCONNECTED	
• Key in ON position. • Carry out the DATA LINK DIAGNOSTICS TEST. • **Did the diagnostic tool indicate SYSTEM PASSED?**	**Yes** GO to P10 . **No** GO to P6 .
P6 CHECK THE RESTRAINT CONTROL MODULE (RCM) C310a FOR DAMAGE	
• Key in OFF position. • Connect: ABS/TC Module C135. • Connect: In-line C213. • Deactivate the air bag system; refer to Section 501-20B . • Disconnect: RCM C310a.	**Yes** GO to P7 . **No** REPAIR the RCM C310a.

• Inspect the RCM C310a for damage. • **Is the RCM C310a OK?**	CARRY OUT the DATA LINK DIAGNOSTICS test.
P7 CHECK CIRCUIT 70 (LB/WH) BETWEEN THE DLC C251 AND THE RCM C310a FOR AN OPEN	
• Measure the resistance between the RCM C310a pin 11, circuit 70 (LB/WH), harness side and the DLC C251 pin 7, circuit 70 (LB/WH), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** GO to P9 . **No** GO to P8 .
P8 CHECK THE RESISTANCE BETWEEN IN-LINE C238M AND THE DLC C251	
• Measure the resistance between in-line C238M pin 48, circuit 70 (LB/WH), harness side and the DLC C251 pin 7, circuit 70 (LB/WH), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** REPAIR the circuit between in-line C238F and the RCM C310a. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** REPAIR the circuit between in-line C238M and the DLC C251. CARRY OUT the DATA LINK DIAGNOSTICS test.
P9 CHECK THE ISO 9141 NETWORK WITH THE RCM C310a DISCONNECTED	
• Key in ON position. • Carry out the DATA LINK DIAGNOSTICS TEST. • **Did the diagnostic tool indicate SYSTEM PASSED?**	**Yes** GO to P11 . **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
P10 CHECK FOR CORRECT ABS/TC MODULE OPERATION	
• Disconnect all the ABS/TC module connectors. • Check for: ◦ corrosion ◦ pushed-out pins • Connect all the ABS/TC module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ABS/TC module. REFER to Section 206-09A . TEST the system for normal operation. CARRY OUT the DATA LINK DIAGNOSTICS test.

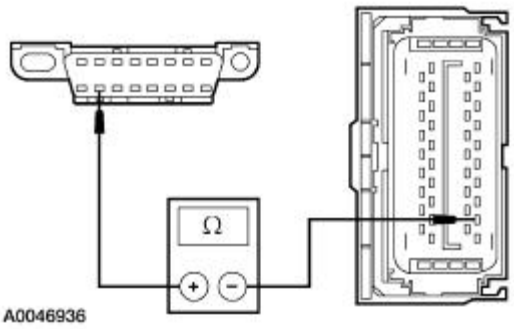
	No The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
P11 CHECK FOR CORRECT RCM OPERATION ● Disconnect all the RCM connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all the RCM connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new RCM; REFER to Section 501-20B . TEST the system for normal operation. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST Q: NO STANDARD CORPORATE PROTOCOL (SCP) NETWORK COMMUNICATION

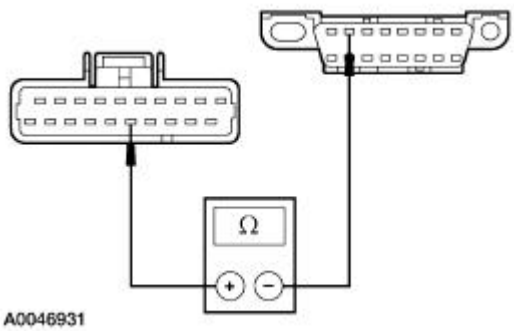
Test Step	Result / Action to Take
Q1 CHECK THE DLC C251 FOR DAMAGE ● Key in OFF position. ● Inspect the DLC C251 for damage. ● **Is the DLC C251 OK?**	**Yes** GO to Q2 . **No** REPAIR the DLC C251. CARRY OUT the DATA LINK DIAGNOSTICS test.
Q2 CHECK THE POWERTRAIN CONTROL MODULE (PCM) C175a ● Key in OFF position. ● Disconnect: PCM C175a. ● Inspect the PCM C175a for damage. ● **Is the PCM C175a OK?**	**Yes** GO to Q3 . **No** REPAIR the PCM C175a. CARRY OUT the DATA LINK DIAGNOSTICS test.
Q3 CHECK CIRCUITS 914 (TN/OG) AND 915 (PK/LB) BETWEEN THE PCM C175a AND THE DLC C251 FOR AN OPEN ● Measure the resistance between the PCM C175a pin 32, circuit 914 (TN/OG), harness side and the DLC C251 pin 2, circuit 914 (TN/OG), harness side.	**Yes** GO to Q6 . **No** GO to Q4 .

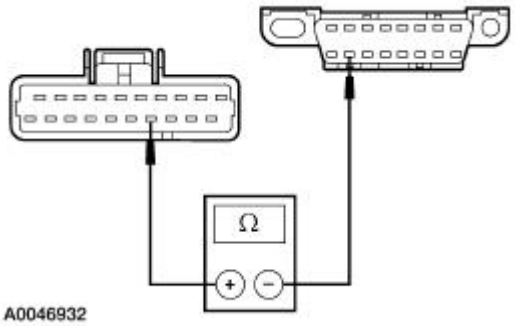
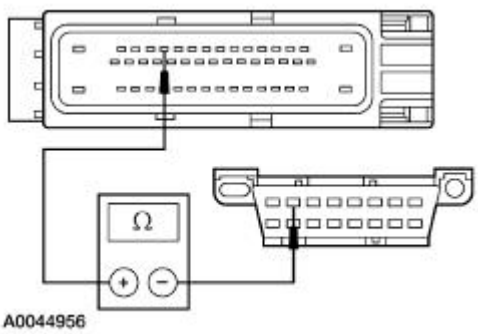


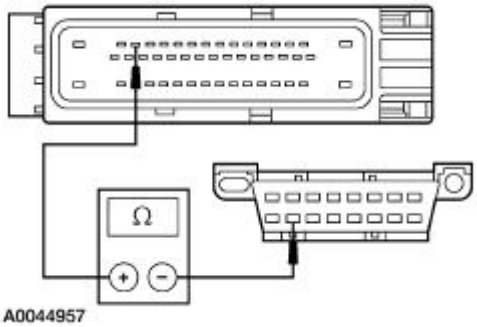
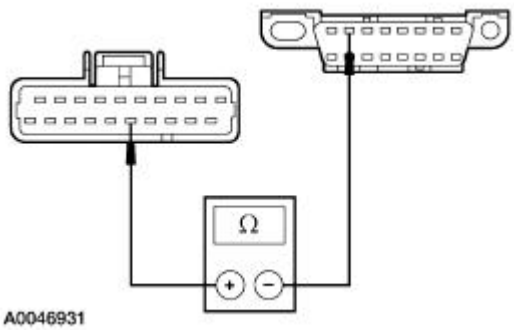
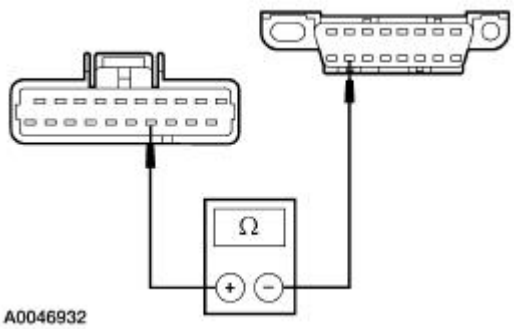
- Measure the resistance between the PCM C175a pin 44, circuit 915 (PK/LB), harness side and the DLC C251 pin 10, circuit 915 (PK/LB), harness side.

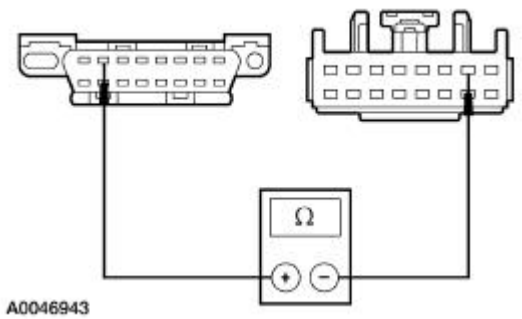
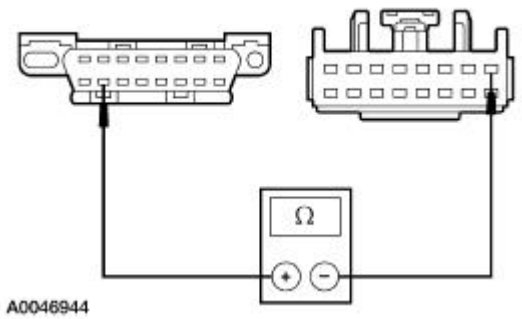


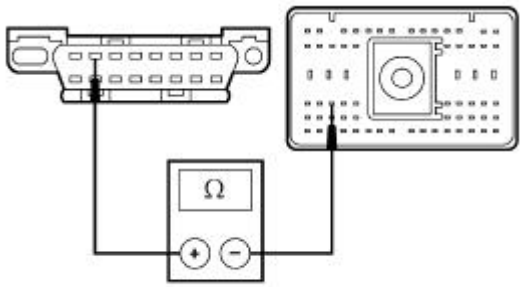
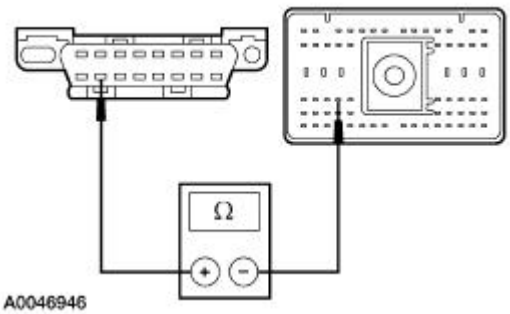
- **Are the resistances less than 5 ohms?**

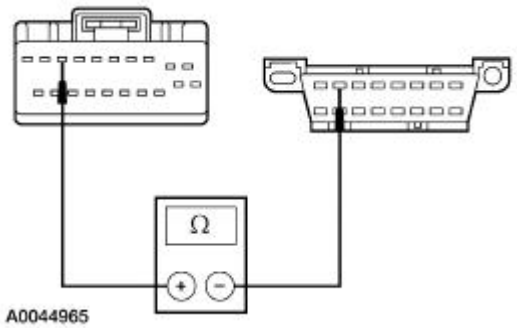
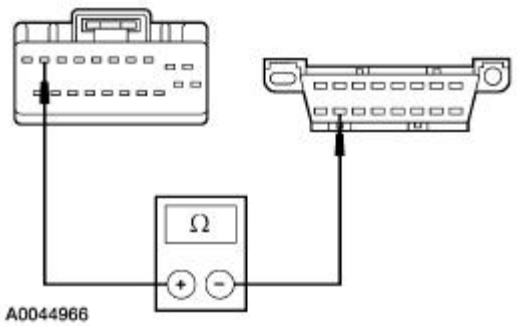
Q4 CHECK IN-LINE C210 FOR DAMAGE - Disconnect: In-Line C210. - Inspect in-lines C210M and C210F for damage. - **Are in-lines C210M and C210F OK?**	**Yes** GO to Q5 . **No** REPAIR the in-lines C210M and C210F. CARRY OUT the DATA LINK DIAGNOSTICS test.
Q5 CHECK CIRCUITS 914 (TN/OG) AND 915 (PK/LB) BETWEEN IN-LINE C210M AND THE DLC C251 FOR AN OPEN - Measure the resistance between in-line C210F pin 15, circuit 914 (TN/OG), harness side and the DLC C251 pin 2, circuit 914 (TN/OG), harness side.  - Measure the resistance between in-line C210F pin 14, circuit 915 (PK/LB), harness side and the DLC C251 pin 10, circuit 915 (PK/LB), harness side.	**Yes** REPAIR the circuit(s) in question between in-line C210M and the PCM C175a. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** REPAIR the circuit(s) in question between in-line C210F and the DLC C251. CARRY OUT the DATA LINK DIAGNOSTICS test.

 A0046932 ● **Are the resistances less than 5 ohms?**	
Q6 CHECK THE SCP NETWORK WITH THE PCM C175a DISCONNECTED	
● Key in ON position. ● Carry out the DATA LINK DIAGNOSTICS TEST. ● **Did the diagnostic tool indicate SYSTEM PASSED?**	**Yes** GO to Q20 . **No** GO to Q7 .
Q7 CHECK THE 4-WHEEL ANTI-LOCK BRAKE/TRACTION CONTROL (ABS/TC) MODULE OR STABILITY ASSIST MODULE (IF EQUIPPED) C135	
● Key in OFF position. ● Connect: PCM C175. ● Connect: In-Line C210. ● Disconnect: ABS/TC Module C135. ● Inspect the ABS/TC module C135 for damage. ● **Is the ABS/TC module C135 OK?**	**Yes** GO to Q8 . **No** REPAIR the ABS/TC module C135. CARRY OUT the DATA LINK DIAGNOSTICS test.
Q8 CHECK CIRCUITS 914 (TN/OG) AND 915 (PK/LB) BETWEEN THE ABS/TC MODULE C135 AND THE DLC C251 FOR AN OPEN	
● Measure the resistance between the ABS/TC module C135 pin 12, circuit 914 (TN/OG), harness side and the DLC C251 pin 2, circuit 914 (TN/OG), harness side.  A0044956 ● Measure the resistance between the ABS/TC module C135 pin 14, circuit 915 (PK/LB), harness side and the DLC C251 pin 10, circuit 915 (PK/LB), harness side.	**Yes** GO to Q11 . **No** GO to Q9 .

 A0044957 ● **Are the resistances less than 5 ohms?**	
Q9 CHECK IN-LINE C210 FOR DAMAGE ● Disconnect: In-Line C210. ● Inspect in-lines C210M and C210F for damage. ● **Are in-lines C210M and C210F OK?**	**Yes** GO to Q10 . **No** REPAIR the in-lines C210M and C210F. CARRY OUT the DATA LINK DIAGNOSTICS test.
Q10 CHECK CIRCUITS 914 (TN/OG) AND 915 (PK/LB) BETWEEN IN-LINE C210F AND THE DLC C251 FOR AN OPEN ● Measure the resistance between in-line C210F pin 15, circuit 914 (TN/OG), harness side and the DLC C251 pin 2, circuit 914 (TN/OG), harness side.  A0046931 ● Measure the resistance between in-line C210F pin 14 circuit 915 (PK/LB), harness side and the DLC C251 pin 10, circuit 915 (PK/LB), harness side.  A0046932 ● **Are the resistances less than 5 ohms?**	**Yes** REPAIR the circuit(s) in question between in-line C210M and the ABS/TC module C135. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** REPAIR the circuit(s) in question between in-line C210F and the DLC C251. CARRY OUT the DATA LINK DIAGNOSTICS test.
Q11 CHECK THE SCP NETWORK WITH THE ABS/TC MODULE C135 DISCONNECTED ● Key in ON position. ● Carry out the DATA LINK DIAGNOSTICS TEST.	**Yes** GO to Q21 .

• **Did the diagnostic tool indicate SYSTEM PASSED?**	**No** GO to Q12 .
Q12 CHECK THE TIRE PRESSURE MONITOR MODULE C3183	
• Key in OFF position. • Connect: ABS/TC Module C135. • Connect: In-Line C210. • Disconnect: Tire Pressure Monitor Module C3183. • Inspect the tire pressure monitor module C3183 for damage. • **Is the tire pressure monitor module C3183 OK?**	**Yes** GO to Q13 . **No** REPAIR the tire pressure monitor module C3183. CARRY OUT the DATA LINK DIAGNOSTICS test.
Q13 CHECK CIRCUITS 914 (TN/OG) AND 915 (PK/LB) BETWEEN THE TIRE PRESSURE MONITOR MODULE C3183 AND THE DLC C251 FOR AN OPEN	
• Measure the resistance between the tire pressure monitor module C3183 pin 2, circuit 914 (TN/OG), harness side and the DLC C251 pin 2, circuit 914 (TN/OG), harness side.  A0046943 • Measure the resistance between the tire pressure monitor module C3183 pin 1, circuit 915 (PK/LB), harness side and the DLC C251 pin 10, circuit 915 (PK/LB), harness side.  A0046944 • **Are the resistances less than 5 ohms?**	**Yes** GO to Q16 . **No** GO to Q14 .
Q14 CHECK IN-LINE C238 FOR DAMAGE	
• Disconnect: In-Line C238. • Inspect in-lines C238M and C238F for damage. • **Are in-lines C238M and C238F OK?**	**Yes** GO to Q15 . **No** REPAIR the in-lines C238M and C238F. CARRY OUT the DATA LINK DIAGNOSTICS test.
Q15 CHECK CIRCUITS 914 (TN/OG) AND 915 (PK/LB) BETWEEN IN-LINE C238M AND THE DLC C251 FOR AN OPEN	

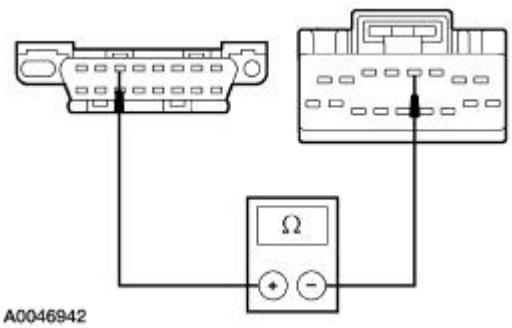
• Measure the resistance between in-line C238M pin 34, circuit 914 (TN/OG), harness side and the DLC C251 pin 2, circuit 914 (TN/OG), harness side.  A0049339 • Measure the resistance between in-line C238M pin 33, circuit 915 (PK/LB), harness side and the DLC C251 pin 10, circuit 915 (PK/LB), harness side.  A0046946 • **Are the resistances less than 5 ohms?**	**Yes** REPAIR the circuit(s) in question between in-line C238F and the tire pressure monitor module C3183 CARRY OUT the DATA LINK DIAGNOSTICS test. **No** REPAIR the circuit(s) in question between in-line C238M and the DLC C251. CARRY OUT the DATA LINK DIAGNOSTICS test.
Q16 CHECK THE SCP NETWORK WITH THE TIRE PRESSURE MONITOR MODULE C3183 DISCONNECTED	
• Key in ON position. • Carry out the DATA LINK DIAGNOSTICS TEST. • **Did the diagnostic tool indicate SYSTEM PASSED?**	**Yes** GO to Q22 . **No** GO to Q17 .
Q17 CHECK THE INSTRUMENT CLUSTER C220a FOR DAMAGE	
• Key in OFF position. • Connect: Tire Pressure Monitor Module C3183. • Connect: In-Line C238. • Disconnect: Instrument Cluster C220a. • Inspect the instrument cluster C220a for damage. • **Is the instrument cluster C220a OK?**	**Yes** GO to Q18 . **No** REPAIR the instrument cluster C220a. TEST the system for normal operation.
Q18 CHECK CIRCUITS 914 (TN/OG) AND 915 (PK/LB) FOR AN OPEN	
• Measure the resistance between the DLC C251 pin 2, circuit 914 (TN/OG), harness side and the instrument cluster C220a pin 8, circuit 914 (TN/OG), harness side.	**Yes** GO to Q19 . **No** REPAIR the circuit(s) in question. CARRY OUT the DATA LINK DIAGNOSTICS test.

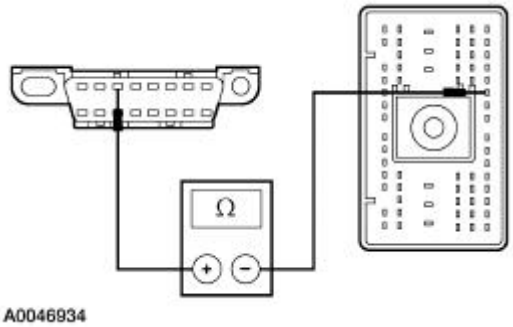
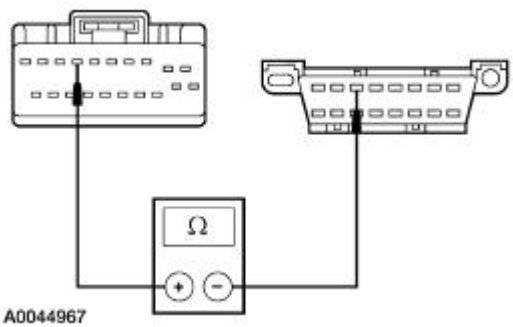
 A0044965 ● Measure the resistance between the DLC C251 pin 10, circuit 915 (PK/LB), harness side and the instrument cluster C220a pin 9, circuit 915 (PK/LB), harness side.  A0044966 ● **Are the resistances less than 5 ohms?**	
Q19 CHECK SCP NETWORK WITH THE INSTRUMENT CLUSTER C220b DISCONNECTED ● Key in ON position. ● Carry out the DATA LINK DIAGNOSTICS TEST. ● **Did the diagnostic tool indicate SYSTEM PASSED?**	**Yes** GO to Q23 . **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
Q20 CHECK FOR CORRECT PCM OPERATION ● Disconnect all the PCM connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all the PCM connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
Q21 CHECK FOR CORRECT ABS/TC MODULE OPERATION ● Disconnect all the ABS/TC module connectors. ● Check for:	**Yes** INSTALL a new ABS/TC

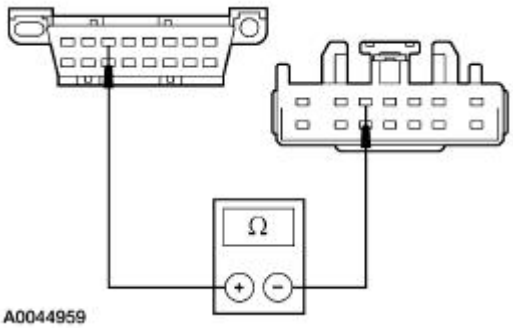
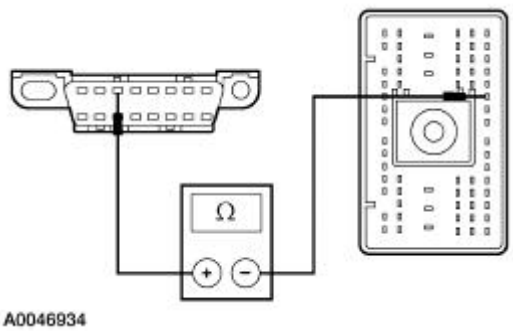
● corrosion ● pushed-out pins ● Connect all the ABS/TC module connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	module. REFER to Section 206-09A . TEST the system for normal operation. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
Q22 CHECK FOR CORRECT TIRE PRESSURE MONITOR MODULE OPERATION	
● Disconnect all the tire pressure monitor module connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all the tire pressure monitor module connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new tire pressure monitor module. REFER to Section 413-08 . TEST the system for normal operation. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
Q23 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
● Disconnect all the instrument cluster connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all the instrument cluster connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Section 413-00 . TEST the system for normal operation. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

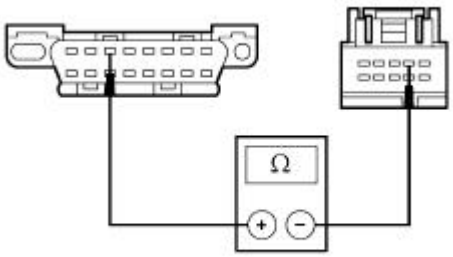
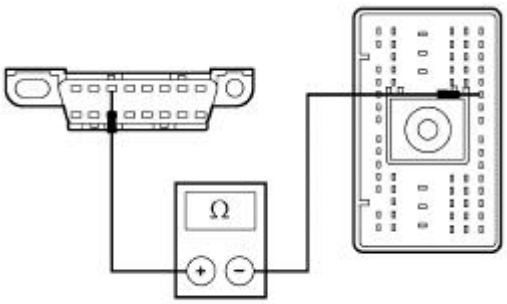
PINPOINT TEST R: NO UART BASED PROTOCOL (UBP) NETWORK COMMUNICATION

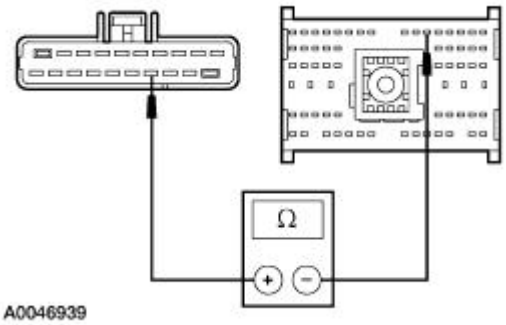
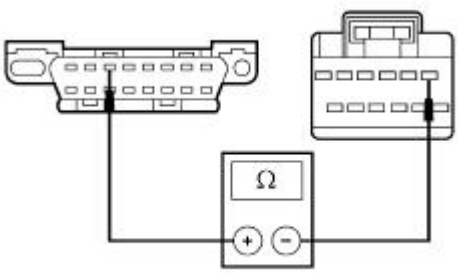
Test Step	Result / Action to Take
R1 CHECK THE DLC C251 FOR DAMAGE	
● Key in OFF position.	**Yes**

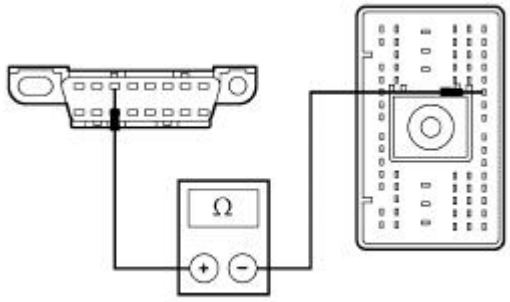
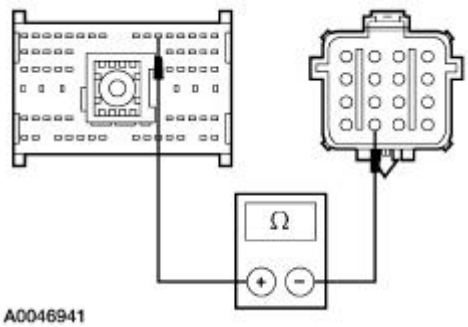
• Inspect the DLC C251 for damage. • **Is the DLC C251 OK?**	GO to R2 . **No** REPAIR the DLC C251. CARRY OUT the DATA LINK DIAGNOSTICS test.
R2 CHECK THE FOUR-WHEEL DRIVE (4WD) CONTROL MODULE C3184b FOR DAMAGE	
• Key in OFF position. • Disconnect: 4WD Control Module C3184b. • Inspect the 4WD control module C3184b for damage. • **Is the 4WD control module C3184b OK?**	**Yes** GO to R3 . **No** REPAIR the 4WD control module C3184b. CARRY OUT the DATA LINK DIAGNOSTICS test.
R3 CHECK CIRCUIT 1906 (VT) BETWEEN THE DLC C251 AND THE 4WD CONTROL MODULE C3184b FOR AN OPEN	
• Measure the resistance between the 4WD control module C3184b pin 4, circuit 1906 (VT), harness side and the DLC C251 pin 3, circuit 1906 (VT), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** GO to R6 . **No** GO to R4 .
R4 CHECK IN-LINE C238 FOR DAMAGE	
• Disconnect: In-Line C238. • Inspect in-lines C238M and C238F for damage. • **Are in-lines C238M and C238F OK?**	**Yes** GO to R5 . **No** REPAIR in-lines C238M and C238F. CARRY OUT the DATA LINK DIAGNOSTICS test.
R5 CHECK CIRCUIT 1906 (VT) BETWEEN IN-LINE C238M AND THE DLC C251 FOR AN OPEN	
• Measure the resistance between the DLC C251 pin 3, circuit 1906 (VT), harness side and in-line C238M pin 6, circuit 1906 (VT), harness side.	**Yes** REPAIR the circuit between in-line C238F and the 4WD control module C3184b. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** REPAIR the circuit between in-line C238M and the DLC C251. CARRY OUT the DATA LINK DIAGNOSTICS test.

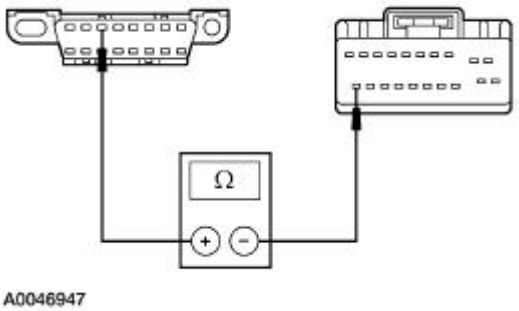
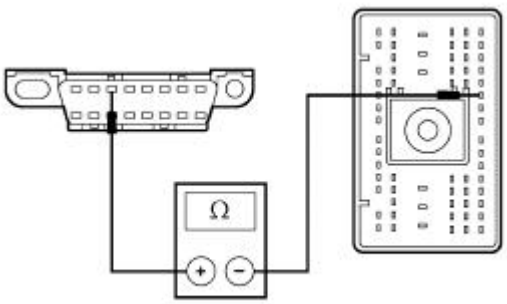
 A0046934 ● **Is the resistance less than 5 ohms?**	
R6 CHECK THE UBP NETWORK WITH THE 4WD CONTROL MODULE C3184b DISCONNECTED ● Key in ON position. ● Carry out the DATA LINK DIAGNOSTICS TEST. ● **Did the diagnostic tool indicate SYSTEM PASSED?**	**Yes** GO to R56 . **No** GO to R7 .
R7 CHECK THE INSTRUMENT CLUSTER C220a FOR DAMAGE ● Key in OFF position. ● Connect: 4WD Control Module C3184b. ● Connect: In-Line C238. ● Disconnect: Instrument Cluster C220a. ● Inspect the instrument cluster C220a for damage. ● **Is the instrument cluster C220a OK?**	**Yes** GO to R8 . **No** REPAIR the instrument cluster C220a. CARRY OUT the DATA LINK DIAGNOSTICS test.
R8 CHECK CIRCUIT 1906 (VT) FOR AN OPEN ● Measure the resistance between the DLC C251 pin 3, circuit 1906 (VT), harness side and the instrument cluster C220a pin 7, circuit 1906 (VT), harness side.  A0044967 ● **Is the resistance less than 5 ohms?**	**Yes** GO to R9 . **No** REPAIR the circuit in question. CARRY OUT the DATA LINK DIAGNOSTICS test.
R9 CHECK THE UBP NETWORK WITH THE INSTRUMENT CLUSTER C220a DISCONNECTED ● Key in ON position. ● Carry out the DATA LINK DIAGNOSTICS TEST. ● **Did the diagnostic tool indicate SYSTEM PASSED?**	**Yes** GO to R57 . **No** GO to R10 .
R10 CHECK THE VEHICLE SECURITY MODULE C2113c FOR DAMAGE ● Key in OFF position. ● Connect: Instrument Cluster C220a. ● Disconnect the battery before removal of any vehicle	**Yes** GO to R11 .

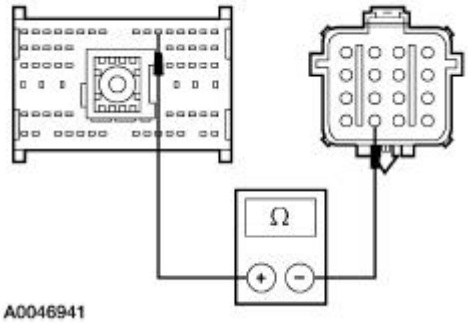
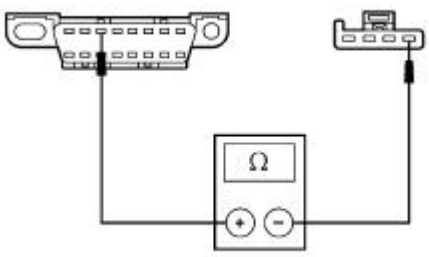
security module connectors. Refer to Section 414-01 . ● Disconnect: Vehicle Security Module C2113c. ● Inspect the vehicle security module C2113c for damage. ● **Is the vehicle security module C2113c OK?**	**No** REPAIR the vehicle security module C2113c. CARRY OUT the DATA LINK DIAGNOSTICS test.
R11 CHECK CIRCUIT 1906 (VT) BETWEEN THE DLC C251 AND THE VEHICLE SECURITY MODULE C2113c FOR AN OPEN	
● Measure the resistance between the vehicle security module C2113c pin 5, circuit 1906 (VT), harness side and the DLC C251 pin 3, circuit 1906 (VT), harness side.  ● **Is the resistance less than 5 ohms?**	**Yes** GO to R13 . **No** GO to R12 .
R12 CHECK CIRCUIT 1906 (VT) BETWEEN IN-LINE C238M AND THE DLC C251 FOR AN OPEN	
● Measure the resistance between in-line C238M pin 6, circuit 1906 (VT), harness side and the DLC C251 pin 3, circuit 1906 (VT), harness side.  ● **Is the resistance less than 5 ohms?**	**Yes** REPAIR the circuit between the vehicle security module and in-line C238F. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** REPAIR the circuit between the DLC C251 and in-line C238M. CARRY OUT the DATA LINK DIAGNOSTICS test.
R13 CHECK THE UBP NETWORK WITH THE VEHICLE SECURITY MODULE C2113c DISCONNECTED	
● Key in ON position. ● Carry out the DATA LINK DIAGNOSTICS TEST. ● **Did the diagnostic tool indicate SYSTEM PASSED?**	**Yes** GO to R58 . **No** GO to R14 .
R14 CHECK THE DRIVER SEAT MODULE (DSM) C341c FOR DAMAGE	
● Key in OFF position. ● Connect: Vehicle Security Module C2113c. ● Connect: In-Line C238. ● Disconnect: DSM C341c. ● Inspect the DSM C341c for damage. ● **Is the DSM C341c OK?**	**Yes** GO to R15 . **No** REPAIR the DSM C341c. CARRY OUT the DATA LINK DIAGNOSTICS test.

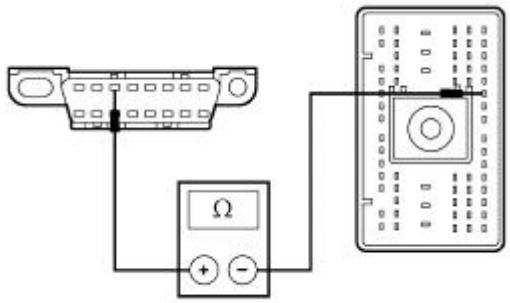
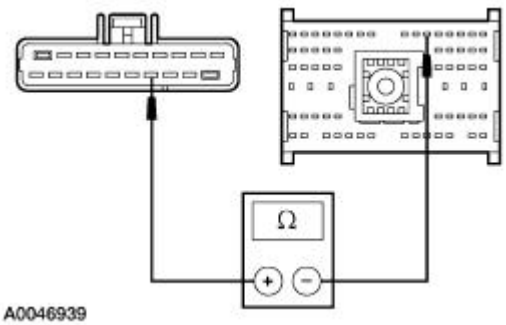
R15 CHECK CIRCUIT 1906 (VT) BETWEEN THE DLC C251 AND THE DSM C341c FOR AN OPEN	
• Measure the resistance between the DSM C341c pin 2, circuit 1906 (VT), harness side and the DLC C251 pin 3, circuit 1906 (VT), harness side.  A0046938 • **Is the resistance less than 5 ohms?**	**Yes** GO to R20 . **No** GO to R16 .
R16 CHECK IN-LINE C238 FOR DAMAGE	
• Disconnect: In-Line C238. • Inspect in-lines C238M and C238F for damage. • **Are in-lines C238M and C238F OK?**	**Yes** GO to R17 . **No** REPAIR in-lines C238M and C238F. CARRY OUT the DATA LINK DIAGNOSTICS test.
R17 CHECK CIRCUIT 1906 (VT) BETWEEN IN-LINE C238M AND THE DLC C251 FOR AN OPEN	
• Measure the resistance between the DLC C251 pin 3, circuit 1906 (VT), harness side and in-line C238M pin 6, circuit 1906 (VT), harness side.  A0046934 • **Is the resistance less than 5 ohms?**	**Yes** GO to R18 . **No** REPAIR the circuit between in-line C238M and the DLC C251. CARRY OUT the DATA LINK DIAGNOSTICS test.
R18 CHECK IN-LINE C312 FOR DAMAGE	
• Disconnect: In-Line C312. • Inspect in-lines C312M and C312F for damage. • **Are in-lines C312M and C312F OK?**	**Yes** GO to R19 . **No** REPAIR in-lines C312M and C312F. CARRY OUT the DATA LINK DIAGNOSTICS test.
R19 CHECK CIRCUIT 1906 (VT) BETWEEN IN-LINE C238F AND IN-LINE C312F FOR AN OPEN	
• Measure the resistance between in-line C238F pin 6, circuit 1906 (VT), harness side and in-line C312F pin 14, circuit 1906 (VT), harness side.	**Yes** REPAIR the circuit between in-line C312M and the DSM C341c. CARRY OUT the DATA LINK DIAGNOSTICS test.

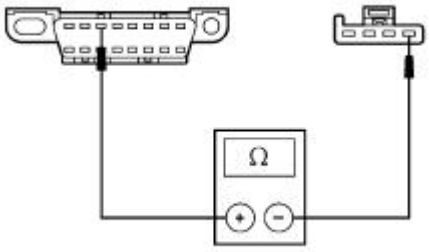
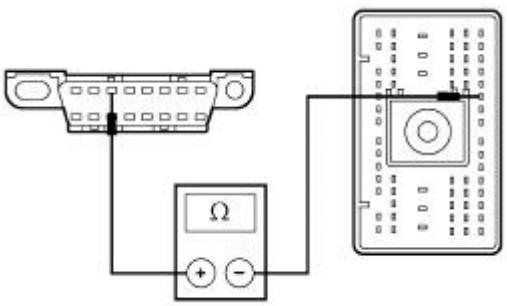
 A0046939 ● **Is the resistance less than 5 ohms?**	**No** REPAIR the circuit between in-lines C238F and C312F. CARRY OUT the DATA LINK DIAGNOSTICS test.
R20 CHECK THE UBP NETWORK WITH THE DSM C341c DISCONNECTED ● Key in ON position. ● Carry out the DATA LINK DIAGNOSTICS TEST. ● **Did the diagnostic tool indicate SYSTEM PASSED?**	**Yes** GO to R59 . **No** GO to R21 .
R21 CHECK THE PARKING AID MODULE C4014b FOR DAMAGE ● Key in OFF position. ● Connect: DSM C341c. ● Connect: In-Line C238. ● Connect: In-Line C312. ● Disconnect: Parking Aid Module C4014b. ● Inspect the parking aid module C4014b for damage. ● **Is the parking aid module C4014b OK?**	**Yes** GO to R22 . **No** REPAIR the parking aid module C4014b. CARRY OUT the DATA LINK DIAGNOSTICS test.
R22 CHECK CIRCUIT 1906 (VT) BETWEEN THE DLC C251 AND THE PARKING AID MODULE C4014b FOR AN OPEN ● Measure the resistance between the parking aid module C4014b pin 1, circuit 1906 (VT), harness side and the DLC C251 pin 3, circuit 1906 (VT), harness side.  A0046940 ● **Is the resistance less than 5 ohms?**	**Yes** GO to R27 . **No** GO to R23 .
R23 CHECK IN-LINE C238 FOR DAMAGE ● Disconnect: In-Line C238. ● Inspect in-lines C238M and C238F for damage. ● **Are in-lines C238M and C238F OK?**	**Yes** GO to R24 . **No** REPAIR in-lines C238M and C238F. CARRY OUT the DATA LINK DIAGNOSTICS test.
R24 CHECK CIRCUIT 1906 (VT) BETWEEN IN-LINE C238M AND THE DLC C251 FOR AN OPEN	

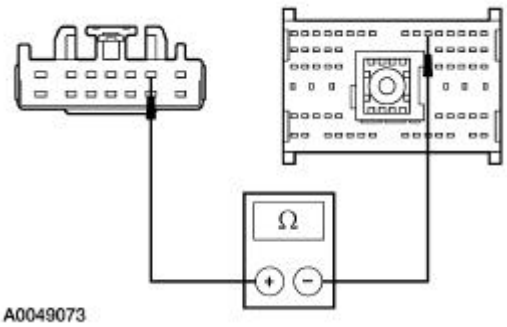
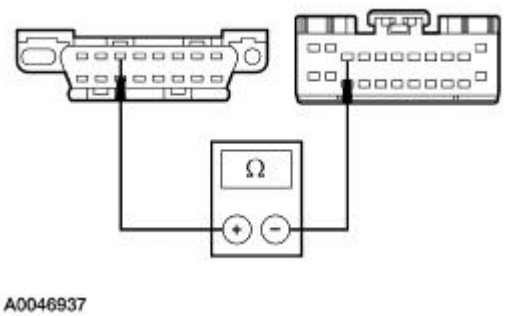
• Measure the resistance between the DLC C251 pin 3, circuit 1906 (VT), harness side and in-line C238M pin 6, circuit 1906 (VT), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** GO to R25 . **No** REPAIR the circuit between in-line C238M and the DLC C251. CARRY OUT the DATA LINK DIAGNOSTICS test.
R25 CHECK IN-LINE C465 FOR DAMAGE	
• Disconnect: In-Line C465. • Inspect in-lines C465M and C465F for damage. • **Are in-lines C465M and C465F OK?**	**Yes** GO to R26 . **No** REPAIR in-lines C465M and C465F. CARRY OUT the DATA LINK DIAGNOSTICS test.
R26 CHECK CIRCUIT 1906 (VT) BETWEEN IN-LINE C238F AND IN-LINE C465F FOR AN OPEN	
• Measure the resistance between in-line C238F pin 6, circuit 1906 (VT), harness side and in-line C465F pin 15, circuit 1906 (VT), harness side.  • **Is the resistance less than 5 ohms?**	**Yes** REPAIR the circuit between in-line C465M and the parking aid module C4014b. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** REPAIR the circuit between in-line C238F and in-line C465F. CARRY OUT the DATA LINK DIAGNOSTICS test.
R27 CHECK THE UBP NETWORK WITH THE PARKING AID MODULE C4014b DISCONNECTED	
• Key in ON position. • Carry out the DATA LINK DIAGNOSTICS TEST. • **Did the diagnostic tool indicate SYSTEM PASSED?**	**Yes** GO to R60 . **No** GO to R28 .
R28 CHECK THE POWER LIFTGATE MODULE C4174d FOR DAMAGE	
• Key in OFF position. • Connect: Parking Aid Module C4014b. • Connect: In-Line C238. • Connect: In-Line C465. • Disconnect: Power Liftgate Module C4174d. • Inspect the power liftgate module C4174d for damage. • **Is the power liftgate module C4174d OK?**	**Yes** GO to R29 . **No** REPAIR the power liftgate module C4174d. CARRY OUT the DATA LINK DIAGNOSTICS test.

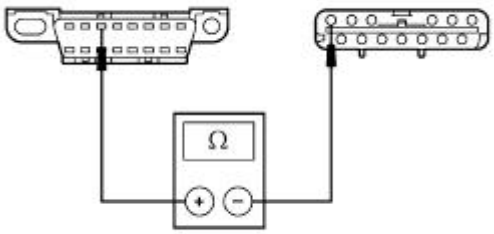
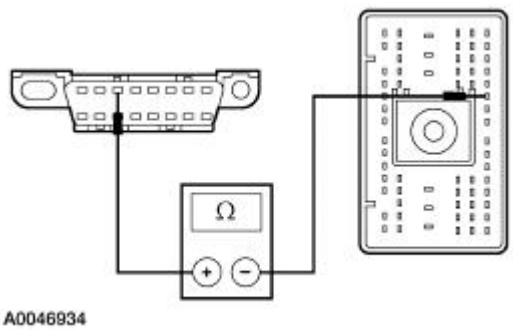
R29 CHECK CIRCUIT 1906 (VT) BETWEEN THE DLC C251 AND THE POWER LIFTGATE MODULE C4174d FOR AN OPEN	
• Measure the resistance between the power liftgate module C4174d pin 20, circuit 1906 (VT), harness side and the DLC C251 pin 3, circuit 1906 (VT), harness side.  A0046947 • **Is the resistance less than 5 ohms?**	**Yes** GO to R34 . **No** GO to R30 .
R30 CHECK IN-LINE C238 FOR DAMAGE	
• Disconnect: In-Line C238. • Inspect in-lines C238M and C238F for damage. • **Are in-lines C238M and C238F OK?**	**Yes** GO to R31 . **No** REPAIR in-lines C238M and C238F. CARRY OUT the DATA LINK DIAGNOSTICS test.
R31 CHECK CIRCUIT 1906 (VT) BETWEEN IN-LINE C238M AND THE DLC C251 FOR AN OPEN	
• Measure the resistance between the DLC C251 pin 3, circuit 1906 (VT), harness side and in-line C238M pin 6, circuit 1906 (VT), harness side.  A0046934 • **Is the resistance less than 5 ohms?**	**Yes** GO to R32 . **No** REPAIR the circuit between in-line C238M and the DLC C251. CARRY OUT the DATA LINK DIAGNOSTICS test.
R32 CHECK IN-LINE C465 FOR DAMAGE	
• Disconnect: In-Line C465. • Inspect in-lines C465M and C465F for damage. • **Are in-lines C465M and C465F OK?**	**Yes** GO to R33 . **No** REPAIR in-lines C465M and C465F. CARRY OUT the DATA LINK DIAGNOSTICS test.
R33 CHECK CIRCUIT 1906 (VT) BETWEEN IN-LINE C238F AND IN-LINE C465F FOR AN OPEN	
• Measure the resistance between in-line C238F pin 6, circuit 1906 (VT), harness side and in-line C465F pin 15, circuit 1906 (VT), harness side.	**Yes** REPAIR the circuit between in-line C465M and the power

 A0046941 ● **Is the resistance less than 5 ohms?**	liftgate module C4174d. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** REPAIR the circuit between in-line C238F and in-line C465F. CARRY OUT the DATA LINK DIAGNOSTICS test.
R34 CHECK THE UBP NETWORK WITH THE POWER LIFTGATE MODULE C4174d DISCONNECTED	
● Key in ON position. ● Carry out the DATA LINK DIAGNOSTICS TEST. ● **Did the diagnostic tool indicate SYSTEM PASSED?**	**Yes** GO to R61 . **No** GO to R35 .
R35 CHECK THE CLIMATE CONTROLLED SEAT MODULE C3031b FOR DAMAGE	
● Key in OFF position. ● Connect: Power Liftgate Module C4174d. ● Connect: In-Line C238. ● Connect: In-Line C465. ● Disconnect: Driver Climate Controlled Seat Module C3031b. ● For passenger climate controlled seat module, GO to R41. ● Inspect the climate controlled seat module C3031b for damage. ● **Is the climate controlled seat module C3031b OK?**	**Yes** GO to R36 . **No** REPAIR the climate controlled seat module C3031b. CARRY OUT the DATA LINK DIAGNOSTICS test.
R36 CHECK CIRCUIT 1906 (VT) BETWEEN THE DLC C251 AND THE CLIMATE CONTROLLED SEAT MODULE C3031b FOR AN OPEN	
● Measure the resistance between the climate controlled seat module C3031b pin 1, circuit 1906 (VT), harness side and the DLC C251 pin 3, circuit 1906 (VT), harness side.  A0046949 ● **Is the resistance less than 5 ohms?**	**Yes** GO to R47 . **No** GO to R37 .
R37 CHECK IN-LINE C238 FOR DAMAGE	
● Disconnect: In-Line C238. ● Inspect in-lines C238M and C238F for damage. ● **Are in-lines C238M and C238F OK?**	**Yes** GO to R38 . **No** REPAIR in-lines C238M and

	C238F. CARRY OUT the DATA LINK DIAGNOSTICS test.
R38 CHECK CIRCUIT 1906 (VT) BETWEEN IN-LINE C238M AND THE DLC C251 FOR AN OPEN	
• Measure the resistance between the DLC C251 pin 3, circuit 1906 (VT), harness side and in-line C238M pin 6, circuit 1906 (VT), harness side.  A0046934 • **Is the resistance less than 5 ohms?**	**Yes** GO to R39 . **No** REPAIR the circuit between in-line C238M and the DLC C251. CARRY OUT the DATA LINK DIAGNOSTICS test.
R39 CHECK IN-LINE C312 FOR DAMAGE	
• Disconnect: In-Line C312. • Inspect in-lines C312M and C312F for damage. • **Are in-lines C312M and C312F OK?**	**Yes** GO to R40 . **No** REPAIR in-lines C312M and C312F. CARRY OUT the DATA LINK DIAGNOSTICS test.
R40 CHECK CIRCUIT 1906 (VT) BETWEEN IN-LINE C238F AND IN-LINE C312F FOR AN OPEN	
• Measure the resistance between in-line C238F pin 6, circuit 1906 (VT), harness side and in-line C312F pin 14, circuit 1906 (VT), harness side.  A0046939 • **Is the resistance less than 5 ohms?**	**Yes** REPAIR the circuit between in-line C312M and the climate controlled seat module C3031b. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** REPAIR the circuit between in-lines C238F and C312F. CARRY OUT the DATA LINK DIAGNOSTICS test.
R41 CHECK THE CLIMATE CONTROLLED SEAT MODULE CONNECTOR FOR DAMAGE	
• Key in OFF position. • Disconnect: Climate Controlled Seat Module C3036b. • Inspect the connector for damage. • **Is the connector OK?**	**Yes** GO to R42 . **No** REPAIR the climate controlled seat module C3036b. CARRY OUT the DATA LINK DIAGNOSTICS test.
R42 CHECK CIRCUIT 1906 (VT) BETWEEN THE DLC C251 AND THE CLIMATE CONTROLLED SEAT MODULE C3036B FOR AN OPEN	

• Measure the resistance between the climate controlled seat module C3036b pin 1, circuit 1906 (VT), harness side and the DLC C251 pin 3, circuit 1906 (VT), harness side.  A0046949 • **Is the resistance less than 5 ohms?**	**Yes** GO to R47 . **No** GO to R43 .
R43 CHECK IN-LINE C238 FOR DAMAGE • Disconnect: In-Line C238. • Inspect in-lines C238M and C238F for damage. • **Are in-lines C238M and C238F OK?**	**Yes** GO to R44 . **No** REPAIR in-lines C238M and C238F. CARRY OUT the DATA LINK DIAGNOSTICS test.
R44 CHECK CIRCUIT 1906 (VT) BETWEEN IN-LINE C238M AND THE DLC C251 FOR AN OPEN • Measure the resistance between the DLC C251 pin 3, circuit 1906 (VT), harness side and in-line C238M pin 6, circuit 1906 (VT), harness side.  A0046934 • **Is the resistance less than 5 ohms?**	**Yes** GO to R45 . **No** REPAIR the circuit between in-line C238M and the DLC C251. CARRY OUT the DATA LINK DIAGNOSTICS test.
R45 CHECK IN-LINE C313 FOR DAMAGE • Disconnect: In-Line C313. • Inspect in-lines C313M and C313F for damage. • **Are in-lines C313M and C313F OK?**	**Yes** GO to R46 . **No** REPAIR in-lines C313M and C313F. CARRY OUT the DATA LINK DIAGNOSTICS test.
R46 CHECK CIRCUIT 1906 (VT) BETWEEN IN-LINE C238F AND IN-LINE C313F FOR AN OPEN • Measure the resistance between in-line C238F pin 6, circuit 1906 (VT), harness side and in-line C313F pin 2, circuit 1906 (VT), harness side.	**Yes** REPAIR the circuit between in-line C313M and the climate controlled seat module C3036b. CARRY OUT the DATA LINK DIAGNOSTICS test.

 ● **Is the resistance less than 5 ohms?**	**No** REPAIR the circuit between in-lines C238F and C313F. CARRY OUT the DATA LINK DIAGNOSTICS test.
R47 CHECK THE UBP NETWORK WITH THE CLIMATE CONTROLLED SEAT MODULE C3031b DISCONNECTED	
● Key in ON position. ● Carry out the DATA LINK DIAGNOSTICS TEST. ● **Did the diagnostic tool indicate SYSTEM PASSED?**	**Yes** GO to R64 . **No** GO to R48 .
R48 CHECK THE ELECTRONIC AUTOMATIC TEMPERATURE CONTROL (EATC) MODULE C228b FOR DAMAGE	
● Key in OFF position. ● Connect: Climate Controlled Seat Module C3031b. ● Connect: In-Line C238. ● Connect: In-Line C312. ● Disconnect: EATC Module C228b. ● Inspect the EATC module C228b for damage. ● **Is the DEATC module C228b OK?**	**Yes** GO to R49 . **No** REPAIR the EATC module C228b. TEST the system for normal operation.
R49 CHECK CIRCUIT 1906 (VT) FOR AN OPEN	
● Measure the resistance between the DLC C251 pin 3, circuit 1906 (VT), harness side and the EATC module C228b pin 3, circuit 1906 (VT), harness side.  ● **Are the resistances less than 5 ohms?**	**Yes** GO to R50 . **No** REPAIR the circuit(s) in question. CARRY OUT the DATA LINK DIAGNOSTICS test.
R50 CHECK THE UBP NETWORK WITH THE EATC MODULE C228b DISCONNECTED	
● Key in ON position. ● Carry out the DATA LINK DIAGNOSTICS TEST. ● **Did the diagnostic tool indicate SYSTEM PASSED?**	**Yes** GO to R62 . **No** GO to R51 .
R51 CHECK THE AIR SUSPENSION CONTROL MODULE C2131b FOR DAMAGE	
● Key in OFF position. ● Connect: EATC Module C228b.	**Yes** GO to R52 .

• Disconnect: Air Suspension Control Module C2131b. • Inspect the air suspension control module C2131b for damage. • **Is the air suspension control module C2131b OK?**	**No** REPAIR the air suspension control module C2131b. CARRY OUT the DATA LINK DIAGNOSTICS test.
R52 CHECK CIRCUIT 1906 (VT) BETWEEN THE DLC C251 AND THE AIR SUSPENSION CONTROL C2131b FOR AN OPEN	
• Measure the resistance between the air suspension control module C2131b pin 26, circuit 1906 (VT), harness side and the DLC C251 pin 3, circuit 1906 (VT), harness side.  A0046948 • **Is the resistance less than 5 ohms?**	**Yes** GO to R55 . **No** GO to R53 .
R53 CHECK IN-LINE C238 FOR DAMAGE	
• Disconnect: In-Line C238. • Inspect in-lines C238M and C238F for damage. • **Are in-lines C238M and C238F OK?**	**Yes** GO to R54 . **No** REPAIR in-lines C238M and C238F. CARRY OUT the DATA LINK DIAGNOSTICS test.
R54 CHECK CIRCUIT 1906 (VT) BETWEEN IN-LINE C238M AND THE DLC C251 FOR AN OPEN	
• Measure the resistance between the DLC C251 pin 3, circuit 1906 (VT), harness side and in-line C238M pin 6, circuit 1906 (VT), harness side.  A0046934 • **Is the resistance less than 5 ohms?**	**Yes** REPAIR the circuit between in-line C238F and the air suspension control module C2131b. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** REPAIR the circuit between in-line C238M and the DLC C251. CARRY OUT the DATA LINK DIAGNOSTICS test.
R55 CHECK THE UBP NETWORK WITH THE AIR SUSPENSION CONTROL C2131b DISCONNECTED	
• Key in ON position. • Carry out the DATA LINK DIAGNOSTICS TEST. • **Did the diagnostic tool indicate SYSTEM PASSED?**	**Yes** GO to R63 . **No** The system is operating

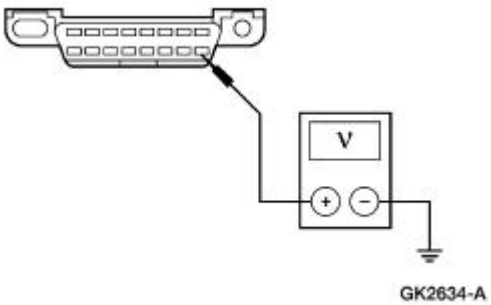
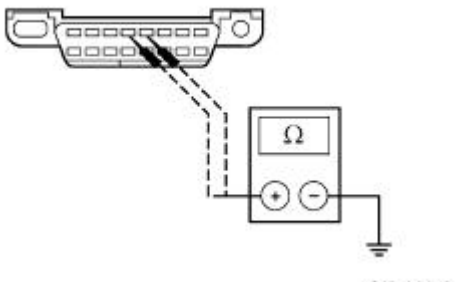
	correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
R56 CHECK FOR CORRECT 4WD CONTROL MODULE OPERATION • Disconnect all the 4WD control module connectors. • Check for: • corrosion • pushed-out pins • Connect all the 4WD control module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new 4WD control module. REFER to Section 308-07A . TEST the system for normal operation. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
R57 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION • Disconnect all the instrument cluster connectors. • Check for: • corrosion • pushed-out pins • Connect all the instrument cluster connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new instrument cluster. REFER to Section 413-00 . TEST the system for normal operation. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
R58 CHECK FOR CORRECT VEHICLE SECURITY MODULE OPERATION • Disconnect all the vehicle security module connectors. • Check for: • corrosion • pushed-out pins • Re-connect the battery. Refer to Section 414-01 . • Connect all the vehicle security module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new vehicle security module. REFER to Section 419-10 . TEST the system for normal operation. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. CARRY OUT the DATA LINK DIAGNOSTICS

	test.
R59 CHECK FOR CORRECT DSM OPERATION • Disconnect all the DSM connectors. • Check for: • corrosion • pushed-out pins • Connect all the DSM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new DSM. REFER to Section 501-10 . TEST the system for normal operation. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
R60 CHECK FOR CORRECT PARKING AID MODULE OPERATION • Disconnect all the power liftgate module connectors. • Check for: • corrosion • pushed-out pins • Connect all the power liftgate module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new power liftgate module. REFER to Section 501-03 . TEST the system for normal operation. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
R61 CHECK FOR CORRECT POWER LIFTGATE MODULE OPERATION • Disconnect all the power liftgate module connectors. • Check for: • corrosion • pushed-out pins • Connect all the power liftgate module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new power liftgate module. REFER to Section 501-03 . TEST the system for normal operation. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
R62 CHECK FOR CORRECT EATC OPERATION • Disconnect all the EATC connectors. • Check for: • corrosion • pushed-out pins • Connect all the EATC connectors and make sure they	**Yes** INSTALL a new EATC module. REFER to Section 412-00 . TEST the system for normal operation.

seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
R63 CHECK FOR CORRECT AIR SUSPENSION CONTROL MODULE OPERATION	
● Disconnect all the air suspension control module connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all the air suspension control module connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new air suspension control module. REFER to Section 204-05 . TEST the system for normal operation. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
R64 CHECK FOR CORRECT CLIMATE CONTROLLED SEAT MODULE OPERATION	
● Disconnect all the climate controlled seat module connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all the climate controlled seat module connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new climate controlled seat module. REFER to Section 501-10 . TEST the system for normal operation. CARRY OUT the DATA LINK DIAGNOSTICS test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST S: NO MODULE/NETWORK COMMUNICATION — NO POWER TO THE DIAGNOSTIC TOOL

Test Step	Result / Action to Take
S1 CHECK THE DIAGNOSTIC TOOL CONNECTOR	
● Inspect the diagnostic tool pins for damage. ● **Are the pins OK?**	**Yes** GO to S2 .

	No REPAIR the diagnostic tool connector. TEST the system for normal operation.
S2 CHECK THE DLC C251 FOR DAMAGE ● Key in OFF position. ● Inspect the DLC C251 pins for damage. ● **Are the pins OK?**	**Yes** GO to S3 . **No** REPAIR the DLC C251. TEST the system for normal operation.
S3 CHECK THE VOLTAGE TO THE DIAGNOSTIC TOOL CIRCUIT 40 (LB/WH) ● Measure the voltage between the DLC C251 pin 16, circuit 40 (LB/WH), harness side and ground.  GK2634-A ● **Is the voltage greater than 10 volts?**	**Yes** GO to S4 . **No** REPAIR the supply circuit. TEST the system for normal operation.
S4 CHECK THE DLC GROUND — CIRCUIT 57 (BK) AND CIRCUIT 570 (BK/WH) ● Measure the resistance between the DLC C251 pin 4, circuit 57 (BK), harness side and ground and between the DLC C251 pin 5, circuit 570 (BK/WH), harness side and ground.  GK4963-A ● **Is the resistance less than 5 ohms?**	**Yes** REPAIR the diagnostic tool. TEST the system for normal operation. **No** REPAIR the circuit(s) in question. TEST the system for normal operation.

Module Configuration

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool

Principles of Operation

Some modules must be programmed as part of the repair procedure. If this procedure is not followed the module will not function correctly and may set a number of DTCs, including B2477 or P1639, which indicate that some necessary data has not been programmed into the module.

Modules that need programming should not be exchanged between vehicles. In most cases the parameter values or settings are unique to that vehicle, and if not set correctly will cause concerns or faults.

Some programmable parameters, such as belt minder on/off, can be changed from the factory setting at the customer's request.

WDS will automatically attempt to retrieve the module configuration information from all modules. If the module does not contain correct information, the diagnostic tool will either request "As Built" data or display a list of items that you will need to manually configure. The diagnostic tool will program the module based on the data you enter.

There are three different methods that are used for module programming:

- programmable module installation (PMI)
- calibration update
- programmable parameters

Some modules do not support all three methods.

Programmable Module Installation (PMI)

The programmable module installation (PMI) method is used when a new programmable module is installed on the vehicle. It is no longer necessary to command the diagnostic tool to gather module option content from the old module. The diagnostic tool automatically obtains any available module option content information from the old module during the vehicle ID routine that runs when the diagnostic tool is initially connected to the vehicle. It is important that you connect WDS to the vehicle and allow it to identify the vehicle and obtain configuration data prior to removing any modules.

Calibration Update

Calibration update is used to install a new calibration and strategy into a module. The updates are usually issued to fix a concern in the module software and would normally be addressed by a technical service bulletin (TSB). This method has been used by the PCM for several years. Other modules will be adopting this strategy as well.

Programmable Parameters

This method is used to configure parameters that can be modified in service. These are typically at the preference of the customer. Not all features controlled by the module are listed in this configuration method. Refer to the Module Configuration Index for a list of features by system.

If a module that has been modified using programmable parameters needs to be installed, the PMI procedure will maintain the parameters in their altered state if WDS is able to communicate with the old module during vehicle ID. Otherwise you may need to use programmable parameters to return them to the altered state.

As-Built Data Center

The As-Built Data Center maintains a record of the vehicle configuration in a database. The vehicle VIN is required to obtain this information. The As-Built Data Center records the applicable module configurations stored in each module before the vehicle leaves the factory. The As-Built Data Center will always reflect the original build of the vehicle as it left the factory. Only contact the As-Built Data Center when directed to do so by the diagnostic tool.

Inspection and Verification

1. Visually inspect for obvious signs of electrical damage. Refer to the following chart:

Visual Inspection Chart

Electrical
• Wiring harness • Connectors

Configurable Modules

The vehicle contains the following modules that are configurable:

- vehicle security module
- 4-wheel anti-lock brake/traction control (ABS/TC) module or stability assist module (if equipped)
- electronic automatic temperature control (EATC) module
- instrument cluster
- powertrain control module (PCM)
- driver seat module (DSM)
- tire pressure monitor module
- vehicle dynamics module
- power liftegate module
- temperature-controlled seat module

Programmable Parameters Index

System	Programmable Parameter Items
Security	● Power door lock inhibit ● Auto-lock/relock
Warnings and Chimes	● Tire pressure monitor system ● Tire pressure warning types ● Beltminder
Power Seats	● Easy entry/exit feature customer preference ● Reverse mirror feature customer preference

Torque Specifications

Description	Nm	lb-in
Battery ground cable	7-10	62-89

Anti-Theft —Passive

The passive anti-theft system (PATS) contains the following components:

- theft indicator
- encoded ignition key
- transceiver module
- powertrain control module (PCM)
- standard corporate protocol (SCP) communication network

Anti-Theft —Passive Anti-Theft System (PATS)

Refer to Wiring Diagrams Cell 112 for schematic and connector information.

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool
 ST1137-A	73III Automotive Meter 105-R0057

Principles of Operation

The PATS uses a specially encoded ignition key. Each encoded ignition key contains a permanently installed electronic device called a transponder. Each transponder contains a unique electronic identification code out of over 18 billion, billion combinations.

The passive anti-theft system (PATS), also known as SecuriLock ®, uses radio frequency identification technology to deter a driveaway theft. This system is known as Securilock® in North America, Safeguard® in the U.K., and PATS in Continental Europe. Passive means that it does not require any activity from the user.

The SecuriLock® System (PATS) is not compatible with aftermarket remote start systems, which allow the vehicle to be started from outside the vehicle. These systems may reduce the vehicle security level, and also may cause no-start issues. If equipped the remote start system must be removed before investigation of PATS-related, no-start issues.

Each encoded ignition key must be programmed into the vehicle's powertrain electronic control (PCM) before it can be used to start the engine. There are special diagnostic repair procedures described in this section that must be carried out if a new encoded ignition key is necessary.

This system contains a new feature named Unlimited Key Mode. This feature allows a customer to program more than eight keys to the vehicle if they request it. Each vehicle in Unlimited Key Mode is set up with a special Unlimited Transponder Security Key. This allows all the customer vehicles to share the same keys, but no other keys from outside can be used to operate the vehicles. For an individual customer, any randomly selected Security Key is acceptable. Refer to Unlimited Key Mode Programming in Key Programming Switch State Control in this section.

The PATS transceiver module communicates with the encoded ignition key. The module is located behind the steering column shroud and contains an antenna connected to a small electronics module. During each vehicle start sequence, the transceiver module reads the encoded ignition key identification code and sends data to the PCM.

The control functions are contained in the PCM. This module carries out all of the PATS functions, such as receiving the identification code from the encoded ignition key and controlling the engine enable. The PCM initiates the key interrogation sequence when the vehicle ignition switch is turned to RUN or START.

All elements of the PATS must be functional before the engine is allowed to start. If any of the components are not working correctly, the vehicle will not start.

The PATS uses a visual theft indicator. The indicator will prove out for three seconds when the ignition switch is turned to RUN or START under normal operation. If there is a PATS concern, this indicator will either flash rapidly or glow steadily when the ignition switch is turned to RUN or START. The PATS system also flashes the theft indicator every two seconds at ignition OFF to act as a visual deterrent.

The following will activate the PATS and will disable the vehicle from starting:

- incorrectly encoded ignition key
- damaged encoded ignition key
- unprogrammed key
- non-encoded key (key has no electronics)
- damaged wiring
- damaged transceiver
- damaged PCM

Inspection and Verification

1. Verify the customer concern by operating the system.

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

Visual Inspection Chart

Mechanical	Electrical
● Large metallic objects, a second ignition key on the same key ring as the PATS ignition key or electronic devices on the key chain that can be used to purchase gasoline or similar items ● Ignition lock cylinder ● PATS key ● Use of a non-PATS key ● More than one PATS key on key chain	● Central junction box (CJB) fuse: ■ 102 (30A) ● PATS transceiver module ● Ignition switch ● Loose or corroded connection(s)

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

4. If the diagnostic tool does not power up, refer to the diagnostic tool manual.

5. Carry out the DATA LINK DIAGNOSTICS test. If the diagnostic tool responds with:
   - CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00.

- NO RESP/NOT EQUIP for PCM, refer to Section 303-14 .
- SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the PCM.

6. If the DTCs retrieved are related to the concern, go to the (PCM) Diagnostic Trouble Code (DTC) Index to continue diagnostics.

7. If no DTCs related to the concern are retrieved, proceed to the Symptom Chart to continue diagnostics.

Powertrain Control Module Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1213	Anti-Theft Number of Programmed Keys is Below Minimum	PCM	GO to Pinpoint Test F .
B2431	Key Program Failure (Defective Key or Transceiver)	PCM	VERIFY if using correct PATS key, if defective USE new key.
B1342	ECU is Defective (EEPROM in PCM not working)	PCM	INSTALL a new PCM. REFER to Section 303-14 .
B2103	Antenna Not Connected	PCM	GO to Pinpoint Test A .
B1600	PATS Ignition Key Transponder Signal is Not Received	PCM	GO to Pinpoint Test B .
B1601	PATS Received Incorrect Key-Code From Ignition Key Transponder	PCM	GO to Pinpoint Test C .
B1602	PATS Received Invalid Format of Key-Code From Ignition Key Transponder	PCM	GO to Pinpoint Test D .
B1681	PATS Transceiver Module Signal is Not Received	PCM	GO to Pinpoint Test E .
—	All other DTCs	PCM	REFER to Section 419-10 .

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• The anti-theft indicator is always/never on — no three second theft indicator prove-out	• Circuitry. • Theft LED. • Powertrain control module (PCM).	• GO to Pinpoint Test G .
• The vehicle does not start	• Starter relay. • PCM. • Circuitry. • Encoded ignition key. • Ignition key code. • Ignition key transponder key code. • Ignition key transponder key	• GO to Pinpoint Test H .

	code format.	

Pinpoint Tests

PINPOINT TEST A: NO ANTENNA DETECTED

Test Step	Result / Action to Take
A1 INSPECT THE ANTENNA FOR CORRECT INSTALLATION OR PHYSICAL DAMAGE	
• Key in OFF position. • Verify the PATS transceiver module is correctly installed. Refer to Passive Anti-Theft System (PATS) Transceiver in this section. • Enter the following diagnostic mode on the diagnostic tool: Clear Continuous DTCs. • Key in OFF position. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Retrieve The PCM Continuous DTCs. • **Is DTC B2103 retrieved?**	**Yes** INSTALL a new PATS transceiver module. REFER to Passive Anti-Theft System (PATS) Transceiver in this section. CLEAR the DTCs. REPEAT the self-test. TURN the ignition OFF then back to RUN. **No** The system is OK.

PINPOINT TEST B: PATS IGNITION KEY TRANSPONDER SIGNAL IS NOT RECEIVED

Test Step	Result / Action to Take
NOTE: Large metallic objects, electronic devices on the key chain that can be used to purchase gasoline or similar items, or a second key on the same key ring as the PATS ignition key may cause vehicle starting problems and record DTCs under certain conditions. If a fault cannot be identified, examine the customer's key ring for such objects or devices. If present, inform the customer that they need to keep these objects from touching the PATS ignition key while starting the engine. These objects and devices cannot damage the PATS ignition key, but can cause a momentary concern if they are too close to the key during engine start. If a concern occurs, turn ignition OFF and restart the engine with all other objects on the key ring held away from the ignition key. Check to make sure the encoded ignition key used by the customer is a Ford approved encoded ignition key (Rotunda is the only approved encoded ignition key).	
B1 CHECK THE DIAGNOSTIC TROUBLE CODES (DTCS)	
• Enter the following diagnostic mode on the diagnostic tool: Clear Continuous PCM DTCs. • Key in OFF position. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Retrieve PCM Continuous DTCs. • **Is DTC B1600 retrieved?**	**Yes** GO to B2 . **No** If other than PATS PCM DTCs are retrieved. REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual. If no PATS DTCs are retrieved, the system is OK.

B2 INSTALL A NEW ENCODED IGNITION KEY	
NOTE: Check to make sure the customer and new encoded ignition keys are Ford approved, encoded PATS ignition keys. Unapproved PATS keys do not always operate correctly over different temperature ranges (Rotunda is the only approved encoded ignition key). ● Cut a new encoded ignition key. ● Program the new encoded ignition key. Refer to Spare Key Programming in this section. ● Enter the following diagnostic mode on the diagnostic tool: Clear PCM Continuous DTCs. ● Key in OFF position. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Retrieve PCM Continuous DTCs. ● **Is DTC B1600 present?**	**Yes** GO to B3 . **No** If other than PATS PCM DTCs are retrieved, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. If no PATS DTCs are retrieved, the system is OK.
B3 INSTALL A NEW PATS TRANSCEIVER	
NOTE: When a new PCM is installed, the encoded ignition keys must be reprogrammed. ● Key in OFF position. ● Install a new PATS transceiver. Refer to Passive Anti-Theft System (PATS) Transceiver in this section. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Clear PCM Continuous DTCs. ● Key in OFF position. ● **NOTE:** Do not use the encoded ignition key that was programmed in Step B2. ● Turn the ignition to RUN using an existing customer encoded ignition key. ● Enter the following diagnostic mode on the diagnostic tool: Retrieve PCM Continuous DTCs. ● **Is DTC B1600 retrieved?**	**Yes** GO to B4 . **No** The system is OK.
B4 CHECK FOR CORRECT PCM OPERATION	
● Disconnect all PCM connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all PCM connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new PCM. REFER to Section 303-14 . REPROGRAM the encoded ignition keys. REFER to Key Programming Using Diagnostic Equipment in this section. CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST C: PATS RECEIVED INCORRECT KEY-CODE FROM IGNITION KEY TRANSPONDER

Test Step	Result / Action to Take

NOTE: The PCM disables the engine for one second every time DTC B1601 is set. The ignition must remain in the RUN position for at least one second before an attempt is made to start the vehicle with any encoded ignition key. Check the PCM PID ANTISCAN for this unprogrammed key timeout status.	
NOTE: Large metallic objects, electronic devices on the key chain that can be used to purchase gasoline or similar items, or a second key on the same key ring as the PATS ignition key may cause vehicle starting problems and record DTCs under certain conditions. If a fault cannot be identified, examine the customer's key ring for such objects or devices. If present, inform the customer that they need to keep these objects from touching the PATS ignition key while starting the engine. These objects and devices cannot damage the PATS ignition key, but can cause a momentary concern if they are too close to the key during engine start. If a concern occurs, turn ignition OFF and restart the engine with all other objects on the key ring held away from the ignition key. Check to make sure the encoded ignition key used by the customer is a Ford approved encoded ignition key (Rotunda is the only approved encoded ignition key).	
C1 RETRIEVE THE DIAGNOSTIC TROUBLE CODES (DTCS) • Enter the following diagnostic mode on the diagnostic tool: Clear PCM Continuous DTCs. • Key in OFF position. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Retrieve PCM Continuous DTCs . • **Is DTC B1601 retrieved?**	**Yes** GO to C2 . **No** The system is OK. CHECK all customer encoded ignition keys by attempting to start the vehicle with each key to verify all other encoded ignition keys are programmed.
C2 CHECK FOR PROGRAMMED ENCODED IGNITION KEYS — MONITOR THE PCM PID NUMKEYS • Enter the following diagnostic mode on the diagnostic tool: Monitor the PCM PID NUMKEYS. • **Does the PCM PID NUMKEYS display 8?**	**Yes** ERASE and REPROGRAM the key codes. REFER to Key Programming Using Diagnostic Equipment in this section. CLEAR the DTCs. REPEAT the self-test. **No** GO to C3 .
C3 CHECK THE NUMBER OF PROGRAMMED ENCODED IGNITION KEYS AVAILABLE • Verify there are at least two currently programmed encoded ignition keys available with the vehicle. • **Are at least two currently programmed encoded ignition keys available with the vehicle?**	**Yes** GO to C4 . **No** CUT a new encoded ignition key so that at least two encoded ignition keys are available. PROGRAM the encoded ignition keys. REFER to Key Programming Using Diagnostic Equipment in this section. GO to C5 .
C4 VERIFY THE PCM PID SPARE_KY INDICATES YES • Enter the following diagnostic mode on the diagnostic tool: Monitor the PCM PID SPARE_KY. • **Does the PCM PID SPARE_KY indicate ENABLE?**	**Yes** Spare Key Programming is enabled. REFER to Key Programming Using Two Programmed Keys in this section. CLEAR the DTCs. REPEAT the self-test. **No** ENABLE the PCM PID SPARE_KEY. REFER to Key Programming Switch State Control in this section. CLEAR the DTCs. REPEAT the self-test.
C5 CHECK THE ENCODED	

IGNITION KEYS FOR CORRECT OPERATION	
• Key in OFF position. • Turn the ignition switch to RUN for three seconds using the first encoded ignition key. • Key in ON position. • Turn the ignition switch to RUN for three seconds using the second ignition key. • Start the vehicle using the second encoded ignition key. • **Does the vehicle start?**	**Yes** The system is OK. If there are additional keys that need to be programmed, REFER to Key Programming Using Two Programmed Keys in this section. **No** GO to C6.
C6 RETRIEVE THE DTCS — CHECK FOR DTC B1601	
NOTE: When a new PCM is installed, the encoded ignition keys must be reprogrammed. • Enter the following diagnostic mode on the diagnostic tool: Clear PCM Continuous DTCs. • Key in OFF position. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Retrieve PCM Continuous DTCs. • **Is DTC B1601 retrieved?**	**Yes** GO to C7. **No** If other than PATS PCM DTCs are retrieved, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. If no PATS DTCs are retrieved, the system is OK.
C7 CHECK FOR CORRECT PCM OPERATION	
• Disconnect all PCM connectors. • Check for: ◦ corrosion ◦ pushed-out pins • Connect all PCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PCM. REFER to Section 303-14. REPROGRAM the encoded ignition keys. REFER to Key Programming Using Diagnostic Equipment in this section. CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

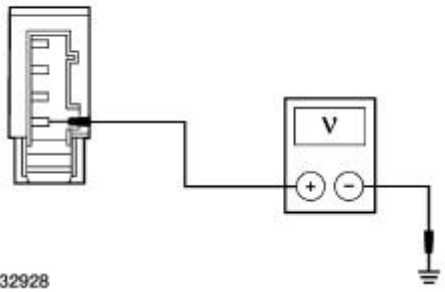
PINPOINT TEST D: PATS RECEIVED INVALID FORMAT OF KEY-CODE FROM IGNITION KEY TRANSPONDER

Test Step	Result / Action to Take
NOTE: Large metallic objects, electronic devices on the key chain that can be used to purchase gasoline or similar items, or a second key on the same key ring as the PATS ignition key may cause vehicle starting problems and record DTCs under certain conditions. If a fault cannot be identified, examine the customer's key ring for such objects or devices. If present, inform the customer that they need to keep these objects from touching the PATS ignition key while starting the engine. These objects and devices cannot damage the PATS ignition key, but can cause a momentary concern if they are too close to the key during engine start. If a concern occurs, turn ignition OFF and restart the engine with all other objects on the key ring held away from the ignition key. Check to make sure the encoded ignition key used by the customer is a Ford approved encoded ignition key (Rotunda is the only approved encoded ignition key).	
D1 RETRIEVE THE DTCS	

• Enter the following diagnostic mode on the diagnostic tool: Clear PCM Continuous DTCs . • Key in OFF position. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Retrieve PCM Continuous DTCs. • **Is DTC B1602 retrieved?**	**Yes** GO to D2 . **No** The system is OK. CHECK all customer encoded ignition keys by cycling them in the ignition switch and determining if the vehicle starts.
D2 INSTALL A NEW ENCODED IGNITION KEY	
NOTE: Check to make sure the customer and new encoded ignition keys are approved encoded PATS ignition keys. Unapproved PATS keys do not always operate correctly over different temperature ranges (Rotunda is the only approved encoded ignition key). • Cut a new encoded ignition key. • Program a new encoded ignition key. Refer to Spare Key Programming in this section. • Key in OFF position. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Retrieve PCM Continuous DTCs. • **Is DTC B1602 retrieved?**	**Yes** GO to D3 . **No** If other than PATS PCM DTCs are retrieved, REFER to thePowertrain Control/Emissions Diagnosis (PC/ED) manual. If no PATS DTCs are retrieved, the system is OK.
D3 INSTALL A NEW PATS TRANSCEIVER	
• Enter the following diagnostic mode on the diagnostic tool: Clear PCM Continuous DTCs. • Key in OFF position. • Install a new PATS transceiver module. Refer to Passive Anti-Theft System (PATS) Transceiver in this section. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Retrieve PCM Continuous DTCs. • **Are any PATS DTCs retrieved?**	**Yes** REFER to the PCM Diagnostic Trouble Code (DTC) Index. **No** The system is OK.

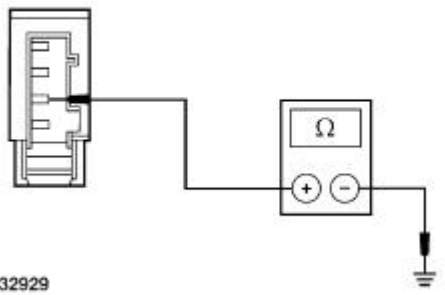
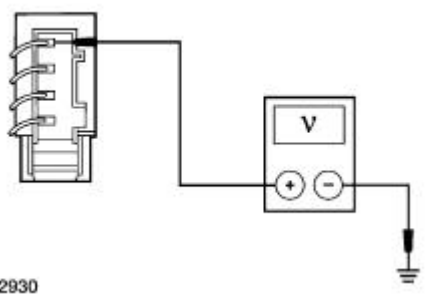
PINPOINT TEST E: THE PATS TRANSCEIVER MODULE SIGNAL IS NOT RECEIVED

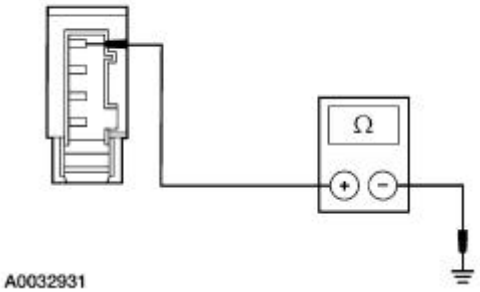
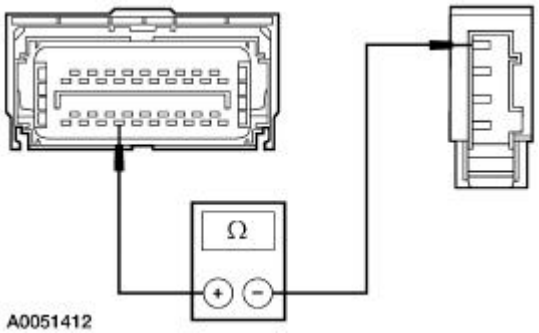
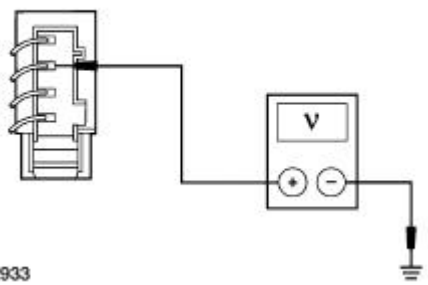
Test Step	Result / Action to Take
E1 RETRIEVE THE DTCS	
• Enter the following diagnostic mode on the diagnostic tool: Clear PCM Continuous DTCs. • Key in OFF position. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Retrieve PCM Continuous DTCs. • **Is DTC B1681 retrieved?**	**Yes** GO to E2 . **No** The system is OK.
E2 CHECK THE PATS TRANSCEIVER FOR VOLTAGE CIRCUIT 1044 (WH/YE)	
• Key in OFF position. • Disconnect: PATS Transceiver C2007. • Key in ON position. • Measure the voltage between the PATS transceiver C2007 pin 1, circuit 1044 (WH/YE), harness side and ground.	**Yes** GO to E3 . **No** REPAIR the supply circuit. CLEAR the DTCs. TEST the system for normal operation.

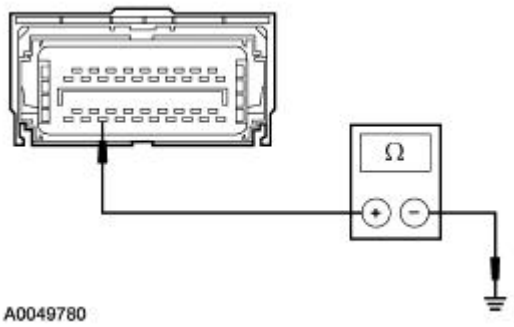
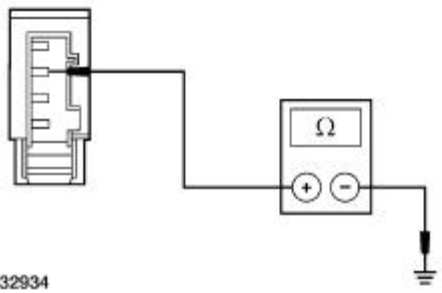
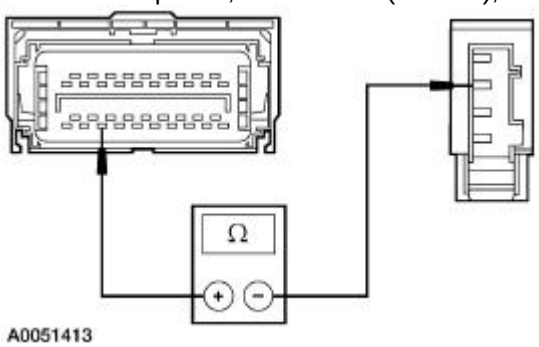


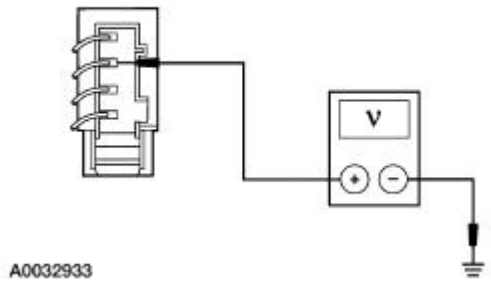
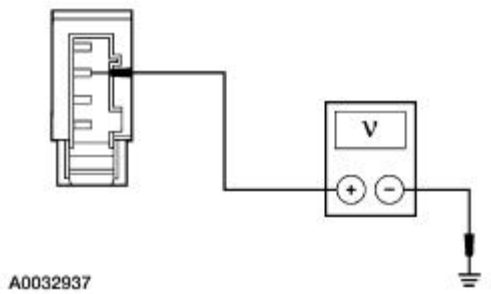
A0032928

- **Is the voltage greater than 10 volts?**

E3 CHECK THE PATS TRANSCEIVER GROUND CIRCUIT 875 (BK/LB)	
• Key in OFF position. • Measure the resistance between the PATS transceiver C2007 pin 2, circuit 875 (BK/LB), harness side and ground.  A0032929 • **Is the resistance less than 5 ohms?**	**Yes** GO to E4 . **No** REPAIR the circuit. CLEAR the DTCs. TEST the system for normal operation.
E4 CHECK THE PATS TRANSCEIVER RECEIVE CIRCUIT FOR VOLTAGE CIRCUIT 1216 (GY/OG)	
• Connect: PATS Transceiver C2007. • Key in ON position. • Measure the voltage by backprobing between the PATS transceiver C2007 pin 4, circuit 1216 (GY/OG), harness side and ground.  A0032930 • **Is the voltage greater than 9 volts?**	**Yes** GO to E6 . **No** GO to E5 .
E5 CHECK THE PATS TRANSCEIVER RECEIVE CIRCUIT FOR A SHORT TO GROUND CIRCUIT 1216 (GY/OG)	
• Key in OFF position. • Disconnect: PATS Transceiver C2007. • Measure the resistance between the PATS transceiver C2007 pin 4, circuit 1216 (GY/OG), harness side and ground.	**Yes** GO to E6 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-

 A0032931 ● **Is the resistance greater than 10,000 ohms?**	test. If the system fails again, GO to E13 .
E6 CHECK CIRCUIT 1216 (GY/OG) FOR AN OPEN	
● Key in OFF position. ● Disconnect: PATS Transceiver C2007. ● Disconnect: PCM C175b. ● Measure the resistance between the PATS transceiver C2007 pin 4, circuit 1216 (GY/OG), harness side and the PCM C175b pin 42, circuit 1216 (GY/OG), harness side.  A0051412 ● **Is the resistance less than 5 ohms?**	**Yes** GO to E7 . **No** REPAIR the circuit. CLEAR the DTCs. TEST the system for normal operation.
E7 CHECK THE PATS TRANSCEIVER TRANSMIT CIRCUIT FOR VOLTAGE CIRCUIT 1215 (WH/LG)	
● Key in OFF position. ● Connect: PATS Transceiver C2007. ● Connect: PCM C175b. ● Key in ON position. ● Measure the voltage by backprobing between the PATS transceiver C2007 pin 3, circuit 1215 (WH/LG), harness side and ground.  A0032933 ● **Is the voltage greater than 9 volts?**	**Yes** GO to E11 . **No** GO to E8 .
E8 CHECK THE PATS TRANSCEIVER TRANSMIT CIRCUIT FOR SHORT TO GROUND CIRCUIT 1215 (WH/LG) TRANSCEIVER CONNECTED	
● Key in OFF position. ● Disconnect: PCM C175b. ● Measure the resistance between the PCM C175b pin 43,	**Yes** GO to E10 .

circuit 1215 (WH/LG), harness side and ground.  ● **Is the resistance greater than 10,000 ohms?**	**No** GO to E9 .
E9 CHECK THE PATS TRANSCEIVER TRANSMIT CIRCUIT FOR A SHORT TO GROUND CIRCUIT 1215 (WH/LG) TRANSCEIVER DISCONNECTED	
● Disconnect: PATS Transceiver C2007. ● Measure the resistance between the PATS transceiver C2007 pin 3, circuit 1215 (WH/LG), harness side and ground.  ● **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new PATS transceiver. REFER to Passive Anti-Theft System (PATS) Transceiver in this section. CLEAR the DTCs. REPEAT the self-test. **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
E10 CHECK THE PATS TRANSMIT CIRCUIT FOR AN OPEN CIRCUIT 1215 (WH/LG)	
NOTE: When a new PCM is installed, the encoded ignition keys must be reprogrammed. ● Disconnect: PATS Transceiver C2007. ● Measure the resistance between the PATS transceiver C2007 pin 3, circuit 1215 (WH/LG), harness side and the PCM C175b pin 43, circuit 1215 (WH/LG), harness side.  ● **Is the resistance less than 5 ohms?**	**Yes** GO to E13 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
E11 CHECK THE TRANSCEIVER TRANSMIT CIRCUIT FOR VOLTAGE CIRCUIT 1215 (WH/LG)	
● Key in ON position. ● Select PCM active command TRANSMIT SIGNAL COMMAND.	**Yes** INSTALL a new PATS transceiver, REFER Passive Anti-Theft System (PATS)

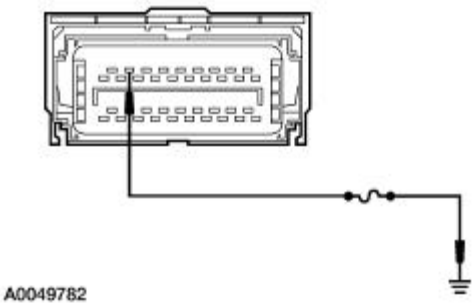
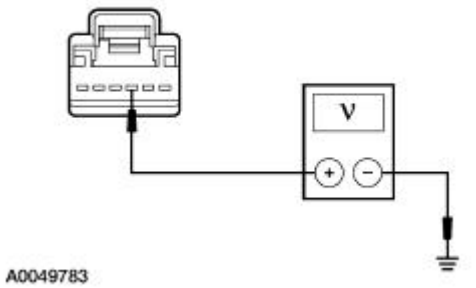
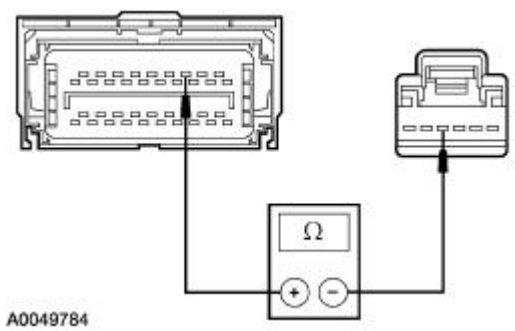
• Trigger TRANSMIT to ON. • Measure the voltage by backprobing between the PATS transceiver C2007 pin 3, circuit 1215 (WH/LG), harness side and ground.  A0032933 • **Is the voltage less than 5 volts?**	Transceiver in this section. CLEAR the DTCs. REPEAT the self-test. **No** GO to E12.
E12 CHECK THE PATS TRANSCEIVER TRANSMIT CIRCUIT FOR A SHORT TO BATTERY	
NOTE: When a new PCM is installed, the encoded ignition keys must be reprogrammed. • Key in OFF position. • Disconnect: PCM C175b. • Disconnect: PATS Transceiver C2007. • Key in ON position. • Measure the voltage between the PATS transceiver C2007 pin 3, circuit 1215 (WH/LG), harness side and ground.  A0032937 • **Is voltage present?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. **No** GO to E13.
E13 CHECK FOR CORRECT PCM OPERATION	
• Disconnect all PCM connectors. • Check for: ◦ corrosion ◦ pushed-out pins • Connect all PCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PCM. REFER to Section 303-14. REPROGRAM the encoded ignition keys. REFER to Key Programming Using Diagnostic Equipment in this section. CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST F: ANTI-THEFT NUMBER OF PROGRAMMED KEYS IS BELOW MINIMUM

Test Step	Result / Action to Take
F1 RETRIEVE THE DTCS ● Enter the following diagnostic mode on the diagnostic tool: Clear PCM Continuous DTCs . ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Retrieve PCM Continuous DTCs. ● **Is DTC B1213 retrieved?**	**Yes** GO to F2 . **No** If other than PATS PCM DTCs are retrieved, REFER to thePowertrain Control/Emissions Diagnosis (PC/ED) manual. If no PATS DTCs are retrieved, the system is OK.
F2 CHECK THE NUMBER OF KEYS ENCODED — MONITOR THE PCM PID NUMKEYS ● Monitor the PCM PID NUMKEYS. ● **Does the PCM PID NUMKEYS display less than PCM PID MIN#KEY?**	**Yes** GO to F3 . **No** The system is OK.
F3 PROGRAM ENCODED IGNITION KEYS ● **NOTE:** Two programmed encoded ignition keys must be available to start the vehicle. ● Cut a new encoded PATS ignition lock cylinder key. ● PROGRAM the new encoded ignition key. Refer to Spare Key Programming in this section. ● **Does the theft LED illuminate for three seconds and then go out?**	**Yes** CLEAR the DTCs. CYCLE the ignition OFF then back to RUN to verify all codes have been cleared. CLEAR the DTCs. REPEAT the self-test. **No** GO to F4 .
F4 CHECK FOR A REPAIR MODULE — MONITOR THE PCM PID SERV_MOD ● Monitor the PCM PID SERV_MOD. ● **Does the PCM PID SERV_MOD indicate YES?**	**Yes** PROGRAM the encoded ignition keys. REFER to Key Programming Using Diagnostic Equipment in this section. CLEAR the DTCs. REPEAT the self-test. **No** If the LED is illuminated continuously, REPEAT Step F3 using a new encoded ignition key. If the LED is flashing, RETRIEVE the PCM DTC stored for the new PATS fault.

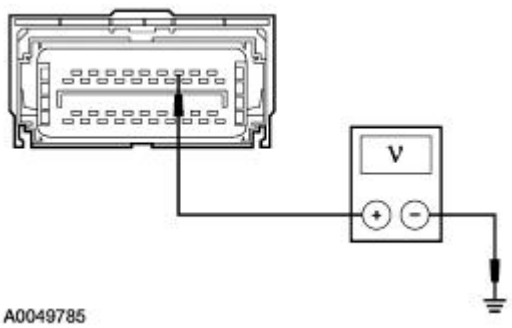
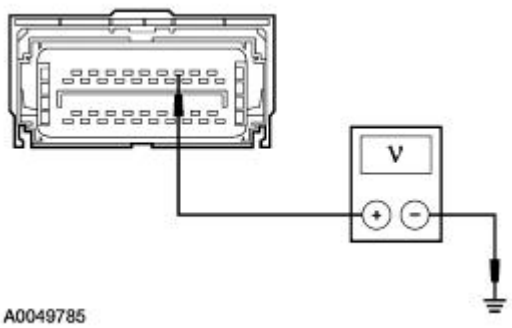
PINPOINT TEST G: THE ANTI-THEFT INDICATOR IS ALWAYS/NEVER ON

Test Step	Result / Action to Take

G1 CHECK THE ANTI-THEFT INDICATOR FOR CORRECT OPERATION	
NOTE: When a new PCM is installed, the encoded ignition keys must be reprogrammed. ● Key in OFF position. ● Disconnect: PCM C175b. ● Connect a fused (15A) jumper wire between the PCM C175b pin 9, circuit 1269 (OG/RD), harness side and ground.  A0049782 ● **Does the theft LED illuminate?**	**Yes** GO to G4 . **No** GO to G2 .
G2 CHECK THE VOLTAGE TO THE ANTI-THEFT LED CIRCUIT 729 (RD/WH)	
● Disconnect: Sunload Sensor C286. ● Measure the voltage between the sunload sensor C286 pin 3, circuit 729 (RD/WH), harness side and ground.  A0049783 ● **Is the voltage greater than 10 volts?**	**Yes** GO to G3 . **No** REPAIR the supply circuit. TEST the system for normal operation.
G3 CHECK CIRCUIT 1269 (OG/RD) FOR AN OPEN BETWEEN THE PCM AND THE SUNLOAD SENSOR	
● Measure resistance between the PCM C175b pin 9, circuit 1269 (OG/RD), harness side and the sunload sensor C286 pin 4, circuit 1269 (OG/RD), harness side.  A0049784 ● **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new sunload sensor. REFER to Section 417-01 . **No** REPAIR the circuit in question. TEST system for normal operation.
G4 CHECK FOR CORRECT PCM OPERATION	
● Disconnect all PCM connectors.	**Yes**

• Check for: • corrosion • pushed-out pins • Connect all PCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	INSTALL a new PCM. REFER to Section 303-14 . REPROGRAM the encoded ignition keys. REFER to Key Programming Using Diagnostic Equipment in this section. CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST H: THE VEHICLE DOES NOT START

Test Step	Result / Action to Take
H1 CHECK THE STARTING SYSTEM FOR CORRECT VOLTAGE • Key in OFF position. • Disconnect: PCM C175b. • Key in ON position. • Measure the voltage between the PCM C175b pin 4, circuit 325 (DB/OG), harness side and ground.  A0049785 • **Is the voltage less than 8 volts?**	**Yes** DIAGNOSE the starting system. REFER to Section 303-06 . **No** GO to H2 .
H2 CHECK THE STARTING SYSTEM GROUND **NOTE:** When a new PCM is installed, the encoded ignition keys must be reprogrammed. • Measure the voltage between the PCM C175b pin 4, circuit 325 (DB/OG), harness side and ground.  A0049785 • **Is the voltage less than 2 volts?**	**Yes** DIAGNOSE the starting system. REFER to Section 303-06 . **No** GO to H3 .

H3 CHECK FOR CORRECT PCM OPERATION	
• Disconnect all PCM connectors. • Check for: • corrosion • pushed-out pins • Connect all PCM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new PCM. Section 303-14 . REPROGRAM the encoded ignition keys. REFER to Key Programming Using Diagnostic Equipment in this section. CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Key Programming Using Two Programmed Keys

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool

NOTE: This procedure only works if two or more programmed ignition keys are available and it is desired to program additional key(s). If two keys are not available, follow the procedure in Key Programming—Erase All Key Codes and Program Two Keys.

NOTE: PID SPARE_KY must be enabled for this procedure to operate. If this Parameter Identification (PID) Index is not enabled, follow the security access procedure and select Spare Key Programming Switch: Enabled.

NOTE: If the programming procedure is successful, the new key(s) will start the vehicle and the THEFT INDICATOR will illuminate for approximately three seconds and the exit ignition proveout.

NOTE: If the programming procedure is not successful, the new key(s) will not start the vehicle and the THEFT INDICATOR will flash. If the programming procedure was not successful, repeat the key programming procedure from Step 1. If the failure repeats, check Circuit 729 (RD/WH) (hot at all times) in instrument cluster for proper battery voltage. Repair the circuit if voltage is not present. For additional information, refer to Diagnosis and Testing to review diagnostic trouble codes (DTCs) and perform pinpoint tests as required.

NOTE: Unless in unlimited key mode a maximum of eight ignition keys can be programmed to a passive anti-theft system (PATS) equipped vehicle. Use PID NUMKEYS to determine how many keys are programmed to the vehicle.

NOTE: If the steps are not performed as outlined, the programming procedure will end.

NOTE: Ignition keys must have correct mechanical key cut for the vehicle and must be a PATS encoded key. (Keys are different from previous model year)

1. Insert the first programmed ignition key into the ignition lock cylinder and turn the ignition switch from OFF to RUN (maintain the ignition switch in RUN for one second).

2. Turn the ignition switch to OFF and remove the first key from the ignition lock cylinder.

3. Within ten seconds of turning the ignition switch to OFF, insert the second programmed ignition key into the ignition lock cylinder and turn the ignition switch from OFF to RUN (maintain the ignition switch in RUN for one second).

4. Turn the ignition switch to OFF and remove the second key from the ignition lock cylinder.

5. Within 20 seconds of turning the ignition lock cylinder to OFF, insert the unprogrammed ignition key (new key) into the ignition lock cylinder and turn the ignition switch from OFF to RUN (maintain the ignition switch in RUN for 1 second).

6. If it is desired to program additional key(s), repeat the key programming procedure from the beginning.

Key Programming Using Diagnostic Equipment

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation Star (NGS) Tester 418-F052 or equivalent diagnostic tool

NOTE: This procedure is used when a customer needs keys programmed into the system and does not have two programmed ignition keys available. This procedure is also useful when programmed ignition key(s) have been lost or a new ignition switch assembly as been installed, and it is desired to erase key(s) from the passive anti-theft system (PATS) memory.

NOTE: This procedure will erase all programmed ignition keys from the vehicle memory and the vehicle will not start until two keys have been reprogrammed to the vehicle.

NOTE: Two PATS encoded keys with the correct mechanical cut must be available to carry out this procedure. One or both of them may be the customer's original keys.

NOTE: If additional keys are to be programmed, refer to Key Programming Using Two Programmed Keys . If the remaining keys are with the customer and are not available with the vehicle, then instruct the customer to refer to the Owner's Guide under the "Programming Spare (SecuriLock ® North America, Safeguard ® U.K. or PATS for all other markets) Keys Procedure" for instructions on programming the remaining keys.

1. Turn the ignition switch from OFF to RUN.
2. Using the diagnostic tool, follow the SECURITY ACCESS to obtain security access. For additional information, refer to Anti-Theft Security Access procedure in this section.
3. From the diagnostic tool menu, select IGNITION KEY CODE ERASE.
4. **NOTE:** Do NOT select any additional commands from this menu.

   Turn the ignition switch to OFF and disconnect the diagnostic tool.
5. Insert the first encoded key into the ignition lock cylinder and turn the ignition switch to RUN for three seconds.
6. Insert the second encoded key into the ignition lock cylinder and turn the switch to the RUN position for three seconds.
7. Remove the second encoded key from the ignition lock cylinder.
8. The vehicle should now start with both ignition keys.

Key Programming Switch State Control

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation Star (NGS) Tester 418-F052 or equivalent diagnostic tool

NOTE: The spare key programming switch is a diagnostic tool programmable switch which provides the capability to enable/disable the customer spare key programming procedure. This procedure is in the Owner's Literature spare key programming procedure or in this section under Key Programming Using Two Programmed Keys . This programmable switch is provided as a convenience for customers who may not want the spare key programming procedure available to the vehicle driver.

NOTE: The spare key programming switch state can be viewed by PCM PID SPARE_KY.

1. Insert a programmed ignition key into the ignition lock cylinder and turn the ignition switch to RUN.

2. Using the diagnostic tool Ford Service Function (FSF) card, select PCM from the menu. Follow SECURITY ACCESS to obtain security access. For additional information, refer to Anti-Theft Security Access procedure in this section.

3. **NOTE:** The default setting on delivery of all new vehicles is <ENABLE>.

   From the diagnostic tool menu, select SPARE KEY PROGRAMMING SWITCH selection to desired setting:
   <ENABLE> Spare key programming procedure is accessible.
   <DISABLE> spare key programming procedure is not accessible.

Unlimited Key Mode Programming

Enabling Unlimited Key Mode

NOTE: Unlimited Key Mode is intended for use by those customers who need more than eight keys for their vehicle.

4. The customer must choose a 4-digit, non-0000 number that will be programmed to all of their vehicles. All customer vehicles need to use the same number. Valid digits are 0-9 plus the letters A-F.

5. Note: If the PID: UNLIMITED TRANSPONDER KEY ID is not available, Unlimited Key Mode is turned on, and must be turned off before viewing the stored code. At this time, unlimited keys may be programmed to the vehicle. To view/change the stored code, follow the procedure for turning off Unlimited Key Mode below. Check the PID: UNLIMITED TRANSPONDER KEY ID and compare its value against the code chosen in Step 1.

6. Using the diagnostic tool, select PCM from the menu. Follow SECURITY ACCESS to obtain security access. For additional information, refer to Anti-Theft Security Access in this section.

7. If the Unlimited Transponder Security Key PID was 0000, select Active Command: SET UNLIMITED TRANSPONDER KEY. Enter the 4-digit code chosen by the user.

8. Select: ENABLE UNLIMITED KEY MODE.

9. Select: IGNITION CODE ERASE.

10. Disconnect the diagnostic tool and turn the ignition keys off.

11. Program in two ignition keys to enable the vehicle by inserting the first encoded key into the ignition lock cylinder and turn the switch to the RUN position for three seconds, then back to OFF.

12. Insert the second encoded key into the ignition lock cylinder and turn the switch to the RUN position, after three seconds the THEFT INDICATOR should extinguish.

13. Program any additional keys using either Key Programming Using Two Programmed Keys or Key Programming Using Diagnostic Equipment in this section.

Disabling Unlimited Key Mode

1. Using a diagnostic tool, select PCM from the menu. Follow SECURITY ACCESS to obtain security access. For additional information, refer to Anti-Theft Security Access in this section.

2. Select: DISABLE UNLIMITED KEY MODE.

3. Select: IGNITION KEY CODE ERASE.

4. Disconnect the diagnostic tool and turn the ignition key to OFF.

5. Program in two keys to enable the vehicle by inserting the first encoded key into the ignition lock cylinder and turning the switch to the RUN position for three seconds, then back to OFF.

6. Insert the second encoded key into the ignition lock cylinder and turn the switch to the RUN position, after three seconds the THEFT INDICATOR should extinguish.

7. Program any additional keys using either Key Programming Using Two Programmed Keys or Key Programming Using Diagnostic Equipment in this section.

Spare Key Programming

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation Star (NGS) Tester 418-F052 or equivalent diagnostic tool

NOTE: This procedure is used when a customer needs to have an additional key programmed into the vehicle without erasing stored key codes, but does not have two programmed keys available. This procedure is also useful when attempting to determine if an ignition key is defective, as a new key can be installed without erasing keys or without having two programmed keys available.

NOTE: Before programming, the new key must have the correct mechanical cut for the ignition lock.

NOTE: If eight keys are already programmed, this procedure will not allow any further ignition keys to be programmed without erasing all stored key codes first. The number of keys programmed into the system can be determined using the PCM PID NUMKEYS.

NOTE: If more than eight keys are needed, refer to Unlimited Key Mode Programming in Key Programming Switch State Control .

1. Turn the ignition switch from the OFF position to the RUN position using the new, unprogrammed ignition key.

2. Using the diagnostic tool Ford Service Function (FSF) card, select PCM from the menu. Follow Security Access to obtain security access. For additional information, refer to Anti-Theft Security Access in this section.

3. From the diagnostic tool menu select: IGNITION KEY CODE PROGRAM.

4. Turn the ignition switch to the OFF position and disconnect the diagnostic tool.

5. Attempt to start the engine with the new ignition key. The vehicle engine should start and run normally.

Anti-Theft Security Access

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation Star (NGS) Tester 418-F052 or equivalent diagnostic tool

NOTE: The security access procedure is utilized to obtain passive anti-theft system (PATS) security access. PATS security access must be granted to erase ignition keys, enable/disable unlimited key mode, and enable/disable the spare key programming switch (PID SPARE_KEY). The security access procedure invokes an inherent 10 minute time delay prior to granting security access during which the diagnostic tool must remain connected to the vehicle. Once security access has been granted, a security access command menu is displayed which offers various command options. (For additional information, refer to Powertrain Control Module (PCM) Configuration Command Index).

NOTE: Once security access has been granted, multiple security access commands should be executed (if necessary) prior to exiting the command menu. This avoids the carrying out of an additional security access procedure and the associated 10 minute time delay.

1. From the diagnostic tool Ford Service Function (FSF) card, enter PCM. Select SECURITY ACCESS. This procedure will take 10 minutes to carry out, during which the ignition switch must be in RUN and the diagnostic tool must be connected to the vehicle.

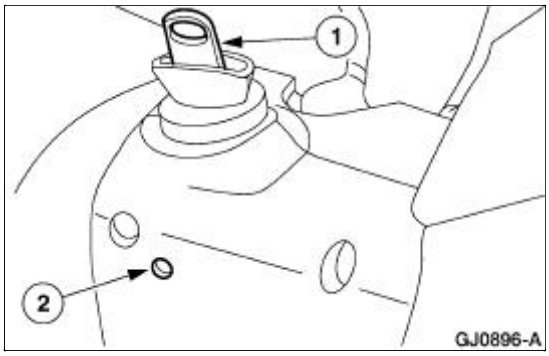
2. After the 10 minute security access procedure has been completed, a new menu will be displayed with command options. Select only those functions necessary before exiting out of this menu. Once exited out of this menu, the security access procedure must be repeated again to carry out additional commands.

Passive Anti-Theft System (PATS) Transceiver

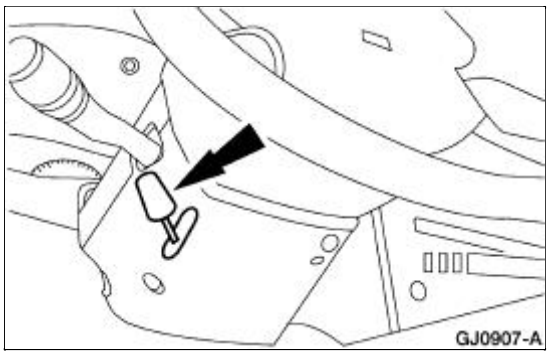
Removal

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

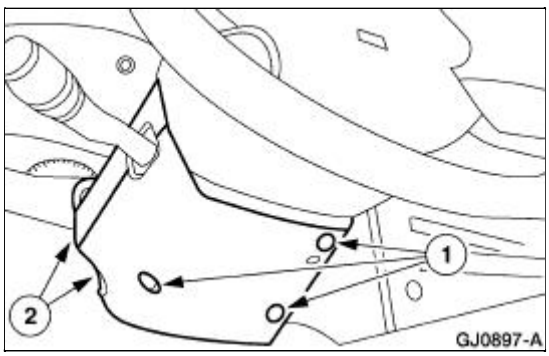
2. Remove the ignition switch lock cylinder.
    1. Insert the ignition key into the ignition switch lock cylinder and turn to the RUN position.
    2. Push the ignition switch lock cylinder release tab with a punch while pulling out the ignition switch lock cylinder.



3. If equipped, remove the tilt wheel handle.

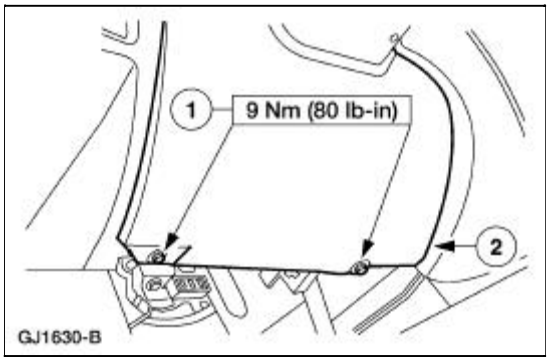


4. Remove the upper and lower steering column shrouds.
    1. Remove the screws.
    2. Remove the upper and lower steering column shrouds.

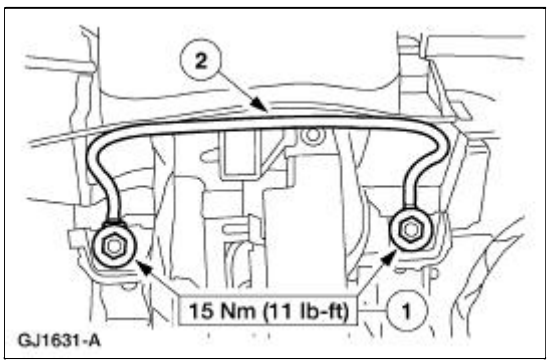


5. Remove the lower instrument panel steering column cover.
    1. Remove the screws.

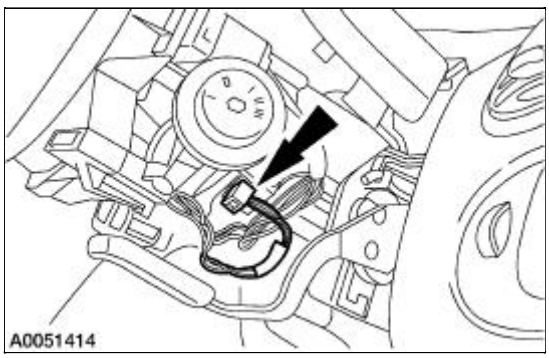
2. Remove the lower instrument panel steering column cover.



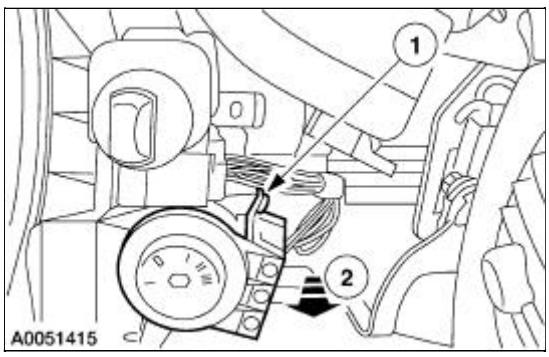
6. Remove the instrument panel steering column opening cover reinforcement.
    1. Remove the bolts.
    2. Remove the instrument panel steering column opening cover reinforcement.



7. Disconnect the passive anti-theft system (PATS) transceiver electrical connector.

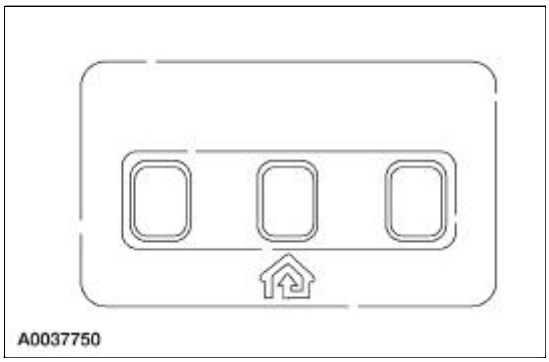


8. Remove the PATS transceiver.
    1. Remove the PATS transceiver retaining screw.
    2. Remove the PATS transceiver.



9. To install, reverse the removal procedure.

Universal Transmitter



The HomeLink® universal transmitter provides a convenient way to substitute up to three hand-held transmitters with a single built-in device. The universal transmitter:

- will operate garage doors, gates and home/office lighting and security systems.
- will actually learn and transmit the radio frequency of up to three hand-held transmitters from any of the systems mentioned above.
- is an integral part of the left sun visor assembly and is powered by the vehicle battery and charging system.

Universal Transmitter

Refer to Wiring Diagrams Cell 89 , Courtesy Lamps for schematic and connector information.

Inspection and Verification

1. Verify the customer concern by operating the system.
2. Visually inspect for obvious signs of mechanical damage.

Visual Inspection Chart

Mechanical
● Damaged universal transmitter ● Damaged receiver

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the fault is not visually evident, verify the symptom and refer to the Symptom Chart.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
● The universal transmitter is inoperative	● Universal transmitter. ● Receiver unit.	● GO to Pinpoint Test A .

Pinpoint Tests

PINPOINT TEST A: THE UNIVERSAL TRANSMITTER IS INOPERATIVE

Test Step	Result / Action to Take
A1 CHECK LEFT VANITY MIRROR OPERATION	
● Check the illumination of the left vanity mirror lamps. ● **Do the left vanity mirror lamps illuminate?**	**Yes** GO to A2 . **No**

	REFER to Section 417-02 .
A2 PROGRAM HAND-HELD TRANSMITTER INTO UNIVERSAL TRANSMITTER	
• **NOTE:** If the garage door is equipped with rolling codes, refer to Training a Garage Door Opener Equipped With "Rolling Codes." • Program the universal transmitter; Refer to Programming . • **Did the universal transmitter program successfully?**	**Yes** The universal transmitter is OK. VERIFY receiver operation. **No** INSTALL a new left sun visor assembly. TEST the system for normal operation.

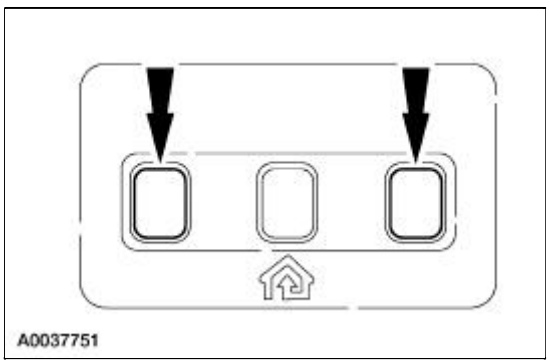
Programming

WARNING: A garage door opening system that cannot stop or reverse itself after detecting an object in its path does not meet current federal safety standards. To decrease the risk of serious injury or death, do not use this HomeLink® transmitter with a door opening system that lacks stop and reverse features as required by federal standards. This includes any garage door opening system manufactured before April 1, 1982. For more information, call HomeLink® customer assistance at 1-800-355-3515.

1. **CAUTION: During this procedure, the system that you are programming will be made to operate. Make sure that people or objects are clear of the garage door or gate being programmed.**

   Verify the hand-held transmitter is operative.

2. Prepare for programming the universal transmitter by erasing all three channels by holding down the two outside buttons until the red light begins to flash (20-30 seconds). Release both buttons.

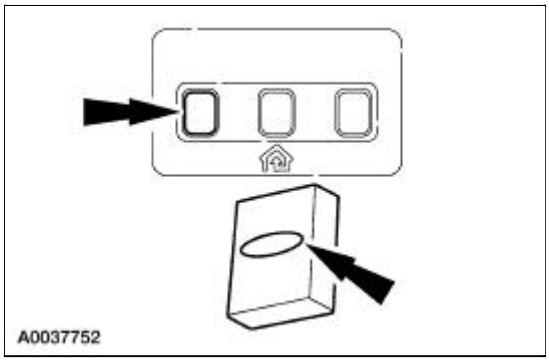


3. Select one of the three universal transmitter channels to be programmed by pressing the desired button.

4. Hold the end of the hand-held transmitter 25-51mm (1-2 in) from the front surface of the universal transmitter so that the red light can still be seen.

5. **NOTE:** During programming, the hand-held transmitter may automatically stop transmitting after two seconds, which may not be long enough to program the universal transmitter. If programming this type of hand-held transmitter, continue to hold the button on the universal transmitter while re-pressing the hand-held transmitter button every two seconds (Canada only).

   Use both hands to press the hand-held transmitter button and the desired button on the universal transmitter. Do not release either button.



6. Hold down both buttons until the red light on the universal transmitter flashes, first slowly and then rapidly. Release both buttons when the rapid flashing begins. The universal transmitter has successfully learned the new frequency signal and can be used in place of the hand-held transmitter(s).

7. **NOTE:** If the hand-held transmitter appears to program the universal transmitter but does not open the garage door, the garage door opener may have a "code protected" or "rolling code" feature.

   To operate, simply press the appropriate button on the universal transmitter. The red light is on while the signal is being transmitted.

Training a Garage Door Opener Equipped With "Rolling Codes"

8. Program the hand-held transmitter to the universal transmitter. For additional information, refer to Programming in this section.

9. Train the garage door opener receiver to recognize the universal transmitter.
   1. Remove the cover panel from the garage door opener receiver.
   2. Locate the training button on the garage door opener receiver. Location and color of the button may vary by garage door opener manufacturer. Refer to the garage door opener instruction manual or call HomeLink® customer assistance at 1-800-355-3515.
   3. Press the training button on the garage door opener receiver for 1-2 seconds.
   4. Press the programmed universal transmitter button for as long as the universal transmitter red light flashes (1-2 seconds). Release the button and re-press the button to confirm that the universal transmitter is trained to the receiver.
   5. The garage door opener should recognize the universal transmitter.

Erasing Channels

1. **NOTE:** Individual channels cannot be erased, but can be reprogrammed using the procedures for programming; for additional information, refer to Programming in this section.

   To erase all three programmed channels, hold down the two outside buttons until the red light begins to flash (20-30 seconds). Release both buttons.

Navigation System —Navigator Built After 2/2003

The vehicle navigation system audibly and visually guides the user to any entered destination. The system utilizes a global positioning system (GPS) antenna, a vehicle speed input and other sensor information to accurately establish the vehicle position. The navigation system module carries out all route calculations and sends the digital versatile disc (DVD) vector map information to the audio unit. The audio unit display provides visual and audible instructions of the maneuvers required to arrive at the pre-entered destination.

Navigation System

The vehicle navigation system audibly and visually guides the user to any entered destination. The system utilizes a global positioning system (GPS) antenna, a vehicle speed input and other sensor information to accurately establish the vehicle position. The audio unit carries out all route calculations through a map compact disc (CD) stored in the audio unit. The audio unit provides the visual and audible instructions of the maneuvers required to arrive at the pre-entered destination.

Navigation System —Navigator Built After 2/2003

Refer to Wiring Diagrams Cell 32 for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052 or equivalent diagnostic tool with appropriate adapter cable

Principles of Operation

Navigation System

The navigation system module controls the operation and the interface between the user, the vehicle subsystems and the external components. The navigation system module is on the standard corporate protocol (SCP) network and can be diagnosed with a diagnostic tool. Communication through the controller area network (CAN) utilizes data transmitted and received between the navigation system module and the audio unit to control the video screen display through the video interface circuits.

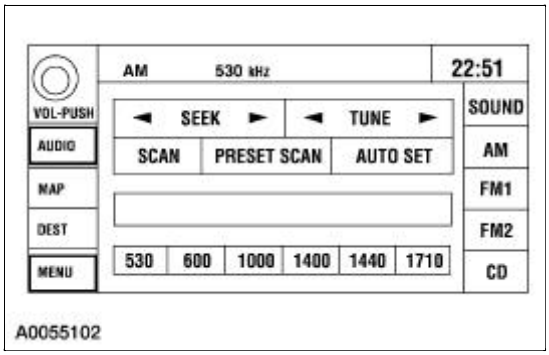
The vehicle navigation system will guide the user to a pre-entered destination. A map digital versatile disc (DVD) stored in the navigation system module sends route calculation data to the audio unit. The audio unit display will audibly and visually instruct the user of the maneuvers required to arrive at the destination entered.

A voice recognition system allows the user to interface with the system without using the touch screen. A microphone located in the rear view mirror provides a direct input to the navigation system module.

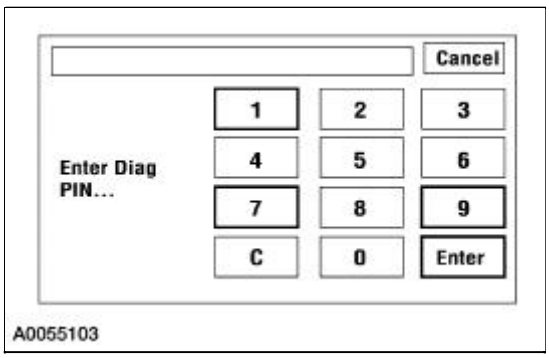
In order to calculate initial vehicle position, the GPS antenna is used to track several available satellites simultaneously. The GPS antenna only receives data and does not communicate with the satellites. A gyroscope integral to the navigation system module monitors the pitch and yaw of the vehicle created during cornering or turning. A hardwired vehicle speed input from the anti-lock brake system (ABS) module and a reverse input from the digital transmission range (TR) sensor through the SCP network are also used to detect vehicle speed and direction changes.

Self Diagnostics

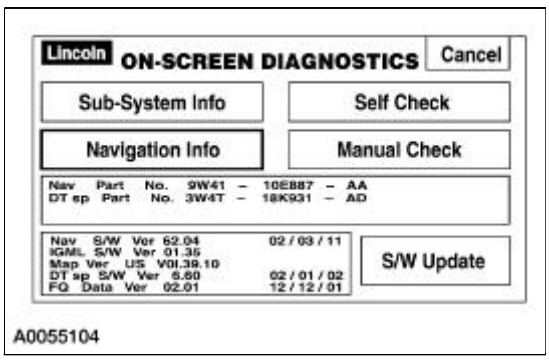
Although on the SCP network, the navigation system provides internal diagnostics to assist with diagnosing vehicle concerns.



Press and hold the AUDIO and MENU buttons for 5 seconds.



Press 917 Enter.



- SELF CHECK provides internal self-test diagnostics. These DTCs are also accessible through the SCP network utilizing a diagnostic tool.
- NAVIGATION INFO provides access to speed signal, gyro, reverse input and GPS information.
- SUB-SYSTEM INFO provides the various component configurations.
- MANUAL CHECK provides access to several diagnostics input tests:
  - Voice Output will verify the audio signals from the navigation system module and audio unit.
  - Hard Switch Test will check the various switches.
  - Microphone Test will check the strength of the voice signal.

Inspection and Verification

1. Verify the customer concern.

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

Visual Inspection Chart

Mechanical	Electrical
● Antenna coaxial cable ● Global positioning system antenna ● Navigation system DVD	● Central junction box (CJB) fuse(s): ■ 4 (15A) ■ 22 (10A) ■ 31 (25A) ● Microphone ● Circuitry ● Navigation system module ● Audio unit

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

4. If the cause is not visually evident, connect the diagnostic tool to the data link connector and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:

- check that the program card is correctly installed.
- check the connections to the vehicle.
- check the ignition switch position.

5. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool operating manual.

6. Carry out the data link diagnostic test. If the diagnostic tool responds with:
   - SCP+, SCP-, or ISO circuit fault; all electronic control units no response/not equipped, refer to Section 418-00 .
   - No response/not equipped for the navigation system module, Go To Pinpoint Test A .
   - System passed, retrieve and record the continuous diagnostic trouble codes (DTCs), clear the continuous DTCs and carry out self-test diagnostics for the navigation system module.

7. If the DTCs retrieved are related to the concern, go to the Navigation System Module Diagnostic Trouble Code (DTC) Index.

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

Navigation System Module Diagnostic Trouble Code (DTC) Index

DTC	Audio Unit Display	Description	Source	Action
B1342	$9342	ECU is Defective	Navigation System Module	CLEAR the DTCs. REPEAT the self-test. If DTC B1342 is retrieved again, INSTALL a new navigation system module. REFER to Navigation System Module—Navigator Built

				After 2/2003 in this section. CLEAR the DTCs. REPEAT the self-test.
B2139	$A139	Data Mismatch	Navigation System Module	CLEAR the DTCs. REPEAT the self-test. If DTC B2139 is retrieved again, REMOVE the navigation system module and SEND it to an authorized Ford audio system repair facility. REFER to Navigation System Module—Navigator Built After 2/2003 in this section. CLEAR the DTCs. REPEAT the self-test.
B2204	$A204	GPS Antenna Connection Open or Short	Navigation System Module	Go To Pinpoint Test B .
B2208	$A208	Navigation to Head Unit Communication Error	Navigation System Module	Go To Pinpoint Test I .
B2477	$A477	Module Configuration Failure	Navigation System Module	CHECK the navigation system module configuration. REFER to Section 418-01 .
B2633	$A633	Driver — Front Microphone Circuit Failure	Navigation System Module	Go To Pinpoint Test J .
B2858	$A858	Satellite ECU is Defective	Navigation System Module	CLEAR the DTCs. REPEAT the self-test. If DTC B2858 is retrieved again, REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. REFER to Section 415-01 . CLEAR the DTCs. REPEAT the self-test.
C1192	$5992	Vehicle Speed Circuit Failure	Navigation System Module	Go To Pinpoint Test C .
U1016	$D016	SCP Invalid Data (PCM)	Navigation System Module	Go To Pinpoint Test K .

For a complete list of navigation system module DTCs, refer to Section 419-10 .

Symptom Chart

Symptom Chart

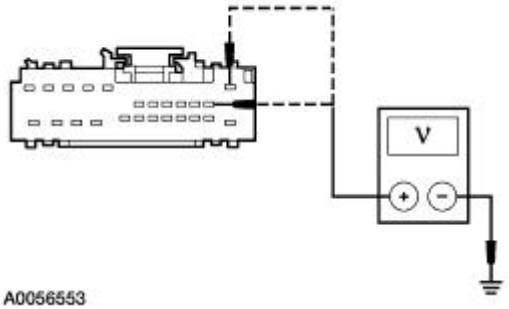
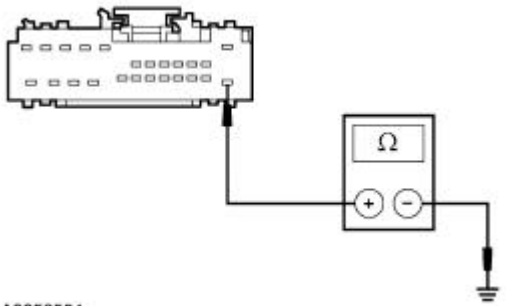
Condition	Possible Sources	Action
• No communication with the navigation system module	• Central junction box (CJB) fuse (s): ■ 4 (15A) ■ 22 (10A) • Circuitry. • Navigation system module.	• Go To Pinpoint Test A .
• Navigation system does not operate correctly — no global positioning system (GPS) antenna signal	• Circuitry. • GPS antenna. • Navigation	• Go To Pinpoint Test B .

	system module.	
• Navigation system does not operate correctly — the position cursor is inoperative	• Circuitry. • Navigation system module.	• Go To Pinpoint Test C .
• Navigation system does not operate correctly — the voice guidance is inoperative/does not operate correctly	• Circuitry. • Audio unit. • Navigation system module.	• Go To Pinpoint Test D .
• Navigation system does not operate correctly — the display screen is inoperative	• Circuitry. • Audio unit. • Navigation system module.	• Go To Pinpoint Test E .
• Navigation system does not operate correctly — the navigation screen is inoperative	• Circuitry. • Audio unit. • Navigation system module.	• Go To Pinpoint Test F .
• Navigation system does not operate correctly — the audible switches are inoperative	• Circuitry. • Audio unit. • Navigation system module.	• Go To Pinpoint Test G .
• Navigation system does not operate correctly — unable to insert or eject a map disc	• Circuitry. • Navigation system module.	• Go To Pinpoint Test H .
• Navigation system does not operate correctly — the audio unit is inoperative	• Central junction box (CJB) fuse (s): ■ 7 (7.5A) ■ 22 (10A) ■ 31 (25A) • Circuitry. • Audio unit. • Navigation system module.	• Go To Pinpoint Test I .

Pinpoint Tests

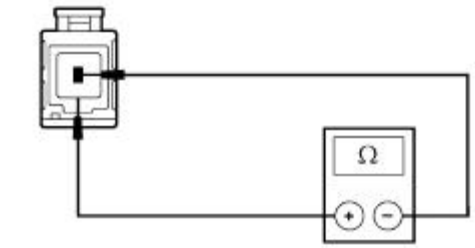
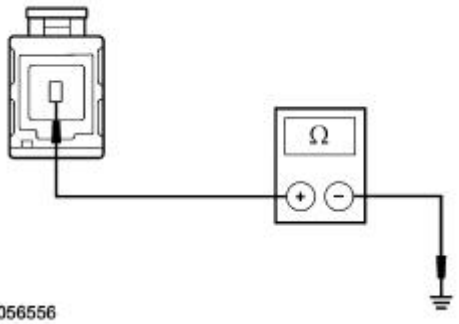
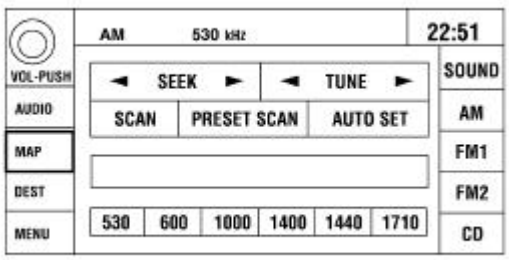
PINPOINT TEST A: NO COMMUNICATION WITH THE NAVIGATION SYSTEM MODULE

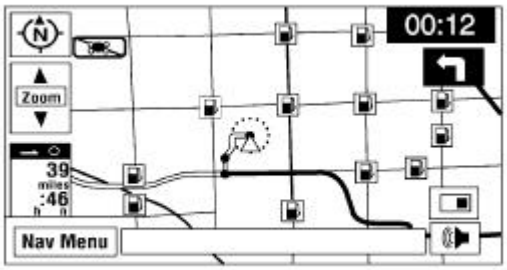
Test Step	Result / Action to Take
A1 CHECK CIRCUITS 720 (RD/YE) AND 194 (PK) FOR VOLTAGE	
• Key in OFF position. • Disconnect: Navigation System Module C2279a. • Key in ON position. • Measure the voltage between the navigation system module C2279a pin 1, circuit 720 (RD/YE), harness side and ground; and between the navigation system module C2279a pin 2, circuit 194 (PK), harness side and ground.	**Yes** GO to A2 . **No** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.

 A0056553 ● **Are the voltages greater than 10.5 volts?**	
A2 CHECK CIRCUIT 694 (BK/LG) FOR AN OPEN	**Yes** REFER to Section 418-00 to continue communication diagnostics. **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
● Key in OFF position. ● Measure the resistance between the navigation system module C2279a pin 13, circuit 694 (BK/LG), harness side and ground.  A0056554 ● **Is the resistance less than 5 ohms?**	

PINPOINT TEST B: NAVIGATION SYSTEM DOES NOT OPERATE CORRECTLY — NO GLOBAL POSITIONING SYSTEM (GPS) ANTENNA SIGNAL

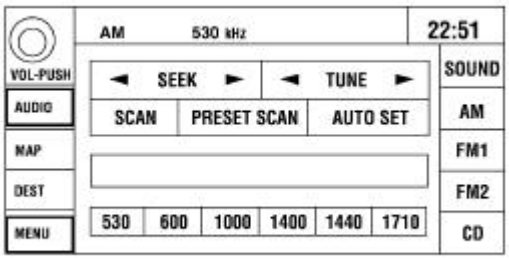
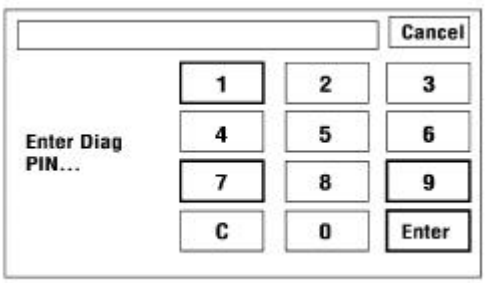
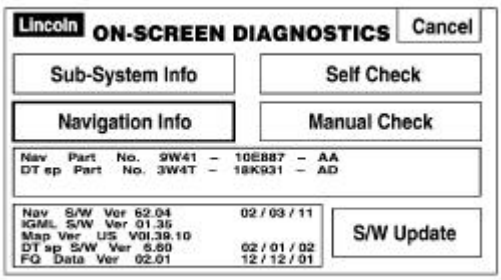
Test Step	Result / Action to Take
NOTE: The vehicle must be driven outside of any enclosed structure to an area that is unobstructed by trees, tall buildings, and bridges.	
B1 CHECK THE RECORDED DIAGNOSTIC TROUBLE CODES (DTCS) FROM THE NAVIGATION SYSTEM MODULE	
● Use the recorded results from the navigation system module self-test. ● **Are any DTCs recorded?**	**Yes** For DTC B2204, GO to B2 . For all other navigation system module DTCs, REFER to the Navigation System Module Diagnostic Trouble Code (DTC) Index in this section. **No** GO to B4 .
B2 CHECK THE GPS ANTENNA	
● Key in OFF position. ● Disconnect: GPS Antenna C2279b. ● Measure the resistance between the GPS antenna	**Yes** GO to B3 .

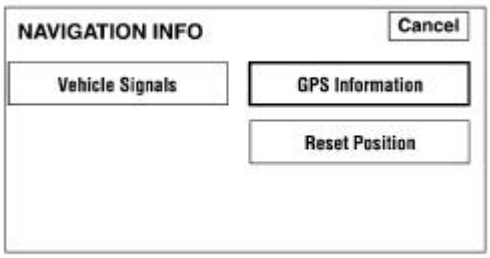
center conductor pin, component side and the GPS antenna shield, component side.  A0056767 • **Is the resistance between 80 and 125 ohms?**	**No** INSTALL a new GPS antenna. REFER to Global Positioning System (GPS) Antenna—Navigator Built After 2/2003 in this section. CLEAR the DTCs. REPEAT the self-test.
B3 CHECK THE GPS ANTENNA CENTER CONDUCTOR FOR A SHORT TO GROUND	
• Measure the resistance between the GPS antenna center conductor pin, component side and ground.  A0056556 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to B7 . **No** INSTALL a new GPS antenna. REFER to Global Positioning System (GPS) Antenna—Navigator Built After 2/2003 in this section. CLEAR the DTCs. REPEAT the self-test.
B4 CHECK THE NAVIGATION SYSTEM	
• Move the vehicle outside of any enclosed structure to an area that is unobstructed by trees, tall buildings, and bridges. • Turn the audio unit on. • Press the MAP button.  A0065067 • Monitor the GPS icon.	**Yes** The system is operating correctly at this time. **No** GO to B5 .



A0057837

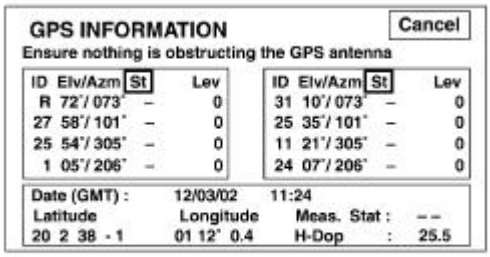
- **Does the GPS icon disappear?**

B5 CHECK THE GPS SIGNAL STATUS	
• Press and hold the AUDIO and MENU buttons for 5 seconds.  A0055102 • Press 917 Enter.  A0055103 • Select Navigation Info.  A0055104 • Select GPS Information.	**Yes** The system is operating correctly at this time. **No** GO to B6 .



A0055105

- Monitor the GPS status.

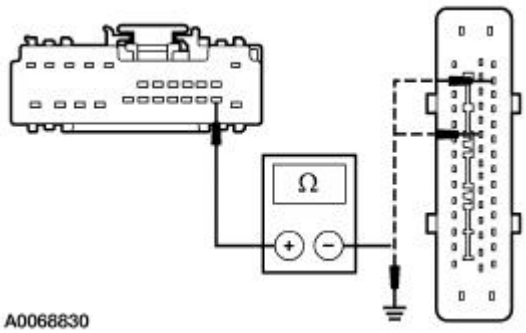


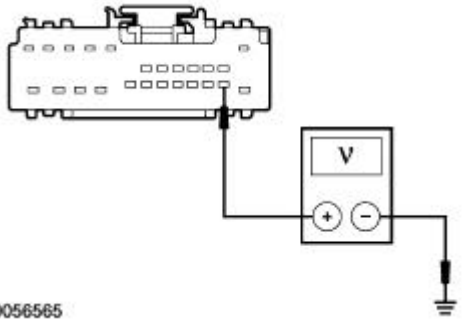
A0055106

- **After 10 minutes, does the ST (status) column of the GPS information display P (position) or T (tracking)?**

B6 SUBSTITUTE THE GPS ANTENNA	
• Substitute a known good GPS antenna. • **After 10 minutes, does the ST (status) column of the GPS information display P (position) or T (tracking)?**	**Yes** INSTALL a new GPS antenna. REFER to Global Positioning System (GPS) Antenna—Navigator Built After 2/2003 in this section. CLEAR the DTCs. REPEAT the self-test. **No** REINSTALL the original antenna. GO to B7 .
B7 CHECK FOR CORRECT NAVIGATION SYSTEM MODULE OPERATION	
• Disconnect all navigation system module connectors. • Check for: ◦ corrosion ◦ pushed-out pins • Connect all navigation system module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new navigation system module. REFER to Navigation System Module—Navigator Built After 2/2003 in this section. CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

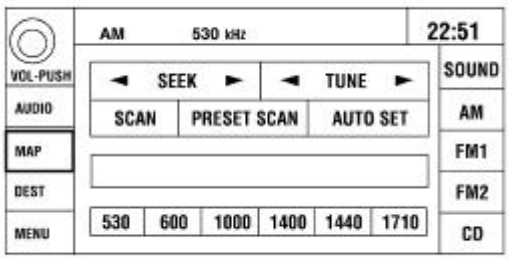
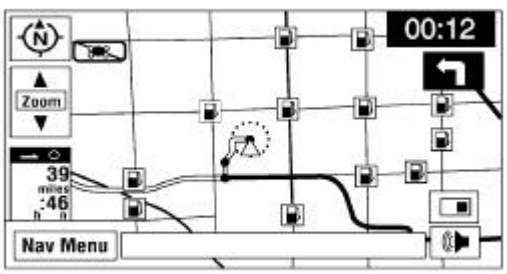
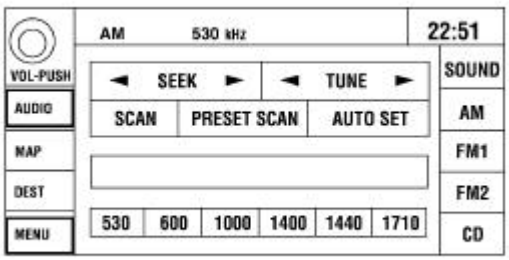
PINPOINT TEST C: NAVIGATION SYSTEM DOES NOT OPERATE CORRECTLY — THE POSITION CURSOR IS INOPERATIVE

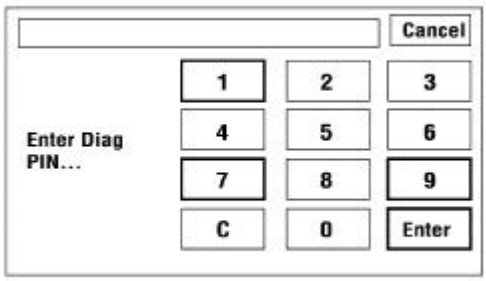
Test Step	Result / Action to Take
NOTE: Outdated map disc information may cause this symptom to recur at the same place.	
C1 CHECK THE RECORDED DIAGNOSTIC TROUBLE CODES (DTCS) FROM THE NAVIGATION SYSTEM MODULE • Use the recorded results from the navigation system module self-test. • **Are any DTCs recorded?**	**Yes** For DTC C1192, GO to C2. For all other navigation system module DTCs, REFER to the Navigation System Module Diagnostic Trouble Code (DTC) Index in this section. **No** GO to C4.
C2 CHECK CIRCUIT 565 (BK/WH) FOR AN OPEN AND A SHORT TO GROUND • Key in OFF position. • Disconnect: Anti-lock Brake System (ABS) Module C135. • Disconnect: Navigation System Module C2279a. • Measure the resistance between the navigation system module C2279a pin 14, circuit 565 (BK/WH), harness side and the ABS module C135 pin 22 (with stability assist) or pin 3 (without stability assist), circuit 565 (BK/WH), harness side; and between the navigation system module C2279a pin 14, circuit 565 (BK/WH), harness side and ground.  A0068830 • **Is the resistance less than 5 ohms between the ABS module and the navigation system module; and is the resistance greater than 10,000 ohms between the navigation system module and ground?**	**Yes** GO to C3. **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
C3 CHECK CIRCUIT 565 (BK/WH) FOR A SHORT TO VOLTAGE • Key in ON position. • Measure the voltage between the navigation system module C2279a pin 14, circuit 565 (BK/WH), harness side and ground.	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. **No** GO to C9.



A0056565

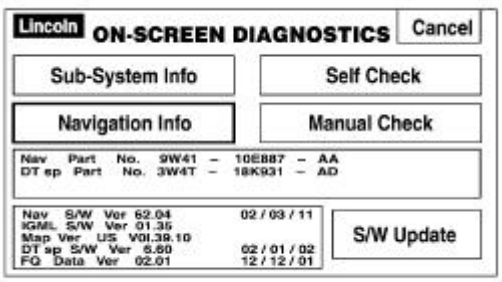
- **Is any voltage indicated?**

C4 CHECK THE NAVIGATION SYSTEM GPS INPUT	
• Move the vehicle outside of any enclosed structure to an area that is unobstructed by trees, tall buildings, and bridges. • Turn the audio unit on. • Press the MAP button.  A0065067 • Monitor the GPS icon.  A0057837 • **Does the GPS icon disappear?**	**Yes** GO to C5 . **No** Go To Pinpoint Test B to diagnose the GPS antenna.
C5 CHECK THE VEHICLE SPEED SIGNAL INPUT	
• Press and hold the AUDIO and MENU buttons for 5 seconds.  A0055102 • Press 917 Enter.	**Yes** GO to C7 . **No** If the speedometer is inoperative, REFER to Section 413-01 . If the speedometer is inaccurate, GO to C6 .



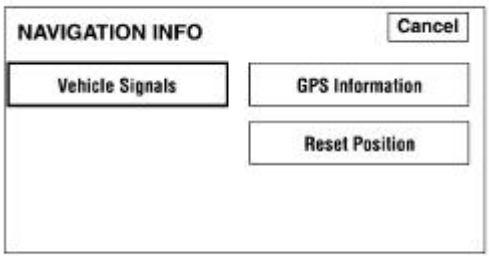
A0055103

- Select Navigation Info.



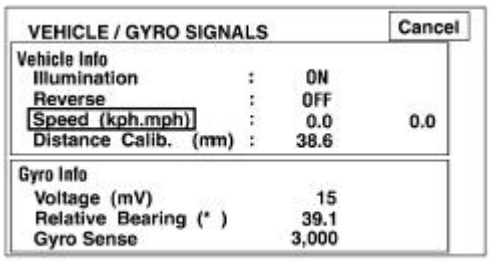
A0055104

- Select Vehicle Signals.



A0055107

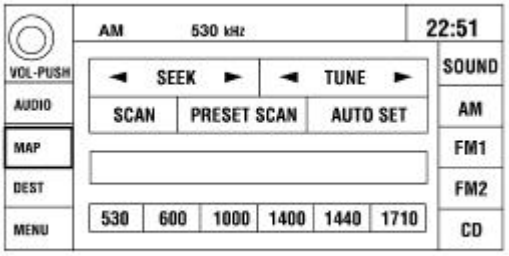
- Drive the vehicle at a minimum speed of 5 km/h (3 mph).



A0055108

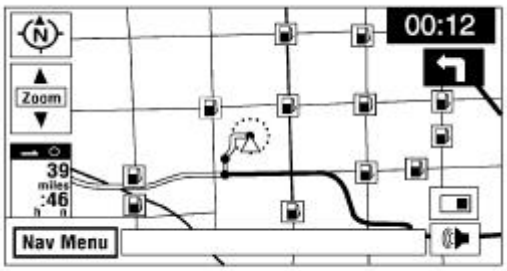
- **Does the vehicle SPEED signal correspond to the speed indicated on the vehicle speedometer?**

C6 CHECK THE VEHICLE SPEED SIGNAL CALIBRATION	
• Select Cancel to exit from the diagnostic screens. • Press the MAP button.	**Yes** The system is operating correctly at this time. Concern may have been caused by a speed signal calibration error. **No** GO to C8 .



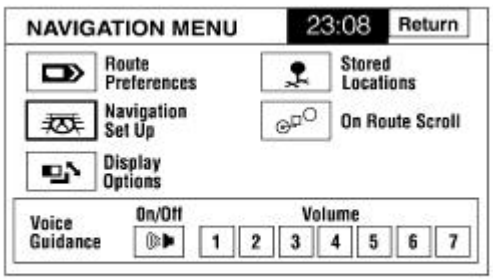
A0065067

- Select Nav Menu.



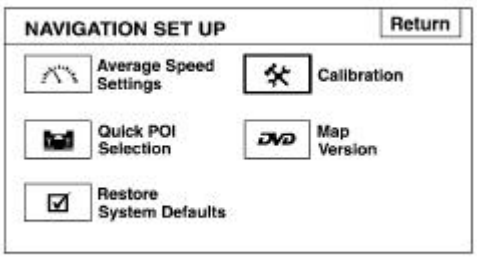
A0057838

- Select Navigation Set Up.



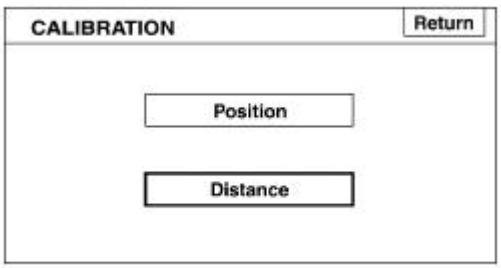
A0055110

- Select Calibration.



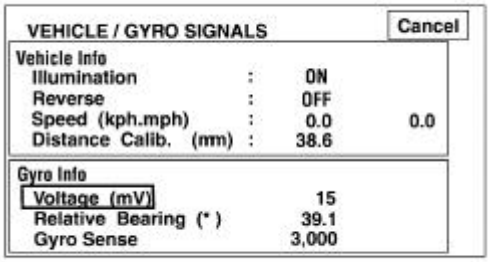
A0055111

- Select Distance.



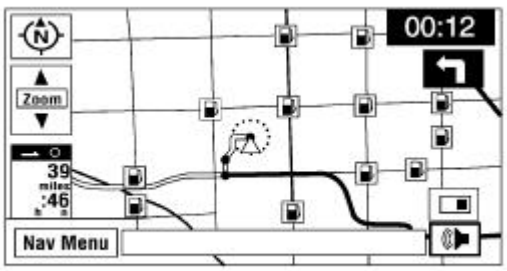
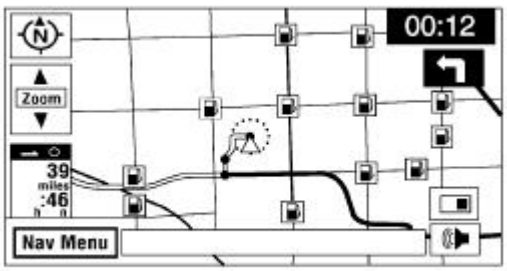
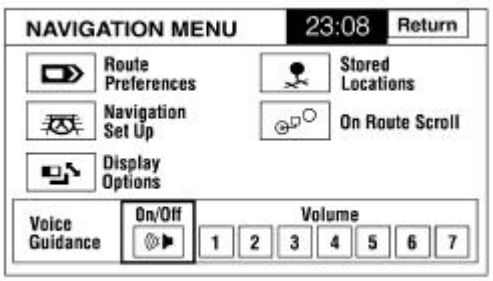
A0055112

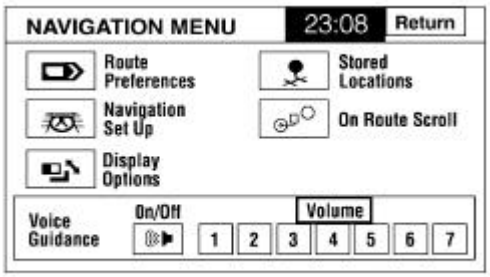
- Drive the vehicle a minimum of 10 km (6.25 miles).

• **Does the position cursor operate correctly?**	
C7 CHECK THE GYROSCOPE SIGNAL	
• Monitor the gyro voltage.  A0055113 • Drive the vehicle turning left and right. • **Does the gyro voltage change when the vehicle turns left or right?**	**Yes** GO to C8 . **No** The gyroscope is integral to the navigation system module. INSTALL a new navigation system module. REFER to Navigation System Module—Navigator Built After 2/2003 in this section. CLEAR the DTCs. REPEAT the self-test.
C8 CHECK FOR CORRECT NAVIGATION SYSTEM MODULE OPERATION	
• Disconnect all navigation system module connectors. • Check for: • corrosion • pushed-out pins • Connect all navigation system module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new navigation system module. REFER to Navigation System Module—Navigator Built After 2/2003 in this section. CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
C9 CHECK FOR CORRECT ABS MODULE OPERATION	
• Disconnect all ABS module connectors. • Check for: • corrosion • pushed-out pins • Connect all ABS module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ABS module. REFER to Section 206-09A or Section 206-09B . CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST D: NAVIGATION SYSTEM DOES NOT OPERATE

CORRECTLY — THE VOICE GUIDANCE IS INOPERATIVE/DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
D1 CHECK THE SPEAKERS	
• Key in ON position. • Turn the audio unit on. • Carry out the speaker walk around self-test by pressing and holding the MAP and DEST buttons on the audio unit while in AM or FM mode for 5 seconds. • **Do the speakers operate correctly?**	**Yes** GO to D2 . **No** REFER to Section 415-00 to diagnose the audio system.
D2 CALCULATE A VEHICLE ROUTE	
• Calculate a vehicle route by setting a desired destination. • Press the voice icon on the present position screen.  A0057839 • **Does the voice guidance system operate correctly?**	**Yes** The system is operating correctly at this time. **No** GO to D3 .
D3 CHECK THE VOICE GUIDANCE SYSTEM	
• Select Nav Menu.  A0057838 • Select Voice Guidance.  A0055114 • **Is the voice guidance system on the navigation menu turned ON?**	**Yes** GO to D4 . **No** Turn the voice guidance system ON. CLEAR the DTCs. REPEAT the self-test.
D4 CHECK THE VOICE GUIDANCE VOLUME	
• Select Volume.	**Yes**



A0055115

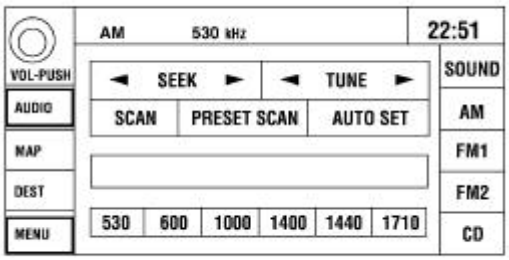
- **Is the volume adjustment set to minimum?**

Increase the sound volume. CLEAR the DTCs. REPEAT the self-test.

No
GO to D5 .

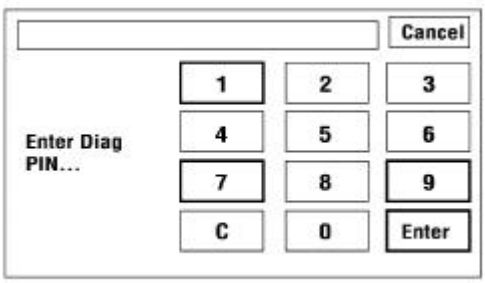
D5 CHECK THE AUDIO UNIT OUTPUT

- Press and hold the AUDIO and MENU buttons for 5 seconds.



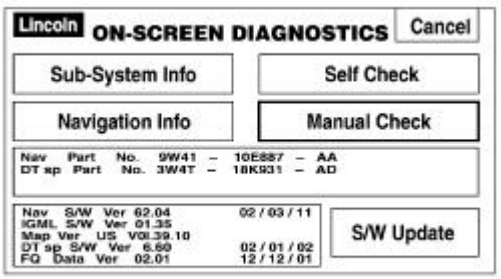
A0055102

- Press 917 Enter.



A0055103

- Select Manual Check.

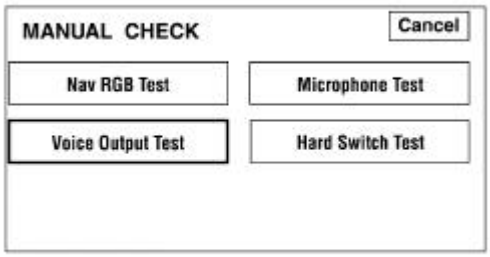


A0055116

- Select Voice Output Test.

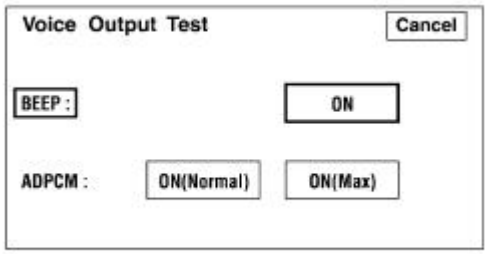
Yes
GO to D6 .

No
REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. REFER to Section 415-01 . CLEAR the DTCs. REPEAT the self-test.



A0055117

- Select BEEP On.

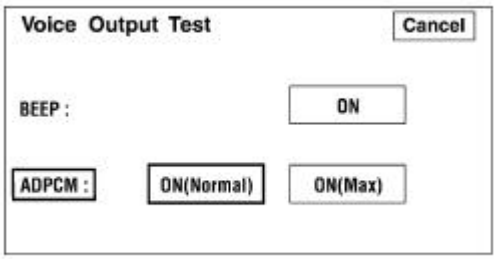


A0055118

- **Was a tone emitted by the audio unit?**

D6 CHECK THE NAVIGATION SYSTEM MODULE OUTPUT

- Select ADPCM ON (Normal).



A0055119

- **Was a tone emitted by the navigation system module?**

Yes
GO to D9 .

No
GO to D7 .

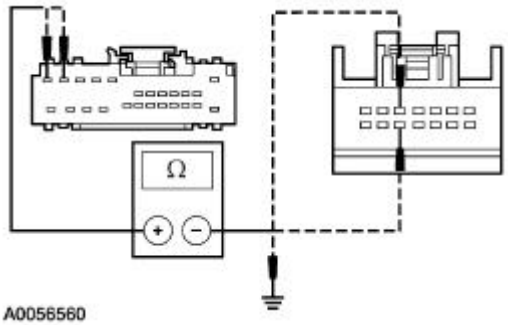
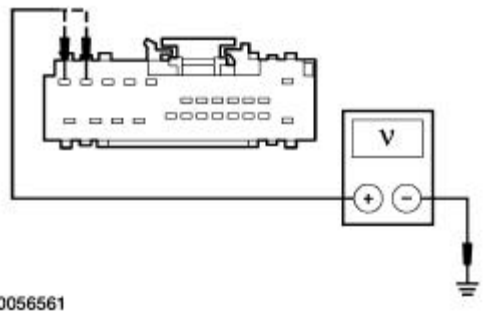
D7 CHECK CIRCUITS 1530 (LB) AND 1531 (LG) FOR AN OPEN AND A SHORT TO GROUND

- Key in OFF position.
- Disconnect: Audio Unit C2253c.
- Disconnect: Navigation System Module C2279a.
- Measure the resistances between the navigation system module C2279a pins, harness side and the audio unit C2253c pins, harness side; and between the navigation system module C2279a pins, harness side and ground as follows:

Navigation System Module	Audio Unit	Circuit
C2279a pin 11	C2253c pin 5	1530 (LB)
C2279a pin 12	C2253c pin 12	1531 (LG)

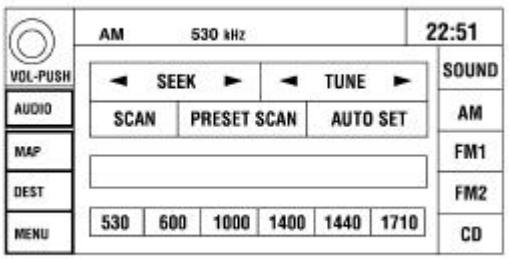
Yes
GO to D8 .

No
REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.

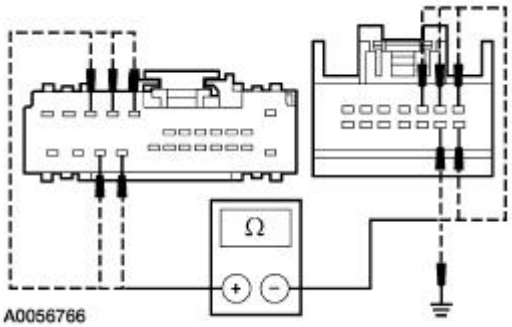
 A0056560 ● **Are the resistances less than 5 ohms between the navigation system module and the audio unit; and are the resistances greater than 10,000 ohms between the navigation system module and ground?**	
D8 CHECK CIRCUITS 1530 (LB) AND 1531 (LG) FOR A SHORT TO BATTERY	
● Key in ON position. ● Measure the voltage between the navigation system module C2279a pin 11, circuit 1530 (LB), harness side and ground; and between the navigation system module C2279a pin 12, circuit 1531 (LG), harness side and ground.  A0056561 ● **Is any voltage indicated?**	**Yes** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test. **No** GO to D9 .
D9 CHECK FOR CORRECT NAVIGATION SYSTEM MODULE OPERATION	
● Disconnect all navigation system module connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all navigation system module connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new navigation system module. REFER to Navigation System Module—Navigator Built After 2/2003 in this section. CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST E: NAVIGATION SYSTEM DOES NOT OPERATE

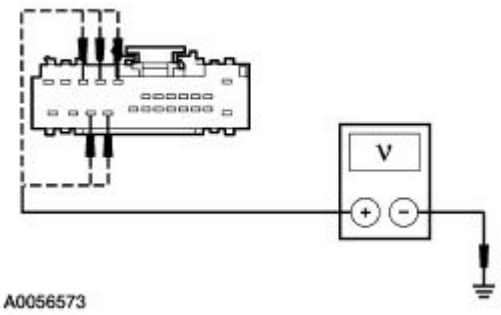
CORRECTLY — THE DISPLAY SCREEN IS INOPERATIVE

Test Step	Result / Action to Take
E1 CHECK THE RECORDED DIAGNOSTIC TROUBLE CODES (DTCS) FROM THE NAVIGATION SYSTEM MODULE ● Use the recorded results from the navigation system module self-test. ● **Are any DTCs recorded?**	**Yes** For DTC B2208, Go To Pinpoint Test I to diagnose the controller area network (CAN) circuits. For all other navigation system module DTCs, REFER to the Navigation System Module Diagnostic Trouble Code (DTC) Index in this section. **No** GO to E2 .
E2 CHECK THE AUDIO UNIT BUTTONS ● Press the MAP, AUDIO, DEST, and MENU buttons.  A0065066 ● **Does the display screen operate correctly?**	**Yes** The system is operating correctly at this time. Concern may have been caused by SCREEN OFF selection on MENU screen. **No** GO to E3 .
E3 CHECK THE VIDEO AND SYNCHRONIZATION CIRCUITS FOR AN OPEN AND A SHORT TO GROUND ● Key in OFF position. ● Disconnect: Audio Unit C2253c. ● Disconnect: Navigation System Module C2279a. ● Measure the resistances between the navigation system module C2279a pins, harness side and the audio unit C2253c pins, harness side; and between the navigation system module C2279a pins, harness side and ground as follows:	**Yes** GO to E4 . **No** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.

Navigation System Module	Audio Unit	Circuit
C2279a pin 8	C2253c pin 1	1534 (BK)
C2279a pin 9	C2253c pin 8	1536 (BK)
C2279a pin 10	C2253c pin 3	1538 (YE/RD)
C2279a pin 21	C2253c pin 2	1535 (BK)
C2279a pin 22	C2253c pin 9	1537 (RD)

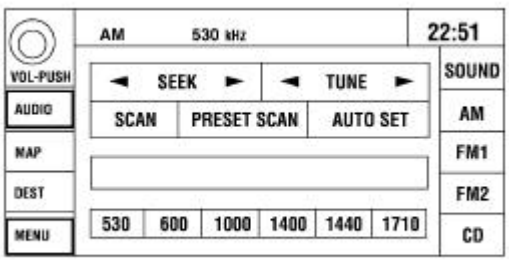
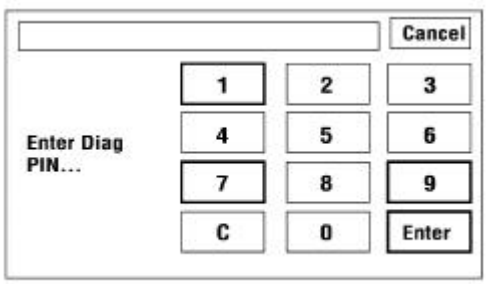


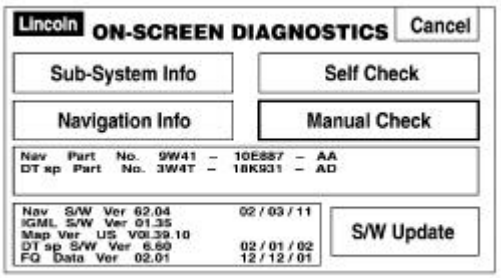
- **Are the resistances less than 5 ohms between the navigation system module and the audio unit; and are the resistances greater than 10,000 ohms between the navigation system module and ground?**

E4 CHECK THE VIDEO AND SYNCHRONIZATION CIRCUITS FOR A SHORT TO BATTERY	
• Key in ON position. • Measure the voltage between the navigation system module C2279a pins, harness side and ground as follows: **Navigation System Module** / **Circuit** C2279a pin 8 — 1534 (BK) C2279a pin 9 — 1536 (BK) C2279a pin 10 — 1538 (YE/RD) C2279a pin 21 — 1535 (BK) C2279a pin 22 — 1537 (RD)  • **Is any voltage indicated?**	**Yes** REPAIR the circuit the question. CLEAR the DTCs. REPEAT the self-test. **No** GO to E5 .
E5 SUBSTITUTE THE AUDIO UNIT	
• Substitute a known good audio unit. • **Does the screen display appear?**	**Yes** REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. REFER to Section 415-01 . CLEAR the DTCs. REPEAT the self-test. **No** REINSTALL the original audio unit. GO to E6 .
E6 CHECK FOR CORRECT NAVIGATION SYSTEM MODULE	

OPERATION	
• Disconnect all navigation system module connectors. • Check for: • corrosion • pushed-out pins • Connect all navigation system module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new navigation system module. REFER to Navigation System Module—Navigator Built After 2/2003 in this section. CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

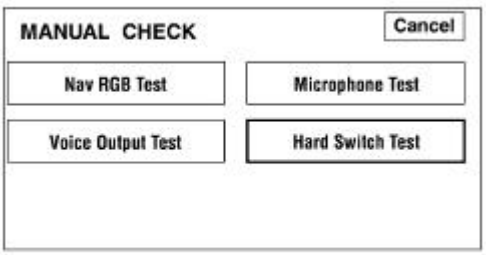
PINPOINT TEST F: NAVIGATION SYSTEM DOES NOT OPERATE CORRECTLY — THE NAVIGATION SCREEN IS INOPERATIVE

Test Step	Result / Action to Take
F1 CHECK THE SWITCH DISPLAY	
• Key in ON position. • Turn the audio unit on. • Press and hold the AUDIO and MENU buttons for 5 seconds.  A0055102 • Press 917 Enter.  A0055103 • Select Manual Check.	**Yes** GO to F2 . **No** REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. REFER to Section 415-01 . CLEAR the DTCs. REPEAT the self-test.



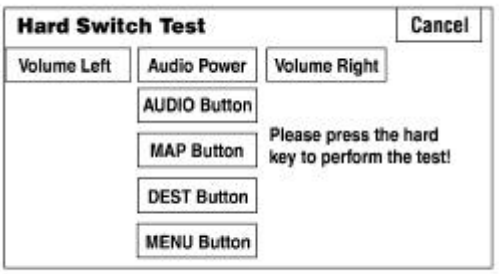
A0055116

- Select Hard Switch Test.



A0055120

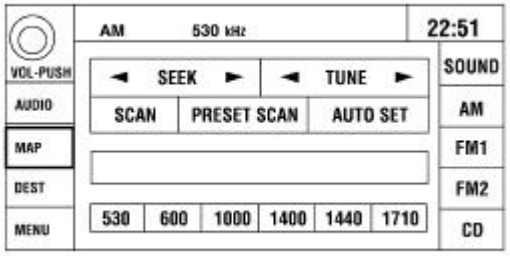
- Push each switch on the display.



A0055121

- **Are all of the switches operating correctly?**

F2 CHECK THE MAP DISC SURFACE	
• Key in OFF position. • Key in ON position. • Remove and visually inspect the map disc surface. • **Is the map disc dirty or scratched?**	**Yes** INSTALL a new map disc. CLEAR the DTCs. REPEAT the self-test. **No** REINSTALL the map disc. GO to F3.
F3 CHECK THE MAP DISPLAY	
• Key in OFF position. • Key in ON position. • Press the MAP button.	**Yes** The system is operating correctly at this time. **No** GO to F4.

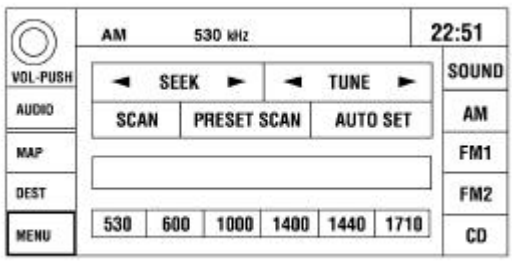


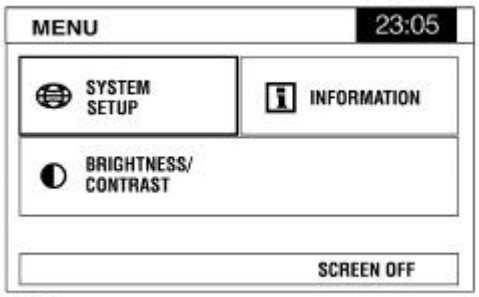
A0065067

- **Is the map displayed?**

F4 CHECK FOR CORRECT NAVIGATION SYSTEM MODULE OPERATION	
• Disconnect all navigation system module connectors. • Check for: • corrosion • pushed-out pins • Connect all navigation system module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new navigation system module. REFER to Navigation System Module—Navigator Built After 2/2003 in this section. CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

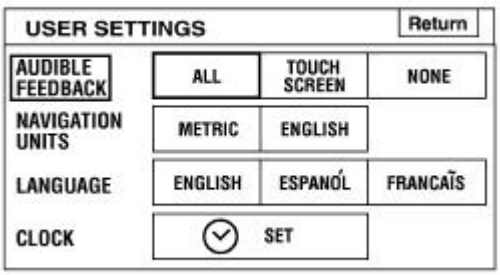
PINPOINT TEST G: NAVIGATION SYSTEM DOES NOT OPERATE CORRECTLY — THE AUDIBLE SWITCHES ARE INOPERATIVE

Test Step	Result / Action to Take
G1 CHECK THE SWITCH DISPLAY	
• Key in ON position. • Turn the audio unit on. • Press the MENU button.  A0066586 • Select SYSTEM SETUP.	**Yes** Select ALL. CLEAR the DTCs. REPEAT the self-test. **No** REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. REFER to Section 415-01 . CLEAR the DTCs. REPEAT the self-test.



A0055122

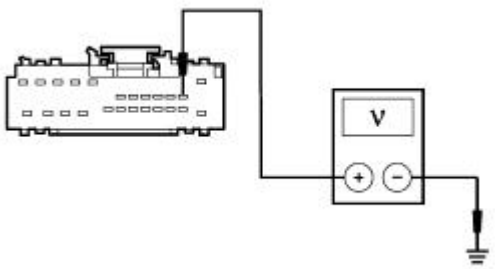
- Select AUDIBLE FEEDBACK.

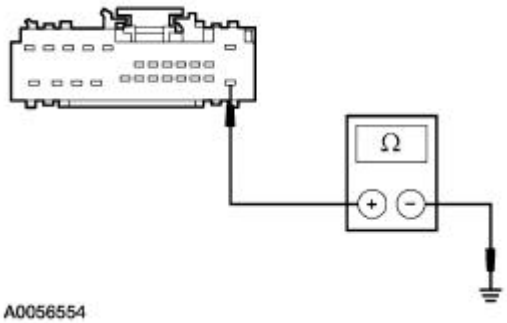


A0067803

- **Is NONE highlighted on the audible feedback settings?**

PINPOINT TEST H: NAVIGATION SYSTEM DOES NOT OPERATE CORRECTLY — UNABLE TO INSERT OR EJECT A MAP DISC

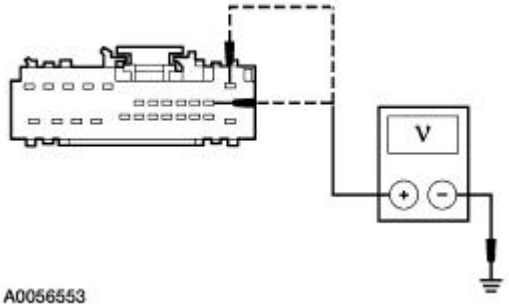
Test Step	Result / Action to Take
H1 CHECK CIRCUIT 194 (PK) FOR VOLTAGE	
• Key in OFF position. • Disconnect: Navigation System Module C2279a. • Key in ON position. • Measure the voltage between the navigation system module C2279a pin 2, circuit 194 (PK), harness side and ground.  A0056574 • **Is the voltage greater than 10 volts?**	**Yes** GO to H2 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
H2 CHECK CIRCUIT 694 (BK/LG) FOR AN OPEN	
• Key in OFF position. • Measure the resistance between the navigation system module C2279a pin 13, circuit 694 (BK/LG), harness side and ground.	**Yes** GO to H3 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

 A0056554 ● **Is the resistance less than 5 ohms?**	
H3 CHECK FOR CORRECT NAVIGATION SYSTEM MODULE OPERATION	
● Disconnect all navigation system module connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all navigation system module connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new navigation system module. REFER to Navigation System Module—Navigator Built After 2/2003 in this section. CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST I: NAVIGATION SYSTEM DOES NOT OPERATE CORRECTLY — THE AUDIO UNIT IS INOPERATIVE

Test Step	Result / Action to Take
I1 CHECK THE RECORDED DTCS FROM THE NAVIGATION SYSTEM MODULE	
● Use the recorded results from the navigation system module self-test. ● **Are any DTCs recorded?**	**Yes** For DTC B2208, GO to I2 . For all other navigation system module DTCs, REFER to the Navigation System Module Diagnostic Trouble Code (DTC) Index in this section. **No** Go To Pinpoint Test E to diagnose the video circuits.
I2 CHECK CIRCUITS 797 (LG/VT) AND 194 (PK) FOR VOLTAGE	
● Key in OFF position. ● Disconnect: Audio Unit C2253a. ● Key in ON position.	**Yes** GO to I3 .

- Measure the voltage between the audio unit C2253a pin 1, circuit 797 (LG/VT), harness side and ground; and between the audio unit C2253a pin 2, circuit 194 (PK), harness side and ground.

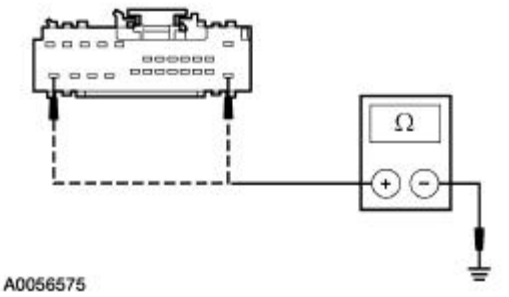


- **Are the voltages greater than 10.5 volts?**

No
REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.

I3 CHECK CIRCUIT 694 (BK/LG) FOR AN OPEN

- Key in OFF position.
- Measure the resistance between the audio unit C2253a pin 13, circuit 694 (BK/LG), harness side and ground; and between the audio unit C2253a pin 24, circuit 694 (BK/LG), harness side and ground.



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

Yes
GO to I4 .

No
REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.

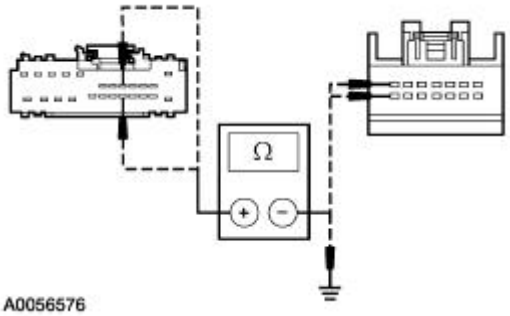
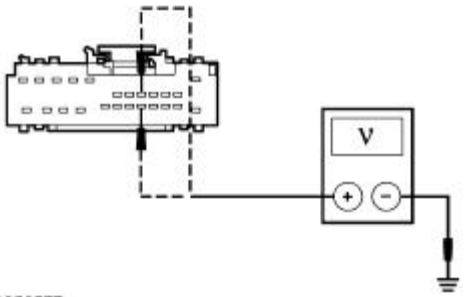
I4 CHECK CIRCUITS 1532 (DB/WH) AND 1533 (DG/OG) FOR AN OPEN AND A SHORT TO GROUND

- Disconnect: Navigation System Module C2279a.
- Disconnect: Audio Unit C2253c.
- Measure the resistances between the navigation system module C2279a pins, harness side and the audio unit C2253c pins, harness side; and between the navigation system module C2279a pins, harness side and ground as follows:

Navigation System Module	Audio Unit	Circuit
C2279a pin 5	C2253c pin 7	1532 (DB/WH)
C2279a pin 17	C2253c pin 14	1533 (DG/OG)

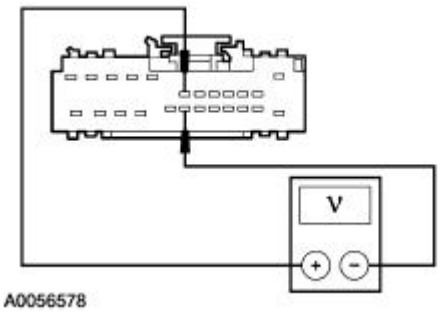
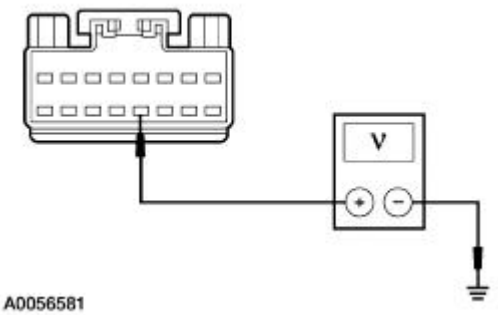
Yes
GO to I5 .

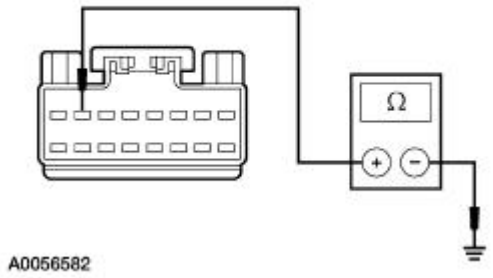
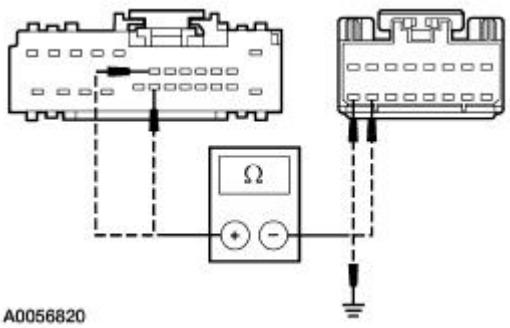
No
REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.

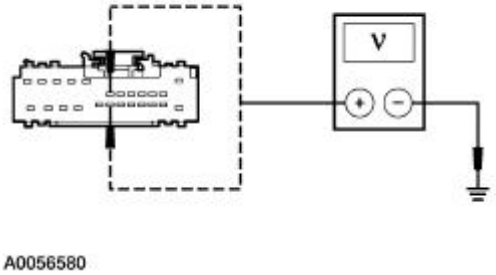
 A0056576 ● **Are the resistances less than 5 ohms between the navigation system module and the audio unit; and are the resistances greater than 10,000 ohms between the navigation system module and ground?**	
I5 CHECK CIRCUITS 1532 (DB/WH) AND 1533 (DG/OG) FOR A SHORT TO BATTERY	
● Key in ON position. ● Measure the voltage between the navigation system module C2279a pin 5, circuit 1532 (DB/WH), harness side and ground; and between the navigation system module C2279a pin 17, circuit 1533 (DG/OG), harness side and ground.  A0056577 ● **Is any voltage indicated?**	**Yes** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test. **No** GO to I6 .
I6 SUBSTITUTE THE AUDIO UNIT	
● Substitute a known good audio unit. ● Repeat the navigation system module self-test. ● **Is DTC B2208 present?**	**Yes** REINSTALL the original audio unit. GO to I7 . **No** REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. REFER to Section 415-01 . CLEAR the DTCs. REPEAT the self-test.
I7 CHECK FOR CORRECT NAVIGATION SYSTEM MODULE OPERATION	
● Disconnect all navigation system module connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all navigation system module connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new navigation system module. REFER to Navigation System Module—Navigator Built After 2/2003 in this section. CLEAR the DTCs. REPEAT the self-

	test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST J: DTC B2633 DRIVER — FRONT MICROPHONE CIRCUIT FAILURE

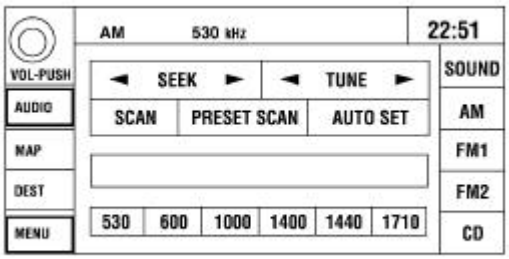
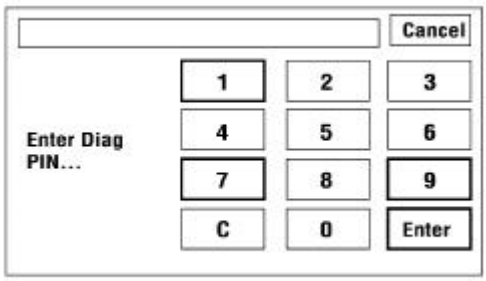
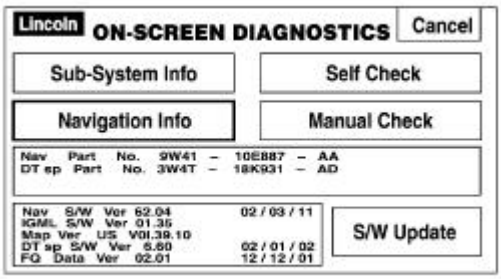
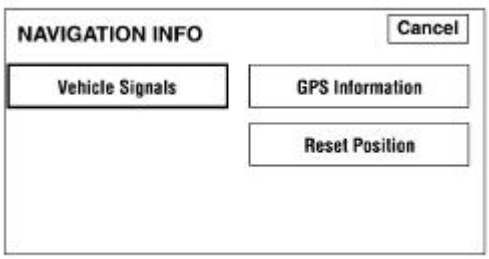
Test Step	Result / Action to Take
J1 CHECK THE VOICE SIGNAL INPUT	
• Key in OFF position. • Disconnect: Navigation System Module C2279a. • Key in ON position. • Measure the voltage between the navigation system module C2279a pin 7, circuit 714 (VT), harness side and between the navigation system module C2279a pin 19, circuit 713 (WH), harness side while speaking loudly into the rear view mirror microphone.  A0056578 • **Is any AC voltage indicated?**	**Yes** GO to J6 . **No** GO to J2 .
J2 CHECK CIRCUIT 194 (PK) FOR VOLTAGE	
• Key in OFF position. • Disconnect: Rear View Mirror C9012. • Key in ON position. • Measure the voltage between the rear view mirror C9012 pin 13, circuit 194 (PK), harness side and ground.  A0056581 • **Is the voltage greater than 10 volts?**	**Yes** GO to J3 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
J3 CHECK CIRCUIT 875 (BK/LB) FOR AN OPEN	

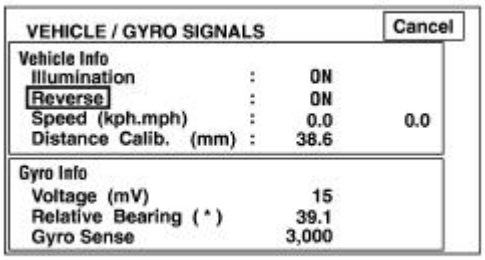
• Key in OFF position. • Measure the resistance between the rear view mirror C9012 pin 2, circuit 875 (BK/LB), harness side and ground.  A0056582 • **Is the resistance less than 5 ohms?**	**Yes** GO to J4 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
J4 CHECK CIRCUITS 713 (WH) AND 714 (VT) FOR AN OPEN AND A SHORT TO GROUND	
• Measure the resistances between the navigation system module C2279a pins, harness side and the rear view mirror C9012 pins, harness side; and between the navigation system module C2279a pins, harness side and ground as follows: **Navigation System Module** / **Rear View Mirror** / **Circuit** C2279a pin 7 / C9012 pin 9 / 714 (VT) C2279a pin 19 / C9012 pin 10 / 713 (WH)  A0056820 • **Are the resistances less than 5 ohms between the navigation system module and the rear view mirror; and are the resistances greater than 10,000 ohms between the navigation system module and ground?**	**Yes** GO to J5 . **No** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.
J5 CHECK CIRCUITS 713 (WH) AND 714 (VT) FOR A SHORT TO VOLTAGE	
• Key in ON position. • Measure the voltage between the navigation system module C2279a pin 7, circuit 714 (VT), harness side and ground; and between the navigation system module C2279a pin 19, circuit 713 (WH), harness side and ground.	**Yes** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new rear view mirror. REFER to Section 501-09 . CLEAR the DTCs. REPEAT the self-test.

 A0056580 ● **Is any voltage indicated?**	
J6 CHECK FOR CORRECT NAVIGATION SYSTEM MODULE OPERATION ● Disconnect all navigation system module connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all navigation system module connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new navigation system module. REFER to Navigation System Module—Navigator Built After 2/2003 in this section. CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST K: DTC U1016 — SCP INVALID DATA

Test Step	Result / Action to Take
K1 CHECK THE RECORDED DIAGNOSTIC TROUBLE CODES (DTCS) FROM THE POWERTRAIN CONTROL MODULE (PCM) ● Use the recorded results from the PCM self-test. ● **Are any DTCs recorded?**	**Yes** For PXXX DTCs, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. For all other DTCs, REFER to Section 419-10 . **No** GO to K2 .
K2 CHECK THE PCM REVERSE SIGNAL ● Enter the following diagnostic mode on the diagnostic tool: PCM PID monitor. ● Monitor the transmission range (TR) sensor PID. ● Place the TR selector lever in reverse. ● **Does the TR sensor PID indicate correctly?**	**Yes** GO to K3 . **No** REFER to Section 307-01A or Section 307-01B to continue

	diagnosis of the reverse signal.
K3 CHECK THE NAVIGATION SYSTEM MODULE REVERSE SIGNAL ● Press and hold the AUDIO and MENU buttons for 5 seconds.  A0055102 ● Press 917 Enter.  A0055103 ● Select Navigation Info.  A0055104 ● Select Vehicle Signals.  A0055107 ● Monitor the reverse signal.	**Yes** CLEAR the DTCs. REPEAT the self-test. If DTC U1016 is retrieved again, GO to K4 . **No** GO to K4 .



A0068110

- **Does the reverse signal indicate ON?**

K4 CHECK FOR CORRECT NAVIGATION SYSTEM MODULE OPERATION	
• Disconnect all navigation system module connectors. • Check for: • corrosion • pushed-out pins • Connect all navigation system module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new navigation system module. REFER to Navigation System Module—Navigator Built After 2/2003 in this section. CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Navigation System

Refer to Wiring Diagrams Cell 130 for schematic and connector information.

Principles of Operation

Navigation System

The navigation system is integral to the audio unit. The audio unit controls the operation and interface between the user, the vehicle subsystems and the external components. A map compact disc (CD) stored in the audio unit will visually guide the user of the maneuvers required to arrive at the destination entered.

In order to calculate initial vehicle position, a global positioning system (GPS) antenna is used to track several available satellites simultaneously. The GPS antenna only receives data and does not communicate with the satellites. A hardwired reverse input from the transmission range sensor and a hardwired vehicle speed input from the anti-lock brake system (ABS) module are also used to improve the accuracy of the navigation system.

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
● GPS antenna ● Navigation system CD ● Audio unit	● Central junction box (CJB) fuse(s): ■ 7 (7.5A) ■ 22 (10A) ■ 31 (25A) ● Circuitry

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and GO to Symptom Chart .

Upgrading The Audio Unit Software

To perform an audio unit software upgrade the following steps must be taken:

1. Turn the ignition switch to the ON or ACC position.
2. Turn the audio unit ON.
3. Install a new database CD.

4. If the audio unit recognizes a revised level of software it will prompt the user to confirm whether they would like to carry out a software upgrade. When the Updating System Software screen is displayed, press the YES button on the display screen to accept the software update.

5. **CAUTION: Do not remove power from the audio unit during the software update.**

   The audio unit will perform a unit reset, upgrade the software and perform a second unit reset upon completion. When the audio unit returns to normal mode, the software upgrade is complete.

Symptom Chart

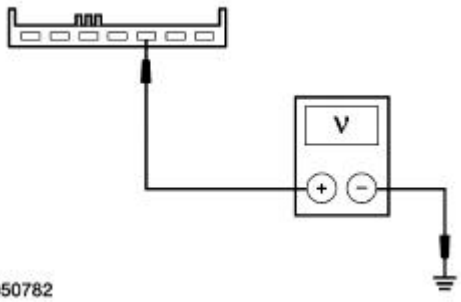
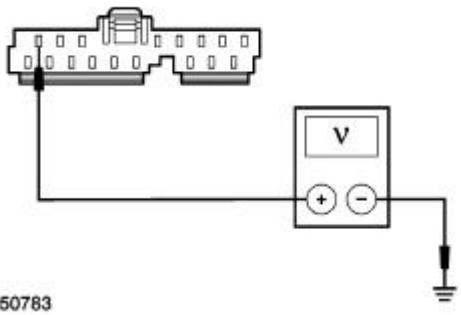
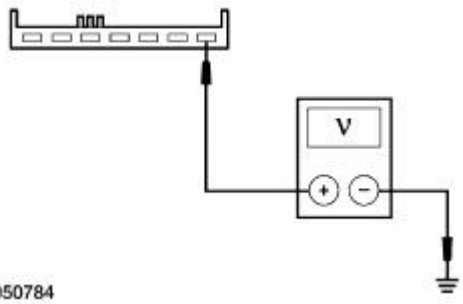
Symptom Chart

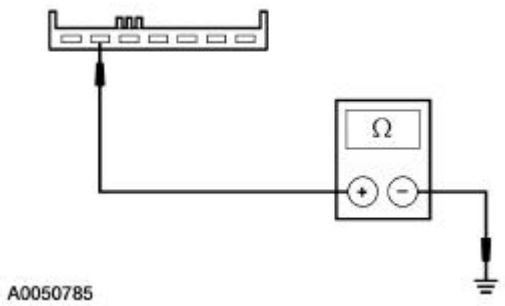
Condition	Possible Sources	Action
● Navigation system will not switch on.	● CJB fuse(s): ■ 7 (7.5A) ■ 22 (10A) ■ 31 (25A) ● Circuitry. ● Audio unit.	● Go To Pinpoint Test L .
● Navigation system does not operate correctly — no reverse tracking	● Circuitry. ● Transmission range (TR) sensor. ● Audio unit.	● Go To Pinpoint Test M .
● Navigation system does not operate correctly — no speedometer signal.	● Circuitry. ● Audio unit.	● Go To Pinpoint Test N .
● Navigation system does not operate correctly — no global positioning system (GPS) antenna signal	● Audio unit. ● Circuitry. ● GPS antenna.	● Go To Pinpoint Test O .

Pinpoint Tests

PINPOINT TEST L: NAVIGATION SYSTEM WILL NOT SWITCH ON

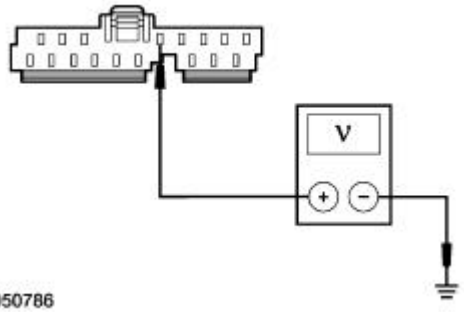
Test Step	Result / Action to Take
L1 CHECK CIRCUIT 1499 (PK/LG) FOR VOLTAGE	
● Key in OFF position. ● Disconnect: Audio Unit C2188a. ● Key in ON position. ● Measure the voltage between the audio unit C2188a pin 3, circuit 1499 (PK/LG), harness side and ground.	**Yes** GO to L2 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

 A0050782 ● **Is the voltage greater than 10 volts?**	
L2 CHECK CIRCUIT 1000 (RD/BK) FOR VOLTAGE ● Key in OFF position. ● Disconnect: Audio Unit C2188c. ● Key in START position. ● Measure the voltage between the audio unit C2188c pin 7, circuit 1000 (RD/BK), harness side and ground.  A0050783 ● **Is the voltage greater than 10 volts?**	**Yes** GO to L3 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
L3 CHECK CIRCUIT 797 (LG/VT) FOR VOLTAGE ● Measure the voltage between the audio unit C2188a pin 1, circuit 797 (LG/VT), harness side and ground.  A0050784 ● **Is the voltage greater than 10 volts?**	**Yes** GO to L4 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
L4 CHECK CIRCUIT 694 (BK/LG) FOR AN OPEN ● Key in OFF position. ● Measure the resistance between the audio unit C2188a pin 6, circuit 694 (BK/LG), harness side and ground.	**Yes** GO to L5 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

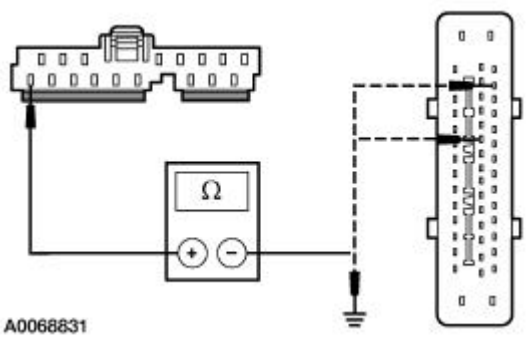
 ● **Is the resistance less than 5 ohms?**	
L5 CHECK FOR CORRECT AUDIO UNIT OPERATION	
● Disconnect all the audio unit connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all the audio unit connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. REFER to Section 415-01 . CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

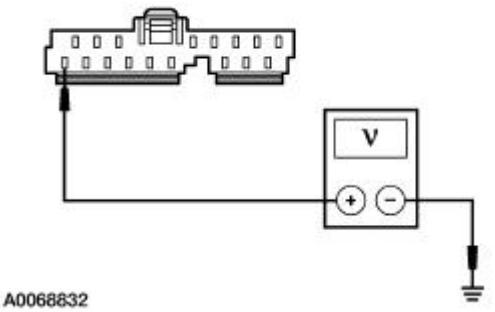
PINPOINT TEST M: THE NAVIGATION SYSTEM DOES NOT OPERATE CORRECTLY — NO REVERSE TRACKING

Test Step	Result / Action to Take
M1 CHECK THE REVERSE LAMP OPERATION	
● Key in ON position. ● Set the parking brake. ● Place the transmission range (TR) selector lever in reverse. ● **Do the reverse lamps operate?**	**Yes** GO to M2 . **No** REFER to Section 417-01 to continue diagnosis of the reverse lamps.
M2 CHECK CIRCUIT 1789 (VT/WH) FOR VOLTAGE	
● Key in OFF position. ● Disconnect: Audio Unit C2188c. ● Key in ON position. ● Place the TR selector lever in reverse. ● Measure the voltage between the audio unit C2188c pin 10, circuit 1789 (VT/WH), harness side and ground.	**Yes** GO to M3 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

 A0050786 ● **Is the voltage greater than 10 volts?**	
M3 CHECK FOR CORRECT AUDIO UNIT OPERATION	
● Disconnect all the audio unit connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all the audio unit connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. REFER to Section 415-01 . CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST N: NAVIGATION SYSTEM DOES NOT OPERATE CORRECTLY — NO SPEEDOMETER SIGNAL

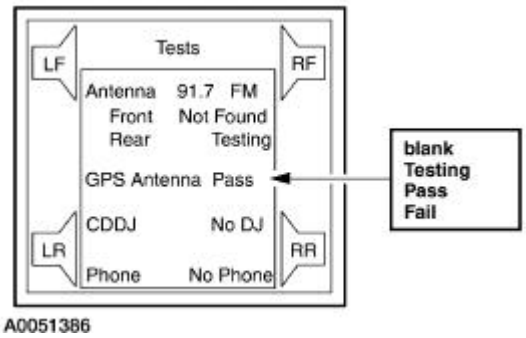
Test Step	Result / Action to Take
N1 CHECK CIRCUIT 565 (BK/WH) FOR AN OPEN AND A SHORT TO GROUND	
● Key in OFF position. ● Disconnect: ABS Module C135. ● Disconnect: Audio Unit C2188c. ● Measure the resistance between the audio unit C2188c pin 6, circuit 565 (BK/WH), harness side and the ABS module C135 pin 22 (with stability assist) or pin 3 (without stability assist), circuit 565 (BK/WH), harness side; and between the audio unit C2188c pin 6, circuit 565 (BK/WH), harness side and ground.  A0068831 ● **Is the resistance less than 5 ohms between the ABS module and the audio unit; and is the resistance greater than 10,000 ohms between the audio unit and ground?**	**Yes** GO to N2 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

N2 CHECK CIRCUIT 565 (BK/WH) FOR A SHORT TO VOLTAGE	
• Key in ON position. • Measure the voltage between the audio unit C2188c pin 6, circuit 565 (BK/WH), harness side and ground.  • **Is any voltage indicated?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. **No** GO to N3 .
N3 SUBSTITUTE THE AUDIO UNIT	
• Substitute a known good audio unit. • **Is the concern still present?**	**Yes** REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. REFER to Section 415-01 . CLEAR the DTCs. REPEAT the self-test. **No** REINSTALL the original audio unit.GO to N4 .
N4 CHECK FOR CORRECT ABS MODULE OPERATION	
• Disconnect all ABS module connectors. • Check for: • corrosion • pushed-out pins • Connect all ABS module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new ABS module. REFER to Section 206-09A or Section 206-09B . CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST O: NAVIGATION SYSTEM DOES NOT OPERATE CORRECTLY — NO GLOBAL POSITIONING SYSTEM (GPS) ANTENNA SIGNAL

Test Step	Result / Action to Take
NOTE: To carry out the speaker walk around self-test the vehicle must be driven outside of any	

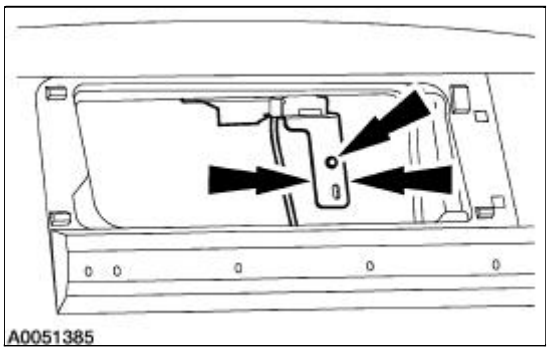
enclosed structure to an area that is unobstructed by trees, tall buildings, and bridges.

O1 CHECK THE GPS ANTENNA SIGNAL USING THE SPEAKER WALK AROUND SELF-TEST	
• Make sure the GPS antenna is correctly connected to the audio unit. • Key in ON position. • Turn the audio unit ON. • Carry out the speaker walk around self-test by pressing the audio preset buttons 3 and 6 on the audio unit.  A0051386 • **Does the GPS antenna indicate Pass?**	**Yes** The GPS system is operating correctly. GO to Symptom Chart for all other navigation system concerns. **No** INSTALL a new GPS antenna. REFER to Navigation System Antenna—Global Positioning Sensor (GPS) in this section. If the system is still inoperative, GO to O2 .
O2 CHECK FOR CORRECT AUDIO UNIT OPERATION	
• Disconnect all the audio unit connectors. • Check for: • corrosion • pushed-out pins • Connect all the audio unit connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. REFER to Section 415-01 . CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Navigation System Antenna —Global Positioning Sensor (GPS)

Removal and Installation

1. Disconnect the battery. For additional information, refer to Section 414-01 .
2. Remove the audio unit. For additional information, refer to Section 415-01 .
3. Remove the glove compartment. For additional information, refer to Section 501-12 .
4. Remove the GPS antenna.
   - Disconnect the electrical connector.
   - Remove the bolt.



5. To install, reverse the removal procedure.

Navigation System Module —Navigator Built After 2/2003

Removal and Installation

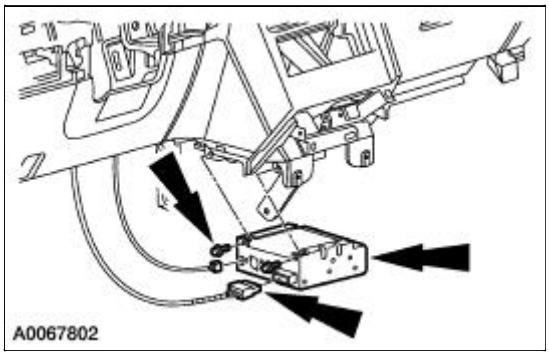
1. **CAUTION: Electronic modules are sensitive to electrical charges. If exposed to these charges, damage may result.**

   NOTE: Prior to removal of the navigation system module, it is necessary to remove the digital versatile disc (DVD) from the navigation system module and store it in the customer case.

   Disconnect the battery. For additional information, refer to Section 414-01 .

2. Remove the lower LH and RH panels from the front floor console.

3. Remove the navigation system module.
   - Remove the electrical connectors.
   - Remove the two screws.

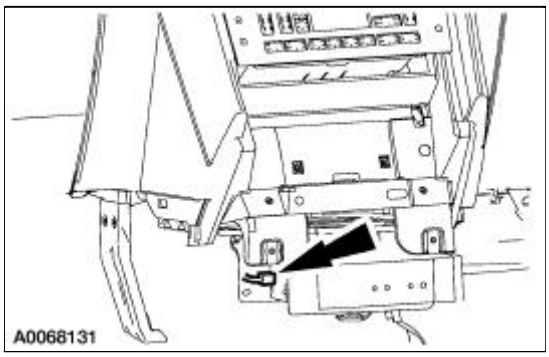


4. To install, reverse the removal procedure.

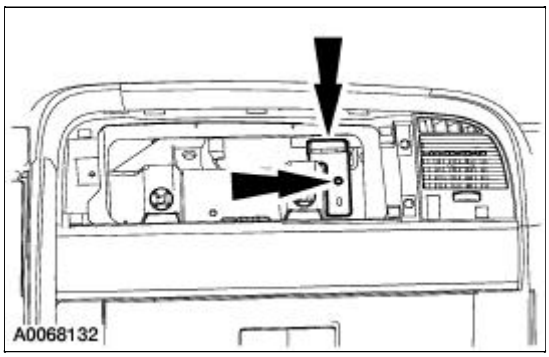
Global Positioning System (GPS) Antenna —Navigator Built After 2/2003

Removal and Installation

1. Disconnect the battery. For additional information, refer to Section 414-01 .
2. Remove the lower LH and RH panels from the front floor console.
3. Disconnect the GPS antenna.



4. Remove the passenger airbag module. For additional information, refer to Section 501-20B .
5. Remove the GPS antenna.
   - Remove the screw.



6. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-in
Instrument panel fuse junction panel bulkhead connector bolts	5.6	35
Vehicle security module nuts	7	62
Instrument panel fuse junction panel nuts	5.6	35

Module Controlled Functions

The multifunction electronic control modules consist of the following:

- driver seat module (DSM)
- vehicle security module

The DSM allows automatic positioning of the memory driver seat and the memory pedals to three programmable positions. For additional information, refer to Section 501-10 .

The vehicle security module controls the remote keyless entry system and the computer-operated lock system. For additional information, refer to Section 501-14 .

Multifunction Electronic Module

For driver seat module (DSM),

Refer to Wiring Diagrams Cell 123 for schematic and connector information.

For vehicle security module,

Refer to Wiring Diagrams Cell 117 for schematic and connector information.

Diagnostic Trouble Code (DTC) Chart

DTC	Description	Source	Action
B1201	Fuel Sender Circuit Failure	Instrument Cluster	REFER to Section 413-01 .
B1204	Fuel Sender Circuit Short to Ground	Instrument Cluster	REFER to Section 413-01 .
B1205	EIC Switch-1 Assembly Circuit Failure	Instrument Cluster	REFER to Section 413-08 .
B1209	EIC Switch-2 Assembly Circuit Failure	Instrument Cluster	REFER to Section 413-08 .
B1217	Horn Relay Coil Circuit Failure	Vehicle Security Module	REFER to Section 413-06 .
B1231	Longitudinal Acceleration Threshold Exceeded	RCM	REFER to Section 501-20B .
B1251	Air Temperature Internal Sensor Circuit Open	EATC Module	REFER to Section 412-00 .
B1253	Air Temperature Internal Sensor Circuit Short to Ground	EATC Module	REFER to Section 412-00 .
B1255	Air Temperature External Sensor Circuit Open	Instrument Cluster	REFER to Section 413-08 .
B1255	Air Temperature External Sensor Circuit Open	EATC Module	REFER to Section 412-00 .
B1257	Air Temperature External Sensor Circuit Short to Ground	Instrument Cluster	REFER to Section 413-08 .
B1257	Air Temperature External Sensor Circuit Short to Ground	EATC Module	REFER to Section 412-00 .
B1259	Solar Radiation Sensor Circuit Open	EATC Module	REFER to Section 412-00 .
B1261	Solar Radiation Sensor Circuit Short to Ground	EATC Module	REFER to Section 412-00 .
B1284	Oil Pressure Switch Failure	Instrument Cluster	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.

B1299	Power Supply Sensor Circuit Short to Ground	Parking Aid Module	REFER to Section 413-13 .
B1300	Power Door Lock Circuit Failure	Vehicle Security Module	REFER to Section 501-14 .
B1311	Power Door Unlock Circuit Failure	Vehicle Security Module	REFER to Section 501-14 .
B1317	Battery Voltage High	Instrument Cluster	REFER to Section 414-01 .
B1317	Battery Voltage High	4WD Control Module	REFER to Section 414-01 .
B1317	Battery Voltage High	Vehicle Security Module	REFER to Section 414-01 .
B1317	Battery Voltage High	Fuel Fired Heater Module	REFER to Section 412-03B .
B1318	Battery Voltage Low	Instrument Cluster	REFER to Section 414-01 .
B1318	Battery Voltage Low	4WD Control Module	REFER to Section 414-01 .
B1318	Battery Voltage Low	Vehicle Security Module	REFER to Section 414-01 .
B1318	Battery Voltage Low	Fuel Fired Heater Module	REFER to Section 412-03B .
B1321	Driver Door Ajar Circuit Short to Battery	Vehicle Security Module	REFER to Section 417-02 .
B1328	Passenger Door Ajar Circuit Open	Instrument Cluster	REFER to Section 417-02 .
B1329	Passenger Door Ajar Circuit Short to Battery	Vehicle Security Module	REFER to Section 417-02 .
B1333	Decklid Ajar Rear Door Circuit Short to Battery	Vehicle Security Module	REFER to Section 417-02 .
B1337	Door Ajar RR Circuit Short to Battery	Vehicle Security Module	REFER to Section 417-02 .
B1342	ECU is Defective	Instrument Cluster	CLEAR the DTCs. REPEAT the Self-Test. If DTC B1342 is retrieved, INSTALL a new HEC module. REFER to Section 413-01 . CLEAR the DTCs. REPEAT the Self-Test.
B1342	ECU is Defective	Climate Controlled Seat Module	CLEAR the DTCs. REPEAT the Self-Test. If DTC B1342 is retrieved, INSTALL a new climate controlled seat module. REFER to Section 501-10 . CLEAR the DTCs. REPEAT the Self-Test.
B1342	ECU is Defective	4WD Control Module	CLEAR the DTCs. REPEAT the Self-Test. If DTC B1342 is retrieved, INSTALL a new 4x4 module. REFER to Section 308-07A . CLEAR the DTCs. REPEAT the Self-Test.
B1342	ECU is Defective	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	CLEAR the DTCs. REPEAT the Self-Test. If DTC B1342 is retrieved, INSTALL a new ABS/TC module. REFER to Section 206-09B . CLEAR the DTCs. REPEAT the Self-Test.
B1342	ECU is Defective	Vehicle Security Module	CLEAR the DTCs. REPEAT the Self-Test. If DTC B1342 is retrieved, INSTALL a new vehicle security

			module. REFER to Vehicle Security Module , in this section. CLEAR the DTCs. REPEAT the Self-Test.
B1342	ECU is Defective	Parking Aid Module	CLEAR the DTCs. REPEAT the Self-Test. If DTC B1342 is retrieved, INSTALL a new parking aid module. REFER to Section 413-13 . CLEAR the DTCs. REPEAT the Self-Test.
B1342	ECU is Defective	DSM	CLEAR the DTCs. REPEAT the Self-Test. If DTC B1342 is retrieved, INSTALL a new DSM. REFER to Section 501-10 . CLEAR the DTCs. REPEAT the Self-Test.
B1342	ECU is Defective	EATC Module	CLEAR the DTCs. REPEAT the Self-Test. If DTC B1342 is retrieved, INSTALL a new EATC module. REFER to Section 412-00 . CLEAR the DTCs. REPEAT the Self-Test.
B1342	ECU is Defective	Fuel Fired Heater Module	CLEAR the DTCs. REPEAT the Self-Test. If DTC B1342 is retrieved, INSTALL a new fuel fired heater module. REFER to Section 412-03B . CLEAR the DTCs. REPEAT the Self-Test.
B1342	ECU is Defective	Power Liftgate Module	CLEAR the DTCs. REPEAT the Self-Test. If DTC B1342 is retrieved, INSTALL a new power liftgate module. REFER to Section 501-03 . CLEAR the DTCs. REPEAT the Self-Test.
B1342	ECU is Defective	RCM	CLEAR the DTCs. REPEAT the Self-Test. If DTC B1342 is retrieved, INSTALL a new RCM. REFER to Section 501-20A or Section 501-20B . CLEAR the DTCs. REPEAT the Self-Test.
B1342	ECU is Defective	Tire Pressure Monitoring System Module	CLEAR the DTCs. REPEAT the Self-Test. If DTC B1342 is retrieved, INSTALL a new tire pressure monitoring system module. REFER to Section 204-04 . CLEAR the DTCs. REPEAT the Self-Test.
B1345	Heated Backlight Input Circuit Short to Ground	Instrument Cluster	REFER to Section 501-11 .
B1352	Ignition Key-In Circuit Failure	Instrument Cluster	REFER to Section 413-09 .
B1358	Ignition Switch or Blower Electronics Circuit Short to Ground	Climate Controlled Seat Module	REFER to Section 211-05 .
B1360	Ignition RUN/ACC Circuit Open	Instrument Cluster	REFER to Section 211-05 .
B1483	Brake Pedal Input Circuit Failure	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09A .
B1529	Memory Set Switch Circuit	DSM	REFER to Section 501-10 .

	Short to Ground		
B1534	Memory 1 Switch Circuit Short to Ground	DSM	REFER to Section 501-10 .
B1538	Memory 2 Switch Circuit Short to Ground	DSM	REFER to Section 501-10 .
B1573	Door Ajar LR Circuit Short to Battery	Vehicle Security Module	REFER to Section 417-02 .
B1663	Seat Driver Front Up/Down Motor Stalled	DSM	REFER to Section 501-10 .
B1664	Seat Driver Rear Up/Down Motor Stalled	DSM	REFER to Section 501-10 .
B1665	Seat Driver Forward/Backward Motor Stalled	DSM	REFER to Section 501-10 .
B1666	Seat Recline Forward/Rearward Motor Stalled	DSM	REFER to Section 501-10 .
C1667	Mirror Driver Up/Down Motor Stalled	DSM	REFER to Section 501-10 .
B1668	Mirror Driver Right/Left Motor Stalled	DSM	REFER to Section 501-10 .
B1669	Mirror Passenger Up/Down Motor Stalled	DSM	REFER to Section 501-10 .
B1670	Mirror Passenger Right/Left Motor Stalled	DSM	REFER to Section 501-10 .
B1676	Battery Pack Voltage Out of Range	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 414-01 .
B1676	Battery Voltage Out of Range	DSM	REFER to Section 414-01 .
B1676	Battery Voltage Out of Range	EATC Module	REFER to Section 414-01 .
B1695	Autolamp On Circuit Failure	Vehicle Security Module	REFER to Section 417-01 .
B1697	Mirror Driver/Passenger Switch Circuit Short to Battery	DSM	REFER to Section 501-10 .
B1703	Seat Driver Recline Forward Switch Circuit Short to Battery	DSM	REFER to Section 501-10 .
B1707	Seat Driver Recline Rearward Switch Circuit Short to Battery	DSM	REFER to Section 501-10 .
B1711	Seat Driver Front Up Switch Circuit Short to Battery	DSM	REFER to Section 501-10 .
B1715	Seat Driver Front Down Switch Circuit Short to Battery	DSM	REFER to Section 501-10 .
B1719	Seat Driver Forward Switch Circuit Short to Battery	DSM	REFER to Section 501-10 .
B1723	Seat Driver Rearward Switch Circuit Short to Battery	DSM	REFER to Section 501-10 .
B1727	Seat Driver Rear Up Switch Circuit Short to Battery	DSM	REFER to Section 501-10 .

B1731	Seat Driver Rear Down Switch Circuit Short to Battery	DSM	REFER to Section 501-10 .
B1735	Mirror Driver Vertical Switch Circuit Short to Battery	DSM	REFER to Section 501-10 .
B1739	Mirror Driver Horizontal Switch Circuit Short to Battery	DSM	REFER to Section 501-10 .
B1743	Mirror Passenger Vertical Switch Circuit Short to Battery	DSM	REFER to Section 501-10 .
B1747	Mirror Passenger Horizontal Switch Circuit Short to Battery	DSM	REFER to Section 501-10 .
B1792	Autolamp Sensor Input Circuit Short to Battery and Open	Vehicle Security Module	REFER to Section 417-01 .
B1793	Autolamp Sensor Input Circuit Short to Ground	Vehicle Security Module	REFER to Section 417-01 .
B1869	Lamp Air Bag Warning Indicator Open	RCM	REFER to Section 501-20B .
B1870	Lamp Air Bag Warning Indicator Short to Battery	RCM	REFER to Section 501-20B .
B1884	PAD Warning Lamp Inoperative	RCM	REFER to Section 501-20B .
B1890	PAD Warning Lamp Short to Battery	RCM	REFER to Section 501-20B .
B1891	Air Bag Tone Warning Indicator Circuit Short to Battery	RCM	REFER to Section 501-20B .
B1892	Air Bag Tone Warning Indicator Circuit Failure	RCM	REFER to Section 501-20B .
B1921	Air Bag Diagnostic Monitor Ground Circuit Open	RCM	REFER to Section 501-20B .
B1950	Seat Rear Up/Down Feedback Potentiometer Circuit Failure	DSM	REFER to Section 501-10 .
B1952	Seat Rear Up/Down Feedback Potentiometer Circuit Short to Battery	DSM	REFER to Section 501-10 .
B1954	Seat Front Up/Down Feedback Potentiometer Circuit Failure	DSM	REFER to Section 501-10 .
B1956	Seat Front Up/Down Feedback Potentiometer Circuit Short to Battery	DSM	REFER to Section 501-10 .
B1958	Seat Recline Forward/Rearward Feedback Potentiometer Circuit Failure	DSM	REFER to Section 501-10 .
B1961	Seat Recline Forward/Rearward Feedback Potentiometer Circuit Short to Ground	DSM	REFER to Section 501-10 .
B1962	Seat Horizontal Forward/Rearward Feedback Potentiometer Circuit Failure	DSM	REFER to Section 501-10 .
B1964	Seat Horizontal Forward/Rearward Feedback	DSM	REFER to Section 501-10 .

	Potentiometer Circuit Short to Battery		
B1987	Pedal Forward/Rearward Motor Stalled	DSM	REFER to Section 501-10 .
B1988	Pedal Position Forward Switch Circuit Short to Battery	DSM	REFER to Section 501-10 .
B1989	Pedal Position Rearward Switch Circuit Short to Battery	DSM	REFER to Section 501-10 .
B1990	Pedal Forward/Rearward Feedback Potentiometer Circuit Failure	DSM	REFER to Section 501-10 .
B1991	Pedal Forward/Rearward Feedback Potentiometer Circuit Short to Battery	DSM	REFER to Section 501-10 .
B2105	Throttle Position Input Out of Range Low	4WD Control Module	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
B2106	Throttle Position Input Out of Range High	4WD Control Module	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
B2143	NVM Memory Failure	Instrument Cluster	REFER to Section 413-01 .
B2266	Driver Blend Door/Lower Actuator Circuit Failure	EATC Module	REFER to Section 412-00 .
B2267	Passenger Blend Door/Lower Actuator Circuit Failure	EATC Module	REFER to Section 412-00 .
B2268	Steering Wheel Climate Control Circuit Open	EATC Module	REFER to Section 412-00 .
B2269	Steering Wheel Climate Control Circuit Short to Ground	EATC Module	REFER to Section 412-00 .
B2276	Less Than Two Transmitters Programmed	Vehicle Security Module	REFER to Section 419-01 .
B2290	Occupant Classification System Fault Status	RCM	REFER to Section 501-20B .
B2292	Restraint System-Saftey Belt Pretensioner Status	RCM	REFER to Section 501-20A .
B2293	Restraint System-Airbag Status	RCM	REFER to Section 501-20B .
B2294	Restraint System-Curtain Status	RCM	REFER to Section 501-20B .
B2296	Restraint System-Impact Sensor Status	RCM	REFER to Section 501-20B .
B2312	Mirror Passenger Horizontal Feedback Potentiometer Circuit Failure	DSM	REFER to Section 501-10 .
B2314	Mirror Passenger Horizontal Feedback Potentiometer Circuit Short to Battery	DSM	REFER to Section 501-10 .
B2316	Mirror Passenger Vertical Feedback Potentiometer Circuit Failure	DSM	REFER to Section 501-10 .

B2318	Mirror Passenger Vertical Feedback Potentiometer Circuit Short to Battery	DSM	REFER to Section 501-10 .
B2320	Mirror Driver Horizontal Feedback Potentiometer Circuit Failure	DSM	REFER to Section 501-10 .
B2322	Mirror Driver Horizontal Feedback Potentiometer Circuit Short to Battery	DSM	REFER to Section 501-10 .
B2324	Mirror Driver Vertical Feedback Potentiometer Circuit Failure	DSM	REFER to Section 501-10 .
B2326	Mirror Driver Vertical Feedback Potentiometer Circuit Short to Battery	DSM	REFER to Section 501-10 .
B2411	Humidity Sensor Open	EATC Module	REFER to Section 412-00 .
B2412	Humidity Sensor Short	EATC Module	REFER to Section 412-00 .
B2413	Humidity Sensor Failure	EATC Module	REFER to Section 412-00 .
B2425	Remote Keyless Entry Out of Sync	Vehicle Security Module	REFER to Section 419-01 .
B2434	Driver Saftey Belt Buckle Switch Circuit Short to Ground	RCM	REFER to Section 501-20A .
B2435	Driver's Safety Belt Buckle Switch Resistance Out of Range	RCM	REFER to Section 501-20A .
B2438	Passenger Seat Belt Buckle Switch Circuit Short to Ground	RCM	REFER to Section 501-20A .
B2439	Passenger Seat Belt Buckle Switch Resistance Out of Range	RCM	REFER to Section 501-20A .
B2449	Auxiliary Heater Glow Plug Circuit Short to Ground	Fuel Fired Heater Module	REFER to Section 412-03B .
B2450	Auxiliary Heater Glow Plug Circuit Open	Fuel Fired Heater Module	REFER to Section 412-03B .
B2451	Auxiliary Heater Fuel Pump Circuit Short to Ground	Fuel Fired Heater Module	REFER to Section 412-03B .
B2452	Auxiliary Heater Fuel Pump Circuit Open	Fuel Fired Heater Module	REFER to Section 412-03B .
B2453	Auxiliary Heater Blower Fan Circuit Short to Ground	Fuel Fired Heater Module	REFER to Section 412-03B .
B2454	Auxiliary Heater Blower Fan Circuit Open	Fuel Fired Heater Module	REFER to Section 412-03B .
B2463	Auxiliary Heater Overheat Fault	Fuel Fired Heater Module	REFER to Section 412-03B .
B2468	Auxiliary Heater Coolant Pump Circuit Short to Ground	Fuel Fired Heater Module	REFER to Section 412-03B .
B2469	Auxiliary Heater Coolant Pump Circuit Open	Fuel Fired Heater Module	REFER to Section 412-03B .
B2477	Module Configuration Failure	Instrument Cluster	REFER to Section 418-01 .
B2477	Module Configuration Failure	Climate Controlled Seat Module	REFER to Section 418-01 .

B2477	Module Configuration Failure	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
B2477	Module Configuration Failure	Vehicle Security Module	REFER to Section 418-01 .
B2477	Module Configuration Failure	DSM	REFER to Section 418-01 .
B2477	Module Configuration Failure	EATC Module	REFER to Section 418-01 .
B2477	Module Configuration Failure	Power Liftgate Module	REFER to Section 418-01 .
B2477	Module Configuration Failure	RCM	REFER to Section 418-01 .
B2477	Module Configuration Failure	Tire Pressure Monitoring System Module	REFER to Section 418-01 .
B2486	Climate Controlled Seat Voltage Out of Range	Climate Controlled Seat Module	REFER to Section 414-01 .
B2488	Thumb-Wheel Switch Voltage Out of Range High	Climate Controlled Seat Module	REFER to Section 414-01 .
B2497	Blower RPM Out of Range	Climate Controlled Seat Module	REFER to Section 412-02 .
B2499	Courtesy Lamp Output Failure	Instrument Cluster	Section 417-02 .
B2511	Horn Output Relay Circuit Short to Battery	Tire Pressure Monitoring System Module	REFER to Section 204-04 .
B2521	Tach Circuit Failure	Climate Controlled Seat Module	REFER to Section 412-02 .
B2537	Auxiliary Heater No Start Fault	Fuel Fired Heater Module	REFER to Section 412-03B .
B2538	Auxiliary Heater Unstable Flame Fault	Fuel Fired Heater Module	REFER to Section 412-03B .
B2547	Auxiliary Heater Flame Prior to Operation Fault	Fuel Fired Heater Module	REFER to Section 412-03B .
B2548	Auxiliary Heater Lockout Mode Fault	Fuel Fired Heater Module	REFER to Section 412-03B .
B2549	Vehicle Air Fan Activation Circuit Short to Ground	Fuel Fired Heater Module	REFER to Section 412-03B .
B2552	Vbatt 2 Circuit Open	Power Liftgate Module	REFER to Section 501-03 .
B2644	Radio Mute Circuit Failure	Parking Aid Module	REFER to Section 413-13 .
B2659	Courtesy Switch Fault	Instrument Cluster	REFER to Section 417-02 .
B2661	Parking Lamp Relay Output Short to Battery	Vehicle Security Module	REFER to Section 417-01 .
B2662	Parking Lamp Relay Output Circuit Open	Vehicle Security Module	REFER to Section 417-01 .
B2663	Headlamp Relay Output Short to Battery	Vehicle Security Module	REFER to Section 417-01 .
B2664	Headlamp Relay Output Circuit Open or Short to Battery	Vehicle Security Module	REFER to Section 417-01

B2667	Liftglass Release Switch Circuit Failure	Vehicle Security Module	REFER to Section 501-11 .
B2675	Keypad B Switch Circuit Failure	Vehicle Security Module	REFER to Section 501-14 .
B2676	Keypad C Switch Circuit Failure	Vehicle Security Module	REFER to Section 501-14 .
B2691	Front Driver Seat Belt Buckle Switch Circuit Fault	RCM	REFER to Section 501-20A .
B2692	Front Passenger Seat Belt Buckle Switch Circuit Fault	RCM	REFER to Section 501-20A .
B2695	Keypad A Switch Circuit Failure	Vehicle Security Module	REFER to Section 501-14 .
B2698	Vbatt 2 Circuit Failure	Power Liftgate Module	REFER to Section 501-03 .
B2699	Left Pinch Strip Open or Short to Battery	Power Liftgate Module	REFER to Section 501-03 .
B2700	Right Pinch Strip Open or Short to Battery	Power Liftgate Module	REFER to Section 501-03 .
B2701	Left Pinch Strip Stuck Active	Power Liftgate Module	REFER to Section 501-03 .
B2702	Right Pinch Strip Stuck Active	Power Liftgate Module	REFER to Section 501-03 .
B2703	Open/Close Switch Stuck Active	Power Liftgate Module	REFER to Section 501-03 .
B2704	Optical Sensor Power Short to Ground	Power Liftgate Module	REFER to Section 501-03 .
B2705	Optical Sensor 1 Input Not Active During Powered Liftgate Movement	Power Liftgate Module	REFER to Section 501-03 .
B2706	Optical Sensor 2 Input Not Active During Powered Liftgate Movement	Power Liftgate Module	REFER to Section 501-03 .
B2707	Gate Open Output Over Current	Power Liftgate Module	REFER to Section 501-03 .
B2708	Gate Close Output Over Current	Power Liftgate Module	REFER to Section 501-03 .
B2709	Gate Open Short to Battery	Power Liftgate Module	REFER to Section 501-03 .
B2710	Gate Close Short to Battery	Power Liftgate Module	REFER to Section 501-03 .
B2711	Gate Open Output Short to Ground or Open	Power Liftgate Module	REFER to Section 501-03 .
B2712	Gate Close Output Short to Ground or Open	Power Liftgate Module	REFER to Section 501-03 .
B2713	Unlatch Output Short to Ground	Power Liftgate Module	REFER to Section 501-03 .
B2714	Release Motor Output Open or Short to Ground	Power Liftgate Module	REFER to Section 501-03 .
B2715	Closing Motor Output Open or Short to Ground	Power Liftgate Module	REFER to Section 501-03 .

B2716	Left Power Running Board Output Short to Battery	Power Liftgate Module	REFER to Section 501-03 .
B2717	Right Power Running Board Output Short to Battery	Power Liftgate Module	REFER to Section 501-03 .
B2718	Gate Ajar Output Short to Battery	Power Liftgate Module	REFER to Section 501-03 .
B2719	Left Power Running Board Output Short to Ground or Open	Power Liftgate Module	REFER to Section 501-03 .
B2720	Right Power Running Board Output Short to Ground or Open	Power Liftgate Module	REFER to Section 501-03 .
B2721	Gate Ajar Output Short to Ground or Open	Power Liftgate Module	REFER to Section 501-03 .
B2722	Open/Close Switch Active During Self-Test	Power Liftgate Module	REFER to Section 501-03 .
B2723	Glass Position Switch Active During Self-Test	Power Liftgate Module	REFER to Section 501-03 .
B2724	Forkbolt Switch Invalid During Self-Test	Power Liftgate Module	REFER to Section 501-03 .
B2725	Detent Switch Invalid During Self-Test	Power Liftgate Module	REFER to Section 501-03 .
B2726	Home Switch Invalid During Self-Test	Power Liftgate Module	REFER to Section 501-03 .
B2729	Cushion Over-temperature Detected	Climate Controlled Seat Module	REFER to Section 501-10 .
B2730	Back-over Temperature Detected	Climate Controlled Seat Module	REFER to Section 501-10 .
B2731	Differential Temperature Fault	Climate Controlled Seat Module	REFER to Section 412-02 .
B2734	Pedal Travel Sensor Supply Error	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
B2736	Pedal Travel Sensor Circuit Fault	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
B2737	Pedal Travel Sensor Jammed Error	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
B2738	Pedal Travel Sensor Velocity Error	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
B2740	Pedal Travel Sensor Spike Error	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC)	REFER to Section 206-09B .

		Module or Stability Assist Module	
B2741	Sensor Cluster Loop End	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
B2792	Heat Switch Short to Ground	Climate Controlled Seat Module	REFER to Section 501-10 .
B2793	Cool Switch Short to Ground	Climate Controlled Seat Module	REFER to Section 501-10 .
B2794	Third Row Power Folding Seat Circuit Failure	Vehicle Security Module	REFER to Section 501-10 .
B2848	Horn Output Relay Shorted to Ground	Tire Pressure Monitoring System Module	REFER to Section 204-04 .
B2849	Horn Output Relay Circuit Open	Tire Pressure Monitoring System Module	REFER to Section 204-04 .
B2868	Left Front Tire Pressure Sensor Fault	Tire Pressure Monitoring System Module	REFER to Section 204-04 .
B2869	Right Front Tire Pressure Sensor Fault	Tire Pressure Monitoring System Module	REFER to Section 204-04 .
B2870	Right Rear Tire Pressure Sensor Fault	Tire Pressure Monitoring System Module	REFER to Section 204-04 .
B2871	Left Rear Tire Pressure Sensor Fault	Tire Pressure Monitoring System Module	REFER to Section 204-04 .
B2872	Tire Pressure Sensor Fault	Tire Pressure Monitoring System Module	REFER to Section 204-04 .
B2900	VIN Mismatch	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09A .
C1095	ABS Hydraulic Pump Motor Circuit Failure	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09A .
C1145	Speed Wheel Sensor RF Input Circuit Failure	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09A .
C1155	Speed Wheel Sensor LF Input Circuit Failure	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09A .

C1165	Speed Wheel Sensor RR Input Circuit Failure	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
C1175	Speed Wheel Sensor LR Input Circuit Failure	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
C1233	Speed Wheel LF Input Signal Missing	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
C1234	Speed Wheel RF Input Signal Missing	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09A .
C1235	Speed Wheel RR Input Signal Missing	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
C1236	Speed Wheel LR Input Signal Missing	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09A .
C1277	Steering Wheel Angle 1 and 2 Circuit Failure	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
C1278	Steering Wheel Angle 1 and 2 Signal Faulted	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
C1279	Yaw Rate Sensor Circuit Failure	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
C1280	Yaw Rate Sensor Signal Fault	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
C1281	Lateral Accelerometer Circuit Failure	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
C1282	Lateral Accelerometer Signal Fault	4-Wheel Anti-Lock Brake/Traction	REFER to Section 206-09B .

		Control (ABS/TC) Module or Stability Assist Module	
C1285	Booster Solenoid Circuit Failure	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
C1287	Booster Pedal Force Switch Circuit Failure	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
C1288	Pressure Transducer Main/Primary Input Circuit Failure	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
C1290	Steering Pressure Transducer Circuit Failure	Air Suspension Control Module	REFER to Section 211-02 .
C1414	Incorrect Module Design Level	RCM	REFER to Section 501-20B .
C1440	Pressure Transducer Main/Primary Signal Faulted	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
C1445	Speed Vehicle Signal Circuit Failure	Air Suspension Control Module	REFER to Section 204-05 .
C1700	Rear Left Sensor Circuit Failure	Parking Aid Module	REFER to Section 413-13 .
C1701	Rear Left Sensor Fault	Parking Aid Module	REFER to Section 413-13 .
C1703	Rear Right Sensor Circuit Failure	Parking Aid Module	REFER to Section 413-13 .
C1704	Rear Right Sensor Fault	Parking Aid Module	REFER to Section 413-13 .
C1724	Air Suspension Height Sensor Power Circuit Failure	Air Suspension Control Module	REFER to Section 204-05 .
C1725	Air Suspension Front Pneumatic Failure	Air Suspension Control Module	REFER to Section 204-05 .
C1728	Transfer Case Unable to Transition between 2H and 4H	4WD Control Module	REFER to Section 308-07A .
C1729	Transfer Case Unable to Transition between 4H and 4L	4WD Control Module	REFER to Section 308-07A .
C1730	Reference Voltage Out of Range (+5V)	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09A .
C1760	Air Suspension Rear Height Sensor High (SE) Signal Circuit Failure	Air Suspension Control Module	REFER to Section 204-05 .
C1770	Air Suspension Vent Solenoid Output Circuit Failure	Air Suspension Control Module	REFER to Section 204-05 .
C1790	Air Suspension LR Air	Air Suspension	REFER to Section 204-05 .

	Spring/Shock Solenoid Output Circuit Failure	Control Module	
C1795	Air Suspension RR Air Spring/Shock Solenoid Output Circuit Failure	Air Suspension Control Module	REFER to Section 204-05 .
C1805	Mismatched PCM and/or ABS-TC Module	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
C1873	Air Suspension RF Air Spring Solenoid Output Circuit Failure	Air Suspension Control Module	REFER to Section 204-05 .
C1830	Air Suspension Compressor Relay Circuit Failure	Air Suspension Control Module	REFER to Section 204-05 .
C1840	Air Suspension Disable Switch Circuit Failure	Air Suspension Control Module	REFER to Section 204-05 .
C1877	Air Suspension LF Air Spring Solenoid Output Circuit Failure	Air Suspension Control Module	REFER to Section 204-05 .
C1881	Air Suspension RF Height Sensor Circuit Failure	Air Suspension Control Module	REFER to Section 204-05 .
C1889	Air Suspension LF Height Sensor Circuit Failure	Air Suspension Control Module	REFER to Section 204-05 .
C1897	Steering VAPS II Circuit Loop Failure	Air Suspension Control Module	REFER to Section 211-02 .
C1947	Seat Track Position Switch Circuit Short to Ground	RCM	REFER to Section 501-20A .
C1948	Seat Track Position Switch Circuit Resistance Out of Range	RCM	REFER to Section 501-20A .
C1960	Driver Brake Apply Circuit Failure	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09A .
C1963	Stability Control Inhibit Warning	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
C1964	Air Suspension Air Compressor Request Exceeding Max Timing	Air Suspension Control Module	REFER to Section 204-05 .
C1979	IWE Solenoid Circuit Failure	4WD Control Module	REFER to Section 308-07A .
C1980	IWE Solenoid Short to Battery	4WD Control Module	REFER to Section 308-07A .
C1981	Front Driver Seat Track Position Switch Circuit Fault	RCM	REFER to Section 501-20A .
C1983	Radar Sensor Fault	Parking Aid Module	REFER to Section 413-13 .
C1984	Radar Sensor Circuit Failure	Parking Aid Module	REFER to Section 413-13 .
C1991	Module Calibration Failure	4-Wheel Anti-Lock Brake/Traction	REFER to Section 418-01 .

		Control (ABS/TC) Module or Stability Assist Module	
C1996	Active Yaw Control Disabled	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
C1998	Module Calibration Not Complete	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
C2769	Longitudinal Acceleration Sensor Circuit Failure	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
C2770	Longitudinal Acceleration Sensor Signal Fault	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
C2777	Sensor Cluster Bus Failure	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
C2778	Sensor Power Supply Failure	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
C2780	ECU in Manufacturer Sub-State	Tire Pressure Monitoring System Module	REFER to Section 418-01 .
P0725	Speed Input Stuck High/Low	Parking Aid Module	REFER to Section 413-13 .
P1628	Ignition Voltage Out of Range	Parking Aid Module	REFER to Section 413-13 .
P1812	Transmission Four-Wheel Drive Mode Select Circuit Failure	4WD Control Module	REFER to Section 308-07A .
P1815	Transmission Four-Wheel Drive Mode Select Short Circuit to Ground	4WD Control Module	REFER to Section 308-07A .
P1824	Transmission Four-Wheel Drive Clutch Relay Circuit Failure	4WD Control Module	REFER to Section 308-07A .
P1826	Transmission Four-Wheel Drive Low Clutch Relay Short Circuit to Battery	4WD Control Module	REFER to Section 308-07A .
P1827	Transmission Four-Wheel Drive Low Clutch Relay Short Circuit to Ground	4WD Control Module	REFER to Section 308-07A .
P1849	Transmission Transfer Case Contact Plate "A" Short Circuit	4WD Control Module	REFER to Section 308-07A .

	to Ground		
P1853	Transmission Transfer Case Contact Plate "B" Short Circuit to Ground	4WD Control Module	REFER to Section 308-07A .
P1857	Transmission Transfer Case Contact Plate "C" Short Circuit to Ground	4WD Control Module	REFER to Section 308-07A .
P1861	Transmission Transfer Case Contact Plate "D" Short Circuit to Ground	4WD Control Module	REFER to Section 308-07A .
P1867	Transmission Transfer Case Contact Plate General Circuit Failure	4WD Control Module	REFER to Section 308-07A .
P1874	Transmission Automatic Hall Effect Sensor Power Circuit Failure	4WD Control Module	REFER to Section 308-07A .
P1875	Transmission Automatic Hall Effect Sensor Power Circuit Short to Battery	4WD Control Module	REFER to Section 308-07A .
P1891	Transmission Transfer Case Contact Plate Ground Return Open Circuit	4WD Control Module	REFER to Section 308-07A .
U1009	SCP (J1850) Bus Invalid or Missing Data for Engine Torque	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
U1027	SCP (J1850) Bus Invalid or Missing Data for Engine RPM	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
U1059	SCP (J1850) Invalid or Missing Data for Transmission/Transaxle/ PRNDL	Instrument Cluster	REFER to Section 413-01 .
U1059	SCP (J1850) Invalid or Missing Data for Transmission/Transaxle/ PRNDL	Instrument Cluster	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U1059	SCP (J1850) Invalid or Missing Data for Transmission/Transaxle/ PRNDL	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
U1073	SCP (J1850) Invalid or Missing Data for Engine Coolant	Instrument Cluster	REFER to Section 413-01 .
U1073	SCP (J1850) Invalid or Missing Data for Engine Coolant	PCM	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U1073	SCP (J1850) Invalid or Missing Data for Engine Coolant	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability	REFER to Section 206-09B .

		Assist Module	
U1075	SCP (J1850) Invalid or Missing Data for Engine Oil Fluid Temperature	Instrument Cluster	REFER to Section 413-01 .
U1075	SCP (J1850) Invalid or Missing Data for Engine Oil Fluid Temperature	Instrument Cluster	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U1123	SCP (J1850) Invalid or Missing Data for Odometer	Instrument Cluster	REFER to Section 413-01 .
U1262	SCP Communication Bus Fault	Instrument Cluster	REFER to Section 418-00 .
U1262	SCP Communication Bus Fault	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 418-00 .
U1900	CAN Communication Bus Fault	4WD Control Module	REFER to Section 308-07A .
U1900	CAN Communication Bus Fault-Recieve Error	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
U1901	Communication Fault from Sensor Cluster	4-Wheel Anti-Lock Brake/Traction Control (ABS/TC) Module or Stability Assist Module	REFER to Section 206-09B .
U1950	UBP Communication Bus Fault	Instrument Cluster	REFER to Section 418-00 .
U1950	UBP Communication Bus Fault	4WD Control Module	REFER to Section 418-00 .
U1950	UBP Communication Bus Fault	DSM	REFER to Section 501-10 .
U1950	UBP Communication Bus Fault	EATC Module	REFER to Section 501-10 .
U2013	Compass Module Not Responding	Instrument Cluster	REFER to Section 413-00 .
U2235	UBP Invalid Data From Node ID $19	Instrument Cluster	REFER to Section 418-00 .
U2235	UBP Invalid Data From Node ID $19	EATC Module	REFER to Section 412-00 .
U2262	UBP Invalid Data From Node ID $98	Instrument Cluster	REFER to Section 418-00 .
U2306	UBP Invalid Node 60	4WD Control Module	REFER to Section 418-00 .
U2306	UBP Invalid Node 60	DSM	REFER to Section 501-10 .
U2306	UBP Invalid Node 60	EATC Module	REFER to Section 412-00 .
U2306	Transmission PRNDL Range Selected Status Invalid	Parking Aid Module	REFER to Section 413-13 .
U2338	UBP Invalid Data From Node ID $80	EATC Module	REFER to Section 418-00 .

U2362	UBP Invalid Data From Node ID $98	Climate Controlled Seat Module	REFER to Section 418-00 .

Vehicle Security Module

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052 or equivalent diagnostic tool

Principles of Operation

The vehicle security module controls the following systems:

- perimeter alarm
- remote keyless entry (and panic feature)
- computer-operated locks
- autolamp

For additional information, refer to Section 501-14 .

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of electrical damage.

Visual Inspection Chart

Electrical
Central junction box (CJB) fuse: ■ 5 (7.5A) ■ 30 (30A)

Wiring harness Connector(s) Circuitry

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

4. If the cause is not visually evident, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:

- check that the program card is correctly installed.
- check the connections to the vehicle.
- check the ignition switch position.

5. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool operating manual.

6. Carry out the DATA LINK DIAGNOSTICS test. If the diagnostic tool responds with:

- CKT914, CKT915, CKT693 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
- NO RESPONSE/NOT EQUIP for vehicle security module, go to Pinpoint Test A.
- SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out the Self-Test diagnostics for the vehicle security module.

7. If the DTCs retrieved are related to the concern, go to the Diagnostic Trouble Code (DTC) Index.

8. If no DTCs related to the concern are retrieved, refer to the appropriate section of the Workshop Manual to continue diagnostics.

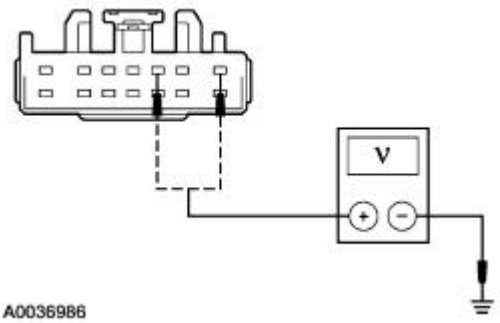
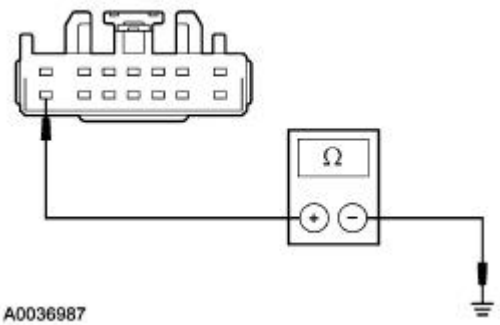
Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
● No communication with the vehicle security module	● Battery junction box (BJB) fuse: ■ 5 (7.5A) ■ 30 (30A) ● Circuitry ● Vehicle security module	● GO to Pinpoint Test A .

Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE VEHICLE SECURITY MODULE

Test Step	Result / Action to Take
A1 CHECK THE VOLTAGE TO THE VEHICLE SECURITY MODULE ● **NOTE:** The battery must be disconnected before disconnecting the vehicle security module connectors to prevent triggering the anti-theft alarm. ● Disconnect the battery ground cable. Refer to Section 414-01 . ● Disconnect: Vehicle Security Module C2113b. ● Connect the battery ground cable. Refer to Section 414-01 . ● Key in ON position. ● Measure the voltage between the vehicle security module C2113b pin 3, circuit 729 (RD/WH), harness side and ground and between the vehicle security module C2113b pin 1, circuit 1523 (DG), harness side and ground.  A0036986 ● **Are the voltages greater than 10 volts?**	**Yes** GO to A2 . **No** REPAIR the power supply circuit(s). CARRY OUT the DATA LINK DIAGNOSTICS test.
A2 CHECK CIRCUIT 57 (BK) FOR AN OPEN ● Key in OFF position. ● Disconnect the negative battery cable. REFER to Section 414-01 . ● Disconnect: Vehicle Security Module C2113a. ● Measure the resistance between the vehicle security module C2113a pin 14, circuit 57 (BK), harness side and ground.  A0036987 ● **Is the resistance less than 5 ohms?**	**Yes** REFER to Section 418-00 . **No** REPAIR the circuit. CARRY OUT the DATA LINK DIAGNOSTICS test.

Driver Seat Module (DSM)

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool

Principles of Operation

The power driver seat and power outside rear view mirrors are controlled by the DSM only when the vehicle is equipped with the programmable/recall memory option. Refer to Section 501-14 .

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of electrical damage.

Visual Inspection Chart

Electrical
Central junction box (CJB) fuse: ■ 109 (30A) ■ 3 (7.5A) Wiring harness Connector(s) Circuitry

3. If an obvious cause for an observed or reported concern is found, correct the cuse (if possible) before proceeding to the next step.
4. If the cause is not visually evident, connect the diagnostic tool to the data link connector (DLC)

located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:

- check that the program card is correctly installed.
- check the connections to the vehicle.
- check the ignition switch position.

5. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool operating manual.

6. Carry out the DATA LINK DIAGNOSTICS test. If the diagnostic tool responds with:

- CKT914, CKT915, CKT693 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
- NO RESPONSE/NOT EQUIP for vehicle security module, go to Pinpoint Test A.
- SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out the Self-Test diagnostics for the vehicle security module.

7. If the DTCs retrieved are related to the concern, go to the Diagnostic Trouble Code (DTC) Index.

8. If no DTCs related to the concern are retrieved, refer to the appropriate section of the Workshop Manual to continue diagnostics.

Symptom Chart

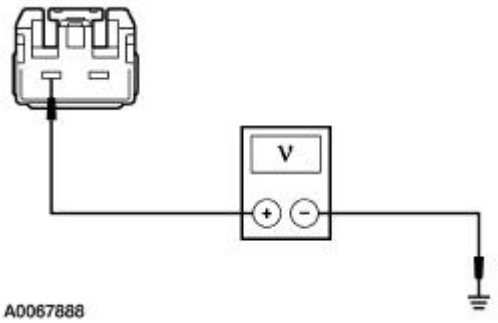
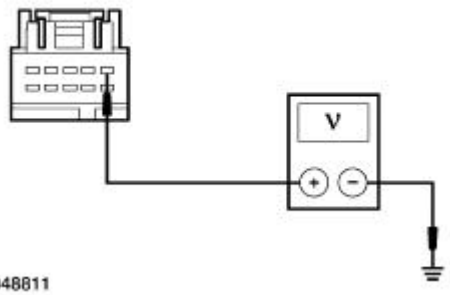
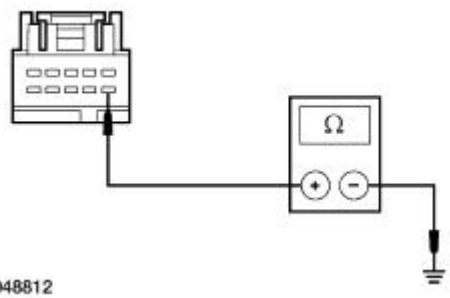
Symptom Chart

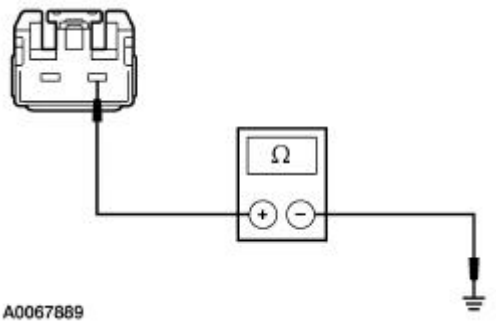
Condition	Possible Sources	Action
● No Communication With The Driver Seat Module (DSM)	● Battery junction box (BJB) fuses: ■ 109 (30A) ■ 3 (7.5A) ● Circuitry ● DSM	● Go To Pinpoint Test B .

Pinpoint Tests

PINPOINT TEST B: NO COMMUNICATION WITH THE DRIVER SEAT MODULE (DSM)

Test Step	Result / Action to Take
B1 CHECK THE VEHICLE FOR MEMORY SEAT/MIRROR OPTION	
● **NOTE:** Driver seat modules are only used on vehicles with memory seat and memory mirror option. ● Check for memory seat and mirror option. ● **Is the vehicle equipped with memory seat and memory mirror option?**	**Yes** GO to B2 . **No** The system is OK. TEST the

	vehicle for normal operation.
B2 CHECK CIRCUIT 566 (DG) FOR VOLTAGE	
• Key in OFF position. • Disconnect: DSM C341a. • Key in ON position. • Measure the voltage between the DSM C341a pin 2, circuit 566 (DG) harness side and ground.  A0067888 • **Is the voltage greater than 10 volts?**	**Yes** GO to B3 . **No** REPAIR the supply circuit. CARRY OUT the DATA LINK DIAGNOSTICS test.
B3 CHECK CIRCUIT 956 (OG/LG) FOR VOLTAGE	
• Key in OFF position. • Disconnect: DSM C341c. • Key in ON position. • Measure the voltage between the DSM C341c pin 1, circuit 956 (OG/LG), harness side and ground.  A0048811 • **Is the voltage greater than 10 volts?**	**Yes** GO to B4 . **No** REPAIR the circuit. CARRY OUT the DATA LINK DIAGNOSTICS test.
B4 CHECK CIRCUIT 875 (BK/LB) FOR AN OPEN	
• Key in OFF position. • Measure the resistance between the DSM C341c pin 6, circuit 875 (BK/LB) harness side and ground.  A0048812 • **Is the resistance less than 5 ohms?**	**Yes** GO to B5 . **No** REPAIR the circuit. CARRY OUT the DATA LINK DIAGNOSTICS test.
B5 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
• Measure the resistance between the DSM C341a pin 1, circuit 57 (BK) harness side and ground.	**Yes** Section 418-00 .

 A0067889 ● **Is the resistance less than 5 ohms?**	**No** REPAIR the circuit. CARRY OUT the DATA LINK DIAGNOSTICS test.

Vehicle Security Module

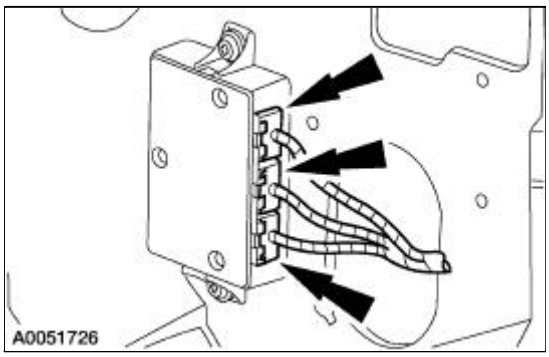
Removal

1. **NOTE:** Prior to removal of the vehicle security module, it is necessary to upload module configuration information to a diagnostic tool. This information needs to be downloaded into the new module once installed. For additional information, refer to Section 418-01 .

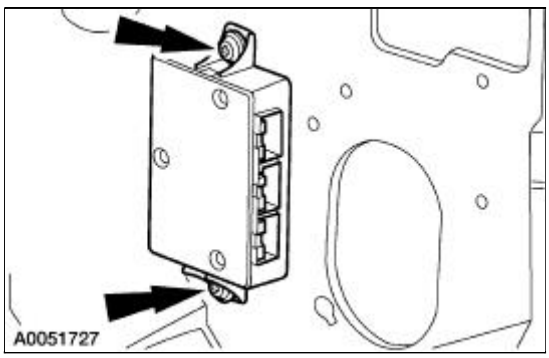
   Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

2. Remove the pushpin and the RH interior kick panel.

3. Disconnect the three vehicle security module electrical connectors.



4. Remove the two screws and the vehicle security module.



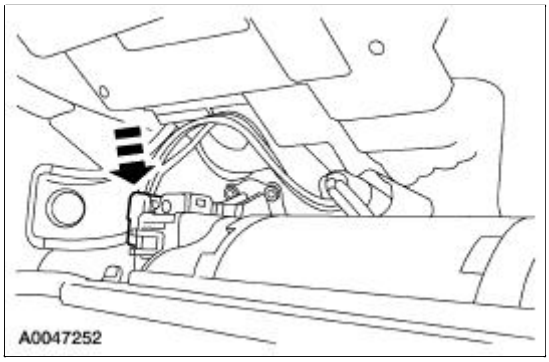
5. To install, reverse the removal procedure.

Module —Driver Seat

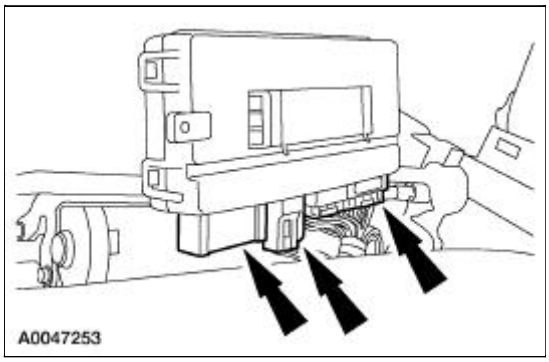
Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. **NOTE:** The module is accessed with the seat fully in the UP position.

   Slide the driver seat module forward to remove from bracket.



3. Disconnect the connectors and remove the DSM.



4. To install, reverse the removal procedure.

General Specifications

Item	Specification
Adhesives	
Weatherstrip and Rubber Adhesive E8AZ-19552-A	ESB-M2G14-A
Lubricants	
Silicone Lubricant F7AZ-19G208-BA	ESR-M13P4-A
Sealants	
HB Fuller E709	ESB-M4G162-A
3M Strip-Caulk — Black 051135-08578	ESB-M4G32-A
Silicone Gasket and Sealant F7AZ-19554-EA	WSK-M2G343-A4

Body

The body:

- Is a cab-forward design.
- Is constructed of lightweight, all steel welded material, with bolted removable front fenders (16005), and hinged doors.
- Has an aluminum liftgate and hood with gas lift cylinders (Expedition).
- Has SMC fenders and hood with gas lift cylinders (Navigator).
- Has roof and body side panels that are separate pieces.
- Is supported by a full frame.

Insulation

Insulation is installed:

- Under the roof.
- Above and below the instrument panel (04304).
- At the cowl sides.
- Over the transmission tunnel.
- Over the floorpan areas.
- Inside the quarter panels.

And has heat-bondable mastic deadeners for improved NVH characteristics (Navigator).

Body Sealer Types And Applications

Liquid Butyl Sealer

HB Fuller E709 or equivalent commercially available material meeting Ford specification ESB-M4G162-A:

- Does not run.
- Is fast-drying.
- Remains semi-elastic.
- Can be used for sealing seams in such areas as the floorpan, wheelhouse, bulkhead, door openings and drip rails.

Caulking Cord

3M Strip-Caulk — Black 051135-08578 or equivalent commercially available product meeting Ford specification ESB-M4G32-A:

- Has a plastic base with a filler.
- Is heavy-bodied.
- Is commonly known as perma-gum.
- Is used on spot-weld holes, around mounting clips and between surfaces not sealed by a gasket.

Weatherstrip Adhesive

Weatherstrip and Rubber Adhesive E8AZ-19552-A or equivalent meeting Ford specification ESB-M2G14-A:

- Is a quick-drying, strong adhesive designed to hold or repair weatherstripping on doors, bodies, and the surrounding metal.

Silicone Lubricant

Silicone Lubricant F7AZ-19G208-BA meeting Ford specification ESR-M13P4-A:

- Is used on the door and window weatherstrip.
- Should be applied to weatherstrip at every lubrication period.
- Makes doors easier to close.
- Avoids weatherstrip squeaks.
- Retards weatherstrip wear.
- Helps retain door window alignment by reducing friction between the glass frame and rubber weatherstrip.
- Should not be used prior to painting.

Body System

Inspection and Verification

Leaks

NOTE: Trim will reveal the location of most leaks. Use spray chalk and hose if necessary.

1. Remove any trim or carpet in the general area of the leak.
2. Road test or water hose test the vehicle.
3. Inspect for a dust pattern around the area in question. Inspect for water paths near and above the area in question.
4. Some leaks can be located by placing bright light under the vehicle, removing any necessary trim or carpet, and inspecting the interior of the body at joints and weld lines.

Noise

Wind noise, rattles and their sources are detected by driving the vehicle at highway speeds. The vehicle should be driven in four different directions, with all windows closed, radio off, blower motor off and all ventilation ducts open.

Most wind noise leaks will occur at the door and window seals or at the sheet metal joints in the door or the door opening.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• Dust and Water Leaks	• Body sealer missing. • Opening in welding or body joints. • Components not fully installed. • Components missing. • Components damaged.	• REMOVE trim. CHECK for leaks and SEAL with appropriate sealer. ROAD TEST or WATER TEST for leaks. RECHECK trim for leaks; USE light under vehicle with trim removed. CHECK interior of body at joints and weld lines.
• Dust/Water Leaks at Floor Pan and Grommets	• Missing or damaged plugs and/or grommets.	• CHECK plugs for proper installation. REPLACE if necessary.
• Door Drain Holes Collecting Water	• Holes clogged with mud or road tar.	• CLEAN drain holes of dirt and foreign material with a punch or screwdriver. CHECK drain holes regularly.

• Wind Noise	• Leaks at door and window seals or sheet metal joints in doors or door openings.	• SEAL leaks with Silicone Gasket and Sealant F7AZ-19554-EA or equivalent meeting Ford specification WSK-M2G343-A4.
	• Loose/misaligned weatherstrip.	• Reattach weatherstrip. Replace any damaged pin-type retainers. Use weatherstrip adhesive E8AZ-19552-A or equivalent meeting Ford Specification ESB-M2G14-A as necessary.
	• Poor Door Fit.	• Adjust the striker or hinges as necessary. For additional information on the hinge adjustment, refer to Section 501-03 . Check for acceptable door efforts after repair.
• Rattles	• Loose objects in door wells, pillars, and quarter panels.	• CHECK doors by carefully STRIKING underside of door with a rubber mallet. LISTEN for loose objects in door. REPAIR. TIGHTEN body bolts and screws.
	• Misalignment (if tightening bolts does not eliminate rattle).	• REFER to Section 501-03 .
	• Loose weatherstripping and/or anti-squeak material.	• APPLY additional sealer. INSTALL in proper location to eliminate rattle.

Torque Specifications

Description	Nm	lb-ft	lb-in
Headlamp bolts	3	—	27
Secondary release handle bolt	3	—	27
Radiator grille opening panel reinforcement bolts	8	—	71
Fender splash shield screws	3	—	27
Fender to front bumper cover bolts	11	8	—
Fender bolts	12	9	—
Hood hinge to hood bolts	30	22	—

Front End Body Panels

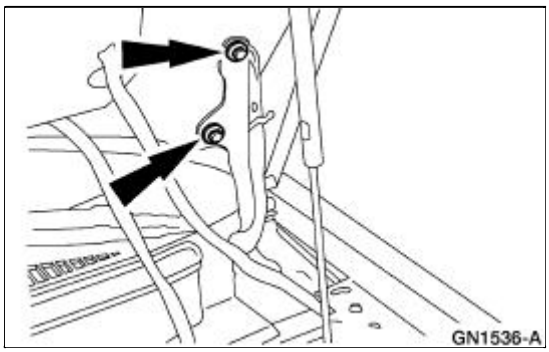
The front end body panels consist of:

- cowl panel grilles
- front fenders
- front fender splash shields
- radiator grille opening panel reinforcement
- air deflectors

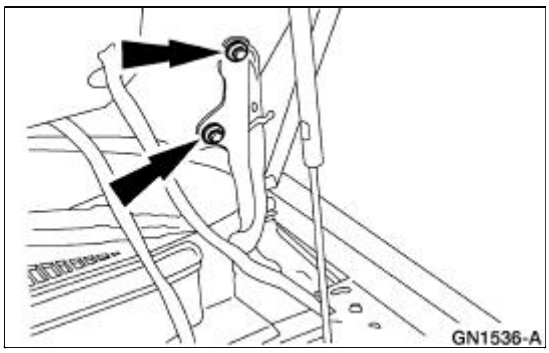
Hood Alignment

NOTE: Navigator shown, Expedition similar.

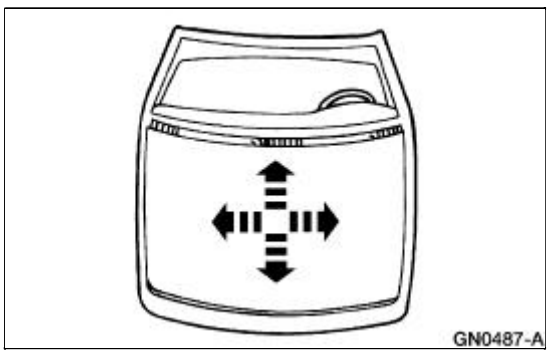
1. Raise and support the hood.
2. Loosen the hood hinge to hood bolts.



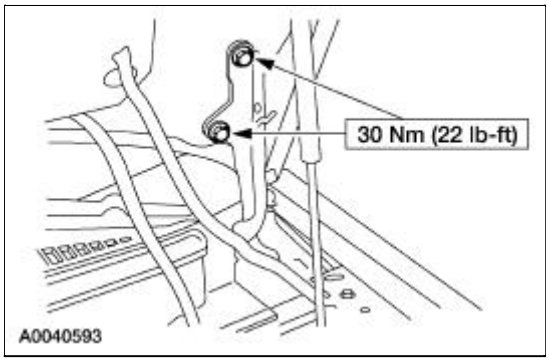
3. Adjust the hood.
4. Tighten the hood hinge to hood bolts enough to hold the hood in place.



5. Check the hood clearance.



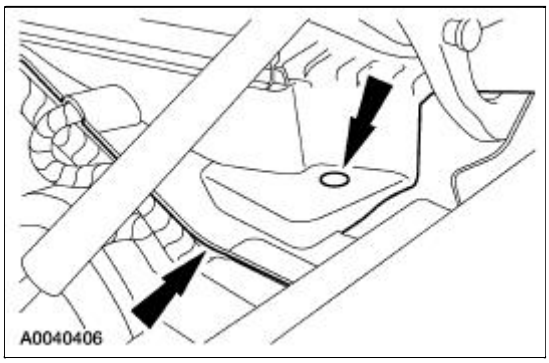
6. Repeat Steps two through five until satisfactory alignment is achieved.
7. Tighten the hood hinge to hood bolts.


30 Nm (22 lb-ft)
A0040593

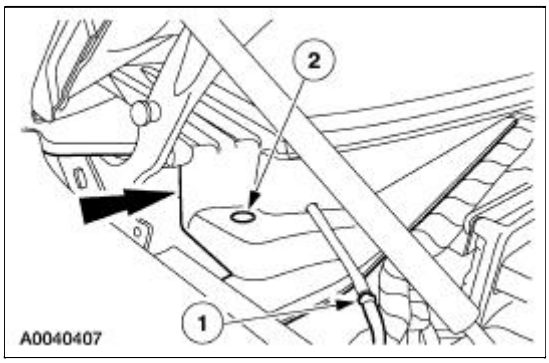
Cowl Panel Grille

Removal and Installation

1. Remove the windshield wipers. For additional information, refer to Section 501-16 .
2. Remove the cowl grille seal.
3. Remove the pin-type retainer and left side cowl trim panel.
   - Disconnect the windshield washer tube.



4. Remove the right side cowl trim panel.
   1. Disconnect the windshield washer tube.
   2. Remove the pin-type retainer.



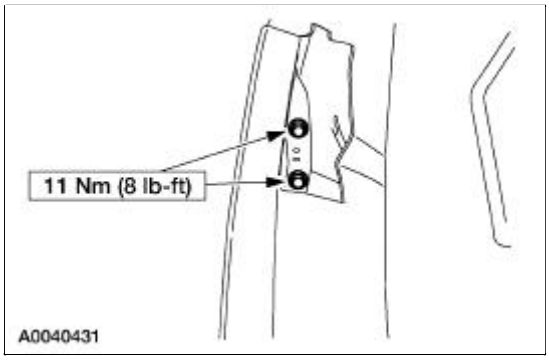
5. To install, reverse the removal procedure.

Fender —Expedition

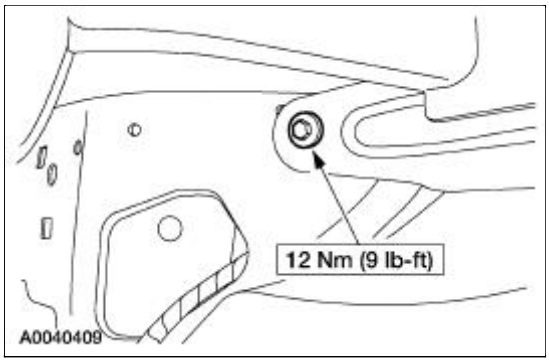
Removal and Installation

NOTE: Left side shown, right side similar.

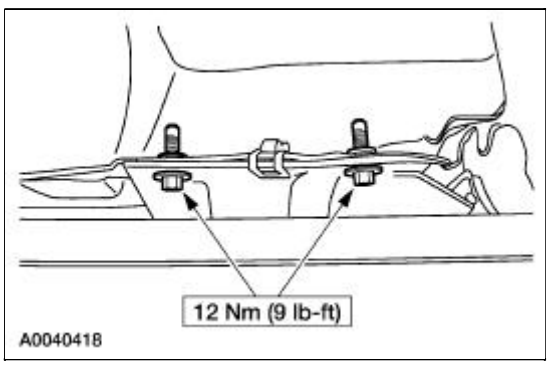
1. Remove the front fender splash shield.
2. Remove the front fender to front bumper cover bolts.



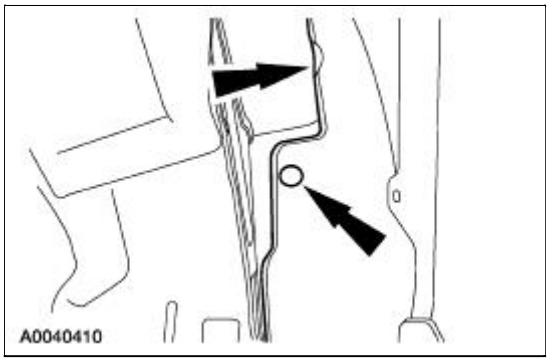
3. Remove the front fender to radiator support bolt.



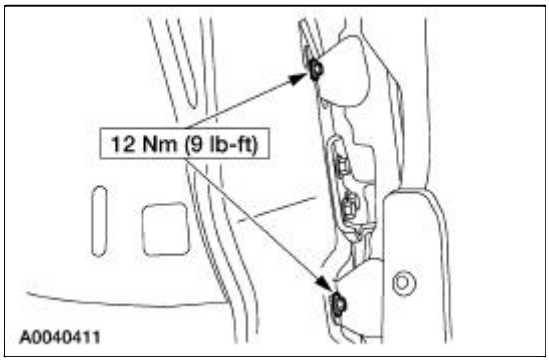
4. Remove the front fender lower bolts.



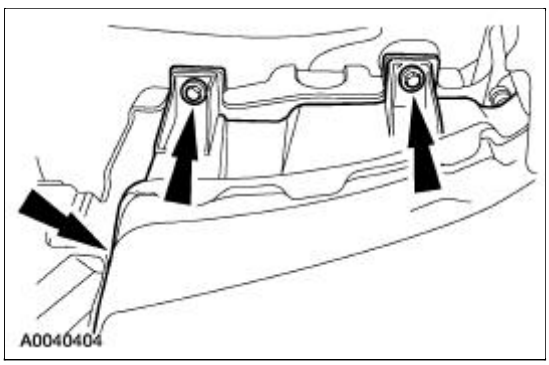
5. Remove the foam insulator.
   - Remove the pin-type retainer.



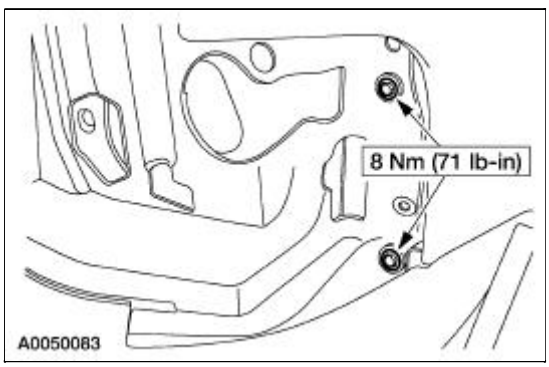
6. Remove the front fender inner bolts.



7. Remove the headlight.
   - Remove the bolts and disconnect the electrical connectors.

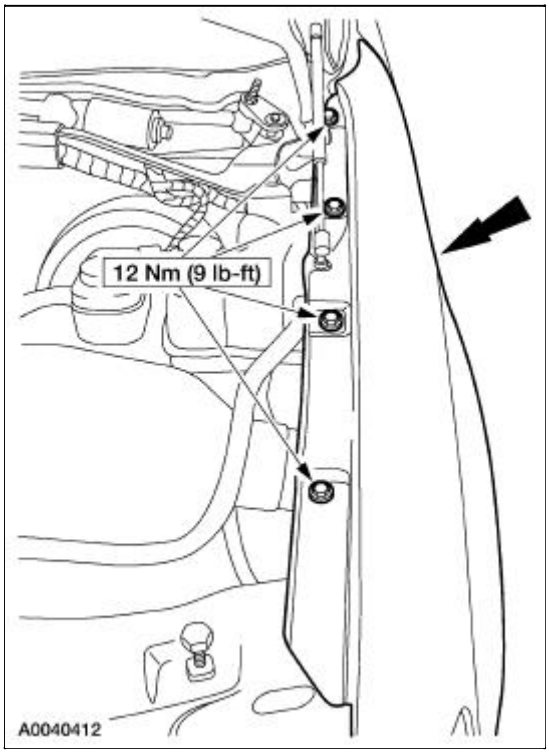


8. Remove the front fender front bolts.



9. Remove the cowl panel grille. For additional information, refer to Cowl Panel Grille in this section.

10. Remove the front fender.
    - Remove the bolts.



11. To install, reverse the removal procedure.

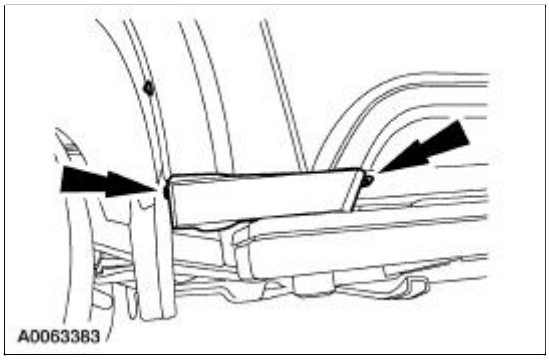
Fender —Navigator

Removal and Installation

NOTE: Left side shown, right side similar.

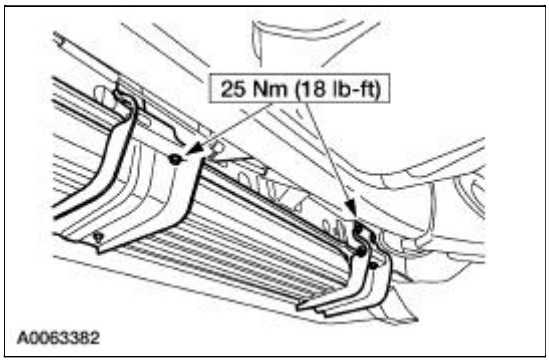
Vehicles with power running boards

1. Remove the lower fender moulding.



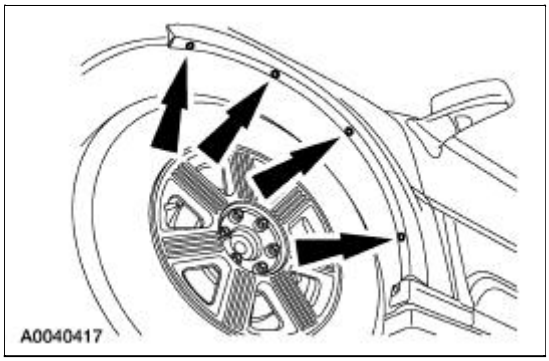
Vehicles without power running boards

2. Lower the running board.
   - Remove the front and middle running board retainer bolts from the body.

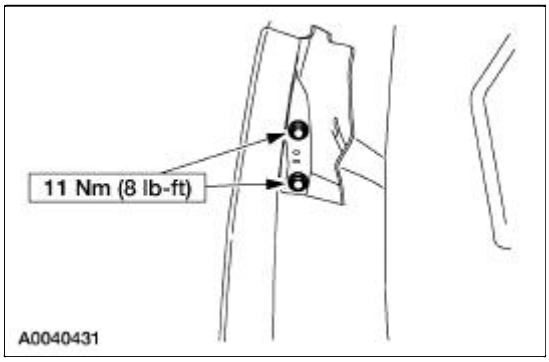


All vehicles

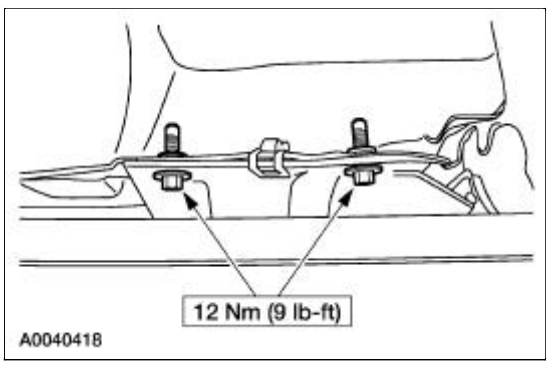
3. Remove the front fender splash shield screws.



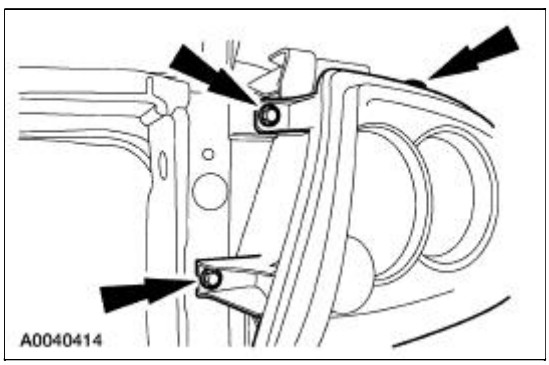
4. Remove the front fender to front bumper cover bolts.



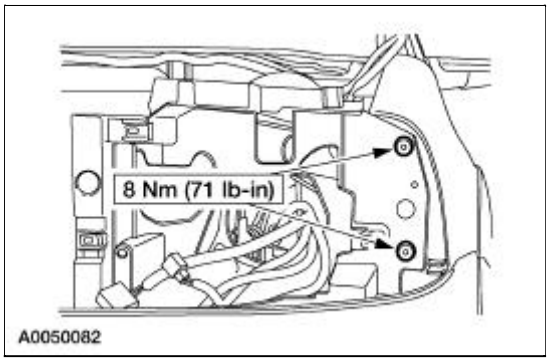
5. Remove the front fender lower bolts.



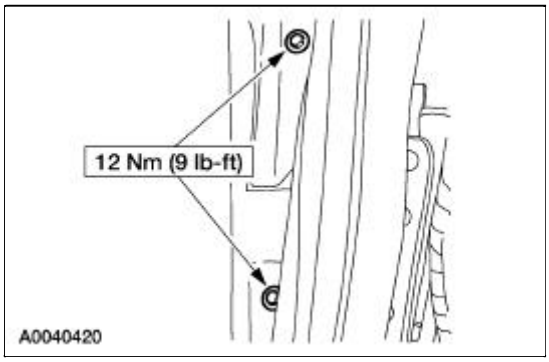
6. Remove the headlight.
    - Remove the bolts and disconnect the electrical connectors.



7. Remove the front fender front bolts.

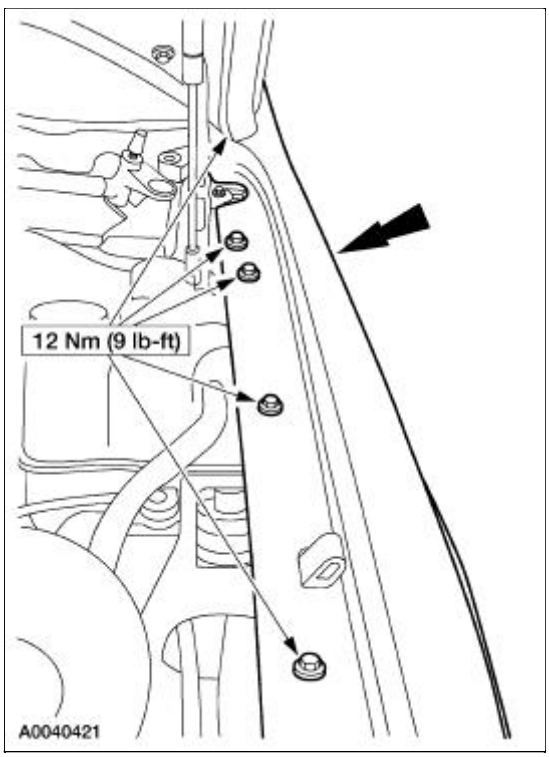


8. Remove the front fender inner bolts.



9. Remove the cowl panel grille. For additional information, refer to Cowl Panel Grille in this section.

10. Remove the front fender.
    - Remove the bolts.

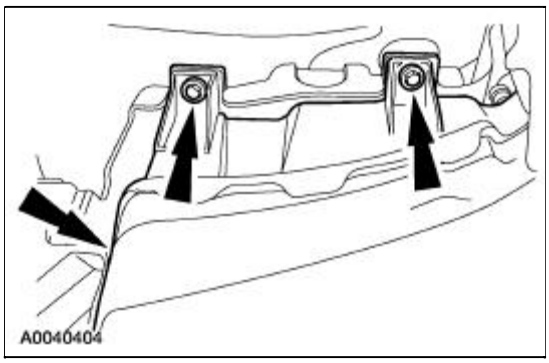


11. To install, reverse the removal procedure.

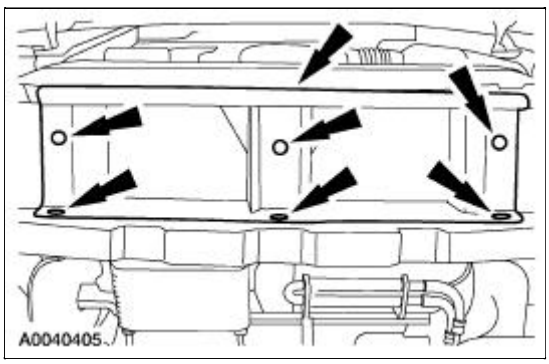
Radiator Grille Opening Panel Reinforcement —Expedition

Removal and Installation

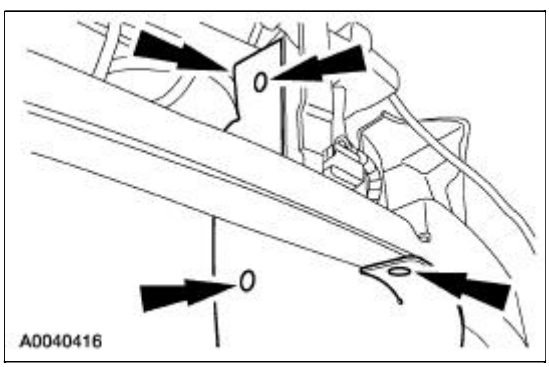
1. Remove the front bumper cover. For additional information, refer to Section 501-19 .
2. Remove the headlights.
   - Remove the bolts and disconnect the electrical connectors.



3. Remove the radiator opening panel.
   - Remove the pin-type retainers.

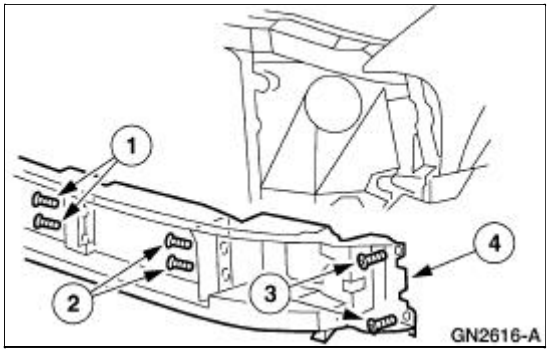


4. Position aside the left and right radiator air deflector shields.
   - Remove the pin-type retainers.



5. Remove the radiator grille opening panel reinforcement.

1. Remove the center bolts.
2. Remove the four reinforcement bolts (two each side).
3. Remove the four remaining bolts (two each side).
4. Remove the radiator grille opening panel reinforcement.



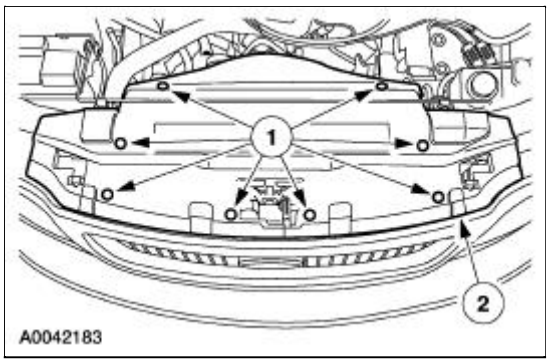
6. To install, reverse the removal procedure.

Radiator Grille Opening Panel Reinforcement —Navigator

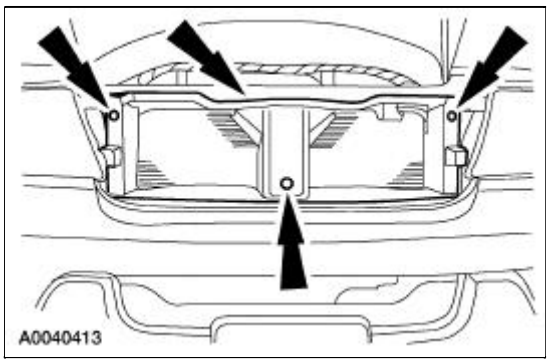
Removal and Installation

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

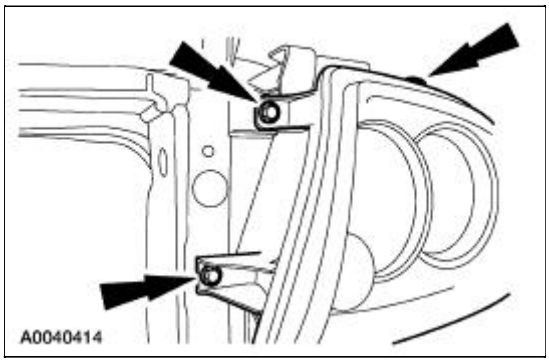
2. Remove the upper air deflector.
    1. Remove the pin-type retainers.
    2. Remove the upper air deflector.



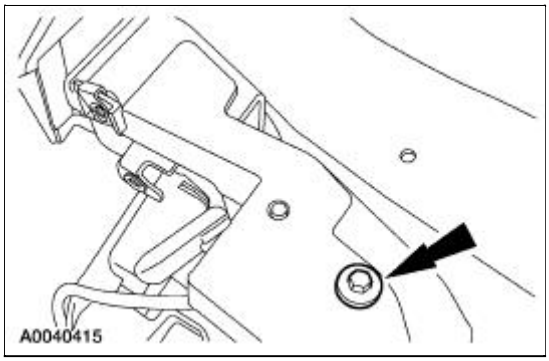
3. Remove the radiator opening panel.
    - Remove the pin-type retainers.



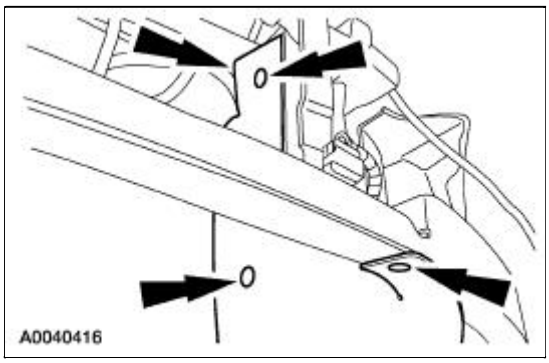
4. Remove the headlights.
    - Remove the bolts and disconnect the electrical connectors.



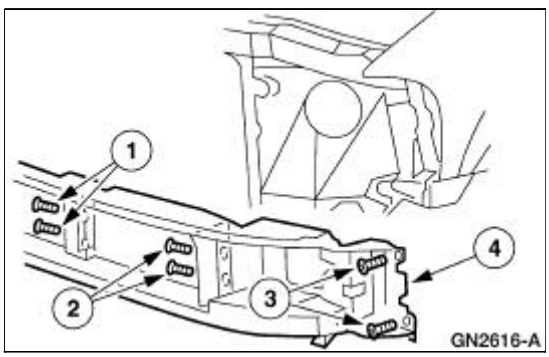
5. Remove the secondary release handle bolts and position aside.



6. Position aside the left and right radiator air deflector shields.
    - Remove the pin-type retainers.



7. Remove the radiator grille opening panel reinforcement.
    1. Remove the center bolts.
    2. Remove the four reinforcement bolts (two each side).
    3. Remove the four remaining bolts (two each side).
    4. Remove the radiator grille opening panel reinforcement.



8. To install, reverse the removal procedure.

General Specifications

Item	Specification
Height Measurements for the Door Clearance Adjustment	
Door clearance; front and rear edge	3.0-7.0 mm (0.118-0.275 in) parallel top to bottom within 1.0 mm (0.04 in)
Door clearance; top of door to roof	3.0-7.0 mm (0.118-0.275 in) parallel top to bottom within 2.0 mm (0.08 in)

Torque Specifications

Description	Nm	lb-ft	lb-in
Front door hinge to front door bolts	30	22	—
Liftgate hinge to liftgate bolts	12	9	—
Liftgate motor bolts	11	8	—
Liftgate motor to liftgate bolts	11	8	—
Liftgate motor pivot bolt	9	—	80
Power liftgate module bolt	11	8	—
Rear door hinge to rear door bolts	30	22	—
Door strikers	12	9	—

Body Closures

The body closures consist of:

- front door hinges
- rear door hinges
- front doors
- rear doors
- door weatherstrips
- liftgate
- liftgate hinges
- door weatherstrips
- liftgate weatherstrips
- liftgate assist cylinders

Power Liftgate

The power liftgate feature will allow the customer to automatically open or close the liftgate by activating the interior open/close switch, the remote keyless entry transmitter, or by manually initiating liftgate movement. The power liftgate uses a power cinch system to latch the liftgate.

The power liftgate system consists of:

- power liftgate control switch (located in the overhead console)
- power liftgate motors (located in the rear headliner area)
- optical sensor (located in the left power liftgate motor assembly)
- pinch strip switches (located on the body by the liftgate)
- home position switch (located on the cinch actuator)
- forkbolt switch (located on the cinching latch assembly)
- detent switch (located on the cinching latch assembly)

The forkbolt and detent switch are located on the cinch latch assembly and the home position switch is located on the cinch actuator assembly. For information on removal of the latch or cinch actuator assembly, refer to Section 501-14 .

The power liftgate may not operate under the following conditions:

- a low voltage or dead battery.
- a disconnected battery.
- a power liftgate that has been left open for more than six hours.
- a power liftgate that has been manually closed and left ajar.

If any of these conditions has occurred, the power liftgate must be reset before performing any pinpoint

tests. For additional information, refer to Power Liftgate Initialization .

Power Liftgate

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool with required communication adapter

Principles of Operation

The power liftgate feature allows the customer to automatically open or close the liftgate by activating the interior open/close switch, the remote keyless entry transmitter, or by manually initiating movement. The power liftgate uses a power cinching system to latch the liftgate.

The power liftgate system consists of the following components:

- power liftgate control switch (located in the overhead console).
- power liftgate motors (located in the rear headliner area).
- optical sensor (located on the left power liftgate motor assembly).
- pinch strip switches (located on the body above the taillamps).
- cinching latch (located in the middle lower portion of the liftgate).
- forkbolt switch (located in the cinching latch mechanism).
- detent switch (located in the cinching latch mechanism).
- liftgate latch remote control (located in the lower right-hand area of the liftgate).
- home position switch (located on the liftgate latch remote control).
- liftgate latch lock/unlock actuator (located in the lower left-hand area of the liftgate).
- power liftgate module (located behind the left rear quarter trim panel).

The power liftgate is controlled by the power liftgate module.

The power liftgate module receives inputs from:

- glass position switch (determines the ajar status of the liftgate glass).

- forkbolt switch (determines the primary position of the latch).
- detent switch (determines the secondary position of the latch).
- home switch (determines the power cinch status).
- power liftgate control switch (activates the power liftgate from the interior of vehicle).
- pinch strip switches (determines if an obstacle is between the pinch strip and liftgate).
- instrument cluster module (activates and sets the options for the power liftgate).
- optical sensor (determines the direction, travel speed and obstacle detection of the liftgate).
- UBP serial communication link.
- power deployable running boards (if equipped).

The power liftgate module sends outputs to:

- liftgate motors.
- power cinching latch system.
- liftgate chime module.
- body security module.
- power deployable running boards (if equipped).

The power liftgate may not operate under the following conditions:

- a low voltage or dead battery.
- a disconnected battery.
- a power liftgate that has been left open for more than six hours.
- a power liftgate that has been manually closed and left ajar.

If any of these conditions has occurred, the power liftgate must be reset before performing any pinpoint tests. For additional information, refer to Power Liftgate Initialization .

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical and electrical damage. Refer to the following chart.

Visual Inspection Chart

Mechanical	Electrical
• Power liftgate motors • Power cinching latch and linkage • Power liftgate pinch strip switches • Liftgate and liftgate hinges • Liftgate assist cylinders • Liftgate strikers • Exterior release handle and linkage	• Battery junction box (BJB) fuse: ▪ 5 (7.5A) ▪ 105 (30A) • Power liftgate control switch • Wiring harness • Connectors

• Liftgate weatherstrip • Liftgate alignment to body and striker	

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

4. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If no continuous DTCs related to the concern are retrieved, GO to Symptom Chart to continue diagnostics.

5. If the diagnostic tool does not communicate with the vehicle:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position (must be in RUN position).
   - check that liftgate latch is in the primary position (fully latched).

6. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool manual.

7. Carry out the DATA LINK DIAGNOSTICS test. If the diagnostic tool responds with:
   - SCP+, SCP- or UBP circuits = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for power liftgate module, refer to Section 419-10 .
   - SYSTEM PASSED, retrieve and record the power liftgate module continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the power liftgate module.

8. If the DTCs retrieved are related to the concern, refer to Power Liftgate Module Diagnostic Trouble Code (DTC) Index to continue diagnostics.

9. If DTCs are retrieved that are not found in the following Power Liftgate Module Diagnostic Trouble Code (DTC) Index, refer to the master Power Liftgate Module Diagnostics Trouble Code (DTC) index in Section 419-10 .

Power Liftgate Module Diagnostic Trouble Code (DTC) Index

Power Liftgate Module Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1342	ECU Is Defective	Power Liftgate Module	INSTALL a new power liftgate module. REFER to Power Liftgate Module in this section.
B2477	Module Configuration Failure	Power Liftgate Module	REFER to Section 418-01 .
B2522	Vbatt1 Circuit Failure	Power Liftgate Module	REFER to Section 419-10 .
B2552	Vbatt2 Circuit Open	Power Liftgate Module	REFER to Section 419-10 .
B2698	Vbatt2 Circuit Failure	Power Liftgate Module	REFER to Section 419-10 .
B2699	Left Pinch Strip Open Or Short To Battery	Power Liftgate Module	Go To Pinpoint Test B .
B2700	Right Pinch Strip Open Or	Power Liftgate Module	Go To Pinpoint Test B .

	Short To Battery		
B2701	Left Pinch Strip Stuck Active	Power Liftgate Module	Go To Pinpoint Test B .
B2702	Right Pinch Strip Stuck Active	Power Liftgate Module	Go To Pinpoint Test B .
B2703	Open/Close Switch Stuck Active	Power Liftgate Module	Go To Pinpoint Test B .
B2704	Optical Sensor Power Short To Ground	Power Liftgate Module	Go To Pinpoint Test B .
B2705	Optical Sensor 1 Input Not Active During Powered Gate Movement	Power Liftgate Module	Go To Pinpoint Test B .
B2706	Optical Sensor 2 Input Not Active During Powered Gate Movement	Power Liftgate Module	Go To Pinpoint Test B .
B2709	Gate Open Output Short To Battery	Power Liftgate Module	Go To Pinpoint Test B .
B2710	Gate Close Output Short To Battery	Power Liftgate Module	Go To Pinpoint Test B .
B2711	Gate Open Output Short To Ground Or Open	Power Liftgate Module	Go To Pinpoint Test B .
B2712	Gate Close Output Short To Ground Or Open	Power Liftgate Module	Go To Pinpoint Test B .
B2713	Unlatch Output Short To Ground Or Open	Power Liftgate Module	Go To Pinpoint Test B .
B2714	Uncinch Output Short To Ground Or Open	Power Liftgate Module	Go To Pinpoint Test B .
B2715	Cinch Output Short To Ground Or Open	Power Liftgate Module	Go To Pinpoint Test B .
B2718	Gate Ajar Output Short To Battery	Power Liftgate Module	Go To Pinpoint Test B .
B2721	Gate Ajar Output Short To Ground Or Open	Power Liftgate Module	Go To Pinpoint Test B .
B2722	Open/Close Switch Active During Self-Test	Power Liftgate Module	Go To Pinpoint Test B .
B2723	Glass Position Switch Active During Self-Test	Power Liftgate Module	Go To Pinpoint Test B .
B2724	Forkbolt Switch Invalid During Self-Test	Power Liftgate Module	Go To Pinpoint Test B .
B2725	Detent Switch Invalid During Self-Test	Power Liftgate Module	Go To Pinpoint Test B .
B2726	Home Switch Invalid During Self-Test	Power Liftgate Module	Go To Pinpoint Test B .
B2819	Gate Motor Circuit Short To Battery	Power Liftgate Module	Go To Pinpoint Test B .
B2820	Gate Motor Circuit Short To Ground Or Open	Power Liftgate Module	Go To Pinpoint Test B .
B2821	Cincher Motor/Unlatch Actuator Short To Ground Or Open	Power Liftgate Module	Go To Pinpoint Test B .
B2822	Cincher Motor/Unlatch Actuator Short To Battery	Power Liftgate Module	Go To Pinpoint Test B .
B2825	Movement Ceased Due To	Power Liftgate Module	Go To Pinpoint Test B .

	Excess Speed Deviation		
B2903	Chime Output Circuit Short To Battery	Power Liftgate Module/ Liftgate Chime Module	Go To Pinpoint Test C .
C1935	Chime Circuit Failure	Power Liftgate Module/ Liftgate Chime Module	Go To Pinpoint Test C .
U1950	UBP Communication BUS Fault	UBP Communi cation	REFER to Section 418-00 .
U2338	Invalid ACM Message Data	Power Liftgate Module	REFER to Section 418-00 .
U2242	Invalid 4WAS Message Data	4WAS Module	REFER to Section 308-07A .
U2403	Invalid CSM Message Data	Vehicle Security Module	REFER to Section 418-00 .
U2406	Invalid IC Message Data	Instrument Cluster Module	REFER to Section 413-01 .
U2469	Power Liftgate Disabled By Customer Interface	Instrument Cluster Module	Turn power liftgate on at message center.
U2470	Unexpected Keyfob/Keypad Button Press	Power Liftgate Module	Go To Pinpoint Test A .
U2471	Unexpected PRNDL State	Power Liftgate Module	REFER to Section 419-10 .
U2472	Unexpected IGN State	Power Liftgate Module	REFER to Section 418-00 .
U2473	Unexpected Vehicle Speed	Instrument Cluster Module/ Powertrian Control Module	REFER to Section 413-01 .
U2528	PRNDL Data Mismatch	Power Liftgate Module/ Instrument Cluster Module	Go To Pinpoint Test D .

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• No communication with power liftgate module	• BJB fuse 5 (7.5A). • Circuitry. • Power liftgate module.	• REFER to Section 419-10 .
• The power liftgate does not operate — using the keyless entry remote transmitter	• Keyless entry remote transmitter. • Batteries. • Power liftgate module. • Vehicle security module.	• Go To Pinpoint Test A .
• The power liftgate does not operate/does not operate correctly	• BJB fuse 105 (30A). • Circuitry. • Liftgate control switch. • Power liftgate module.	• Go To Pinpoint Test B .

	• Pinch strip switches. • Forkbolt/detent switch. • Home position switch. • Liftgate drive motor assembly. • Cinching actuator motor. • Unlatch actuator motor. • Glass position switch. • Liftgate optical sensor.	
• The power liftgate does not operate — liftgate close chime	• Circuitry. • Liftgate close chime. • Power liftgate module.	• Go To Pinpoint Test C .
• The interior lights remain on and the instrument cluster message center indicates liftgate ajar	• Liftgate latch is not in primary position	• Manually pull on the liftgate. If liftgate moves, open and close the liftgate to the primary latch position. Manually pull on liftgate glass. If liftgate glass moves, open and close the liftgate glass. If the liftgate ajar condition still exists, Go To Pinpoint Test B .
• The power liftgate stops during power open operation	• The vehicle was started or taken out of PARK during a power open operation. • Mechanical binding.	• Manually close the liftgate to the primary latch position and open the liftgate using the exterior handle or liftgate control switch with the vehicle in PARK and the ignition in the ON position. If the condition still exists and there is no mechanical binding, Go To Pinpoint Test B .
• The power liftgate reverses during power close operation (mid-travel)	• Power liftgate motor drive link alignment. • Mechanical binding.	• Turn the power liftgate OFF from the instrument cluster message center and manually operate the liftgate. If no mechanical binding exists and DTC B2825 is not present Go To Pinpoint Test B . If DTC B2825 is present, disconnect each power liftgate motor drive link from the liftgate and manually push drive link into the power liftgate motor housing. If the drive link moves easily into the housing, install a new power liftgate motor.
• The power liftgate opens when the lock/unlock control switches are	• Incorrect installation of the lock/unlock actuator rod into	• Remove the liftgate trim panel and inspect for correct installation of lock/unlock actuator rod. If installation is

pressed	the cinch latch assembly.	correct Go To Pinpoint Test B .
• Intrument cluster message center indicates liftgate data error	• Fuse 5 (7.5A).	• Check fuse 5 (7.5A). If fuse is OK, refer to Section 418-00 to diagnose the comunication problem. If fuse is blown, install a new fuse and clear DTCs. If new fuse fails and condition still exists, refer to Section 418-00 .
• Instrument cluster message center indicates power liftgate mode status OFF and change to ON is inhibited	• Fuse 105 (30A).	• Check fuse 105 (30A). If fuse is OK, Go To Pinpoint Test B . If fuse is blown, install a new fuse and clear DTCs. If new fuse fails and condition still exists, Go To Pinpoint Test B .

Pinpoint Tests

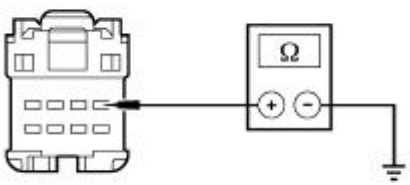
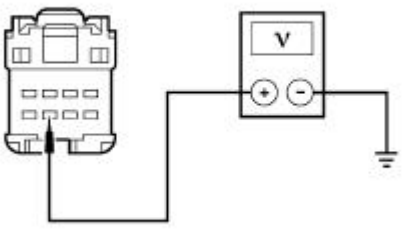
PINPOINT TEST A: THE POWER LIFTGATE DOES NOT OPERATE — USING THE KEYLESS ENTRY REMOTE TRANSMITTER

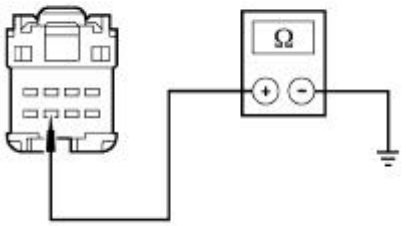
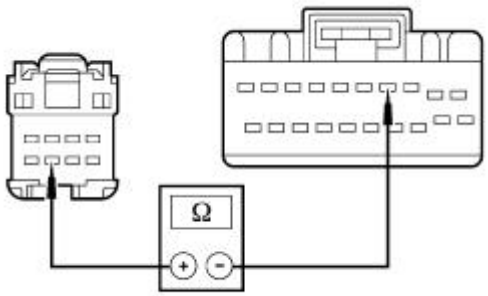
Test Step	Result / Action to Take
A1 CHECK THE KEYLESS ENTRY REMOTE TRANSMITTER FOR OPERATION OF LOCKS	
• Operate the power locks using the keyless entry remote transmitter. • **Do the power locks operate correctly?**	**Yes** GO to A2 . **No** REFER to Section 501-14 to diagnose the keyless entry remote transmitter.
A2 VERIFY POWER LIFTGATE OPERATION	
• Operate the power liftgate at the liftgate control switch. • **Does the power liftgate operate correctly?**	**Yes** INSTALL a new vehicle security module. REFER to Section 419-10 . TEST the system for normal operation. If still not working correctly, INSTALL a new power liftgate module. REFER to Power Liftgate Module in this section. TEST the system for normal operation. **No** Go To Pinpoint Test B to diagnose the inoperative power liftgate.

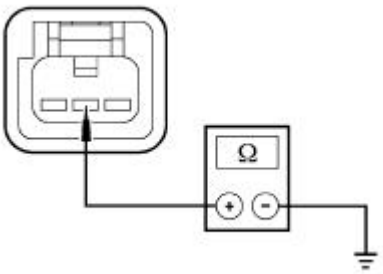
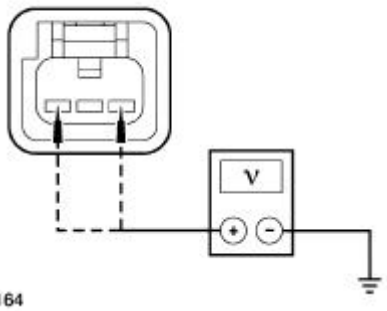
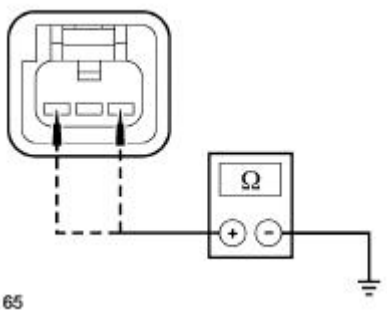
PINPOINT TEST B: THE POWER LIFTGATE DOES NOT OPERATE/DOES NOT OPERATE CORRECTLY

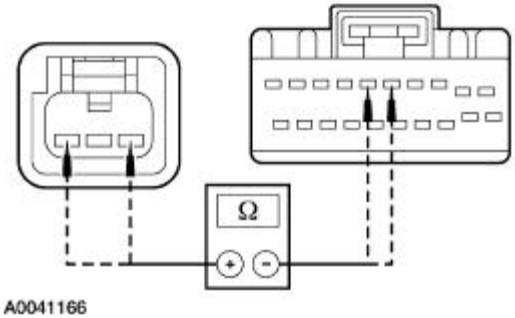
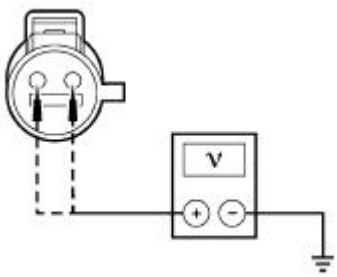
Test Step	Result / Action to Take

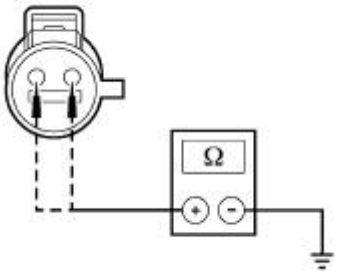
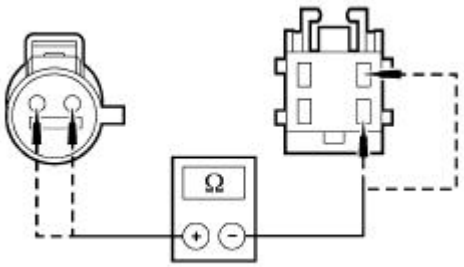
B1 RETRIEVE THE DTCs FROM POWER LIFTGATE MODULE	
• Use the recorded power liftgate module DTCs from the continuous and power liftgate module self-tests. • **Are any power liftgate module DTCs recorded?**	**Yes** If DTC B2699 or B2701, GO to B38 . If DTC B2700 or B2702, GO to B39 . If DTC B2703 or 2722, GO to B4 . If DTC B2704, B2705 or B2706, GO to B29 . If DTC B2709, B2710, B2711, B2712, B2819, B2825 or B2820, GO to B23 . If DTC B2713, GO to B19 . If DTC B2714, B2715, B2821 or B2822, GO to B15 . If DTC B2718 or B2721, GO to B44 . If DTC B2723, GO to B48 . If DTC B2724 or B2725, GO to B10 . If DTC B2726, GO to B33 . **No** GO to B2 .
B2 VERIFY POWER LIFTGATE OPERATION AT THE LIFTGATE CONTROL SWITCH	
• Operate the power liftgate at the power liftgate control switch. • **Does the power liftgate operate correctly?**	**Yes** GO to B3 . **No** GO to Symptom Chart and VERIFY the symptom. If sent back here from the Symptom Chart, GO to B3 .
B3 VERIFY POWER LIFTGATE OPERATION AT THE FORKBOLT/DETENT SWITCH	
• Operate the power liftgate at the power liftgate handle. • **Does the power liftgate operate correctly?**	**Yes** If the control switch and handle operated correctly, GO to Symptom Chart and VERIFY the symptom.

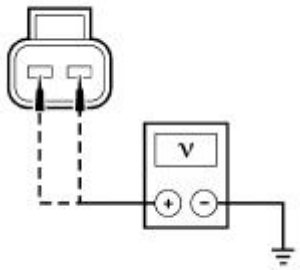
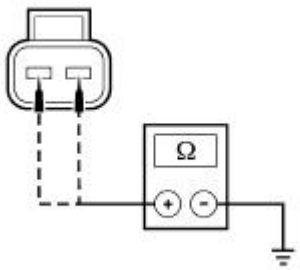
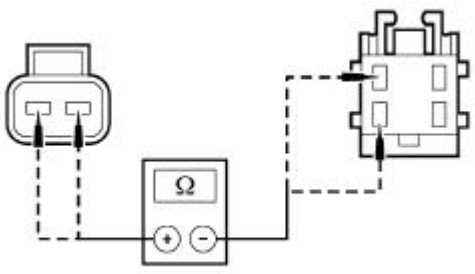
	If the control switch did not operate correctly, GO to B4 . **No** GO to B10 .
B4 VERIFY THE POWER LIFTGATE CONTROL SWITCH PID	
• Monitor the power liftgate OPEN/CLOSE switch PID while operating the power liftgate control switch. • **Do the PID values agree with the switch positions?**	**Yes** CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to B5 .
B5 CHECK THE POWER LIFTGATE CONTROL SWITCH	
• Carry out the Power Liftgate Control Switch Component Test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. • **Does the power liftgate control switch pass the component test?**	**Yes** GO to B6 . **No** INSTALL a new power liftgate control switch. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B6 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
• Measure the resistance between power liftgate control switch C9000-4 circuit 57 (BK) harness side and ground.  A0050101 • **Is the resistance less than 5 ohms?**	**Yes** GO to B7 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B7 CHECK CIRCUIT 913 (GY/RD) FOR A SHORT TO POWER	
• Disconnect: Power Liftgate Module C4174d. • Key in ON position. • Measure the voltage between power liftgate control switch C9000-7, circuit 913 (GY/RD) harness side and ground.  A0041160	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to B8 .

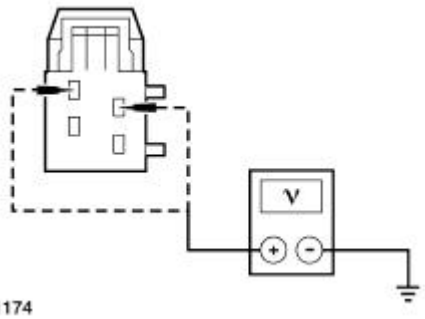
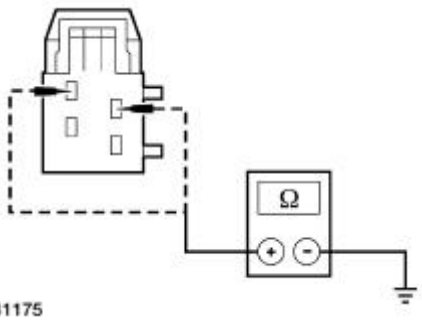
• **Is the voltage greater than 10 volts?**	
B8 CHECK CIRCUIT 913 (GY/RD) FOR A SHORT TO GROUND	
• Key in OFF position. • Measure the resistance between power liftgate control switch C9000-7, circuit 913 (GY/RD) harness side and ground.  A0041161 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to B9 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B9 CHECK CIRCUIT 913 (GY/RD) FOR AN OPEN	
• Disconnect: Power Liftgate Module C9000. • Measure the resistance between power liftgate control switch C9000-7, circuit 913 (GY/RD) harness side and ground, and power liftgate module C4174d-4, circuit 913 (GY/RD) harness side.  A0041162 • **Are the resistances less than 5 ohms?**	**Yes** GO to B52 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B10 CHECK THE FORKBOLT/DETENT SWITCH IN THE CINCHING LATCH ASSEMBLY	
• Enter the following diagnostic mode on the diagnostic tool: Forkbolt and Detent Switch PIDs. • **NOTE:** The liftgate is in the primary position when the liftgate is in the fully closed position and in the unlatch position when the liftgate is open and completly out of the striker. The liftgate can be placed in the secondary latch position by opening the liftgate and closing the latch lever/pawl by hand and can be released back into the unlatched position by lifting up on the liftgate handle. • Move the liftgate into each of three positions specified by the table below. **Liftgate Latching Position** / **Forkbolt Switch PID** / **Detent Switch PID** Primary Latch / Not Active / Active Secondary Latch / Active / Active Unlatched / Not Active / Not Active • **Do the switch states agree with the table?**	**Yes** GO to B11 . **No** INSTALL a new forkbolt/detent switch. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

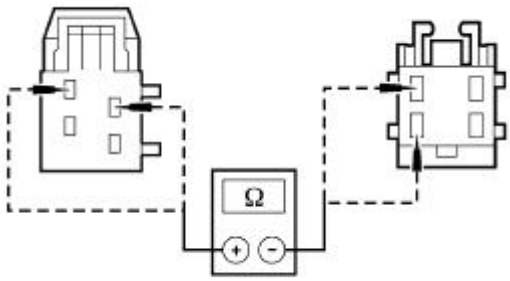
B11 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
• Measure the resistance between forkbolt/detent switch C4190-2, circuit 57 (BK) harness side and ground.  A0041163 • **Is the resistance less than 5 ohms?**	**Yes** GO to B12 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B12 CHECK CIRCUIT 1962 (LG/VT) AND 1963 (OG/LB) FOR A SHORT TO POWER	
• Disconnect: Power Liftgate Module C4174d. • Key in ON position. • Measure the voltage between forkbolt/detent switch C4190-1, circuit 1962 (LG/VT) harness side and ground, and forkbolt/detent switch C4190-3, circuit 1963 (OG/LB) harness side and ground.  A0041164 • **Are the voltages greater than 10 volts?**	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to B13 .
B13 CHECK CIRCUIT 1962 (LG/VT) AND 1963 (OG/LB) FOR A SHORT TO GROUND	
• Key in OFF position. • Measure the resistance between forkbolt/detent switch C4190-1, circuit 1962 (LG/VT) harness side and ground, and forkbolt/detent switch C4190-3, circuit 1963 (OG/LB) harness side and ground.  A0041165 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to B14 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B14 CHECK CIRCUIT 1962 (LG/VT) AND 1963 (OG/LB) FOR AN OPEN	
• Measure the resistance between forkbolt/detent switch C4190-1, circuit 1962 (LG/VT) and liftgate module C4174d-5, circuit 1962 (LG/VT) harness side; and between forkbolt/detent switch C4190-	**Yes** GO to B52 .

3, circuit 1963 (OG/LB) and power liftgate module C4174d-6, circuit 1963 (OG/LB) harness side.  A0041166 ● **Are the resistances less than 5 ohms?**	**No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B15 VERIFY CINCHING ACTUATOR MOTOR OPERATION	
● **NOTE:** The liftgate trim panel must be removed for this visual inspection. ● Visually monitor the cinching actuator assembly while activating the cinching actuator motor with the diagnostic tool power liftgate output command. ● **Does the cinch actuator assembly carry out the function requested?**	**Yes** GO to B19 . **No** GO to B16 .
B16 CHECK CIRCUIT 1604 (VT/OG) AND 1606 (DG/WH) FOR A SHORT TO POWER	
● Key in ON position. ● Disconnect: Cinching Actuator Motor C4188. ● Disconnect: Power Liftgate Module C4174a. ● Measure the voltage between cinching actuator motor C4188-2, circuit 1604 (VT/OG) harness side and ground, and cinching actuator motor C4188-1, circuit 1606 (DG/WH) harness side and ground.  A0041168 ● **Are the voltages greater than 10 volts?**	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to B17 .
B17 CHECK CIRCUIT 1604 (VT/OG) AND 1606 (DG/WH) FOR A SHORT TO GROUND	
● Key in OFF position. ● Measure the resistance between cinching actuator motor C4188-2, circuit 1604 (VT/OG) harness side and ground, and cinching actuator motor C4188-1, circuit 1606 (DG/WH) harness side and ground.	**Yes** GO to B18 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

 A0041169 ● **Are the resistances greater than 10,000 ohms?**	
B18 CHECK CIRCUIT 1604 (VT/OG) AND 1606 (DG/WH) FOR AN OPEN	
● Measure the resistance between cinching actuator motor C4188-2, circuit 1604 (VT/OG) and power liftgate module C4174a-3, circuit 1604 (VT/OG) harness side; and between cinching actuator motor C4188-1, circuit 1606 (DG/WH) and power liftgate module C4174a-1, circuit 1606 (DG/WH) harness side.  A0041170 ● **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new cinching actuator motor. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B19 VERIFY UNLATCHING ACTUATOR MOTOR OPERATION	
● **NOTE:** The liftgate must be in the primary latch position. The liftgate is in the primary position when the liftgate is in the fully closed position. ● Visually monitor the unlatch actuator assembly while activating the unlatch actuator with the diagnostic tool power liftgate module output command. ● **Does the unlatch actuator perform the operation?**	**Yes** GO to B23 . **No** GO to B20 .
B20 CHECK CIRCUIT 1247 (RD/LG) AND 1241 (GY/YE) FOR A SHORT TO POWER	
● Disconnect: Unlatching Actuator Motor C4189. ● Disconnect: Power Liftgate Module C4174a. ● Key in ON position. ● Measure the voltage between unlatching actuator motor C4189-1, circuit 1247 (RD/LG) harness side and ground, and unlatching actuator motor C4189-2, circuit 1241 (GY/YE) harness side and ground.	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to B21 .

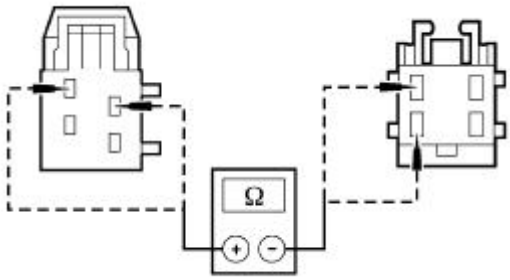
 A0041171 ● **Are the voltages greater than 10 volts?**	
B21 CHECK CIRCUIT 1247 (RD/LG) AND 1241 (GY/YE) FOR A SHORT TO GROUND	
● Key in OFF position. ● Measure the resistance between unlatching actuator motor C4189-1, circuit 1247 (RD/LG) harness side and ground, and unlatching actuator motor C4189-2, circuit 1241 (GY/YE) harness side and ground.  A0041172 ● **Are the resistances greater than 10,000 ohms?**	**Yes** GO to B22 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B22 CHECK CIRCUIT 1247 (RD/LG) AND 1241 (GY/YE) FOR AN OPEN	
● Measure the resistance between unlatching actuator motor C4189-1, circuit 1247 (RD/LG) and power liftgate module C4174a-4, circuit 1247 (RD/LG) harness side; and between unlatching actuator motor C4189-2, circuit 1241 (GY/YE) and power liftgate module C4174a-2, circuit 1241 (GY/YE) harness side.  A0041173 ● **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new liftgate latch control assembly. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B23 VERIFY LIFTGATE DRIVE MOTOR OPERATION	
● Open the liftgate to the full open position. ● Using the diagnostic tool, activate the power liftgate output command to the gate closed position. ● **Did the liftgate move in the closed direction?**	**Yes** GO to B27 . **No** GO to B24 .

B24 CHECK CIRCUIT 1601 (WH/PK) AND 1599 (TN/LB) FOR A SHORT TO POWER	
• Disconnect: Left Liftgate Drive Motor C997. • Disconnect: Right Liftgate Drive Motor C996. • Disconnect: Power Liftgate Module C4174b. • Key in ON position. • Measure the voltage between left liftgate drive motor C997-1, circuit 1601 (WH/PK) harness side and ground, and left liftgate drive motor C997-2, circuit 1599 (TN/LB) harness side and ground.  A0041174 • **Are the voltages greater than 10 volts?**	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to B25 .
B25 CHECK CIRCUIT 1601 (WH/PK) AND 1599 (TN/LB) FOR A SHORT TO GROUND	
• Key in OFF position. • Measure the resistance between left liftgate drive motor C997-1, circuit 1601 (WH/PK) harness side and ground, and left liftgate drive motor C997-2, circuit 1599 (TN/LB) harness side and ground.  A0041175 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to B26 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B26 CHECK CIRCUIT 1601 (WH/PK) AND 1599 (TN/LB) FOR AN OPEN	
• Measure the resistance between left liftgate drive motor C997-1, circuit 1601 (WH/PK) and power liftgate module C4174b-3, circuit 1601 (WH/PK) harness side; and between left liftgate drive motor C997-2, circuit 1599 (TN/LB) and power liftgate module C4174b, circuit 1599 (TN/LB) harness side.	**Yes** GO to B27 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.



A0041176

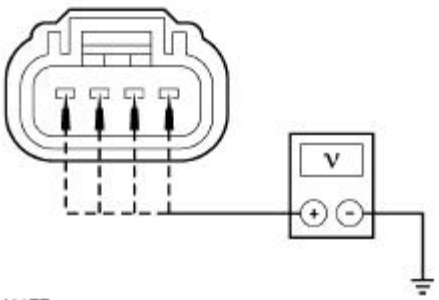
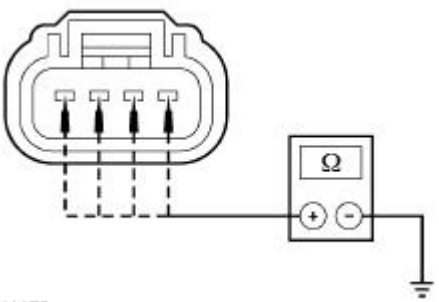
- Measure the resistance between right liftgate drive motor C996-2, circuit 1601 (WH/PK) and power liftgate module C4174b-3, circuit 1601 (WH/PK) harness side; and between right liftgate drive motor C996-1, circuit 1599 (TN/LB) and power liftgate module C4174b-4, circuit 1599 (TN/LB) harness side.



A0041176

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

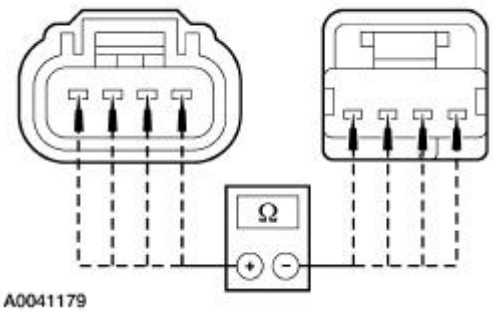
B27 CHECK LEFT LIFTGATE DRIVE MOTOR	
• Connect: Power Liftgate Module C4174b. • Disconnect: Right Liftgate Drive Motor C996. • Open the liftgate to the full open position. • Using the diagnostic tool, activate the power liftgate output command to the gate closed position. • **Did the liftgate move in the closed direction?**	**Yes** GO to B28 . **No** INSTALL a new left liftgate drive motor. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B28 CHECK RIGHT LIFTGATE DRIVE MOTOR	
• Connect: Right Liftgate Drive Motor C996. • Disconnect: Left Liftgate Drive Motor C997. • Open the liftgate to the full open position. • Using the diagnostic tool, activate the power liftgate output command to the gate closed position. • **Did the liftgate move in the closed direction?**	**Yes** GO to B52 . **No** INSTALL a new right liftgate drive motor. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B29 VERIFY THE LIFTGATE OPTICAL SENSOR OPERATION	
• Turn the power liftgate OFF from the instrument cluster message center. • Enter the following diagnostic mode on the diagnostic tool: Optical Sensor Feedback PID. • Monitor optical sensor 1 PID and optical sensor 2 PID while manually closing the liftgate. • **Does the optical sensor 1 PID and optical sensor 2 PID**	**Yes** GO to B52 . **No** GO to B30 .

change from inactive/active to active/inactive while the liftgate is manually moved?	
B30 CHECK CIRCUIT 1968 (YE), 1969 (WH/YE), 1970 (RD/LB), AND 1971 (LB/OG) FOR A SHORT TO POWER	
• Disconnect: Liftgate Optical Sensor C955. • Disconnect: Power Liftgate Module C4174c. • Key in ON position. • Measure the voltage between the following optical sensor circuits and ground: **Connector / Pin / Circuit** C955 / Pin 1 / 1968 (YE) C955 / Pin 2 / 1969 (WH/YE) C955 / Pin 3 / 1970 (RD/LB) C955 / Pin 4 / 1971 (LB/OG)  A0041177 • **Are the voltages greater than 10 volts?**	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to B31 .
B31 CHECK CIRCUIT 1968 (YE), 1969 (WH/YE), 1970 (RD/LB), AND 1971 (LB/OG) FOR A SHORT TO GROUND	
• Key in OFF position. • Measure the resistance between following optical sensor circuits and ground: **Connector / Pin / Circuit** C955 / Pin 1 / 1968 (YE) C955 / Pin 2 / 1969 (WH/YE) C955 / Pin 3 / 1970 (RD/LB) C955 / Pin 4 / 1971 (LB/OG)  A0041178 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to B32 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

B32 CHECK CIRCUIT 1968 (YE), 1969 (WH/YE), 1970 (RD/LB), AND 1971 (LB/OG) FOR AN OPEN

- Measure the resistance between optical sensor C955 harness side and power liftgate module C4174c harness side using the following table:

Optical Sensor	Circuit	Power Liftgate Module
C955-1	1968 (YE)	C4174c-1
C955-2	1969 (WH/YE)	C4174c-2
C955-3	1970 (RD/LB)	C4174c-3
C955-4	1971 (LB/OG)	C4174c-4



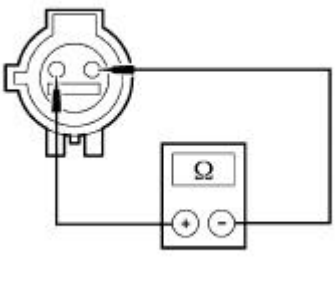
- **Are the resistances less than 5 ohms?**

Yes
INSTALL a new left power liftgate motor. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

No
REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

B33 CHECK THE HOME POSITION SWITCH

- Disconnect: Home Position Switch C4187.
- Measure the resistance between home position switch pin 1 and pin 2 component side while manually activating the home position switch.



- **Is the resistance less than 5 ohms when activated and greater than 10,000 ohms when not activated?**

Yes
GO to B34 .

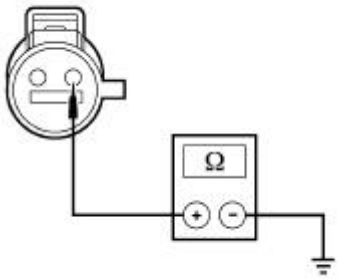
No
INSTALL a new liftgate latch control assembly. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

B34 CHECK CIRCUIT 57 (BK) FOR AN OPEN

- Measure the resistance between home position switch C4187-2 circuit 57 (BK) harness side and ground.

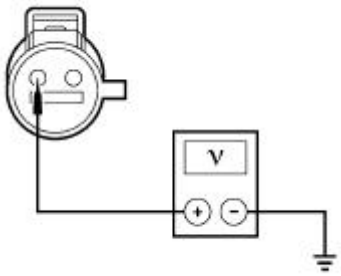
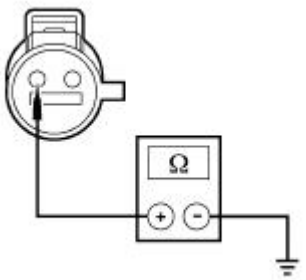
Yes
GO to B35 .

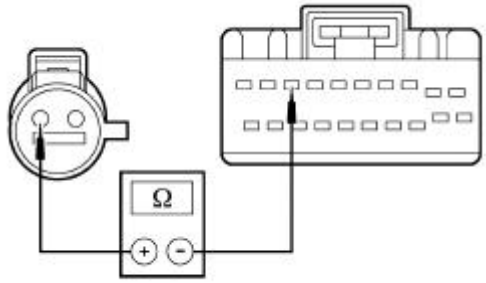
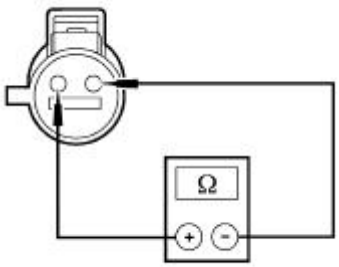
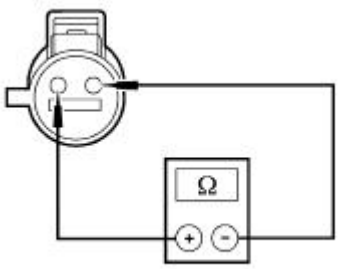
No
REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

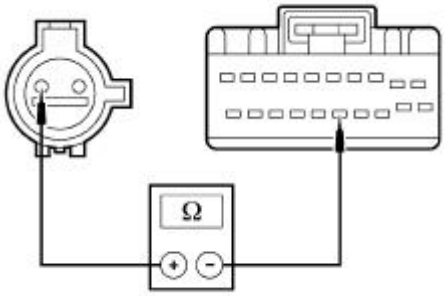
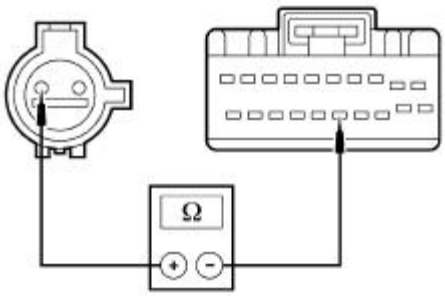
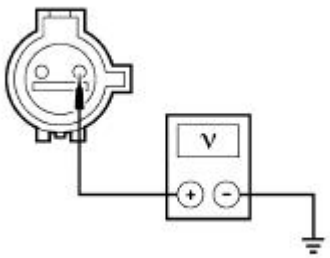


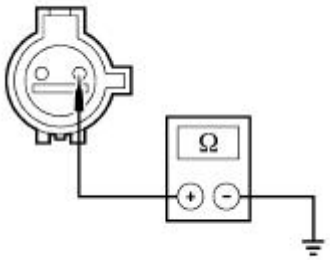
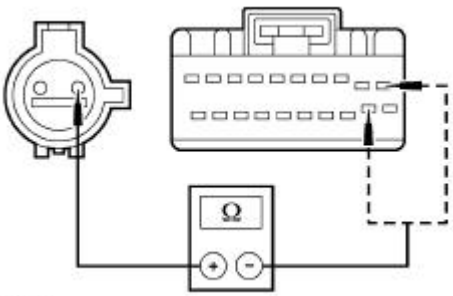
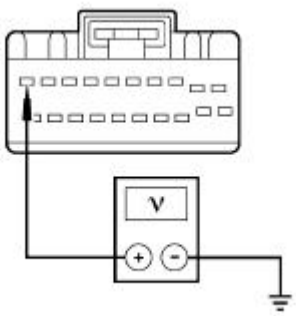
A0041182

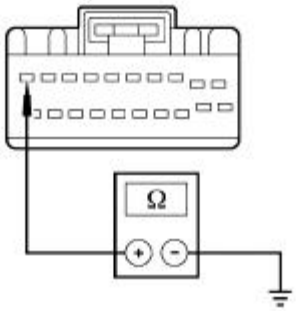
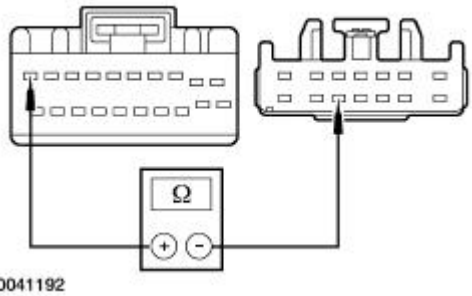
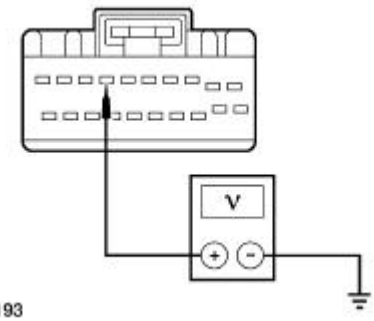
- **Is the resistance less than 5 ohms?**

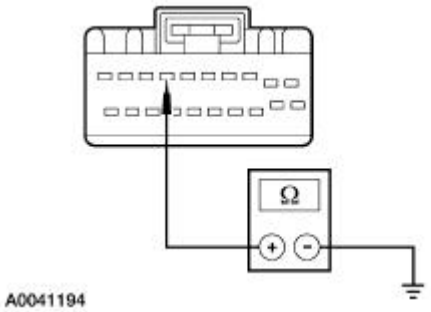
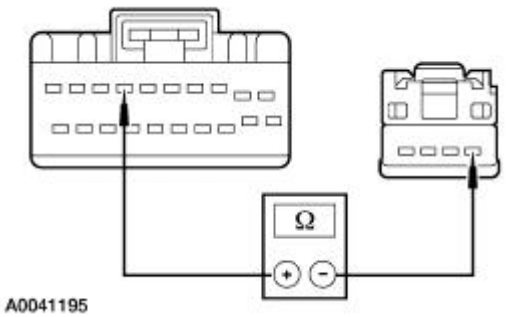
B35 CHECK CIRCUIT 1964 (DG/WH) FOR A SHORT TO POWER	
• Disconnect: Power Liftgate Module C4174d. • Key in ON position. • Measure the voltage between home position switch C4187-1, circuit 1964 (DG/WH) harness side and ground.  A0067609 • **Is the voltage greater than 10 volts?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to B36 .
B36 CHECK CIRCUIT 1964 (DG/WH) FOR A SHORT TO GROUND	
• Key in OFF position. • Measure the resistance between home position switch C4187-1, circuit 1964 (DG/WH) harness side and ground.  A0041180 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to B37 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B37 CHECK CIRCUIT 1964 (DG/WH) FOR AN OPEN	
• Measure the resistance between home position switch C4187-1, circuit 1964 (DG/WH) and power liftgate module C4174d-8, circuit 1964 (DG/WH) harness side.	**Yes** GO to B52 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

 A0041183 ● **Is the resistance less than 5 ohms?**	
B38 CHECK LEFT PINCH STRIP SWITCH	
● Disconnect: Left Pinch Strip Switch C4172. ● Measure the resistance between left pinch strip switch pin 1 and pin 2 component side while manually activating the left pinch strip switch.  A0042045 ● **Is the resistance less than 5 ohms when activated and greater than 5 ohms when not activated?**	**Yes** GO to B40 . **No** INSTALL a new left pinch strip switch. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B39 CHECK RIGHT PINCH STRIP SWITCH	
● Disconnect: Right Pinch Strip Switch C4173. ● Measure the resistance between right pinch strip switch pin 1 and pin 2 component side while manually activating the right pinch strip switch.  A0042045 ● **Is the resistance less than 5 ohms when activated and greater than 5 ohms when not activated?**	**Yes** GO to B40 . **No** INSTALL a new right pinch strip switch. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B40 CHECK CIRCUIT 1967 (GY/OG) FOR AN OPEN	
● Measure the resistance between right pinch strip switch C4173-2, circuit 1967 (GY/OG) and power liftgate module C4174d-15, circuit 1967 (GY/OG) harness side.	**Yes** GO to B41 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for

 A0041186 ● Measure the resistance between left pinch strip switch C4172-2, circuit 1967 (GY/OG) and power liftgate module C4174d-15, circuit 1967 (GY/OG) harness side.  A0041186 ● **Are the resistances less than 5 ohms?**	normal operation.
B41 CHECK CIRCUIT 1965 (VT) AND 1966 (LB/BK) FOR A SHORT TO POWER ● Measure the voltage between right pinch strip switch C4173-1, circuit 1965 (VT) and left pinch strip switch C4172-1, circuit 1966 (LB/BK) harness side and ground.  A0041187 ● **Are the voltages greater than 10 volts?**	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to B42 .
B42 CHECK CIRCUIT 1965 (VT) AND 1966 (LB/BK) FOR A SHORT TO GROUND ● Measure the resistance between right pinch strip switch C4173-1, circuit 1965 (VT) and left pinch strip switch C4172-1, circuit 1966 (LB/BK) harness side and ground.	**Yes** GO to B43 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

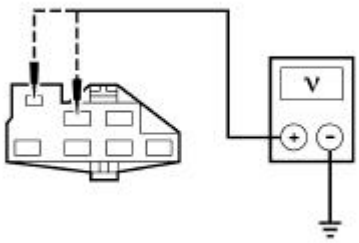
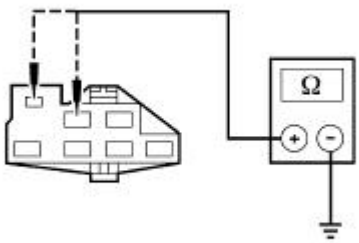
 A0041188 ● **Are the resistances greater than 10,000 ohms?**	
B43 CHECK CIRCUIT 1965 (VT) AND 1966 (LB/BK) FOR AN OPEN	
● Measure the resistance between right pinch strip switch C4173-1, circuit 1965 (VT) and power liftgate module C4174d-1, circuit 1965 (VT) harness side; and between left pinch strip switch C4172-1, circuit 1966 (LB/BK) and power liftgate module C4174d-12, circuit 1966 (LB/BK) harness side.  A0041189 ● **Are the resistances less than 5 ohms?**	**Yes** GO to B52 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B44 VERIFY THE LIFTGATE AJAR OPERATION	
● Monitor the power liftgate module liftgate ajar PID while opening and closing the liftgate. ● **Does the PID match the position of the liftgate?**	**Yes** GO to B52 . **No** GO to B45 .
B45 CHECK CIRCUIT 700 (WH/VT) FOR A SHORT TO POWER	
● Disconnect: Power Liftgate Module C4174d. ● Disconnect: Body Security Module C2113a. ● Key in ON position. ● Measure the voltage between power liftgate module C4174d-10, circuit 700 (WH/VT) harness side and ground.  A0041190 ● **Is the voltage greater than 10 volts?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to B46 .
B46 CHECK CIRCUIT 700 (WH/VT) FOR A SHORT TO GROUND	
● Key in OFF position.	**Yes**

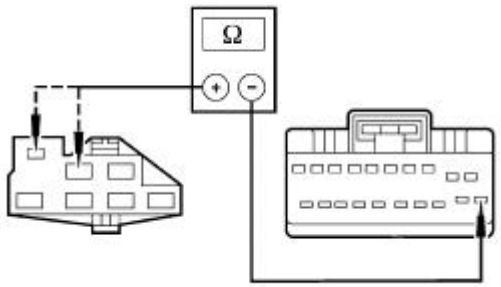
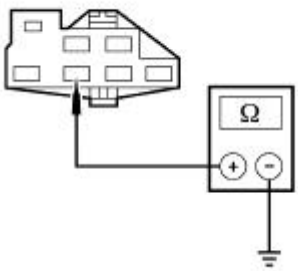
• Measure the resistance between power liftgate module C4174d-10, circuit 700 (WH/VT) harness side and ground.  A0041191 • **Is the resistance greater than 10,000 ohms?**	GO to B47 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B47 CHECK CIRCUIT 700 (WH/VT) FOR AN OPEN	
• Measure the resistance between power liftgate module C4174d-10, circuit 700 (WH/VT) and body security module C2113a-12, circuit 700 (WH/VT) harness side.  A0041192 • **Is the resistance less than 5 ohms?**	**Yes** GO to B52 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B48 VERIFY THE GLASS POSITION SWITCH OPERATION	
• Monitor the power liftgate module glass position PID while opening and closing the liftgate. • **Does the PID match the position of the liftgate glass?**	**Yes** CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to B49 .
B49 CHECK CIRCUIT 1961 (BN/LB) FOR A SHORT TO POWER	
• Disconnect: Power Liftgate Module C4174d. • Disconnect: Liftgate Glass Release Motor C4040. • Measure the voltage between power liftgate module C4174d-7, circuit 1961 (BN/LB) harness side and ground.  A0041193 • **Is the voltage greater than 10 volts?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to B50 .
B50 CHECK CIRCUIT 1961 (BN/LB) FOR A SHORT TO GROUND	

• Measure the resistance between power liftgate module C4174d-7, circuit 1961 (BN/LB) harness side and ground.  A0041194 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to B51 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B51 CHECK CIRCUIT 1961 (BN/LB) FOR AN OPEN	
• Measure the resistance between power liftgate module C4174d-7, circuit 1961 (BN/LB) and liftgate glass release motor C4040-1, circuit 1961 (BN/LB) harness side.  A0041195 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new liftgate glass position switch. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
B52 CHECK THE POWER LIFTGATE MODULE FOR CORRECT OPERATION	
• Disconnect all power liftgate module connectors. • Check for: • corrosion. • pushed-out pins. • Connect all power liftgate module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new power liftgate module. REFER to Power Liftgate Module in this section. CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST C: THE POWER LIFTGATE DOES NOT OPERATE — LIFTGATE CLOSE CHIME

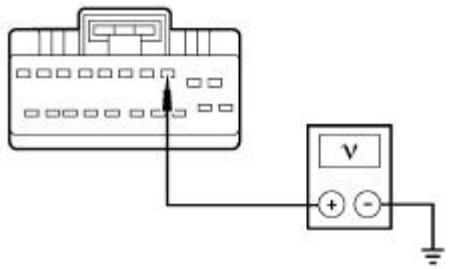
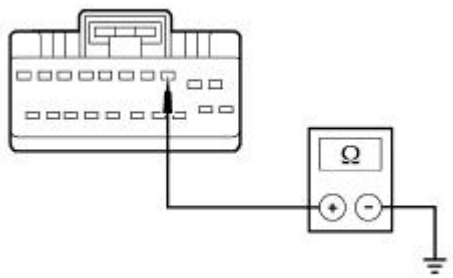
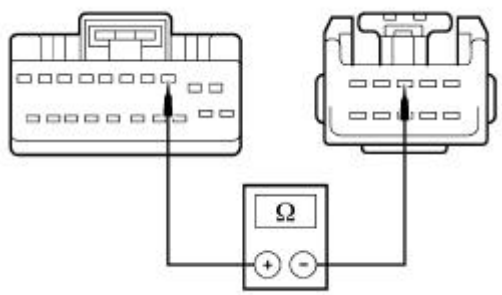
Test Step	Result / Action to Take
C1 VERIFY THE LIFTGATE CHIME OPERATION	

• Connect the diagnostic tool. • Using the diagnostic tool, activate the power liftgate chime output command. • **Does the power liftgate chime sound?**	**Yes** CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. **No** GO to C2.
C2 CHECK POWER LIFTGATE MODULE OUTPUT	
• Disconnect: Liftgate Close Chime Module C4186. • Measure the voltage between liftgate close chime module C4186-6, circuit 1972 (PK/BK) and liftgate close chime module C4186-7, circuit 1972 (PK/BK) harness side and ground while closing the liftgate.  A0050475 • **Is the voltage greater than 10 volts while closing and 0 volts when closed?**	**Yes** GO to C5. **No** If the voltage is greater than 10 volts when liftgate is closing and closed, REPAIR the circuit. TEST the system for normal operation. If there is no voltage present, GO to C3.
C3 CHECK CIRCUIT 1972 (PK/BK) FOR A SHORT TO GROUND	
• Key in OFF position. • Disconnect: Power Liftgate Module C4174d. • Measure the resistance between liftgate close chime module C4186-6, circuit 1972 (PK/BK) and liftgate close chime module C4186-7, circuit 1972 (PK/BK) harness side and ground  A0050476 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to C4. **No** REPAIR the circuit. TEST the system for normal operation.
C4 CHECK CIRCUIT 1972 (PK/BK) FOR AN OPEN	
• Measure the resistance between power liftgate module C4174d-11, circuit 1972 (PK/BK) harness side and liftgate close chime module C4186-6, circuit 1972 (PK/BK) and liftgate close chime module C4186-7, circuit 1972 (PK/BK) harness side.	**Yes** GO to C6. **No** REPAIR the circuit. TEST the system for normal operation.

 A0050477 ● **Is the resistance less than 5 ohms?**	
C5 CHECK LIFTGATE CLOSE CHIME GROUND	**Yes** INSTALL a new liftgate close chime module. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
● Measure the resistance between liftgate close chime module C4186-2, circuit 57 (BK) harness side and ground.  A0050478 ● **Is the resistance less than 5 ohms?**	
C6 CHECK THE POWER LIFTGATE MODULE FOR CORRECT OPERATION	**Yes** INSTALL a new power liftgate module. REFER to Power Liftgate Module in this section. CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
● Disconnect all power liftgate module connectors. ● Check for: ● corrosion. ● pushed-out pins. ● Connect all power liftgate module connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	

PINPOINT TEST D: DTC U2528 — PRNDL DATA MISMATCH

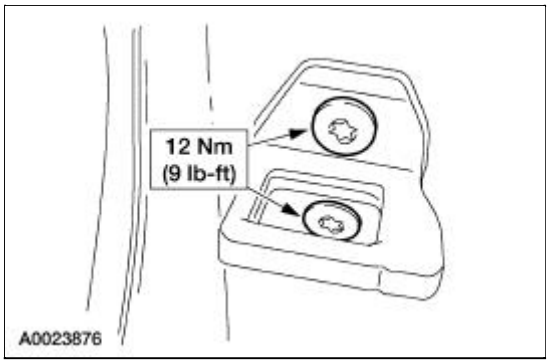
Test Step	Result / Action to Take
NOTE: Diagnose any other PRNDL DTCs before performing this pinpoint test.	
D1 CHECK CIRCUIT 3410 (YE) FOR A SHORT TO VOLTAGE	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for
● Disconnect: Power Liftgate Module C4174d. ● Disconnect: Floor Shifter C2096. ● Disconnect: Ignition Switch C250. ● Key in ON position.	

• Measure the voltage between power liftgate module C4174d-3, circuit 3410 (YE) harness side and ground.  A0062528 • **Is any voltage present?**	normal operation. **No** GO to D2 .
D2 CHECK CIRCUIT 3410 (YE) FOR A SHORT TO GROUND	
• Key in OFF position. • Measure the resistance between power liftgate module C4174d-3, circuit 3410 (YE) harness side and ground.  A0062527 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to D3 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
D3 CHECK CIRCUIT 3410 (YE) FOR AN OPEN	
• Measure the resistance between power liftgate module C4174d-3, circuit 3410 (YE) harness side and floor shifter C2096-3 harness side.  A0062526 • **Is the resistance less than 5 ohms?**	**Yes** GO to D4 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
D4 CHECK THE POWER LIFTGATE MODULE FOR CORRECT OPERATION	
• Disconnect all power liftgate module connectors. • Check for: • corrosion. • pushed-out pins. • Connect all power liftgate module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new power liftgate module. REFER to Power Liftgate Module in this section. CLEAR the DTCs. REPEAT the self-test. **No** The system is operating

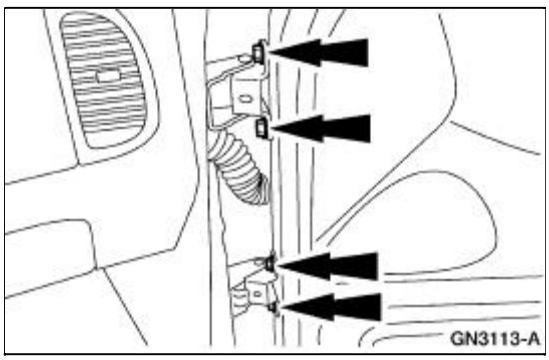
	correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Hinge Adjustment —Front Door, Horizontal and Vertical

1. Remove the door striker.

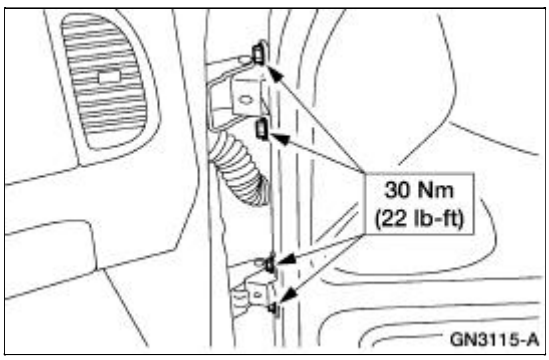


2. Loosen the front door hinge-to-front door bolts enough to permit movement of the door.

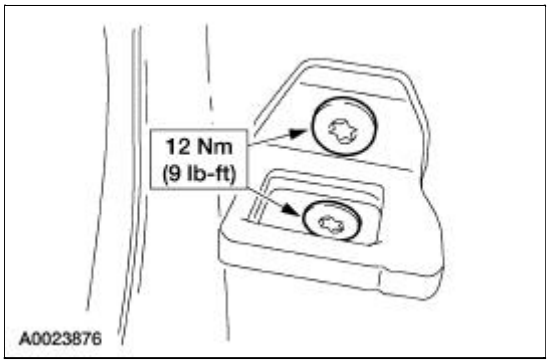


3. Adjust the front door alignment.

4. Tighten the front door hinge-to-front door bolts.



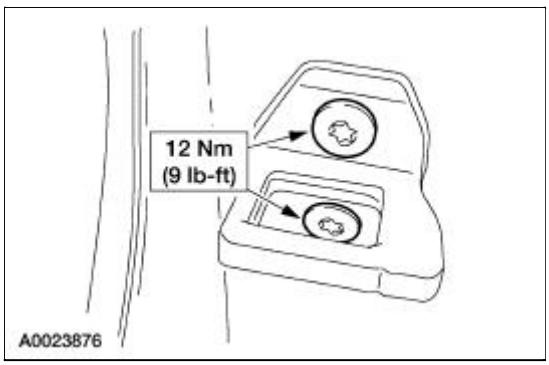
5. Install and adjust the door striker.


12 Nm
(9 lb-ft)
A0023876

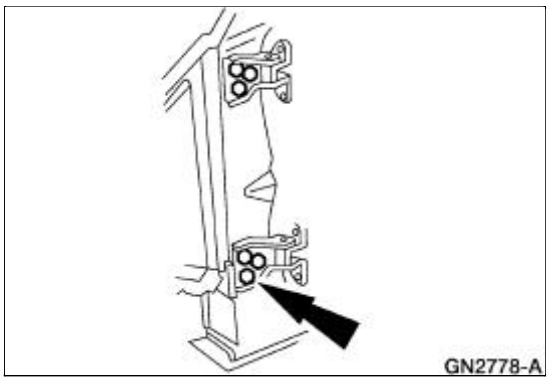
Hinge Adjustment —Front Door, Fore and Aft

NOTE: Check the rear door hinge adjustment before adjusting the front door hinge.

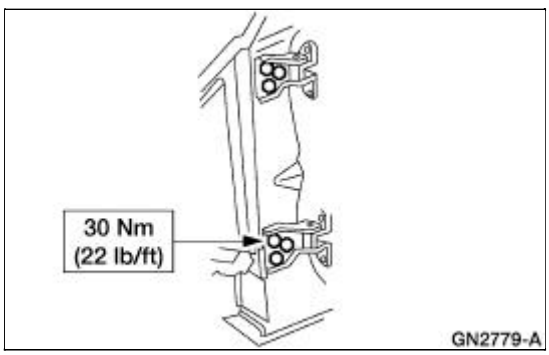
1. Remove the door striker.



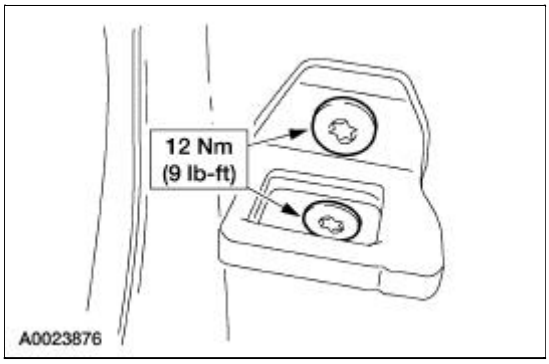
2. Remove the front fender. For additional information, refer to Section 501-02 .
3. Loosen the front door hinge-to-body bolts.



4. Adjust the front door alignment to specification.
5. Tighten the front door hinge-to-body bolts.

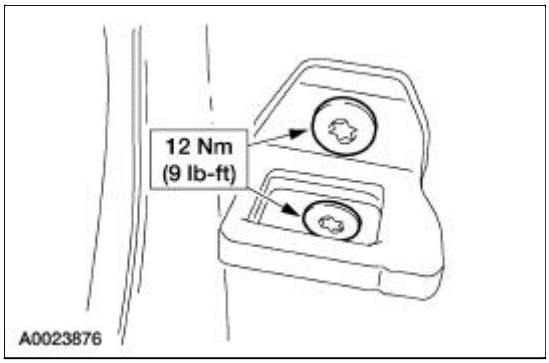


6. Install the front fender. For additional information, refer to Section 501-02 .
7. Install and adjust the door striker.

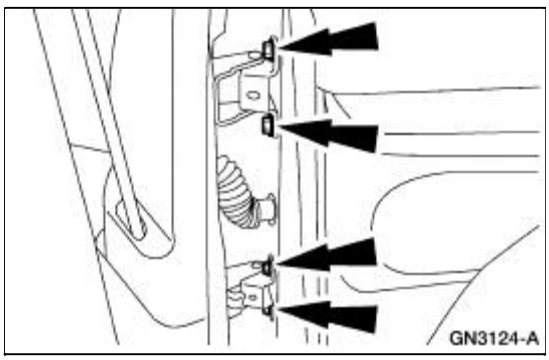

12 Nm
(9 lb-ft)
A0023876

Hinge Adjustment —Door, Rear, In, Out, Up and Down

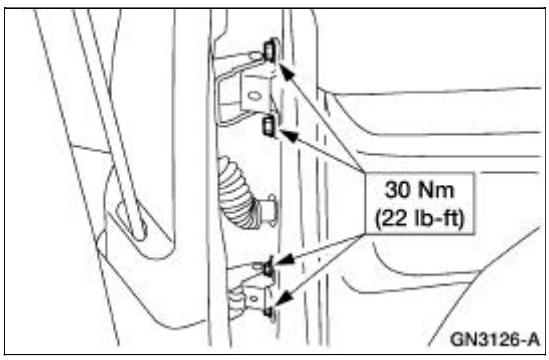
1. Remove the door striker.



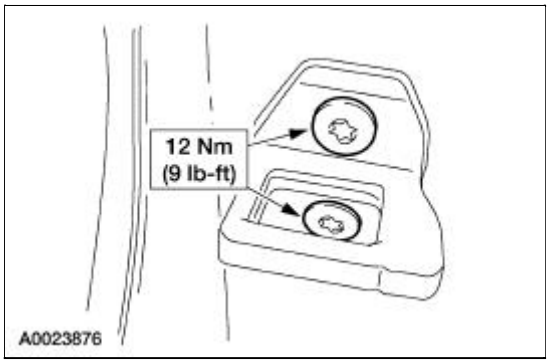
2. Loosen the hinge-to-door bolts enough to allow door movement.



3. Adjust the door until it is uniform to adjacent panels.
4. Tighten the hinge-to-door bolts.

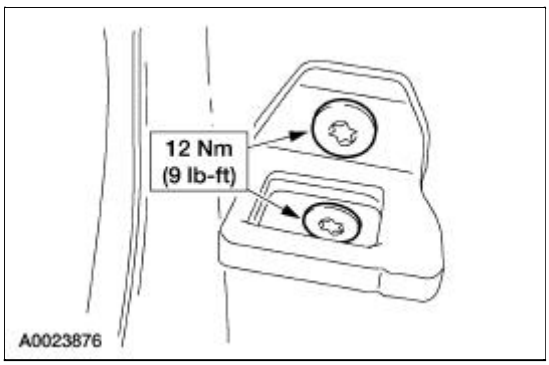


5. Install the door striker.

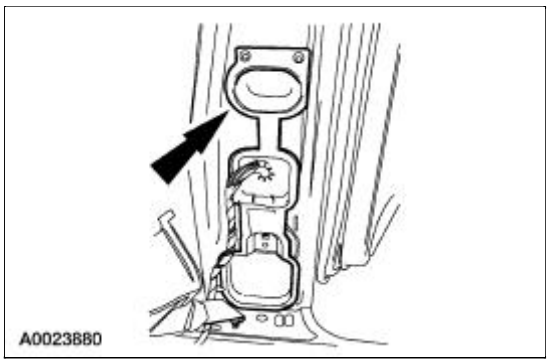

12 Nm
(9 lb-ft)
A0023876

Hinge Adjustment —Door, Rear, Fore, Aft and Tilt

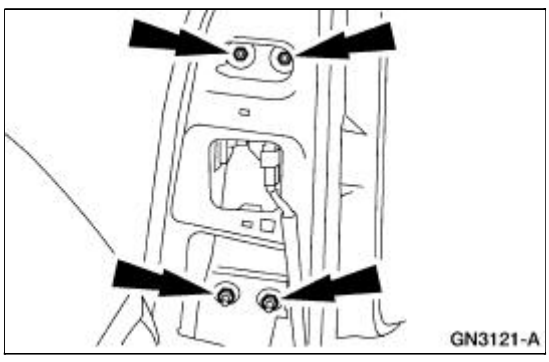
1. Position the front seat in the full forward position.
2. Remove the door striker.



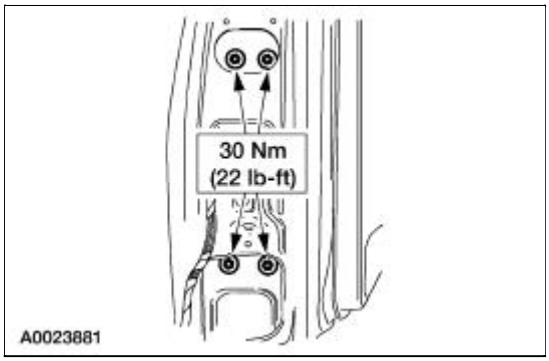
3. Remove the lower B-pillar trim panel. For additional information, refer to Section 501-05 .
4. Remove the B-pillar weathershield.



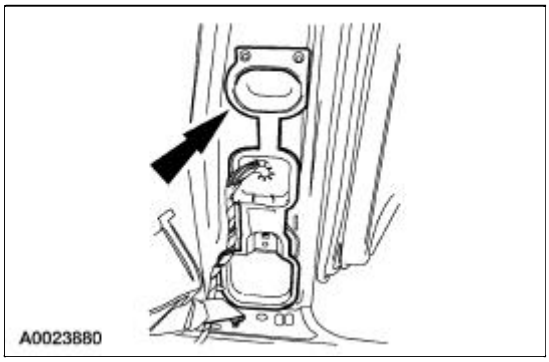
5. Loosen the hinge-to-B-pillar nuts enough to allow movement of the rear door.



6. Adjust the rear door until it is uniform to adjacent panels.
7. Tighten the hinge-to-B-pillar nuts.

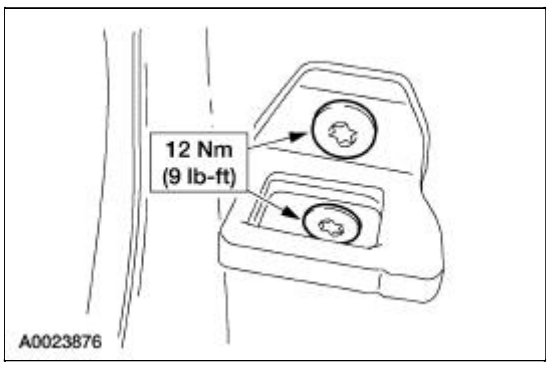


8. Install the B-pillar weathershield.



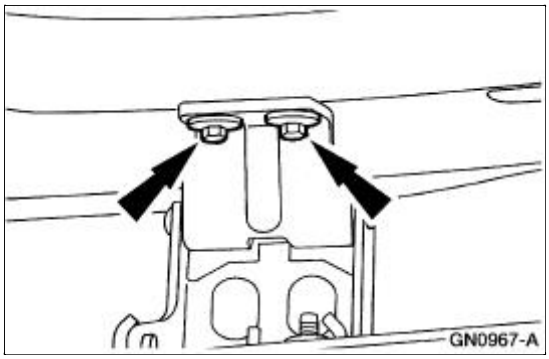
9. Install the lower B-pillar trim panel. For additional information, refer to Section 501-05 .

10. Install the door striker.

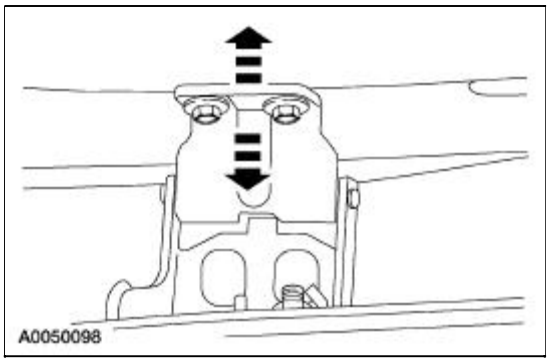


Hinge Adjustment —Liftgate

1. Loosen the liftgate hinge to liftgate bolts.

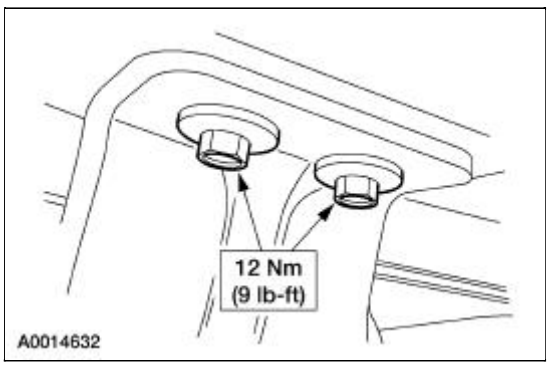


2. Adjust the liftgate alignment.



3. **NOTE:** The bolt washers must make full contact with the liftgate bracket when tightened.

   Tighten the liftgate hinge to liftgate bolts.



Power Liftgate Initialization

NOTE: If the power liftgate system is turned OFF in the message center, the system cannot be activated with any switches or with the liftgate handle. The system will need to be turned ON for any power operation to occur.

NOTE: The power liftgate may not operate under the following conditions:

- a low voltage or dead battery.
- a disconnected battery
- a power liftgate that has been left open for more than six hours.
- a power liftgate that has been manually closed and left ajar.

If any of these conditions has occurred, the power liftgate must be reset.

1. Manually close and fully latch the power liftgate.
2. **NOTE:** If the power liftgate does not open during this step, refer to the symptom chart to diagnose the power liftgate for no operation.

   Power open the power liftgate by using the keyfob or overhead console switch.
3. Once the power liftgate is fully open, close the power liftgate by using the keyfob or overhead console switch.

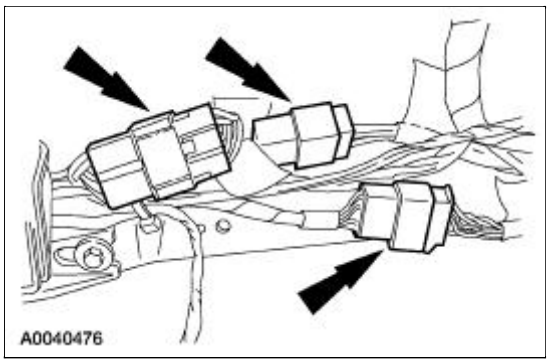
Liftgate

Removal and Installation

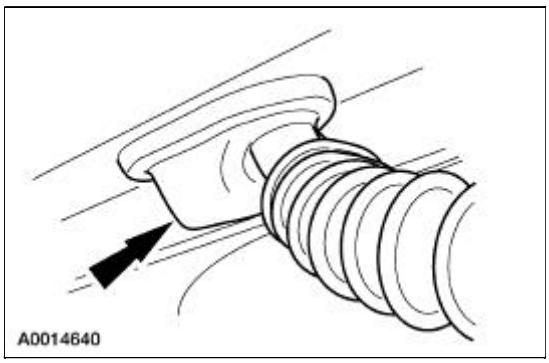
All vehicles

NOTE: Left side shown, right side similar.

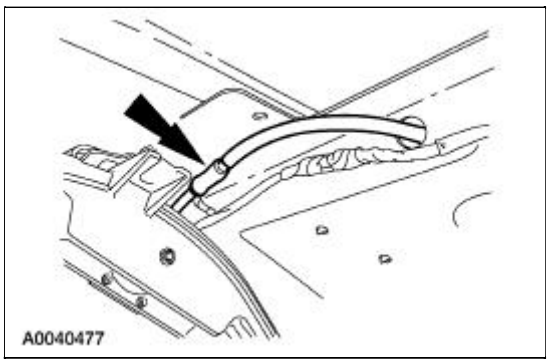
1. Remove the D-pillar trim panels. For additional information, refer to Section 501-05 .
2. Remove the headliner rear pin-type retainers and lower the rear of headliner.
3. Disconnect the liftgate electrical connectors.



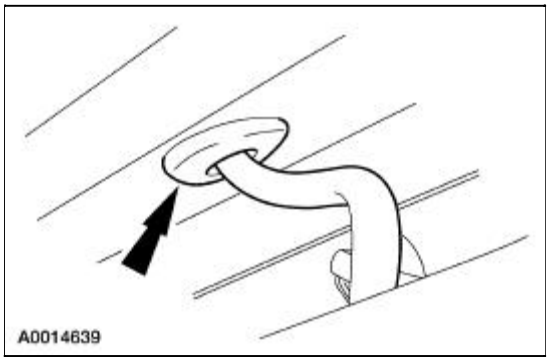
4. Remove the wire harness grommet and route the wire harness out from the roof.



5. Disconnect the rear washer tube.

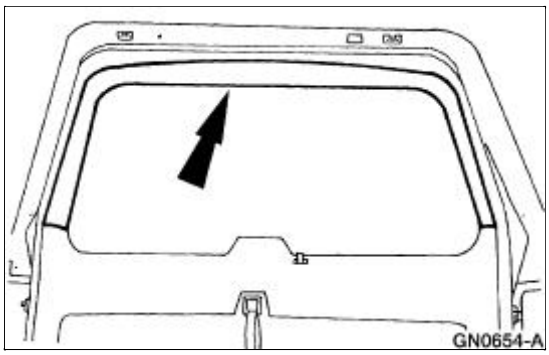


6. Remove the rear washer tube grommet and route the rear washer tube out from the roof.

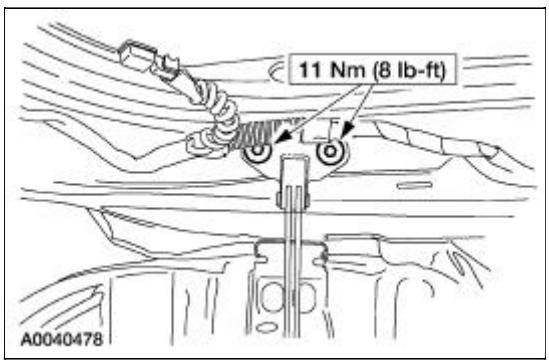


Vehicles with power liftgate

7. Remove the upper liftgate trim.



8. Remove the power liftgate motor to liftgate bolts.

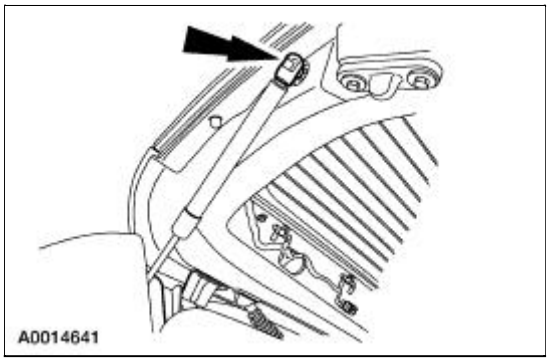


All vehicles

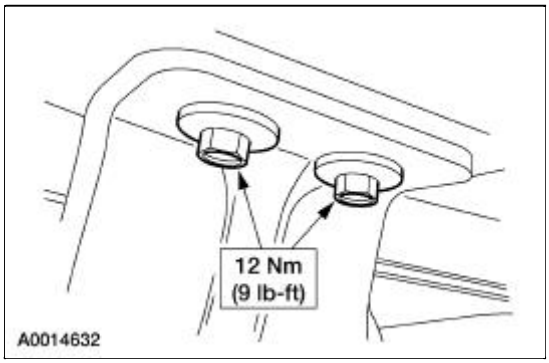
9. **NOTE:** Left side shown, right side similar.

   NOTE: An assistant is necessary for the removal of the liftgate.

   Disconnect the assist cylinders at the liftgate side.



10. Remove the four hinge bolts and remove the liftgate.



11. To install, reverse the removal procedure.

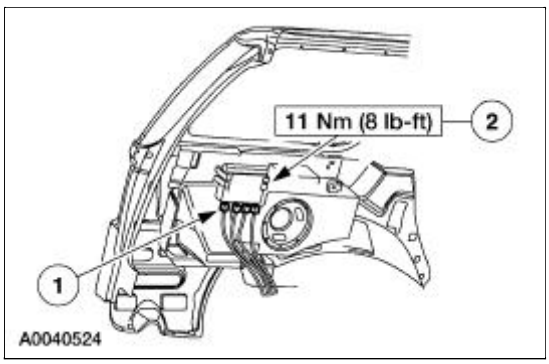
Power Liftgate Module

Removal and Installation

NOTE: Prior to removal of the power liftgate module, it is necessary to upload module configuration information to a diagnostic tool. This information needs to be downloaded into the new power liftgate module once installed. For additional information, refer to Section 418-01 .

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

2. Remove the power liftgate module.
   1. Disconnect the electrical connectors.
   2. Remove the bolts.



3. **NOTE:** Once the new power liftgate module is installed, it is necessary to download the module configuration information from the diagnostic tool into the new power liftgate module. For additional information, refer to Section 418-01 .

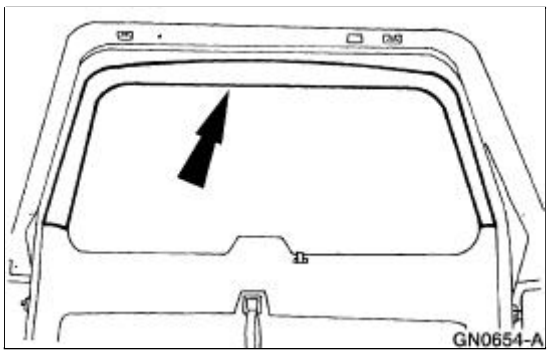
   To install, reverse the removal procedure.

Power Liftgate Motor

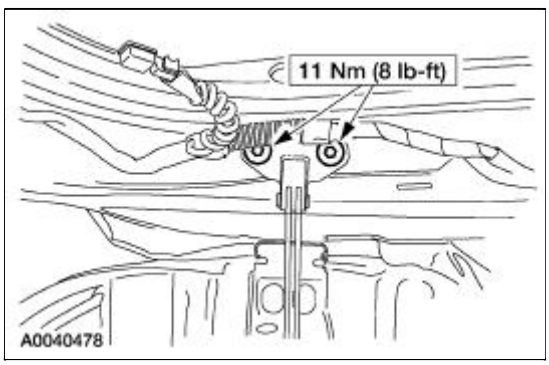
Removal and Installation

NOTE: Left side shown, right side similar.

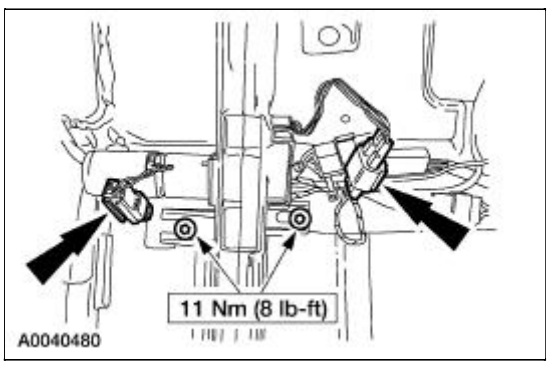
1. Remove the headliner. For additional information, refer to Section 501-05 .
2. Remove the upper liftgate trim.



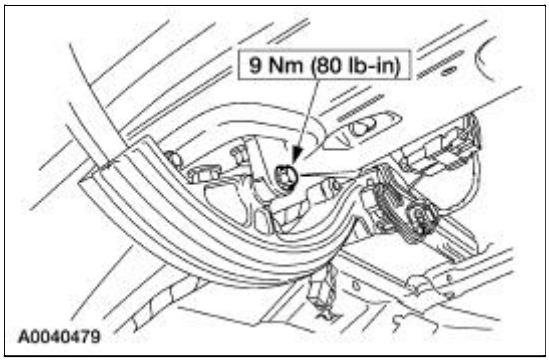
3. Remove the power liftgate motor to liftgate bolts.



4. Disconnect the electrical connectors and remove the power liftgate motor bolts.



5. Remove the power liftgate motor pivot bolt.



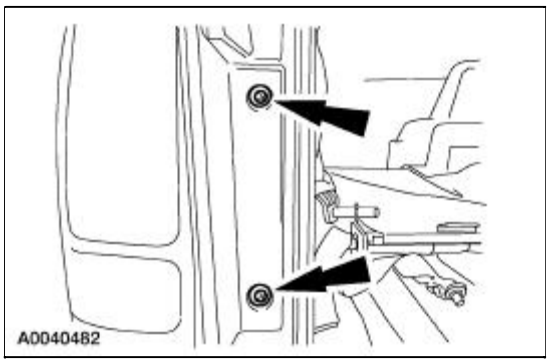
6. Slide the power liftgate motor assembly forward and remove the power liftgate motor.
7. To install, reverse the removal procedure.

Pinch Strip Switch

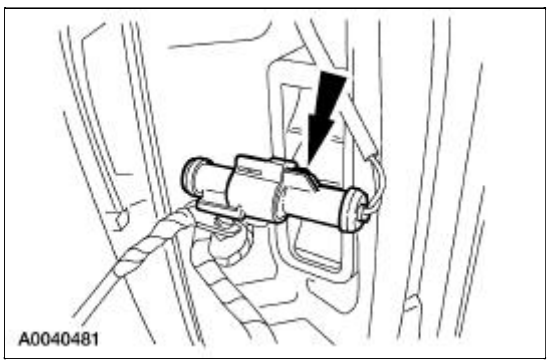
Removal and Installation

NOTE: Left side shown, right side similar.

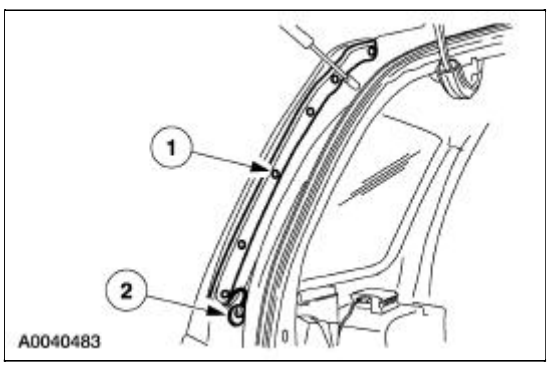
1. Remove brake light.
   - Remove the screws.



2. Disconnect the pinch strip electrical connector.



3. Remove the pinch strip.
   1. Remove the pin-type retainers.
   2. Remove the grommet and route the harness out of the vehicle.



4. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-ft	lb-in
A-pillar assist handle screws	5	—	44
Safety belt guide nuts	40	30	—
B-pillar and C-pillar trim panel bolts	8	—	71
Lower safety belt bolts	40	30	—
Door trim panel screws	1	—	9
Door trim panel armrest screws	2	—	18
Liftgate assist handle screws	5	—	44
Sun visor screws	2	—	18

Interior Trim

The interior trim consists of the following components:

- A-pillar trim panels
- B-pillar trim panels
- C-pillar trim panels
- D-pillar trim panels
- front door trim panels
- rear door trim panels
- rear quarter trim panels
- door handle bezels
- liftgate trim panel
- headliner
- sun visors
- scuff plates
- coat hooks
- assist handles

B-Pillar Trim Panel

Removal and Installation

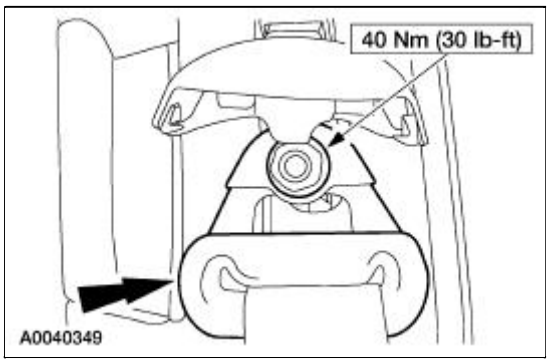
NOTE: Left side shown, right side similar.

Upper and lower

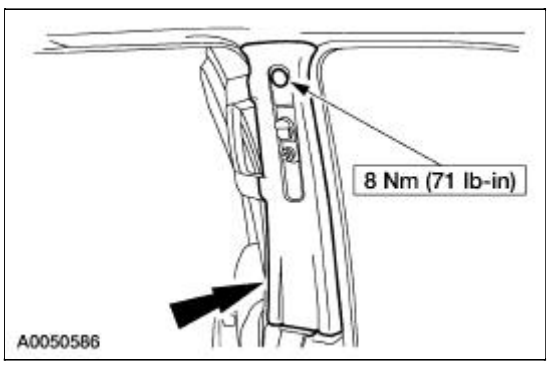
1. **NOTE:** Position the safety belt guide to the lowest position.

   NOTE: Inspect the shoulder safety belt guide cover for damage. If the shoulder safety belt guide cover is damaged or cover does not remain closed, install a new shoulder safety belt guide cover.

   Remove the safety belt guide.
   - Lift up on the cover and remove the nut.



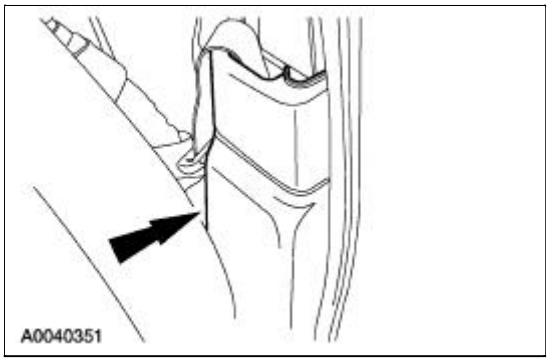
2. Remove the upper B-pillar trim panel.
   - Remove the bolt cover and bolt.
   - Remove the upper B-pillar trim panel by pulling outward to release the clips.



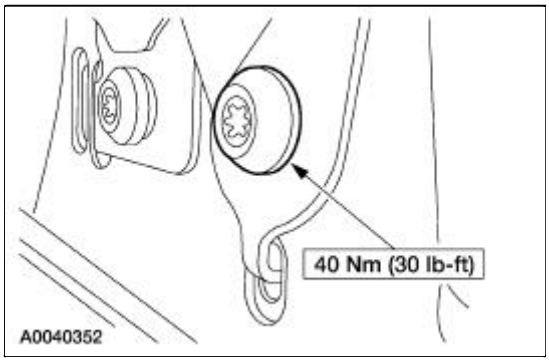
Lower

3. Remove the front and rear door scuff plates.

4. Position the lower B-pillar trim panel aside.



5. Remove the front safety belt anchor.



6. Feed the safety belt through the lower B-pillar trim panel and remove.

Upper and lower

7. To install, reverse the removal procedure.
    - When installing the upper B-pillar trim panel, insert the safety belt guide slide into the upper B-pillar trim panel.

C-Pillar Trim Panel

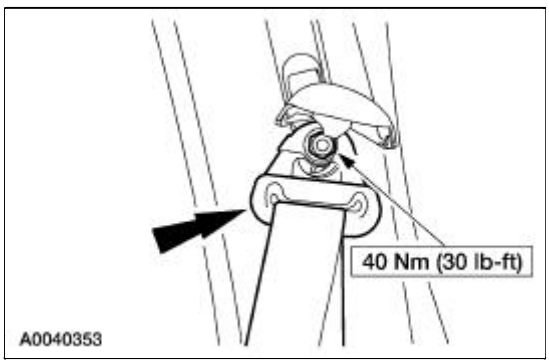
Removal and Installation

NOTE: Right side shown, left side similar.

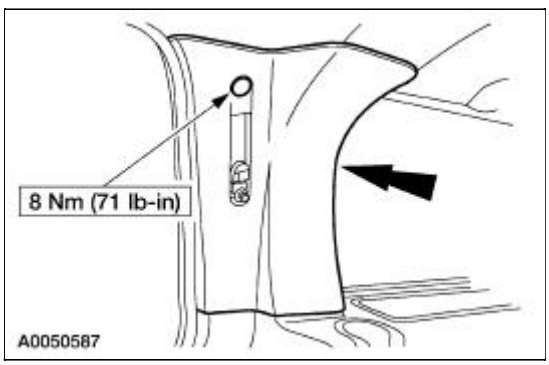
1. **NOTE:** Position the safety belt guide to the lowest position.

   NOTE: Inspect the shoulder safety belt guide cover for damage. If the shoulder safety belt guide cover is damaged or cover does not remain closed, install a new shoulder safety belt guide cover.

   Remove the safety belt guide.
   - Lift up on the cover and remove the nut.



2. Remove the C-pillar trim panel.
   - Remove the bolt cover and bolt and pull outward to release the retainers.



3. To install, reverse the removal procedure.

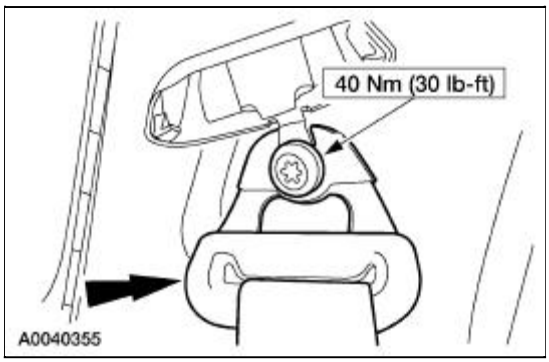
D-Pillar Trim Panel

Removal and Installation

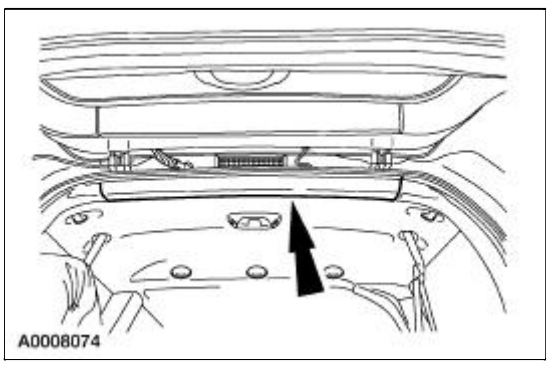
NOTE: Right side with power vent windows and power liftgate shown, all others similar.

1. **NOTE:** Inspect the shoulder safety belt guide cover for damage. If the shoulder safety belt guide cover is damaged or cover does not remain closed, install a new shoulder safety belt guide cover.

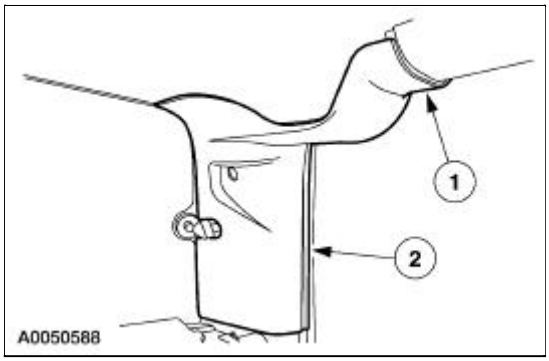
   Remove the safety belt guide.
   - Lift up on the cover and remove the nut.



2. Remove rear upper headliner trim panel.



3. Remove the D-pillar trim panel.
   1. Disengage the upper clip by pulling downward.
   2. Unseat the D-pillar trim panel and rotate forward to remove.



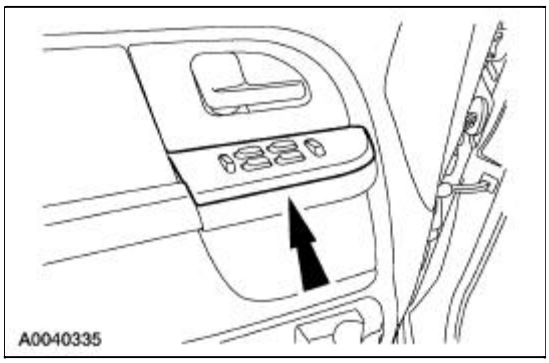
4. To install, reverse the removal procedure.

Front Door Trim Panel —Expedition

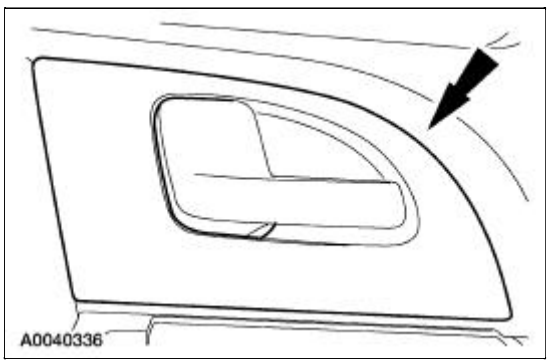
Removal and Installation

NOTE: Left front door shown, right front similar.

1. Remove the window control switch plate.
   - Use service notch and disconnect the electrical connectors.

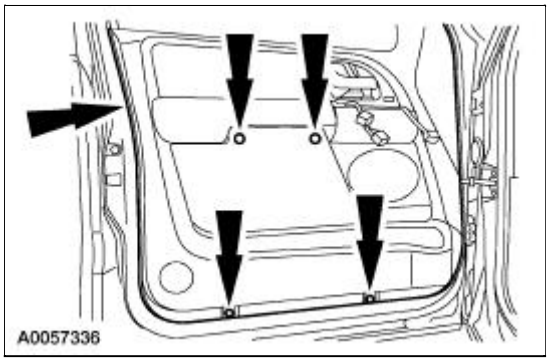


2. Remove the door handle bezel.
   - Use service notch.



3. **CAUTION: To avoid damage to the door trim panel, lift the door trim panel by pulling directly upward on the armrest to disengage the panel clips.**

   Remove the two bolts and three screws, and remove the door trim panel.
   - Remove the finish cover to access the two center screws.
   - Disconnect the electrical connectors.



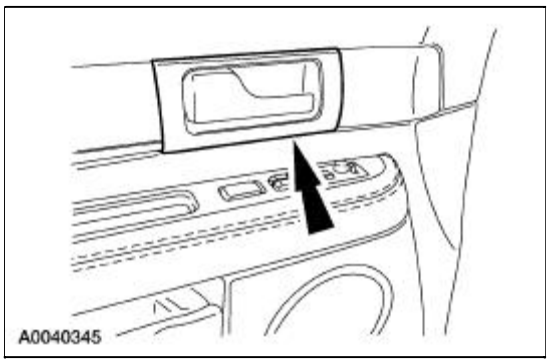
4. To install, reverse the removal procedure.

Front Door Trim Panel —Navigator

Removal and Installation

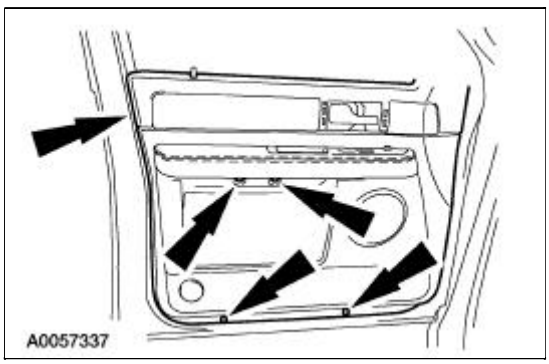
NOTE: Left front door shown, right front similar.

1. Remove the door handle bezel.
   - Use service notch.



2. **CAUTION: To avoid damage to the door trim panel, lift the door trim panel by pulling directly upward on the armrest to disengage the panel clips.**

   Remove the two bolts and three screws, and remove the door trim panel.
   - Disconnect the electrical connectors.



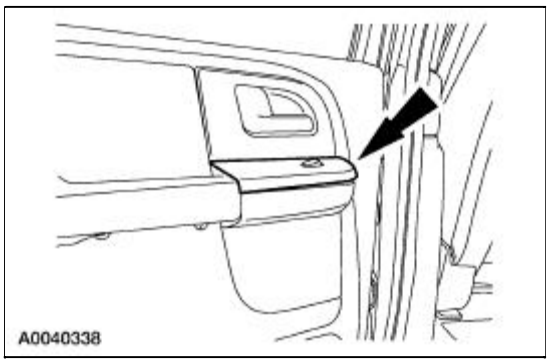
3. To install, reverse the removal procedure.
   - Transfer components as necessary.

Rear Door Trim Panel —Expedition

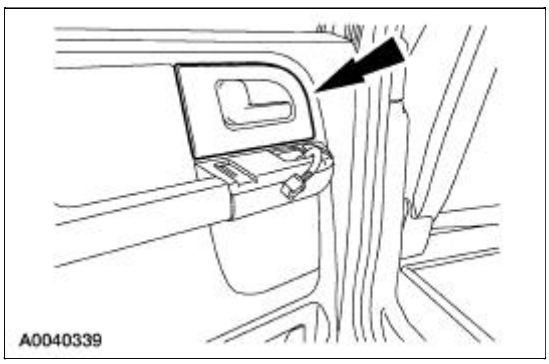
Removal and Installation

NOTE: Left rear door shown, right rear similar.

1. If equipped with power windows, remove the window control switch plate.
   - Use service notch.

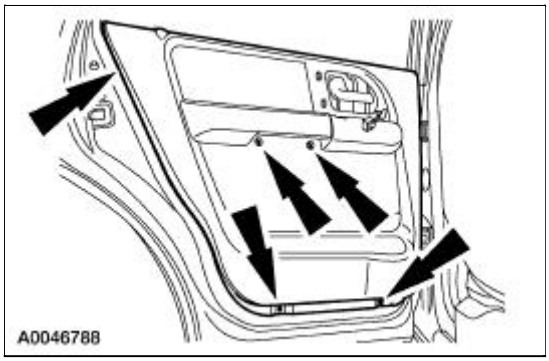


2. Remove the door handle bezel.
   - Use service notch.



3. **CAUTION: To avoid damage to the door trim panel, lift the door trim panel by pulling directly upward on the armrest to disengage the panel clips.**

   Remove the two bolts and three screws, and remove the door trim panel.
   - Remove the finish cover to access the two center screws.
   - If equipped, disconnect the electrical connector.



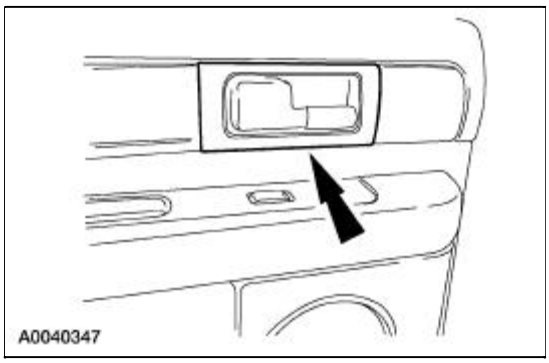
4. To install, reverse the removal procedure.

Rear Door Trim Panel —Navigator

Removal and Installation

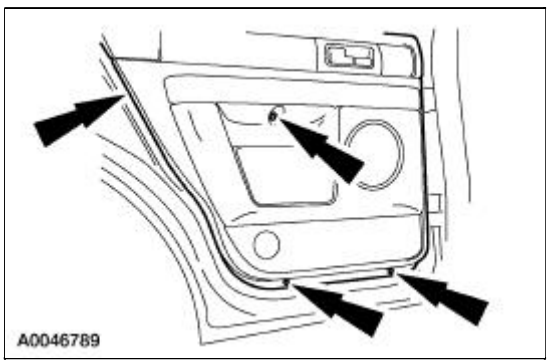
NOTE: Left rear door shown, right rear similar.

1. Remove the door handle bezel.
   - Use service notch.



2. **CAUTION: To avoid damage to the door trim panel, lift the door trim panel by pulling directly upward on the armrest to disengage the panel clips.**

   Remove the two bolts and two screws, and remove the door trim panel.
   - Disconnect the window switch electrical connector.

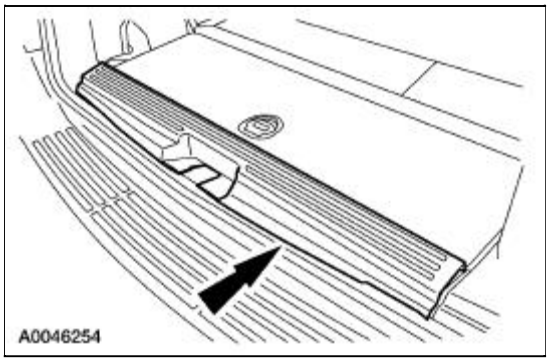


3. To install, reverse the removal procedure.

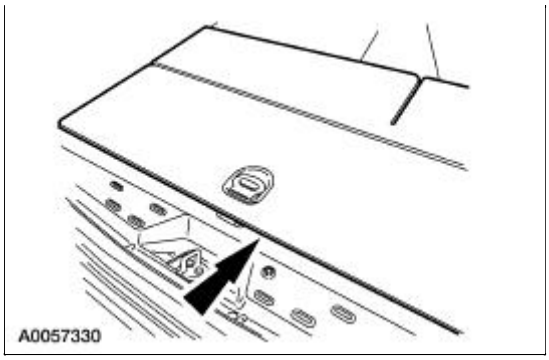
Rear Quarter Trim Panel

Removal and Installation

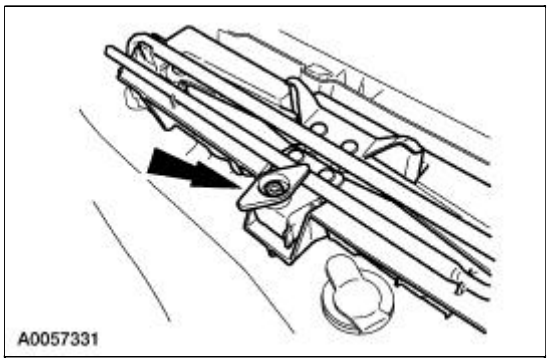
1. Remove the C-pillar trim panel. For additional information, refer to C-Pillar Trim Panel in this section.
2. Remove the D-pillar trim panel. For additional information, refer to D-Pillar Trim Panel in this section.
3. Remove the liftgate scuff plate by pulling upward.



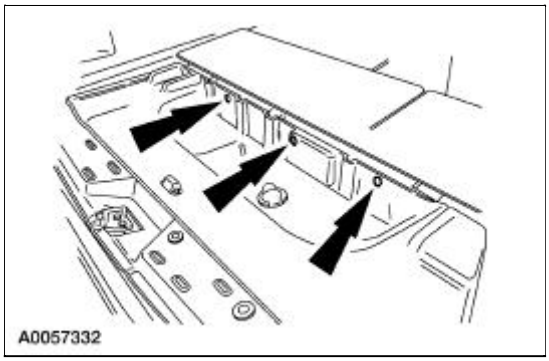
4. Remove the rear floor loadspace trim panel.



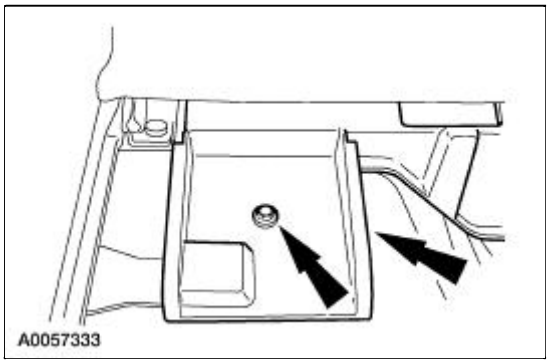
5. Remove the floor jack assembly.



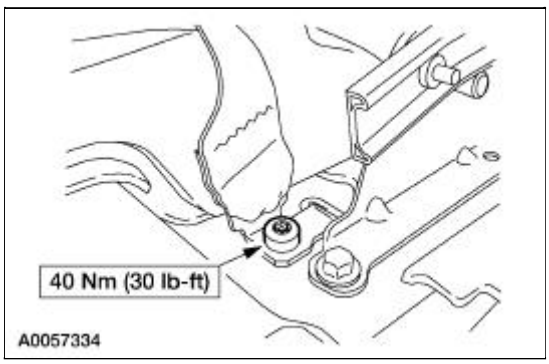
6. Remove the pin-type retainers and pull back the carpeting.



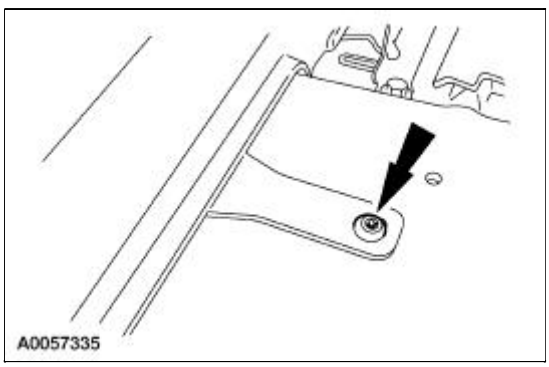
7. Remove the two bolts and the loadspace trim panel by pulling upward.



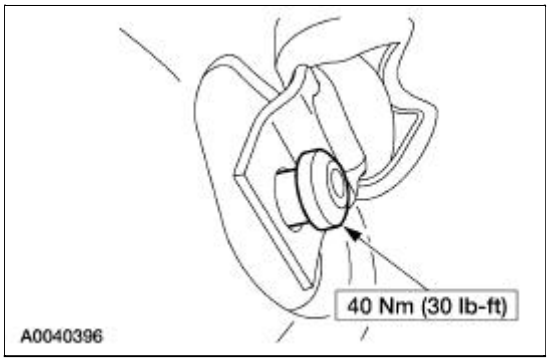
8. Remove the third row seat safety belt anchor bolt.



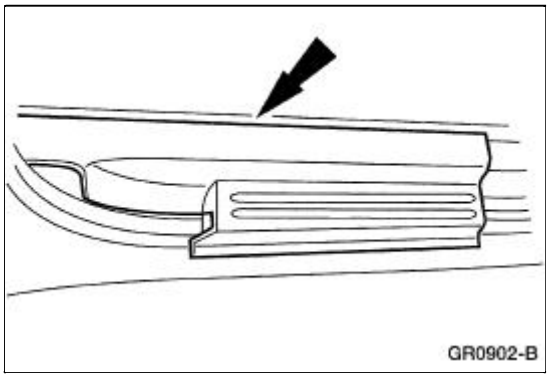
9. Remove the rear quarter trim panel pin-type retainer.



10. Remove the second row safety belt anchor.

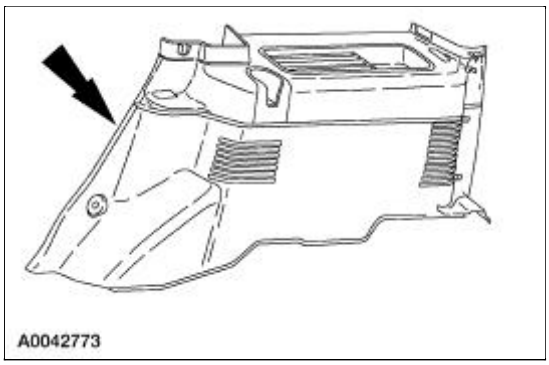


11. Remove the rear door scuff plate by pulling upward.



12. Fold the third row seat down.

13. Remove the rear quarter trim panel by pulling outward.
    - If equipped, disconnect the power point and power third row seat switch electrical connector at the rear.

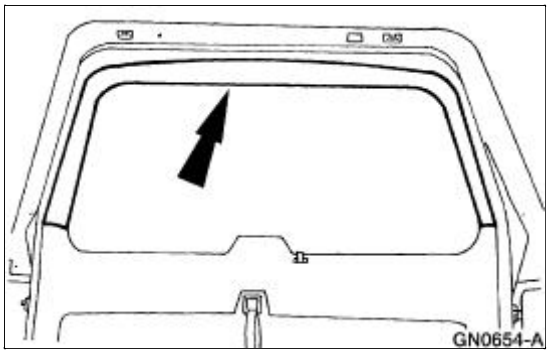


14. To install, reverse the removal procedure.

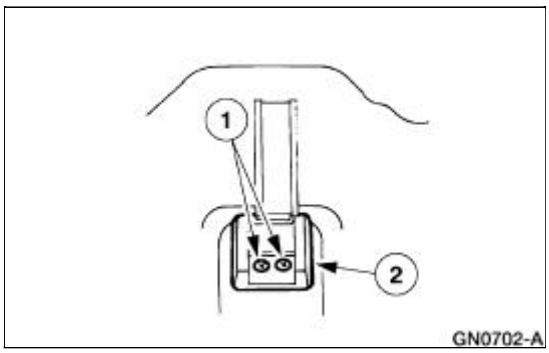
Liftgate Trim Panel

Removal and Installation

1. Remove the upper liftgate trim panel.
   - Pull lower corners toward the center on both sides and pull down along the top.

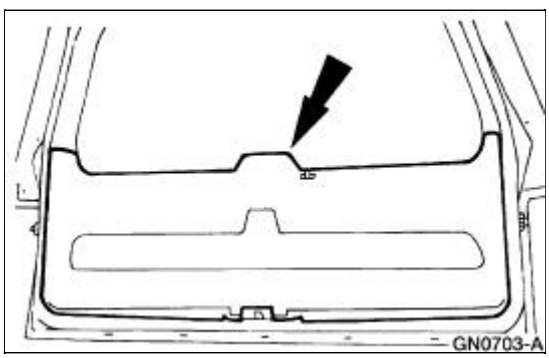


2. Remove the assist handle.
   1. Remove the screws.
   2. Remove the assist handle.



3. Open the tailgate glass.

4. Remove the lower liftgate trim panel.
   - Remove the two pin-type retainers and slide liftgate trim panel upward to remove.



5. To install, reverse the removal procedure.

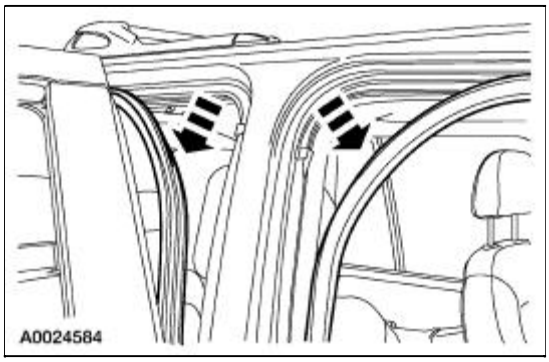
Headliner

Removal and Installation

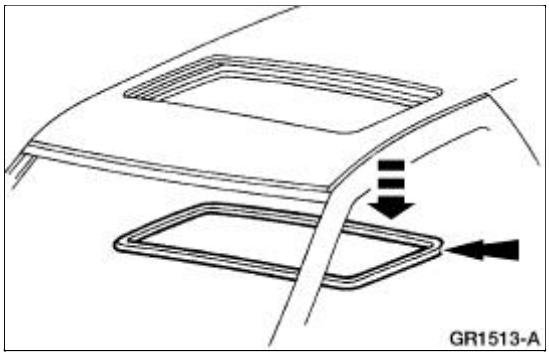
All vehicles

1. Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

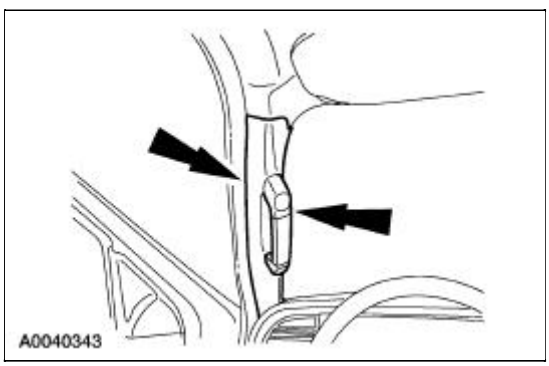
2. Position aside the front and rear door seals.



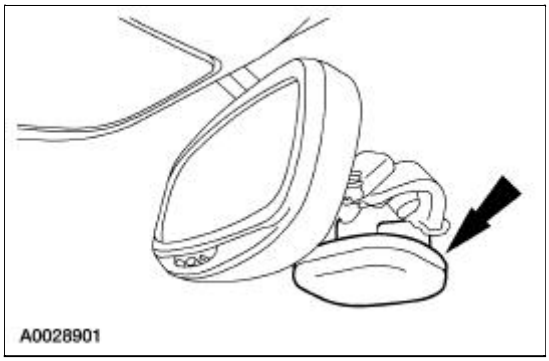
3. If equipped, remove the roof opening panel trim.



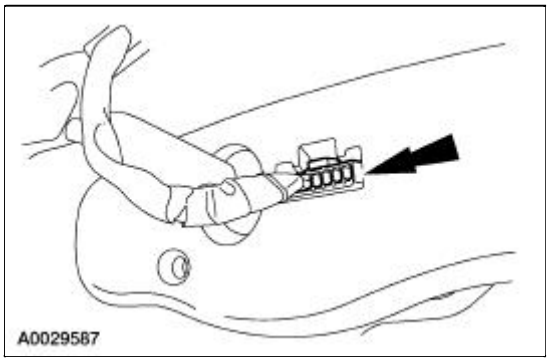
4. Remove the A-pillar trim panels.
    - Remove the bolt covers and bolts.



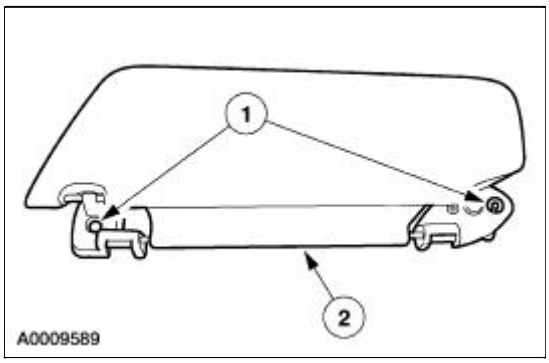
5. If equipped, remove the electronic compass sensor.



6. If equipped, disconnect the auto dimming mirror electrical connector.



7. Remove the two sun visors and visor clips.
    1. Remove the eight screws.
    2. Remove the two sun visors and visor clips.
        - If equipped, disconnect the electrical connectors.



8. If equipped, remove the overhead console.

9. If equipped, remove the DVD player. For additional information, refer to Section 415-07 .

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

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

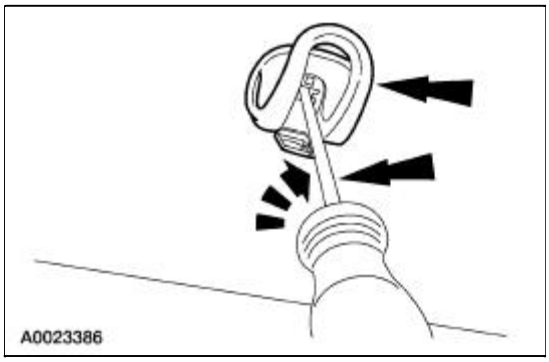
12. Remove the D-pillar trim panel. For additional information, refer to D-Pillar Trim Panel in this section.

13. **CAUTION: To prevent damage to the coat hanger retainer, use a 3/16-inch flat-blade**

screwdriver for this step.

Remove the four coat hooks.

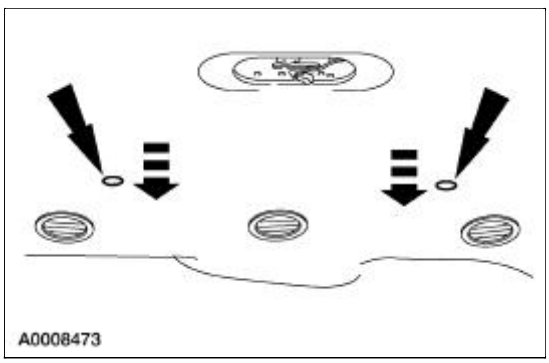
- Open the access cover.
- Insert a screwdriver into the slot and rotate.



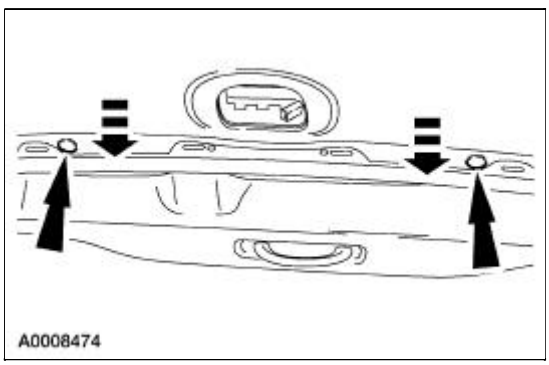
14. Disconnect the two electrical connectors at the right side C-pillar and one electrical connector at the left side C-pillar.

Vehicles equipped with rear climate control

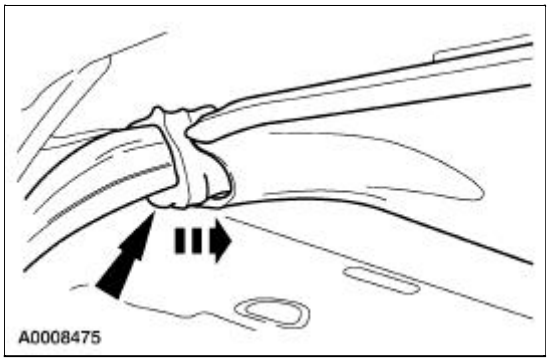
15. Remove the center pin-type retainers.



16. Remove the rear pin-type retainers.



17. Tilt the headliner to release the vent duct.



All vehicles

18. Remove the headliner.
19. To install, reverse the removal procedure.
    - Transfer parts as necessary.

Torque Specifications

Description	Nm	lb-ft	lb-in
Wheel opening moulding screws	2	—	18
Retractable running board bolts	11	8	—
Retractable running board motor bolts	5	—	44
Retractable running board sensor wiring harness bolts	2	—	18

Exterior Trim

The Expedition/Navigator exterior trim and ornamentation components consist of the:

- rear door finish panel (24736).
- body side opening moulding (291C20).
- front fender wheel opening moulding (16A074).
- grille assembly (8200).
- front fender side finish panel (16A066).
- front door side finish panel (20206).
- front door window outside rear moulding (20982).
- body side window outside front moulding (290A66).
- running boards.
- power running boards (if equipped).

Retractable Running Board

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool

Principles of Operation

The retractable running boards are controlled by the power liftgate module and retractable running board motor assembly. The retractable running board motors receive a ground signal from the power liftgate module to deploy and an open signal to retract.

When the power liftgate module is in self-test mode, the retractable running board motor sends a 200 ms pulse to the power liftgate module to verify a deploy/retract command was sent by the power liftgate module. When the retractable running board reaches the fully deployed/retracted position, the retractable running board motor assembly will send a 200 ms pulse to the power liftgate module to indicate the operation is complete.

The power liftgate module receives information from the instrument cluster module (ICM) regarding retractable running board system ON or OFF and set for AUTOMATIC/IN or MANUAL/OUT status.

When in AUTOMATIC/IN mode, the retractable running boards will deploy when a door on the same side of the vehicle is opened. When both doors on the same side are closed, the retractable running boards will retract. The power liftgate module receives door ajar status from the body security module through the UART based protocol (UBP) communications network.

When in MANUAL/OUT mode, both retractable running boards will stay deployed until MANUAL/OUT mode is deselected or vehicle speed is greater than 5 mph.

When an obstacle is detected, the retractable running board will reverse direction. If a second obstacle is detected the retractable running board will reverse direction again. If a third obstacle is detected the retractable running board will stop in its current position until the following conditions are met:

- Change in door ajar status.
- Change in manual (OUT) deploy status.
- Vehicle speed greater than 5 mph.

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical and electrical damage. Refer to the following chart.

Visual Inspection Chart

Mechanical	Electrical
● Retractable running board	● Battery junction box (BJB) fuse: ■ 5 (7.5A) ■ 105 (30A) ■ 110 (30A)

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.
5. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool manual.
6. Carry out the DATA LINK DIAGNOSTICS test. If the diagnostic tool responds with:
   - CKT930 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for power liftgate module, refer to Section 419-10 .
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the power liftgate module.
7. If the DTCs retrieved are related to the concern, refer to power liftgate module Diagnostic Trouble Code (DTC) Index to continue diagnostics.
8. If DTCs are retrieved that are not found in the following power liftgate module Diagnostic Trouble Code (DTC) Index, refer to the master power liftgate module Diagnostics Trouble Code (DTC) index in Section 419-10 .
9. If no DTCs related to the concern are retrieved, GO to Symptom Chart to continue diagnostics.

Power Liftgate Module Diagnostic Trouble Code (DTC) Index

Power Liftgate Module Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B2716	Left Power Running Board Output Short To Battery	Power Liftgate Module	Go To Pinpoint Test B .
B2717	Right Power Running Board Output Short To Battery	Power Liftgate Module	Go To Pinpoint Test C .
B2719	eft Power Running Board Output Short To Ground Or Open	Power Liftgate Module	Go To Pinpoint Test B .
B2720	Right Power Running Board Output Short To Ground Or Open	Power Liftgate Module	Go To Pinpoint Test C .
B2812	Left Power Running Board Connection Failure	Power Liftgate Module	Go To Pinpoint Test B . If both running boards are inoperative, Go To Pinpoint Test A .
B2813	Left Power Running Board Stow Time Failure	Power Liftgate Module	Go To Pinpoint Test B . If both running boards are inoperative, Go To Pinpoint Test A .
B2814	Left Power Running Board Deploy Time Failure	Power Liftgate Module	Go To Pinpoint Test B . If both running boards are inoperative, Go To Pinpoint Test A .
B2815	Right Power Running Board Connection Failure	Power Liftgate Module	Go To Pinpoint Test C . If both running boards are inoperative, Go To Pinpoint Test A .
B2816	Right Power Running Board Stow Time Failure	Power Liftgate Module	Go To Pinpoint Test C . If both running boards are inoperative, Go To Pinpoint Test A .
B2817	Right Power Running Board Deploy Time Failure	Power Liftgate Module	Go To Pinpoint Test C . If both running boards are inoperative, Go To Pinpoint Test A .

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• No communication with the power liftgate module	• Battery junction box (BJB) fuse 5 (7.5A). • Circuitry. • Power liftgate module.	• REFER to Section 419-10 .
• The retractable running board does not operate correctly — both running boards	• Battery junction box (BJB) fuse 104 (30A). • Circuitry. • Body security module (BSM). • Power liftgate module (PLGM). • Powertrain control module (PCM). • Instrument cluster	• Go To Pinpoint Test A .

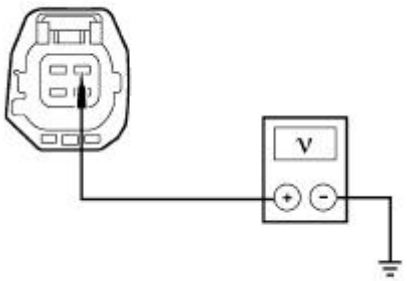
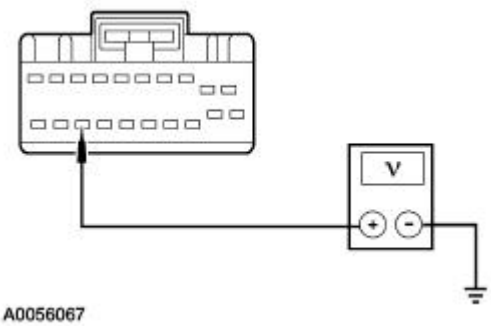
	module (ICM).	
• The retractable running board does not operate correctly — left running board	• Circuitry. • Retractable running board assembly. • Retractable running board sensor harness. • Retractable running board motor. • Power liftgate module (PLGM). • Door ajar switches.	• Go To Pinpoint Test B .
• The retractable running board does not operate correctly — right running board	• Circuitry. • Retractable running board assembly. • Retractable running board sensor harness. • Retractable running board motor. • Power liftgate module (PLGM). • Door ajar switches.	• Go To Pinpoint Test C .

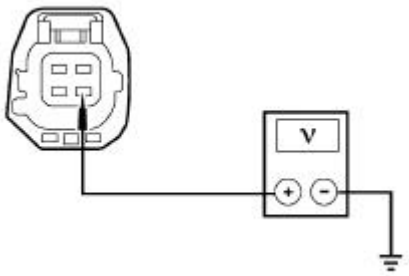
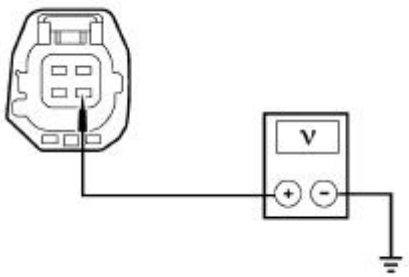
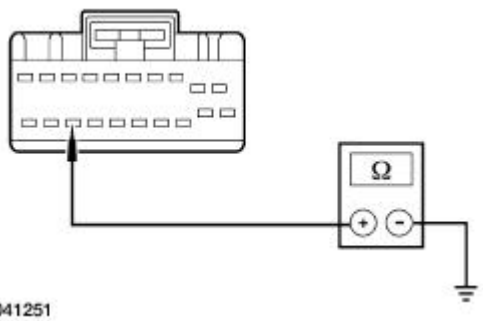
Pinpoint Tests

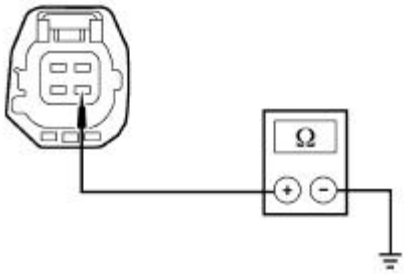
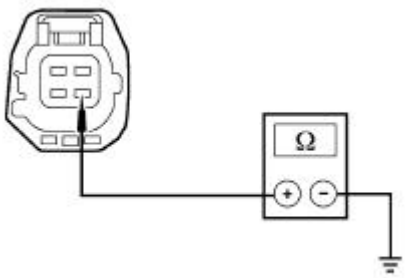
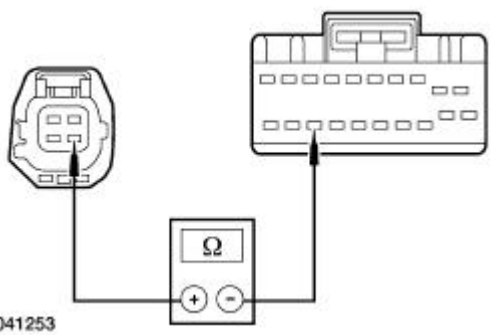
NOTE: If any door ajar or VSS related DTCs are present, diagnose the door ajar and VSS related DTCs before performing this pinpoint test.

PINPOINT TEST A: THE RETRACTABLE RUNNING BOARD DOES NOT OPERATE CORRECTLY — BOTH RUNNING BOARDS

Test Step	Result / Action to Take
A1 VERIFY THE VEHICLE SPEED STATUS PID	
• Enter the following diagnostic mode on the diagnostic tool: Access the PCM Module VSS PID. • Operate the vehicle and verify the vehicle speed. • **Does the VSS PID read correctly?**	**Yes** GO to A2 . **No** REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual to diagnose the VSS.
A2 VERIFY THE MESSAGE CENTER SWITCH PID	
• Enter the following diagnostic mode on the diagnostic tool: Access the Instrument Cluster Module (ICM) Retractable Running Board PID. • Operate the switch to the ENABLE, DISABLE and the MANUAL/OUT positions. • **Does the switch operate correctly?**	**Yes** GO to A3 . **No** REFER to Section 413-01 to diagnose the ICM.
A3 VERIFY THE DOOR AJAR OPERATION	
• Enter the following diagnostic mode on the diagnostic tool: Access the Body Security Module Door Ajar PIDs. • Monitor the PIDs while opening and closing each door one	**Yes** GO to A4 .

at a time. ● **Do the PIDs read correctly?**	**No** REFER to Section 417-02 to diagnose the door ajar system.
A4 CHECK THE OPERATION OF THE RETRACTABLE RUNNING BOARDS	
● Enter the following diagnostic mode on the diagnostic tool: Access the left and right retractable running board PIDs. ● Enter the following diagnostic mode on the diagnostic tool: Access the left and right retractable running board active commands. ● Monitor the PIDs while operating the left and right retractable running board active command to ENABLE and DISABLE positions. ● **Did the PIDs agree with the left and right retractable running board active commands?**	**Yes** GO to A13 . **No** GO to A5 .
A5 CHECK CIRCUIT 1943 (RD/WH) FOR VOLTAGE	
● Disconnect: Retractable Running Board Motor C3185/C3186. ● Key in ON position. ● Measure the voltage between retractable running board motor C3185-1, circuit 1943 (RD/WH) for LH, and retractable running board motor C3186-1, circuit 1943 (RD/WH) for RH, harness side and ground.  A0041246 ● **Are the voltages greater than 10 volts?**	**Yes** GO to A6 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test.
A6 CHECK CIRCUIT 1975 (DG/YE) FOR A SHORT TO VOLTAGE	
● Connect: Retractable Running Board Motor C3185/C3186. ● Disconnect: Power Liftgate Module C4174d. ● Measure the voltage between power liftgate module C4174d-18, circuit 1975 (DG/YE) harness side and ground.  A0056067 ● **Is any voltage present**	**Yes** GO to A7 . **No** GO to A9 .
A7 CHECK THE LEFT RETRACTABLE RUNNING BOARD FOR A SHORT TO VOLTAGE	

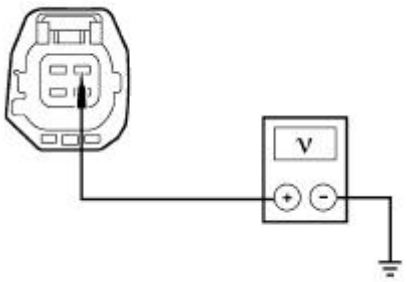
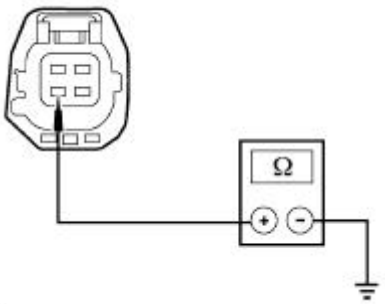
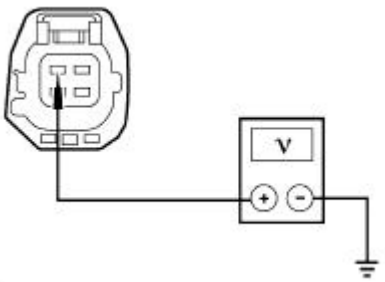
• Disconnect: Left Retractable Running Board Motor C3185. • Measure the voltage between left retractable running board motor C3185-3, circuit 1975 (DG/YE) harness side and ground.  A0056068 • **Is any voltage present?**	**Yes** GO to A8 . **No** INSTALL a new left retractable running board motor. REFER to Retractable Running Board Motor in this section. CLEAR the DTCs. REPEAT the self-test.
A8 CHECK THE RIGHT RETRACTABLE RUNNING BOARD FOR A SHORT TO VOLTAGE	
• Disconnect: Right Retractable Running Board Motor C3186. • Measure the voltage between right retractable running board motor C3186-3, circuit 1975 (DG/YE) harness side and ground.  A0056068 • **Is any voltage present?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new right retractable running board motor. REFER to Retractable Running Board Motor in this section. CLEAR the DTCs. REPEAT the self-test.
A9 CHECK CIRCUIT 1975 (DG/YE) FOR A SHORT TO GROUND	
• Key in OFF position. • Measure the resistance between the power liftgate module C4174d-18, circuit 1975 (DG/YE) harness side and ground.  A0041251 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to A12 . **No** GO to A10 .
A10 CHECK THE LEFT RETRACTABLE RUNNING BOARD FOR A SHORT TO GROUND	
• Disconnect: Left Retractable Running Board Motor C3185. • Measure the resistance between left retractable running	**Yes** INSTALL a new left

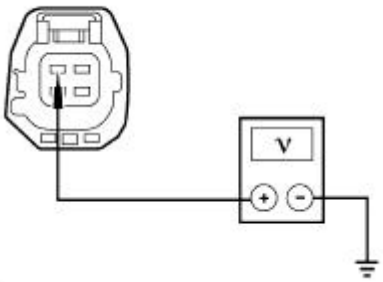
board motor C3185-3, circuit 1975 (DG/YE) harness side and ground.  A0041252 ● **Is the resistance greater than 10,000 ohms?**	retractable running board motor. REFER to Retractable Running Board Motor in this section. CLEAR the DTCs. REPEAT the self-test. **No** GO to A11.
A11 CHECK THE RIGHT RETRACTABLE RUNNING BOARD FOR A SHORT TO GROUND	
● Disconnect: Right Retractable Running Board Motor C3186. ● Measure the resistance between right retractable running board motor C3186-3, circuit 1975 (DG/YE) harness side and ground.  A0041252 ● **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new right retractable running board motor. REFER to Retractable Running Board Motor in this section. CLEAR the DTCs. REPEAT the self-test. **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
A12 CHECK CIRCUIT 1975 (DG/YE) FOR AN OPEN	
● Measure the resistance between the retractable running board motor C3185-3/ C3186-3, circuit 1975 (DG/YE) harness side and power liftgate module C4174d-18, circuit 1975 (DG/YE) harness side.  A0041253 ● **Is the resistance less than 5 ohms?**	**Yes** GO to A13. **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
A13 CHECK THE POWER LIFTGATE MODULE FOR CORRECT OPERATION	
● Disconnect all power liftgate module connectors. ● Check for: ● corrosion. ● pushed-out pins. ● Connect all power liftgate module connectors and make	**Yes** INSTALL a new power liftgate module. REFER to Section 501-03. CLEAR the DTCs. REPEAT the self-test.

sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST B: THE RETRACTABLE RUNNING BOARD DOES NOT OPERATE CORRECTLY — LEFT RUNNING BOARD

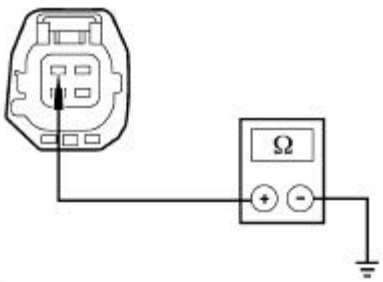
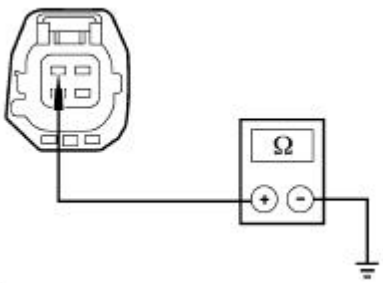
Test Step	Result / Action to Take
B1 CHECK FOR CORRECT OPERATION OF THE LEFT RETRACTABLE RUNNING BOARD	
● Operate the left retractable running board. ● **Does the left retractable running board falsely reverse, partially deploy or retract, or is noisy or jerky?**	**Yes** CARRY OUT the linkage component test in this section. TEST the system for normal operation. **No** GO to B2 .
B2 CHECK THE LEFT RETRACTABLE RUNNING BOARD FOR DEBRIS	
● **NOTE:** It may require as much as 150 lbs. of force to slip the running board motor clutch. ● Extend and retract the left running board by hand. ● **Does the retractable running board operate correctly now?**	**Yes** Hidden debris may have stopped correct operation of the retractable running board. TEST the system for normal operation. **No** GO to B3 .
B3 VERIFY THE DOOR AJAR OPERATION	
● Enter the following diagnostic mode on the diagnostic tool: Access the Body Security Module Door Ajar PIDs. ● Monitor the PIDs while opening and closing each door one at a time. ● **Do the PIDs read correctly?**	**Yes** GO to B4 . **No** REFER to Section 417-02 to diagnose the door ajar system.
B4 CHECK CIRCUIT 1943 (RD/WH) FOR VOLTAGE	
● Disconnect: Left Retractable Running Board Motor C3185. ● Key in ON position. ● Measure the voltage between left retractable running board motor C3185-1, circuit 1943 (RD/WH) harness side and ground.	**Yes** GO to B5 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test.

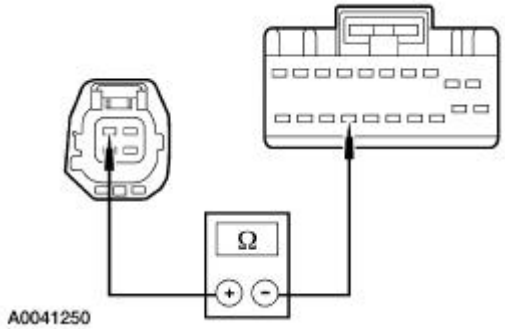
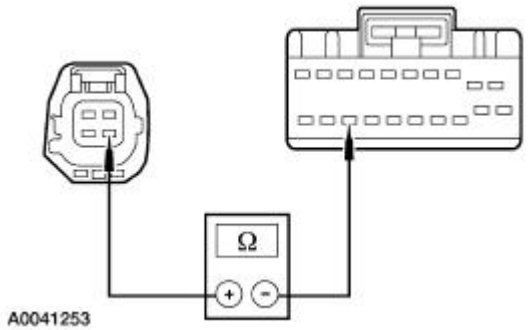
 A0041246 ● **Is the voltage greater than 10 volts?**	
B5 CHECK GROUND AT THE LEFT RETRACTABLE RUNNING BOARD MOTOR	
● Measure the resistance between left retractable running board motor C3185-4, circuit 57 (BK) harness side ground.  A0041247 ● **Is the resistance less than 5 ohms?**	**Yes** GO to B6 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
B6 CHECK CIRCUIT 1944 (BN/PK) FOR A SHORT TO VOLTAGE	
● Measure the voltage between left retractable running board motor C3185-2, circuit 1944 (BN/PK) harness side and ground.  A0041249 ● **Is voltage present?**	**Yes** GO to B7 . **No** GO to B8 .
B7 CHECK POWER LIFTGATE MODULE FOR A SHORT TO VOLTAGE	
● Disconnect: Power Liftgate Module C4174d. ● Measure the voltage between left retractable running board motor C3185-2, circuit 1944 (BN/PK) harness side and ground.	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. **No** GO to B12 .



A0041249

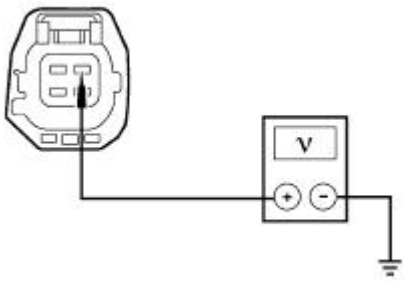
- **Is voltage present?**

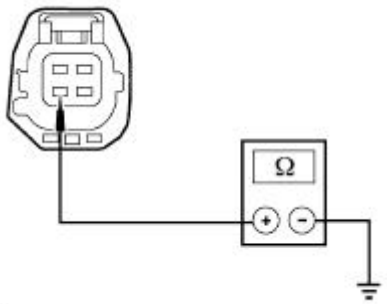
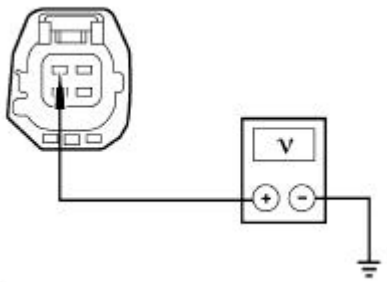
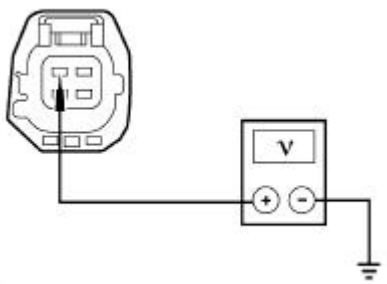
B8 CHECK CIRCUIT 1944 (BN/PK) FOR A SHORT TO GROUND	
• Measure the resistance between left retractable running board motor C3185-2, circuit 1944 (BN/PK) harness side ground.  A0041248 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to B9 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
B9 CHECK THE POWER LIFTGATE MODULE OUTPUT	
• Measure the resistance between left retractable running board motor C3185-2, circuit 1944 (BN/PK) harness side and ground while using the diagnostic tool to deploy and retract the retractable running board or by opening or closing a left side door.  A0041248 • **Is the resistance less than 5 ohms while deploying and greater than 10,000 ohms while retracting?**	**Yes** CARRY OUT the linkage component test in this section. TEST the system for normal operation. **No** GO to B10 .
B10 CHECK CIRCUIT 1944 (BN/PK) FOR AN OPEN	
• Measure the resistance between left retractable running board motor C3185-2, circuit 1944 (BN/PK) and power liftgate module C4174d-17, circuit 1944 (BN/PK) harness side.	**Yes** GO to B11 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

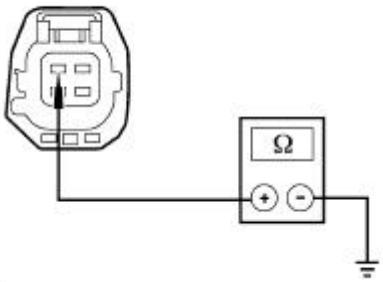
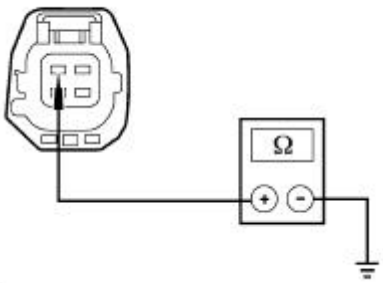
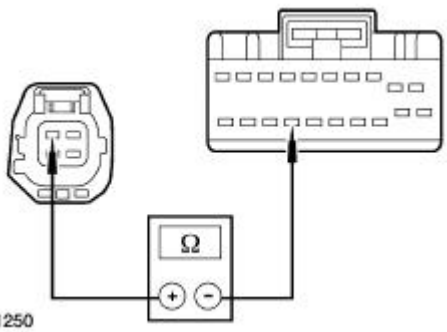
 ● **Is the resistance less than 5 ohms?**	
B11 CHECK CIRCUIT 1975 (DG/YE) FOR AN OPEN	**Yes** GO to B12 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
● Measure the resistance between left retractable running board motor C3185-3, circuit 1975 (DG/YE) harness side and power liftgate module C4174d-18, circuit 1975 (DG/YE) harness side.  ● **Is the resistance less than 5 ohms?**	
B12 CHECK THE POWER LIFTGATE MODULE FOR CORRECT OPERATION	**Yes** INSTALL a new power liftgate module. REFER to Section 501-03 . CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
● Disconnect all power liftgate module connectors. ● Check for: ● corrosion. ● pushed-out pins. ● Connect all power liftgate module connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	

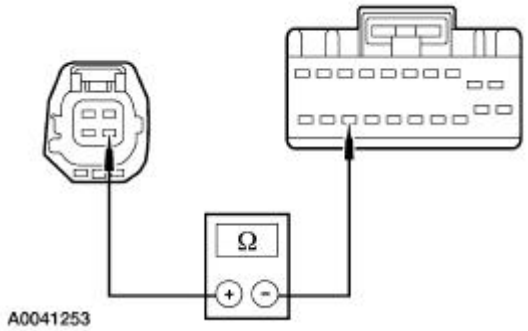
PINPOINT TEST C: THE RETRACTABLE RUNNING BOARD DOES NOT OPERATE CORRECTLY — RIGHT RUNNING BOARD

Test Step	Result / Action to Take
C1 CHECK FOR CORRECT OPERATION OF THE RIGHT RETRACTABLE RUNNING BOARD	**Yes** CARRY OUT the linkage component test
● Operate the right retractable running board. ● **Does the right retractable running board falsely reverse, partially deploy or retract, or is noisy or jerky?**	

	in this section. TEST the system for normal operation. **No** GO to C2 .
C2 CHECK THE RIGHT RETRACTABLE RUNNING BOARD FOR DEBRIS ● **NOTE:** It may require as much as 150 lbs. of force to slip the running board motor clutch. ● Extend and retract the right running board by hand. ● **Does the retractable running board operate correctly now?**	**Yes** Hidden debris may have stopped correct operation of the retractable running board. TEST the system for normal operation. **No** GO to C3 .
C3 VERIFY THE DOOR AJAR OPERATION ● Enter the following diagnostic mode on the diagnostic tool: Access the Body Security Module Door Ajar PIDs. ● Monitor the PIDs while opening and closing each door one at a time. ● **Do the PIDs read correctly?**	**Yes** GO to C4 . **No** REFER to Section 417-02 to diagnose the door ajar system.
C4 CHECK CIRCUIT 1943 (RD/WH) FOR VOLTAGE ● Disconnect: Right Retractable Running Board Motor C3186. ● Key in ON position. ● Measure the voltage between right retractable running board motor C3186-1, circuit 1943 (RD/WH) harness side and ground.  A0041246 ● **Is the voltage greater than 10 volts?**	**Yes** GO to C5 . **No** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test.
C5 CHECK GROUND AT THE RIGHT RETRACTABLE RUNNING BOARD MOTOR ● Measure the resistance between right retractable running board motor C3186-4, circuit 57 (BK) harness side ground.	**Yes** GO to C6 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

 A0041247 ● **Is the resistance less than 5 ohms?**	
C6 CHECK CIRCUIT 1945 (VT/WH) FOR A SHORT TO VOLTAGE	
● Measure the voltage between right retractable running board motor C3186-2, circuit 1945 (VT/WH) harness side and ground.  A0041249 ● **Is voltage present?**	**Yes** GO to C7 . **No** GO to C8 .
C7 CHECK POWER LIFTGATE MODULE FOR A SHORT TO VOLTAGE	
● Disconnect: Power Liftgate Module C4174d. ● Measure the voltage between right retractable running board motor C3186-2, circuit 1945 (VT/WH) harness side and ground.  A0041249 ● **Is voltage present?**	**Yes** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. **No** GO to C12 .
C8 CHECK CIRCUIT 1945 (VT/WH) FOR A SHORT TO GROUND	
● Measure the resistance between right retractable running board motor C3186-2, circuit 1945 (VT/WH) harness side ground.	**Yes** GO to C9 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

 A0041248 ● **Is the resistance greater than 10,000 ohms?**	
C9 CHECK THE POWER LIFTGATE MODULE OUTPUT ● Measure the resistance between right retractable running board motor C3186-2, circuit 1945 (VT/WH) harness side and ground while using the diagnostic tool to deploy and retract the retractable running board or by opening or closing a left side door.  A0041248 ● **Is the resistance less than 5 ohms while deploying and greater than 10,000 ohms while retracting?**	**Yes** CARRY OUT the linkage component test in this section. TEST the system for normal operation. **No** GO to C10 .
C10 CHECK CIRCUIT 1945 (VT/WH) FOR AN OPEN ● Measure the resistance between right retractable running board motor C3186-2, circuit 1945 (VT/WH) and power liftgate module C4174d-17, circuit 1945 (VT/WH) harness side.  A0041250 ● **Is the resistance less than 5 ohms?**	**Yes** GO to C11 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
C11 CHECK CIRCUIT 1975 (DG/YE) FOR AN OPEN ● Measure the resistance between right retractable running board motor C3186-3, circuit 1975 (DG/YE) harness side and power liftgate module C4174d-18, circuit 1975 (DG/YE) harness side.	**Yes** GO to C12 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

 ● **Is the resistance less than 5 ohms?**	
C12 CHECK THE POWER LIFTGATE MODULE FOR CORRECT OPERATION	
● Disconnect all power liftgate module connectors. ● Check for: ● corrosion. ● pushed-out pins. ● Connect all power liftgate module connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new power liftgate module. REFER to Section 501-03 . CLEAR the DTCs. REPEAT the self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Component Tests

Linkage

NOTE: If the system has false bounce back, stops in mid travel, or will not stow completely, check to see if any foreign material is caught in the guide and pivot areas.

NOTE: If the retractable running board cannot be extended, extend the running board by hand. It may require as much as 150 lbs. of force to slip the running board motor clutch.

1. Extend the retractable running board.

2. Remove the retractable running board motor. For additional information, refer to Retractable Running Board Motor in this section.

3. Insert a 1/2-inch bit with a torque wrench into the worm gear. The system at ambient temperature should move between 0.5 to 4.0Nm.

4. If the torque required to move the system is less than 4.0Nm, install the retractable running board motor with the limit switches disconnected. Open and close one of the vehicle doors. If the retractable running board deploys-retracts-deploys or retracts-deploys-retracts with out stopping in between, install a new retractable running board sensor wiring harness. For additional information, refer to Retractable Running Board Sensor Wiring Harness in this section. If the retractable running board does not, install a new retractable running board motor. For additional information, refer to Retractable Running Board Motor in this section.

5. If the torque required to move the system is greater than 4.0Nm, the system has a binding condition.

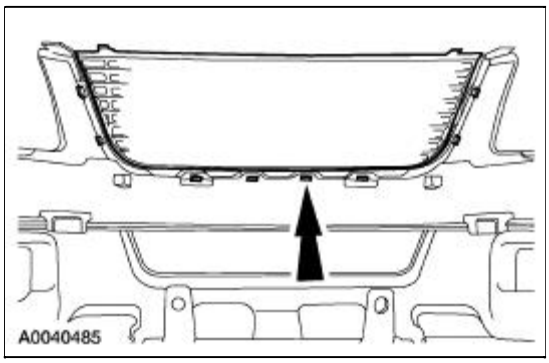
6. Remove the two spool locks from the guide tracks and use the torque wrench to determine the torque required to move the system. If the torque required is less than 4.0Nm, install new spool locks.

7. If the torque is greater than 4.0Nm, install a new retractable running board assembly. For additional information, refer to Retractable Running Board in this section.

Radiator Grille —Expedition

Removal and Installation

1. Remove the front bumper cover. For additional information, refer to Section 501-19 .
2. Remove the clips and remove the front grille.



3. To install, reverse the removal procedure.

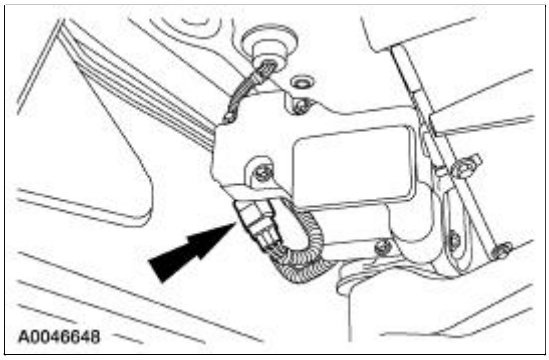
Retractable Running Board

Removal and Installation

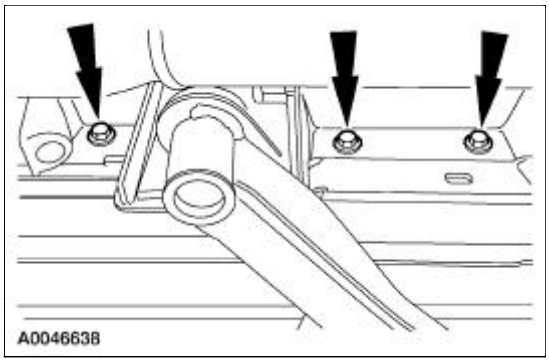
1. **NOTE:** If the retractable running board cannot be extended, extend the running board by hand.

   Extend the retractable running board.

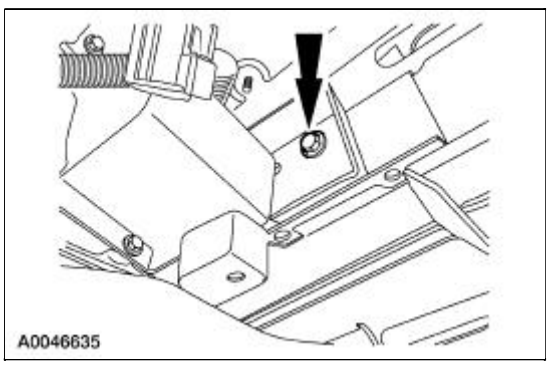
2. Disconnect the retractable running board motor electrical connector.



3. Remove the rear retractable running board bolts.

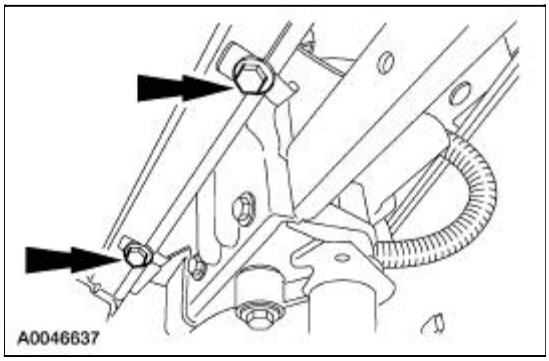


4. Remove the front retractable running board bolts.

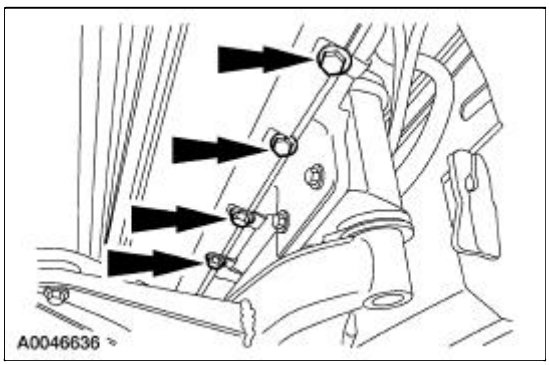


5. **CAUTION: An assistant is required to hold the retractable running board before removing the lower bolts.**

Remove the front retractable running board lower bolts.



6. Remove the rear retractable running board lower bolts and remove the retractable running board.



7. To install, reverse the removal procedure.

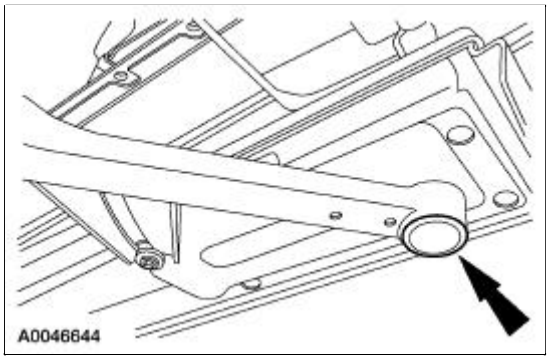
Retractable Running Board —Step

Removal and Installation

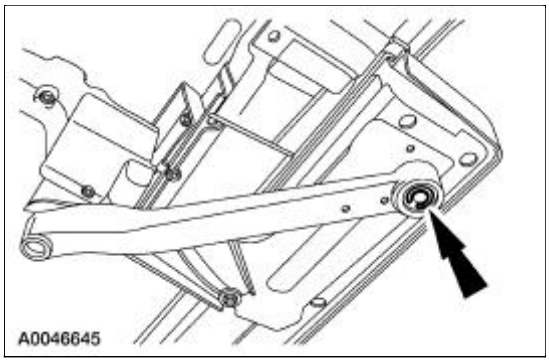
1. **NOTE:** If the retractable running board cannot be extended, extend the running board by hand.

   Extend the retractable running board.

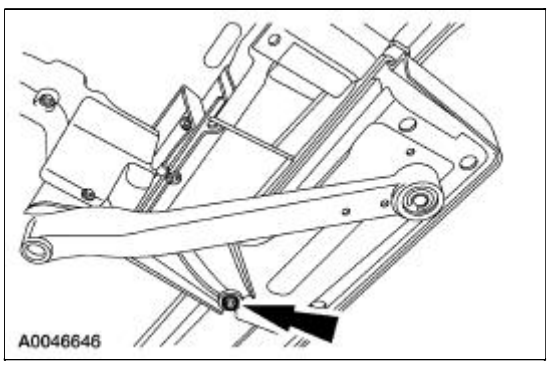
2. Remove the front and rear retractable running board pivot arm covers.



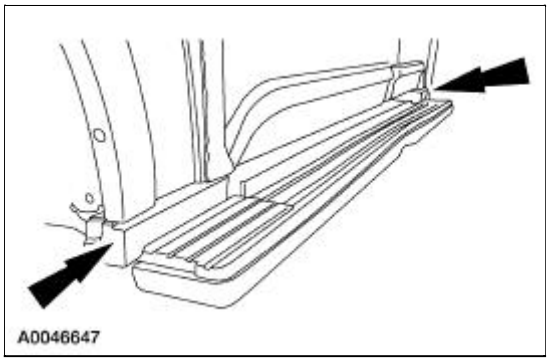
3. Remove the front and rear retractable running board pivot arm clips.



4. Remove the front and rear retractable running board bolts.



5. Remove the front fender and rear quarter panel trim.



6. Remove the retractable running board step.
7. To install, reverse the removal procedure.
    - Transfer the retractable running board trim pieces as necessary.

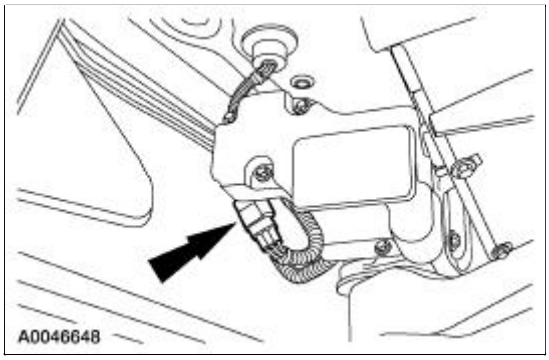
Retractable Running Board Motor

Removal and Installation

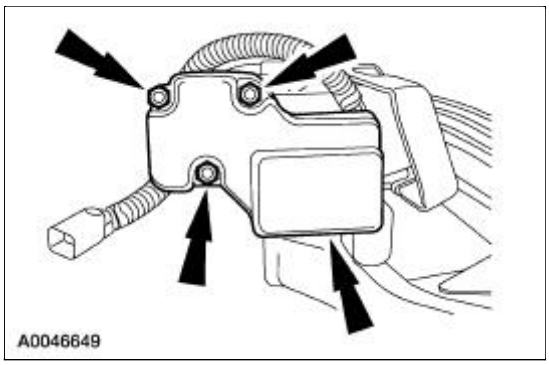
1. **NOTE:** If the retractable running board cannot be extracted, extend the running board by hand.

   Extend the retractable running board.

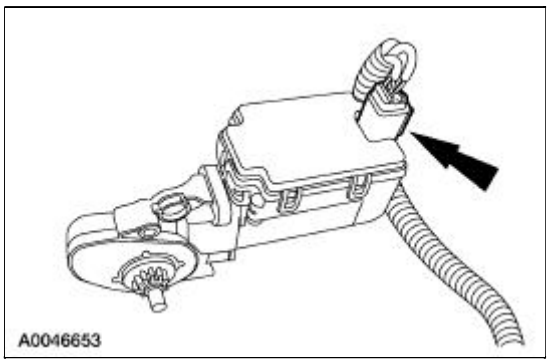
2. Disconnect the retractable running board motor electrical connector.



3. Remove the retractable running board motor.
   - Remove the bolts and remove the cover and retractable running board motor.



4. Disconnect the retractable running board sensor wiring harness.

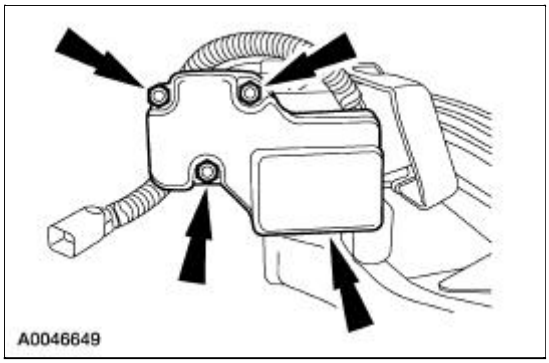


5. To install, reverse the removal procedure.

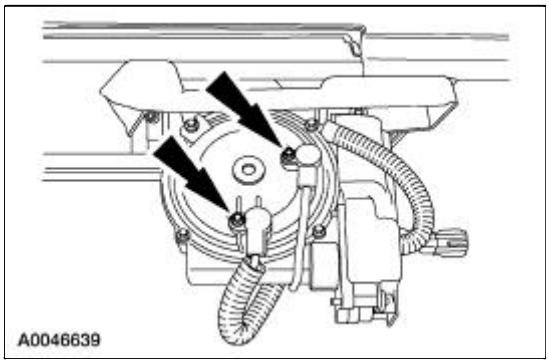
Retractable Running Board Sensor Wiring Harness

Removal and Installation

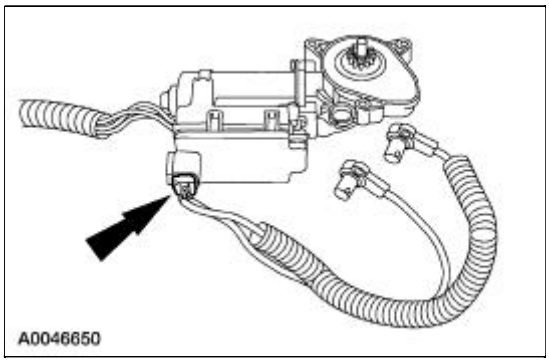
1. Remove the retractable running board motor.
   - Remove the bolts and remove the cover and retractable running board motor.



2. Remove the retractable running board sensor wiring harness bolts.



3. Disconnect the electrical connector and remove the retractable running board sensor wiring harness.



4. To install, reverse the removal procedure.

General Specifications

Item	Specification
Rear View Mirror Adhesive D9AZ-19554-CA	ESB-M2G176-A

Torque Specifications

Description	Nm	lb-in
Exterior mirror nuts	7	62

Rear View Mirrors

The rear view mirror components consist of:

- the interior mirror.
- the auto dimming mirror (optional).
- the exterior power folding mirror (optional).
- the exterior mirror (17682/17683).
- the exterior mirror glass (17K707).
- the exterior mirror cover (17D742/17D743).
- the exterior mirror motor (17D696).
- the exterior mirror control switch.
- the memory set switch.

The interior mirror:

- is windshield mounted.
- is a manual hand-set day/night or an optional auto dimming interior mirror.

The auto dimming interior mirror has two features:

- automatic dimming
- normal view state automatic lock-in when the vehicle is placed in R (reverse)

The automatic dimming feature darkens the interior mirror whenever the front ambient light sensor detects low outside light and glare reaches the light sensor (photo cell), which is located inside the interior mirror. The auto dimming interior mirror starts to return to the normal view once the glare goes away.

The exterior mirrors:

- are controlled by power controls on the LH front door trim panel.
- are of a foldaway design.
- may contain turn signal indicators.
- may be heated when the heated back window glass is activated.
- may have a programmable recall memory option.
- may have a reverse drive feature.

Driver Seat Module

The power driver seat and power exterior mirrors are controlled by the driver seat module (DSM) only when the vehicle is equipped with the programmable/recall memory option.

The DSM system consists of the following components:

- driver seat module (DSM)
- driver memory seat switch
- memory mirror switch
- memory set switch
- front vertical seat motor
- rear vertical seat motor
- driver horizontal seat motor
- LH heated memory mirror
- RH heated memory mirror

The DSM incorporates multiple functions into one module and offers diagnostics to easily locate and repair concerns affecting the subsystems that it controls.

Power Exterior Mirror Operation

The power exterior mirrors are controlled by the DSM and are operational all the time, whether the ignition switch is on or off. Using the power exterior mirror switch, the driver can adjust the driver and passenger exterior mirrors four ways.

Up/Down Motion

The power exterior mirrors can be moved up and down under motor control by actuating the power mirrors UP/DOWN switch. The DSM will power the driver or passenger mirror up/down motor until the switch is released or until the travel limit is reached.

Left/Right Motion

The power exterior mirrors can be moved left and right under motor control by actuating the power mirrors LEFT/RIGHT switch. The DSM will power the driver or passenger mirror left/right motor until the switch is released or until the travel limit is reached.

Mirror Selection — Driver/Passenger

The driver can select the driver or passenger mirror to be adjusted by setting the mirror select switch to the appropriate position.

Turn Signal Mirror

The exterior mirror may be equipped with a mirror-mounted turn signal assembly. For Diagnosis and Testing, refer to Section 417-01 .

Power Folding Mirrors

The power folding exterior mirrors are controlled by the power folding mirror switch. The power folding mirror switch has power at all times.

Memory Power Exterior Rear View Mirror Operation

The memory power exterior mirrors feature allows the driver to program personalized mirror positions that can be recalled using the memory switches or remote transmitter. There are three memory settings possible. The power driver seat positions are also stored, and recalled with the memory exterior mirrors positions.

Reverse Drive Rear View Mirror

The reverse drive rear view mirror function:

- tilts the exterior rear view mirror downward to improve the visibility in the rear bumper area.
- is operated by the driver seat module (DSM).
- is turned ON and OFF through the message center.

When the reverse drive rear view mirror function is enabled:

- The driver exterior rear view mirror tilts down three degrees and the passenger exterior rear view mirror tilts down five and a half degrees when the ignition switch is in RUN and REVERSE is selected.

The exterior rear view mirror will return to the original setting when the transmission is shifted out of reverse.

- Pressing the exterior rear view mirror control will cancel the reverse tilt or automatic mirror position return if it is operating.
- If the transmission is shifted out of REVERSE and then back into REVERSE within 10 seconds, the driver seat module will delay reverse tilt operation for 5 seconds.

Rear View Mirrors

Refer to Wiring Diagrams Cell 124 , Power Mirrors for schematic and connector information.

Refer to Wiring Diagrams Cell 125 , Electronic Day/Night Mirror for schematic and connector information.

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool with required communication adapter
 ST1137-A	73III Automotive Meter 105-R0057

Inspection and Verification

1. Verify the customer concern by operating the power exterior mirrors or memory mirrors.
2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
● Exterior mirror(s) ● Interior mirror	● Central junction box (CJB) fuse ● Circuitry ● Exterior mirror control switch ● Exterior mirror motor ● Interior mirror ● Driver seat module (DSM) ● Memory set switch

3. If the vehicle is equipped with memory exterior mirrors and the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel. Select the vehicle to be tested from the diagnostic tool menu.
   - Check to make sure the program card is correctly installed.
   - Check the connections to the vehicle.

- Check the ignition switch position.

4. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool manual.

5. Carry out the DATA LINK DIAGNOSTICS test. If the diagnostic tool responds with:
   - SCP+, SCP- OR UBP = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESPONSE/NOT EQUIPPED for DSM, go to Section 419-10 .
   - SYSTEM PASSED for the DSM, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self test diagnostics for the DSM.

6. If the DTCs retrieved are related to the concern, go to DSM Diagnostic Trouble Code (DTC) Index.

7. If DTCs are retrieved that are not found in the following DSM Diagnostic Trouble Code (DTC) Index, refer to the master DSM Diagnostic Trouble Code (DTC) Index in Section 419-10 .

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

DSM Diagnostic Trouble Code (DTC) Index

DSM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1342	ECU Is Defective	DSM	REFER to Section 419-10 .
B1529	Memory Set Switch Circuit Short to Ground	DSM	Go To Pinpoint Test F .
B1534	Memory 1 Switch Circuit Short to Ground	DSM	Go To Pinpoint Test F .
B1538	Memory 2 Switch Circuit Short to Ground	DSM	Go To Pinpoint Test F .
B1667	Mirror Driver Up/Down Motor Stalled	DSM	If the memory mirror is inoperative, Go To Pinpoint Test D . If the memory mirror is inoperative from the memory set switch, Go To Pinpoint Test F .
B1668	Mirror Driver Right/Left Motor Stalled	DSM	If the memory mirror is inoperative, Go To Pinpoint Test D . If the memory mirror is inoperative from the memory set switch, Go To Pinpoint Test F .
B1669	Mirror Passenger Up/Down Motor Stalled	DSM	If the memory mirror is inoperative, Go To Pinpoint Test D . If the memory mirror is inoperative from the memory set switch, Go To Pinpoint Test F .
B1670	Mirror Passenger Right/Left Motor Stalled	DSM	If the memory mirror is inoperative, Go To Pinpoint Test D . If the memory mirror is inoperative from the memory set switch, Go To Pinpoint Test F .
B1697	Mirror Driver/Passenger Switch Circuit Short to Battery	DSM	Go To Pinpoint Test D .
B1735	Mirror Driver Vertical Switch Circuit Short to Battery	DSM	Go To Pinpoint Test D .
B1739	Mirror Driver Horizontal Switch Circuit Short to Battery	DSM	Go To Pinpoint Test D .
B1743	Mirror Passenger Vertical	DSM	Go To Pinpoint Test D .

	Switch Circuit Short to Battery		
B1747	Mirror Passenger Horizontal Switch Circuit Short to Battery	DSM	Go To Pinpoint Test D .
B2312	Passenger Mirror Horizontal Feedback Pot. Circuit Failure	DSM	Go To Pinpoint Test F .
B2314	Passenger Mirror Horizontal Feedback Pot. Circuit Short to Battery	DSM	Go To Pinpoint Test F .
B2316	Passenger Mirror Vertical Feedback Pot. Circuit Failure	DSM	Go To Pinpoint Test F .
B2318	Passenger Mirror Vertical Feedback Pot. Circuit Short to Battery	DSM	Go To Pinpoint Test F .
B2320	Driver Mirror Horizontal Feedback Pot. Circuit Failure	DSM	Go To Pinpoint Test F .
B2322	Driver Mirror Horizontal Feedback Pot. Circuit Short to Battery	DSM	Go To Pinpoint Test F .
B2324	Driver Mirror Vertical Feedback Pot. Circuit Failure	DSM	Go To Pinpoint Test F .
B2326	Driver Mirror Vertical Feedback Pot. Circuit Short to Battery	DSM	Go To Pinpoint Test F .
U1950	UBP Communication Bus Fault	DSM	REPAIR all DTCs related to the concern first. If U1950 is still retrieved, GO to Section 418-00 to diagnose communication network.

Symptom Chart

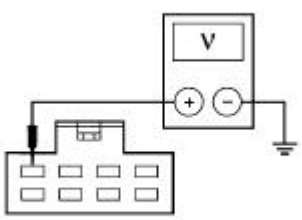
Symptom Chart

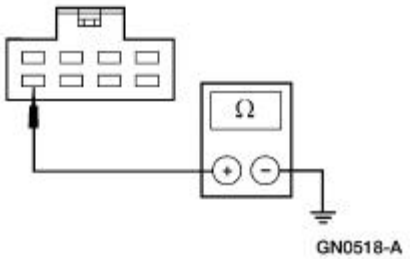
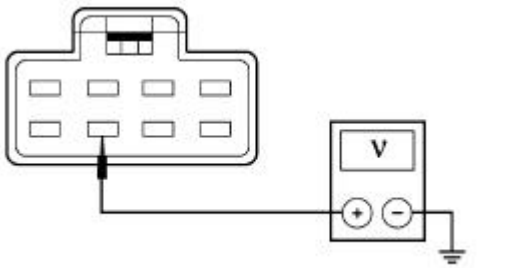
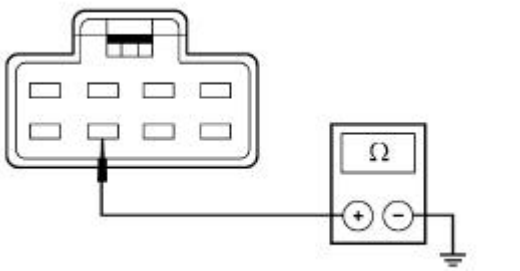
Condition	Possible Sources	Action
● The mirrors are inoperative	● Circuitry. ● Central junction box (CJB) fuse. ● Exterior mirror control switch.	● Go To Pinpoint Test A .
● A single mirror is inoperative	● Circuitry. ● Exterior mirror control switch. ● Exterior mirror motor.	● Go To Pinpoint Test B .
● A single mirror does not function with switch logic	● Exterior mirror control switch. ● Exterior mirror motor. ● Circuitry.	● Go To Pinpoint Test C .
● The memory mirror is inoperative	● Driver seat module (DSM). ● Circuitry. ● CJB fuse 3	● Go To Pinpoint Test D .

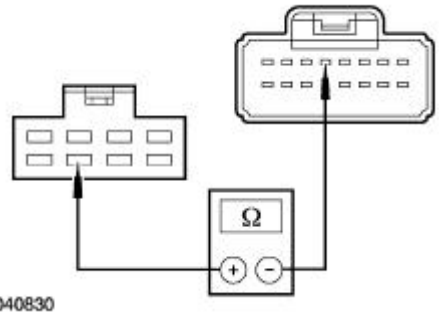
	(7.5A). ● Exterior mirror motor. ● Mirror control switch.	
● The power folding mirrors do not operate	● Circuitry. ● Power folding exterior mirror. ● CJB fuse.	● Go To Pinpoint Test E .
● The memory mirror is inoperative — does not operate from the memory set switch	● Circuitry. ● Driver seat module (DSM). ● Exterior mirror motor. ● Memory set switch.	● Go To Pinpoint Test F .
● The memory mirror is inoperative — the heated exterior mirrors do not defrost	● Circuitry. ● Exterior rear view mirror. ● CJB fuse.	● Go To Pinpoint Test G .
● The auto dimming mirror does not operate correctly	● Circuitry. ● CJB fuse. ● Auto dimming interior mirror.	● Go To Pinpoint Test H .
● The reverse drive rear view mirrors are inoperative	● DSM. ● Circuitry.	● Go To Pinpoint Test I .

Pinpoint Tests

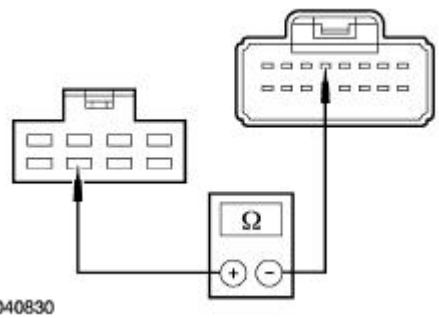
PINPOINT TEST A: THE MIRRORS ARE INOPERATIVE

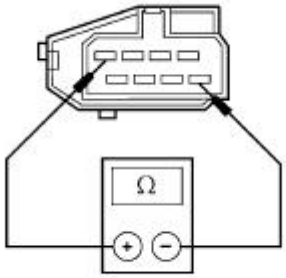
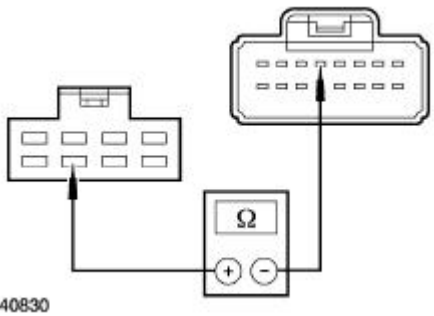
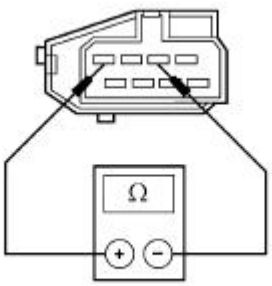
Test Step	Result / Action to Take
A1 CHECK THE VOLTAGE TO THE EXTERIOR MIRROR CONTROL SWITCH — CIRCUIT 956 (OG/LG)	
● Key in OFF position. ● Disconnect: Exterior Mirror Control Switch C527. ● Measure the voltage between exterior mirror control switch C527-1, circuit 956 (OG/LG) harness side and ground.  GN0517-A ● **Is the voltage greater than 10 volts?**	**Yes** GO to A2 . **No** REPAIR the circuit. TEST the system for normal operation.
A2 CHECK CIRCUIT 57 (BK) FOR AN OPEN	

• Measure the resistance between exterior mirror control switch C527-5, circuit 57 (BK) harness side and ground.  GN0518-A • **Is the resistance less than 5 ohms?**	**Yes** GO to A3 . **No** REPAIR the circuit. TEST the system for normal operation.
A3 CHECK CIRCUIT 542 (YE) FOR A SHORT TO VOLTAGE	
• Measure the voltage between exterior mirror control switch C527-6, circuit 542 (YE) harness side and ground.  GN1956-A • **Is any voltage indicated?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** GO to A4 .
A4 CHECK CIRCUIT 542 (YE) FOR A SHORT TO GROUND	
• Measure the resistance between exterior mirror control switch C527-6, circuit 542 (YE) harness side and ground.  GN1957-A • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to A5 . **No** REPAIR the circuit. TEST the system for normal operation.
A5 CHECK CIRCUIT 542 (YE) FOR AN OPEN	
• Disconnect: LH Exterior Mirror C516. • Measure the resistance between exterior mirror control switch C527-6, circuit 542 (YE) and LH exterior mirror control switch C516-4, circuit 542 (YE) harness side.	**Yes** INSTALL a new exterior mirror control switch. REFER to Exterior Mirror Control Switch in this section. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.

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

PINPOINT TEST B: A SINGLE MIRROR IS INOPERATIVE

Test Step	Result / Action to Take
B1 CHECK THE LH AND RH EXTERIOR MIRRORS	
● Operate the exterior mirrors. ● **Do the LH exterior mirrors operate?**	**Yes** GO to B2 . **No** GO to B4 .
B2 CHECK CIRCUIT 542 (YE) FOR AN OPEN	
● Key in OFF position. ● Disconnect: RH Exterior Mirror C622. ● Disconnect: Exterior Mirror Control Switch C527. ● Measure the resistance between exterior mirror control switch C527-6, circuit 542 (YE) and RH exterior mirror C622-4, circuit 542 (YE) harness side.  ● **Is the resistance less than 5 ohms?**	**Yes** GO to B3 . **No** REPAIR the circuit. TEST the system for normal operation.
B3 CHECK THE EXTERIOR MIRROR CONTROL SWITCH IN THE RH POSITION	
● Place the exterior mirror control switch selector in the right exterior mirror position. ● Measure the resistance between exterior mirror control switch terminals 1 and 8 while holding the exterior mirror control switch in the UP position.	**Yes** INSTALL a new RH exterior mirror motor. REFER to Exterior Mirror Motor in this section. TEST the system for normal operation. **No** INSTALL a new exterior mirror control switch. REFER to Exterior Mirror Control Switch in this section. TEST the system

 A0014784 ● **Is the resistance less than 5 ohms?**	for normal operation.
B4 CHECK CIRCUIT 542 (YE) FOR AN OPEN	
● Key in OFF position. ● Disconnect: LH Exterior Mirror C516. ● Disconnect: Exterior Mirror Control Switch C527. ● Measure the resistance between exterior mirror control switch C527-6, circuit 542 (YE) and LH exterior mirror C516-4, circuit 542 (YE) harness side.  A0040830 ● **Is the resistance less than 5 ohms?**	**Yes** GO to B5 . **No** REPAIR the circuit. TEST the system for normal operation.
B5 CHECK THE EXTERIOR MIRROR CONTROL SWITCH IN THE LH POSITION	
● Place the exterior mirror control switch selector switch in the left exterior mirror position. ● Measure the resistance between exterior mirror control switch terminals 1 and 3 while holding the exterior mirror control in the UP position.  A0014785 ● **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new LH exterior mirror motor. REFER to Exterior Mirror Motor in this section. TEST the system for normal operation. **No** INSTALL a new exterior mirror control switch. REFER to Exterior Mirror Control Switch in this section. TEST the system for normal operation.

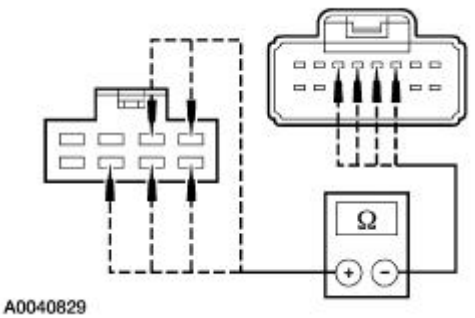
PINPOINT TEST C: A SINGLE MIRROR DOES NOT FUNCTION WITH SWITCH LOGIC

Test Step	Result / Action to Take

C1 CHECK THE EXTERIOR MIRROR HARNESS

- Disconnect: Inoperative Exterior Mirror C516/C622.
- Use the following table to measure the resistance between the exterior mirror control switch C527 pins and the inoperative exterior mirror (C516 LH or C622 RH) harness side pins.

Circuit	LH Exterior Mirror	RH Exterior Mirror	Exterior Mirror Control Switch
540 (RD)	C516-5	—	C527-4
541 (DB)	C516-3	—	C527-7
542 (YE)	C516-4	C622-4	C527-6
543 (DG)	—	C622-5	C527-3
544 (PK)	—	C622-3	C527-8



A0040829

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

Yes
GO to C2 .

No
REPAIR the circuit(s) in question. TEST the system for normal operation.

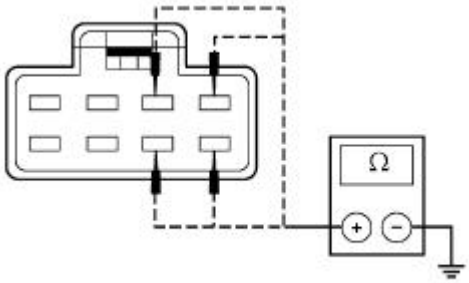
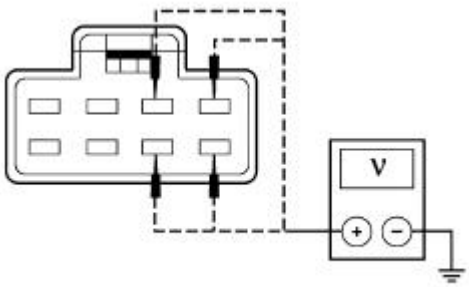
C2 CHECK CIRCUITS 544 (PK), 543 (DG), 541 (DB) AND 540 (RD) FOR A SHORT TO GROUND

- Key in OFF position.
- Measure the resistance between the following exterior mirror control C527 pins harness side and ground(s):

Connector	Circuit
C527-8	544 (PK)
C527-3	543 (DG)
C527-7	541 (DB)
C527-4	540 (RD)

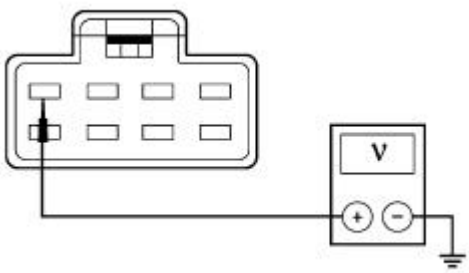
Yes
GO to C3 .

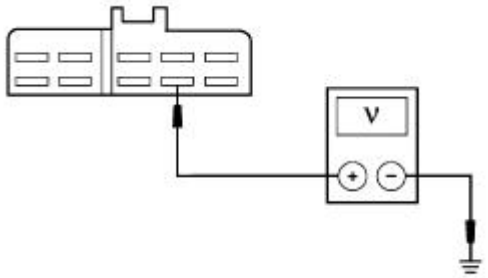
No
REPAIR the circuit(s) in question. TEST the system for normal operation.

 GN1961-A ● **Are the resistances greater than 10,000 ohms?**	
C3 CHECK CIRCUITS 544 (PK), 543 (DG), 541 (DB) AND 540 (RD) FOR A SHORT TO VOLTAGE ● Key in ON position. ● Measure the voltage between the following exterior rear view mirror control C527 pins harness side and ground: **Connector** / **Circuit** C527-8 / 544 (PK) C527-3 / 543 (DG) C527-7 / 541 (DB) C527-4 / 540 (RD)  GN1960-A ● **Is any voltage indicated?**	**Yes** REPAIR the circuit(s) in question. TEST the system for normal operation. **No** INSTALL a new exterior rear view mirror motor. REFER to Exterior Mirror Motor in this section. TEST the system for normal operation.

PINPOINT TEST D: THE MEMORY MIRROR IS INOPERATIVE

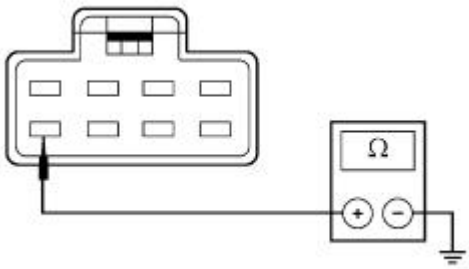
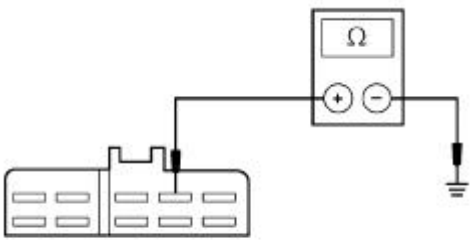
Test Step	Result / Action to Take
D1 RETRIEVE THE DTCs FROM DRIVER SEAT MODULE (DSM) ● Use the recorded DSM DTCs from the continuous and on-demand self tests. ● **Are any DTCs retrieved?**	**Yes** If DTC B1667, GO to D10 . If DTC B1668, GO to D10 . If DTC B1669, GO to D14 . If DTC B1670, GO to D14 .

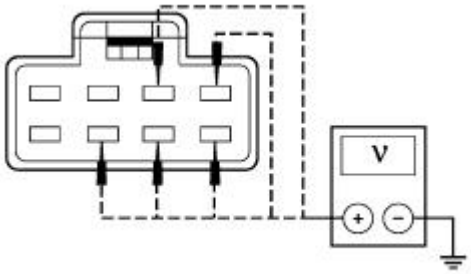
	If DTC B1697, GO to D3 . If DTC B1735, GO to D3 . If DTC B1739, GO to D3 . If DTC B1743, GO to D3 . If DTC B1747, GO to D3 . **No** GO to D2 .
D2 CHECK THE DSM FOR CORRECT EXTERIOR MIRROR CONTROL SWITCH INPUTS ● **NOTE:** DSM PID MIR_SEL will not read PASSENGER until the exterior mirror control switch is moved horizontally or vertically. ● Monitor the DSM PIDs MIR_SEL, MIRV_SW and MIRH_SW while operating the exterior mirror control switch. ● **Do the PID values agree with the switch positions?**	**Yes** GO to D9 . **No** GO to D3 .
D3 CHECK THE EXTERIOR MIRROR CONTROL SWITCH ● Key in OFF position. ● Disconnect: Exterior Mirror Control Switch C527/C577. ● Check the exterior mirror control switch. Refer to Wiring Diagrams Cell 149 for schematic and connector information. ● **Is the exterior mirror control switch OK?**	**Yes** GO to D4 . **No** INSTALL a new exterior mirror control switch. REFER to Exterior Mirror Control Switch in this section. CLEAR the DTCs. REPEAT the self test.
D4 CHECK CIRCUIT 956 (OG/LG) FOR VOLTAGE ● If not equipped with power fold exterior mirrors, measure the voltage between exterior mirror control switch C527-1, circuit 956 (OG/LG) harness side and ground.  GN1941-A ● If equipped with power fold exterior mirrors, measure the voltage between exterior mirror control switch C577-7, circuit 956 (OG/LG) harness side and ground.	**Yes** GO to D5 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self test.



A0015484

- **Is the voltage greater than 10 volts?**

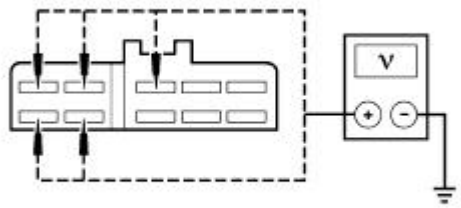
D5 CHECK CIRCUIT 875 (BK/LB) FOR AN OPEN	
• If not equipped with power fold mirrors, measure the resistance between exterior mirror control switch C527-5, circuit 875 (BK/LB) harness side and ground.  GN1942-A • If equipped with power fold mirrors, measure the resistance between exterior mirror control switch C577-2, circuit 875 (BK/LB) harness side and ground.  A0015485 • **Is the resistance less than 5 ohms?**	**Yes** GO to D6 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self test.
D6 CHECK CIRCUITS 1475 (PK/OG), 1479 (DB/OG), 1478 (DG/OG), 1476 (RD/OG) AND 1477 (YE/BK) FOR A SHORT TO VOLTAGE	
• Disconnect: DSM C341d. • Key in ON position. • If not equipped with power fold exterior mirrors, measure the voltage between the following exterior mirror control switch C527 pins harness side and ground:	**Yes** REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the self test. **No** GO to D7 .



GN1943-A

- If equipped with power fold exterior mirrors, measure the voltage between the following exterior mirror control switch C577 pins harness side and ground:

Without Power Fold Exterior Mirrors, Connector	With Power Fold Exterior Mirror, Connector	Circuit
C527-3	C577-9	1478 (DG/OG)
C527-4	C577-10	1476 (RD/OG)
C527-6	C577-3	1477 (YE/BK)
C527-7	C577-4	1479 (DB/OG)
C527-8	C577-5	1475 (PK/OG)



A0040907

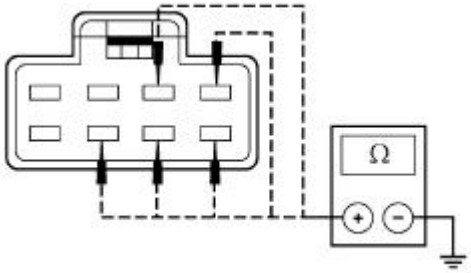
- **Is any voltage indicated?**

D7 CHECK CIRCUITS 1475 (PK/OG), 1479 (DB/OG), 1478 (DG/OG), 1476 (RD/OG) AND 1477 (YE/BK) FOR A SHORT TO GROUND

- Key in OFF position.
- If not equipped with power fold exterior mirrors, measure the resistance between the following exterior mirror control switch C527 pins harness side and ground:

Yes
GO to D8 .

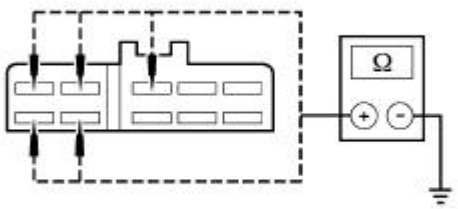
No
REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the self test.



GN1944-A

- If equipped with power fold exterior mirrors, measure the resistance between the following exterior mirror control switch C577 harness side pins and ground:

Without Power Fold Exterior Mirrors, Connector	With Power Fold Exterior Mirror, Connector	Circuit
C527-3	C577-9	1478 (DG/OG)
C527-4	C577-10	1476 (RD/OG)
C527-6	C577-3	1477 (YE/BK)
C527-7	C577-4	1479 (DB/OG)
C527-8	C577-5	1475 (PK/OG)



A0040908

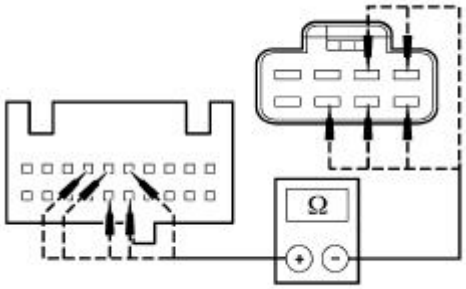
- **Are the resistances greater than 10,000 ohms?**

D8 CHECK CIRCUITS 1475 (PK/OG), 1479 (DB/OG), 1478 (DG/OG), 1476 (RD/OG) AND 1477 (YE/BK) FOR AN OPEN

- If not equipped with power fold exterior mirrors, measure the resistance between the following DSM C341d pins and exterior mirror control switch C527 harness side pins:

Yes
GO to D18 .

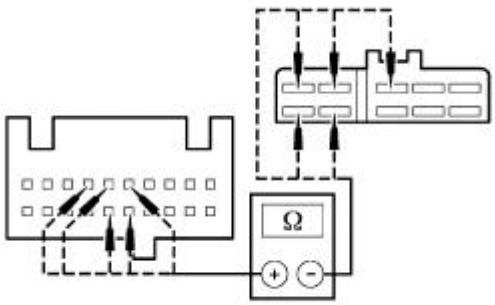
No
REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the self test.



A0040910

- If equipped with power fold exterior mirrors, measure the resistance between the following DSM C341d pins and exterior mirror control switch C577 harness side pins:

DSM	Circuit	Without Power Fold Exterior Mirrors, Connector	With Power Fold Exterior Mirror, Connector
C341d-7	1478 (DG/OG)	C527-3	C577-9
C341d-16	1476 (RD/OG)	C527-4	C577-10
C341d-6	1477 (YE/BK)	C527-6	C577-3
C341d-15	1479 (DB/OG)	C527-7	C577-4
C341d-5	1475 (PK/OG)	C527-8	C577-5



A0040909

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

D9 CHECK THE DRIVER SEAT MODULE (DSM) FOR CORRECT OUTPUTS

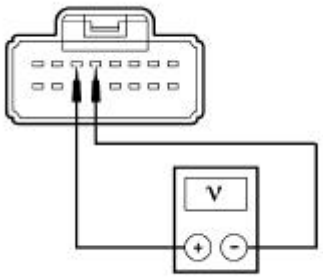
- Toggle the DSM active command DR_UP to ON and OFF.
- Toggle the DSM active command DR_DOWN to ON and OFF.
- Toggle the DSM active command DR_LEFT to ON and OFF.
- Toggle the DSM active command DR_RIGHT to ON and OFF.
- Toggle the DSM active command PR_UP to ON and OFF.
- Toggle the DSM active command PR_DOWN to ON and OFF.
- Toggle the DSM active command PR_LEFT to ON and OFF.
- Toggle the DSM active command PR_RIGHT to ON and OFF.
- **Does the left mirror operate in all directions?**

Yes
GO to D14 .

No
GO to D10 .

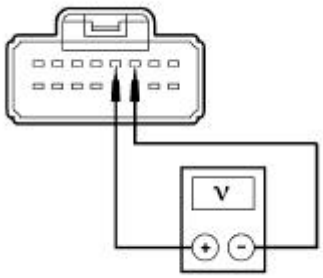
D10 CHECK THE LH EXTERIOR MIRROR FOR VOLTAGE FROM THE DSM

- Key in OFF position.
- Disconnect: LH Exterior Mirror C516.
- Key in ON position.
- Measure the voltage between LH exterior mirror C516-4, circuit 1487 (DB) and C516-3, circuit 1486 (YE/LB) harness side while toggling the DSM active commands DR_UP and DR_DOWN to ON and OFF.



A0040911

- Measure the voltage between LH exterior mirror C516-6, circuit 1485 (RD) and C516-5, circuit 1484 (YE/RD) harness side while toggling the DSM active commands DR_LEFT and DR_RIGHT to ON and OFF.



A0040912

- **Does the voltage swing from 0 volt to ± 12 volts when each active command is toggled on?**

Yes
INSTALL a new LH exterior mirror motor. REFER to Exterior Mirror Motor in this section. CLEAR the DTCs. REPEAT the self test.

No
GO to D11 .

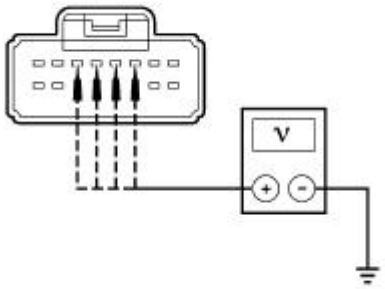
D11 CHECK CIRCUITS 1487 (DB), 1486 (YE/LB), 1485 (RD) AND 1484 (YE/RD) FOR A SHORT TO VOLTAGE

- Key in OFF position.
- Disconnect: DSM C341d.
- Key in ON position.
- Measure the voltage between the following LH exterior mirror C516 pins harness side and ground:

Connector	Circuit
C516-4	1487 (DB)
C516-3	1486 (YE/LB)
C516-6	1485 (RD)
C516-5	1484 (YE/RD)

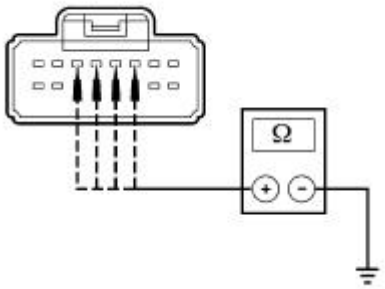
Yes
REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the self test.

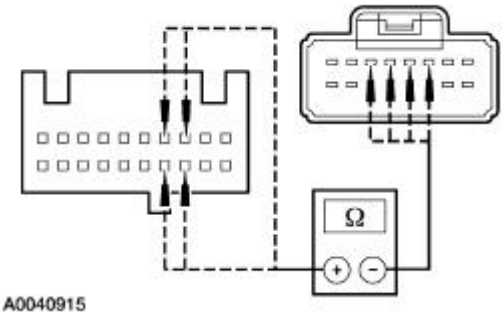
No
GO to D12 .



A0040913

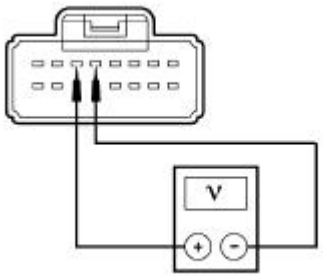
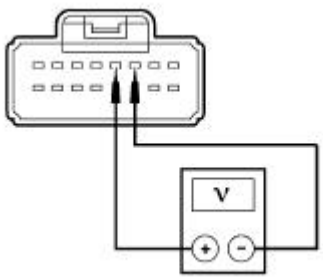
- **Is any voltage indicated?**

D12 CHECK THE EXTERIOR MIRROR CIRCUITS FOR SHORT TO VOLTAGE	
• Key in OFF position. • Measure the resistance between the following LH exterior mirror C516 pins harness side and ground: **Connector** / **Circuit** C516-4 — 1487 (DB) C516-3 — 1486 (YE/LB) C516-6 — 1485 (RD) C516-5 — 1484 (YE/RD)  A0040914 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to D13 . **No** REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the self test.
D13 CHECK CIRCUITS 1487 (DB), 1486 (YE/LB), 1485 (RD) AND 1484 (YE/RD) FOR AN OPEN	
• Measure the resistance between the following DSM C341d pins and LH exterior mirror C516 harness side pins: **DSM** / **Circuit** / **LH Exterior Mirror** C341d-4 — 1487 (DB) — C516-4 C341d-3 — 1486 (YE/LB) — C516-3 C341d-14 — 1485 (RD) — C516-6 C341d-13 — 1484 (YE/RD) — C516-5	**Yes** GO to D18 . **No** REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the self test.

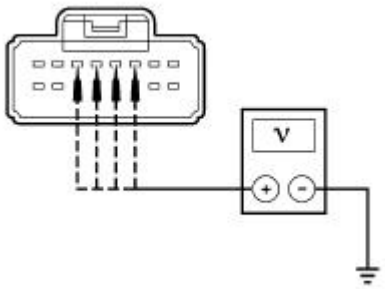


A0040915

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

D14 CHECK THE RH EXTERIOR MIRROR FOR VOLTAGE FROM THE DSM	
• Key in OFF position. • Disconnect: RH Exterior Mirror C622. • Key in ON position. • Measure the voltage between the RH exterior mirror C622-3, circuit 1482 (PK) and C622-4 circuit 1483 (WH/PK) harness side while toggling the DSM active commands PR_UP and PR_DOWN to ON and OFF.  A0040911 • Measure the voltage between the RH exterior mirror C622-5, circuit 1480 (WH/LG) and C622-6 circuit 1481 (DG) harness side while toggling the DSM active commands PR_LEFT and PR_RIGHT to ON and OFF.  A0040912 • **Does the voltage swing from 0 volt to ± 12 volts when each active command is toggled ON?**	**Yes** INSTALL a new RH exterior mirror motor. REFER to Exterior Mirror Motor in this section. CLEAR the DTCs. REPEAT the self test. **No** GO to D15.
D15 CHECK CIRCUITS 1482 (PK), 1483 (WH/PK), 1480 (WH/LG) AND 1481 (DG) FOR A SHORT TO VOLTAGE	
• Key in OFF position. • Disconnect: DSM C341d. • Key in ON position. • Measure the voltage between the following RH exterior mirror C622 harness side pins and ground: **Connector** | **Circuit**	**Yes** REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the self test. **No**

C622-3	1482 (PK)
C622-4	1483 (WH/PK)
C622-5	1480 (WH/LG)
C622-6	1481 (DG)



A0040913

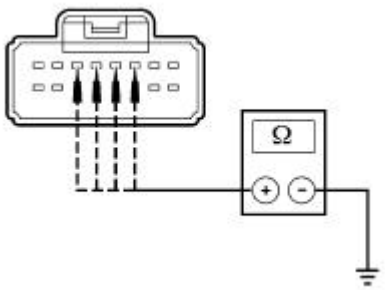
- **Is any voltage indicated?**

GO to D16 .

D16 CHECK CIRCUITS 1482 (PK), 1483 (WH/PK), 1480 (WH/LG) AND 1481 (DG) FOR A SHORT TO GROUND

- Key in OFF position.
- Measure the resistance between the following RH exterior mirror C622 pins harness side and ground:

Connector	Circuit
C622-3	1482 (PK)
C622-4	1483 (WH/PK)
C622-5	1480 (WH/LG)
C622-6	1481(DG)



A0040914

- **Are the resistances greater than 10,000 ohms?**

Yes
GO to D17 .

No
REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the self test.

D17 CHECK CIRCUITS 1482 (PK), 1483 (WH/PK), 1480 (WH/LG) AND 1481 (DG) FOR AN OPEN

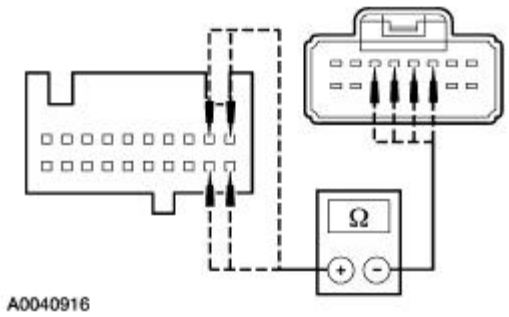
- Measure the resistance between the following DSM C341d pins and RH exterior mirror C622 harness side pins:

DSM	Circuit	RH Exterior Mirror
C341d-1	1482 (PK)	C622-3
C341d-2	1483 (WH/PK)	C622-4
C341d-12	1480 (WH/LG)	C622-5

Yes
GO to D18 .

No
REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the self test.

C341d-11	1481 (DG)	C622-6

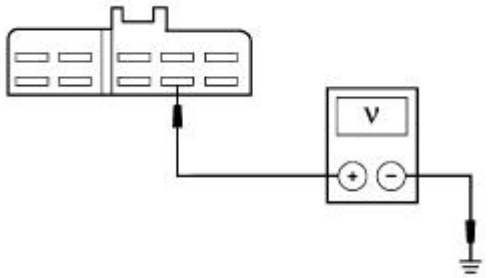


- **Are the resistances less than 5 ohms?**

D18 CHECK THE DSM FOR CORRECT OPERATION	
• Disconnect all DSM connectors. • Check for: • corrosion • pushed-out pins • Connect all DSM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new DSM. REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self test.

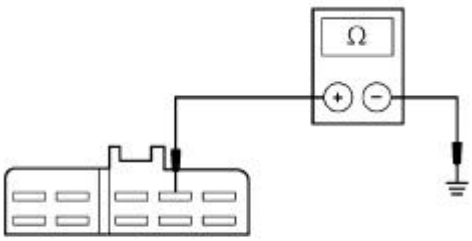
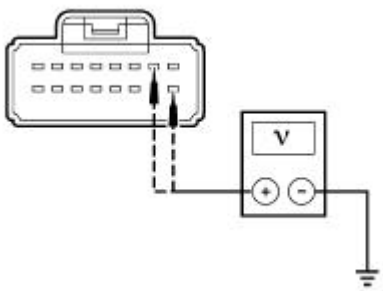
PINPOINT TEST E: THE POWER FOLDING MIRRORS DO NOT OPERATE

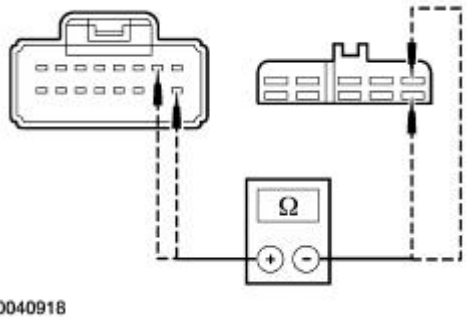
Test Step	Result / Action to Take
E1 CHECK THE OPERATION OF THE EXTERIOR MIRRORS	
• Activate the LH exterior mirror to the UP position. • **Does the LH exterior mirror operate correctly?**	**Yes** GO to E4 . **No** GO to E2 .
E2 CHECK CIRCUIT 956 (OG/LG) FOR VOLTAGE	
• Disconnect: Exterior Mirror Control Switch C577. • Measure the voltage between the exterior mirror control switch C577-7, circuit 956 (OG/LG), harness side and ground.	**Yes** GO to E3 . **No** REPAIR the circuit. TEST the system for normal operation.



A0015484

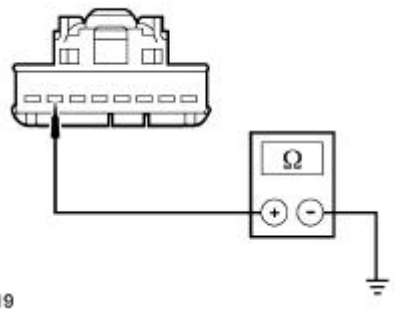
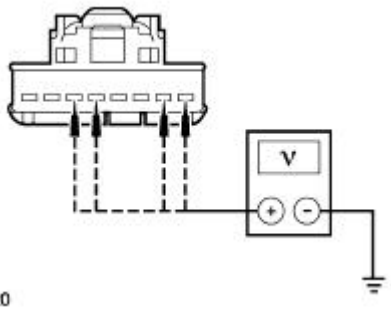
- **Is the voltage greater than 10 volts?**

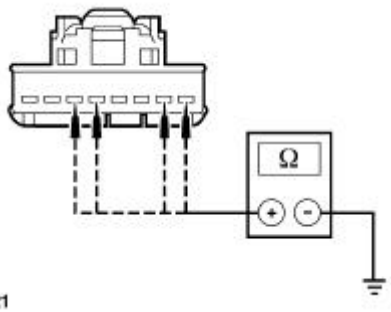
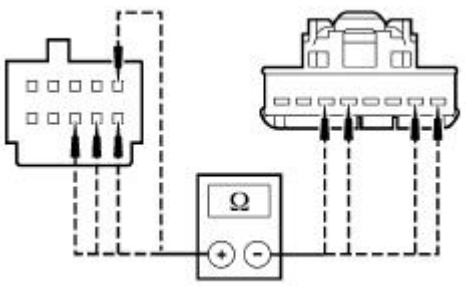
E3 CHECK CIRCUIT 875 (BK/LB) FOR AN OPEN	
• Measure the resistance between the exterior mirror control switch C577-2, circuit 875 (BK/LB), harness side and ground.  A0015485 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new exterior mirror control switch. REFER to Exterior Mirror Control Switch in this section. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
E4 CHECK THE POWER FOLD EXTERIOR MIRROR FOR VOLTAGE	
• Disconnect: Inoperative Exterior Mirror Connector C516/C622. • Measure the voltage between the suspect power folding exterior mirror C516-16 (LH)/C622-16 (RH), circuit 1038 (PK/YE), harness side and ground while activating the exterior mirror control switch to the IN position; and between pin 7, circuit 1037 (PK/LG), harness side and ground while activating the exterior mirror control switch to the OUT position.  A0040917 • **Are the voltages greater than 10 volts?**	**Yes** INSTALL a new power folding mirror. REFER to Exterior Mirror in this section. TEST the system for normal operation. **No** GO to E5 .
E5 CHECK THE POWER FOLD EXTERIOR MIRROR FOR GROUND	
• Measure the resistance between the exterior mirror control switch C577-1 circuit 1037 (PK/LG), harness side and the suspect power folding mirror C516-7 (LH)/C622-7 (RH), circuit 1037 (PK/LG), harness side; and between exterior mirror control switch C577-6 circuit 1038 (PK/YE), harness side and the suspect power folding mirror C516-16 (LH)/C622-16 (RH), circuit 1038 (PK/YE), harness side.	**Yes** INSTALL a new exterior mirror control switch. REFER to Exterior Mirror Control Switch in this section. TEST the

 A0040918 ● **Are the resistances less than 5 ohms?**	system for normal operation. **No** REPAIR the circuit in question. TEST the system for normal operation.

PINPOINT TEST F: THE MEMORY MIRROR IS INOPERATIVE — DOES NOT OPERATE FROM THE MEMORY SET SWITCH

Test Step	Result / Action to Take
F1 CHECK OPERATION OF THE REMOTE TRANSMITTER ONE	
● Adjust the driver seat to a new position and store for Memory 1. ● Adjust the driver seat to a different position. ● Press the UNLOCK button on the remote transmitter one. ● **Does the driver seat move to memory seat position one?**	**Yes** GO to F2 . **No** GO to Section 501-14 to diagnose the driver seat memory recall inoperative from the Remote Transmitter.
F2 RETRIEVE THE DTCs FROM DRIVER SEAT MODULE (DSM)	
● Use the recorded DSM DTCs from the continuous and on-demand self tests. ● **Are any DTCs retrieved or does the memory set LED fail to illuminate?**	**Yes** If DTCs B1667, B1668, B1669 and B1670 are all retrieved, GO to F9 . If DTCs B2312, B2314, B2316, B2318, B2320, B2322, B2324, or B2326, GO to F9 GO to F9 . If DTC B1529, GO to F7 . If DTC B1534, GO to F7 . If DTC B1538, GO to F7 . If DTC B1667, GO to F10 . If DTC B1668, GO to F10 . If DTC B1669, GO to F13 . If DTC B1670, GO to F13 . **No** GO to F3 .
F3 CHECK THE DSM FOR CORRECT MEMORY SET SWITCH INPUTS	

• Monitor the DSM PIDs MEM1_SW, MEM2_SW and MEM_SW while depressing each memory recall switch and the memory set switch. • **Do the PID values agree with the switch positions?**	**Yes** GO to F9 . **No** GO to F4 .
F4 CHECK THE MEMORY SET SWITCH • Key in OFF position. • Disconnect: Memory Set Switch C503. • Check the memory set switch. Refer to Wiring Diagrams Cell 149 for schematic and connector information. • **Is the memory set switch OK?**	**Yes** GO to F5 . **No** INSTALL a new memory set switch. CLEAR the DTCs. REPEAT the self test.
F5 CHECK CIRCUIT 875 (BK/LB) FOR AN OPEN • Measure the resistance between memory set switch C503-7, circuit 875 (BK/LB) harness side and ground.  A0040919 • **Is the resistance less than 5 ohms?**	**Yes** GO to F6 . **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self test.
F6 CHECK CIRCUITS 267 (BR/LG), 268 (BK/OG), 270 (BR/OG) AND 272 (WH/OG) FOR A SHORT TO VOLTAGE • Disconnect: DSM C341c. • Key in ON position. • Measure the voltage between the following memory set switch C503 pins harness side and ground: **Connector** / **Circuit** C503-2 — 267 (BR/LG) C503-6 — 268 (BK/OG) C503-5 — 270 (BR/OG) C503-1 — 272 (WH/OG)  A0040920 • **Is any voltage indicated?**	**Yes** REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test. **No** GO to F7 .

F7 CHECK CIRCUITS 267 (BR/LG), 268 (BK/OG), 270 (BR/OG) AND 272 (WH/OG) FOR A SHORT TO GROUND	
• Key in OFF position. • Measure the resistance between the following memory set switch C503 pins harness side and ground: **Connector** / **Circuit** C503-2 — 267 (BR/LG) C503-6 — 268 (BK/OG) C503-5 — 270 (BR/OG) C503-1 — 272 (WH/OG)  A0040921 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to F8 . **No** REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the self test.
F8 CHECK CIRCUITS 267 (BR/LG), 268 (BK/OG), 270 (BR/OG) AND 272 (WH/OG) FOR AN OPEN	
• Measure the resistance between the following DSM C341c pins and memory set switch C503 harness side pins: **DSM** / **Circuit** / **Memory Set Switch** C341c-4 — 267 (BR/LG) — C503-2 C341c-3 — 268 (BK/OG) — C503-6 C341c-5 — 270 (BR/OG) — C503-5 C341c-10 — 272 (WH/OG) — C503-1  A0040922 • **Are the resistances less than 5 ohms?**	**Yes** GO to F16 . **No** REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the self test.
F9 CHECK THE DSM FOR CORRECT OUTPUTS	
• Select PARK. • Monitor the DSM PIDs DMIR_R, DMIR_UP, PMIR_R and	**Yes** GO to F16 .

PMIR_UP during active commands.
- Toggle the DSM active command DR_UP to ON and OFF.
- Toggle the DSM active command DR_DOWN to ON and OFF.
- Toggle the DSM active command DR_LEFT to ON and OFF.
- Toggle the DSM active command DR_RIGHT to ON and OFF.
- Toggle the DSM active command PR_UP to ON and OFF.
- Toggle the DSM active command PR_DOWN to ON and OFF.
- Toggle the DSM active command PR_LEFT to ON and OFF.
- Toggle the DSM active command PR_RIGHT to ON and OFF.
- **Do the PIDs (position % of travel) values agree with the exterior rear view mirrors actual movement?**

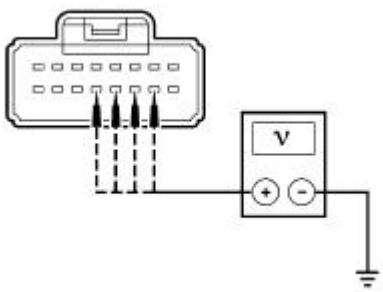
No
If the LH exterior mirror is not operating correctly,GO to F10 .

If the RH exterior mirror is not operating correctly,GO to F13 .

F10 CHECK CIRCUITS 951 (DB/WH), 958 (GY/RD), 949 (RD/WH) AND 955 (GY) FOR A SHORT TO VOLTAGE

- Key in OFF position.
- Disconnect: DSM C341d.
- Disconnect: LH Exterior Mirror C516.
- Key in ON position.
- Measure the voltage between the following LH exterior mirror C516 pins harness side and ground:

Connector	Circuit
C516-14	951 (DB/WH)
C516-12	958 (GY/RD)
C516-13	949 (RD/WH)
C516-15	955 (GY)



A0040923

- **Is any voltage indicated?**

Yes
REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the self test.

No
GO to F11 .

F11 CHECK CIRCUITS 951 (DB/WH), 958 (GY/RD), 949 (RD/WH) AND 955 (GY) FOR A SHORT TO GROUND

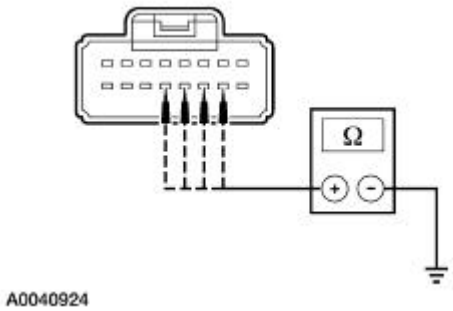
- Key in OFF position.
- Measure the resistance between the following LH exterior mirror C516 pins harness side and ground:

Connector	Circuit
C516-14	951 (DB/WH)

Yes
GO to F12 .

No
REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the self test.

C516-12	958 (GY/RD)
C516-13	949 (RD/WH)
C516-15	955 (GY)



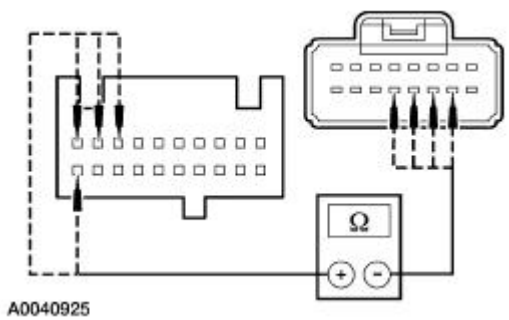
A0040924

- **Are the resistances greater than 10,000 ohms?**

F12 CHECK CIRCUITS 951 (DB/WH), 958 (GY/RD), 949 (RD/WH) AND 955 (GY) FOR AN OPEN

- Measure the resistance between the following DSM C341d pins and LH exterior mirror C516 harness side pins:

DSM	Circuit	LH Exterior Mirror
C341d-9	951 (DB/WH)	C516-14
C341d-20	958 (GY/RD)	C516-12
C341d-8	949 (RD/WH)	C516-13
C341d-10	955 (GY)	C516-15



A0040925

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

Yes
INSTALL a new LH exterior mirror motor. REFER to Exterior Mirror Motor in this section. CLEAR the DTCs. REPEAT the self test.

No
REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the self test.

F13 CHECK CIRCUITS 955 (GY), 957 (PK/WH), 958 (GY/RD) AND 954 (DG/WH) FOR A SHORT TO VOLTAGE

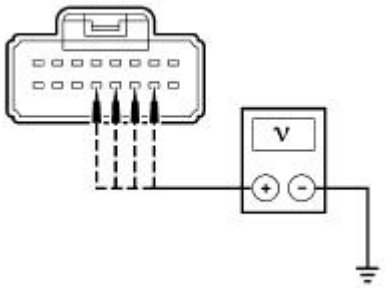
- Key in OFF position.
- Disconnect: DSM C341d.
- Disconnect: RH Exterior Mirror C622.
- Key in ON position.
- Measure the voltage between the following RH exterior mirror C622 pins harness side and ground:

Connector	Circuit
C622-15	955 (GY)

Yes
REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the self test.

No
GO to F14 .

C622-14	957 (PK/WH)
C622-12	958 (GY/RD)
C622-13	954 (DG/WH)



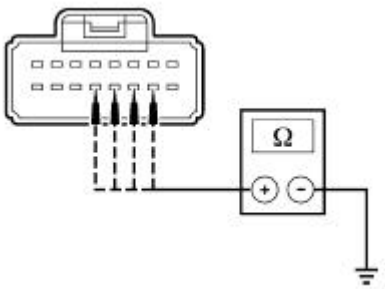
A0040923

- **Is any voltage indicated?**

F14 CHECK CIRCUITS 955 (GY), 957 (PK/WH), 958 (GY/RD) AND 954 (DG/WH) FOR A SHORT TO GROUND

- Key in OFF position.
- Measure the resistance between the following RH exterior mirror C622 pins harness side and ground:

Connector	Circuit
C622-15	955 (GY)
C622-14	957 (PK/WH)
C622-12	958 (GY/RD)
C622-13	954 (DG/WH)



A0040924

- **Are the resistances greater than 10,000 ohms?**

Yes
GO to F15 .

No
REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the self test.

F15 CHECK CIRCUITS 955 (GY), 957 (PK/WH), 958 (GY/RD) AND 954 (DG/WH) FOR AN OPEN

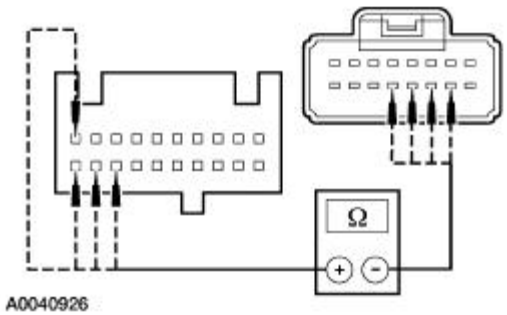
- Measure the resistance between the following DSM C341d pins and RH exterior mirror C622 harness side pins:

DSM	Circuit	RH Exterior Mirror
C341d-10	955 (GY)	C622-15
C341d-19	957 (PK/WH)	C622-14
C341d-20	958 (GY/RD)	C622-12

Yes
INSTALL a new RH exterior rear view mirror motor. REFER to Exterior Mirror Motor in this section. CLEAR the DTCs. REPEAT the self test.

No
REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the self test.

C341d-18	954 (DG/WH)	C622-13

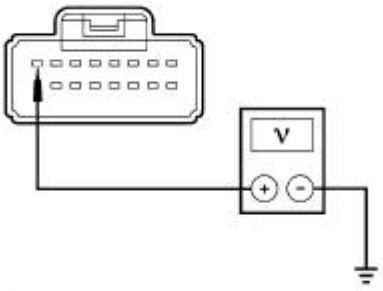
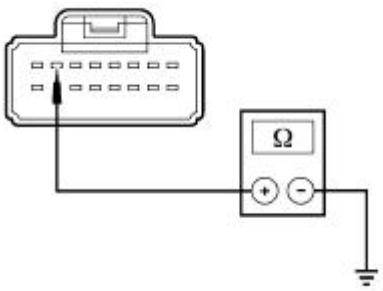


- **Are the resistances less than 5 ohms?**

F16 CHECK THE DSM FOR CORRECT OPERATION	
• Disconnect all DSM connectors. • Check for: • corrosion • pushed-out pins • Connect all DSM connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new DSM. REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self test.

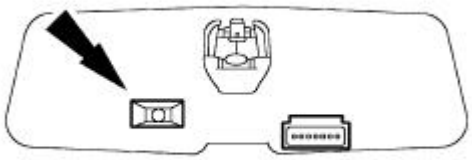
PINPOINT TEST G: THE MEMORY MIRROR IS INOPERATIVE — THE HEATED EXTERIOR MIRRORS DO NOT DEFROST

Test Step	Result / Action to Take
G1 CHECK THE HEATED REAR WINDOW OPERATION	
• Select PARK. • Key in ON position. • Depress the heated rear window switch to ON. • **Does the heated rear window defrost or warm up?**	**Yes** GO to G2 . **No** REFER to Section 501-11 to diagnose the heated rear window system.
G2 CHECK THE EXTERIOR MIRROR FOR POWER	
• Disconnect: Inoperative Exterior Mirror C516/C622. • Depress the heated rear window switch to ON. • Measure the voltage between the inoperative exterior mirror C516-1 (LH)/C622-1 (RH), circuit 59 (DG/PK) harness side and ground.	**Yes** GO to G3 . **No** REPAIR the circuit. TEST the system for normal operation.

 A0040927 ● **Is the voltage greater than 10 volts?**	
G3 CHECK THE EXTERIOR REAR VIEW MIRROR GROUND CIRCUIT FOR AN OPEN	
● Measure the resistance between the inoperative exterior mirror C516-2 (LH)/C622-2 (RH), circuit 57 (BK) harness side and ground.  A0040928 ● **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new exterior mirror glass. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.

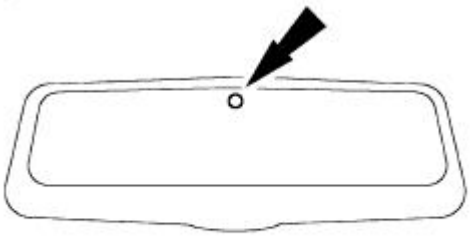
PINPOINT TEST H: THE AUTO DIMMING MIRROR DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
NOTE: If the transmission range (TR) sensor is malfunctioning and the backup lamps are on all the time or do not turn on, the auto dimming interior mirror will not darken or return to normal view.	
H1 CHECK OPERATION OF THE BACKUP LAMPS	
● Key in ON position. ● Move the shift control selector through the entire range. ● **Do the backup lamps illuminate only in REVERSE?**	**Yes** GO to H2 . **No** REFER to Section 417-01 .
H2 CHECK OPERATION OF THE INTERIOR REAR VIEW MIRROR	
● Select PARK. ● Cover the back sensor with dark tape.	**Yes** The interior mirror is OK. REVIEW the auto dimming interior mirror operation with the customer. **No** GO to H3 .



GN1964-A

- Use a flashlight to shine light into the sensor on the front of the auto dimming interior mirror.

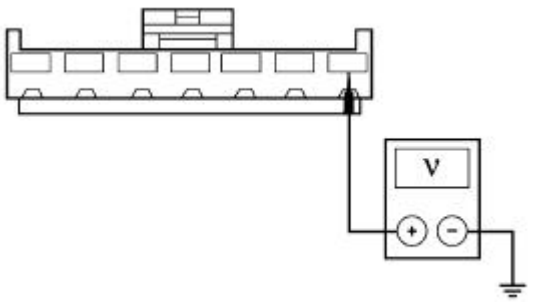


GN1965-A

- Select REVERSE.
- **Does the interior mirror glass darken with the vehicle in PARK (P) and then return to normal view with the vehicle in REVERSE (R)?**

H3 CHECK CIRCUIT 294 (WH/LB) FOR VOLTAGE

- Disconnect: Interior Mirror C911.
- Measure the voltage between interior mirror C911-1 circuit 294 (WH/LB) harness side and ground.



GN1966-A

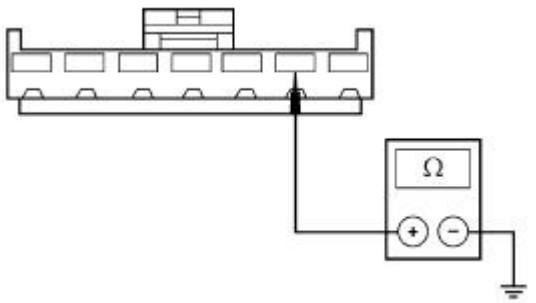
- **Is the voltage greater than 10 volts?**

Yes
GO to H4 .

No
REPAIR the circuit. TEST the system for normal operation.

H4 CHECK CIRCUIT 57 (BK) FOR AN OPEN

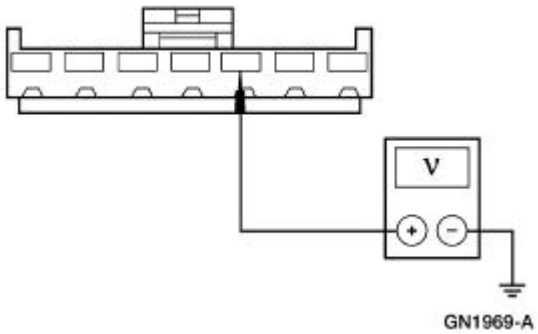
- Key in OFF position.
- Measure the resistance between interior mirror C911-6, circuit 57 (BK) harness side and ground.



GN1968-A

Yes
GO to H5 .

No
REPAIR the circuit. TEST the system for normal operation.

• **Is the resistance less than 5 ohms?**	
H5 CHECK CIRCUIT 1789 (PK/WH) FOR VOLTAGE	
• Key in ON position. • Select REVERSE. • Measure the voltage between interior mirror C911-3 circuit 1789 (PK/WH) harness side and ground.  • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new interior mirror. REFER to Auto-dimming Interior Mirror in this section. REPAIR the circuit. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.

PINPOINT TEST I: THE REVERSE DRIVE REAR VIEW MIRRORS ARE INOPERATIVE

Test Step	Result / Action to Take
I1 CHECK THE EXTERIOR REAR VIEW MIRROR OPERATION	
• Operate both exterior mirrors using the exterior rear view mirror control switch. • **Do the exterior rear view mirrors move through all positions?**	**Yes** GO to I2 . **No** REFER to the Symptom Chart to diagnose the inoperative exterior rear view mirror function.
I2 CHECK FOR REVERSE MIRRORS FEATURE ENABLED	
• Key in ON position. • Select the REVERSE MIRRORS feature from the message center. • **Is the REVERSE MIRRORS feature ON?**	**Yes** GO to I3 . **No** ENABLE the REVERSE MIRRORS feature. TEST the system for normal operation. INSTRUCT the customer on the systems correct operation.
I3 CHECK REVERSE DRIVE MIRRORS OPERATION	
• Key in ON position. • Set the vehicle parking brake. • Move the transmission range selector lever to REVERSE, wait 15 seconds, then return the selector lever to PARK. • **Do the exterior rear view mirrors move downward when the transmission selector lever is in REVERSE, and return to their original position when the selector lever is placed in PARK?**	**Yes** The system is operating correctly. INSTRUCT the customer on operation. **No** GO to I4 .
I4 CHECK FOR DTC FROM THE DRIVER SEAT MODULE (DSM)	

• Refer to the recorded results from the DSM self-test. • **Are any DSM DTCs recorded?**	**Yes** If DTCs B1667 and B2324 are retrieved, Go To Pinpoint Test F . If DTCs B1667 and B2326 are retrieved, Go To Pinpoint Test F . If DTCs B1669 and B2316 are retrieved, Go To Pinpoint Test F . If DTCs B1669 and B2318 are retrieved, Go To Pinpoint Test F . If DTC U1950 is retrieved, REFER to the DSM Diagnostic Trouble Code (DTC) Index. **No** GO to I5 .
I5 CHECK FOR DSM OPERATION	
• Key in OFF position. • Disconnect all DSM connectors. • Check for: ■ corrosion. ■ pushed-out pins. • Connect all DSM connectors and make sure they are seated correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new DSM. REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector.

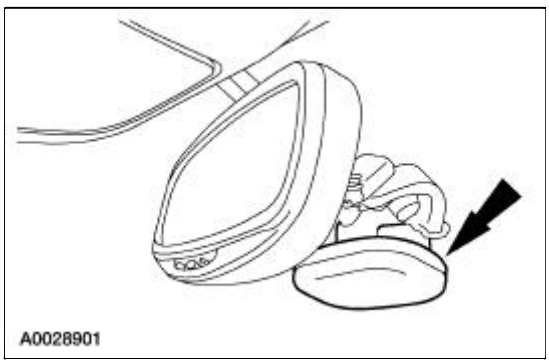
Interior Rear View Mirror

Special Tool(s)

 ST1793-A	Installer, Rear View Mirror 501-025 (T94P-17700-AH)

Removal

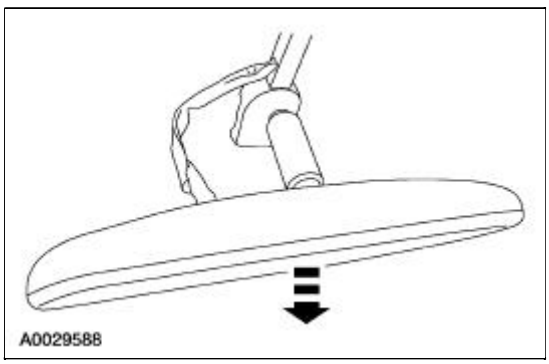
1. If equipped, position the electronic compass sensor aside.


A0028901

2. **CAUTION: Do not use tools or other objects to pry the mount or interior mirror away from the windshield. Use of tools can damage the interior mirror/mount.**

   Remove the interior mirror.

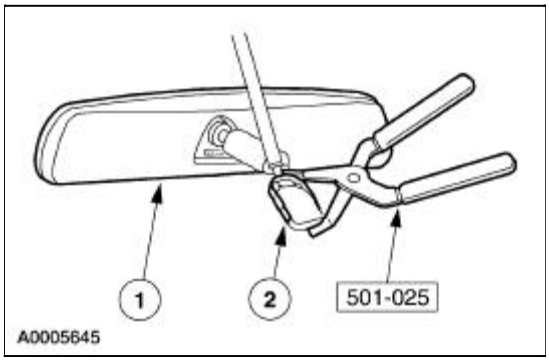
   - Position the interior mirror in the full down position. Grasp the interior mirror and rotate, in a downward and toward the windshield direction, until it is released from the interior mirror windshield bracket.


A0029588

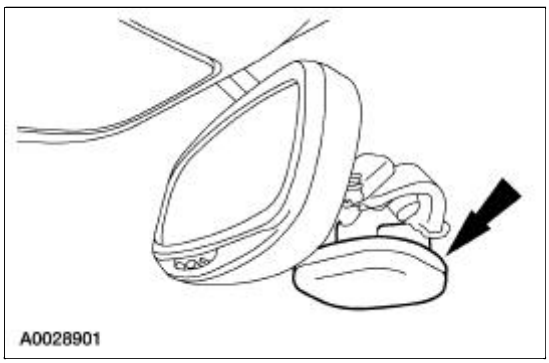
Installation

1. Install the interior mirror.
   1. Position the interior mirror on the windshield bracket.

2. Using the special tool, press the interior mirror in place until fully seated.



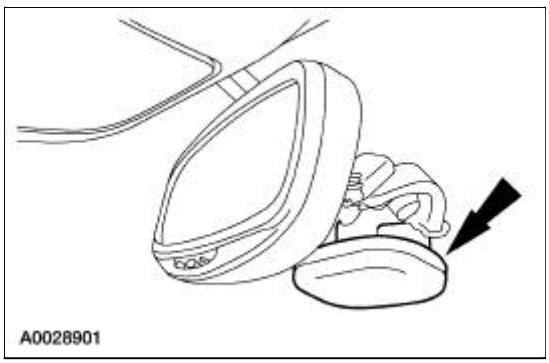
2. If equipped, install the electronic compass sensor.



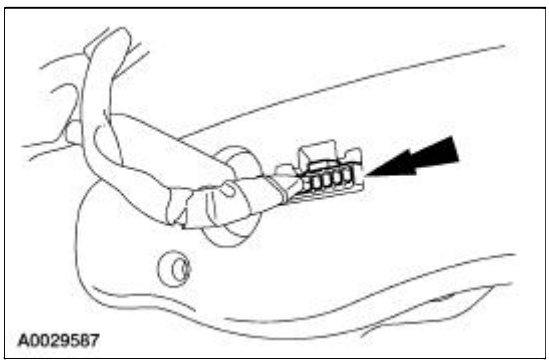
Auto-dimming Interior Mirror

Removal

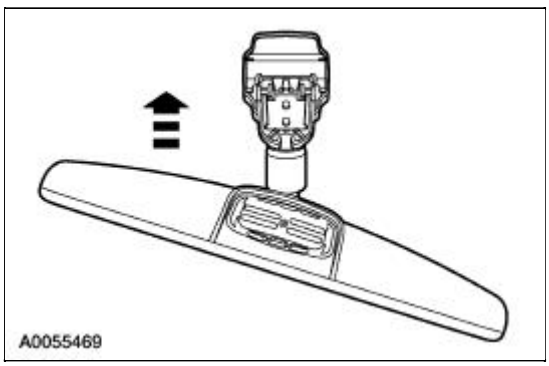
1. If equipped, position the electronic compass sensor aside.



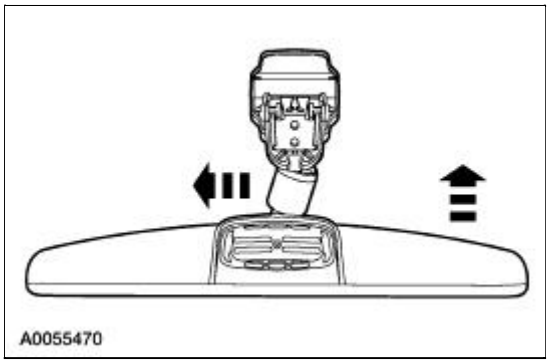
2. Disconnect the auto-dimming interior mirror electrical connector.



3. Position the auto-dimming interior mirror outboard (towards the driver door) to its full extension.

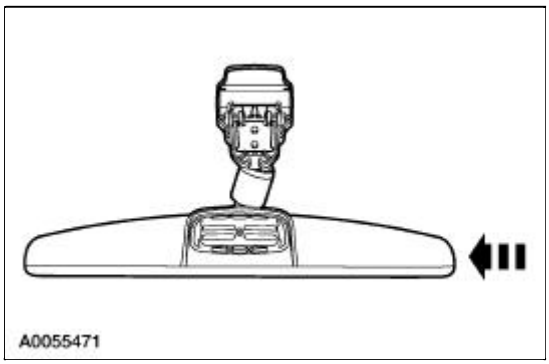


4. Rotate the auto-dimming interior mirror back until it is parallel with the windshield. The auto-dimming interior mirror mount is now locked between the two adjustment balls and joints.



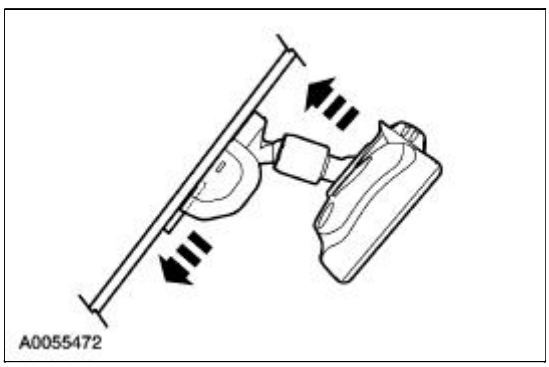
5. **NOTE:** It takes approximately ten pounds of force to remove the auto-dimming interior mirror from the windshield bracket.

   Hold the auto-dimming interior mirror firmly in one hand and strike the auto-dimming interior mirror with the palm of an open hand.

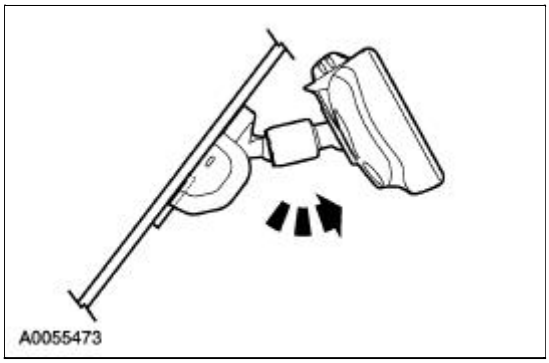


Installation

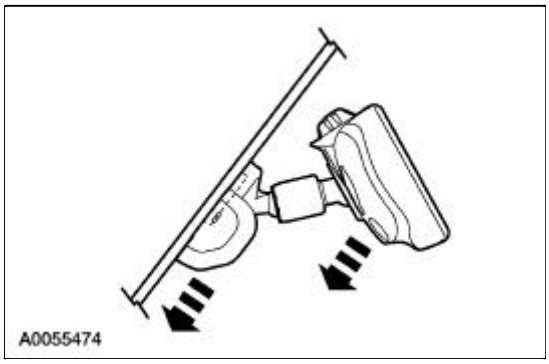
1. Seat the auto-dimming interior mirror base partially on the mounting button.



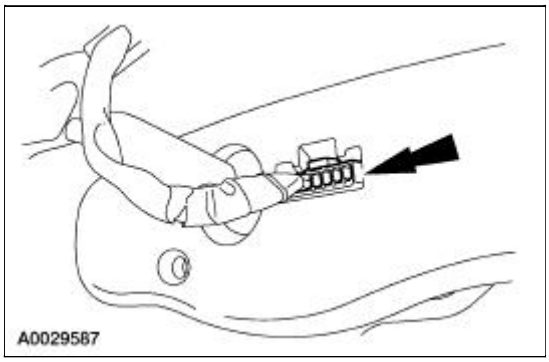
2. Rotate the auto-dimming interior mirror fully up.



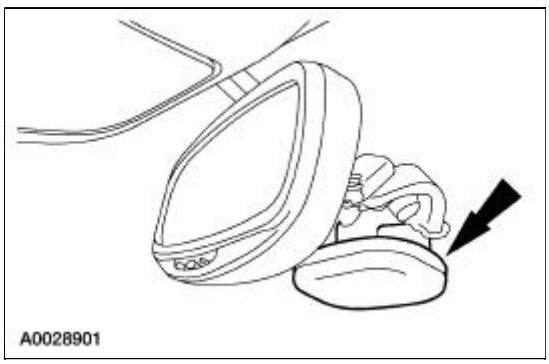
3. Slide the auto-dimming interior mirror base down on the mounting button until an audible **click** is heard.



4. Connect the auto-dimming interior mirror electrical connector.



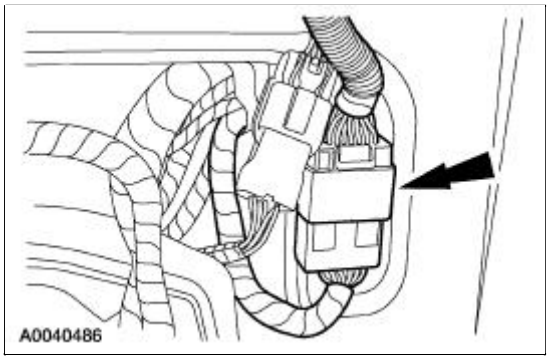
5. If equipped, install the electronic compass sensor.



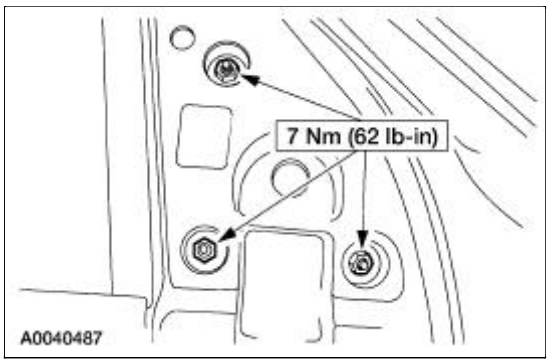
Exterior Mirror

Removal and Installation

1. Remove the front door trim panel. For additional information, refer to Section 501-05 .
2. Remove the weather shield.
3. Disconnect the exterior mirror electrical connector.



4. Remove the exterior mirror.
   - Remove the nuts.



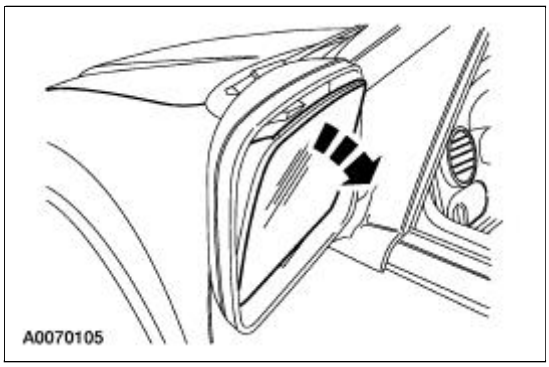
5. To install, reverse the removal procedure.
   - Install top nut first.

Exterior Mirror Motor

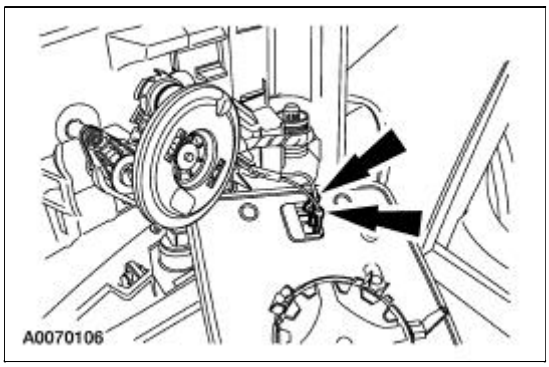
Removal and Installation

1. **WARNING: Place a shop towel between the exterior mirror glass and the hand to avoid personal injury in the instance of glass breakage.**

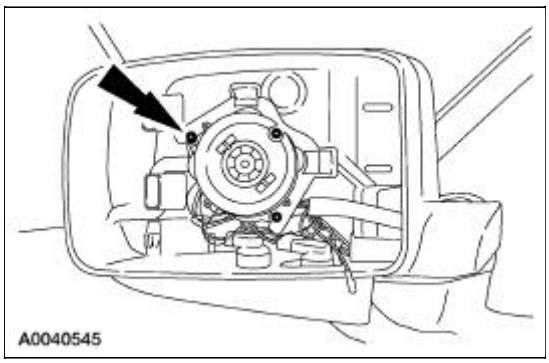
   Position the exterior mirror glass to obtain a gap at the top edge of the mirror and carefully pull the top edge of the glass away from the exterior mirror housing.



2. If equipped, disconnect the heated mirror electrical connectors.



3. Remove the exterior mirror motor screws and exterior mirror motor.
   - Disconnect the electrical connectors.

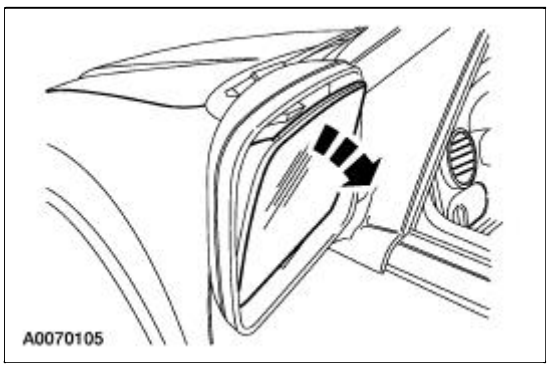


4. To install, reverse the removal procedure.

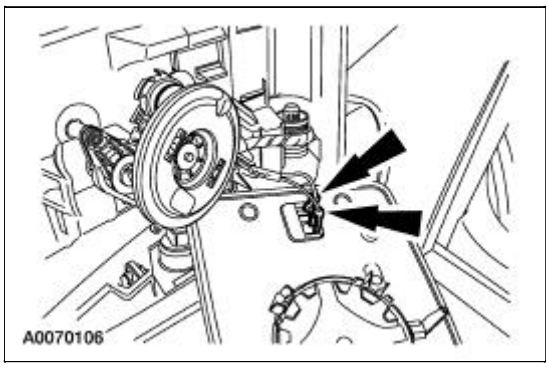
Exterior Mirror Glass

1. **WARNING: Place a shop towel between the exterior mirror glass and the hand to avoid personal injury in the instance of glass breakage.**

   Position the exterior mirror glass to obtain a gap at the edge of the mirror and carefully pull the top edge of the glass away from the exterior mirror housing.



2. If equipped, disconnect the heated mirror electrical connectors.

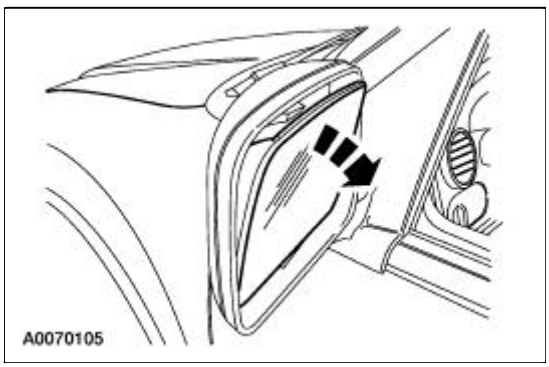


3. To install, reverse the removal procedure.
   - Rotate the exterior mirror glass in all directions after the installation to make sure all clips are completely attached.

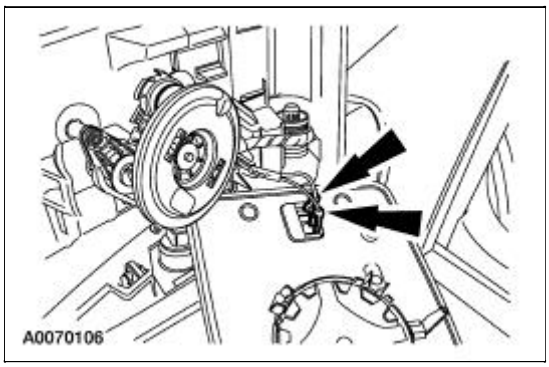
Exterior Mirror Cover

1. **WARNING: Place a shop towel between the exterior mirror glass and the hand to avoid personal injury in the instance of glass breakage.**

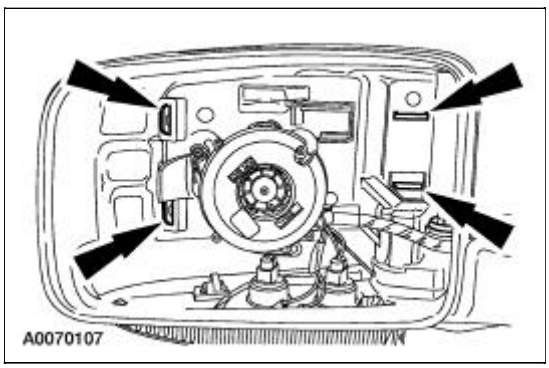
   Position the exterior mirror glass to obtain a gap at the top edge of the mirror and carefully pull the top edge of the glass away from the exterior mirror housing.



2. If equipped, disconnected the heated mirror electrical connectors.



3. Release the four retaining tabs and remove the exterior mirror cover.
   - The two outboard vertical tabs are released by moving them in the outboard direction. The two inboard horizonal tabs are released by moving them in the downward direction.



4. To install, reverse the removal procedure.
   - Rotate the exterior mirror glass in all directions after installation to make sure all clips are

completely attached.

Exterior Mirror Control Switch

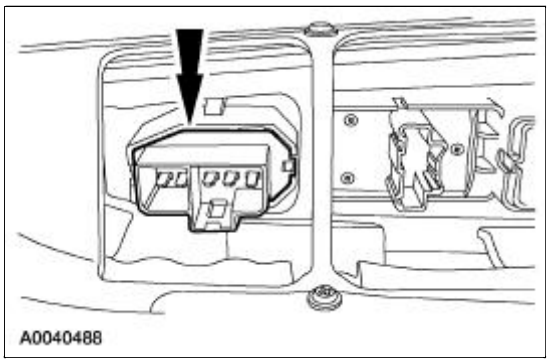
Removal and Installation

All vehicles

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

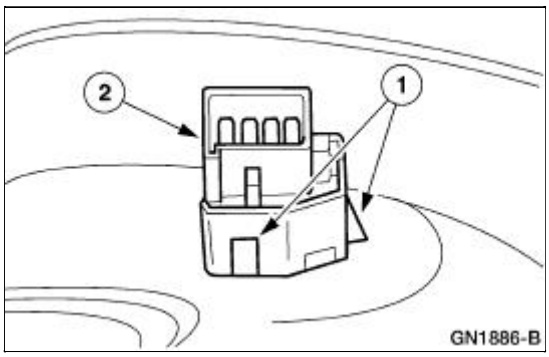
Navigator

2. Depress the locking tabs and remove the exterior mirror control switch.



Expedition

3. Remove the exterior mirror control switch.
    1. Depress the locking tabs.
    2. Remove the exterior mirror control switch.



All vehicles

4. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-ft	lb-in
Front seat adjuster and hinge bolts	50	37	—
Front seat armrest shield screws	3	—	27
Front seat back adjust handle screw	3	—	27
Front seat back pad adjuster screws	3	—	27
Front seat center armrest bolts	50	37	—
Front seat center armrest latch bolts	50	37	—
Front seat center armrest mounting bracket bolts	50	37	—
Front seat manual seat track release bar bolts	7	—	62
Front seat riser support to floorpan bolts and nut	55	41	—
Front seat riser support to seat track bolts	43	32	—
Front seat track bolts (manual)	24	18	—
Front seat track bolts (power)	35	26	—
Front seat track shield screws	3	—	27
Front seat safety belt buckle pretensioner nut	40	30	—
Seat regulator control switch screws	3	—	27
Second row 40 percent seat E-Z entry seat adjuster and hinge bolts	40	30	—
Second row 40 percent seat E-Z entry seat safety belt bolt	40	30	—
Second row 40 percent seat E-Z entry seat back pivot bracket bolt	40	30	—
Second row 40 percent seat E-Z entry seat front bolts	40	30	—
Second row 40 percent seat E-Z entry seat back bolts	40	30	—
Second row 40 percent seat back bolts	40	30	—
Second row 40 percent seat trim cover screws	3	—	27
Second row 20 percent seat to floor bolts	40	30	—
Second row 20 percent seat trim cover screws	3		27
Second row 20 percent seat belt anchor bolt	40	30	—
Second row 20 percent seat inner swivel nuts	15	11	—
Second row 20 percent seat pivot bolt	40	30	—
Second row 20 percent seat backrest bolts	40	30	—
Second row 20 percent seat belt retractor cover screws	3	—	27
Second row 20 percent seat safety belt retractor bolt	40	30	—
Second row 20 percent seat riser to cushion bolts	30	22	—
Third row seat front seat riser to floor bolts	30	22	—
Third row seat rear floor bolts	40	30	—
Third row seat power fold pivot bolt	30	22	—
Third row 60 percent seat belt anchor bolt	40	30	—

Third row seat trim screws	3	—	27
Third row 60 percent seat backrest bolt	35	26	—
Third row 60 percent seat backrest bolts	55	41	—
Third row 40 percent seat belt buckle bolt	40	30	—
Third row 40 percent seat backrest nuts	15	11	—
Third row 60 percent seat backrest bolts	55	41	—
Third row cushion nuts	15	11	—
Third row seat riser to cushion bolts	30	22	—
Third row seat backrest to slide bolts	15	11	—
Third row tether anchor bolt	28	21	—

Seats

Driver Seat Module

The power driver seat, power outside rear view mirrors and power adjustable pedals are controlled by the driver seat module (DSM) only when the vehicle is equipped with the programmable/recall memory option.

The DSM system consists of the following components:

- Driver seat module (DSM).
- Driver memory seat switch.
- Memory mirror switch.
- Memory set switch.
- Adjustable pedal switch.
- Front vertical seat motor.
- Rear vertical seat motor.
- Horizontal seat motor.
- Power recliner seat motor (Navigator only).
- LH heated memory mirror.
- RH heated memory mirror.
- Power adjustable memory pedals.
- Remote entry key fob.

The DSM incorporates multiple functions into one module and offers diagnostics to easily locate and repair concerns affecting the subsystems that it controls.

For additional information on the DSM, refer to Section 419-10 .

Memory Power Driver Seat Operation

The memory driver seat feature allows the driver to program a personalized seat position that can be recalled using the memory switches or remote entry key fob. There are two memory settings possible. The outside rear view mirror positions and the power adjustable pedals are also stored and recalled with the power driver seat positions.

Programming Seat Positions

- A power driver seat position can be stored at any time. The driver must move the seat to the desired position using the driver seat switch assembly. The driver must then depress the memory SET switch which activates the memory SET switch light emitting diode (LED). Within

five seconds (before the LED goes out), the driver must select a memory position. Memory 1 is selected by depressing memory switch 1. Memory 2 is selected by depressing memory switch 2.

- If no memory switch input is received within the five-second time limit, the operation is aborted and the memory SET switch LED is turned off. If one of the following inputs is received during the five-second programming limit, the operation is aborted and the memory SET switch LED is turned off:
  - Power driver seat switch.
  - Power outside rear view mirror switch.
  - Memory SET switch.
  - Power adjustable pedal switch.

Recalling a Stored Seat Position

NOTE: A memory recall can be initiated only if the vehicle is in PARK or NEUTRAL gear and the ignition switch is not in START. A memory recall in progress will not be affected by moving the ignition switch to START or by moving the gearshift lever out of PARK or NEUTRAL.

Once the driver has stored the driver seat position, the driver can recall the setting by depressing the corresponding memory switch or by using a programmed remote entry transmitter.

- The driver can recall the desired driver seat position by depressing one of the memory recall switches. Depressing memory switch 1 will initiate a recall of the power driver seat position stored in memory 1. Depressing memory switch 2 will initiate a recall of the power driver seat position stored in memory 2.
- A remote transmitter can be used to recall previously set memory positions. The transmitter that has been assigned with personality 1 is capable of recalling memory position 1 only. Similarly, the personality 2 transmitter can recall only memory position 2.
- Memory recall occurs when the UNLOCK switch is depressed on the transmitter. The second depression of the UNLOCK switch, which unlocks passenger doors, does not initiate a memory recall.
- A memory recall in progress does not prohibit the initiation of another memory recall; the most recently requested memory recall will be executed.

40 Percent Chairs

The Expedition 40 percent chairs:

- are divided by a center console.
- have a standard manual lumbar adjuster on the driver seat.
- have 6-way power adjusters (standard on driver seat, optional on passenger seat).
- have optional climate controlled seating.
- have an optional memory driver seat.

The Navigator 40 percent chairs:

- are a bucket design.

- are divided by a center console.
- have standard power lumbar.
- have a standard 8-way power adjuster.
- have a standard driver memory seat.
- have optional climate controlled seating.
    - With climate controlled seating, there is an air filter located in the fan motor housing under the seat. See the owner literature for additional service and scheduled maintenance interval information.

60/40 Split Bench

The 60/40 split bench seats:

- have a front seat center armrest that divides the front seat backs.
- are available with a manual passenger seat only.
- may have an optional storage bin center armrest with cupholder.

Seats — Second Row

Two different types of second row seat configurations are available:

40/20/40

The second row can have 40/20/40 seats:

- is equipped with a 40 percent E-Z entry seat that provides easy access to the third row.
- folds down for more cargo area.

40/Center Console/40

The second row can have 40/center console/40 seats:

- is equipped with a 40 percent E-Z entry seat that provides easy access to the third row.
- the 40 percent seat will fold down for more cargo area.
- the center console has storage bin and beverage holder.

Seats — Third Row

The third row seat:

- is three-passenger seat.
- a 60/40 bench seat.
- folds down for more cargo area.
- has optional power fold down seats.

Third Row Power-Fold Seat

CAUTION: To prevent possible damage to the third row seat or the safety belts, make sure that the safety belts are not fastened when moving the seat to the load floor position.

CAUTION: Make sure that no objects such as books, purses or briefcases are on the floor in front of the third row seats or on the seat cushion before lowering the backrest(s).

The third row power-fold seat consists of the following electrical components:

- right third row seat relay.
- left third row seat relay.
- right power-fold seat motor.
- left power-fold seat motor.
- right front third row seat switch.
- left front third row seat switch.
- right rear third row seat switch.
- left rear third row seat switch.

For the third row power-fold seat to operate, a shared ground is supplied by the body security module (BSM) to both of the power-fold seat relays, enabling the seats to then be moved by pressing one of the third row power-fold seat switches. The third row power-fold seat operates only when the vehicle is in PARK and the ignition switch is ON (or the battery saver yet tripped), and the liftgate glass or liftgate door must be open.

The third row power-fold seat motors transfer movement to a drive gear assembly to raise and lower the seat backrest. The power-fold seat motors rotate a short drive cable which is connected to the drive gear assembly.

Seats

Refer to Wiring Diagrams Cell 119 for schematic and connector information.

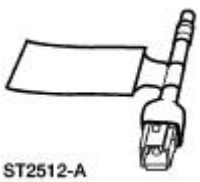
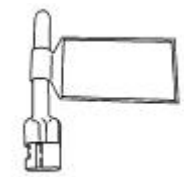
Refer to Wiring Diagrams Cell 120 , Power Seats for schematic and connector information.

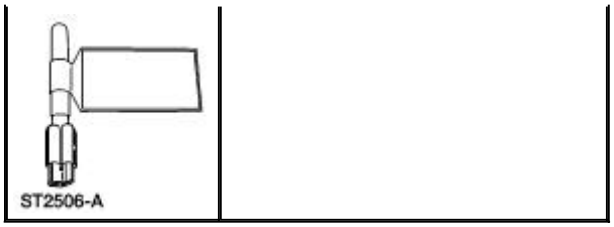
Refer to Wiring Diagrams Cell 122 for schematic and connector information.

Refer to Wiring Diagrams Cell 123 , Memory Seats for schematic and connector information.

Refer to Wiring Diagrams Cell 149 for schematic and connector information.

Special Tool(s)

 ST2516-A	78 Automotive Meter 105-R0054 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-FS317 New Generation STAR (Scan Tool) Tester 418-F052, or equivalent scan tool
 ST2512-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F403
 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395 (014-R1079)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (014-R1076)
	Diagnostic Tool, Restraint System (2 Req'd) 418-F088 (105-00012)



Principles of Operation

Climate Controlled Seat System

Both the driver and front passenger seats have an independent climate controlled seat system installed. A climate controlled seat module mounted to the bottom of the seat cushion electronically controls the climate controlled seat system. The climate controlled seat system receives power from both the battery power and vehicle run circuits. The vehicle must be running and the climate controlled seat switch fan speed selector thumb wheel switch in position 1, 2, 3, 4 or 5 for the climate controlled seat system to activate.

Cabin air is drawn through the a fan motor and distributed to each of the thermo-electric device (TED) modules located in the seat cushion and backrest. The TEDs then heat or cool the air. The air is then directed into the foam pad B-surface. Channels in the A-surface of the foam pad are used to distribute the air along the surface of the seat.

Once the system is activated, the climate controlled seat module uses a set of flexible algorithms to control the heating/cooling modes, and the fan motor speed based on the climate controlled seat switch settings. These algorithms are designed to protect the user from potentially harmful prolonged exposure to temperature extremes.

The TED uses a "Peltier" circuit of p-type and n-type semiconductors connected in series, using copper electrical conductors. The semiconductors are sandwiched between two insulating ceramic plates. When current is applied to the TED, one side releases energy as heat, while the opposite side absorbs energy and gets cold. By reversing the current flow, the hot and cold sides reverse.

Heating Characteristics

- The climate controlled seat system draws approximately 7.5 amps until reaching the set point, and then the system draws approximately 2 amps to maintain the temperature setting.
- In HEAT mode, the TED can add up to 40-60°C (72-108°F) to the ambient air temperature entering the system.
- There are two HEAT mode settings based on the position of the climate controlled seat switch thumb wheel. Position one is the low setting and position five is the high setting
- In the low setting, the climate controlled seat module is set to maintain seat surface temperature at 37°C (99°F).
- In the high setting, the climate controlled seat module is set to maintain seat surface temperature at 43-45°C (109-113°F).
- If the temperature at one of the TEDs rises above 70°C (158°F), the climate controlled seat module will the go into an over temperature mode and shut down the TEDs. The fan motor will continue to operate during over temperature mode.
- In HEAT mode, there is no linear correlation between the thumb wheel position, seat fan motor speed, and TED supply voltage. The climate controlled seat module will independently vary the fan speed TED supply voltage in order to reach and maintain the temperature determined by the thumb wheel.

Cooling Characteristics

- The climate controlled seat system draws approximately seven amps until reaching the set point, and then the system draws approximately two amps to maintain the temperature setting.
- In COOL mode, the TED can remove up to 8-10°C (14-18°F) from the ambient air temperature entering the system.
- There are five COOL mode settings based on the position of the climate controlled seat switch thumb wheel. Position one is the low setting and position five is the high setting.
- If the temperature at one of the TEDs falls below 18°C (64°F), the climate controlled seat module will shut down the TEDs. If the temperature continues to drop below 12°C (54°F), the climate controlled seat module will shut down the fan motor.
- In COOL mode, there is a linear correlation between the climate controlled seat switch thumbwheel position, seat fan motor speed, and TED supply voltage. For additional information, refer to the following chart.

Climate Controlled Seat Switch Thumbwheel Position	Seat Fan Motor Supply Voltage	Thermo- Electric Device Supply Voltage
0	Off	Off
1	7 volts	0 volts
2	5.4 volts	2.1 volts
3	5.4 volts	3.5 volts
4	5.5 volts	4.1 volts
5	5.5 volts	4.1 volts

The climate controlled seat system is deactivated by one of the following actions:

- Setting the climate controlled seat switch to off.
- Cooling seats time-out after 30 minutes.
- Heated seats time-out after 15 minutes.
- Turning the vehicle off.

Inspection and Verification

1. Verify the customer concern by operating the power seat, memory seat or climate controlled seat functions.
2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Seat track • Climate controlled seat ducts	• Fuse(s) • Circuitry • Driver seat module (DSM) • Lumbar control switch

	• Memory set switch • Power seat motor • Seat control switch • Seat fan motor • Climate controlled seat module • Climate controlled seat switch

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

4. If the concern is with the power seat (non-memory seat) or the power lumbar and the cause is not visually evident, verify the symptom and GO to Symptom Chart .

5. If the concern is with the memory seat or climate controlled seat and the cause is not visually evident, connect the scan tool to the data link connector (DLC) and select the vehicle to be tested from the scan tool menu. If the scan tool does not communicate with the vehicle:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

6. If the scan tool still does not communicate with the vehicle, refer to the scan tool manual.

7. Carry out the DATA LINK DIAGNOSTICS test. If the scan tool responds with:
   - CKT914, CKT915, or CKT70=ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESPONSE/NOT EQUIPPED for driver DSM, refer to Section 419-01 .
   - NO RESPONSE/NOT EQUIPPED for climate controlled seat module, Section 419-01 .
   - SYSTEM PASSED for the DSM, retrieve and record the continuous diagnostic trouble codes (DTCs), clear the continuous DTCs and carry out self-test diagnostics for the DSM.
   - SYSTEM PASSED for the climate controlled seat module, retrieve and record the continuous diagnostic trouble codes (DTCs), clear the continuous DTCs and carry out self-test diagnostics for the climate controlled seat module.

8. If the DTCs retrieved are related to the concern, go to DSM Diagnostic Trouble Code (DTC) Index or the climate controlled Seat Module Diagnostic Trouble Code (DTC) Index.

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

DSM Diagnostic Trouble Code (DTC) Index

DSM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1342	ECU Is Faulted	DSM	INSTALL a new DSM. REFER to Section 419-10 .
B1530	Memory Set Switch Circuit Short to Ground	DSM	Go To Pinpoint Test J .
B1534	Memory 1 Switch Circuit Short to Ground	DSM	Go To Pinpoint Test J .
B1538	Memory 2 Switch Circuit Short to	DSM	Go To Pinpoint Test J .

	Ground		
B1663	Seat Driver Front Up/Down Motor Stalled	DSM	If the motor does not operate, Go To Pinpoint Test H (Navigator) or Go To Pinpoint Test I (Expedition). If motor operates, Go To Pinpoint Test J .
B1664	Seat Driver Rear Up/Down Motor Stalled	DSM	If the motor does not operate, Go To Pinpoint Test H (Navigator) or Go To Pinpoint Test I (Expedition). If motor operates, Go To Pinpoint Test J .
B1665	Seat Driver Forward/Backward Motor Stalled	DSM	If the motor does not operate, Go To Pinpoint Test H (Navigator) or Go To Pinpoint Test I (Expedition). If motor operates, Go To Pinpoint Test J .
B1666	Seat Recline Forward/Rearward Motor Stalled	DSM	If the motor does not operate, Go To Pinpoint Test H (Navigator). If motor operates, Go To Pinpoint Test J .
B1667	Mirror Driver Up/Down Motor Stalled	DSM	REFER to Section 501-09 .
B1668	Mirror Driver Right/Left Motor Stalled	DSM	REFER to Section 501-09 .
B1669	Mirror Passenger Up/Down Motor Stalled	DSM	REFER to Section 501-09 .
B1670	Mirror Passenger Right/Left Motor Stalled	DSM	REFER to Section 501-09 .
B1676	Battery Voltage Out of Range	DSM	REFER to Section 414-00 .
B1703	Seat Driver Recline Forward Switch Circuit Short to Battery	DSM	Go To Pinpoint Test H (Navigator).
B1707	Seat Driver Recline Rearward Switch Circuit Short to Battery	DSM	Go To Pinpoint Test H (Navigator).
B1711	Seat Driver Front Up Switch Circuit Short to Battery	DSM	Go To Pinpoint Test H (Navigator) or Go To Pinpoint Test I (Expedition).
B1715	Seat Driver Front Down Switch Circuit Short to Battery	DSM	Go To Pinpoint Test H (Navigator) or Go To Pinpoint Test I (Expedition).
B1719	Seat Driver Forward Switch Circuit Short to Battery	DSM	Go To Pinpoint Test H (Navigator) or Go To Pinpoint Test I (Expedition).
B1723	Seat Driver Rearward Switch Circuit Short to Battery	DSM	Go To Pinpoint Test H (Navigator) or Go To Pinpoint Test I (Expedition).
B1727	Seat Driver Rear Up Switch Circuit Short to Battery	DSM	Go To Pinpoint Test H (Navigator) or Go To Pinpoint Test I (Expedition).
B1731	Seat Driver Rear Down Switch Circuit Short to Battery	DSM	Go To Pinpoint Test H (Navigator) or Go To Pinpoint Test I (Expedition).
B1735	Mirror Driver Vertical Switch Circuit Short to Battery	DSM	REFER to Section 501-09 .
B1739	Mirror Driver Horizontal Switch Circuit Short to Battery	DSM	REFER to Section 501-09 .
B1743	Mirror Passenger Vertical Switch Circuit Short to Battery	DSM	REFER to Section 501-09 .
B1747	Mirror Passenger Horizontal Switch Circuit Short to Battery	DSM	REFER to Section 501-09 .
B1950	Seat Rear Up/Down Feedback Potentiometer Circuit Failure	DSM	Go To Pinpoint Test J .

B1952	Seat Rear Up/Down Feedback Potentiometer Circuit Short to Battery	DSM	Go To Pinpoint Test J .
B1954	Seat Front Up/Down Feedback Potentiometer Circuit Failure	DSM	Go To Pinpoint Test J .
B1956	Seat Front Up/Down Feedback Potentiometer Circuit Short to Battery	DSM	Go To Pinpoint Test J .
B1958	Seat Recline Fwd/Backward Feedback Potentiometer Circuit Failure	DSM	Go To Pinpoint Test J .
B1961	Seat Recline Fwd/Backward Feedback Potentiometer Circuit Short to Ground	DSM	Go To Pinpoint Test J .
B1962	Seat Horizontal Forward/Rearward Feedback Potentiometer Circuit Failure	DSM	Go To Pinpoint Test J .
B1964	Seat Horizontal Forward/Rearward Feedback Potentiometer Circuit Short to Battery	DSM	Go To Pinpoint Test J .
B1987	Pedal Forward / Rearward Motor Stalled	DSM	REFER to Section 206-00 .
B1988	Pedal Position Forward Switch Circuit Short to Battery	DSM	REFER to Section 206-00 .
B1989	Pedal Position Rearward Switch Circuit Short to Battery	DSM	REFER to Section 206-00 .
B1990	Pedal Forward/Rearward Feedback Potentiometer Circuit Failure	DSM	REFER to Section 206-00 .
B1991	Pedal Forward/Rearward Feedback Potentiometer Circuit Short to Battery	DSM	REFER to Section 206-00 .
B2312	Mirror Passenger Horizontal Feedback Potentiometer Circuit Failure	DSM	REFER to Section 501-09 .
B2314	Mirror Passenger Horizontal Feedback Potentiometer Short to Battery	DSM	REFER to Section 501-09 .
B2316	Mirror Passenger Vertical Feedback Potentiometer Circuit Failure	DSM	REFER to Section 501-09 .
B2318	Mirror Passenger Vertical Feedback Potentiometer Short to Battery	DSM	REFER to Section 501-09 .
B2320	Mirror Driver Horizontal Feedback Potentiometer Circuit Failure	DSM	REFER to Section 501-09 .
B2322	Mirror Driver Horizontal Feedback Potentiometer Short to Battery	DSM	REFER to Section 501-09 .
B2324	Mirror Driver Vertical Feedback Potentiometer Circuit Failure	DSM	REFER to Section 501-09 .
B2326	Mirror Driver Vertical Feedback Potentiometer Short to Battery	DSM	REFER to Section 501-09 .
B2477	Module Configuration Failure	DSM	INSTALL a new DSM.

Climate Controlled Seat Module (CCSM) Diagnostic Trouble Code (DTC) Index

Climate Controlled Seat Module (CCSM) Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1342	ECU Is Faulted	CCSM	INSTALL a new CCSM. REFER to Climate Controlled Seat Module .
B1358	Ignition Switch or Blower Electronics Circuit Short to Ground	CCSM	Go To Pinpoint Test P .
B2477	Module Configuration Error	CCSM	RECONFIGURE the CCSM. CLEAR the DTC. If the DTC resets, INSTALL a new CCSM.
B2486	Climate Controlled Seat Module Voltage Out of Range	CCSM	CHECK circuit 294 (WH/LB) for a fault and REPAIR as needed. If okay, REFER to Section 414-00 .
B2488	Thumb-Wheel Switch Voltage Out of Range High	CCSM	Go To Pinpoint Test P .
B2521	Tach Circuit Failure	CCSM	Go To Pinpoint Test P .
B2729	Cushion Over-Temp Detected	CCSM	Go To Pinpoint Test P .
B2730	Back Over-Temp Detected	CCSM	Go To Pinpoint Test P .
B2731	Differential Temperature Fault	CCSM	Go To Pinpoint Test P .
B2792	Heat Switch Short to Ground	CCSM	Go To Pinpoint Test P .
B2793	Cool Switch Short to Ground	CCSM	Go To Pinpoint Test P .
U2362	UBP Invalid Data Node ID	CCSM	REFER to Section 418-00 .

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• The power seat is inoperative — Expedition	• PDJB Fuse 109 (30A) (driver). • PDJB Fuse 108 (30A) (passenger). • Seat control switch (14A701). • Circuitry.	• Go To Pinpoint Test A .
• The power seat is inoperative — Navigator — Passenger	• PDJB Fuse 108 (30A) (passenger). • Seat control switch (14A701). • Circuitry.	• Go To Pinpoint Test B .

• The power seat moves but is noisy	• Seat tracks. • Fwd/Rwd drive cables. • Power seat motors.	• Go To Pinpoint Test C.
• The power seat moves but is loose	• Fastening hardware. • Seat tracks. • Power seat motors.	• Go To Pinpoint Test D.
• The power seat does not make full travel	• Track obstruction. • Seat tracks. • Fwd/Rwd drive cables. • Power seat motors.	• Go To Pinpoint Test E.
• The power seat does not move horizontally/vertically — Expedition	• Seat tracks. • Circuitry. • Seat control switch. • Power seat motors. • Fwd/Rwd drive cables.	• Go To Pinpoint Test F.
• The power seat does not move horizontally/vertically/recline — Navigator — Passenger	• Seat tracks. • Circuitry. • Seat control switch. • Power seat motors. • Fwd/Rwd drive cables.	• Go To Pinpoint Test G
• The memory seat is inoperative	• Circuitry. • Seat control switch. • Seat track. • DSM. • PDJB Fuse 109 (30A). • Power seat motor.	• Go To Pinpoint Test H (Navigator) or Go To Pinpoint Test I (Expedition).
• The memory seat does not operate correctly — does not operate using the memory set switch	• Memory set switch. • DSM. • Circuitry.	• Go To Pinpoint Test J.
• The memory seat does not operate correctly — does not operate using the remote transmitter	• Circuitry. • DSM. • Keyless entry transmitter. • RAP module.	• REFER to the DTC Index.
• No communication with the module — DSM	• Circuitry. • DSM. • Fuse(s).	• REFER to Section 419-01.
• No communication with the module — unable to carry out on-demand self-test with the DSM	• DSM. • Circuitry. • Fuse(s).	• REFER to Section 419-01.

• The power lumbar is inoperative	• Circuitry. • Lumbar control switch. • Power lumbar assembly. • Power lumbar motor.	• Go To Pinpoint Test K (driver) or Go To Pinpoint Test L (passenger).
• The third row power fold seat is inoperative/does not operate correctly — Both	• Fuse(s). • Circuitry. • Body Security Module (BSM).	• Go To Pinpoint Test M .
• The third row power fold seat is inoperative/does not operate correctly — Left	• Fuse(s). • Circuitry. • Seat control switch(es). • Power seat motor. • Power seat relay. • Power seat motor drive cable.	• Go To Pinpoint Test N .
• The third row power fold seat is inoperative/does not operate correctly — Right	• Fuse(s). • Circuitry. • Seat control switch(es). • Power seat motor. • Power seat relay. • Power seat motor drive cable.	• Go To Pinpoint Test O .
• All climate controlled seats are inoperative	• CJB Fuse F1.118 (30A). • Circuitry.	• CHECK driver CCSM C3031b-4 (or passenger CCSM C3036b-4), circuit 1153 (RD/BK) for battery voltage, REPAIR as needed. If okay, REPAIR ground to driver CCSM C3016b-3 (or passenger CCSM C3036b-3 and C3036a-9), circuit 57 (BK).
• A single climate controlled seat is inoperative/does not operate correctly	• Circuitry. • Climate controlled seat ducts. • Climate controlled seat switch. • Seat fan	• Go To Pinpoint Test P .

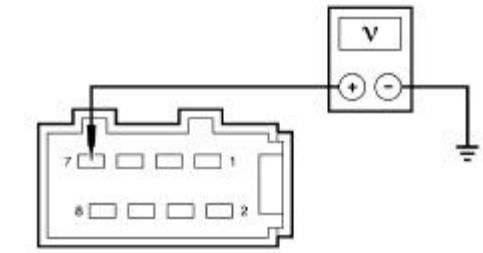
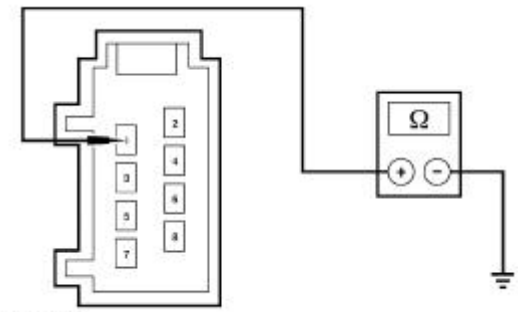
	motor. ● Seat cushion TED. ● Seat backrest TED. ● CCSM.	
● No communication with the driver CCSM	● Circuitry. ● CCSM.	● CHECK driver CCSM C3031b-2 (or passenger CCSM C3036b-2), circuit 294 (WH/LB) for ignition voltage and C3031b-3 (or C3036b-3 and passenger CCSM C3031a-9), circuit 57 (BK) for ground, REPAIR as needed. If okay, REFER to Section 418-00 .

Pinpoint Tests

CAUTION: Electronic modules are sensitive to electrostatic discharge. If exposed to these charges, damage may result.

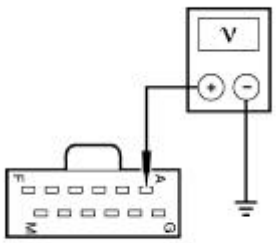
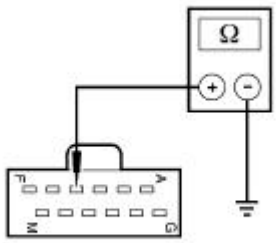
PINPOINT TEST A: THE POWER SEAT IS INOPERATIVE — EXPEDITION

Test Step	Result / Action to Take
A1 CHECK THE VOLTAGE TO THE SEAT SWITCH — CIRCUIT 566 (DG) OR (PASSENGER 1462 [RD/WH])	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards. NOTE: If a seat equipped with a seat-mounted side air bag and/or a safety belt pretensioner (if equipped) system is being serviced, **the air bag system must be deactivated.** Refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in the General Procedures portion of this section. **NOTE:** Restraint system diagnostic tools **MUST** be installed under the seats in the seat side air bag (if equipped) and safety belt pretensioner (if equipped) to floor connectors. **NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. ● Key in OFF position. ● Deactivate the supplemental restraint system (SRS). Refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. ● Disconnect: Seat Control Switch C352 (C355 Passenger). ● Measure the voltage between driver seat control switch C352-7,	**Yes** GO to A2 . **No** REPAIR driver circuit 566 (DG) (or passenger circuit 1462 [RD/WH]). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

circuit 566 (DG) (or passenger seat control switch C355-7, circuit 1462 [RD/WH]), harness side and ground.  A0033450 • **Is the voltage greater than 10 volts?**	
A2 CHECK CIRCUIT 57 (BK) FOR OPEN	
• Measure the resistance between driver seat control switch C352-1, circuit 57 (BK) (or passenger seat control switch C355-1, circuit 57 [BK]), harness side and ground.  A0017417 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new seat control switch. REFER to Seat Control Switch—6-Way in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** REPAIR circuit 57 (BK). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

PINPOINT TEST B: THE POWER SEAT IS INOPERATIVE — NAVIGATOR — PASSENGER

Test Step	Result / Action to Take
B1 CHECK THE VOLTAGE TO THE SEAT SWITCH	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to	**Yes** GO to B2.

road use. Failure to remove could result in injury and possible violation of vehicle safety standards. NOTE: If a seat equipped with a seat-mounted side air bag and/or a safety belt pretensioner (if equipped) system is being serviced, **the air bag system must be deactivated.** Refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in the General Procedures portion of this section. **NOTE:** Restraint system diagnostic tools **MUST** be installed under the seats in the seat side air bag (if equipped) and safety belt pretensioner (if equipped) to floor connectors. **NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. ● Key in OFF position. ● Deactivate the supplemental restraint system (SRS). Refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. ● Disconnect: Seat Control Switch C3026. ● Measure the voltage between seat control switch C3026-A, circuit 1462 (RD/WH), harness side and ground.  A0049730 ● **Is the voltage greater than 10 volts?**	**No** REPAIR circuit 1462 (RD/WH). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
B2 CHECK GROUND CIRCUIT FOR OPEN ● Measure the resistance between seat control switch C3026-D, circuit 57 (BK), harness side and ground.  A0049731 ● **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new seat control switch. REFER to Seat Control Switch—8-Way in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** REPAIR circuit 57 (BK). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental

	Restraint System (SRS) Deactivation and Reactivation in this section.

PINPOINT TEST C: THE POWER SEAT MOVES BUT IS NOISY

Test Step	Result / Action to Take
C1 CHECK THE TRACK ALIGNMENT	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards. NOTE: If a seat equipped with a seat-mounted side air bag and/or a safety belt pretensioner (if equipped) system is being serviced, **the air bag system must be deactivated.** Refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in the General Procedures portion of this section. **NOTE:** Restraint system diagnostic tools **MUST** be installed under the seats in the seat side air bag (if equipped) and safety belt pretensioner (if equipped) to floor connectors. **NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. ● Key in OFF position. ● Deactivate the supplemental restraint system (SRS). Refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. ● Key in OFF position. ● Check the alignment of the track to the floor and the track to the seat. ● **Is the track out of alignment?**	**Yes** ALIGN the track to the seat and the floor. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** INSTALL a new seat track part. REFER to Seat Track—Power or Front Seat Track Motor in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

PINPOINT TEST D: THE POWER SEAT MOVES BUT IS LOOSE

Test Step	Result / Action to Take
D1 CHECK THE FASTENING HARDWARE	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards. NOTE: If a seat equipped with a seat-mounted side air bag and/or a safety belt pretensioner (if equipped) system is being serviced, **the air bag system must be deactivated.** Refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in the General Procedures portion of this section. **NOTE:** Restraint system diagnostic tools **MUST** be installed under the seats in the seat side air bag (if equipped) and safety belt pretensioner (if equipped) to floor connectors. **NOTE:** After diagnosing or	**Yes** TIGHTEN all fastening hardware to specifications. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** IDENTIFY the cause and

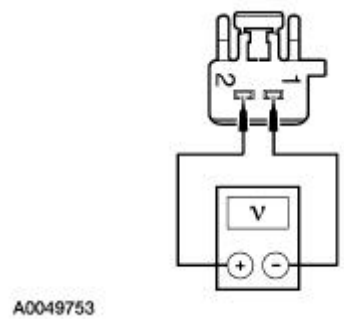
repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. ● Key in OFF position. ● Deactivate the supplemental restraint system (SRS). Refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. ● Key in OFF position. ● **Is the fastening hardware loose?**	INSTALL a new seat track component. REFER to Seat Track—Power or Front Seat Track Motor in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

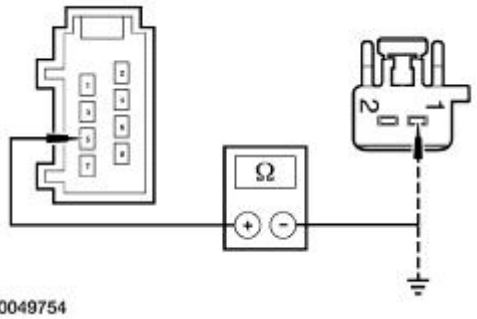
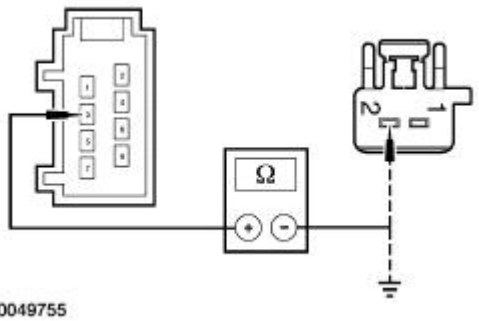
PINPOINT TEST E: THE POWER SEAT DOES NOT MAKE FULL TRAVEL

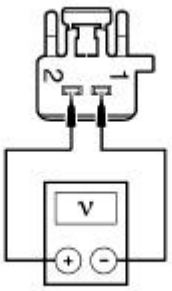
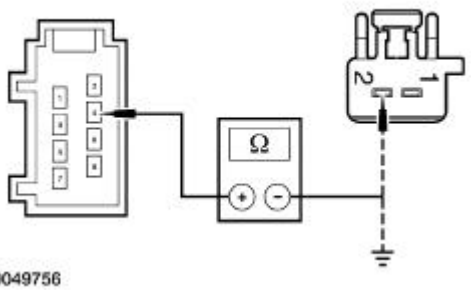
Test Step	Result / Action to Take
E1 CHECK FOR OBSTRUCTION IN THE SEAT TRACK	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards. NOTE: If a seat equipped with a seat-mounted side air bag and/or a safety belt pretensioner (if equipped) system is being serviced, **the air bag system must be deactivated.** Refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in the General Procedures portion of this section. **NOTE:** Restraint system diagnostic tools **MUST** be installed under the seats in the seat side air bag (if equipped) and safety belt pretensioner (if equipped) to floor connectors. **NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. ● Key in OFF position. ● Deactivate the supplemental restraint system (SRS). Refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. ● Key in OFF position. ● Remove the seat. For additional information, refer to Front Seat—40 Percent in this section. ● **Are there any obstructions in the track?**	**Yes** REMOVE the obstruction(s) and GREASE the track(s). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** IDENTIFY the cause and INSTALL a new seat track component. REFER to Seat Track—Power or Front Seat Track Motor in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

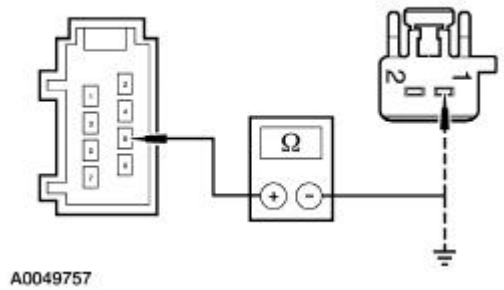
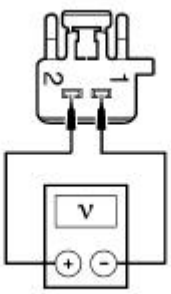
PINPOINT TEST F: THE POWER SEAT DOES NOT MOVE HORIZONTALLY/VERTICALLY — EXPEDITION

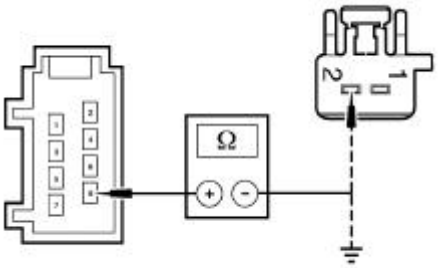
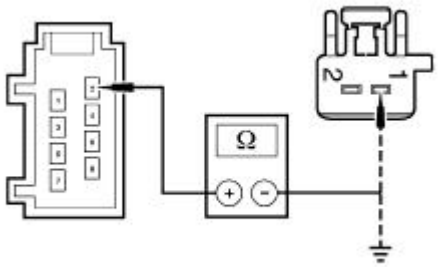
Test Step	Result / Action to Take
F1 DETERMINE WHICH POWER SEAT HAS FAILED	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to	**Yes** GO to F13.

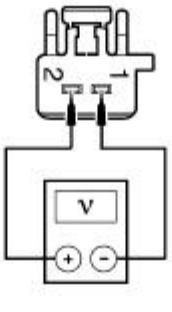
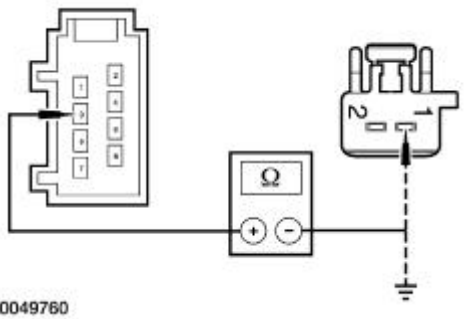
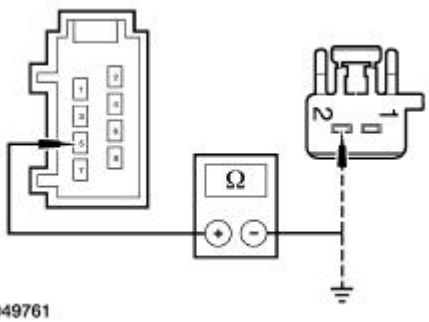
road use. Failure to remove could result in injury and possible violation of vehicle safety standards. NOTE: If a seat equipped with a seat-mounted side air bag and/or a safety belt pretensioner (if equipped) system is being serviced, **the air bag system must be deactivated.** Refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in the General Procedures portion of this section. **NOTE:** Restraint system diagnostic tools **MUST** be installed under the seats in the seat side air bag (if equipped) and safety belt pretensioner (if equipped) to floor connectors. **NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. ● Key in OFF position. ● Deactivate the supplemental restraint system (SRS). Refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. ● Key in OFF position. ● **Does the driver power seat operate correctly?**	**No** GO to F2 .
F2 DETERMINE WHICH DIRECTION HAS FAILED	
● Operate the power seat forward and rearward. ● **Will the track move horizontally?**	**Yes** GO to F6 . **No** GO to F3 .
F3 CHECK THE VOLTAGE TO FORWARD/REVERSE SEAT MOTOR	
● Disconnect: Power Seat Motor C362. ● Measure the voltage between power seat motor assembly C362-1, circuit 980 (YE/WH), harness side and C362-2, circuit 981 (RD/WH), harness side while pushing the forward/reverse switch forward and backward.  A0049753 ● **Is the voltage greater than -10 volts when the forward/reverse switch is pressed forward, greater than +10 volts with the forward reverse switch is pressed backward and 0 volts when the switch is in the rest position?**	**Yes** INSTALL a new forward/reverse power seat motor. REFER to Front Seat Track Motor in this section. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to F4 .
F4 CHECK CIRCUIT 980 (YE/WH) FOR AN OPEN AND A SHORT TO GROUND	
● Disconnect: Seat Control Switch C352. ● Measure the resistance between seat control switch C352-5, circuit 980 (YE/WH), harness side and power seat motor C362-1, circuit 980 (YE/WH), harness side; and between seat control switch C352-5, circuit 980 (YE/WH), harness side and ground.	**Yes** GO to F5 . **No** REPAIR circuit 980 (YE/WH). TEST the system for normal operation. REACTIVATE the supplemental

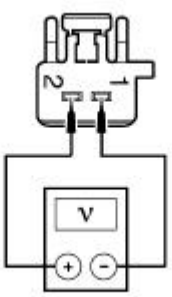
 A0049754 ● **Is the resistance less than 5 ohms between the power seat motor and the seat control switch, and greater than 10,000 ohms between the seat control switch and ground?**	restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
F5 CHECK CIRCUIT 981 (RD/WH) FOR AN OPEN AND A SHORT TO GROUND	
● Measure the resistance between seat control switch C352-3, circuit 981 (RD/WH), harness side and power seat motor C362-2, circuit 981 (RD/WH), harness side; and between seat control switch C352-3, circuit 981 (RD/WH), harness side and ground.  A0049755 ● **Is the resistance less than 5 ohms between the power seat motor and the seat control switch, and greater than 10,000 ohms between the seat control switch and ground?**	**Yes** INSTALL a new seat control switch. REFER to Seat Control Switch—6-Way in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** REPAIR circuit 981 (RD/WH). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
F6 DETERMINE SEAT TILTING FAILURE	
● Determine seat tilting failure. ● **Can the seat be tilted forward or backward?**	**Yes** If only the forward tilting operates, GO to F7. If only the rear tilting operates, GO to F10. **No** INSTALL a new seat

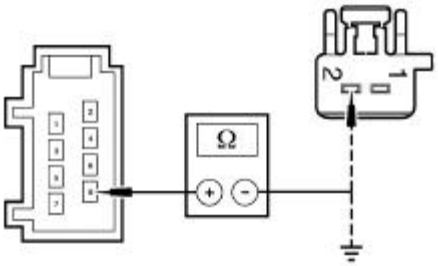
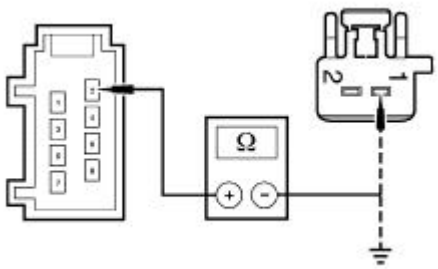
	control switch. REFER to Seat Control Switch—6-Way in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
F7 CHECK THE VOLTAGE TO THE REAR HEIGHT MOTOR • Disconnect: Power Seat Motor C363. • Measure the voltage between power seat motor C363-2, circuit 983 (RD/LG), harness side and C363-1, circuit 982 (YE/LG), harness side while depressing the rear tilt switch up and down.  A0049753 • **Is the voltage greater than +10 volts when the rear tilt switch is pressed up, greater than -10 volts when the rear tilt switch is pressed down and 0 volts when the switch is in the rest position?**	**Yes** INSTALL a new rear height power seat motor. REFER to Front Seat Track Motor in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to F8.
F8 CHECK CIRCUIT 983 (RD/LG) FOR AN OPEN AND A SHORT TO GROUND • Disconnect: Seat Control Switch C352. • Measure the resistance between seat control switch C352-4, circuit 983 (RD/LG), harness side and power seat motor C363-2, circuit 983 (RD/LG), harness side; and between seat control switch C352-4, circuit 983 (RD/LG), harness side and ground.  A0049756 • **Is the resistance less than 5 ohms between the power seat motor and the seat control switch, and greater than 10,000 ohms between the seat control switch and ground?**	**Yes** GO to F9. **No** REPAIR circuit 983 (RD/LG). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
F9 CHECK CIRCUIT 982 (YE/LG) FOR AN OPEN AND A SHORT TO GROUND	

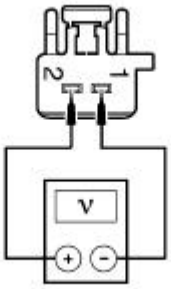
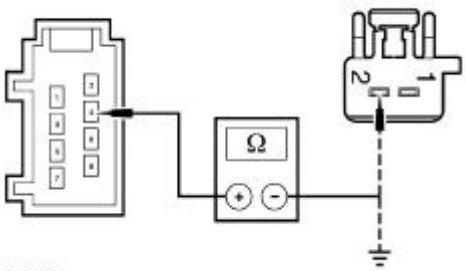
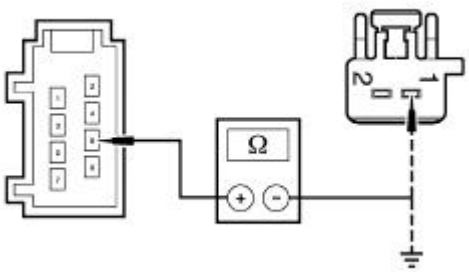
• Measure the resistance between seat control switch C352-6, circuit 982 (YE/LG), harness side and power seat motor assembly C363-1, circuit 982 (YE/LG), harness side; and between seat control switch C352-6, circuit 982 (YE/LG), harness side and ground.  A0049757 • **Is the resistance less than 5 ohms between the power seat motor and the seat control switch, and greater than 10,000 ohms between the seat control switch and ground?**	**Yes** INSTALL a new seat control switch. REFER to Seat Control Switch—6-Way in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** REPAIR circuit 982 (YE/LG). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
F10 CHECK THE VOLTAGE TO FRONT HEIGHT MOTOR	
• Disconnect: Power Seat Motor C382. • Measure the voltage between power seat motor C382-2, circuit 979 (RD/LB), harness side and C382-1, circuit 978 (YE/LB), harness side while pushing the rear tilting switch up and down.  A0049753 • **Is the voltage greater than +10 volts when the front tilt switch is pressed up, greater than -10 volts when the front tilt switch is pressed down and 0 volts when the switch is in the rest position?**	**Yes** INSTALL a new front height power seat motor. REFER to Front Seat Track Motor in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to F11 .
F11 CHECK CIRCUIT 979 (RD/LB) FOR AN OPEN AND A SHORT TO GROUND	
• Disconnect: Seat Control Switch C352. • Measure the resistance between seat control switch C352-8, circuit 979 (RD/LB), harness side and power seat motor C382-2, circuit 979 (RD/LB), harness side; and between seat control switch C352-8, circuit 979 (RD/LB), harness side and ground.	**Yes** GO to F12 . **No** REPAIR circuit 979 (RD/LB). TEST the

 A0049758 ● **Is the resistance less than 5 ohms between the power seat motor and the seat control switch, and greater than 10,000 ohms between the seat control switch and ground?**	system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
F12 CHECK CIRCUIT 978 (YE/LB) FOR AN OPEN	
● Measure the resistance between seat control switch C352-2, circuit 978 (YE/LB), harness side and power seat motor C382-1, circuit 978 (YE/LB), harness side; and between seat control switch C352-2, circuit 978 (YE/LB), harness side and ground.  A0049759 ● **Is the resistance less than 5 ohms between the power seat motor and the seat control switch, and greater than 10,000 ohms between the seat control switch and ground?**	**Yes** INSTALL a new seat control switch. REFER to Seat Control Switch—6-Way in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** REPAIR circuit 978 (YE/LB). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
F13 DETERMINE WHICH DIRECTION HAS FAILED — PASSENGER SEAT	
● Operate the power seat forward and rearward. ● **Will the track move horizontally?**	**Yes** GO to F17. **No** GO to F14.
F14 CHECK THE VOLTAGE TO FORWARD REVERSE SEAT MOTOR — PASSENGER SEAT	
● Disconnect: Power Seat Motor C332. ● Measure the voltage between power seat motor C332-1, circuit 986 (YE/WH), harness side and C332-2, circuit 987 (RD/WH),	**Yes** INSTALL a new forward/reverse

harness side while pushing the forward/reverse switch forward and backward.  A0049753 • **Is the voltage greater than -10 volts when the forward/reverse switch is pressed forward, greater than +10 volts when the forward/reverse switch is pressed backward and 0 volts when the switch is in the rest position?**	power seat motor assembly. REFER to Front Seat Track Motor in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to F15.
F15 CHECK CIRCUIT 986 (YE/WH) FOR AN OPEN AND A SHORT TO GROUND	
• Disconnect: Seat Control Switch C355. • Measure the resistance between seat control switch C355-3, circuit 986 (YE/WH), harness side and power seat motor C332-1, circuit 986 (YE/WH), harness side; and between seat control switch C355-3, circuit 986 (YE/WH), harness side and ground.  A0049760 • **Is the resistance less than 5 ohms between the power seat motor and the seat control switch, and greater than 10,000 ohms between the seat control switch and ground?**	**Yes** GO to F16. **No** REPAIR circuit 986 (YE/WH). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
F16 CHECK CIRCUIT 987 (RD/WH) FOR AN OPEN AND A SHORT TO GROUND	
• Measure the resistance between seat control switch C355-5, circuit 987 (RD/WH), harness side and power seat motor C332-2, circuit 987 (RD/WH), harness side; and between seat control switch C355-5, circuit 987 (RD/WH), harness side and ground.  A0049761 • **Is the resistance less than 5 ohms between the power seat motor and the seat control switch, and greater than 10,000 ohms between the seat control switch and ground?**	**Yes** INSTALL a new seat control switch. REFER to Seat Control Switch—6-Way in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No**

	REPAIR circuit 987 (RD/WH). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
F17 DETERMINE SEAT TILTING FAILURE — PASSENGER SEAT	
• Determine seat tilting failure. • **Can the seat be tilted forward or backward?**	**Yes** If only the forward tilting operates, GO to F18 . If only the rear tilting operates, GO to F21 . **No** INSTALL a new seat control switch. REFER to Seat Control Switch—6-Way in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
F18 CHECK THE VOLTAGE TO THE REAR HEIGHT MOTOR — PASSENGER SEAT	
• Disconnect: Power Seat Motor C3075. • Measure the voltage between power seat motor C3075-2, circuit 989 (RD/LG), harness side and C3075-1, circuit 988 (YE/LG), harness side while depressing the rear tilt switch up and down.  A0049753 • **Is the voltage greater than +10 volts when the rear tilt switch is pressed up, greater than -10 volts when the rear tilt switch is pressed down and 0 volts when the switch is in the rest**	**Yes** INSTALL a new rear height power seat motor. REFER to Front Seat Track Motor in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No**

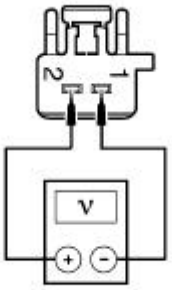
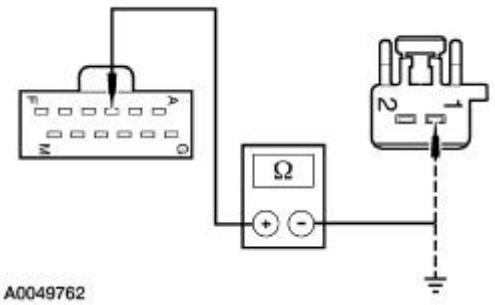
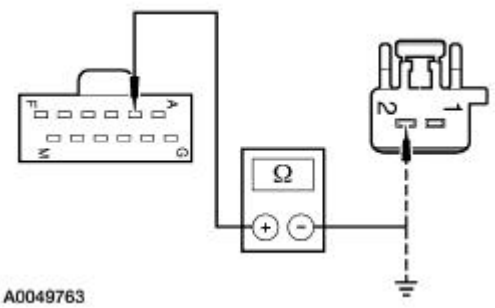
position?	GO to F19 .
F19 CHECK CIRCUIT 989 (RD/LG) FOR OPEN AND A SHORT TO GROUND	
• Disconnect: Seat Control Switch C355. • Measure the resistance between seat control switch C355-8, circuit 989 (RD/LG), harness side and power seat motor C3075-2, circuit 989 (RD/LG), harness side; and between seat control switch C355-8, circuit 989 (RD/LG), harness side and ground.  A0049758 • **Is the resistance less than 5 ohms between the power seat motor and the seat control switch, and greater than 10,000 ohms between the seat control switch and ground?**	**Yes** GO to F20 . **No** REPAIR circuit 989 (RD/LG). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
F20 CHECK CIRCUIT 988 (YE/LG) FOR AN OPEN AND A SHORT TO GROUND	
• Measure the resistance between seat control switch C355-2, circuit 988 (YE/LG), harness side and power seat motor C3075-1, circuit 988 (YE/LG), harness side; and between seat control switch C355-2, circuit 988 (YE/LG), harness side and ground.  A0049759 • **Is the resistance less than 5 ohms between the power seat motor and the seat control switch, and greater than 10,000 ohms between the seat control switch and ground?**	**Yes** INSTALL a new seat control switch. REFER to Seat Control Switch—6-Way in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** REPAIR circuit 988 (YE/LG). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
F21 CHECK THE VOLTAGE TO FRONT HEIGHT MOTOR — PASSENGER SEAT	
• Disconnect: Power Seat Motor C3074.	**Yes**

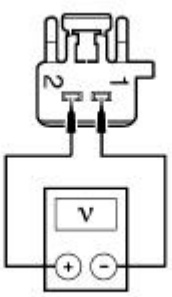
• Measure the voltage between power seat motor C3074-2, circuit 985 (RD/LB), harness side and C3074-1, circuit 984 (YE/LB), harness side while pushing the rear tilting switch up and down.  A0049753 • **Is the voltage greater than +10 volts when the front tilt switch is pressed up, greater than -10 volts when the front tilt switch is pressed down and 0 volts when the switch is in the rest position?**	INSTALL a new front height power seat motor. REFER to Front Seat Track Motor in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to F22 .
F22 CHECK CIRCUIT 985 (RD/LB) FOR AN OPEN AND A SHORT TO GROUND	
• Disconnect: Seat Control Switch C355. • Measure the resistance between seat control switch C355-4, circuit 985 (RD/LB), harness side and power seat motor C3074-2, circuit 985 (RD/LB), harness; side and between seat control switch C355-4, circuit 985 (RD/LB), harness side and ground.  A0049756 • **Is the resistance less than 5 ohms between the power seat motor and the seat control switch, and greater than 10,000 ohms between the seat control switch and ground?**	**Yes** GO to F23 . **No** REPAIR circuit 985 (RD/LB). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
F23 CHECK CIRCUIT 984 (YE/LB) FOR AN OPEN	
• Measure the resistance between seat control switch C355-6, circuit 984 (YE/LB), harness side and power seat motor C3074-1, circuit 984 (YE/LB), harness side; and between seat control switch C355-6, circuit 984 (YE/LB), harness side and ground.  A0049757 • **Is the resistance less than 5 ohms between the power seat motor and the seat control switch, and greater than 10,000 ohms between the seat control switch and ground?**	**Yes** INSTALL a new seat control switch. REFER to Seat Control Switch—6-Way in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No**

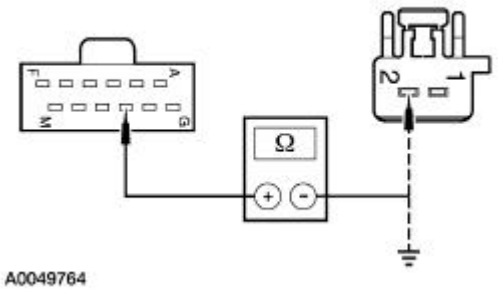
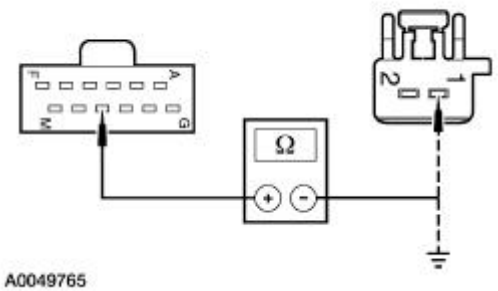
	REPAIR circuit 984 (YE/LB). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

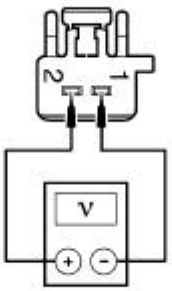
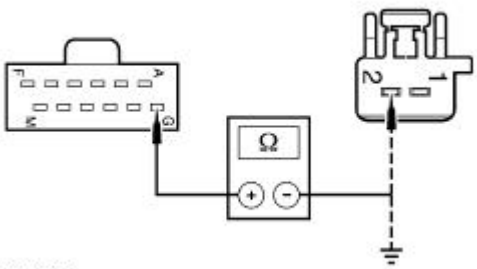
PINPOINT TEST G: THE POWER SEAT DOES NOT MOVE HORIZONTALLY/VERTICALLY/RECLINE — PASSENGER SIDE, NAVIGATOR

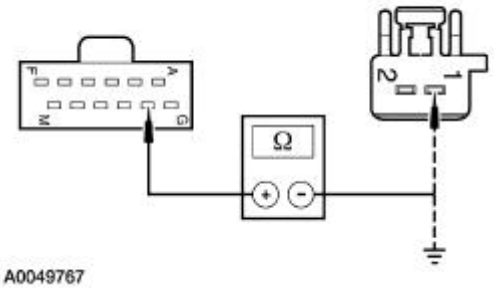
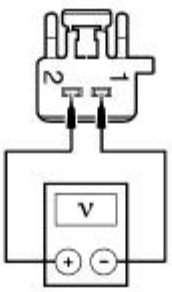
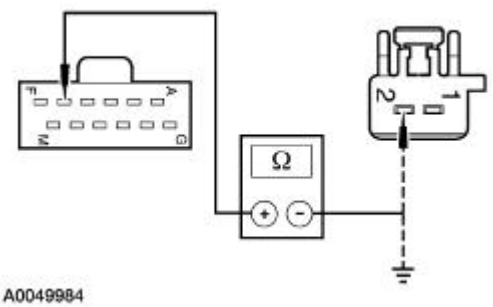
Test Step	Result / Action to Take
G1 DETERMINE WHICH DIRECTION HAS FAILED — PASSENGER SEAT	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards. NOTE: If a seat equipped with a seat-mounted side air bag and/or a safety belt pretensioner (if equipped) system is being serviced, **the air bag system must be deactivated.** Refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in the General Procedures portion of this section. **NOTE:** Restraint system diagnostic tools **MUST** be installed under the seats in the seat side air bag (if equipped) and safety belt pretensioner (if equipped) to floor connectors. **NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. ● Key in OFF position. ● Deactivate the supplemental restraint system (SRS). Refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. ● Key in OFF position. ● Operate the power seat forward and rearward. ● **Will the track move horizontally?**	**Yes** GO to G5. **No** GO to G2.
G2 CHECK THE VOLTAGE TO THE FORWARD REVERSE SEAT MOTOR — PASSENGER SEAT	
● Disconnect: Power Seat Motor C332. ● Measure the voltage between power seat motor C332-1, circuit 986 (YE/WH), harness side and C332-2, circuit 987 (RD/WH), harness side while pushing the forward/reverse switch forward and backward.	**Yes** INSTALL a new forward/reverse power seat motor. REFER to Front Seat Track Motor in this section. TEST the system for normal operation. REACTIVATE the supplemental

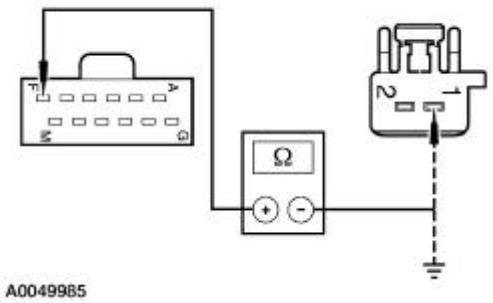
 A0049753 ● **Is the voltage greater than -10 volts when the forward/reverse switch is pressed forward, greater than +10 volts when the forward/reverse switch is pressed backward and 0 volts when the switch is in the rest position?**	restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to G3.
G3 CHECK CIRCUIT 986 (YE/WH) FOR AN OPEN AND A SHORT TO GROUND	
● Disconnect: Seat Control Switch C3026. ● Measure the resistance between seat control switch C3026-C, circuit 986 (YE/WH), harness side and power seat motor C332-1, circuit 986 (YE/WH), harness side; and between seat control switch C3026-C, circuit 986 (YE/WH), harness side and ground.  A0049762 ● **Is the resistance less than 5 ohms between the power seat motor and the seat control switch, and greater than 10,000 ohms between the seat control switch and ground?**	**Yes** GO to G4. **No** REPAIR circuit 986 (YE/WH). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
G4 CHECK CIRCUIT 987 (RD/WH) FOR AN OPEN AND A SHORT TO GROUND	
● Measure the resistance between seat control switch C3026-B, circuit 987 (RD/WH), harness side and power seat motor C332-2, circuit 987 (RD/WH), harness side; and between seat control switch C3026-B, circuit 987 (RD/WH), harness side and ground.  A0049763 ● **Is the resistance less than 5 ohms between the power seat motor and the seat control switch, and greater than 10,000 ohms between the seat control switch and ground?**	**Yes** INSTALL a new seat control switch. REFER to Seat Control Switch—8-Way in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** REPAIR circuit 987 (RD/WH). TEST the

	system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
G5 DETERMINE SEAT TILTING FAILURE — PASSENGER SEAT	
• Determine seat tilting failure. • **Can the seat be tilted forward or backward or recline?**	**Yes** If the rear tilting does not operate, GO to G6. If the front tilting does not operate, GO to G9. If the recline does not operate, GO to G12. **No** INSTALL a new seat control switch. REFER to Seat Control Switch—8-Way in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
G6 CHECK THE VOLTAGE TO THE REAR HEIGHT MOTOR — PASSENGER SEAT	
• Disconnect: Power Seat Motor C3075. • Measure the voltage between rear height power seat motor C3075-2, circuit 989 (RD/LG), harness side and C3075-1, circuit 988 (YE/LG), harness side while depressing the rear tilt switch up and down.  A0049753 • **Is the voltage greater than +10 volts when the rear tilt switch**	**Yes** INSTALL a new rear height power seat motor. REFER to Front Seat Track Motor in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

is pressed up, greater than -10 volts when the rear tilt switch is pressed down and 0 volts when the switch is in the rest position?	**No** GO to G7 .
G7 CHECK CIRCUIT 989 (RD/LG) FOR AN OPEN AND A SHORT TO GROUND	
• Disconnect: Seat Control Switch C3026. • Measure the resistance between seat control switch C3026-J, circuit 989 (RD/LG), harness side and rear height power seat motor C3075-2, circuit 989 (RD/LG), harness side; and between seat control switch C3026-J, circuit 989 (RD/LG), and ground.  A0049764 • **Is the resistance less than 5 ohms between the power seat motor and the seat control switch, and greater than 10,000 ohms between the seat control switch and ground?**	**Yes** GO to G8 . **No** REPAIR circuit 989 (RD/LG). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
G8 CHECK CIRCUIT 988 (YE/LG) FOR AN OPEN AND A SHORT TO GROUND	
• Measure the resistance between seat control switch C3026-K, circuit 988 (YE/LG), harness side and rear height power seat motor C3075-1, circuit 988 (YE/LG), harness side; and between seat control switch C3026-K, circuit 988 (YE/LG), harness side and ground.  A0049765 • **Is the resistance less than 5 ohms between the power seat motor and the seat control switch, and greater than 10,000 ohms between the seat control switch and ground?**	**Yes** INSTALL a new seat control switch. REFER to Seat Control Switch—8-Way in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** REPAIR circuit 988 (YE/LG). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
G9 CHECK THE VOLTAGE TO FRONT HEIGHT MOTOR — PASSENGER SEAT	

• Disconnect: Power Seat Motor C3074. • Measure the voltage between front height power seat motor C3074-2, circuit 985 (RD/LB), harness side and C3074-1, circuit 984 (YE/LB), harness side while pushing the rear tilting switch up and down.  A0049753 • **Is the voltage greater than +10 volts when the front tilt switch is pressed up, greater than -10 volts when the front tilt switch is pressed down and 0 volts when the switch is in the rest position?**	**Yes** INSTALL a new front height power seat motor. REFER to Front Seat Track Motor in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to G10.
G10 CHECK CIRCUIT 985 (RD/LB) FOR AN OPEN AND A SHORT TO GROUND	
• Disconnect: Seat Control Switch C3026. • Measure the resistance between seat control switch C3026-G, circuit 985 (RD/LB), harness side and front height power seat motor C3074-2, circuit 985 (RD/LB), harness side; and between seat control switch C3026-G, circuit 985 (RD/LB), harness side and ground.  A0049766 • **Is the resistance less than 5 ohms between the power seat motor and the seat control switch, and greater than 10,000 ohms between the seat control switch and ground?**	**Yes** GO to G11. **No** REPAIR circuit 985 (RD/LB). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
G11 CHECK CIRCUIT 984 (YE/LB) FOR AN OPEN	
• Measure the resistance between seat control switch C3026-H, circuit 984 (YE/LB), harness side and front height power seat motor C3074-1, circuit 984 (YE/LB), harness side; and between seat control switch C3026-H, circuit 984 (YE/LB), harness side and ground.	**Yes** INSTALL a new seat control switch. REFER to Seat Control Switch—8-Way in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in

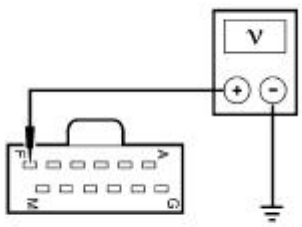
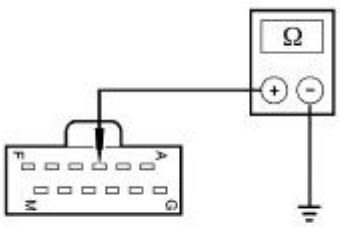
 A0049767 ● **Is the resistance less than 5 ohms between the power seat motor and the seat control switch, and greater than 10,000 ohms between the seat control switch and ground?**	this section. **No** REPAIR circuit 984 (YE/LB). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
G12 CHECK THE VOLTAGE TO THE RECLINER MOTOR — PASSENGER SEAT	
● Disconnect: Recliner Motor C3189. ● Measure the voltage between recliner motor C3189-2, circuit 919 (GY/BK), harness side and C3189-1, circuit 918 (GY), harness side while depressing the recliner switch up and down.  A0049753 ● **Is the voltage greater than +10 volts when the recliner switch is pressed up, greater than -10 volts when the recliner switch is pressed down and 0 volts when the switch is in the rest position?**	**Yes** INSTALL a new recliner power seat motor. REFER to Front Seat Recliner Motor in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to G13 .
G13 CHECK CIRCUIT 919 (GY/BK) FOR AN OPEN AND A SHORT TO GROUND	
● Disconnect: Seat Control Switch C3026. ● Measure the resistance between seat control switch C3026-E, circuit 919 (GY/BK), harness side and power recliner seat motor C3189-2, circuit 919 (GY/BK), harness side; and between seat control switch C3026-E, circuit 919 (GY/BK), and ground.  A0049984 ● **Is the resistance less than 5 ohms between the power recliner seat motor and the seat control switch, and greater than 10,000 ohms between the seat control switch and ground?**	**Yes** GO to G14 . **No** REPAIR circuit 919 (GY/BK). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
G14 CHECK CIRCUIT 918 (GY) FOR AN OPEN AND A SHORT TO	

GROUND	
• Measure the resistance between seat control switch C3026-F, circuit 918 (GY), harness side and power recline seat motor C3075-1, circuit 918 (GY), harness side; and between seat control switch C3026-F, circuit 918 (GY), harness side and ground.  • **Is the resistance less than 5 ohms between the power recline seat motor and the seat control switch, and greater than 10,000 ohms between the seat control switch and ground?**	**Yes** INSTALL a new seat control switch. REFER to Seat Control Switch—8-Way in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** REPAIR circuit 918 (GY). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

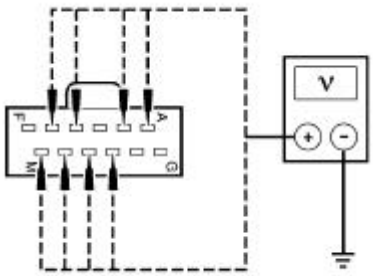
PINPOINT TEST H: THE MEMORY SEAT IS INOPERATIVE — NAVIGATOR

Test Step	Result / Action to Take
H1 RETRIEVE THE DTCS	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards. NOTE: If a seat equipped with a seat-mounted side air bag and/or a safety belt pretensioner (if equipped) system is being serviced, **the air bag system must be deactivated.** Refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in the General Procedures portion of this section. **NOTE:** Restraint system diagnostic tools **MUST** be installed under the seats in the seat side air bag (if equipped) and safety belt pretensioner (if equipped) to floor connectors. **NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. • Deactivate the supplemental restraint system (SRS). Refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.	**Yes** If DTCs B1663, B1664, and B1665 are all retrieved, GO to H10. If DTC B1663, GO to H18. If DTC B1664, GO to H21. If DTC B1665, GO to H24. If DTC B1711, GO to H3. If DTC B1715, GO to

• Key in OFF position. • Connect the diagnostic tool. • Enter the following diagnostic mode on the diagnostic tool: Retrieve and Document Continuous DTCs. • Enter the following diagnostic mode on the diagnostic tool: Clear the Continuous DTCs. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self-Test. • **Are any DTCs retrieved?**	H3 . If DTC B1719, GO to H3 . If DTC B1723, GO to H3 . If DTC B1727, GO to H3 . If DTC B1731, GO to H3 . If DTC B1342, INSTALL a new DSM. REFER to Section 419-10 . TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to H2 .
H2 CHECK THE DSM FOR CORRECT MEMORY SEAT SWITCH INPUTS — MONITOR THE DSM PIDS SFNT_SW, SREARSW, SFWS_SW AND SRCL_SW	
• Enter the following diagnostic mode on the diagnostic tool: Monitor PIDs. • Monitor the PIDs SFNT_SW, SREARSW, SFWS_SW and SRCLSW while activating the seat switch. • **Do the PID values agree with the switch positions?**	**Yes** GO to H9 . **No** If Power Distribution Junction Box (PDJB) fuse 3 (7.5A) fails while operating the seat control switch, DISCONNECT the seat control switch C3016 and GO to H7 . If PDJB fuse 3 (7.5A) is OK, GO to H3 .
H3 CHECK THE SEAT CONTROL SWITCH	
• Key in OFF position. • Disconnect: Seat Control Switch C3016. • Check the seat control switch. For additional information, refer to Refer to Wiring Diagrams Cell 149 for schematic and connector information. • **Is the seat control switch OK?**	**Yes** GO to H4 . **No** INSTALL a new seat control switch. REFER to Seat Control Switch—8-Way in this section. TEST the system for normal operation.

	REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
H4 CHECK FOR VOLTAGE TO THE SEAT CONTROL SWITCH — CIRCUIT 956 (OG/LG) • Measure the voltage between seat control switch C3016-F, circuit 956 (OG/LG), harness side and ground.  A0050068 • **Is the voltage greater than 10 volts?**	**Yes** GO to H5 . **No** REPAIR circuit 956 (OG/LG). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
H5 CHECK CIRCUIT 875 (BK/LB) FOR AN OPEN • Measure the resistance between seat control switch C3016-C, circuit 875 (BK/LB), harness side and ground.  A0050069 • **Is the resistance less than 5 ohms?**	**Yes** GO to H6 . **No** REPAIR circuit 875 (BK/LB). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
H6 CHECK CIRCUITS 1468, 1467, 1466, 1463, 1465, 1464 456 AND 457 FOR A SHORT TO POWER • Disconnect: Driver Seat Module (DSM) C341b. • Key in ON position. • Measure the voltage between the following seat control switch C3016 pins, harness side and ground. **Connector C3016** / **Circuit** Pin M / 1463 (RD/WH) Pin D / 1466 (GY/OG) Pin J / 1467 (GY/WH)	**Yes** REPAIR the circuit(s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation

Pin E	1465 (GY/WH)
Pin K	1468 (GY/LB)
Pin L	1464 (YE)
Pin B	456 (DG/OG)
Pin A	457 (DB/YE)



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- **Is any voltage indicated?**

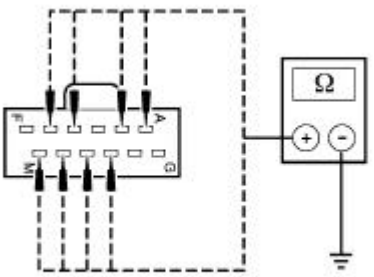
and Reactivation in this section.

No
GO to H7 .

H7 CHECK CIRCUITS 1468, 1467, 1466, 1463, 1465, 1464 456 AND 457 FOR A SHORT TO GROUND

- Key in OFF position.
- Measure the resistance between the following seat control switch C3016 pins, harness side and ground.

Connector C3016	Circuit
Pin M	1463 (RD/WH)
Pin D	1466 (GY/OG)
Pin J	1467 (GY/WH)
Pin E	1465 (GY/WH)
Pin K	1468 (GY/LB)
Pin L	1464 (YE)
Pin B	456 (DG/OG)
Pin A	457 (DB/YE)



A0050490

- **Are the resistances greater than 10,000 ohms?**

Yes
REPAIR the circuit(s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

No
GO to H8 .

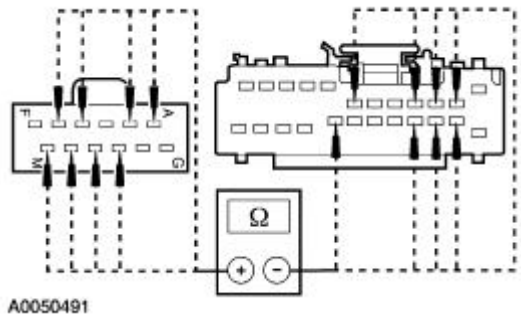
H8 CHECK CIRCUITS 1468, 1467, 1466, 1463, 1465, 1464 456 AND 457 FOR AN OPEN

- Measure the resistance between the following seat control switch

Yes

C3016 pins, harness side and driver seat module (DSM) C341b pins, harness side.

Seat Control Switch C3016	Circuit	Driver Seat Module (DSM) C341b
Pin M	1463 (RD/WH)	Pin 7
Pin D	1466 (GY/OG)	Pin 14
Pin J	1467 (GY/WH)	Pin 3
Pin E	1465 (GY/WH)	Pin 15
Pin K	1468 (GY/LB)	Pin 4
Pin L	1464 (YE)	Pin 16
Pin B	456 (DG/OG)	Pin 20
Pin A	457 (DB/YE)	Pin 2



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

INSTALL a new DSM. REFER to Section 419-10 . TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

No
REPAIR the circuit(s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

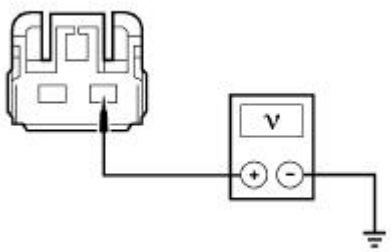
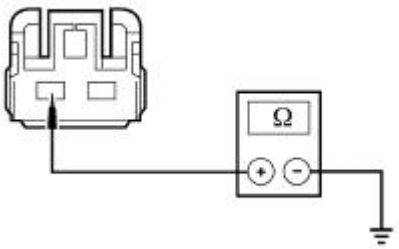
H9 CHECK THE DRIVER SEAT MODULE (DSM) FOR CORRECT OUTPUTS USING SCAN TOOL DSM ACTIVE COMMANDS

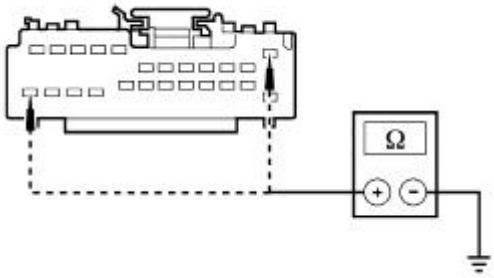
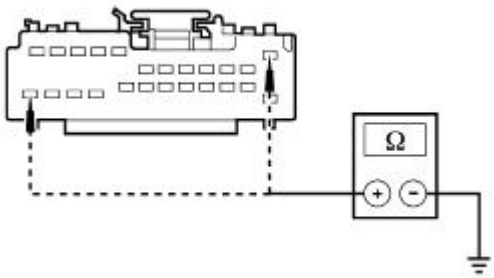
- Enter the following diagnostic mode on the diagnostic tool: Active Commands.
- Toggle the following DSM active commands:
  - FRONT UP on and off.
  - FRONT DWN on and off.
  - REAR UP on and off.
  - REAR DWN on and off.
  - HORZ FWD on and off.
  - HORZ RWD on and off.
  - RECL FWD on and off.
  - RECL RWD on and off.
- **Does the driver seat operate correctly?**

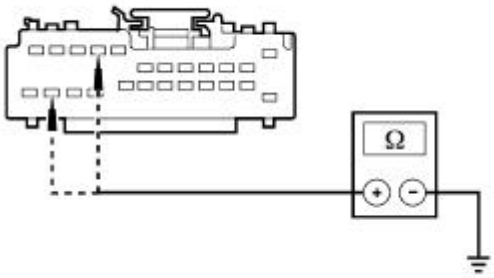
Yes
INSTALL a new DSM. REFER to Section 419-10 . TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

No
If no seat movement, GO to H10 .

If no front vertical

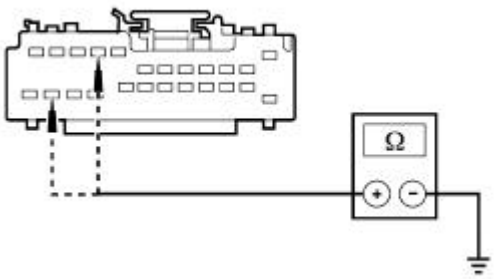
	seat movement, GO to H20 . If no rear vertical seat movement, GO to H23 . If no horizontal seat movement, GO to H26 . If no recline seat movement, GO to H29 .
H10 CHECK THE DRIVER SEAT MODULE (DSM) FOR VOLTAGE — CIRCUIT 566 (DG)	
• Key in OFF position. • Disconnect: Driver Seat Module (DSM) C341a. • Measure the voltage between driver seat module (DSM) C341a-1, circuit 566 (DG), harness side and ground.  A0042092 • **Is the voltage greater than 10 volts?**	**Yes** GO to H11 . **No** REPAIR circuit 566 (DG). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
H11 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
• Measure the resistance between driver seat module (DSM) C341a-2, circuit 57 (BK), harness side and ground.  A0042093 • **Is the resistance less than 5 ohms?**	**Yes** GO to H12 . **No** REPAIR circuit 57 (BK). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
H12 CHECK CIRCUITS 1469 (RD/LB) AND 1470 (YE/LB) FOR A SHORT TO GROUND	
• Disconnect: Driver Seat Module (DSM) C341b. • Measure the resistance between driver seat module (DSM) C341b-1, circuit 1469 (RD/LB), harness side and ground; and between DSM C341b-24, circuit 1470 (YE/LB), harness side and ground.	**Yes** GO to H14 . **No** GO to H13 .

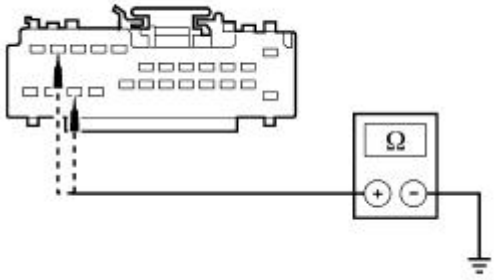
 A0042094 ● **Are the resistances greater than 10,000 ohms?**	
H13 CHECK FRONT HEIGHT MOTOR FOR A SHORT TO GROUND — CIRCUITS 1469 (RD/LB) AND 1470 (YE/LB)	
● Disconnect: Driver Seat Module (DSM) C341b. ● Disconnect: Front Height Power Seat Motor C382. ● Measure the resistance between driver seat module (DSM) C341b-1, circuit 1469 (RD/LB), harness side and ground; and between DSM C341b-24, circuit 1470 (YE/LB), harness side and ground.  A0042094 ● **Are the resistances greater than 10,000 ohms?**	**Yes** INSTALL a new front height power seat motor. REFER to Front Seat Track Motor in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** REPAIR the circuit(s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
H14 CHECK CIRCUITS 1474 (RD/LG) AND 1473 (YE/LG) FOR A SHORT TO GROUND	
● Measure the resistance between driver seat module (DSM) C341b-9, circuit 1474 (RD/LG), harness side and ground; and between DSM C341b-23, circuit 1473 (YE/LG), harness side and ground.	**Yes** GO to H16 . **No** GO to H15 .



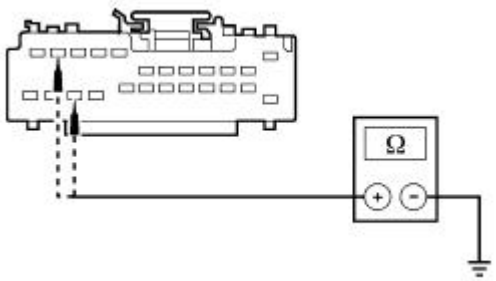
A0042095

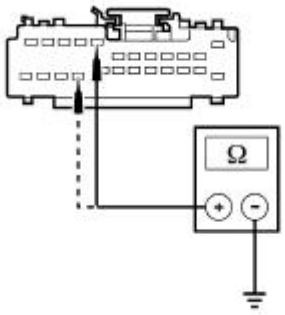
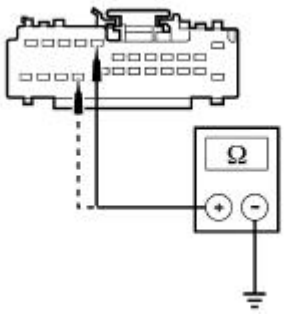
- **Are the resistances greater than 10,000 ohms?**

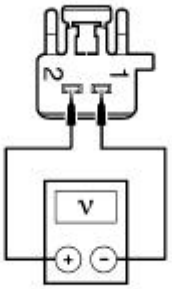
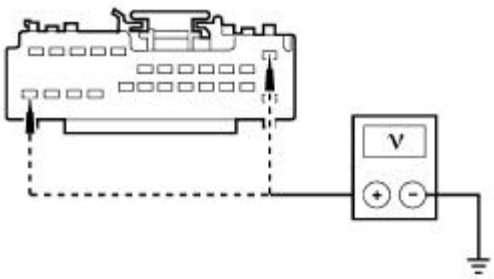
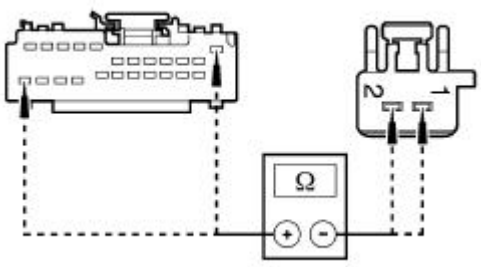
H15 CHECK THE REAR HEIGHT MOTOR FOR A SHORT TO GROUND — CIRCUITS 1474 (RD/LG) AND 1473 (YE/LG)	
• Disconnect: Rear Height Power Seat Motor C363. • Measure the resistance between driver seat module (DSM) C341b-9, circuit 1474 (RD/LG), harness side and ground; and between DSM C341b-23, circuit 1473 (YE/LG), harness side and ground.  A0042095 • **Are the resistances greater than 10,000 ohms?**	**Yes** INSTALL a new rear height power seat motor. REFER to Front Seat Track Motor in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** REPAIR the circuit(s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
H16 CHECK CIRCUITS 1472 (YE/WH) AND 1471 (RD/WH) FOR A SHORT TO GROUND	
• Measure the resistance between driver seat module (DSM) C341b-22, circuit 1472 (YE/WH), harness side and ground; and between DSM C341b-11, circuit 1471 (RD/WH), harness side and ground.	**Yes** GO to H18 . **No** GO to H17 .

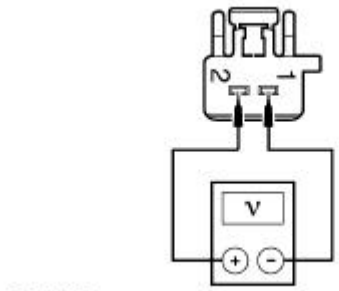
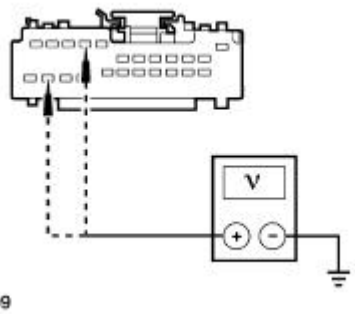


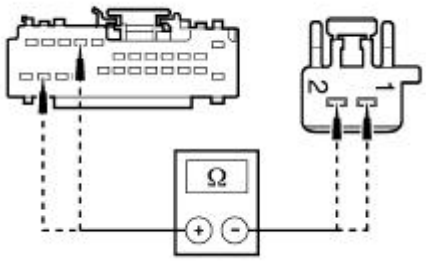
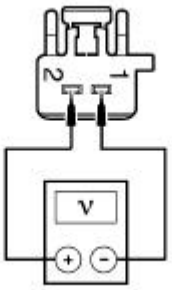
- **Are the resistances greater than 10,000 ohms?**

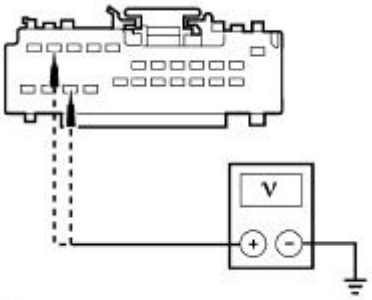
H17 CHECK THE HORIZONTAL MOTOR FOR A SHORT TO GROUND — CIRCUITS 1472 (YE/WH) AND 1471 (RD/WH)	
• Disconnect: Horizontal Power Seat Motor C362. • Measure the resistance between driver seat module (DSM) C341b-22, circuit 1472 (YE/WH), harness side and ground; and between DSM C341b-11, circuit 1471 (RD/WH), harness side and ground.  • **Are the resistances greater than 10,000 ohms?**	**Yes** INSTALL a new horizontal power seat motor. REFER to Front Seat Track Motor in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** REPAIR the circuit(s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
H18 CHECK CIRCUITS 918 (GY) AND 919 (GY/BK) FOR A SHORT TO GROUND	
• Measure the resistance between driver seat module (DSM) C341b-8, circuit 918 (GY), harness side and ground; and between DSM C341b-21, circuit 919 (GY/BK) harness side and ground.	**Yes** INSTALL a new DSM. REFER to Section 419-10 . TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System

 A0050492 ● **Are the resistances greater than 10,000 ohms?**	(SRS) Deactivation and Reactivation in this section. **No** GO to H19 .
H19 CHECK THE RECLINER MOTOR FOR A SHORT TO GROUND — CIRCUITS 918 (GY) AND 919 (GY/BK)	
● Disconnect: Power Recliner Seat Motor C3187. ● Measure the resistance between driver seat module (DSM) C341b-8, circuit 918 (GY), harness side and ground; and between DSM C341b-21, circuit 919 (GY/BK), harness side and ground.  A0050492 ● **Are the resistances greater than 10,000 ohms?**	**Yes** INSTALL a new recliner power seat motor. REFER to Front Seat Recliner Motor in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** REPAIR the circuit(s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
H20 CHECK THE FRONT HEIGHT MOTOR FOR CORRECT OPERATION	
● Key in OFF position. ● Disconnect: Front Height Power Seat Motor C382. ● Key in ON position. ● Measure the voltage between front height power seat motor C382-1, circuit 1469 (RD/LB), and C382-2, circuit 1470 (YE/LB), harness side while toggling DSM active commands FRONT UP and FRONT DOWN on and off.	**Yes** INSTALL a new front height power seat motor. REFER to Front Seat Track Motor in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to

 A0049753 ● **Does the voltage change from zero volts?**	Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to H21.
H21 CHECK CIRCUITS 1469 (RD/LB) AND 1470 (YE/LB) FOR A SHORT TO POWER	
● Key in OFF position. ● Disconnect: Driver Seat Module (DSM) C341b. ● Key in ON position. ● Measure the voltage between driver seat module (DSM) C341b-1, circuit 1469 (RD/LB), harness side and ground; and between DSM C341b-24, circuit 1470 (YE/LB), harness side and ground.  A0042097 ● **Is any voltage indicated?**	**Yes** REPAIR the circuit(s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to H22.
H22 CHECK CIRCUITS 1469 (RD/LB) AND 1470 (YE/LB) FOR AN OPEN	
● Key in OFF position. ● Measure the resistance between driver seat module (DSM) C341b-1, circuit 1469 (RD/LB), harness side and front height power seat motor C382-1, circuit 1469 (RD/LB), harness side; and between DSM C341b-24, circuit 1470 (YE/LB), harness side and front height power seat motor C382-2 circuit 1470 (YE/LB), harness side.  A0050493 ● **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new DSM. REFER to Section 419-10. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** REPAIR the circuit(s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to

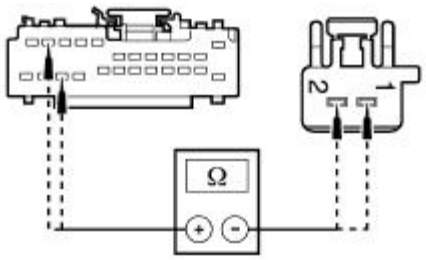
	Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
H23 CHECK THE REAR HEIGHT MOTOR FOR CORRECT OPERATION	
• Key in OFF position. • Disconnect: Rear Height Power Seat Motor C363. • Key in ON position. • Measure the voltage between rear height power seat motor C363-1, circuit 1474 (RD/LG), harness side and C363-2, circuit 1473 (YE/LG), harness side while toggling DSM active commands REAR UP and REAR DOWN ON and OFF.  A0049753 • **Does the voltage change from zero volts?**	**Yes** INSTALL a new rear height power seat motor. REFER to Front Seat Track Motor in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to H24.
H24 CHECK CIRCUITS 1474 (RD/LG) AND 1473 (YE/LG) FOR A SHORT TO POWER	
• Key in OFF position. • Disconnect: Driver Seat Module (DSM) C341b. • Key in ON position. • Measure the voltage between driver seat module (DSM) C341b-9, circuit 1474 (RD/LG), harness side and ground; and between DSM C341b-23, circuit 1473 (YE/LG), harness side and ground.  A0042099 • **Is any voltage indicated?**	**Yes** REPAIR the circuit(s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to H25.
H25 CHECK CIRCUITS 1474 (RD/LG) AND 1473 (YE/LG) FOR AN OPEN	
• Key in OFF position. • Measure the resistance between driver seat module (DSM) C341b-9, circuit 1474 (RD/LG), harness side and rear height power seat motor C363-1, circuit 1474 (RD/LG), harness side; and between DSM C341b-23, circuit 1473 (YE/LG), harness side and rear height power seat motor C363-2, circuit 1473 (YE/LG), harness side.	**Yes** INSTALL a new DSM. REFER to Section 419-10. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to

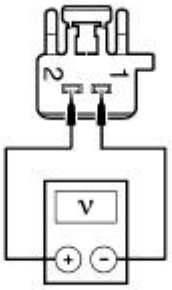
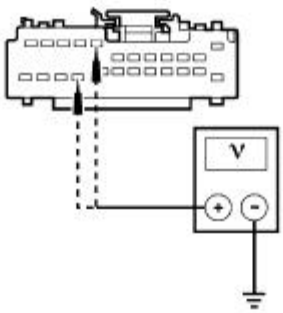
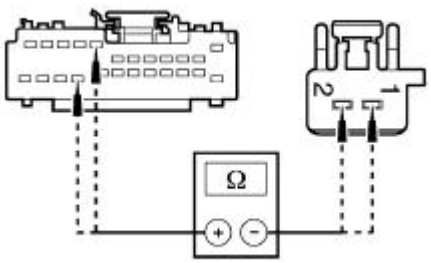
 A0050494 ● **Are the resistances less than 5 ohms?**	[Supplemental Restraint System (SRS) Deactivation and Reactivation] in this section. **No** REPAIR the circuit(s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to [Supplemental Restraint System (SRS) Deactivation and Reactivation] in this section.
H26 CHECK THE HORIZONTAL MOTOR FOR CORRECT OPERATION	
● Key in OFF position. ● Disconnect: Horizontal Power Seat Motor C362. ● Key in ON position. ● Measure the voltage between horizontal power seat motor C362-2, circuit 1472 (YE/WH), and C362-1, circuit 1471 (RD/WH), harness side while toggling DSM active commands HORZ FWD and HORZ RWD ON and OFF.  A0049753 ● **Does the voltage change from zero volts?**	**Yes** INSTALL a new horizontal power seat motor. REFER to [Front Seat Track Motor] in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to [Supplemental Restraint System (SRS) Deactivation and Reactivation] in this section. **No** GO to [H27].
H27 CHECK CIRCUITS 1472 (YE/WH) AND 1471 (RD/WH) FOR A SHORT TO POWER	
● Key in OFF position. ● Disconnect: Driver Seat Module (DSM) C341b. ● Key in ON position. ● Measure the voltage between driver seat module (DSM) C341b-22, circuit 1472 (YE/WH), harness side and ground; and between DSM C341b-11, circuit 1471 (RD/WH), harness side and ground.	**Yes** REPAIR the circuit(s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to [Supplemental Restraint System (SRS) Deactivation and Reactivation] in this section. **No** GO to [H28].



A0042101

- **Is any voltage indicated?**

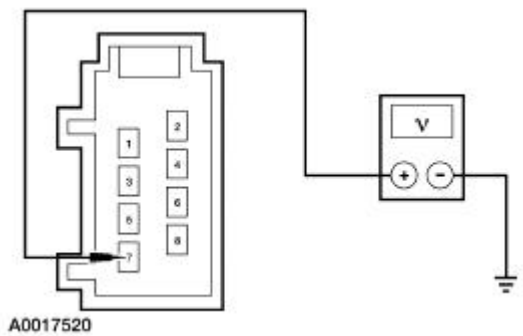
H28 CHECK CIRCUITS 1472 (YE/WH) AND 1471 (RD/WH) FOR AN OPEN	
• Key in OFF position. • Measure the resistance between driver seat module (DSM) C341b-22, circuit 1472 (YE/WH), harness side and horizontal power seat motor C362-2, circuit 1472 (YE/WH), harness side; and between DSM C341b-11, circuit 1471 (RD/WH), harness side and horizontal power seat motor C362-1, circuit 1471 (RD/WH), harness side.  A0050495 • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new DSM. REFER to Section 419-10 . TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** REPAIR the circuit(s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
H29 CHECK THE RECLINER MOTOR FOR CORRECT OPERATION	
• Key in OFF position. • Disconnect: Power Recliner Seat Motor C3187. • Key in ON position. • Measure the voltage between recliner power seat motor C3187-1, circuit 918 (GY), and C3187-2, circuit 919 (GY/BK), harness side while toggling DSM active commands RECLINE FWD and RECLINE RWD ON and OFF.	**Yes** INSTALL a new power recliner seat motor. REFER to Front Seat Recliner Motor in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation

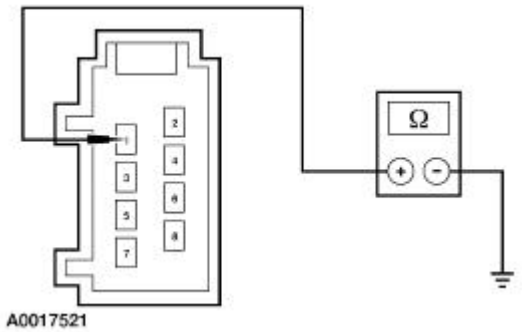
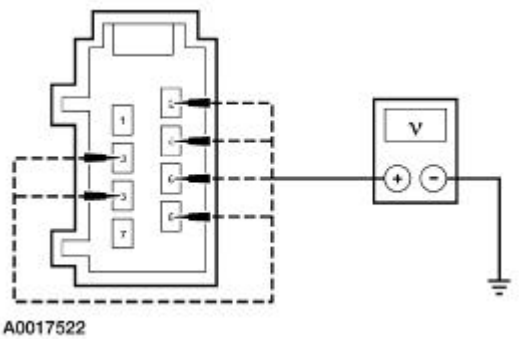
 A0049753 ● **Does the voltage change from zero volts?**	and Reactivation in this section. **No** GO to H30.
H30 CHECK CIRCUITS 918 (GY) AND 919 (GY/BK) FOR A SHORT TO POWER	
● Key in OFF position. ● Disconnect: Driver Seat Module (DSM) C341b. ● Key in ON position. ● Measure the voltage between driver seat module (DSM) C341b-8, circuit 918 (GY), harness side and ground; and between DSM C341b-21, circuit 919 (GY/BK), harness side and ground.  A0050496 ● **Is any voltage indicated?**	**Yes** REPAIR the circuit(s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to H31.
H31 CHECK CIRCUITS 918 (GY) AND 919 (GY/BK) FOR AN OPEN	
● Key in OFF position. ● Measure the resistance between driver seat module (DSM) C341b-8, circuit 918 (GY), harness side and recliner power seat motor C3187-1, circuit 918 (GY), harness side; and between DSM C341b-21, circuit 919 (GY/BK), harness side and recliner power seat motor C3187-2, circuit 919 (GY/BK), harness side.  A0050497 ● **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new DSM. REFER to Section 419-10. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** REPAIR the circuit(s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental

	Restraint System (SRS) Deactivation and Reactivation in this section.

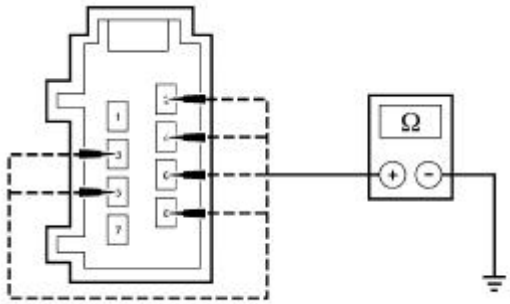
PINPOINT TEST I: THE MEMORY SEAT IS INOPERATIVE — EXPEDITION

Test Step	Result / Action to Take
I1 RETRIEVE THE DTCS	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards. NOTE: If a seat equipped with a seat-mounted side air bag and/or a safety belt pretensioner (if equipped) system is being serviced, **the air bag system must be deactivated.** Refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in the General Procedures portion of this section. **NOTE:** Restraint system diagnostic tools **MUST** be installed under the seats in the seat side air bag (if equipped) and safety belt pretensioner (if equipped) to floor connectors. **NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. ● Deactivate the supplemental restraint system (SRS). Refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. ● Key in OFF position. ● Connect the diagnostic tool. ● Enter the following diagnostic mode on the diagnostic tool: Retrieve and Document Continuous DTCs. ● Enter the following diagnostic mode on the diagnostic tool: Clear the Continuous DTCs. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self-Test. ● **Are any DTCs retrieved?**	**Yes** If DTCs B1663, B1664, and B1665 are all retrieved, GO to I10 . If DTC B1663, GO to I18 . If DTC B1664, . If DTC B1665, GO to I24 . If DTC B1711, GO to I3 . If DTC B1715, GO to I3 . If DTC B1719, GO to I3 . If DTC B1723, GO to I3 . If DTC B1727, GO to I3 . If DTC B1731, GO to I3 . If DTC B1342, INSTALL a new DSM. REFER to Section 419-10 . TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

	No GO to I2 .
I2 CHECK THE DSM FOR CORRECT MEMORY SEAT SWITCH INPUTS — MONITOR THE DSM PIDS SFNT_SW, SREARSW AND SFWS_SW ● Enter the following diagnostic mode on the diagnostic tool: Monitor PIDs. ● Monitor the PIDs SFNT_SW, SREARSW and SFWS_SW while activating the seat switch. ● **Do the PID values agree with the switch positions?**	**Yes** GO to I9 . **No** If Power Distribution Junction Box (PDJB) fuse 3 (7.5A) fails while operating the seat control switch, GO to I7 . If PDJB fuse 3 (7.5A) is OK, GO to I3 .
I3 CHECK THE SEAT CONTROL SWITCH ● Key in OFF position. ● Disconnect: Seat Control Switch C352. ● Check the seat control switch. For additional information, Refer to Wiring Diagrams Cell 149 for schematic and connector information. ● **Is the seat control switch OK?**	**Yes** GO to I4 . **No** INSTALL a new seat control switch. REFER to Seat Control Switch—6-Way in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
I4 CHECK FOR VOLTAGE TO THE SEAT CONTROL SWITCH — CIRCUIT 956 (OG/LG) ● Measure the voltage between seat control switch C352-7, circuit 956 (OG/LG), harness side and ground.  A0017520 ● **Is the voltage greater than 10 volts?**	**Yes** GO to I5 . **No** REPAIR circuit 956 (OG/LG). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

I5 CHECK CIRCUIT 875 (BK/LB) FOR AN OPEN	
• Measure the resistance between seat control switch C352-1, circuit 875 (BK/LB), harness side and ground.  A0017521 • **Is the resistance less than 5 ohms?**	**Yes** GO to I6 . **No** REPAIR circuit 875 (BK/LB). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
I6 CHECK CIRCUITS 1468, 1467, 1466, 1463, 1465, AND 1464 FOR A SHORT TO POWER	
• Disconnect: Driver Seat Module (DSM) C341b. • Key in ON position. • Measure the voltage between the following seat control switch C352 pins, harness side and ground. **Connector C352 / Circuit** Pin 2 — 1463 (RD/WH) Pin 3 — 1466 (GY/OG) Pin 4 — 1467 (GY/WH) Pin 5 — 1465 (GY/WH) Pin 6 — 1468 (GY/LB) Pin 8 — 1464 (YE)  A0017522 • **Is any voltage indicated?**	**Yes** REPAIR the circuit (s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to I7 .
I7 CHECK CIRCUITS 1468, 1467, 1466, 1463, 1465, AND 1464 FOR A SHORT TO GROUND	
• Key in OFF position. • Measure the resistance between the following seat control switch C352 pins, harness side and ground. **Connector C352 / Circuit** Pin 2 — 1463 (RD/WH)	**Yes** REPAIR the circuit (s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system

Pin 3	1466 (GY/OG)
Pin 4	1467 (GY/WH)
Pin 5	1465 (GY/WH)
Pin 6	1468 (GY/LB)
Pin 8	1464 (YE)



- **Are the resistances greater than 10,000 ohms?**

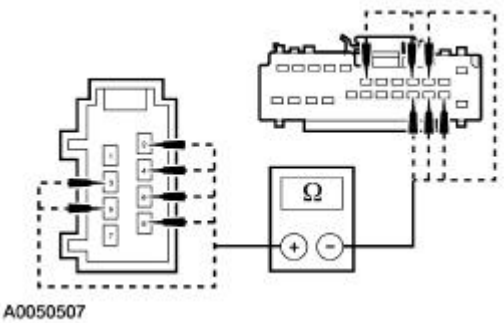
(SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

No
GO to I8.

I8 CHECK CIRCUITS 1468, 1467, 1466, 1463, 1465, AND 1464 FOR AN OPEN

- Measure the resistance between the following seat control switch C352 pins harness side and driver seat module (DSM) C341b pins, harness side.

Seat Control Switch C352	Circuit	Driver Seat Module (DSM) C341b
Pin 2	1463 (RD/WH)	Pin 7
Pin 3	1466 (GY/OG)	Pin 14
Pin 4	1467 (GY/WH)	Pin 3
Pin 5	1465 (GY/WH)	Pin 15
Pin 6	1468 (GY/LB)	Pin 4
Pin 8	1464 (YE)	Pin 16

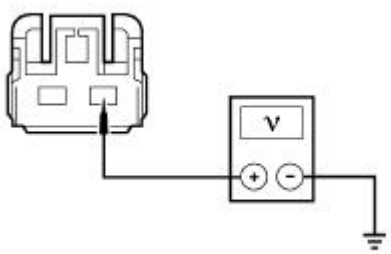


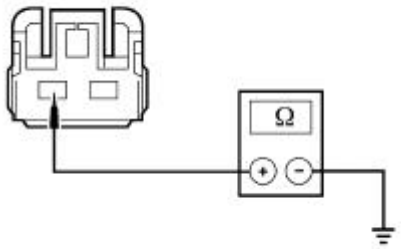
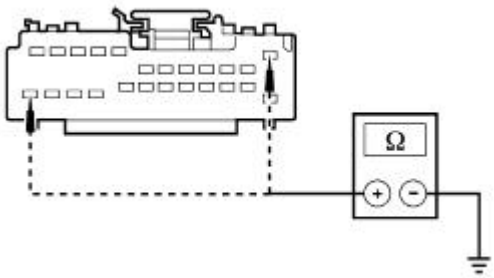
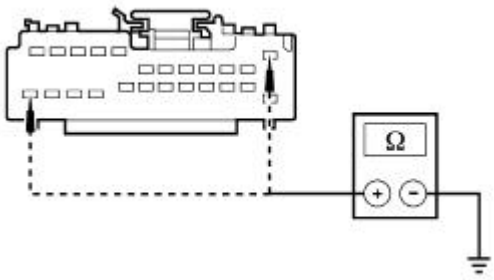
- **Are the resistances less than 5 ohms?**

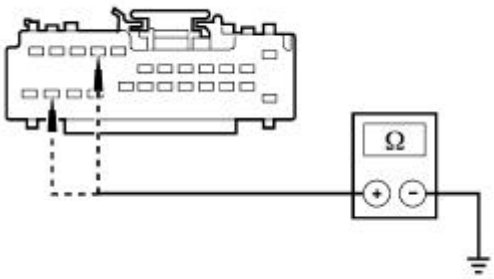
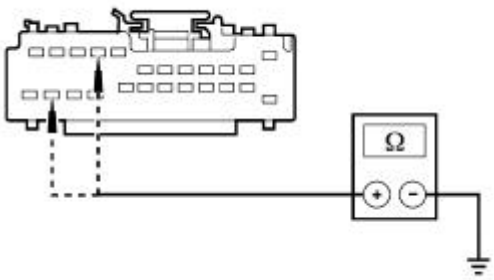
Yes
INSTALL a new DSM. REFER to Section 419-10. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

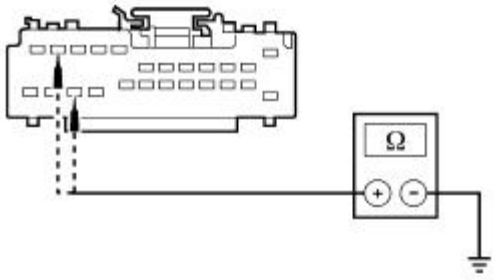
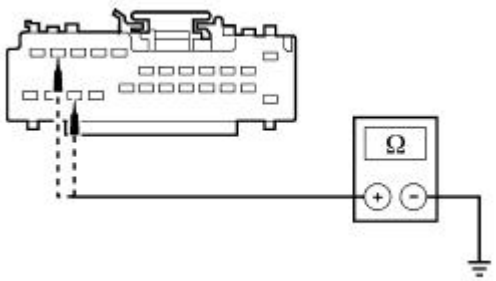
No
REPAIR the circuit (s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

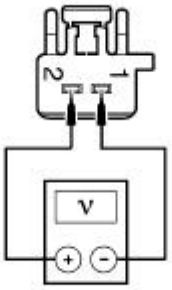
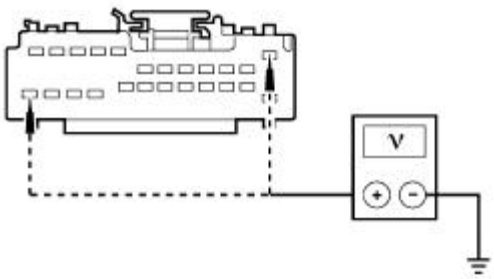
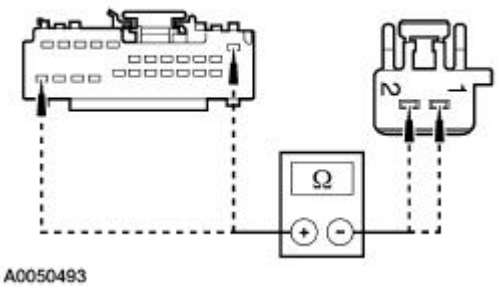
I9 CHECK THE DRIVER SEAT MODULE (DSM) FOR CORRECT

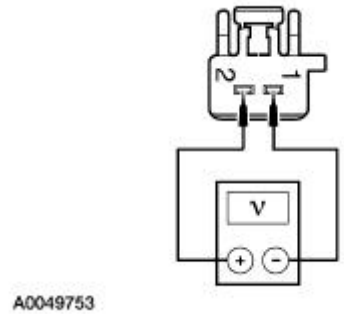
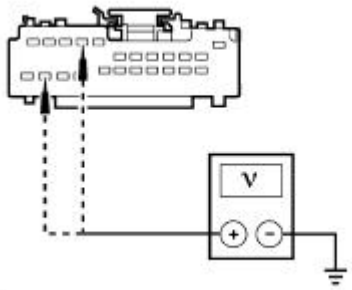
OUTPUTS USING SCAN TOOL DSM ACTIVE COMMANDS	
• Enter the following diagnostic mode on the diagnostic tool: Active Commands. • Toggle the following DSM active commands: ■ FRONT UP on and off. ■ FRONT DWN on and off. ■ REAR UP on and off. ■ REAR DWN on and off. ■ HORZ FWD on and off. ■ HORZ RWD on and off. • **Does the driver seat operate correctly?**	**Yes** INSTALL a new DSM. REFER to Section 419-10 . TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** If no seat movement, GO to I10 . If no front vertical seat movement, GO to I18 . If no rear vertical seat movement, GO to I21 . If no horizontal seat movement, GO to I24 .
I10 CHECK THE DRIVER SEAT MODULE (DSM) FOR VOLTAGE — CIRCUIT 566 (DG)	
• Key in OFF position. • Disconnect: Driver Seat Module (DSM) C341a. • Measure the voltage between driver seat module (DSM) C341a-1, circuit 566 (DG), harness side and ground.  A0042092 • **Is the voltage greater than 10 volts?**	**Yes** GO to I11 . **No** REPAIR circuit 566 (DG). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
I11 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
• Measure the resistance between driver seat module (DSM) C341a-2, circuit 57 (BK), harness side and ground.	**Yes** GO to I12 . **No** REPAIR circuit 57 (BK). TEST the system for normal operation.

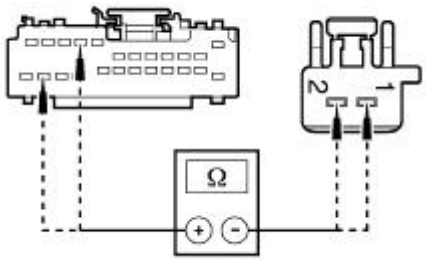
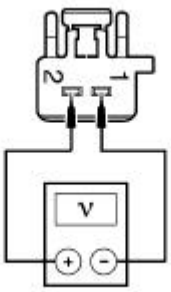
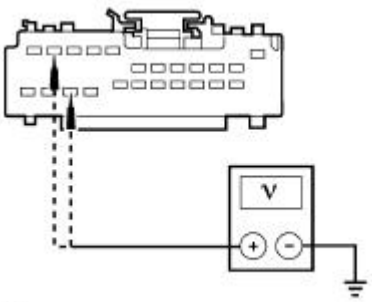
 A0042093 ● **Is the resistance less than 5 ohms?**	REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
I12 CHECK CIRCUITS 1469 (RD/LB) AND 1470 (YE/LB) FOR A SHORT TO GROUND	
● Disconnect: Driver Seat Module (DSM) C341b. ● Measure the resistance between driver seat module (DSM) C341b-1, circuit 1469 (RD/LB), harness side and ground; and between DSM C341b-24, circuit 1470 (YE/LB), harness side and ground.  A0042094 ● **Are the resistances greater than 10,000 ohms?**	**Yes** GO to I14. **No** GO to I13.
I13 CHECK FRONT HEIGHT MOTOR FOR A SHORT TO GROUND — CIRCUITS 1469 (RD/LB) AND 1470 (YE/LB)	
● Disconnect: Driver Seat Module (DSM) C341b. ● Disconnect: Front Height Power Seat Motor C382. ● Measure the resistance between driver seat module (DSM) C341b-1, circuit 1469 (RD/LB), harness side and ground; and between DSM C341b-24, circuit 1470 (YE/LB), harness side and ground.  A0042094 ● **Are the resistances greater than 10,000 ohms?**	**Yes** INSTALL a new front height power seat motor. REFER to Front Seat Track Motor in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** REPAIR the circuit (s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to

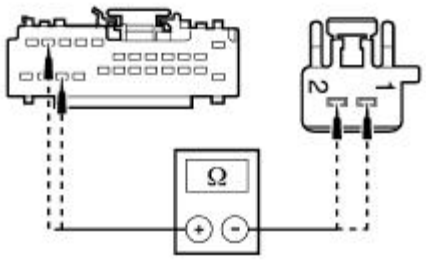
	Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
I14 CHECK CIRCUITS 1474 (RD/LG) AND 1473 (YE/LG) FOR A SHORT TO GROUND	
• Measure the resistance between driver seat module (DSM) C341b-9, circuit 1474 (RD/LG), harness side and ground; and between DSM C341b-23, circuit 1473 (YE/LG), harness side and ground.  A0042095 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to I16 . **No** GO to I15 .
I15 CHECK THE REAR HEIGHT MOTOR FOR A SHORT TO GROUND — CIRCUITS 1474 (RD/LG) AND 1473 (YE/LG)	
• Disconnect: Rear Height Power Seat Motor C363. • Measure the resistance between driver seat module (DSM) C341b-9, circuit 1474 (RD/LG), harness side and ground; and between DSM C341b-23, circuit 1473 (YE/LG), harness side and ground.  A0042095 • **Are the resistances greater than 10,000 ohms?**	**Yes** INSTALL a new rear height power seat motor. REFER to Front Seat Track Motor in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** REPAIR the circuit (s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
I16 CHECK CIRCUITS 1472 (YE/WH) AND 1471 (RD/WH) FOR A SHORT TO GROUND	
• Measure the resistance between driver seat module (DSM) C341b-	**Yes**

22, circuit 1472 (YE/WH), harness side and ground; and between DSM C341b-11, circuit 1471 (RD/WH), harness side and ground.  A0042096 ● **Are the resistances greater than 10,000 ohms?**	INSTALL a new DSM. REFER to Section 419-10 . TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to I17 .
I17 CHECK THE HORIZONTAL MOTOR FOR A SHORT TO GROUND — CIRCUITS 1472 (YE/WH) AND 1471 (RD/WH)	
● Disconnect: Horizontal Power Seat Motor C362. ● Measure the resistance between driver seat module (DSM) C341b-22, circuit 1472 (YE/WH), harness side and ground; and between DSM C341b-11, circuit 1471 (RD/WH), harness side and ground.  A0042096 ● **Are the resistances greater than 10,000 ohms?**	**Yes** INSTALL a new horizontal power seat motor. REFER to Front Seat Track Motor in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** REPAIR the circuit (s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
I18 CHECK THE FRONT HEIGHT MOTOR FOR CORRECT OPERATION	
● Key in OFF position. ● Disconnect: Front Height Power Seat Motor C382. ● Key in ON position. ● Measure the voltage between front height power seat motor C382-1, circuit 1469 (RD/LB), and C382-2, circuit 1470 (YE/LB), harness side while toggling DSM active commands FRONT UP and FRONT DOWN on and off.	**Yes** INSTALL a new front height power seat motor. REFER to Front Seat Track Motor in this section. TEST the system for normal operation.

 A0049753 ● **Does the voltage change from zero volts?**	REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to I19.
I19 CHECK CIRCUITS 1469 (RD/LB) AND 1470 (YE/LB) FOR A SHORT TO POWER	
● Key in OFF position. ● Disconnect: Driver Seat Module (DSM) C341b. ● Key in ON position. ● Measure the voltage between driver seat module (DSM) C341b-1, circuit 1469 (RD/LB), harness side and ground; and between DSM C341b-24, circuit 1470 (YE/LB), harness side and ground.  A0042097 ● **Is any voltage indicated?**	**Yes** REPAIR the circuit (s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to I20.
I20 CHECK CIRCUITS 1469 (RD/LB) AND 1470 (YE/LB) FOR AN OPEN	
● Key in OFF position. ● Measure the resistance between driver seat module (DSM) C341b-1, circuit 1469 (RD/LB), harness side and front height power seat motor C382-1, circuit 1469 (RD/LB), harness side; and between DSM C341b-24, circuit 1470 (YE/LB), harness side and front height power seat motor C382-2, circuit 1470 (YE/LB), harness side.  A0050493 ● **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new DSM. REFER to Section 419-10. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** REPAIR the circuit (s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to

	Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
I21 CHECK THE REAR HEIGHT MOTOR FOR CORRECT OPERATION	
• Key in OFF position. • Disconnect: Rear Height Power Seat Motor C363. • Key in ON position. • Measure the voltage between rear height power seat motor C363-1, circuit 1474 (RD/LG), harness side and C363-2, circuit 1473 (YE/LG), harness side while toggling DSM active commands REAR UP and REAR DOWN ON and OFF.  A0049753 • **Does the voltage change from zero volts?**	**Yes** INSTALL a new rear height power seat motor. REFER to Front Seat Track Motor in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to I22.
I22 CHECK CIRCUITS 1474 (RD/LG) AND 1473 (YE/LG) FOR A SHORT TO POWER	
• Key in OFF position. • Disconnect: Driver Seat Module (DSM) C341b. • Key in ON position. • Measure the voltage between driver seat module (DSM) C341b-9, circuit 1474 (RD/LG), harness side and ground; and between DSM C341b-23, circuit 1473 (YE/LG), harness side and ground.  A0042099 • **Is any voltage indicated?**	**Yes** REPAIR the circuit (s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to I23.
I23 CHECK CIRCUITS 1474 (RD/LG) AND 1473 (YE/LG) FOR AN OPEN	
• Key in OFF position. • Measure the resistance between driver seat module (DSM) C341b-9, circuit 1474 (RD/LG), harness side and rear height power seat motor C363-1, circuit 1474 (RD/LG), harness side; and between DSM C341b-23, circuit 1473 (YE/LG), harness side and rear height power seat motor C363-2, circuit 1473 (YE/LG), harness side.	**Yes** INSTALL a new DSM. REFER to Section 419-10. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental

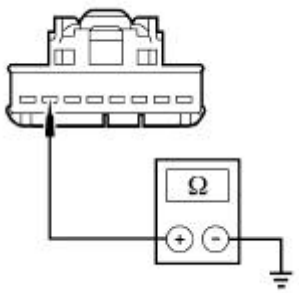
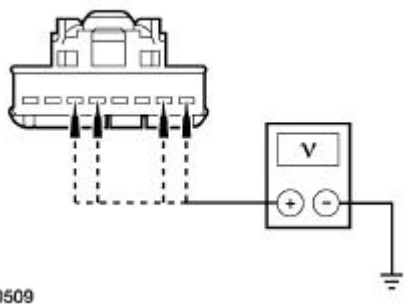
 A0050494 ● **Are the resistances less than 5 ohms?**	Restraint System (SRS) Deactivation and Reactivation in this section. **No** REPAIR the circuit (s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
I24 CHECK THE HORIZONTAL MOTOR FOR CORRECT OPERATION	
● Key in OFF position. ● Disconnect: Horizontal Power Seat Motor C362. ● Key in ON position. ● Measure the voltage between horizontal power seat motor C362-2, circuit 1472 (YE/WH), and C362-1, circuit 1471 (RD/WH), harness side while toggling DSM active commands HORZ FWD and HORZ RWD ON and OFF.  A0049753 ● **Does the voltage change from zero volts?**	**Yes** INSTALL a new horizontal power seat motor. REFER to Front Seat Track Motor in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to I25.
I25 CHECK CIRCUITS 1472 (YE/WH) AND 1471 (RD/WH) FOR A SHORT TO POWER	
● Key in OFF position. ● Disconnect: Driver Seat Module (DSM) C341b. ● Key in ON position. ● Measure the voltage between driver seat module (DSM) C341b-22, circuit 1472 (YE/WH), harness side and ground; and between DSM C341b-11, circuit 1471 (RD/WH), harness side and ground.  A0042101 ● **Is any voltage indicated?**	**Yes** REPAIR the circuit (s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to I26.

I26 CHECK CIRCUITS 1472 (YE/WH) AND 1471 (RD/WH) FOR AN OPEN	
• Key in OFF position. • Measure the resistance between driver seat module (DSM) C341b-22, circuit 1472 (YE/WH), harness side and horizontal power seat motor C362-2, circuit 1472 (YE/WH), harness side; and between DSM C341b-11, circuit 1471 (RD/WH), harness side and horizontal power seat motor C362-1, circuit 1471 (RD/WH), harness side.  A0050495 • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new DSM. REFER to Section 419-10 . TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** REPAIR the circuit (s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

PINPOINT TEST J: THE MEMORY SEAT DOES NOT OPERATE CORRECTLY — DOES NOT OPERATE USING THE MEMORY SET SWITCH

Test Step	Result / Action to Take
J1 RETRIEVE THE DTCS	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards. NOTE: If a seat equipped with a seat-mounted side air bag and/or a safety belt pretensioner (if equipped) system is being serviced, **the air bag system must be deactivated.** Refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in the General Procedures portion of this section. **NOTE:** Restraint system diagnostic tools **MUST** be installed under the seats in the seat side air bag (if equipped) and safety belt pretensioner (if equipped) to floor connectors. **NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. • Deactivate the supplemental restraint system (SRS). Refer to Supplemental Restraint System (SRS) Deactivation and	**Yes** If the memory set LED fails to illuminate during the On-Demand Self-Test, GO to J5 . If DTCs B1950, B1954, and B1962 are all retrieved, GO to J8 . If DTC B1530, GO to J3 . If DTC B1534, GO to J3 .

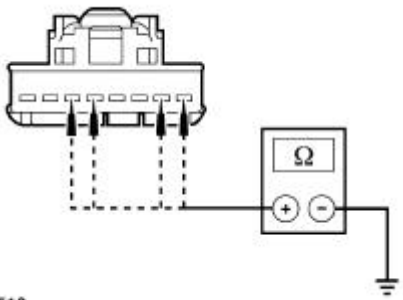
Reactivation in this section. ● Key in OFF position. ● Connect the diagnostic tool. ● Enter the following diagnostic mode on the diagnostic tool: Retrieve and Document Continuous DTCs. ● Enter the following diagnostic mode on the diagnostic tool: Clear Continuous DTCs. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self-Test. ● **NOTE:** During the On-Demand Self-Test, document when the memory set LED illuminates and turns off. ● **Are any DTCs retrieved or does the memory set LED fail to illuminate during the On-Demand Self-Test?**	If DTC B1538, GO to J3. If DTC B1663, GO to J9. If DTC B1664, GO to J13. If DTC B1665, GO to J15. If DTC B1950, GO to J12. If DTC B1952, GO to J12. If DTC B1954, GO to J9. If DTC B1956, GO to J9. If DTC B1962, GO to J15. If DTC B1964, GO to J15. If DTC B1342, INSTALL a new DSM. REFER to Section 419-10. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to J2.
J2 CHECK THE DSM FOR CORRECT MEMORY SET SWITCH INPUTS — MONITOR THE DSM PIDS MEM1_SW, MEM2_SW AND MEMS_SW	
● Enter the following diagnostic mode on the diagnostic tool: Monitor PIDs. ● Monitor the DSM PIDs MEM1_SW, MEM2_SW and MEMS_SW while activating the seat switch. ● **Do the PID values agree with the switch positions?**	**Yes** GO to J8. **No** GO to J3.
J3 CHECK THE MEMORY SET SWITCH	
● Key in OFF position. ● Disconnect: Memory Set Switch C503. ● Carry out the Memory Set Switch Component Test. ● **Is the memory set switch OK?**	**Yes** GO to J4. **No** INSTALL a new

	memory set switch. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
J4 CHECK GROUND CIRCUIT TO THE MEMORY SET SWITCH — CIRCUIT 875 (BK/LB) • Key in ON position. • Measure the resistance between memory set switch C503-7, circuit 875 (BK/LB), harness side and ground.  A0042473 • **Is the resistance less than 5 ohms?**	**Yes** GO to J5 . **No** REPAIR circuit 875 (BK/LB). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
J5 CHECK CIRCUITS 267 (BN/LG), 268 (BK/OG), 270 (BN/OG), AND 272 (WH/OG) FOR A SHORT TO POWER • Disconnect: DSM C341c. • Key in ON position. • Measure the voltage between the following memory set switch C503 pins, harness side and ground: **Connector C503** / **Circuit** Pin 2 — 267 (BN/LG) Pin 6 — 268 (BK/OG) Pin 5 — 270 (BN/OG) Pin 1 — 272 (WH/OG)  A0050509 • **Is any voltage indicated?**	**Yes** REPAIR the circuit (s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to J6 .

J6 CHECK CIRCUITS 267 (BN/LG), 268 (BK/OG), 270 (BN/OG), AND 272 (WH/OG) FOR A SHORT TO GROUND

- Key in OFF position.
- Measure the resistance between the following memory set switch C503 pins, harness side and ground:

Connector C503	Circuit
Pin 2	267 (BN/LG)
Pin 6	268 (BK/OG)
Pin 5	270 (BN/OG)
Pin 1	272 (WH/OG)



A0050510

- **Are the resistances greater than 10,000 ohms?**

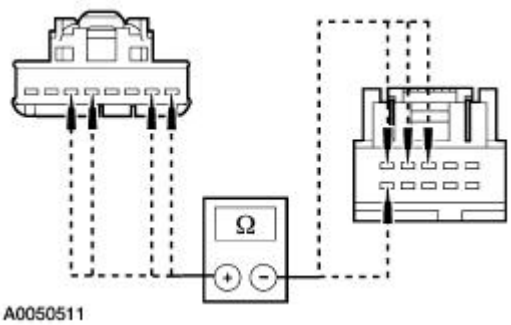
Yes
GO to J7 .

No
REPAIR the circuit (s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

J7 CHECK CIRCUITS 267 (BN/LG), 268 (BK/OG), 270 (BN/OG), AND 272 (WH/OG) FOR AN OPEN

- Measure the resistance between the following memory set switch C503 pins and DSM C341c pins:

Memory Set Switch C503	Circuit	DSM C341c
Pin 2	267 (BN/LG)	Pin 4
Pin 6	268 (BK/OG)	Pin 3
Pin 5	270 (BN/OG)	Pin 5
Pin 1	272 (WH/OG)	Pin 10



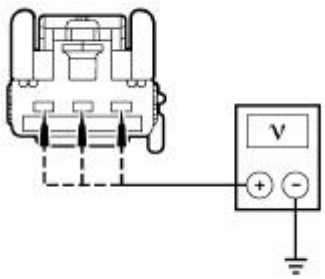
A0050511

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

Yes
INSTALL a new DSM. REFER to Section 419-10 . TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

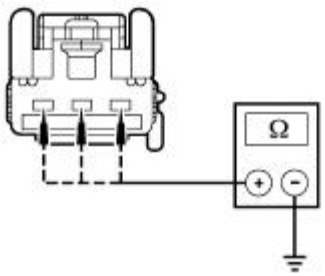
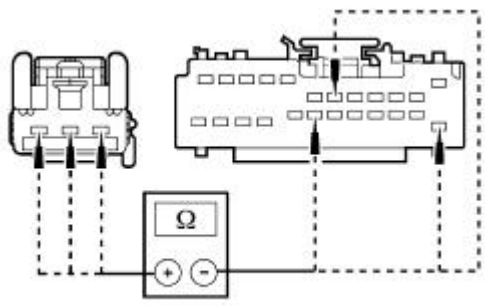
No
REPAIR the circuit (s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

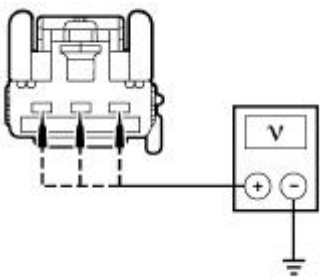
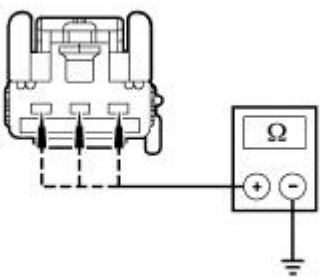
J8 CHECK THE DSM FOR CORRECT OUTPUTS — MONITOR THE DSM PIDS SFWD_P, SFNT_P, SREAR_P AND SEATRCN	
• Place the seat in a central position, using the seat control switch. • Enter the following diagnostic mode on the diagnostic tool: Monitor PIDs. • Monitor the following DSM PIDs ■ SFWD_P while operating the seat control switch forward/rearward switch. ■ SFNT_P while operating the seat control switch front up/down switch. ■ SREAR_P while operating the seat control switch rear up/down switch. ■ SRCL_SW while operating the seat control switch recline forward/rearward switch. • **Do the PID (position % of travel) values increase with forward/down movement and decrease with rearward/up movement throughout entire travel?**	**Yes** INSTALL a new DSM. REFER to Section 419-10 . TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** If the PID SFWD_P values do not increase or decrease, GO to J15 . If the PID SFNT_P values do not increase or decrease, GO to J9 . If the PID SREAR_P values do not increase or decrease, GO to J12 . If the PID SRCL_SW values do not increase or decrease GO to J18 .
J9 CHECK CIRCUITS 443 (LG/RD), 447 (OG/RD) AND 446 (OG/WH) FOR A SHORT TO POWER	
• Key in OFF position. • Disconnect: DSM C341b. • Disconnect: Front Height Position Sensor C383. • Key in ON position. • Measure the voltage between front height position sensor C383, circuit 443 (LG/RD), harness side and ground; and between front height position sensor C383, circuit 447 (OG/RD), harness side and ground; and between front height position sensor C383, circuit 446 (OG/WH), harness side and ground.	**Yes** REPAIR the circuit (s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to J10 .

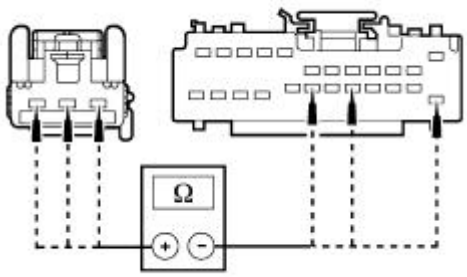
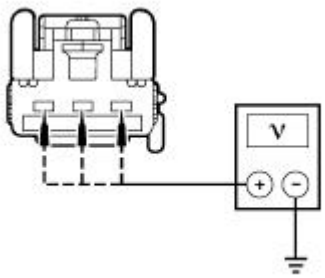


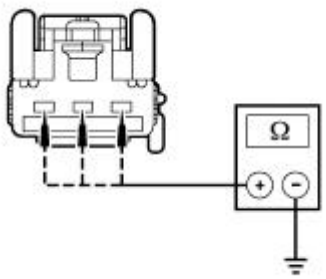
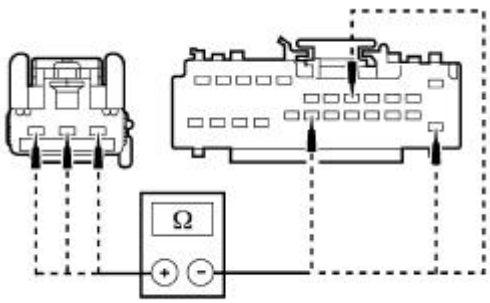
A0050512

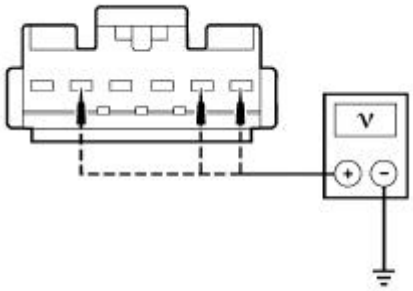
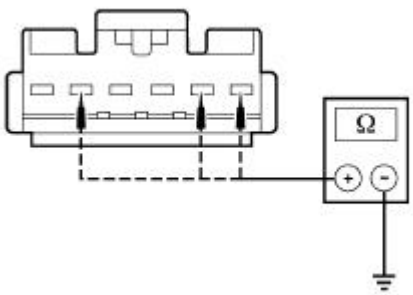
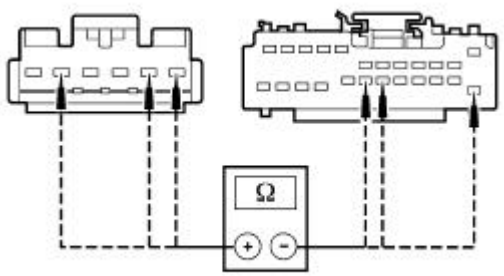
- **Is any voltage indicated?**

J10 CHECK CIRCUITS 443 (LG/RD), 447 (OG/RD) AND 446 (OG/WH) FOR A SHORT TO GROUND	
• Key in OFF position. • Measure the resistance between front height position sensor C383, circuit 443 (LG/RD), harness side and ground; and between front height position sensor C383, circuit 447 (OG/RD), harness side and ground; and between front height position sensor C383, circuit 446 (OG/WH), harness side and ground.  A0050513 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to J11 . **No** REPAIR the circuit (s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
J11 CHECK CIRCUITS 443 (LG/RD), 447 (OG/RD) AND 446 (OG/WH) FOR AN OPEN	
• Measure the resistance between front height position sensor C383, circuit 443 (LG/RD), harness side and DSM C341b-6, circuit 443 (LG/RD), harness side; between front height position sensor C383, circuit 447 (OG/RD), harness side and DSM C341b-13, circuit 447 (OG/RD), harness side; and between front height position sensor C383, circuit 446 (OG/WH), harness side and DSM C341b-19, circuit 446 (OG/WH), harness side.  A0050514 • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new front height power seat motor. REFER to Front Seat Track Motor in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** REPAIR the circuit (s) in question. TEST the system for normal operation. REACTIVATE the supplemental

	restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
J12 CHECK CIRCUITS 444 (LG/BK), 447 (OG/RD) AND 446 (OG/WH) FOR A SHORT TO POWER ● Key in OFF position. ● Disconnect: DSM C341b. ● Disconnect: Rear Height Position Sensor C373. ● Measure the voltage between rear height position sensor C373, circuit 444 (LG/BK), harness side and ground; between rear height position sensor C373, circuit 447 (OG/RD), harness side and ground; and between rear height position sensor C373, circuit 446 (OG/WH), harness side and ground.  A0050512 ● **Is any voltage indicated?**	**Yes** REPAIR the circuit (s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to J13 .
J13 CHECK CIRCUITS 444 (LG/BK), 447 (OG/RD) AND 446 (OG/WH) FOR A SHORT TO GROUND ● Key in OFF position. ● Measure the resistance between rear height position sensor C373, circuit 444 (LG/BK), harness side and ground; between rear height position sensor C373, circuit 447 (OG/RD), harness side and ground; and between rear height position sensor C373, circuit 446 (OG/WH), harness side and ground.  A0050513 ● **Are the resistances greater than 10,000 ohms?**	**Yes** GO to J14 . **No** REPAIR the circuit (s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
J14 CHECK CIRCUITS 444 (LG/BK), 447 (OG/RD) AND 446 (OG/WH) FOR OPEN ● Measure the resistance between rear height position sensor C373, circuit 444 (LG/BK), harness side and DSM C341b-17, circuit 444 (LG/BK), harness side; between rear height position sensor C373, circuit 447 (OG/RD), harness side, and DSM C341b-13, circuit 447 (OG/RD), harness side; and between rear height position sensor C373, circuit 446 (OG/WH), harness side, and DSM C341b-19, circuit 446 (OG/WH), harness side.	**Yes** INSTALL a new rear height power seat motor. REFER to Front Seat Track Motor in this section. TEST the system for

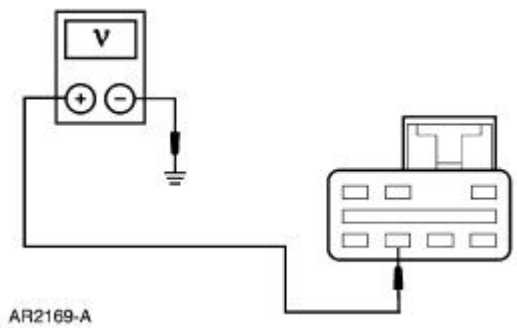
 A0050515 ● **Are the resistances less than 5 ohms?**	normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** REPAIR the circuit (s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
J15 CHECK CIRCUITS 442 (LG/OG), 447 (OG/RD) AND 446 (OG/WH) FOR A SHORT TO POWER	
● Key in OFF position. ● Disconnect: DSM C341b. ● Disconnect: Forward/Rearward Position Sensor C372. ● Measure the voltage between forward/rearward position sensor C372, circuit 442 (LG/OG), harness side and ground; between forward/rearward position sensor C372, circuit 447 (OG/RD), harness side and ground; and between forward/rearward position sensor C372, circuit 446 (OG/WH), harness side and ground.  A0050512 ● **Is any voltage indicated?**	**Yes** REPAIR the circuit (s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to J16.
J16 CHECK CIRCUITS 442 (LG/OG), 447 (OG/RD) AND 446 (OG/WH) FOR A SHORT TO GROUND	
● Key in OFF position. ● Measure the resistance between forward/rearward position sensor C372, circuit 442 (LG/OG), harness side and ground; between forward/rearward position sensor C372, circuit 447 (OG/RD), harness side and ground; and between forward/rearward position sensor C372, circuit 446 (OG/WH), harness side and ground.	**Yes** GO to J17. **No** REPAIR the circuit (s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system

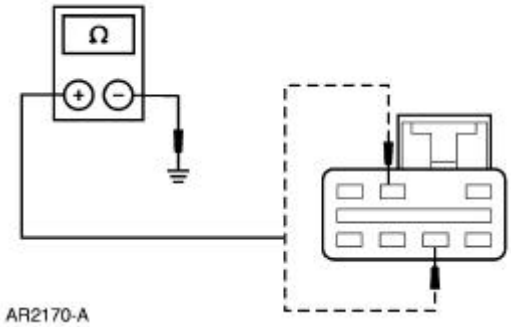
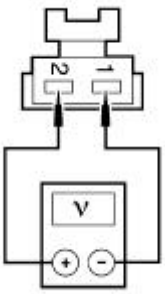
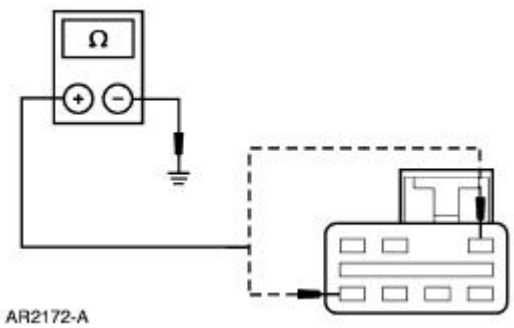
 A0050513 ● **Are the resistances greater than 10,000 ohms?**	(SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
J17 CHECK CIRCUITS 442 (LG/OG), 447 (OG/RD) AND 446 (OG/WH) FOR AN OPEN	
● Measure the resistance between forward/rearward position sensor C372, circuit 442 (LG/OG), harness side and DSM C341b-5, circuit 442 (LG/OG), harness side; between forward/rearward position sensor C372, circuit 447 (OG/RD), harness side and DSM C341b-13, circuit 447 (OG/RD), harness side; and between forward/rearward position sensor C372, circuit 446 (OG/WH), harness side, and DSM C341b-19, circuit 446 (OG/WH), harness side.  A0050516 ● **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new horizontal power seat motor. REFER to Front Seat Track Motor in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** REPAIR the circuit (s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
J18 CHECK CIRCUITS 445 (OG/LB), 447 (OG/RD) AND 446 (OG/WH) FOR A SHORT TO POWER	
● Key in OFF position. ● Disconnect: DSM C341b. ● Disconnect: Recliner Position Sensor C3188. ● Measure the voltage between recliner position sensor C3188, circuit 445-2 (OG/LB), harness side and ground; between recliner position sensor C3188, circuit 447-6 (OG/RD), harness side and ground; and between recliner position sensor C3188, circuit 446-5 (OG/WH), harness side and ground.	**Yes** REPAIR the circuit (s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation

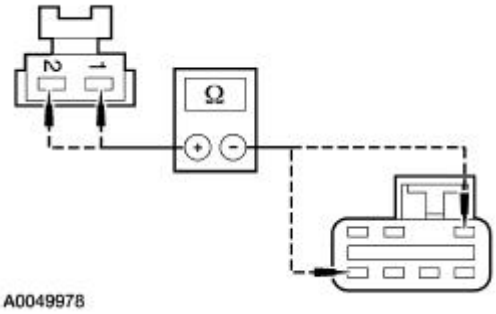
 A0050517 ● **Is any voltage indicated?**	and Reactivation in this section. **No** GO to J19.
J19 CHECK CIRCUITS 445 (OG/LB), 447 (OG/RD) AND 446 (OG/WH) FOR A SHORT TO GROUND	
● Key in OFF position. ● Measure the resistance between recliner position sensor C3188, circuit 445-2 (OG/LB), harness side and ground; between recliner position sensor C3188, circuit 447-6 (OG/RD), harness side and ground; and between recliner position sensor C3188, circuit 446-5 (OG/WH), harness side and ground.  A0050518 ● **Are the resistances greater than 10,000 ohms?**	**Yes** GO to J20. **No** REPAIR the circuit (s) in question. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
J20 CHECK CIRCUITS 445 (OG/LB), 447 (OG/RD) AND 446 (OG/WH) FOR AN OPEN	
● Measure the resistance between recliner position sensor C3188, circuit 445 (OG/LB), harness side and DSM C341b-18, circuit 445 (OG/LB), harness side; between recliner position sensor C3188, circuit 447 (OG/RD), harness side and DSM C341b-13, circuit 447 (OG/RD), harness side; and between recliner position sensor C3188, circuit 446 (OG/WH), harness side and DSM C341b-19, circuit 446 (OG/WH), harness side.  A0050519 ● **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new recline power seat motor. REFER to Front Seat Recliner Motor in this section. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** REPAIR the circuit (s) in question. TEST the system for normal operation. REACTIVATE the supplemental

	restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

PINPOINT TEST K: THE POWER LUMBAR IS INOPERATIVE—DRIVER

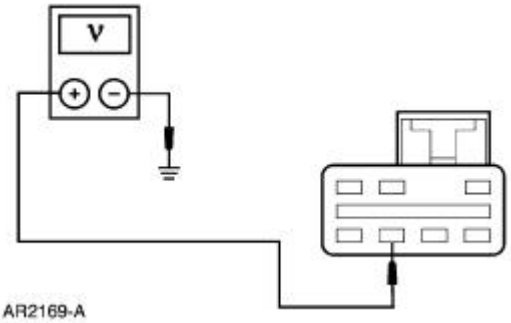
Test Step	Result / Action to Take
K1 CHECK CIRCUIT 566 (DG) FOR AN OPEN	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards. NOTE: If a seat equipped with a seat-mounted side air bag and/or a safety belt pretensioner (if equipped) system is being serviced, **the air bag system must be deactivated.** Refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in the General Procedures portion of this section. **NOTE:** Restraint system diagnostic tools **MUST** be installed under the seats in the seat side air bag (if equipped) and safety belt pretensioner (if equipped) to floor connectors. **NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. ● Key in OFF position. ● Deactivate the supplemental restraint system (SRS). Refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. ● Disconnect: Lumbar Switch C361. ● Measure the voltage between driver power lumbar switch C361 pin 2, circuit 566 (DG), harness side and ground.  ● **Is the voltage greater than 10 volts?**	**Yes** GO to R2 . **No** **No** REPAIR the circuit. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
K2 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
● Measure the resistance between driver power lumbar switch C361 pin 3, circuit 57 (BK), harness side and ground; and between driver power lumbar switch C361 pin 6, circuit 57 (BK), harness side and ground.	**Yes** GO to R3 . **No** REPAIR the circuit. TEST the system for normal operation.

 AR2170-A ● **Are both resistances less than 5 ohms?**	REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
K3 CHECK THE LUMBAR MOTOR	
● Connect: Lumbar Switch C361. ● Disconnect: Lumbar Motor C366. ● Measure the voltage between driver power lumbar motor C366, circuit 1097 (BN), harness side and driver power lumbar motor C366, circuit 1094 (PK), harness side.  A0049979 ● Operate the driver power lumbar switch in both directions. ● **Is the voltage less than 10 volts in both directions?**	**Yes** INSTALL a new driver power lumbar motor. REFER to Lumbar Motor in this section. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to R4 .
K4 CHECK CIRCUIT 1094 (PK) AND CIRCUIT 1097 (BN) FOR A SHORT TO GROUND	
● Disconnect: Lumbar Switch C361. ● Measure the resistance between driver power lumbar switch C361 pin 1, circuit 1094 (PK), harness side and ground; and between driver power lumbar switch C361 pin 7, circuit 1097 (BN), harness side and ground.  AR2172-A ● **Are the resistances greater than 10,000 ohms?**	**Yes** GO to R5 . **No** REPAIR the circuit. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
K5 CHECK CIRCUIT 1094 (PK) AND CIRCUIT 1097 (BN) FOR AN OPEN	
● Measure the resistance between driver power lumbar switch C361, pin 7, circuit 1097 (BN), harness side and driver power lumbar motor C366, circuit 1097 (BN), harness side; and between driver power lumbar switch C361, pin 1, circuit 1094 (PK), harness side and driver power lumbar motor C366, circuit 1094 (PK), harness side.	**Yes** INSTALL a new power lumbar switch. REFER to Lumbar Control

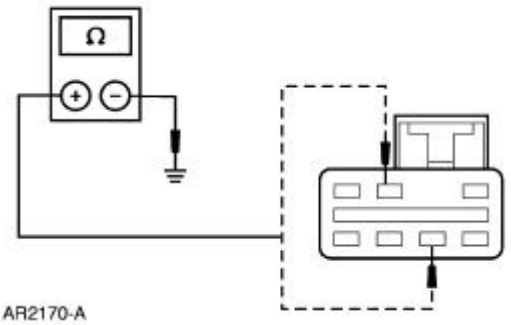
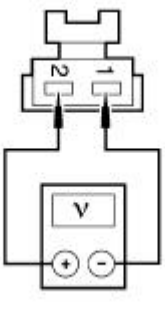
 ● **Are the resistances less than 5 ohms?**	Switch in this section. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** REPAIR the circuit. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

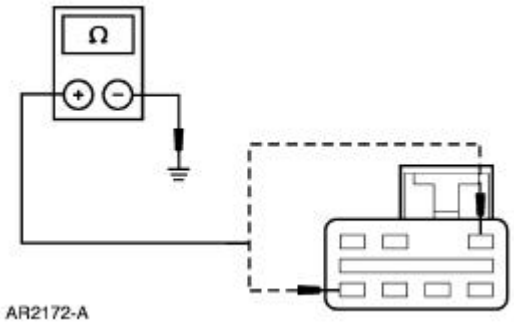
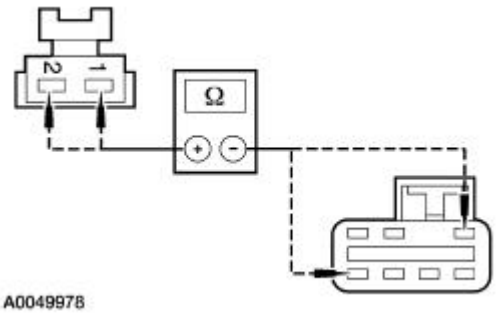
PINPOINT TEST L: THE POWER LUMBAR IS INOPERATIVE—PASSENGER

Test Step	Result / Action to Take
L1 CHECK CIRCUIT 1462 (RD/WH) FOR AN OPEN	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards. NOTE: If a seat equipped with a seat-mounted side air bag and/or a safety belt pretensioner (if equipped) system is being serviced, **the air bag system must be deactivated.** Refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in the General Procedures portion of this section. **NOTE:** Restraint system diagnostic tools **MUST** be installed under the seats in the seat side air bag (if equipped) and safety belt pretensioner (if equipped) to floor connectors. **NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. ● Key in OFF position. ● Deactivate the supplemental restraint system (SRS). Refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. ● Disconnect: Lumbar Switch C331. ● Measure the voltage between driver power lumbar switch C331 pin 2, circuit 1462 (RD/WH), harness side and ground.	**Yes** GO to S2 . **No** REPAIR the circuit. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.



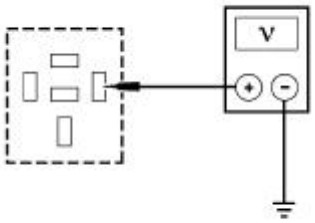
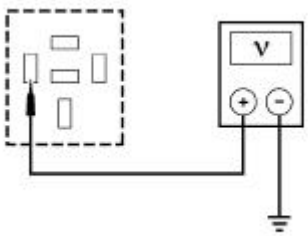
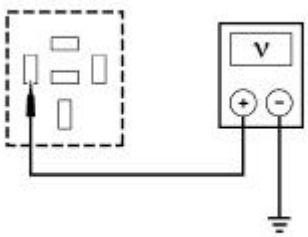
- **Is the voltage greater than 10 volts?**

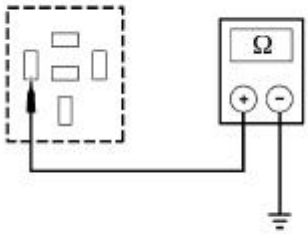
L2 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
• Measure the resistance between driver power lumbar switch C331 pin 3, circuit 57 (BK), harness side and ground; and between driver power lumbar switch C331 pin 6, circuit 57 (BK), harness side and ground.  • **Are both resistances less than 5 ohms?**	**Yes** GO to S3 . **No** REPAIR the circuit. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
L3 CHECK THE LUMBAR MOTOR	
• Connect: Driver Lumbar Switch C331. • Disconnect: Lumbar Motor C336. • Measure the voltage between driver power lumbar motor C336, circuit 1097 (BN), harness side and driver power lumbar motor C336, circuit 1094 (PK), harness side.  • Operate the driver power lumbar switch in both directions. • **Is the voltage less than 10 volts in both directions?**	**Yes** INSTALL a new power lumbar motor. REFER to Lumbar Motor in this section. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to S4 .
L4 CHECK CIRCUIT 1094 (PK) AND CIRCUIT 1097 (BN) FOR A SHORT TO GROUND	
• Disconnect: Lumbar Switch C331. • Measure the resistance between driver power lumbar switch C331 pin 7, circuit 1094 (PK), harness side and ground; and between driver power lumbar switch C331 pin 1, circuit 1097 (BN), harness side and ground.	**Yes** GO to S5 . **No** REPAIR the circuit. TEST the system for normal

 AR2172-A ● **Are the resistances greater than 10,000 ohms?**	operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
L5 CHECK CIRCUIT 1094 (PK) AND CIRCUIT 1097 (BN) FOR AN OPEN	
● Measure the resistance between driver power lumbar switch C331, pin 1, circuit 1097 (BN), harness side and driver power lumbar motor C336, circuit 1097 (BN), harness side; and between driver power lumbar switch C331, pin 7, circuit 1094 (PK), harness side and driver power lumbar motor C336, circuit 1094 (PK), harness side.  A0049978 ● **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new power lumbar switch. REFER to Lumbar Control Switch in this section. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** REPAIR the circuit. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

PINPOINT TEST M: THE THIRD ROW POWER FOLD SEAT IS INOPERATIVE/DOES NOT OPERATE CORRECTLY — BOTH

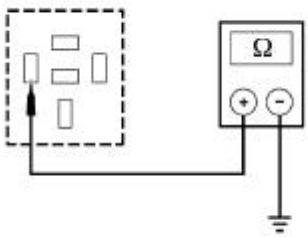
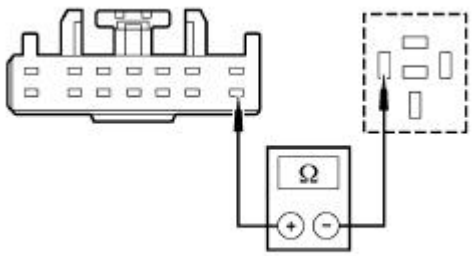
Test Step	Result / Action to Take
M1 CHECK CIRCUIT 729 (RD/WH) FOR AN OPEN	
● Key in ON position. ● Disconnect: Left Third Row Seat Relay C4183. ● Measure the voltage between left third row relay C4183-86, circuit 729 (RD/WH), harness side and ground.	**Yes** GO to M2 . **No** REPAIR the circuit. TEST the system for

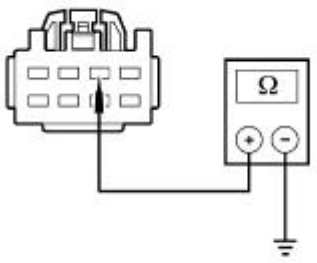
 A0050607 ● **Is the voltage greater than 10 volts?**	normal operation.
M2 CHECK CIRCUIT 1951 (BK/WH) FOR POWER	
● Key in OFF position. ● Disconnect: Right Third Row Seat Relay C4184. ● Key in ON position. ● Measure the voltage between left third row seat relay C4183-85, circuit 1951 (TN), harness side and ground.  A0050608 ● **Is the voltage greater than 10 volts?**	**Yes** GO to M3 . **No** GO to M4 .
M3 CHECK CIRCUIT 1951 (BK/WH) FOR A SHORT TO POWER	
● Key in OFF position. ● Disconnect: Body Security Module (BSM) C2113c. ● Key in ON position. ● Measure the voltage between left third row seat relay C4183-85, circuit 1951 (TN), harness side and ground.  A0050608 ● **Is the voltage less than 10 volts in both directions?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** INSTALL a new BSM. REFER to Section 501-14 . Test the system for normal operation.
M4 CHECK CIRCUIT 1951 (TN) FOR GROUND	
● Key in ON position. ● Measure the resistance between left third row seat relay C4183-85, circuit 1951 (TN), harness side and ground.	**Yes** GO to M5 . **No** GO to M6 .



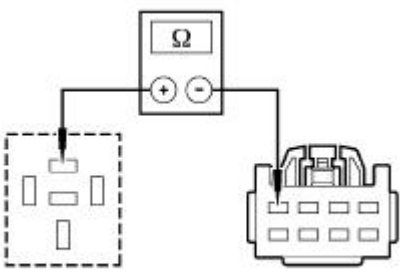
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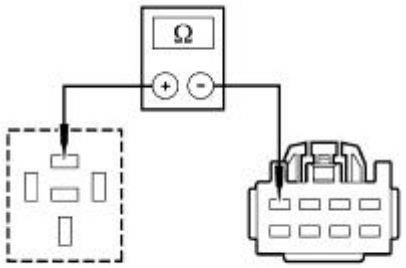
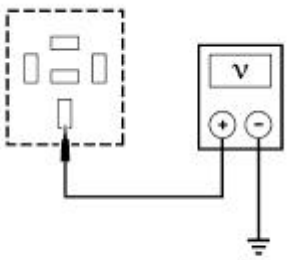
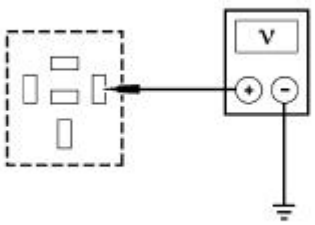
- **Is the resistance less than 5 ohms?**

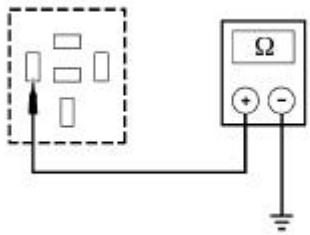
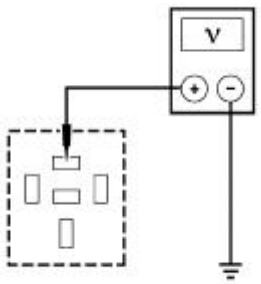
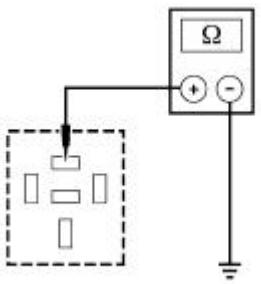
M5 CHECK CIRCUIT 1951 (TN) FOR A SHORT TO GROUND - Key in OFF position. - Disconnect: Body Security Module C2113c. - Measure the resistance between left third row seat relay C4183-85, circuit 1951 (TN), harness side and ground.  A0050609 - **Is the resistance greater than 10,000 ohms?**	**Yes** GO to M7 . **No** REPAIR the circuit. TEST the system for normal operation.
M6 CHECK CIRCUIT 1951 (TN) FOR AN OPEN - Key in OFF position. - Disconnect: Body Security Module C2113c. - Measure the resistance between BSM C2113c-8, circuit 1951 (TN), harness side and left third row seat relay C4183-85, circuit 1951 (TN), harness side.  A0050610 - **Is the resistance less than 5 ohms?**	**Yes** REFER to Section 501-14 to determine the BSM fault. Test the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
M7 CHECK CIRCUIT 57 (BK) FOR AN OPEN - Key in OFF position. - Disconnect: Left Rear Third Row Seat Switch C4179. - Measure the resistance between left rear third row seat switch C4179-2, circuit 57 (BK), harness side and ground.	**Yes** REPLACE the BSM. REFER to Section 501-14 . Test the system for normal operation. **No** REPAIR the circuit. TEST the system for

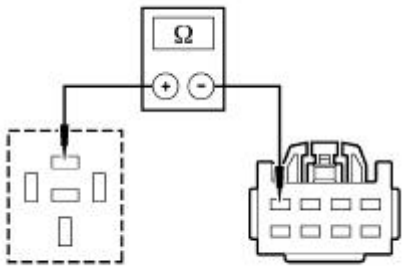
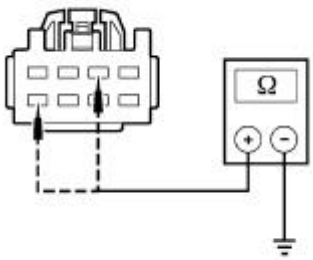
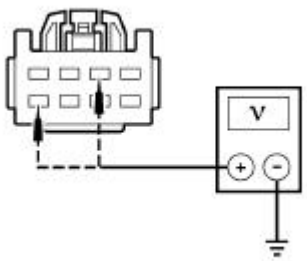
 A0050611 ● **Is the resistance less than 5 ohms?**	normal operation.

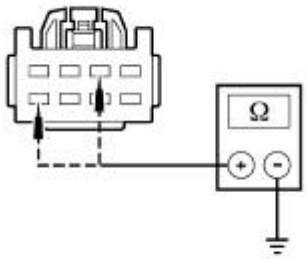
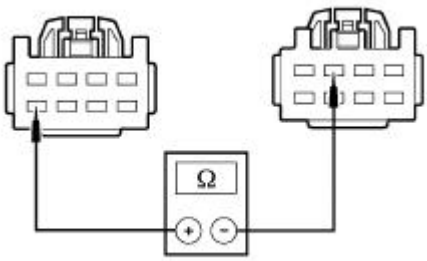
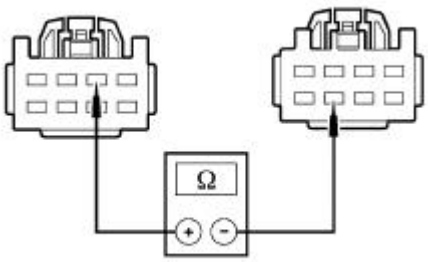
PINPOINT TEST N: THE THIRD ROW POWER FOLD SEAT IS INOPERATIVE/DOES NOT OPERATE CORRECTLY — LEFT

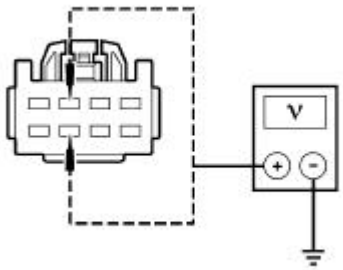
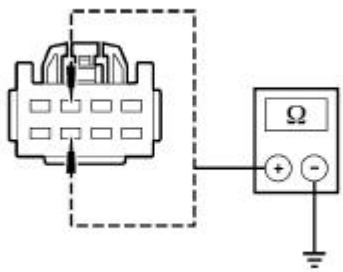
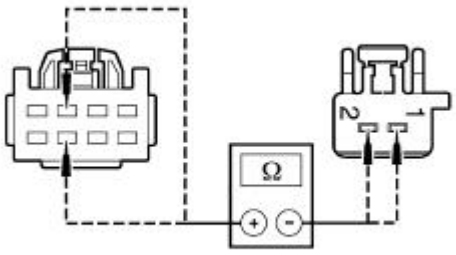
Test Step	Result / Action to Take
N1 VERIFY LEFT THIRD ROW SEAT SYMPTOM	
● Verify if the third row seat is not operating properly at both switches or at a single switch. ● **Is the left third row seat inoperative from both switches?**	**Yes** GO to N4. **No** If the left front switch does not operate GO to N2. If the left rear does not operate GO to N3.
N2 CHECK CIRCUIT 51 (BK/WH) FOR AN OPEN	
● Key in OFF position. ● Disconnect: Left Front Third Row Seat Switch C3199. ● Disconnect: Left Third Row Seat Relay C4183. ● Measure the resistance between left third row seat relay C4183-87, circuit 51 (BK/WH), harness side and the left front third row seat switch C3199-4, circuit 51 (BK/WH), harness side.  A0050616 ● **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new left front third row seat switch. TEST system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
N3 CHECK CIRCUIT 51 (BK/WH) FOR AN OPEN	
● Key in OFF position. ● Disconnect: Left Rear Third Row Seat Switch C4179. ● Disconnect: Left Third Row Seat Relay C4183. ● Measure the resistance between left third row seat relay C4183-87, circuit 51 (BK/WH), harness side and the left front third row seat switch	**Yes** INSTALL a new left rear third row seat switch. TEST system for

C4179-4, circuit 51 (BK/WH), harness side.  A0050612 • **Is the resistance less than 5 ohms?**	normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
N4 CHECK CIRCUIT 2115 (OG) FOR AN OPEN	
• Key in ON position. • Measure the voltage between left third row seat relay C4183-30, circuit 2115 (OG), harness side and ground.  A0050613 • **Is the voltage greater than 10 volts?**	**Yes** GO to N5 . **No** REPAIR the circuit. TEST the system for normal operation.
N5 CHECK CIRCUIT 729 (RD/WH) FOR AN OPEN	
• Measure the voltage between left third row seat relay C4183-86, circuit 729 (RD/WH), harness side and ground.  A0050607 • **Is the voltage greater than 10 volts?**	**Yes** GO to N6 . **No** REPAIR the circuit. TEST the system for normal operation.
N6 CHECK LEFT THIRD ROW SEAT RELAY	
• Key in OFF position. • Perform component test on the left third row seat relay. Refer to Wiring Diagrams Cell 149 for schematic and connector information. • **Did the relay pass?**	**Yes** GO to N7 . **No** INSTALL a new left third row seat relay. TEST the system for normal operation.
N7 CHECK CIRCUIT 1951 (TN) FOR AN OPEN	

• Key in ON position. • Measure the resistance between left third row seat relay C4183-85, circuit 1951 (TN), harness side and ground.  A0050609 • **Is the resistance less than 5 ohms?**	**Yes** GO to N8 . **No** REPAIR the circuit. TEST the system for normal operation.
N8 CHECK CIRCUIT 51 (BK/WH) FOR A SHORT TO POWER	
• Key in OFF position. • Disconnect: Left Front and Left Rear Third Row Seat Switches C3199 and C4179. • Key in ON position. • Measure the voltage between left rear third row seat relay C4183-87, circuit 51 (BK/WH), harness side and ground.  A0050614 • **Is the resistance greater than 10,000 ohms?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** GO to N9 .
N9 CHECK CIRCUIT 51 (BK/WH) FOR A SHORT TO GROUND	
• Key in OFF position. • Measure the resistance between left third row seat relay C4183-87, circuit 51 (BK/WH), harness side and ground.  A0050615 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to N10 . **No** REPAIR the circuit. TEST the system for normal operation.
N10 CHECK CIRCUIT 51 (BK/WH) FOR AN OPEN	
• Key in OFF position. • Measure the resistance between left third row seat relay C4183-87, circuit 51 (BK/WH), harness side and left front third row seat switch C3199-4, circuit 51 (BK/WH), harness side.	**Yes** GO to N11 . **No** REPAIR the circuit. TEST the

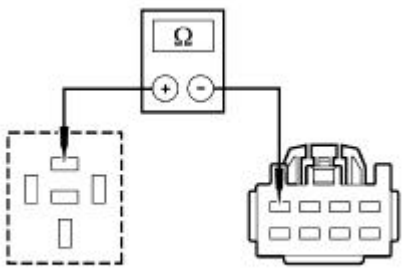
 A0050616 ● **Is the resistance less than 5 ohms?**	system for normal operation.
N11 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
● Key in OFF position. ● Measure the resistance between left rear third row seat switch C4179-8, circuit 57 (BK), harness side and ground and between C4179-2 circuit 57 (BK), harness side and ground.  A0050617 ● **Is the resistance less than 5 ohms?**	**Yes** GO to N12 . **No** REPAIR the circuit. TEST the system for normal operation.
N12 CHECK CIRCUIT 2112 (OG/BK) AND 2111 (OG/WH) FOR A SHORT TO POWER	
● Key in ON position. ● Measure the voltage between left front third row seat switch C3199-8, circuit 2112 (OG/BK), harness side and ground and between C3199-2, circuit 2111 (OG/WH), harness side and ground.  A0050618 ● **Is the voltage greater than 10 volts?**	**Yes** REPAIR the circuit(s). TEST the system for normal operation. **No** GO to N13 .
N13 CHECK CIRCUIT 2112 (OG/BK) AND 2111 (OG/WH) FOR A SHORT TO GROUND	
● Key in OFF position. ● Measure the resistance between left front third row seat switch C3199-8, circuit 2112 (OG/BK), harness side and ground and between C3199-2, circuit 2111 (OG/WH), harness side and ground.	**Yes** GO to N14 . **No** REPAIR the circuit(s). TEST the system for normal

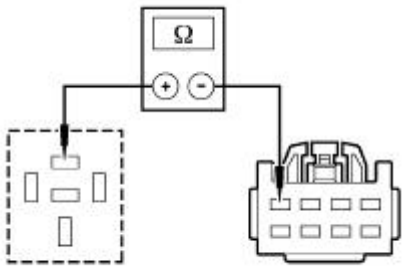
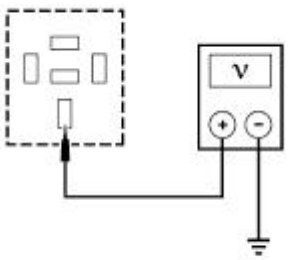
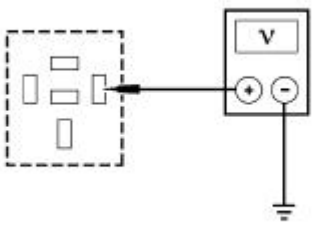
 A0050619 ● **Is the resistance greater than 10,000 ohms?**	operation.
N14 CHECK CIRCUIT 2112 (OG/BK) FOR AN OPEN	
● Key in OFF position. ● Measure the resistance between left front third row seat switch C3199-8, circuit 2112 (OG/BK), harness side and ground and between left rear third row seat switch C4179-3, circuit 2112 (OG/BK), harness side and ground.  A0050620 ● **Is the resistance less than 5 ohms?**	**Yes** GO to N15 . **No** REPAIR the circuit. TEST the system for normal operation.
N15 CHECK CIRCUIT 2111 (OG/WH) FOR AN OPEN	
● Key in OFF position. ● Measure the resistance between left front third row seat switch C3199-2, circuit 2111 (OG/WH), harness side and ground and between left rear third row seat switch C4179-7, circuit 2111 (OG/WH), harness side and ground.  A0050621 ● **Is the resistance less than 5 ohms?**	**Yes** GO to N16 . **No** REPAIR the circuit. TEST the system for normal operation.
N16 CHECK LEFT FRONT AND LEFT REAR THIRD ROW SEAT SWITCHES	
● Perform component test on both switches. Refer to Wiring Diagrams Cell 149 for schematic and connector information. ● **Did the switches pass?**	**Yes** GO to N17 . **No** INSTALL a new switch(es). TEST the system for

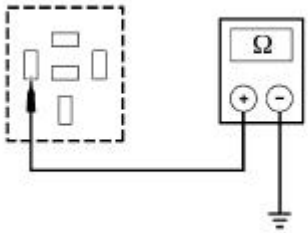
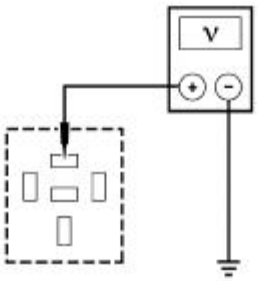
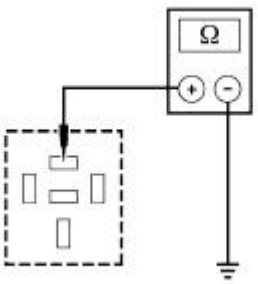
	normal operation.
N17 CHECK CIRCUIT 1948 (LB/WH) AND 1947 (DG/WH) FOR A SHORT TO POWER	
• Disconnect: Left Front Third Row Seat Switch C3199. • Key in ON position. • Measure the voltage between left front third row seat switch C3199-7, circuit 1948 (LB/WH), harness side and ground and between C3199-3, circuit 1947 (DG/WH), harness side and ground.  A0050622 • **Is the voltage greater than 10 volts?**	**Yes** REPAIR the circuit(s). TEST the system for normal operation. **No** GO to N18 .
N18 CHECK CIRCUIT 1948 (LB/WH) AND 1947 (DG/WH) FOR A SHORT TO GROUND	
• Key in OFF position. • Measure the resistance between left front third row seat switch C3199-7, circuit 1948 (LB/WH), harness side and ground and between C3199-3, circuit 1947 (DG/WH), harness side and ground.  A0050623 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to N19 . **No** REPAIR the circuit(s). TEST the system for normal operation.
N19 CHECK CIRCUIT 1948 (LB/WH) AND 1947 (DG/WH) FOR AN OPEN	
• Key in OFF position. • Measure the resistance between left front third row seat switch C3199-7, circuit 1948 (LB/WH), harness side and left third row seat motor C4181-2, circuit 1948 (LB/WH) harness side; and between left third row seat switch, C3199-3, circuit 1947 (DG/WH), harness side and left third row seat motor C4181-1, circuit 1947 (DG/WH), harness side.  A0050624	**Yes** INSTALL a new left third row power seat motor. TEST the system for normal operation. **No** REPAIR the circuit(s). TEST the system for normal operation.

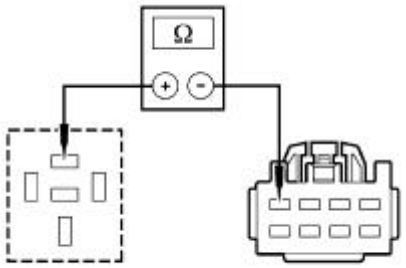
• **Is the resistance less than 5 ohms?**	

PINPOINT TEST O: THE THIRD ROW POWER FOLD SEAT IS INOPERATIVE/DOES NOT OPERATE CORRECTLY — RIGHT

Test Step	Result / Action to Take
O1 VERIFY RIGHT THIRD ROW SEAT SYMPTOM	
• Verify if the third row seat is not operating properly at both switches or at a single switch. • **Is the right third row seat inoperative from both switches?**	**Yes** GO to O4. **No** If the right front switch does not operate, GO to O2. If the right rear switch does not operate, GO to O3.
O2 CHECK CIRCUIT 1946 (OG/LB) FOR AN OPEN	
• Key in OFF position. • Disconnect: Right Front Third Row Seat Switch C3200. • Disconnect: Right Third Row Seat Relay C4184. • Measure the resistance between right third row seat relay C4184-87, circuit 1946 (OG/LB), harness side and the right front third row seat switch C3200-4, circuit 1946 (OG/LB), harness side.  A0050612 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new right front third row seat switch. TEST system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
O3 CHECK CIRCUIT 1946 (OG/LB) FOR AN OPEN	
• Key in OFF position. • Disconnect: Right Rear Third Row Seat Switch C4180. • Disconnect: Right Third Row Seat Relay C4184. • Measure the resistance between right third row seat relay C4184-87, circuit 1946 (OG/LB), harness side and the right rear third row seat switch C4180-4, circuit 1946 (OG/LB), harness side.	**Yes** INSTALL a new right front third row seat switch. TEST system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.

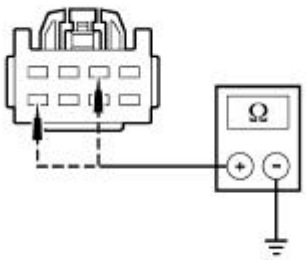
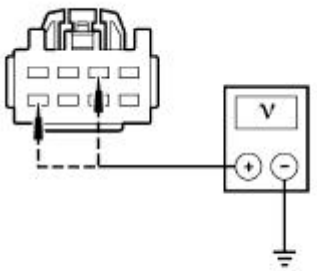
 A0050616 ● **Is the resistance less than 5 ohms?**	
O4 CHECK CIRCUIT 2116 (YE) FOR AN OPEN	
● Key in ON position. ● Measure the voltage between right third row seat relay C4184-30, circuit 2116 (YE), harness side and ground.  A0050613 ● **Is the voltage greater than 10 volts?**	**Yes** GO to O5 . **No** REPAIR the circuit. TEST the system for normal operation.
O5 CHECK CIRCUIT 729 (RD/WH) FOR AN OPEN	
● Measure the voltage between right third row seat relay C4184-86, circuit 729 (RD/WH), harness side and ground.  A0050607 ● **Is the voltage greater than 10 volts?**	**Yes** GO to O6 . **No** REPAIR the circuit. TEST the system for normal operation.
O6 CHECK RIGHT THIRD ROW SEAT RELAY	
● Key in OFF position. ● Perform component test on the right third row seat relay. Refer to Wiring Diagrams Cell 149 for schematic and connector information. ● **Did the relay pass?**	**Yes** GO to O7 . **No** INSTALL a new right third row seat relay. TEST the system for normal operation.
O7 CHECK CIRCUIT 1951 (TN) FOR AN OPEN	
● Key in ON position. ● Measure the resistance between right third row seat relay C4184-85,	**Yes** GO to O8 .

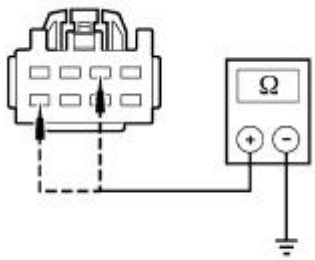
circuit 1951 (TN), harness side and ground.  A0050609 ● **Is the resistance less than 5 ohms?**	**No** REPAIR the circuit. TEST the system for normal operation.
O8 CHECK CIRCUIT 1946 (OG/LB) FOR A SHORT TO POWER	
● Key in OFF position. ● Disconnect: Right Front and Right Rear Third Row Seat Switches C3200 and C4180. ● Key in ON position. ● Measure the voltage between right rear third row seat relay C4184-87, circuit 1946 (OG/LB), harness side and ground.  A0050614 ● **Is the resistance greater than 10,000 ohms?**	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** GO to O9 .
O9 CHECK CIRCUIT 1946 (OG/LB) FOR A SHORT TO GROUND	
● Key in OFF position. ● Measure the resistance between right third row seat relay C4184-87, circuit 1946 (OG/LB), harness side and ground.  A0050615 ● **Is the resistance greater than 10,000 ohms?**	**Yes** GO to O10 . **No** REPAIR the circuit. TEST the system for normal operation.
O10 CHECK CIRCUIT 1946 (OG/LB) FOR AN OPEN	
● Key in OFF position. ● Measure the resistance between right third row seat relay C4184-87, circuit 1946 (OG/LB), harness side and right front third row seat switch C3200-4, circuit 1946 (OG/LB), harness side.	**Yes** GO to O11 . **No** REPAIR the circuit. TEST the system for normal operation.



A0050612

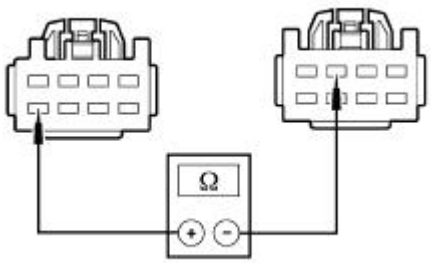
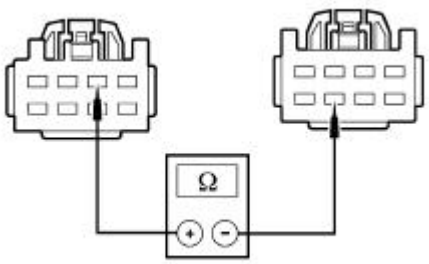
- **Is the resistance less than 5 ohms?**

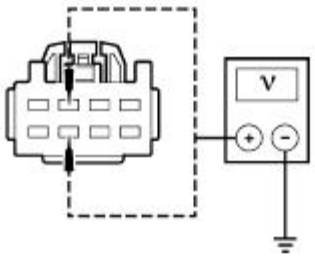
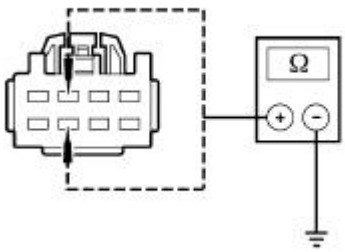
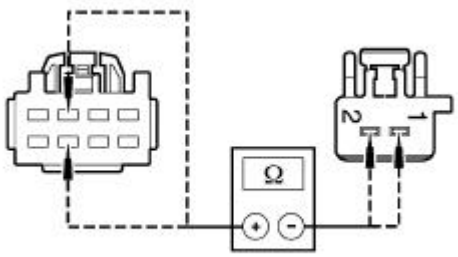
O11 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
• Key in OFF position. • Measure the resistance between right rear third row seat switch C4180-8, circuit 57 (BK), harness side and ground and between C4180-2 circuit 57 (BK), harness side and ground.  A0050619 • **Is the resistance less than 5 ohms?**	**Yes** GO to O12 . **No** REPAIR the circuit. TEST the system for normal operation.
O12 CHECK CIRCUIT 2113 (YE/WH) AND 2114 (YE/BK) FOR A SHORT TO POWER	
• Key in ON position. • Measure the voltage between right front third row seat switch C3200-8, circuit 2113 (YE/WH), harness side and ground and between C3200-2, circuit 2114 (YE/BK), harness side and ground.  A0050625 • **Is the voltage greater than 10 volts?**	**Yes** REPAIR the circuit(s). TEST the system for normal operation. **No** GO to O13 .
O13 CHECK CIRCUIT 2113 (YE/WH) AND 2114 (YE/BK) FOR A SHORT TO GROUND	
• Key in OFF position. • Measure the resistance between right front third row seat switch C3200-8, circuit 2113 (YE/WH), harness side and ground and between C3200-2, circuit 2114 (YE/BK), harness side and ground.	**Yes** GO to O14 . **No** REPAIR the circuit(s). TEST the system for normal operation.



A0050617

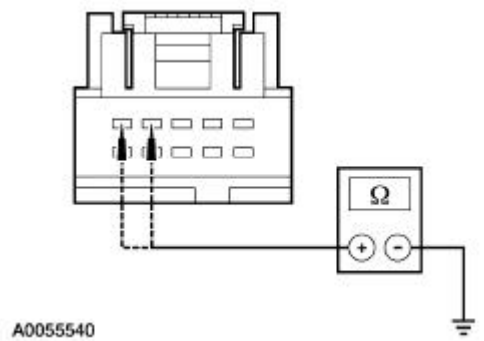
- **Is the resistance greater than 10,000 ohms?**

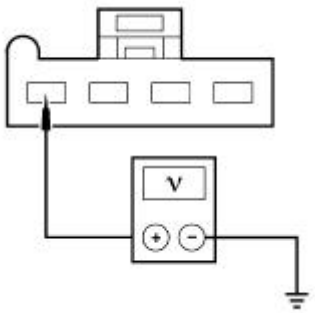
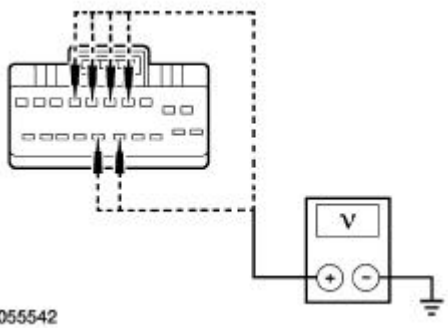
O14 CHECK CIRCUIT 2113 (YE/WH) FOR AN OPEN	
• Key in OFF position. • Measure the resistance between right front third row seat switch C3200-8, circuit 2113 (YE/WH), harness side and ground and between right rear third row seat switch C4180-3, circuit 2113 (YE/WH), harness side and ground.  A0050626 • **Is the resistance less than 5 ohms?**	**Yes** GO to O15 . **No** REPAIR the circuit. TEST the system for normal operation.
O15 CHECK CIRCUIT 2114 (YE/BK) FOR AN OPEN	
• Key in OFF position. • Measure the resistance between right front third row seat switch C3200-2, circuit 2114 (YE/BK), harness side and ground and between right rear third row seat switch C4180-7, circuit 2114 (YE/BK), harness side and ground.  A0050627 • **Is the resistance less than 5 ohms?**	**Yes** GO to O16 . **No** REPAIR the circuit. TEST the system for normal operation.
O16 CHECK RIGHT FRONT AND RIGHT REAR THIRD ROW SEAT SWITCHES	
• Perform component test on both switches. Refer to Wiring Diagrams Cell 149 for schematic and connector information. • **Did the switches pass?**	**Yes** GO to O17 . **No** INSTALL a new switch(es). TEST the system for

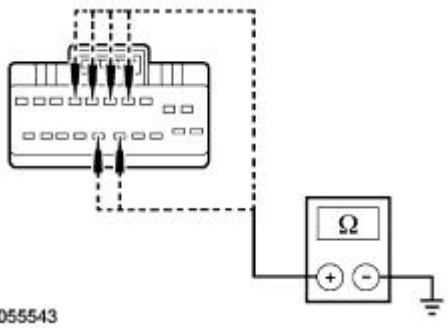
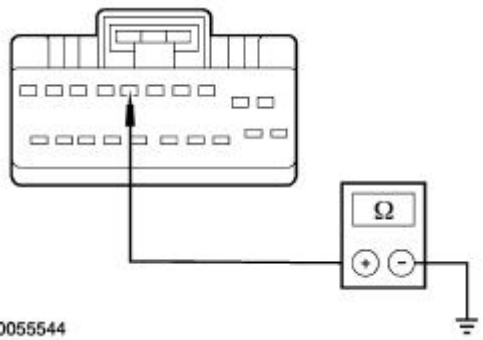
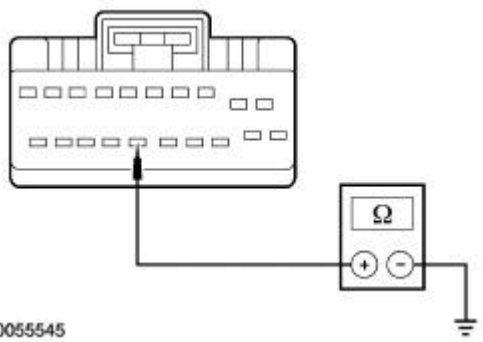
	normal operation.
O17 CHECK CIRCUIT 1949 (OG/BK) AND 1950 (PK/DB) FOR A SHORT TO POWER	
• Disconnect: Right Front Third Row Seat Switch C3200. • Key in ON position. • Measure the voltage between right front third row seat switch C3200-7, circuit 1949 (OG/BK), harness side and ground and between C3200-3, circuit 1950 (PK/DB), harness side and ground.  A0050628 • **Is the voltage greater than 10 volts?**	**Yes** REPAIR the circuit(s). TEST the system for normal operation. **No** GO to O18 .
O18 CHECK CIRCUIT 1949 (OG/BK) AND 1950 (PK/DB) FOR A SHORT TO GROUND	
• Key in OFF position. • Measure the resistance between right front third row seat switch C3200-7, circuit 1949 (OG/BK), harness side and ground and between C3200-3, circuit 1950 (PK/DB) harness side and ground.  A0050629 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to O19 . **No** REPAIR the circuit(s). TEST the system for normal operation.
O19 CHECK CIRCUIT 1949 (OG/BK) AND 1950 (PK/DB) FOR AN OPEN	
• Key in OFF position. • Measure the resistance between right front third row seat switch C3200-7, circuit 1949 (OG/BK), harness side and right third row seat motor C4182-1, circuit 1949 (OG/BK) harness side; and between right third row seat switch, C3200-3, circuit 1950 (PK/DB), harness side and right third row seat motor C4182-2, circuit 1950 (PK/DB), harness side.  A0050630	**Yes** INSTALL a new right third row power seat motor. TEST the system for normal operation. **No** REPAIR the circuit(s). TEST the system for normal operation.

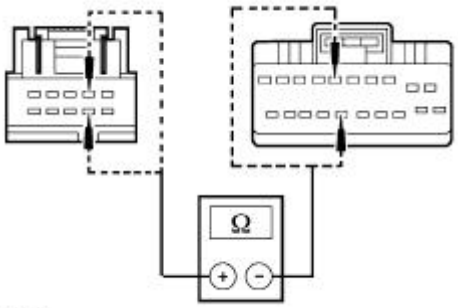
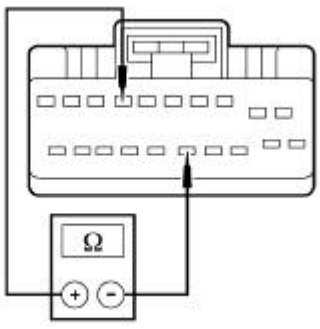
• **Is the resistance less than 5 ohms?**	

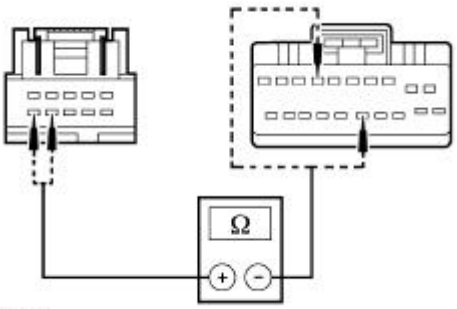
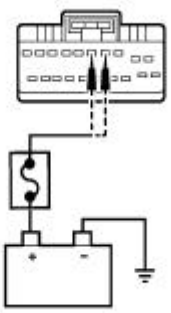
PINPOINT TEST P: A SINGLE CLIMATE CONTROLLED SEAT IS INOPERATIVE/DOES NOT OPERATE CORRECTLY

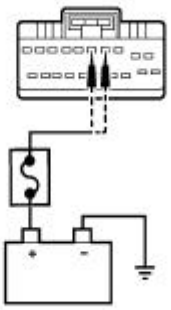
Test Step	Result / Action to Take
P1 CHECK FOR DTCS	
WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards. NOTE: If a seat equipped with a seat-mounted side air bag and/or a safety belt pretensioner (if equipped) system is being serviced, **the air bag system must be deactivated.** Refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in the General Procedures portion of this section. **NOTE:** Restraint system diagnostic tools **MUST** be installed under the seats in the seat side air bag (if equipped) and safety belt pretensioner (if equipped) to floor connectors. **NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. • Key in OFF position. • Deactivate the supplemental restraint system (SRS). Refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. • Connect the diagnostic tool. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • **Were any DTCs retrieved?**	**Yes** If DTC B1358 was retrieved, GO to P13 . If DTC B2488 was retrieved, GO to P2 . If DTC B2521 was retrieved, GO to P3 . If DTC B2729 was received, GO to P23 . If DTC B2730 was retrieved, GO to P23 . If DTC B2731 was received, GO to P23 . If DTC B2792 was received, GO to P5 . If DTC B2793 was retrieved, GO to P5 . **No** GO to P2 .
P2 CHECK CIRCUIT 57 (BK)	
• Key in OFF position. • Disconnect: Driver Climate Controlled Seat Switch C3032 or Passenger Climate Controlled Seat Switch C3037. • Measure the resistance between the driver climate controlled seat switch C3032-4 (or passenger climate controlled seat switch C3037-4), circuit 57 (BK), harness side and ground and between the driver climate controlled seat switch C3032-5 (or passenger climate controlled seat switch C3037-5), circuit 57 (BK), harness side and ground.  • **Are the resistances less than 5 ohms?**	**Yes** GO to P3 . **No** REPAIR circuit 57 (BK). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
P3 CHECK CIRCUIT 1153 (RD/BK)	

• Key in OFF position. • Disconnect: Driver CCSM C3031b or Passenger CCSM C3036b. • Key in ON position. • Measure the voltage between the driver CCSM C3031b-4 (or passenger CCSM C3036b-4), circuit 1153 (RD/BK), harness side and ground.  A0055541 • **Is the voltage greater than 10 volts?**	**Yes** GO to P4 . **No** REPAIR circuit 1153 (RD/BK). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
P4 CHECK THE CLIMATE CONTROLLED SEAT SWITCH CIRCUITS FOR A SHORT TO VOLTAGE	
• Key in OFF position. • Connect: Driver CCSM C3031b or Passenger CCSM C3036b. • Disconnect: Driver Climate Controlled Seat Switch C3032 or Passenger Climate Controlled Seat Switch C3037 (as needed). • Disconnect: Driver CCSM C3031a or Passenger CCSM C3036a. • Key in ON position. • Measure the voltage between the driver CCSM C3031a (or passenger CCSM C3036a): ■ pin 4, circuit 1973 (RD), harness side and ground (Navigator and Expedition driver side only). ■ pin 5, circuit 1974 (LB), harness side and ground (Navigator and Expedition driver side only). ■ pin 4, circuit 1255 (WH/OG), harness side and ground (Expedition passenger side only). ■ pin 5, circuit 1256 (WH/YE), harness side and ground (Expedition passenger side only). ■ pin 6, circuit 1551 (VT/WH), harness side and ground. ■ pin 7, circuit 1018 (LG/OG), harness side and ground. ■ pin 15, circuit 1019 (TN/LB), harness side and ground. ■ pin 16, circuit 1550 (WH/OG), harness side and ground.  A0055542 • **Is voltage greater than 10 volts on any circuit?**	**Yes** REPAIR the affected circuits. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to P5 .
P5 CHECK THE CLIMATE CONTROLLED SEAT SWITCH CIRCUITS FOR A SHORT TO GROUND	
• Key in OFF position. • Measure the resistance between the driver CCSM C3031a (or	**Yes** GO to P6 .

passenger CCSM C3036a): ■ pin 4, circuit 1973 (RD), harness side and ground (Navigator and Expedition driver side only). ■ pin 5, circuit 1974 (LB), harness side and ground (Navigator and Expedition driver side only). ■ pin 4, circuit 1255 (WH/OG), harness side and ground (Expedition passenger side only). ■ pin 5, circuit 1256 (WH/YE), harness side and ground (Expedition passenger side only). ■ pin 6, circuit 1551 (VT/WH), harness side and ground. ■ pin 7, circuit 1018 (LG/OG), harness side and ground. ■ pin 15, circuit 1019 (TN/LB), harness side and ground. ■ pin 16, circuit 1550 (WH/OG), harness side and ground.  ● **Are the resistances greater than 10,000 ohms?**	**No** REPAIR the affected circuit(s). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
P6 CHECK THE CLIMATE CONTROLLED SEAT SWITCH OUTPUTS	
● Measure the resistance between the driver CCSM C3031a-6 (or passenger C3036a-6), circuit 1551 (VT/WH), harness side and ground while pressing the HEAT button.  ● Measure the resistance between the driver CCSM C3031a-16 (or passenger C3036a-16), circuit 1550 (WH/OG), harness side and ground while pressing the COOL button.  ● **Are the resistances less than 5 ohms when a button is pressed and greater than 10,000 ohms when a button is released?**	**Yes** GO to P8 . **No** GO to P7 .

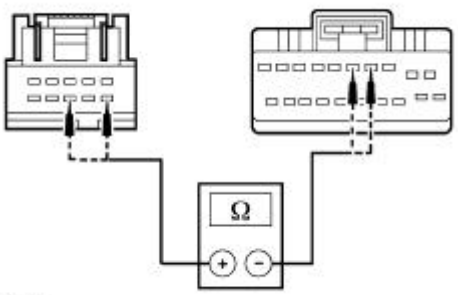
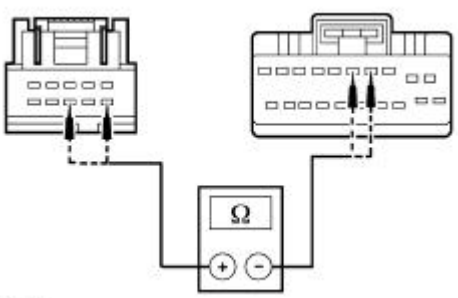
P7 CHECK CIRCUIT 1550 (WH/OG) AND CIRCUIT 1551 (VT/WH)	
• Disconnect: Driver Climate Controlled Seat Switch C3032 or Passenger Climate Controlled Seat Switch C3037. • Measure the resistance between the driver climate controlled seat switch C3032-7 (or passenger climate controlled seat switch C3037-7), circuit 1550 (WH/OG), harness side and the driver CCSM C3031a-16 (or passenger CCSM C3036a-16), circuit 1550 (WH/OG), harness side; and between the driver climate controlled seat switch C3032-2 (or passenger climate controlled seat switch C3037-2), circuit 1551 (VT/WH), harness side and the driver CCSM C3031a-6 (or passenger CCSM C3036a-6), circuit 1551 (VT/WH), harness side.  A0055546 • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new climate controlled seat switch. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** REPAIR the affected circuit. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
P8 CHECK THE CLIMATE CONTROLLED SEAT SWITCH THUMBWHEEL RESISTANCE	
• Measure the resistance between the driver CCSM C3031a-7 (or passenger C3036a-7), circuit 1018 (LG/OG), harness side and between the driver CCSM C3031a-15 (or passenger C3036a-15), circuit 1019 (TN/LB), harness side. Set the thumbwheel at each position and compare the resistance to values in the following table. **Position** / **Resistance [a]** 1 — 2,364 ohms 2 — 1,100 ohms 3 — 618 ohms 4 — 394 ohms 5 — 239.1 ohms [a] Acceptable tolerance is ± 4%.  A0055547 • **Is the resistance for each thumbwheel position within the**	**Yes** GO to P10 . **No** GO to P9 .

tolerance?	
P9 CHECK CIRCUIT 1018 (LG/OG) AND CIRCUIT 1019 (TN/LB)	
• Disconnect: Driver Climate Controlled Seat Switch C3032 or Passenger Climate Controlled Seat Switch C3037. • Measure the resistance between the driver climate controlled seat switch C3032-10 (or passenger climate controlled seat switch C3037-10), circuit 1018 (LG/OG), harness side and the driver CCSM C3031a-7 (or passenger CCSM C3036a-7), circuit 1018 (LG/OG), harness side; and between the driver climate controlled seat switch C3032-9 (or passenger climate controlled seat switch C3037-9), circuit 1019 (TN/LB), harness side and the driver CCSM C3031a-15 (or passenger CCSM C3036a-15), circuit 1019 (TN/LB), harness side.  A0055548 • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new climate controlled seat switch. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** REPAIR the affected circuit. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
P10 CHECK THE CLIMATE CONTROLLED SEAT SWITCH LED INDICATORS	
• Key in ON position. • For Navigator and Expedition driver side only, connect a fused (5A) jumper lead between battery positive and the driver CCSM C3031a-4 (or passenger CCSM C3036a-4), circuit 1973 (RD), harness side; and connect a second fused (5A) jumper lead between battery positive and the driver CCSM C3031a-5 (or passenger CCSM C3036a-5), circuit 1974 (LB), harness side.  A0055549 • For Expedition passenger side only, connect a fused (5A) jumper lead between battery positive and the passenger CCSM C3036a-4, circuit 1255 (WH/OG), harness side; and between connect a second fused (5A) jumper lead battery positive and the passenger CCSM C3036a-5, circuit 1256 (WH/YE), harness side.	**Yes** GO to P13 . **No** If a jumper lead fuse (5A) opens, REPAIR the affected circuit. If the jumper lead fuse does not open, GO to P11 .

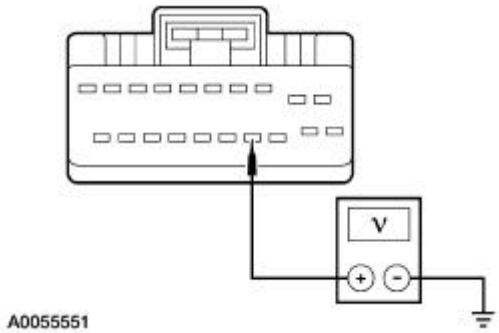
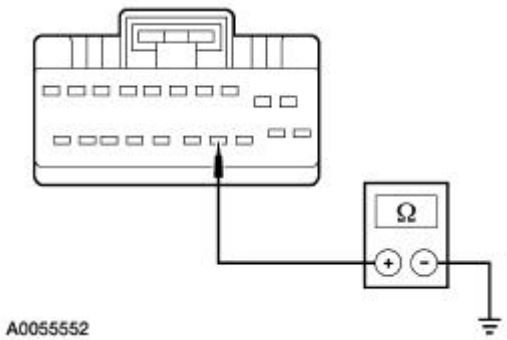
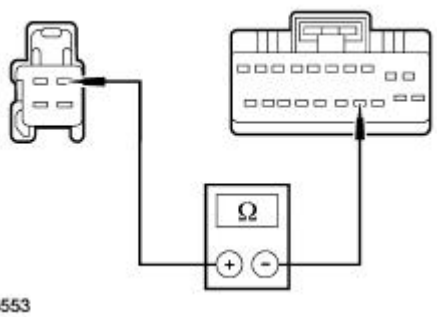


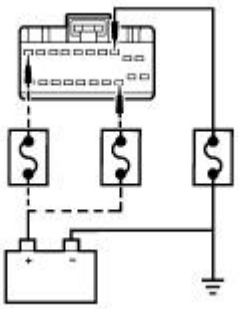
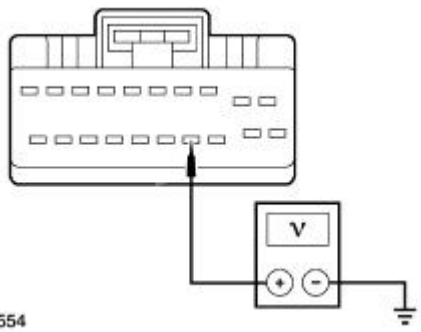
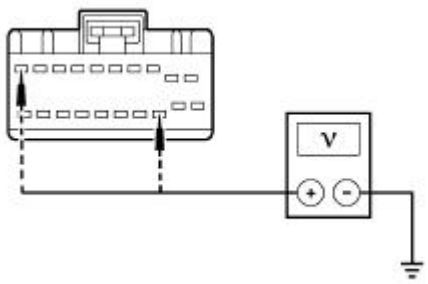
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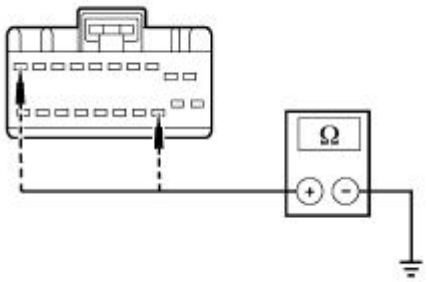
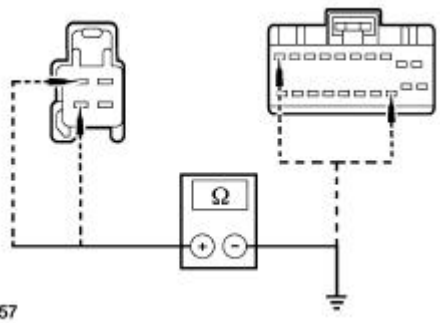
- **Did the climate control seat switch LED indicators illuminate?**

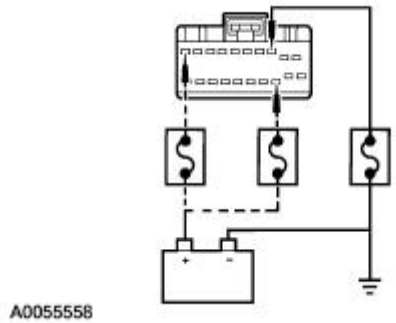
P11 CHECK THE LED INDICATOR CIRCUITS	
• Key in OFF position. • For Navigator and Expedition driver side only, measure the resistance between the driver climate controlled seat switch C3032-6 (or passenger climate controlled seat switch C3037-6), circuit 1974 (LB), harness side and the driver CCSM C3031a-5 (or passenger CCSM C3036a-5), circuit 1974 (LB), harness side; and between the driver climate controlled seat switch C3032-8 (or passenger climate controlled seat switch C3037-8), circuit 1973 (RD), harness side and the driver CCSM C3031a-4 (or passenger CCSM C3036a-4), circuit 1973 (RD), harness side.  A0055550 • For Expedition passenger side only, measure the resistance between the passenger climate controlled seat switch C3037-6, circuit 1256 (WH/YE), harness side and the passenger CCSM C3036a-5, circuit 1256 (WH/YE), harness side; and between the passenger climate controlled seat switch C3037-8, circuit 1255 (WH/OG), harness side and the passenger CCSM C3036a-4, circuit 1255 (WH/OG), harness side.  A0055550 • **Are the resistances less than 5 ohms?**	**Yes** GO to P12 . **No** REPAIR the affected circuit. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
P12 CHECK THE LED INDICATOR OUTPUTS FROM THE CCSM	
• Connect: Driver Climate Controlled Seat Switch C3032 or Passenger Climate Controlled Seat Switch C3037.	**Yes** REPAIR the affected

• Connect: Driver CCSM C3031a or Passenger CCSM C3036a. • Key in START position. • For Navigator and Expedition driver side only, measure the voltage between the driver climate controlled seat switch C3032-6 (or passenger climate controlled seat switch C3037-6), circuit 1974 (LB), harness side and ground by back-probing the driver climate controlled seat switch C3032 (or passenger climate controlled seat switch C3037); and between the driver climate controlled seat switch C3032-8 (or passenger climate controlled seat switch C3037-8), circuit 1973 (RD), harness side and ground by back-probing driver climate controlled seat switch C3032 (or passenger climate controlled seat switch C3037). • For Expedition passenger side only, measure the voltage between the passenger climate controlled seat switch C3037-6, circuit 1256 (WH/YE), harness side and ground by back-probing the passenger climate controlled seat switch C3037; and between the passenger climate controlled seat switch C3037-8, circuit 1255 (WH/OG), harness side and ground by back-probing the passenger climate controlled seat switch C3037. • **Are the voltages greater than 7 volts?**	circuits. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** INSTALL a new climate controlled seat switch. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
P13 CHECK THE FAN MOTOR RPM INPUT	
• Key in OFF position. • Connect: Driver CCSM C3031a or Passenger CCSM C3036a (if needed). • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: CCSM Active Command Menu TURN BLOWER FULL POWER. • **NOTE:** After the active command FULL BLOW to is commanded to the ON state, the climate controlled seat blower fan will operate for 15 seconds then turn off. • **NOTE:** The CCSM is not the source of the fault if the active command mode is operational. • Monitor the PID BLWRRPM while commanding the FULL BLOW active command ON then OFF. • **Does the PID value change when the climate controlled seat blower fan was commanded ON and OFF?**	**Yes** GO to P23 . **No** GO to P14 .
P14 VERIFY THE CLIMATE CONTROLLED SEAT BLOWER FAN OPERATION	
• **NOTE:** After the active command FULL BLOW to is commanded to the ON state, the climate controlled seat blower fan will operate for 15 seconds then turn off. • **NOTE:** The CCSM is not the source of the fault if the active command mode is operational. • Command the FULL BLOW active command ON then OFF and note the climate controlled seat blower fan operation. • **Does the climate controlled seat blower fan operate?**	**Yes** GO to P15 . **No** GO to P19 .
P15 CHECK CIRCUIT 1554 (WH) FOR A SHORT TO VOLTAGE	
• Key in OFF position. • Disconnect: Driver CCSM C3031a or Passenger CCSM C3036a. • Key in ON position. • Measure the voltage between the driver CCSM C3031a-14 (of passenger CCSM C3036a-14), circuit 1554 (WH), harness side and ground.	**Yes** REPAIR circuit 1554 (WH). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental

 A0055551 ● **Is the voltage greater than 10 volts?**	Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to P16 .
P16 CHECK CIRCUIT 1554 (WH) FOR SHORT TO GROUND	
● Key in OFF position. ● Measure the resistance between the driver CCSM C3031a-14 (or passenger CCSM C3036a-14), circuit 1554 (WH), harness side and ground.  A0055552 ● **Is the resistance greater than 10,000 ohms?**	**Yes** GO to P17 . **No** REPAIR circuit 1554 (WH). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
P17 CHECK CIRCUIT 1554 (WH) FOR AN OPEN	
● Disconnect: Driver Climate Controlled Seat Blower Fan C3033 or Passenger Climate Controlled Seat Blower Fan C3038. ● Measure the resistance between the driver CCSM C3031a-14 (or passenger CCSM C3036a-14), circuit 1554 (WH), harness side and the driver climate controlled seat blower fan C3033-2 (or passenger climate controlled seat blower fan C3038-2), circuit 1554 (WH), harness side.  A0055553 ● **Is the resistance less than 5 ohms?**	**Yes** GO to P18 . **No** REPAIR circuit 1554 (WH). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
P18 CHECK THE CLIMATE CONTROLLED SEAT BLOWER FAN OUTPUT	
● Connect: Driver Climate Controlled Seat Blower Fan C3033 or Passenger Climate Controlled Seat Blower Fan C3038. ● Connect fused (5A) jumper leads between the driver CCSM C3031a (or passenger CCSM C3036a) as follows: ■ driver CCSM C3031a-10 (or passenger CCSM C3036a-10), circuit 1565 (VT), harness side and battery positive.	**Yes** INSTALL a new CCSM. TEST the system for normal operation. REACTIVATE the supplemental restraint

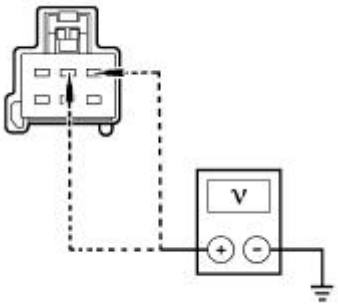
■ driver CCSM C3031a-13 (or passenger CCSM C3036a-13), circuit 1552 (RD), harness side and battery positive. ■ driver CCSM C3031a-3 (or passenger CCSM C3036a-3), circuit 1553 (BK), harness side and ground.  A0055558 ● Measure the voltage between the driver CCSM C3031a-14 (or passenger CCSM C3036a-14), circuit 1554 (WH), harness side and ground.  A0055554 ● **Is voltage present?**	system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** INSTALL a new climate controlled seat blower fan. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
P19 CHECK CIRCUIT 1552 (RD) AND CIRCUIT 1565 (VT) FOR A SHORT TO VOLTAGE	
● Key in OFF position. ● Disconnect: Driver CCSM C3031a or Passenger CCSM C3036a. ● Disconnect: Driver Climate Controlled Seat Blower Fan C3033 or Passenger Climate Controlled Seat Blower Fan C3038. ● Key in ON position. ● Measure the voltage between the driver CCSM C3031a-10 (or passenger CCSM C3036a-10), circuit 1565 (VT), harness side and ground and between the driver CCSM C3031a-13 (or passenger CCSM C3036a-13), circuit 1552 (RD), harness side and ground.  A0055555 ● **Is the voltage greater than 10 volts on either circuit?**	**Yes** REPAIR the affected circuits. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to P20 .
P20 CHECK CIRCUIT 1552 (RD) AND CIRCUIT 1565 (VT) FOR A SHORT TO GROUND	

• Key in OFF position. • Measure the resistance between the driver CCSM C3031a-10 (or passenger CCSM C3036a-10), circuit 1565 (VT), harness side and ground and between the driver CCSM C3031a-13 (or passenger CCSM C3036a-13), circuit 1552 (RD), harness side and ground.  A0055556 • **Are the resistances greater than 10,000 ohms?**	**Yes** GO to P21 . **No** REPAIR the affected circuit(s). TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
P21 CHECK CIRCUIT 1552 (RD) AND CIRCUIT 1565 (VT) FOR AN OPEN	
• Measure the resistance between the driver CCSM C3031a-10 (or passenger CCSM C3036a-10), circuit 1565 (VT), harness side and the driver climate controlled seat blower fan C3033-1 (or passenger climate controlled seat blower fan C3038-1), circuit 1565 (VT), harness side; and between the driver CCSM C3031a-13 (or passenger CCSM C3036a-13), circuit 1552 (RD), harness side and the driver climate controlled seat blower fan C3033-3 (or passenger climate controlled seat blower fan C3038-3), circuit 1552 (RD), harness side and ground.  A0055557 • **Are the resistances less than 5 ohms?**	**Yes** GO to P22 . **No** REPAIR the affected circuit. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
P22 CHECK THE CLIMATE CONTROLLED BLOWER FAN OPERATION	
• Connect: Driver Climate Controlled Seat Blower Fan C3033 or Passenger Climate Controlled Seat Blower Fan C3038. • Connect fused (5A) jumper leads between the driver CCSM C3031a (or passenger CCSM C3036a) as follows: ■ driver CCSM C3031a-10 (or passenger CCSM C3036a-10), circuit 1565 (VT), harness side and battery positive. ■ driver CCSM C3031a-13 (or passenger CCSM C3036a-13), circuit 1552 (RD), harness side and battery positive. ■ driver CCSM C3031a-3 (or passenger CCSM C3036a-3), circuit 1553 (BK), harness side and ground.	**Yes** INSTALL a new CCSM. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** INSTALL a new climate controlled seat blower

 A0055558 ● **Does the climate controlled seat blower fan operate?**	fan. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
P23 CHECK THE SEAT CUSHION TED EXHAUST NOZZLE FOR WASTE AIRFLOW	
● Check for air exhausting from the seat cushion TED exhaust nozzle and compare it to the air exhausting from the opposite seat. ● **Is air exhausting from the seat cushion TED exhaust nozzle comparable to the air exhausting from the opposite seat?**	**Yes** GO to P26 . **No** GO to P24 .
P24 INSPECT THE SEAT CUSHION DUCTS	
● Inspect the seat cushion ducts for damaged, restricted, or disconnected ducts. ● **Are any duct(s) damaged, restricted, or disconnected?**	**Yes** REPAIR or INSTALL new duct(s) as needed. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to P25 .
P25 INSPECT THE SEAT CUSHION TED FOR CORRECT INSTALLATION	
● Inspect the TED for correct installation to the seat cushion. ● **Is the seat cushion TED correctly installed?**	**Yes** REMOVE the seat and the seat cushion trim cover. INSPECT for a worn, damaged, or incorrectly installed foam wedge, cushion foam, or seat cushion trim cover. INSPECT for collapsed airflow channels in the seat cushion foam. REPAIR or INSTALL a new foam wedge, seat cushion foam, or seat cushion trim cover as needed. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER

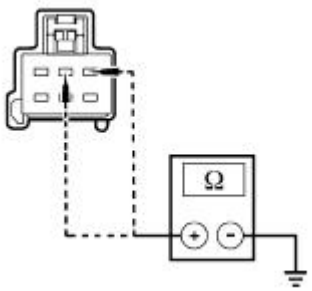
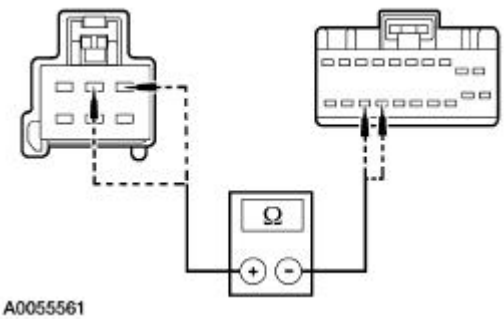
	to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** INSTALL the seat cushion TED correctly. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
P26 CHECK THE SEAT BACKREST TED EXHAUST NOZZLE FOR WASTE AIRFLOW	
• Check for air exhausting from the seat backrest TED exhaust nozzle and compare it to the air exhausting from the opposite seat. • **Is air exhausting from the seat backrest TED exhaust nozzle comparable to the air exhausting from the opposite seat?**	**Yes** GO to P29 . **No** GO to P27 .
P27 INSPECT THE SEAT BACKREST DUCTS	
• Inspect the seat backrest ducts for damaged, restricted, or disconnected ducts. • **Are any duct(s) damaged, restricted, or disconnected?**	**Yes** REPAIR or INSTALL new duct(s) as needed. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to P28 .
P28 INSPECT THE SEAT BACKREST TED FOR CORRECT INSTALLATION	
• Inspect the TED for correct installation to the seat cushion. • **Is the seat backrest TED correctly installed?**	**Yes** REMOVE the seat and the seat backrest trim cover. INSPECT for a worn, damaged, or incorrectly installed foam wedge, backrest foam, or seat backrest trim cover. INSPECT for collapsed airflow channels in the seat backrest foam. REPAIR or INSTALL a new foam wedge, seat backrest

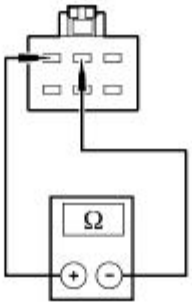
	foam, or seat backrest trim cover as needed. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** INSTALL the seat backrest TED correctly. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
P29 CHECK THE SEAT CUSHION AND SEAT BACKREST TEMPERATURE PIDS	
• Enter the following diagnostic mode on the diagnostic tool: CCSM Active Command Menu TED HEAT MODE. • **NOTE:** After the active command TED HEAT is commanded to the ON state, the climate controlled seat TED will operate for 15 seconds then turn off. • **NOTE:** The CCSM is not the source of the fault if the active command mode is operational. • Monitor the PIDs CSHTEMP and BK_TEMP while commanding the TED HEAT active command ON. • **Are both PIDs greater than 185° F (85° C)?**	**Yes** If the only the PID CSHTEMP is greater than 185° F (85° C), GO to P30. If the only the PID BK_TEMP is greater than 185° F (85° C), GO to P39. **No** GO to P34.
P30 CHECK THE SEAT CUSHION TED TEMPERATURE SENSOR CIRCUITS 1548 (DG/LG) AND 1060 (BK/LB) FOR A SHORT TO VOLTAGE	
• Key in OFF position. • Disconnect: Driver Seat Cushion TED C3035 or Passenger Seat Cushion TED C3040. • Measure the voltage between the driver seat cushion TED C3035-3 (or passenger seat cushion TED C3040-3), circuit 1548 (DG/LG), harness side and ground; and between the driver seat cushion TED C3035-2 (or passenger seat cushion TED C3040-2), circuit 1060 (BK/LB), harness side an ground.	**Yes** REPAIR the affected circuits. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to P31.

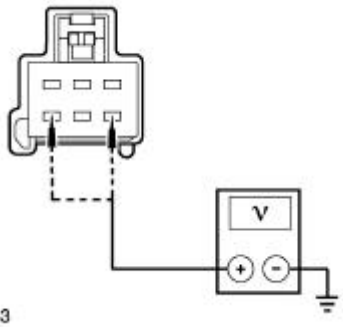
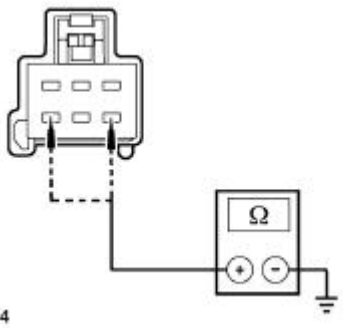


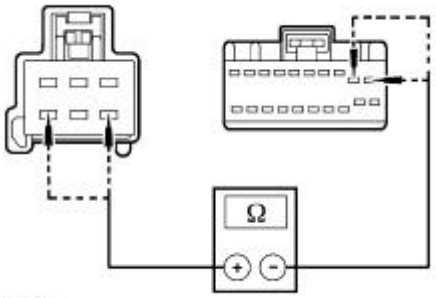
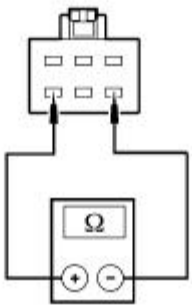
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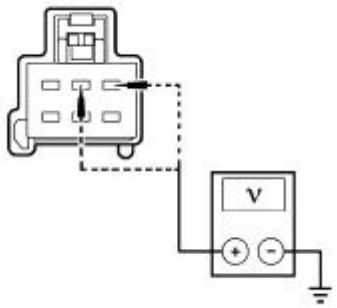
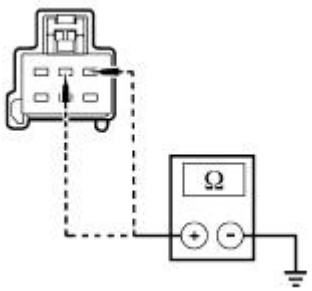
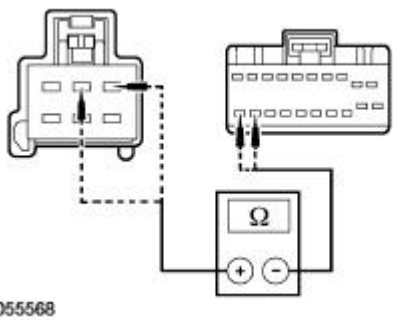
- **Is the voltage greater than 10 volts?**

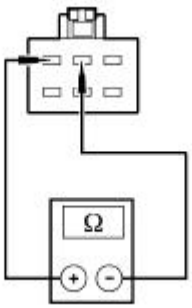
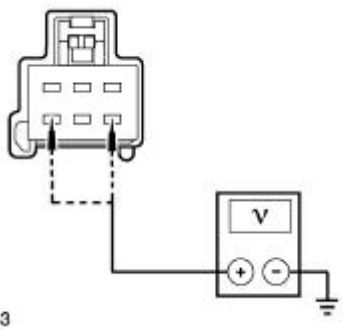
P31 CHECK THE SEAT CUSHION TED TEMPERATURE SENSOR CIRCUITS 1548 (DG/LG) AND 1060 (BK/LB) FOR A SHORT TO GROUND	
• Measure the resistance between the driver seat cushion TED C3035-3 (or passenger seat cushion TED C3040-3), circuit 1548 (DG/LG), harness side and ground; and between the driver seat cushion TED C3035-2 (or passenger seat cushion TED C3040-2), circuit 1060 (BK/LB), harness side an ground.  A0055560 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to P32 . **No** REPAIR the affected circuit. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
P32 CHECK THE SEAT CUSHION TED TEMPERATURE SENSOR CIRCUITS 1548 (DG/LG) AND 1060 (BK/LB) FOR AN OPEN	
• Disconnect: Driver CCSM C3031a or Passenger CCSM C3036a. • Measure the resistance between the driver seat cushion TED C3035-3 (or passenger seat cushion TED C3040-3), circuit 1548 (DG/LG), harness side and the driver CCSM C3031a-18 (or passenger CCSM C3036a-18), circuit 1548 (DG/LG), harness side; and between the driver seat cushion TED C3035-2 (or passenger seat cushion TED C3040-2), circuit 1060 (BK/LB), harness side and the driver CCSM C3031a-17 (or passenger CCSM C3036a-17), circuit 1060 (BK/LB), harness side.  A0055561 • **Are the resistances less than 5 ohms?**	**Yes** GO to P33 . **No** REPAIR the affected circuit. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
P33 CHECK THE SEAT CUSHION TED	

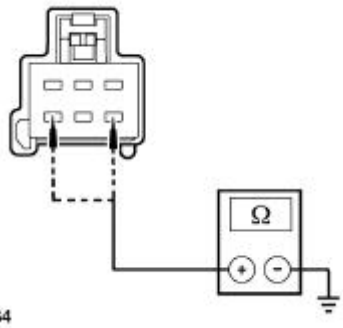
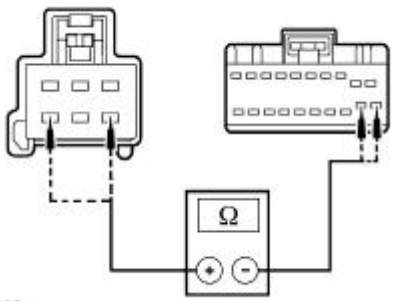
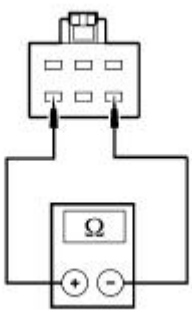
• Measure the resistance between the seat cushion TED pin 3 and pin 2, component side.  A0055562 • **Is the resistance greater than 1,000 ohms?**	**Yes** INSTALL a new CCSM. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** INSTALL a new seat cushion TED. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
P34 CHECK THE SEAT CUSHION AND SEAT BACKREST TEMPERATURE PIDS	
• Enter the following diagnostic mode on the diagnostic tool: CCSM Active Command Menu TED HEAT MODE. • **NOTE:** After the active command TED HEAT is commanded to the ON state, the climate controlled seat TED will operate for 15 seconds then turn off. • **NOTE:** The CCSM is not the source of the fault if the active command mode is operational. • Monitor the PIDs CSHTEMP and BK_TEMP while commanding the TED HEAT active command ON. • **Did the PID values change?**	**Yes** REPAIR the climate controlled seat for airflow leaks. INSPECT the fan, TEDs, ducts, foam wedges, foam pads, trim covers and their connection points and REPAIR as needed. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** If the PID CSHTEMP does not change, GO to P35. If the PID BK_TEMP does not change, GO to P43.
P35 CHECK THE SEAT CUSHION TED HEATING ELEMENT CIRCUITS 1064 (YE/LB) AND 1065 (WH/LB) FOR A SHORT TO VOLTAGE	
• Key in OFF position.	**Yes**

• Disconnect: Driver Seat Cushion TED C3035 or Passenger Seat Cushion TED C3040. • Measure the voltage between the driver seat cushion TED C3035-4 (or passenger seat cushion TED C3040-4), circuit 1065 (WH/LB), harness side and ground; and between the driver seat cushion TED C3035-6 (or passenger seat cushion TED C3040-6), circuit 1064 (YE/LB), harness side an ground.  A0055563 • **Is the voltage greater than 10 volts?**	REPAIR the affected circuits. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to P36 .
P36 CHECK THE SEAT CUSHION TED HEATING ELEMENT CIRCUITS 1064 (YE/LB) AND 1065 (WH/LB) FOR A SHORT TO GROUND	
• Measure the resistance between the driver seat cushion TED C3035-4 (or passenger seat cushion TED C3040-4), circuit 1065 (WH/LB), harness side and ground; and between the driver seat cushion TED C3035-6 (or passenger seat cushion TED C3040-6), circuit 1064 (YE/LB), harness side and ground.  A0055564 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to P37 . **No** REPAIR the affected circuit. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
P37 CHECK THE SEAT CUSHION TED HEATING ELEMENT CIRCUITS 1064 (YE/LB) AND 1065 (WH/LB) FOR AN OPEN	
• Disconnect: Driver CCSM C3031a or Passenger CCSM C3036a. • Measure the resistance between the driver seat cushion TED C3035-4 (or passenger seat cushion TED C3040-4), circuit 1065 (WH/LB), harness side and the driver CCSM C3031a-2 (or passenger CCSM C3036a-2), circuit 1065 (WH/LB), harness side; and between the driver seat cushion TED C3035-6 (or passenger seat cushion TED C3040-6), circuit 1064 (YE/LB), harness side and the driver CCSM C3031a-1 (or passenger CCSM C3036a-1), circuit 1064 (YE/LB), harness side.	**Yes** GO to P38 . **No** REPAIR the affected circuit. TEST the system for normal operation.

 A0055565 ● **Are the resistances less than 5 ohms?**	
P38 CHECK THE SEAT CUSHION TED	
● Measure the resistance between the seat cushion TED pin 4 and pin 6, component side.  A0055566 ● **Is the resistance greater than 1,000 ohms?**	**Yes** INSTALL a new CCSM. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** INSTALL a new seat cushion TED. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
P39 CHECK THE SEAT BACKREST TED TEMPERATURE SENSOR CIRCUITS 1549 (DB/OG) AND 1062 (RD/LB) FOR A SHORT TO VOLTAGE	
● Key in OFF position. ● Disconnect: Driver Seat Backrest TED C3034 or Passenger Seat Backrest TED C3039. ● Measure the voltage between the driver seat backrest TED C3034-3 (or passenger seat backrest TED C3039-3), circuit 1549 (DB/OG), harness side and ground; and between the driver seat backrest TED C3034-2 (or passenger seat backrest TED C3039-2), circuit 1062 (RD/LB), harness side and ground.	**Yes** REPAIR the affected circuits. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to P40 .

 A0055567 ● **Is the voltage greater than 10 volts?**	
P40 CHECK THE SEAT BACKREST TED TEMPERATURE SENSOR CIRCUITS 1549 (DB/OG) AND 1062 (RD/LB) FOR A SHORT TO GROUND	
● Measure the resistance between the driver seat backrest TED C3034-3 (or passenger seat backrest TED C3039-3), circuit 1549 (DB/OG), harness side and ground; and between the driver seat backrest TED C3034-2 (or passenger seat backrest TED C3039-2), circuit 1062 (RD/LB), harness side and ground.  A0055560 ● **Is the resistance greater than 10,000 ohms?**	**Yes** GO to P41 . **No** REPAIR the affected circuit. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
P41 CHECK THE SEAT BACKREST TED TEMPERATURE SENSOR CIRCUITS 1549 (DB/OG) AND 1062 (RD/LB) FOR AN OPEN	
● Disconnect: Driver CCSM C3031a or Passenger CCSM C3036a. ● Measure the resistance between the driver seat backrest TED C3034-3 (or passenger seat backrest TED C3039-3), circuit 1549 (DB/OG), harness side and the driver CCSM C3031a-19 (or passenger CCSM C3036a-19), circuit 1549 (DB/OG), harness side; and between the driver seat backrest TED C3034-2 (or passenger seat backrest TED C3039-2), circuit 1062 (RD/LB), harness side and the driver CCSM C3031a-20 (or passenger CCSM C3036a-20), circuit 1062 (RD/LB), harness side.  A0055568 ● **Are the resistances less than 5 ohms?**	**Yes** GO to P42 . **No** REPAIR the affected circuit. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

P42 CHECK THE SEAT BACKREST TED	
• Measure the resistance between the seat backrest TED pin 2 and pin 3, component side.  A0055562 • **Is the resistance greater than 1,000 ohms?**	**Yes** INSTALL a new CCSM. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** INSTALL a new seat backrest TED. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
P43 CHECK THE SEAT BACKREST TED HEATING ELEMENT CIRCUITS 1066 (GY/LB) AND 1067 (VT/LB) FOR A SHORT TO VOLTAGE	
• Key in OFF position. • Disconnect: Driver Seat Backrest TED C3034 or Passenger Seat Backrest TED C3039. • Measure the voltage between the driver seat backrest TED C3034-4 (or passenger seat backrest TED C3039-4), circuit 1067 (VT/LB), harness side and ground; and between the driver seat backrest TED C3034-6 (or passenger seat backrest TED C3039-6), circuit 1066 (GY/LB), harness side an ground.  A0055563 • **Is the voltage greater than 10 volts?**	**Yes** REPAIR the affected circuits. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** GO to P44 .
P44 CHECK THE SEAT BACKREST TED HEATING ELEMENT CIRCUITS 1066 (GY/LB) AND 1067 (VT/LB) FOR A SHORT TO GROUND	
• Measure the resistance between the driver seat backrest TED C3034-4 (or passenger seat backrest TED C3039-4), circuit 1067 (VT/LB), harness side and ground; and between the driver seat backrest TED C3034-6 (or passenger seat backrest TED C3039-6), circuit 1066 (GY/LB), harness side an ground.	**Yes** GO to P45 . **No** REPAIR the affected circuit. TEST the system for normal

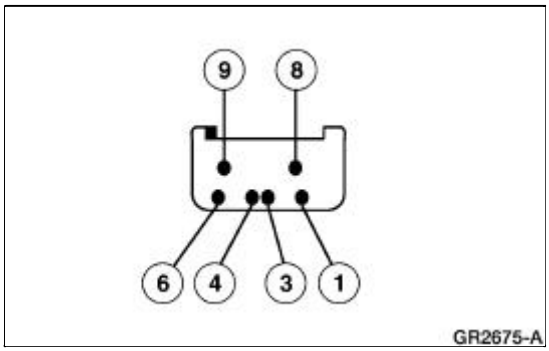
 A0055564 ● **Is the resistance greater than 10,000 ohms?**	operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
P45 CHECK THE SEAT BACKREST TED HEATING ELEMENT CIRCUITS 1066 (GY/LB) AND 1067 (VT/LB) FOR AN OPEN	
● Disconnect: Driver CCSM C3031a or Passenger CCSM C3036a. ● Measure the resistance between the driver seat backrest TED C3034-4 (or passenger seat backrest TED C3039-4), circuit 1067 (VT/LB), harness side and the driver CCSM C3031a-12 (or passenger CCSM C3036a-12), circuit 1067 (VT/LB), harness side; and between the driver seat backrest TED C3034-6 (or passenger seat backrest TED C3039-6), circuit 1066 (GY/LB), harness side and the driver CCSM C3031a-11 (or passenger CCSM C3036a-11), circuit 1066 (GY/LB), harness side.  A0055569 ● **Are the resistances less than 5 ohms?**	**Yes** GO to P46 . **No** REPAIR the affected circuit. TEST the system for normal operation.
P46 CHECK THE SEAT BACKREST TED	
● Measure the resistance between the seat backrest TED pin 4 and pin 6, component side.  A0055566 ● **Is the resistance greater than 1,000 ohms?**	**Yes** INSTALL a new CCSM. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section. **No** INSTALL a new seat backrest TED. TEST the system for normal operation. REACTIVATE the supplemental restraint system (SRS). REFER to Supplemental

	Restraint System (SRS) Deactivation and Reactivation in this section.

Component Test

Switch — Memory Set

Memory Set Switch



Remove the memory set switch.

Measure the resistance between the following indicated terminals while pressing the requested switches.

Switch	Terminals
Memory Switch 1	6 and 4
Memory Switch 2	6 and 3
Memory Set Switch	6 and 1

The resistance should be less than 5 ohms for each switch position.

If the resistance is not less than 5 ohms for each switch, install a new switch; otherwise, return to the calling pinpoint test.

Switch	Terminals
Memory Switch LED	8 and 9

NOTE: Refer to multimeter user's manual for testing diodes.

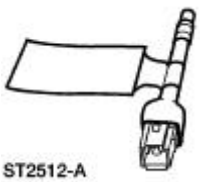
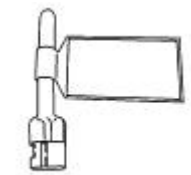
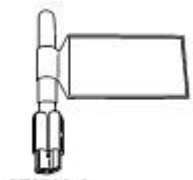
To check the memory set switch LED, connect the positive meter lead to terminal 8 and the negative lead to terminal 9. The meter should indicate greater than 0.3 volts. Reversing the leads, the meter

should read O L.

If the meter readings are not as indicated above, install a new switch; otherwise, return to the calling pinpoint test.

Supplemental Restraint System (SRS) Deactivation and Reactivation

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (2 req'd) 418-F395 (014-R1079)
 ST2512-A	Diagnostic Tool, Restraint System (1 req'd) 418-F403
 ST2507-A	Diagnostic Tool, Restraint System (2 req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 req'd) 418-F088 (105-R0012)

Deactivation

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Do not set a live air bag module down with the trim cover face down. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an airbag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

WARNING: Never probe the connectors on the safety canopy module. Doing so can result in safety canopy module deployment.

WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

WARNING: Restraint system diagnostic tools are for service only. Tools must be removed prior to operating the vehicle over the road. Failure to remove restraint system diagnostic tools could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side air bag and/or a safety belt pretensioner (if equipped) system is being serviced, **the air bag system must be deactivated.**

NOTE: Restraint system diagnostic tools **MUST** be installed under the seats in the seat side air bag (if equipped) and safety belt pretensioner (if equipped) to floor connectors.

NOTE: Diagnostics or repairs are not to be carried out on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road.**

NOTE: After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

All vehicles

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

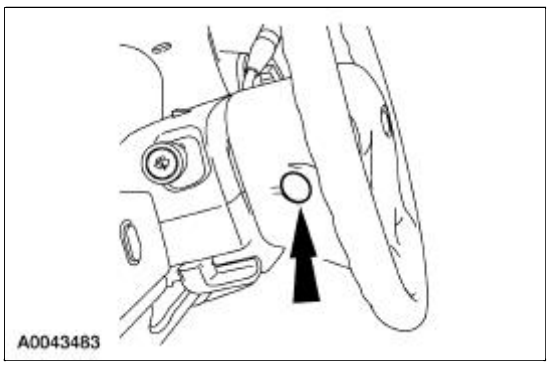
   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

The second row side impact sensors (if equipped) are located at or near the base of the C-pillars.

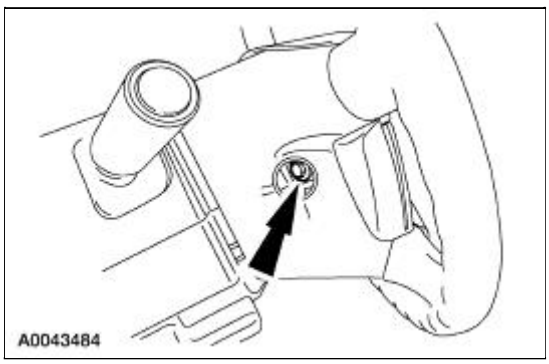
To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

2. Remove the two steering wheel back cover plugs (one shown).

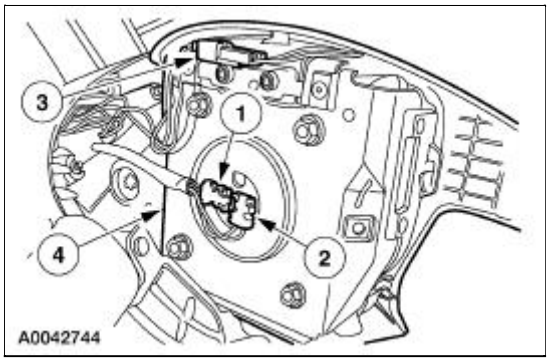


3. Remove the two driver air bag module bolts (one shown).



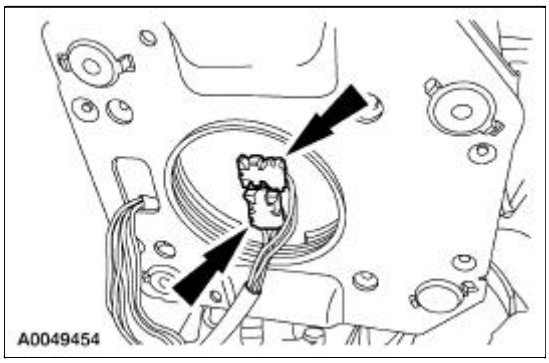
Expedition vehicles

4. Remove the driver air bag module.
    1. Release the two retaining tabs. Disconnect the driver air bag module electrical connector.
        - Label the driver air bag module squib number on the driver air bag module electrical connector before disconnecting.
    2. Release the two retaining tabs. Disconnect the driver air bag module electrical connector.
        - Label the driver air bag module squib number on the driver air bag module electrical connector before disconnecting.
    3. Disconnect the horn switch electrical connector.
    4. Remove the driver air bag module.

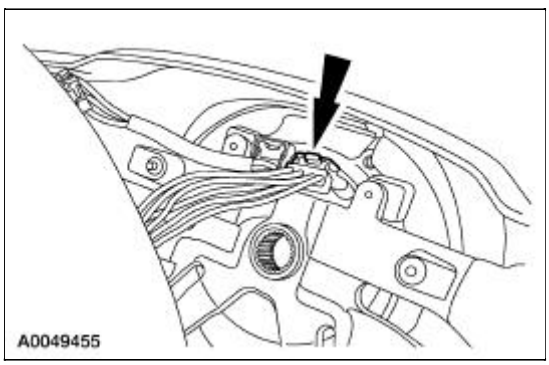


Navigator vehicles

5. Disconnect the driver air bag module
    - Release the two tabs on each driver air bag module electrical connector and disconnect them.
        - Label each driver air bag module electrical connector before disconnecting.

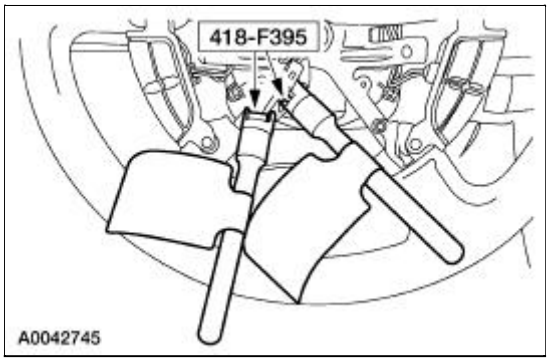


6. Release the tab and disconnect the driver air bag module accessories electrical connector at the top of the clockspring and remove the driver air bag module.

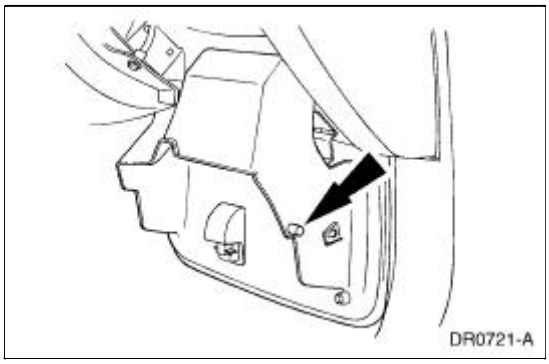


All vehicles

7. Attach the restraint system diagnostic tools to the clockspring electrical connectors at the top of the steering column.

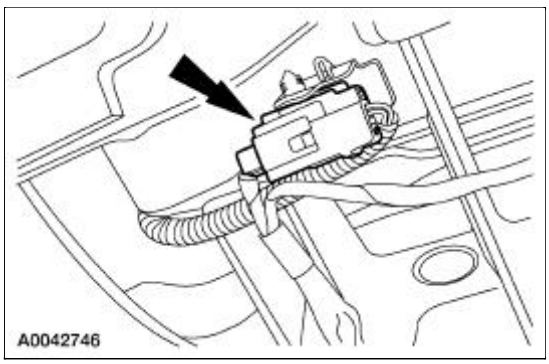


8. While pushing in on the two glove compartment door tabs, position the glove compartment downward.

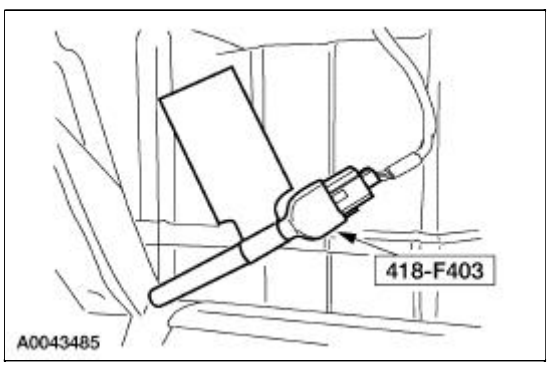


9. **NOTE:** The Expedition is shown, the Navigator is similar.

   Through the glove compartment opening, release the tab and disconnect the passenger air bag module electrical connector.



10. Attach the restraint system diagnostic tool to the vehicle harness side of the passenger air bag module electrical connector.



Vehicles without safety canopies

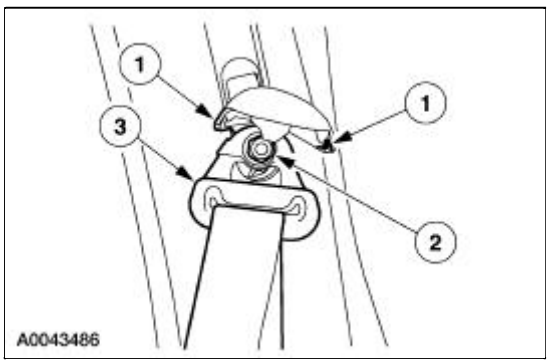
11. **CAUTION: Do not deactivate the safety canopy module circuit by removing the safety canopy bridge resistor from the safety canopy electrical connector.**

    If the safety canopy bridge resistor is removed, an open circuit fault will be generated by the restraints control module (RCM).
    If a restraint system diagnostic tool is installed at the safety canopy electrical connector, a low resistance fault will be generated by the RCM.

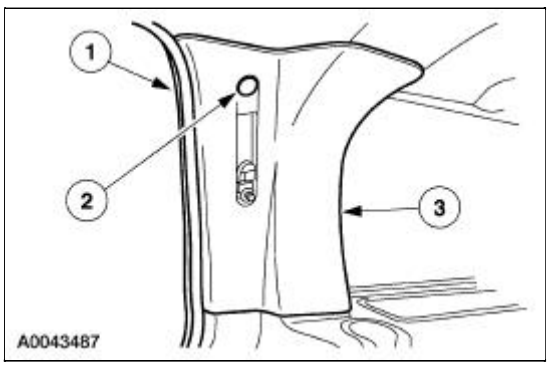
Vehicles with safety canopies

12. **NOTE:** Inspect the shoulder safety belt guide cover for damage. If the shoulder safety belt guide cover is damaged or if it does not remain closed, install a new shoulder safety belt guide cover.

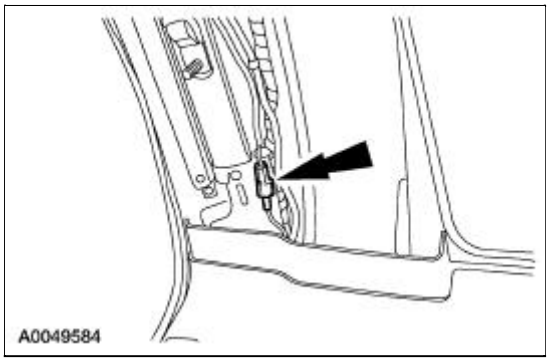
    Remove the second row passenger side safety belt guide.
    1. Release the retaining tab at each side and open the safety belt guide cover.
    2. Remove the nut.
    3. Remove the second row passenger side safety belt guide.



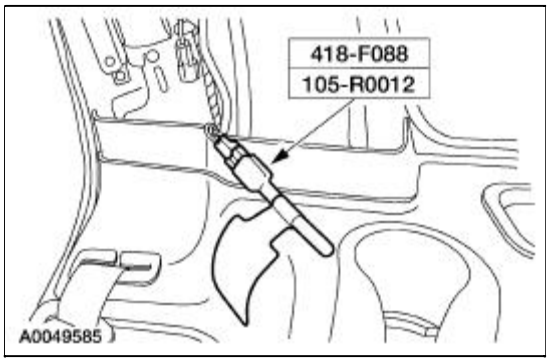
13. Remove the passenger side C-pillar trim panel.
    1. Separate the weather-stripping along the passenger side C-pillar trim panel.
    2. Remove the bolt cover and bolt.
    3. Pull out to release the retainers and remove the passenger side C-pillar trim panel.



14. Disconnect the passenger side safety canopy electrical connector.

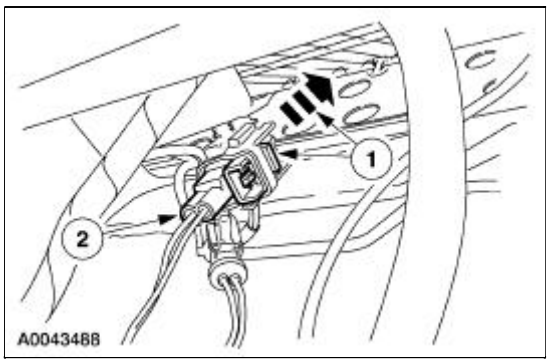


15. Attach the restraint system diagnostic tool to the vehicle harness side of the passenger side safety canopy electrical connector.

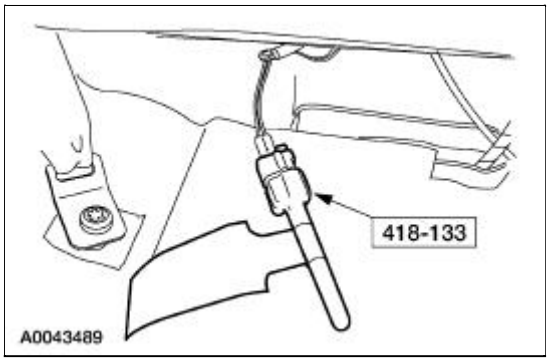


All vehicles

16. Disconnect the passenger seat safety belt buckle pretensioner electrical connector.
    1. Slide and disengage the passenger seat safety belt buckle pretensioner electrical connector locking clip.
    2. Push in to release the tab and disconnect the passenger seat safety belt buckle pretensioner electrical connector.



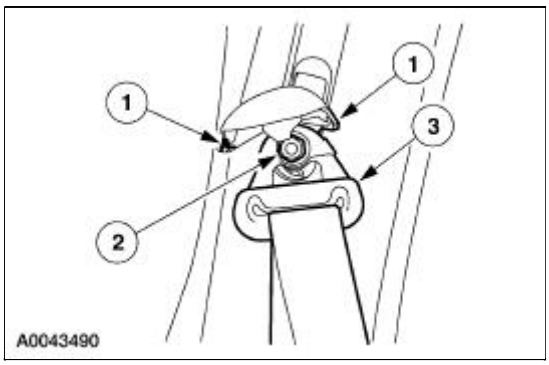
17. Attach the restraint system diagnostic tool to the passenger seat safety belt buckle pretensioner floor electrical connector.



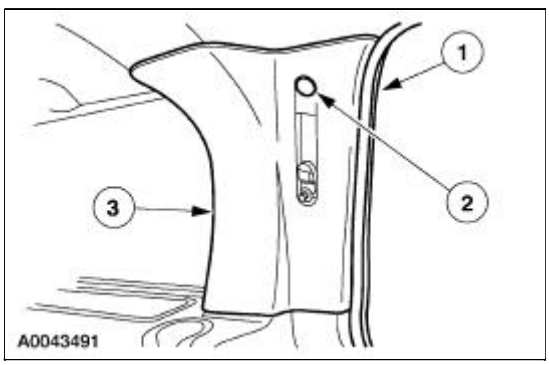
Vehicles with safety canopies

18. **NOTE:** Inspect the shoulder safety belt guide cover for damage. If the shoulder safety belt guide cover is damaged or if it does not remain closed, install a new shoulder safety belt guide cover.

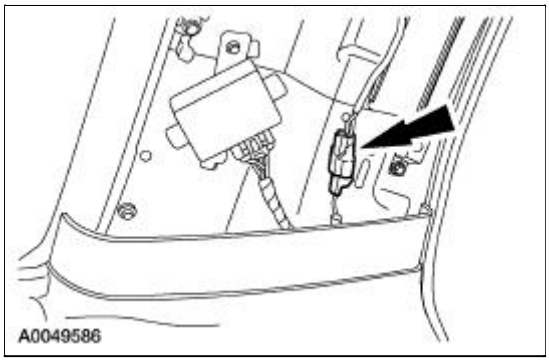
    Remove the second row driver side safety belt guide.
    1. Release the retaining tab at each side and open the safety belt guide cover.
    2. Remove the nut.
    3. Remove the second row driver side safety belt guide.



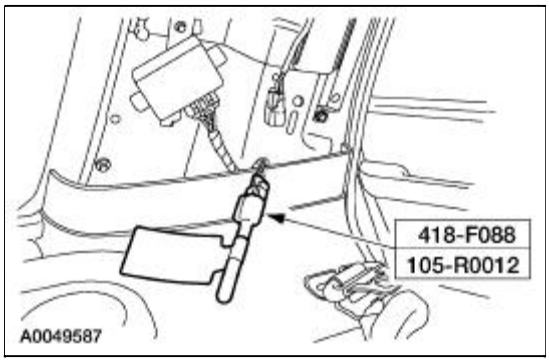
19. Remove the driver side C-pillar trim panel.
    1. Separate the weather-stripping along the driver side C-pillar trim panel.
    2. Remove the bolt cover and bolt.
    3. Pull out to release the retainers and remove the driver side C-pillar trim panel.



20. Disconnect the driver side safety canopy electrical connector.

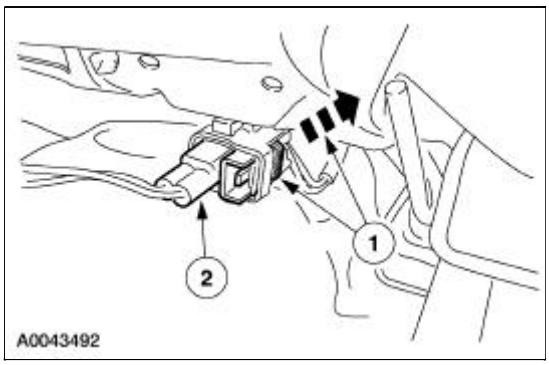


21. Attach the restraint system diagnostic tool to the vehicle harness side of the driver side safety canopy electrical connector.

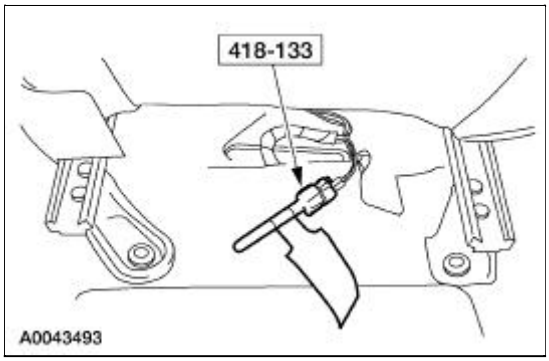


All vehicles

22. Disconnect the driver seat safety belt buckle pretensioner electrical connector.
    1. Slide and disengage the driver seat safety belt buckle pretensioner electrical connector locking clip.
    2. Push in to release the tab and disconnect the driver seat safety belt buckle pretensioner electrical connector.



23. Attach the restraint system diagnostic tool to the driver seat safety belt buckle pretensioner floor electrical connector.



24. Connect the battery ground cable. For additional information, refer to Section 414-01 .

25. With the restraint system diagnostic tools installed at all deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of Section 501-20B .

26. Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

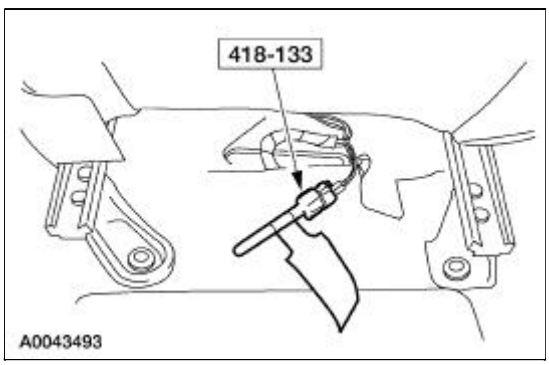
Reactivation

WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the deactivation procedure.

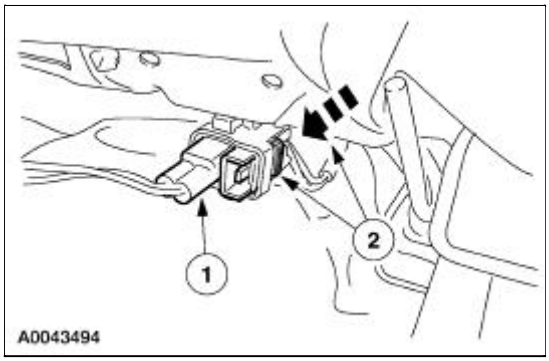
All vehicles

1. **NOTE:** Make sure the battery negative cable is still disconnected before proceeding with the reactivation portion of this procedure.

   Remove the restraint system diagnostic tool from the driver seat safety belt buckle pretensioner floor electrical connector.

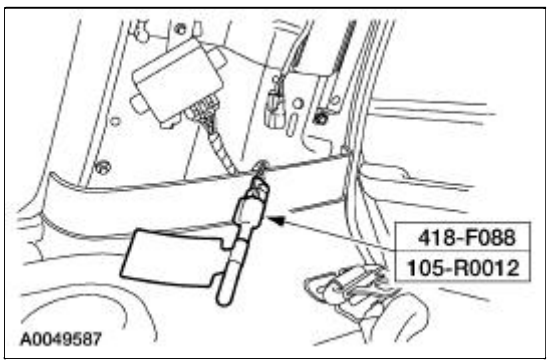


2. Connect the driver seat safety belt buckle pretensioner electrical connector.
   1. Connect the driver seat safety belt buckle pretensioner electrical connector.
   2. Slide and engage the driver seat safety belt buckle pretensioner electrical connector locking clip.

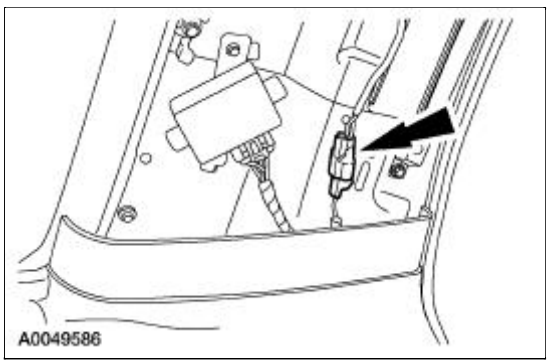


Vehicles with safety canopies

3. Remove the restraint system diagnostic tool from the vehicle harness side of the driver side safety canopy electrical connector.

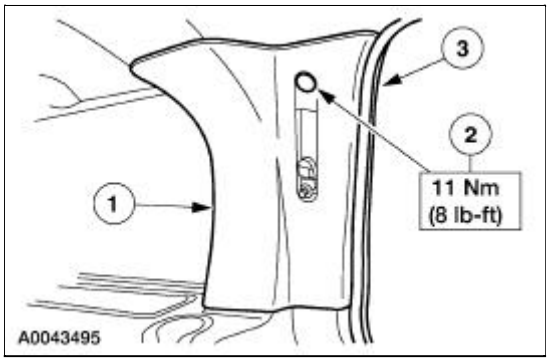


4. Connect the driver side safety canopy electrical connector.



5. **WARNING: Anytime the safety canopy module has deployed, the headliner, and all A, B, and C pillar upper trim panels and attaching hardware must be replaced along with any other damaged components and hardware. Failure to do so may result in personal injury in the event of a safety canopy module deployment.**

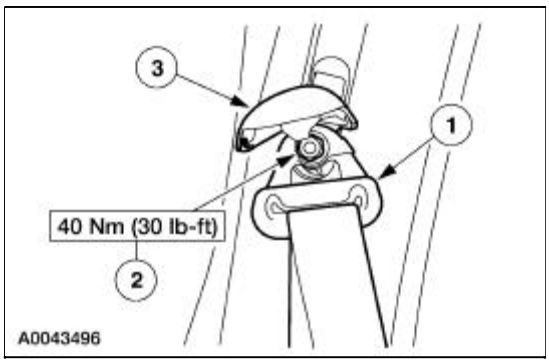
   Install the driver side C-pillar trim panel.
   1. Position the driver side C-pillar trim panel and push in, engaging the retainers.
   2. Install the bolt and bolt cover.
   3. Install the weather-stripping along the driver side C-pillar trim panel.



6. **NOTE:** Inspect the shoulder safety belt guide cover for damage. If the shoulder safety belt guide cover is damaged or if it does not remain closed, install a new shoulder safety belt guide cover.

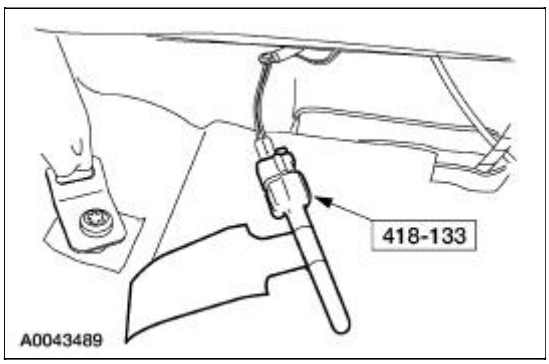
   NOTE: Make sure the safety belt is not twisted prior to installation.

   Install the second row driver side safety belt guide.
   1. Position the second row driver side safety belt guide.
   2. Install the nut.
   3. Close the safety belt guide cover.

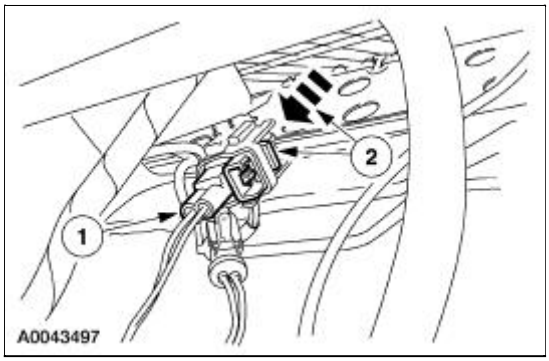


All vehicles

7. Remove the restraint system diagnostic tool from the passenger seat safety belt buckle pretensioner floor electrical connector.

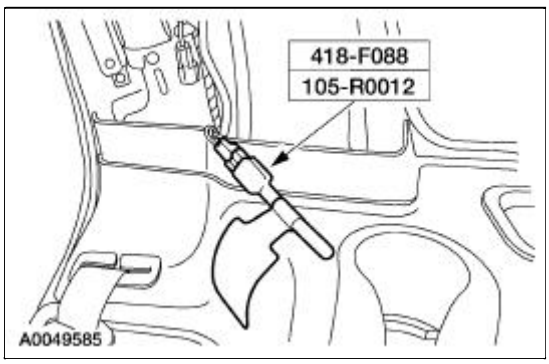


8. Connect the passenger seat safety belt buckle pretensioner electrical connector.
   1. Connect the passenger seat safety belt buckle pretensioner electrical connector.
   2. Slide and engage the passenger seat safety belt buckle pretensioner electrical connector locking clip.

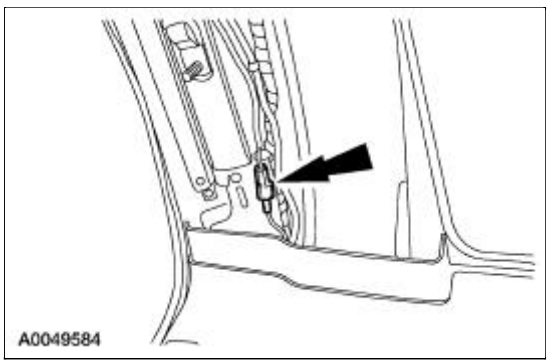


Vehicles with safety canopies

9. Remove the restraint system diagnostic tool from the vehicle harness side of the passenger side safety canopy electrical connector.

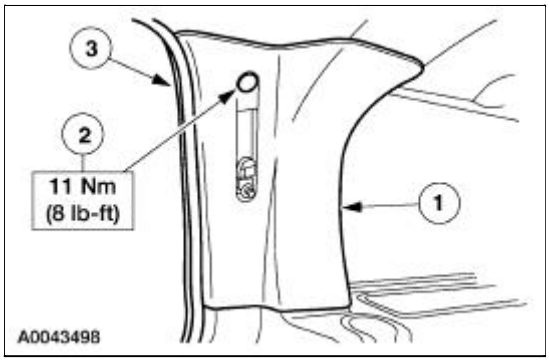


10. Connect the passenger side safety canopy electrical connector.



11. **WARNING: Anytime the safety canopy module has deployed, the headliner, and all A, B, and C pillar upper trim panels and attaching hardware must be replaced along with any other damaged components and hardware. Failure to do so may result in personal injury in the event of a safety canopy module deployment.**

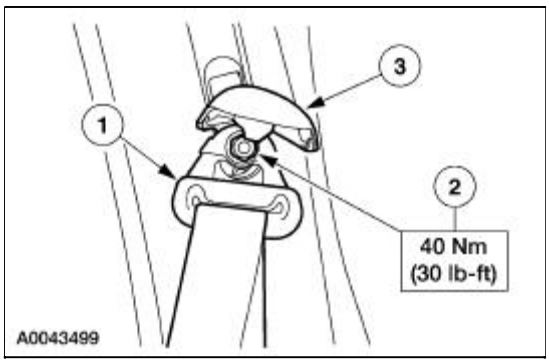
    Install the passenger C-pillar trim panel.
    1. Position the passenger side C-pillar trim panel and push in, engaging the retainers.
    2. Install the bolt and bolt cover.
    3. Install the weather-stripping along the passenger side C-pillar trim panel.



12. **NOTE:** Inspect the shoulder safety belt guide cover for damage. If the shoulder safety belt guide cover is damaged or if it does not remain closed, install a new shoulder safety belt guide cover.

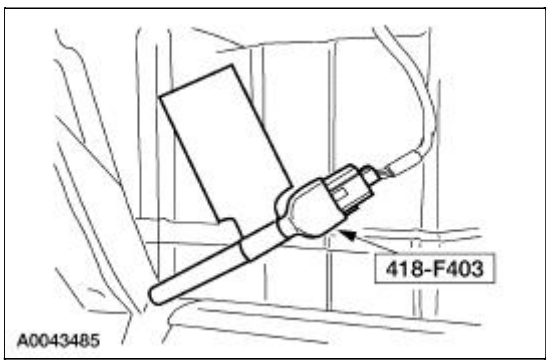
    NOTE: Make sure the safety belt is not twisted prior to installation.

    Install the second row passenger side safety belt guide.
    1. Position the second row passenger side safety belt guide.
    2. Install the nut.
    3. Close the safety belt guide cover.



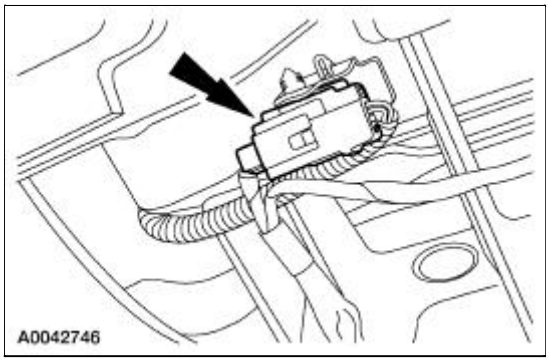
All vehicles

13. Remove the restraint system diagnostic tool from the vehicle harness side of the passenger air bag module electrical connector.



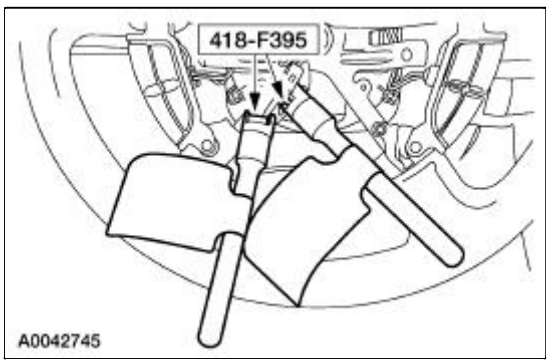
14. **NOTE:** The Expedition is shown, the Navigator is similar.

    Connect the passenger air bag module electrical connector.



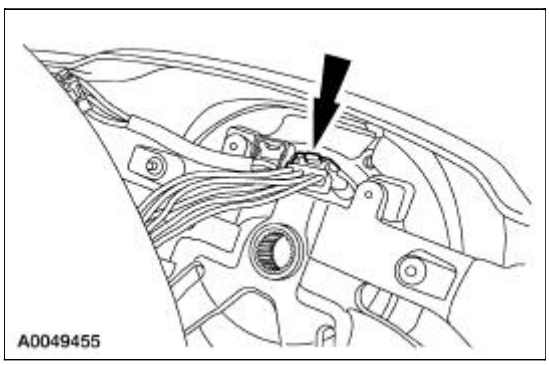
15. Close the glove compartment.

16. Remove the restraint system diagnostic tools from the clockspring electrical connector at the top of the steering column.



Navigator vehicles

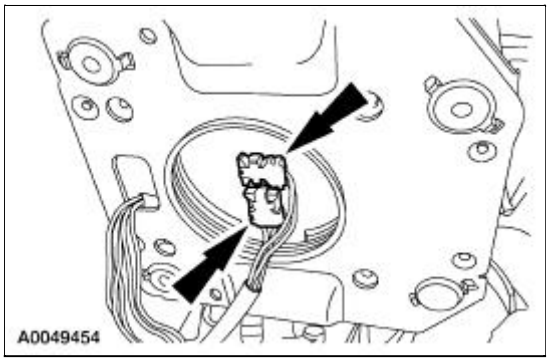
17. Connect the driver air bag module accessories electrical connector to the connector end at the top of the clockspring.



18. **CAUTION: The clockspring electrical connectors are unique and cannot be reversed when connected to the driver air bag module. Match the electrical connector key to the keyway in the driver air bag module. Do not force the electrical connectors into the driver air bag module.**

    Connect the driver air bag module electrical connectors as noted during removal.

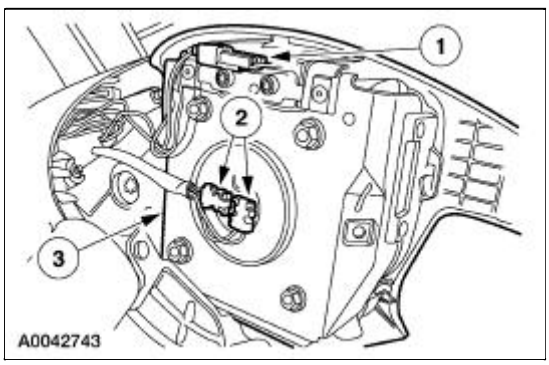
    - Position the driver air bag module to the steering wheel.



Expedition vehicles

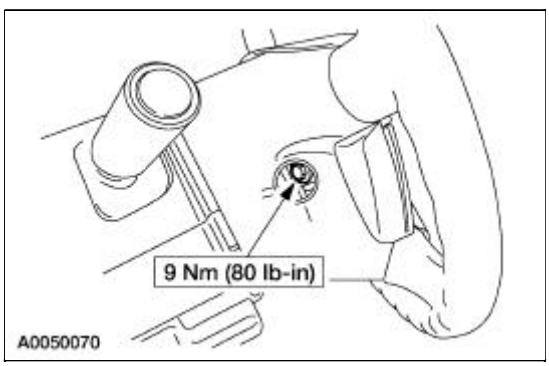
19. Position the driver air bag module to the steering wheel.
    1. Connect the horn switch electrical connector.
    2. **CAUTION: The clockspring electrical connectors are unique and cannot be reversed when connected to the driver air bag module. Match the electrical connector key to the keyway in the driver air bag module. Do not force the electrical connectors into the driver air bag module.**

       Connect the driver air bag module electrical connectors as noted during removal.
    3. Position the driver air bag module to the steering wheel.

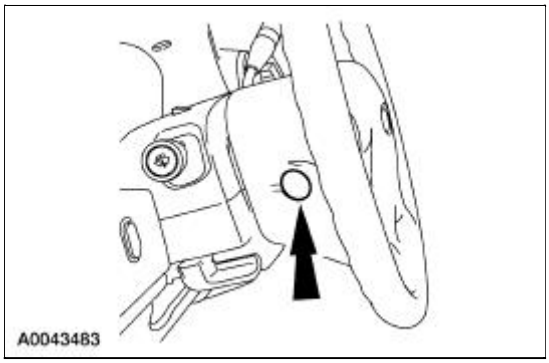


All vehicles

20. Install the two driver air bag module bolts (one shown).



21. Install the two steering wheel back cover plugs (one shown).



22. Connect the battery ground cable. For additional information, refer to Section 414-01 .

23. **WARNING: Restraint system diagnostic tools are for service only. Tools must be removed prior to operating the vehicle over the road. Failure to remove restraint system diagnostic tools could result in injury and possible violation of vehicle safety standards.**

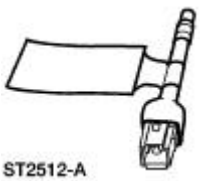
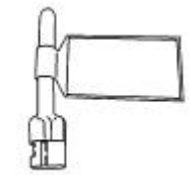
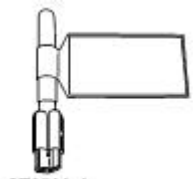
    With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of Section 501-20B .

Vehicles with safety canopies

24. Check the active restraint system for correct operation. For additional information, refer to Section 501-20A .

Front Seat —40 Percent

Special Tool(s)

 ST2512-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F403
 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395 (014-R1079)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F088 (105-00012)

Removal

WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe pretensioner electrical connectors. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

NOTE: Driver side shown, passenger side similar.

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

The second row side impact sensors (if equipped) are located at or near the base of the C-pillars.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

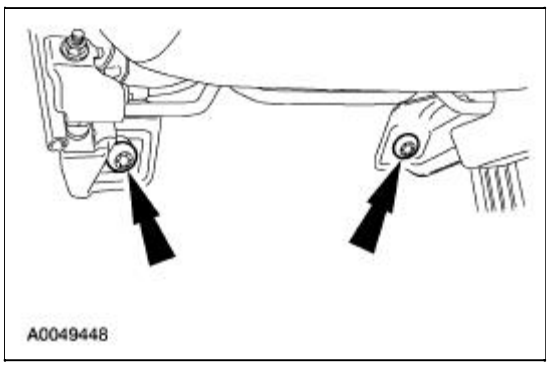
NOTE: Before disconnecting the battery in vehicles with power seats, adjust the seat position to allow for access to the necessary components.

Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

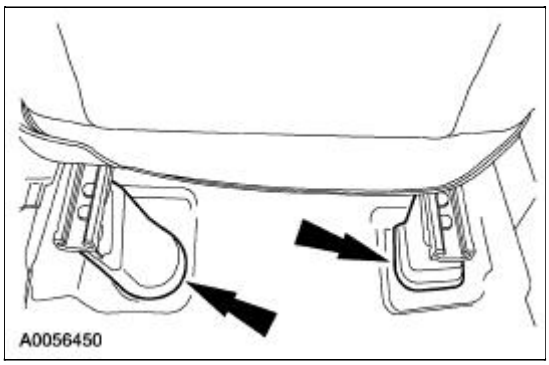
2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

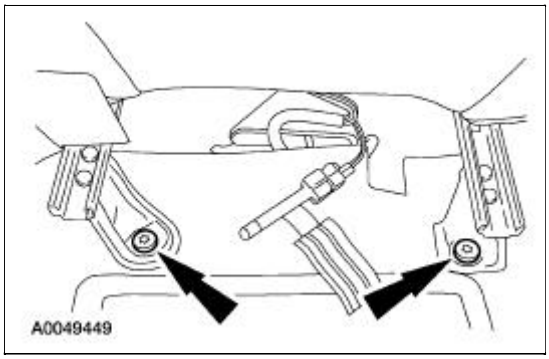
3. Remove the front bolts.



4. Remove the rear bolt covers.

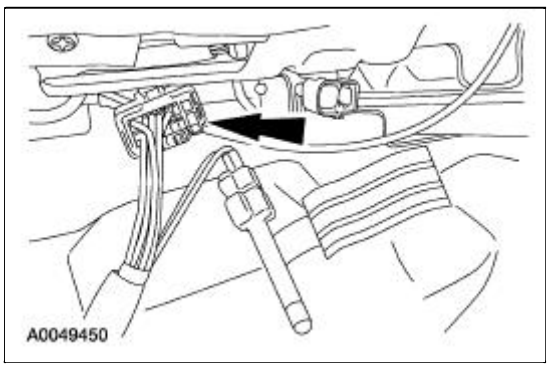


5. Remove the rear bolts.



6. **NOTE:** Some component connectors may not exist due to vehicle options.

   Disconnect the electrical connector.

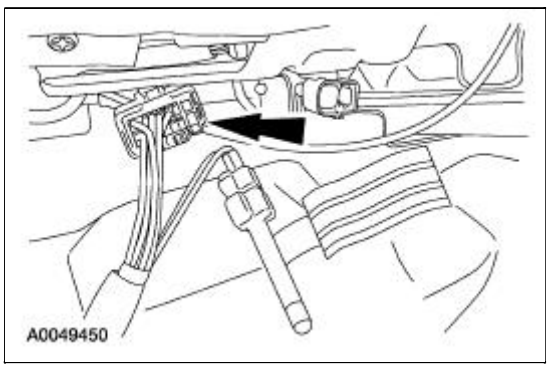


Installation

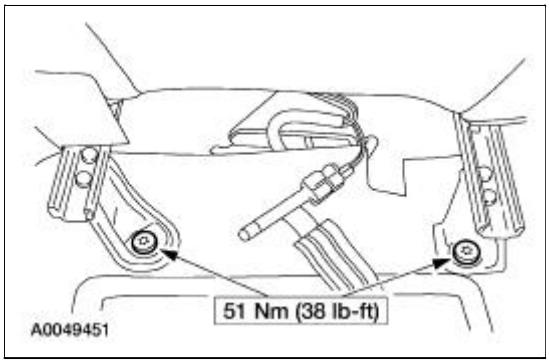
WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the removal procedure.

1. **NOTE:** Some component connectors may not exist due to vehicle options.

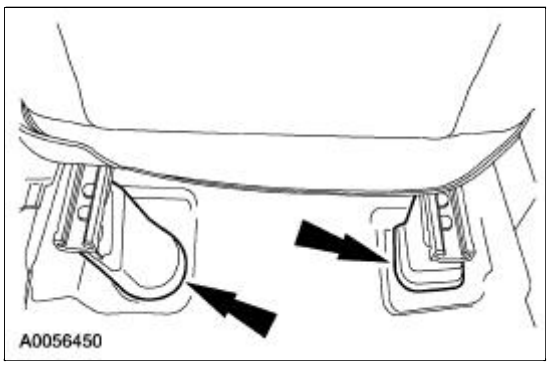
   Connect the electrical connector.



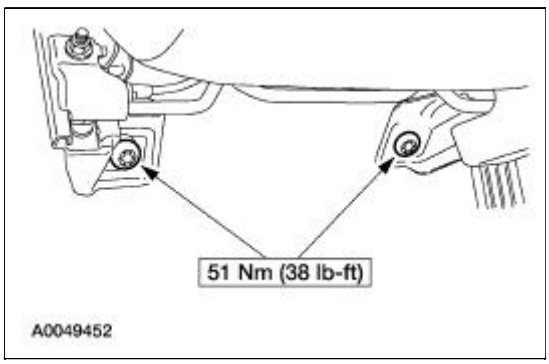
2. Install the rear inboard bolt first, then the rear outboard bolt.



3. Install the rear bolt covers.

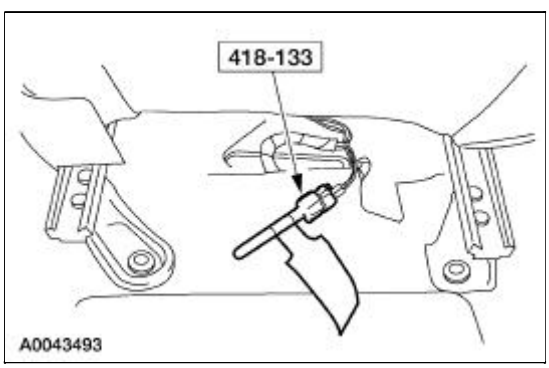


4. Install the front bolts.

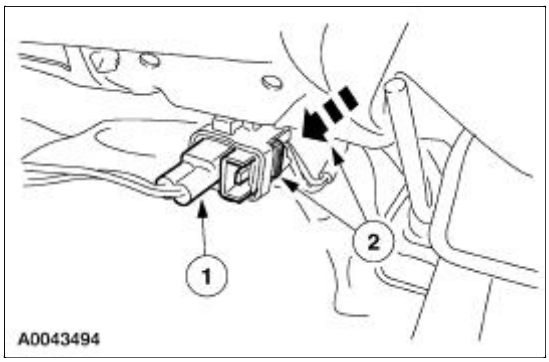


5. **NOTE:** Make sure the negative battery cable is still disconnected before proceeding with the reactivation portion of this procedure.

   Remove the restraint system diagnostic tool from the driver seat safety belt buckle pretensioner floor electrical connector.



6. Connect the driver seat safety belt buckle pretensioner electrical connector.
    1. Connect the driver seat safety belt buckle pretensioner electrical connector.
    2. Slide and engage the driver seat safety belt buckle pretensioner electrical connector locking clip.



7. Connect the battery ground cable. For additional information, refer to Section 414-01 .

8. With the restraint system diagnostic tools still installed at the remaining deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B , in the Diagnosis and Testing portion of that section.

9. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

    The front impact severity sensor is located at the bottom of the hood latch support bracket.

    The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

    The second row side impact sensors (if equipped) are located at or near the base of the C-pillars.

    To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

    Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

10. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

    Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

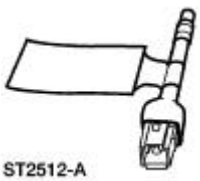
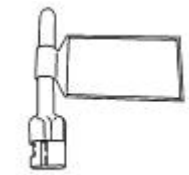
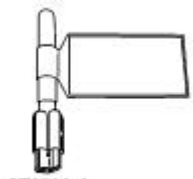
11. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

    With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B in this section.

12. Check the active restraint system for correct operation. For additional information, refer to Section 501-20A .

Front Seat —60 Percent

Special Tool(s)

 ST2512-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F403
 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395 (014-R1079)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F088 (105-00012)

Removal

WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe pretensioner electrical connectors. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

   The second row side impact sensors (if equipped) are located at or near the base of the

C-pillars.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

NOTE: Before disconnecting the battery in vehicles with power seats, adjust the seat position to allow for access to the necessary components.

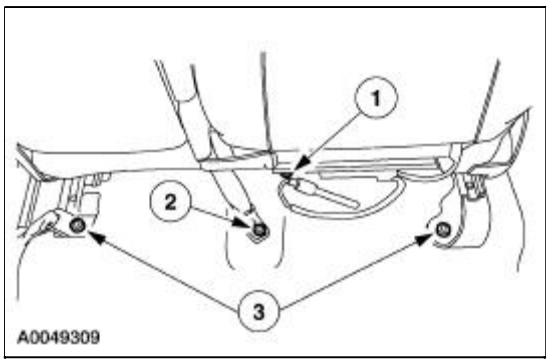
Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

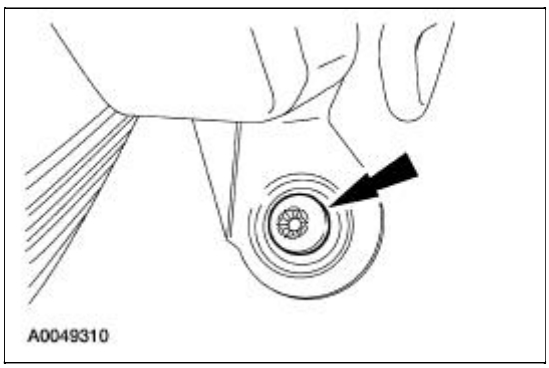
3. Remove the front seat rear floor bolt covers.

4. Remove the 60 percent front seat rear bolts.
   1. Disconnect the usage detection electrical connector.
   2. Remove the center seat belt anchor bolt.
   3. Remove the two seat-to-floor bolts.



5. Move the 60 percent seat to its rearmost position.

6. Remove the two front seat-to-floor bolts (one shown).



7. **NOTE:** Removing the 60 percent front seat requires more than one technician.

   Remove the 60 percent seat from the vehicle.

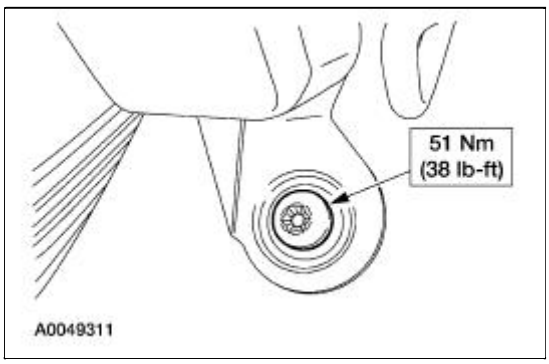
Installation

WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the removal procedure.

1. **NOTE:** Installing the 60 percent front seat requires more than one technician.

   Install the 60 percent seat in the vehicle.

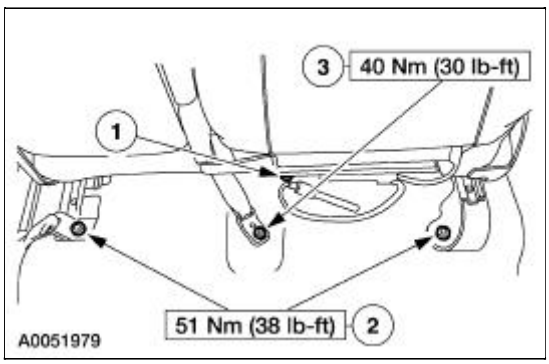
2. Install the front seat-to-floor bolts (one shown).
   - Make sure the safety belt webbing is not twisted prior to installation.



3. Move the 60 percent seat to its most forward position.

4. **NOTE:** Make sure the LH rear seat belt anchor is located before securing the seat.

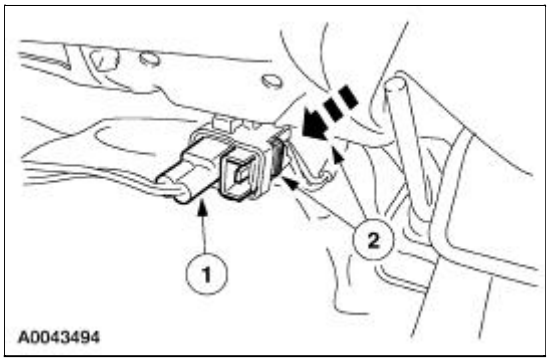
   Install the front seat rear bolts.
   1. Connect the usage detection electrical connector.
   2. Install the two seat-to-floor bolts.
   3. Install the center seat belt anchor bolt.



5. **NOTE:** Make sure the negative battery cable is still disconnected before proceeding with the reactivation portion of this procedure.

   Remove the restraint system diagnostic tool from the passenger seat safety belt buckle pretensioner floor electrical connector.

6. Connect the passenger seat safety belt buckle pretensioner electrical connector.
   1. Connect the passenger seat safety belt buckle pretensioner electrical connector.
   2. Slide and engage the passenger seat safety belt buckle pretensioner electrical connector locking clip.



7. Connect the battery ground cable. For additional information, refer to Section 414-01 .

8. With the restraint system diagnostic tools still installed at the remaining deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B , in the Diagnosis and Testing portion of that section.

9. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

   The second row side impact sensors (if equipped) are located at or near the base of the C-pillars.

   To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

   Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

10. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

    Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation .

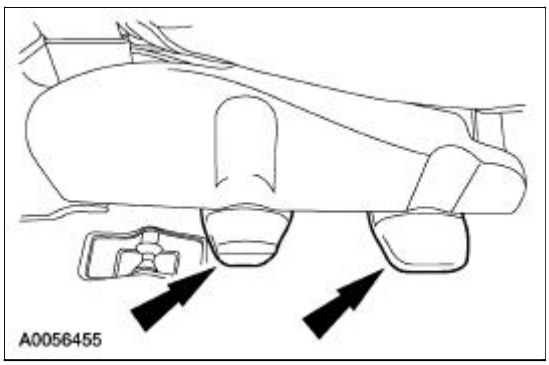
11. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

    With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .

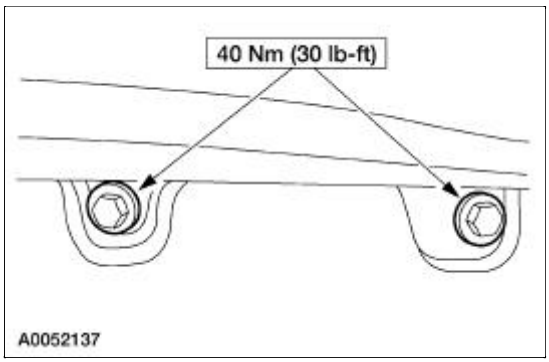
12. Check the active restraint system for correct operation. For additional information, refer to Section 501-20A .

Rear Seat —Second Row, 20 Percent

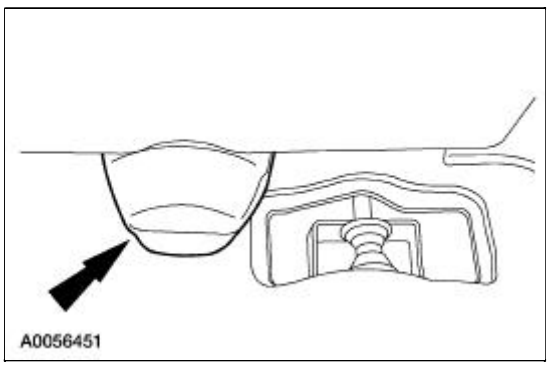
1. Fold both 40 percent seats up to the E-Z entry position.
2. Remove the right side seat-to-floor bolt covers.



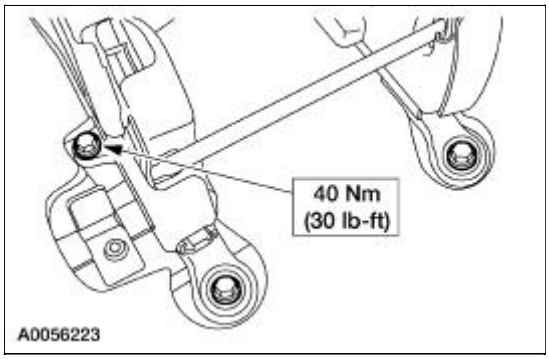
3. Remove the right side seat-to-floor bolts.



4. Remove the left side seat-to-floor bolt cover.



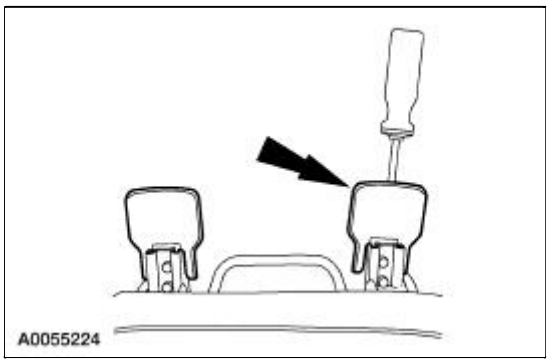
5. Remove the left side seat-to-floor bolt.



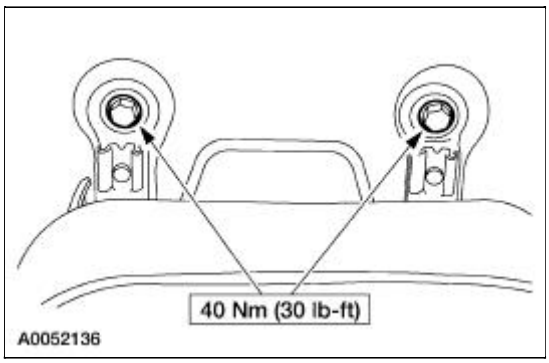
6. Fold the seats down to normal seating position.

7. **CAUTION: Use a screwdriver to pry beneath the attaching metal clips.**

   Remove the 20 percent front and rear seat-to-floor bolt covers (front shown).

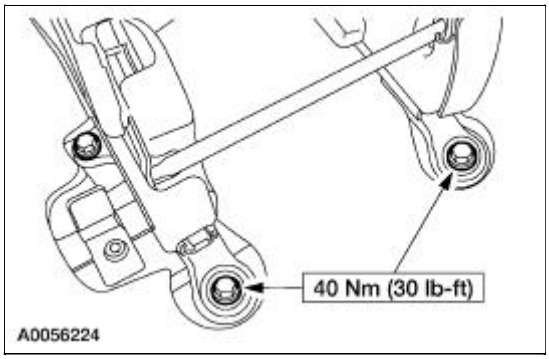


8. Remove the front seat-to-floor bolts.



9. Fold both 40 percent seats up to the E-Z entry position.

10. Remove the left rear bolt and then the right rear bolt.



11. Remove the 20 percent seat from the vehicle.

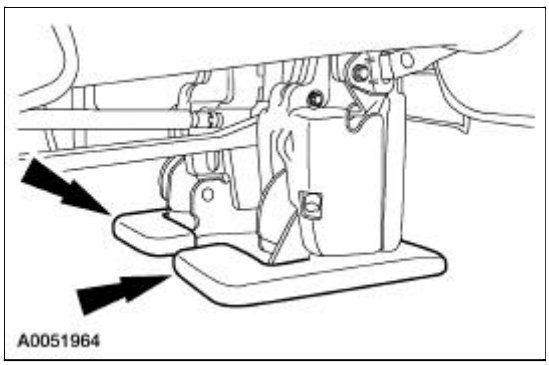
12. To install, reverse the removal procedure.
    - Install the fasteners as follows:
        - Install the right rear bolt.
        - Install the left rear bolt.
        - Install the two front bolts.
        - Install the side (3) shoulder bolts (note, shoulder bolts do not tighten to seat brackets).

13. Check the active restraint system for correct operation. For additional information, refer to Section 501-20A .

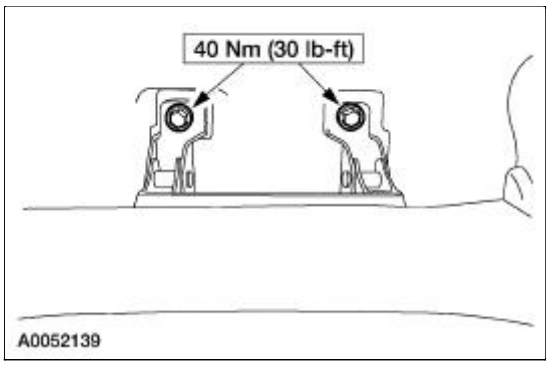
Rear Seat —Second Row, 40 Percent

Removal

1. Remove the two seat-to-floor bolt covers.

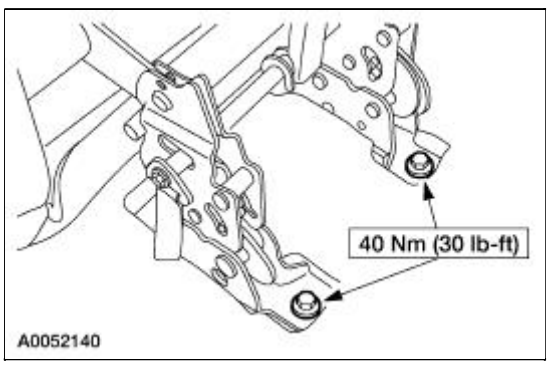


2. Remove the front seat-to-floor bolts.



3. Fold the seat up to the E-Z entry position.

4. Remove the rear seat-to-floor bolts.



5. Remove the 40 percent seat from the vehicle.

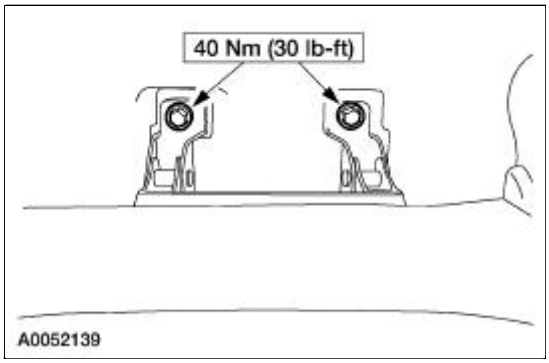
Installation

1. Install the seat in the vehicle.

2. Install both locator pins into the locator holes in the floor pan.

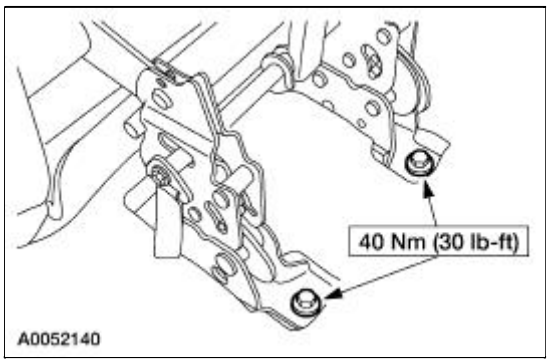
3. Latch the rear latches to strikers.

4. Install the front outboard seat-to-floor bolt and then the inboard seat-to-floor bolt.



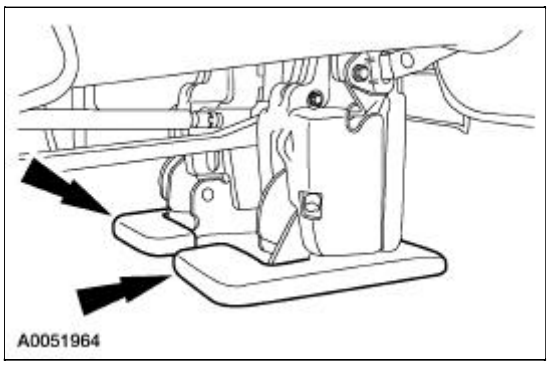
5. Fold the seat up into E-Z entry position.

6. Install the rear seat-to-floor bolts.



7. **NOTE:** Make sure the seat latches when allowed to free fall from the E-Z entry position (if the seat does not completely latch after free fall, raise the seat back. The seat must latch prior to the seat backrest locking in the upright position).

   Install the two second row seat-to-floor bolt covers.



8. Check the active restraint system for correct operation. For additional information, refer to Section 501-20A .

Rear Seat —Third Row

Removal and Installation

CAUTION: To prevent possible damage to the third row seat or the safety belts, make sure that the safety belts are not fastened when moving the seat to the load floor position.

CAUTION: Make sure that no objects such as books, purses or briefcases are on the floor in front of the third row seats or on the seat cushion before lowering the backrest(s).

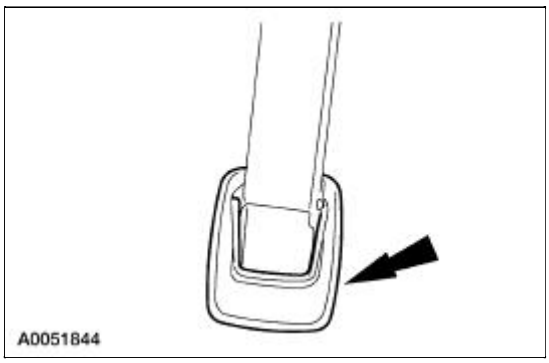
NOTE: The third row seat backrests need to be in the raised position for removal of the third row seats.

NOTE: If a third row power-fold seat motor (if equipped) is inoperative and the backrest is locked in the down position, refer to Power-Fold Seat Motor in this section.

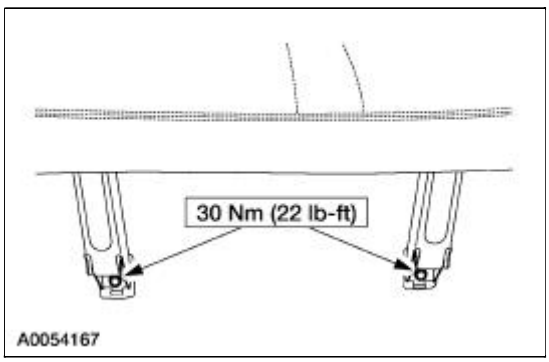
All vehicles

1. **NOTE:** 60 percent seat shown, 40 percent seat similar.

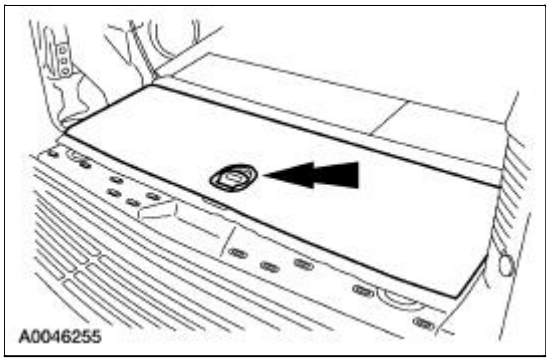
   Remove the third row front seat-to-floor bolt covers (one shown) by opening rear tabs and slide cover forward.



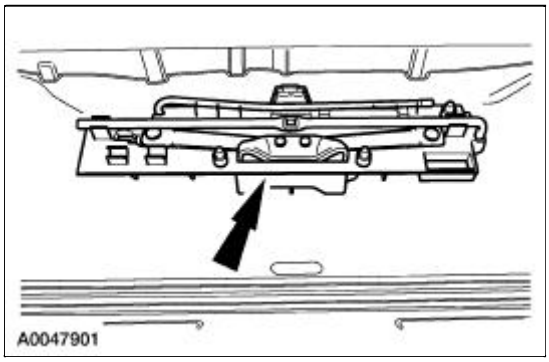
2. Remove the seat riser-to-floor front bolts.



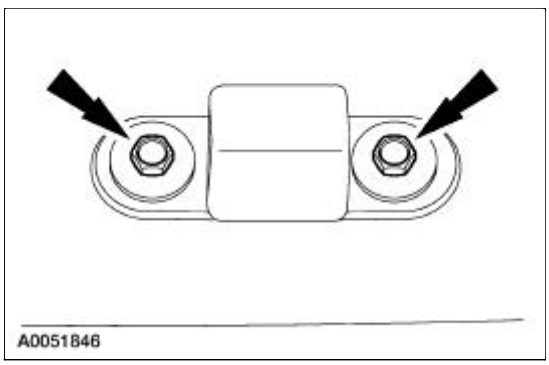
3. Remove the rear load floor panel.



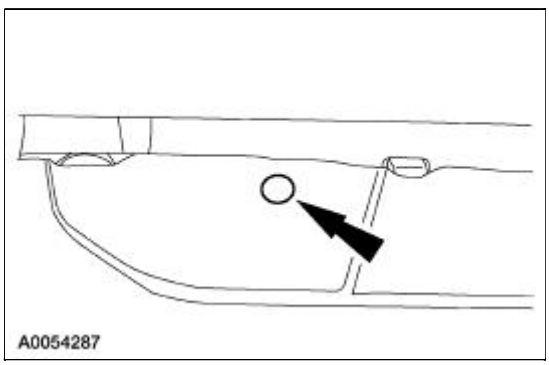
4. Remove the jack assembly.



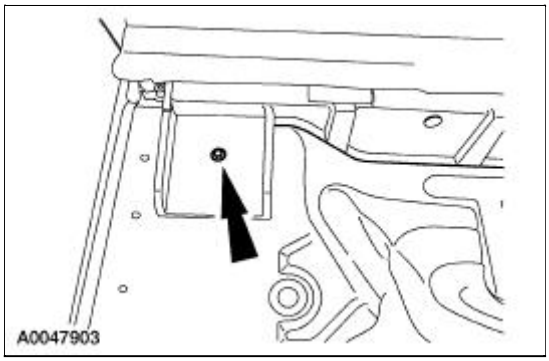
5. Remove the load floor panel latch striker bolts and the striker latch.



6. Remove the three pin-type retainers (one shown) and the jack storage compartment liner.

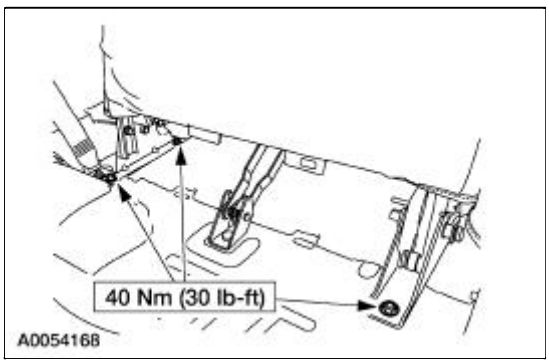


7. Remove the two bolts in mid-floor panel support (one shown).



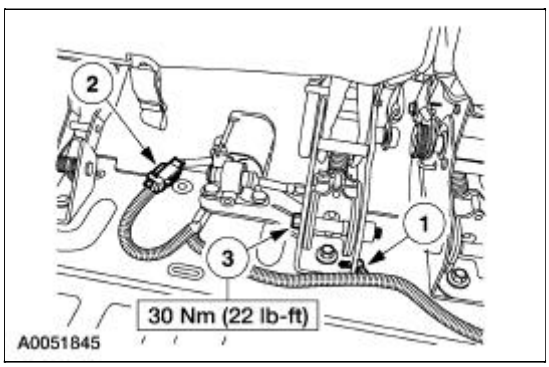
8. Lift on the front of mid-floor panel support to release the three retainer clips and remove the support panel.

9. Remove the four seat-to-floor bolts (three shown).

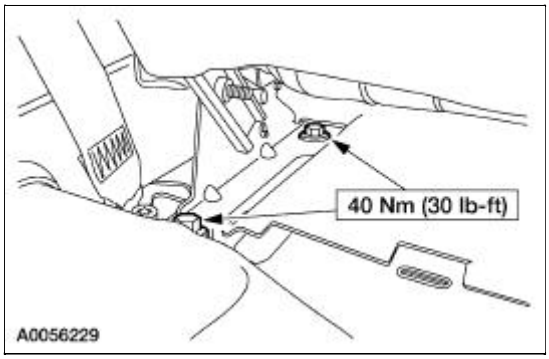


Vehicles with power fold seats

10. Remove the rear power seat attachments.
    1. Detach the pin-type retainer.
    2. Disconnect the electrical connector.
    3. Remove the pivot bolt.



11. Remove the four seat-to-floor bolts (two shown).



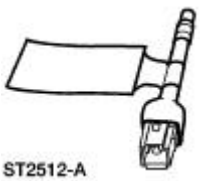
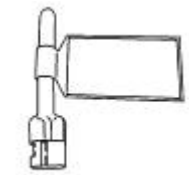
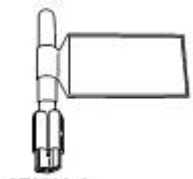
12. **NOTE:** Check location of the 60 percent safety belt buckle for correct location while installing the 60 percent seat.

    To install, reverse the removal procedure.

13. Check the active restraint system for correct operation. For additional information, refer to Section 501-20A .

Seat Control Switch —8-Way

Special Tool(s)

 ST2512-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F403
 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395 (014-R1079)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F088 (105-00012)

Removal

WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe pretensioner electrical connectors. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

NOTE: Driver side shown, passenger side similar.

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

The second row side impact sensors (if equipped) are located at or near the base of the C-pillars.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

NOTE: Before disconnecting the battery in vehicles with power seats, adjust the seat position to allow for access to the necessary components.

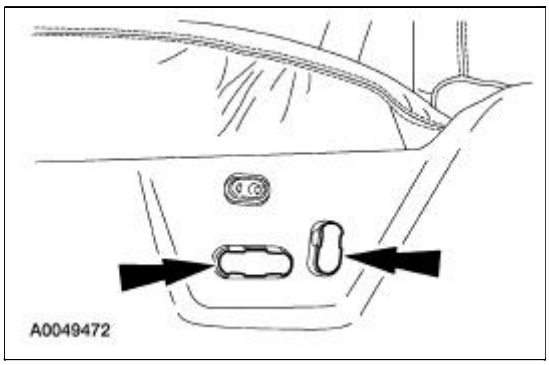
Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

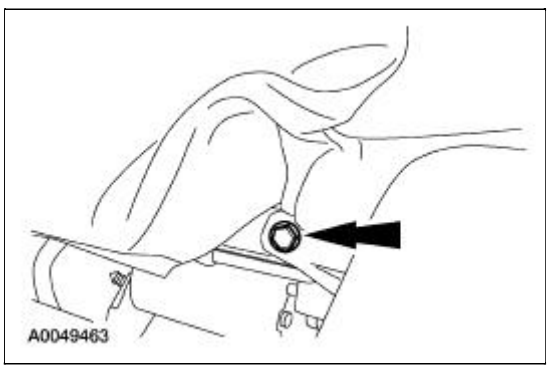
   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

3. Remove the affected seat. For additional information, refer to Front Seat—40 Percent in this section.

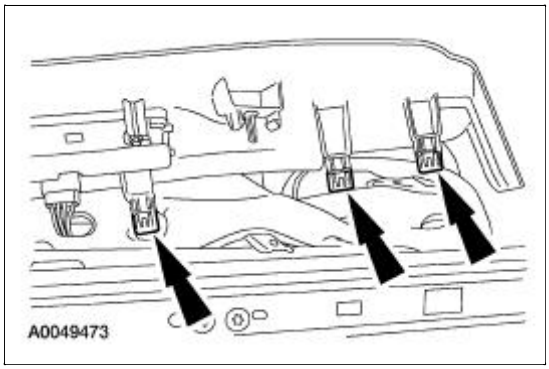
4. Pry to remove the two power seat knobs and remove the knobs.



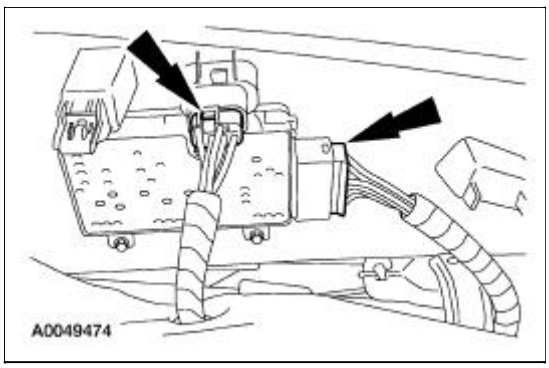
5. Access and remove the front side shield screw.



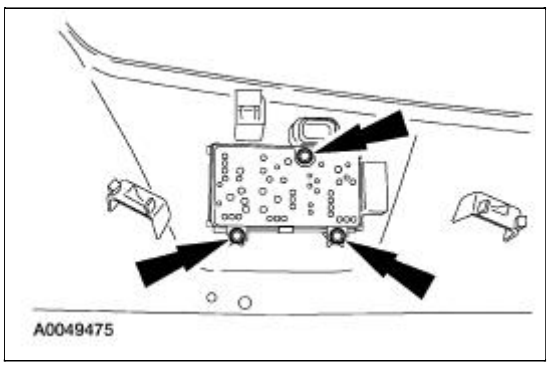
6. Pull out from the bottom and rear side of side shield to release the three retainer clips.



7. Disconnect the power lumbar switch and 8-way power seat switch electrical connectors.



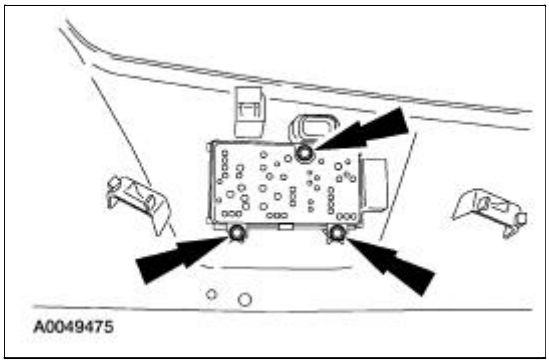
8. Remove the three screws and remove the power seat switch.



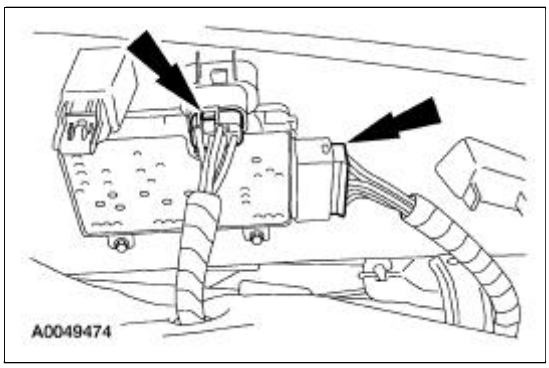
Installation

WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes at the beginning of the removal procedure.

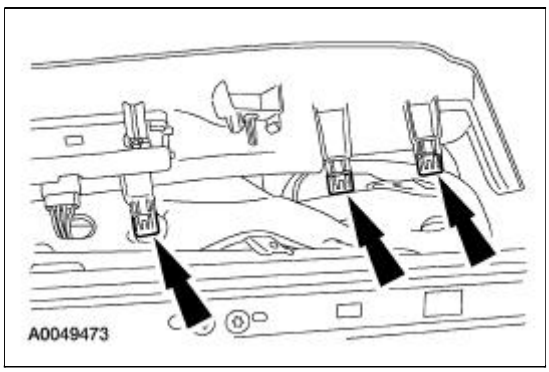
1. Install the power seat switch and install the three screws.



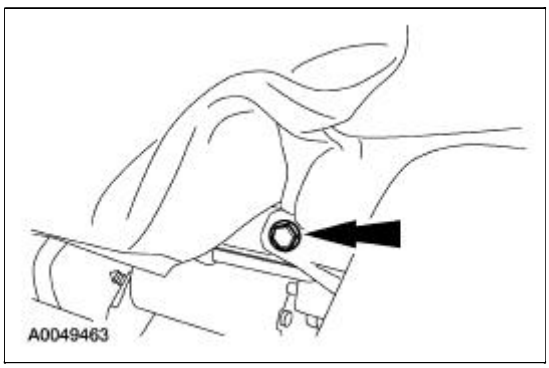
2. Connect the 8-way power seat and power lumbar switch electrical connectors.



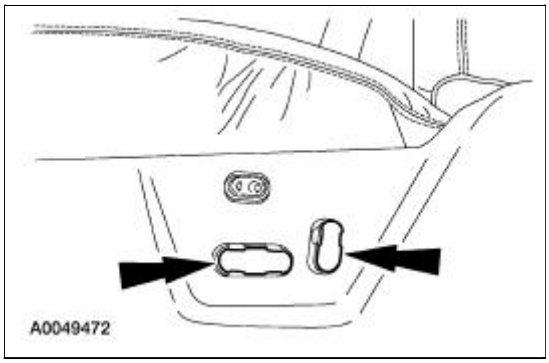
3. Push to install the three side shield retainers onto the seat frame.



4. Access and install the front side shield screw.



5. Install the two power seat knobs.



6. Install the affected seat. For additional information, refer to Front Seat—40 Percent in this section.

7. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

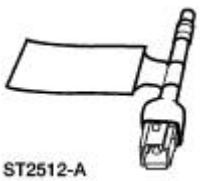
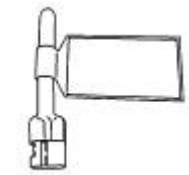
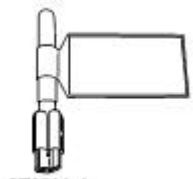
   Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation .

8. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

   With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .

Seat Control Switch —6-Way

Special Tool(s)

 ST2512-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F403
 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395 (014-R1079)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F088 (105-00012)

Removal

WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe pretensioner electrical connectors. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

NOTE: Driver seat is shown, passenger is similar.

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

The second row side impact sensors (if equipped) are located at or near the base of the C-pillars.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

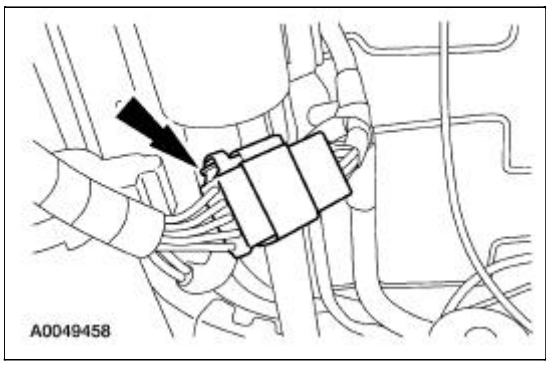
2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

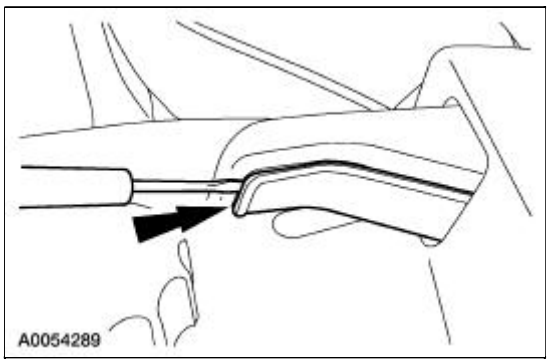
3. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the seat removal and installation procedure.**

   Remove the affected seat. For additional information, refer to Front Seat—40 Percent in this section.

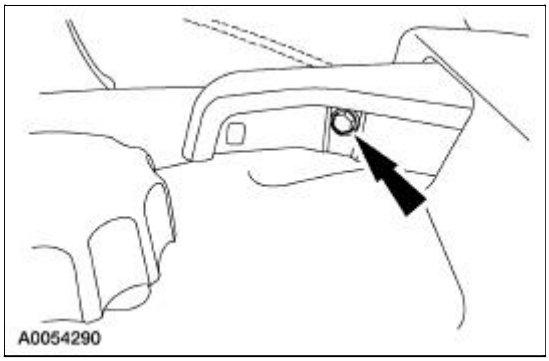
4. Disconnect the 6-way power seat switch electrical connector.



5. Remove the recliner handle screw cover.

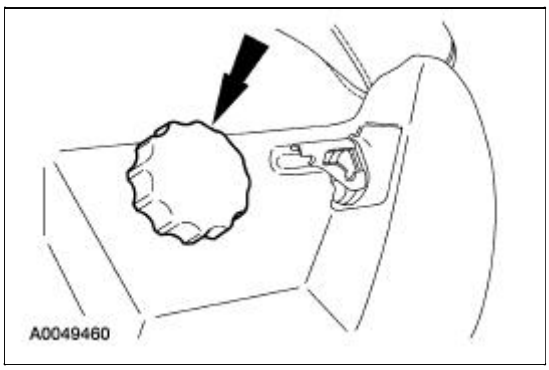


6. Remove the recliner handle screw and the recliner handle.

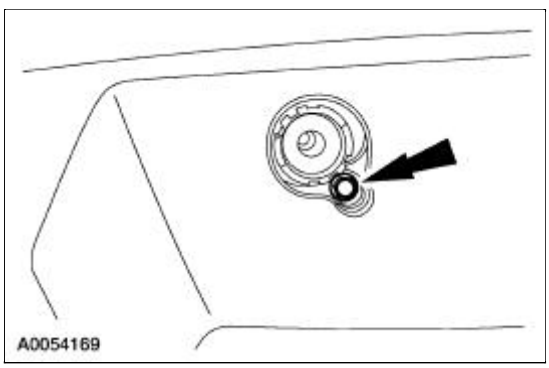


7. **CAUTION: Use care when removing the lumbar knob. Using both hands, pull with even pressure on both sides of the knob to remove.**

   Pull out to remove the lumbar knob.

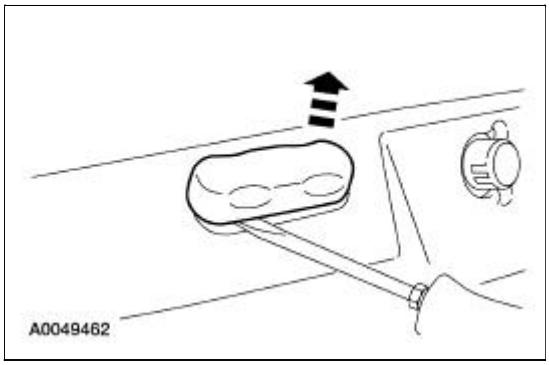


8. Remove the screw from the side shield under the lumbar knob.

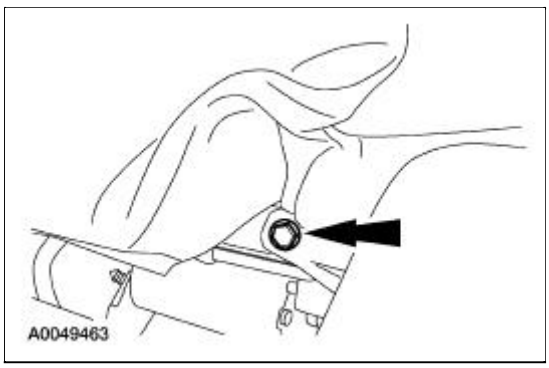


9. **CAUTION: Use care not to scratch the side shield when removing the power seat knob.**

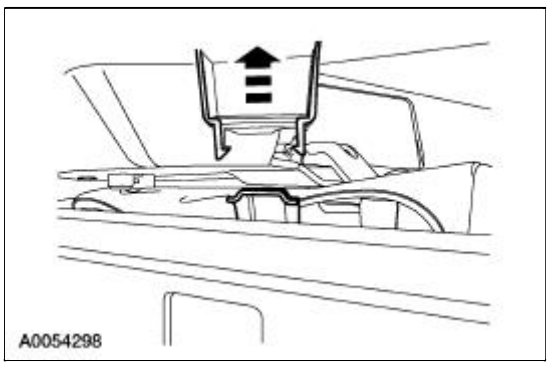
   Pry the power seat knob off.



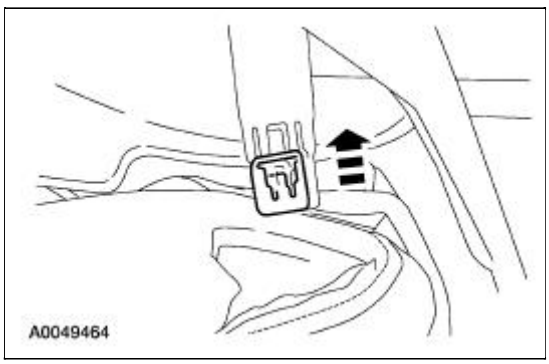
10. Access and remove the front side shield screw.



11. Pull to release the center retainer on side shield.

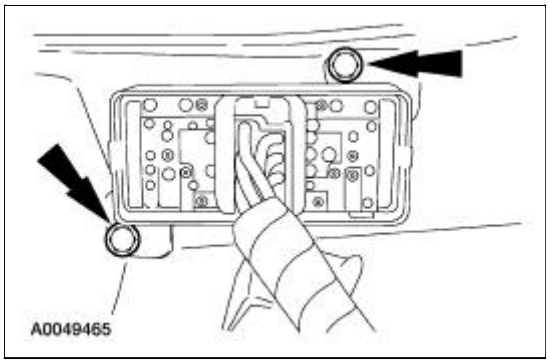


12. Pull to release the retainer clip on the rear of side shield.



13. Remove the side shield from the seat.

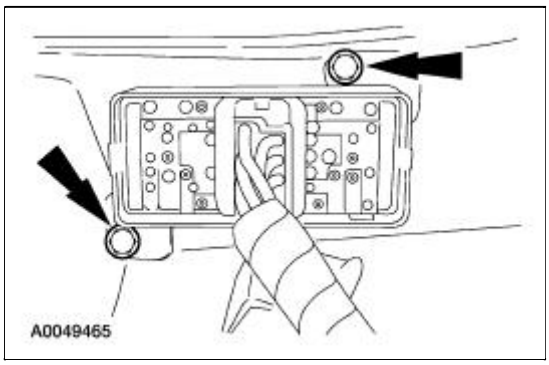
14. Remove the two screws and remove the 6-way power seat switch from the side shield.



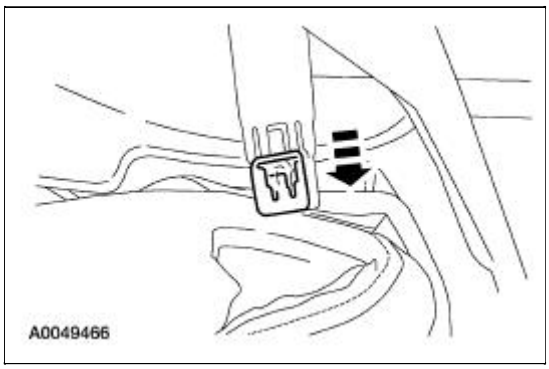
Installation

WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the removal procedure.

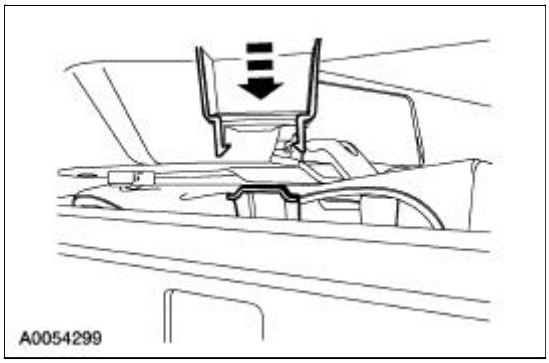
1. Install the 6-way power seat switch on the side shield and install the two screws.



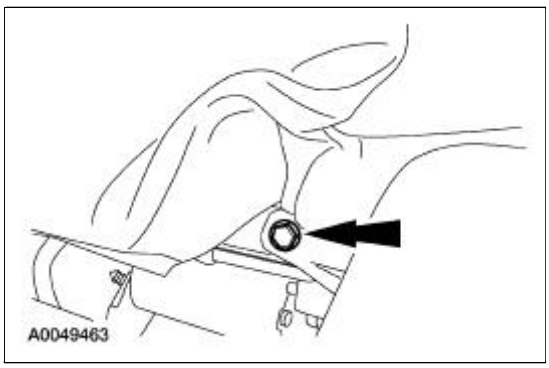
2. Push to install the rear side shield retainer on seat frame.



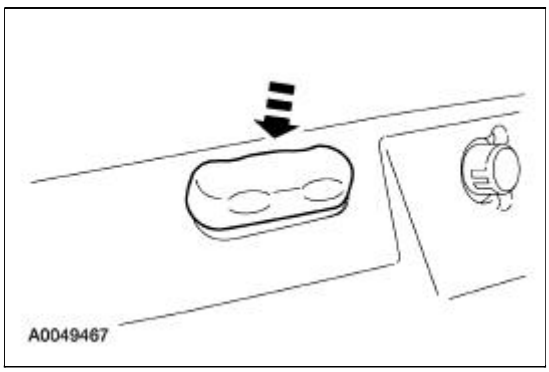
3. Push to install the middle side shield retainer on the seat.



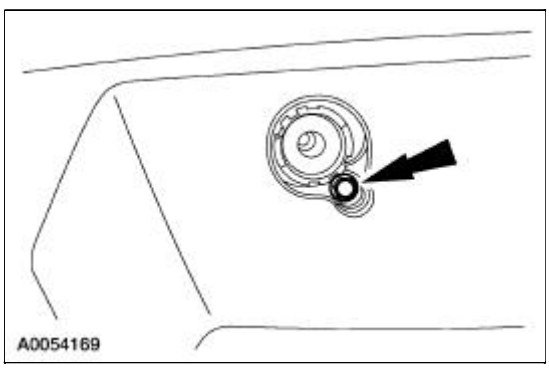
4. Access and install the front side shield screw.



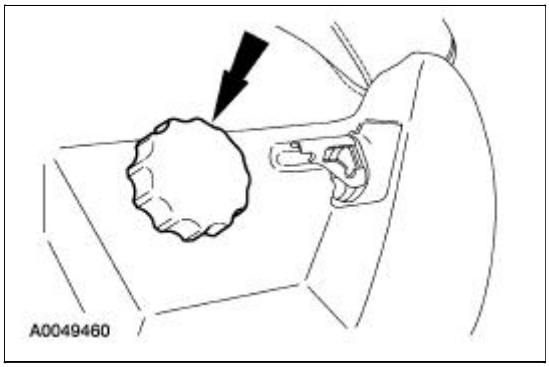
5. Install the 6-way power seat knob.



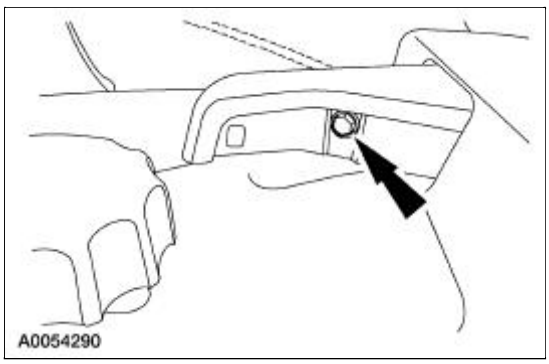
6. Install the screw on the side shield under the lumbar knob.



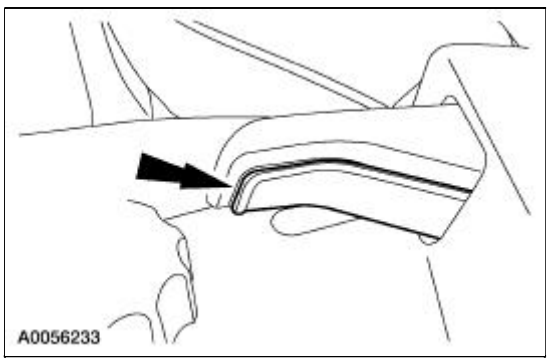
7. Align and install the lumbar knob.



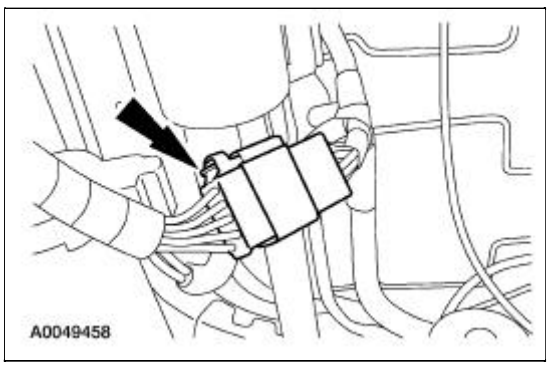
8. Install the recliner handle and install the screw.



9. Install the recliner handle cover.



10. Connect the 6-way power seat switch electrical connector.



11. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the seat removal and installation procedure.**

Install the affected seat. For additional information, refer to Front Seat—40 Percent .

12. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

    Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation .

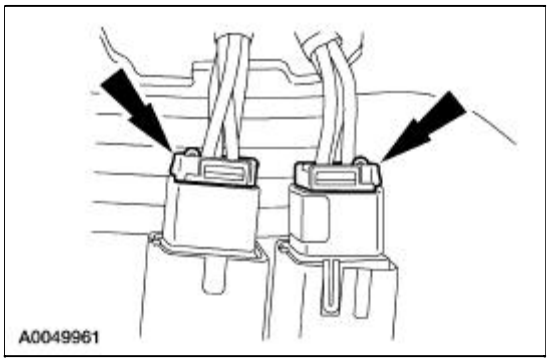
13. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

    With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .

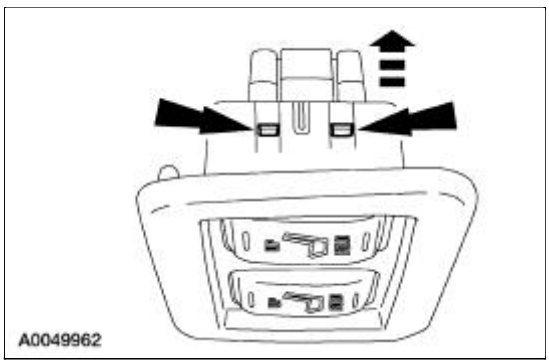
Seat Control Switch —Third Row

Removal and Installation

1. Partially remove the right rear quarter trim panel for access to the third row power seat switches. For additional information, refer to Section 501-05 .
2. Remove the retainer nuts on the back side of the power seat switch housing.
3. Disconnect the power seat switch electrical connectors.



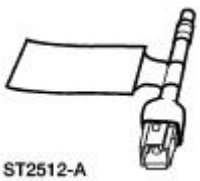
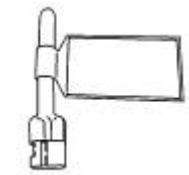
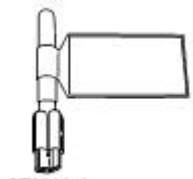
4. Release the four locking tabs (two shown) on the affected switch, and remove the switch.



5. To install, reverse the removal procedure.

Lumbar Control Switch

Special Tool(s)

 ST2512-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F403
 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395 (014-R1079)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F088 (105-00012)

Removal

WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe pretensioner electrical connectors. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

   The second row side impact sensors (if equipped) are located at or near the base of the

C-pillars.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

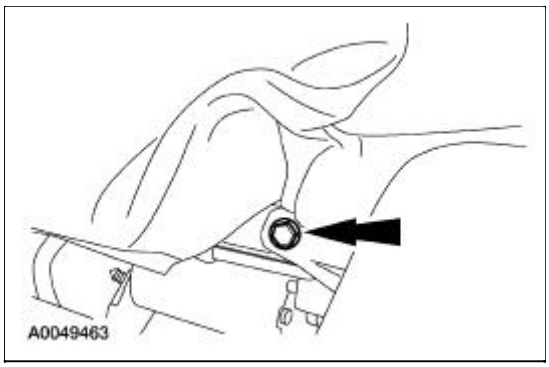
2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

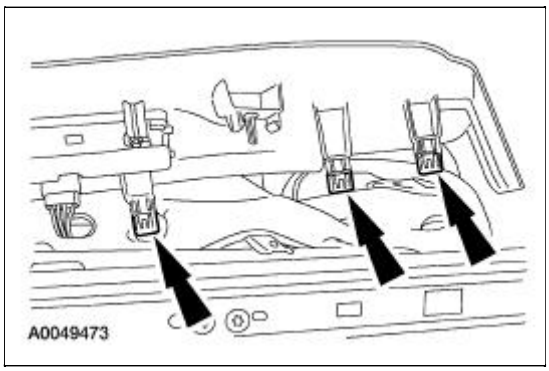
3. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the front seat removal and installation procedure.**

   Remove the 40 percent seat. For additional information, refer to Front Seat—40 Percent in this section

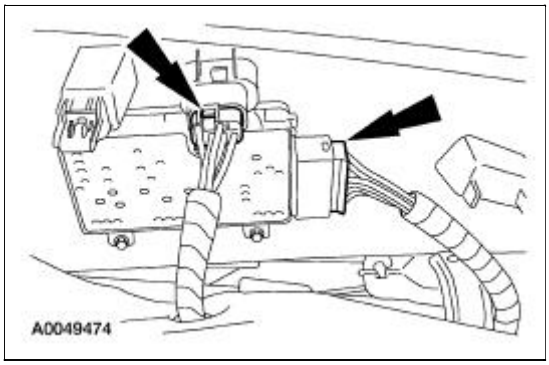
4. Access and remove the front side shield screw.



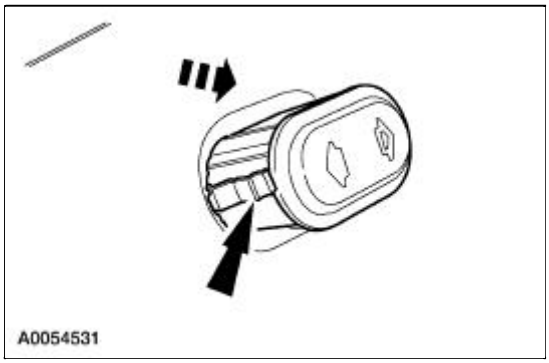
5. Pull out from the bottom and rear side of side shield to release the three retainer clips.



6. Disconnect the power lumbar switch and 8-way power seat switch electrical connectors.



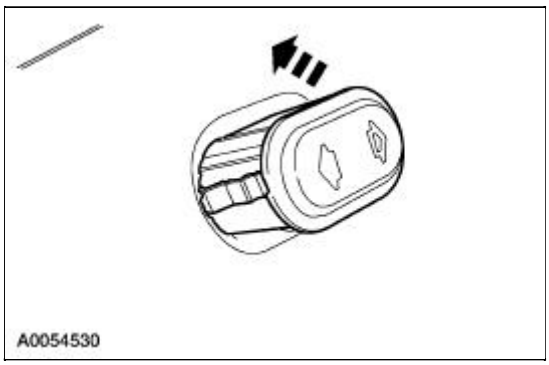
7. Pinch retainer in and push from the rear of power lumbar switch to remove the switch from the side shield.



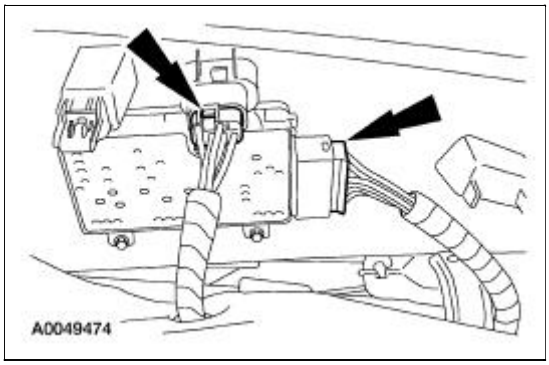
Installation

WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the removal procedure.

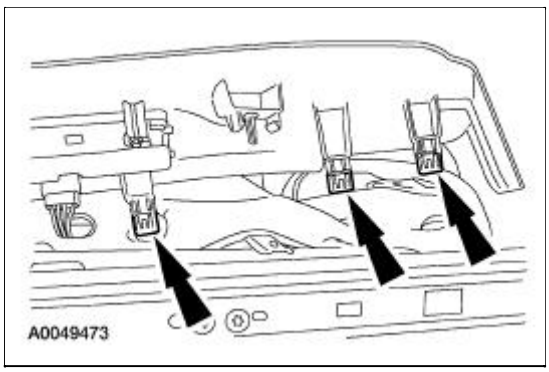
1. Install the power lumbar switch into the side shield.



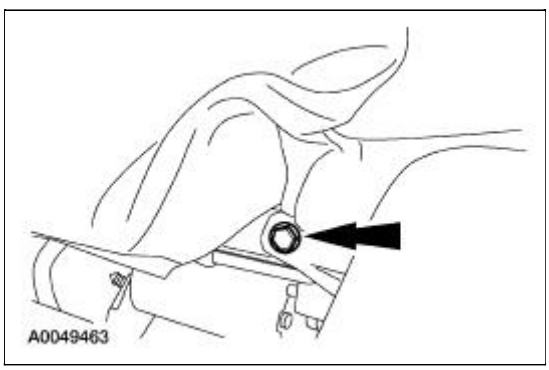
2. Connect the 8-way power seat and power lumbar switch electrical connectors.



3. Push to install the three side shield retainers onto the seat frame.



4. Access and install the front side shield screw.



5. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the front seat removal and installation procedure.**

   Install the 40 percent seat. For additional information, refer to Front Seat—40 Percent in this section.

6. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation .

7. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and**

possible violation of vehicle safety standards.

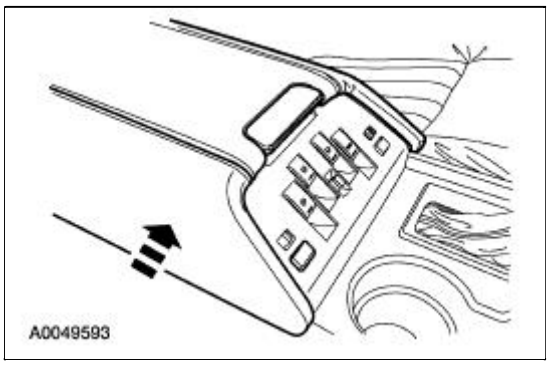
With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .

Climate Controlled Seat Switch

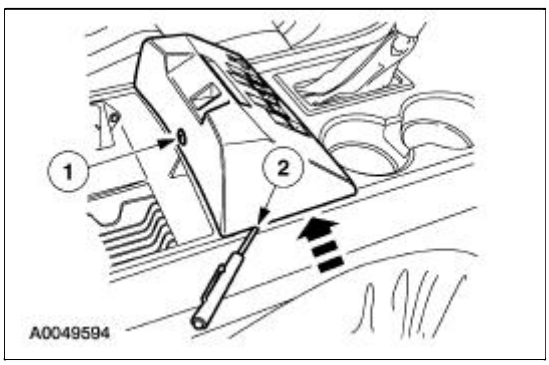
Removal and Installation

Navigator

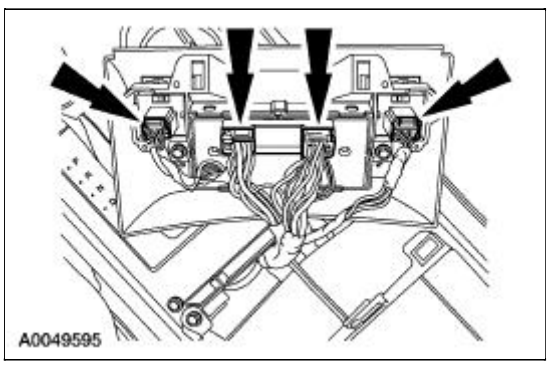
1. Open the center console lid.



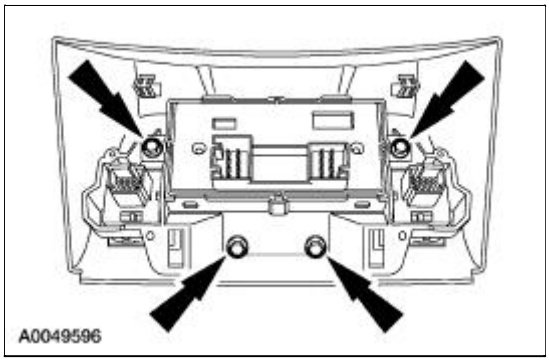
2. Remove the temperature controlled seat switch housing.
    1. Remove the scrivet.
    2. Pry the switch housing up from the retaining clips.



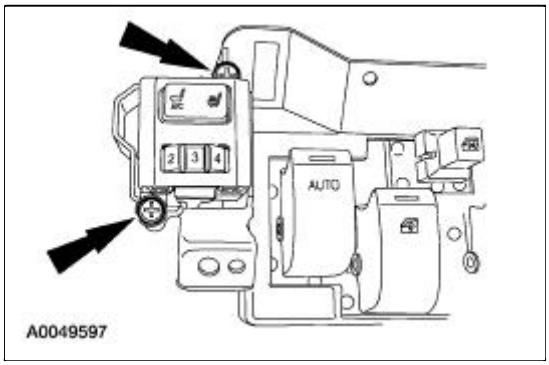
3. Disconnect the electrical connectors.



4. Remove the screws and remove the switches from the switch housing.



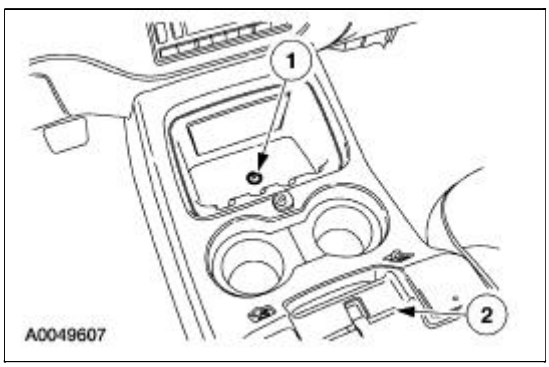
5. Remove the screws and remove the temperature controlled switch (passenger side shown).



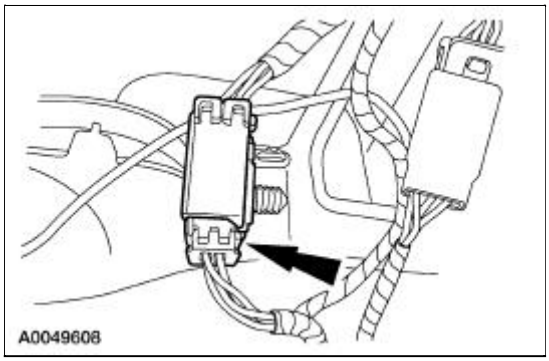
Expedition

6. Open the center console lid.

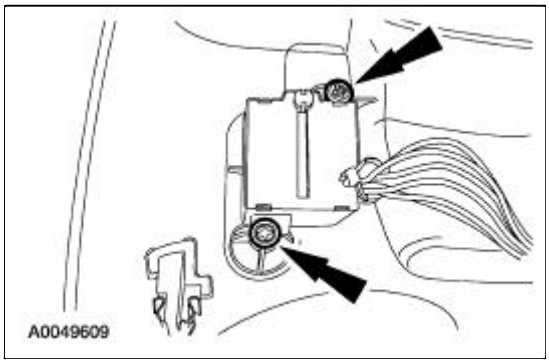
7. Remove the temperature controlled switch housing.
    1. Remove the screw.
    2. Pry up on the back of the switch housing and release the retaining clips.



8. Detach and disconnect the electrical connector.



9. Remove the screws and remove the temperature controlled switch.



All vehicles

10. To install, reverse the removal procedure.

Seat Armrest —Second Row

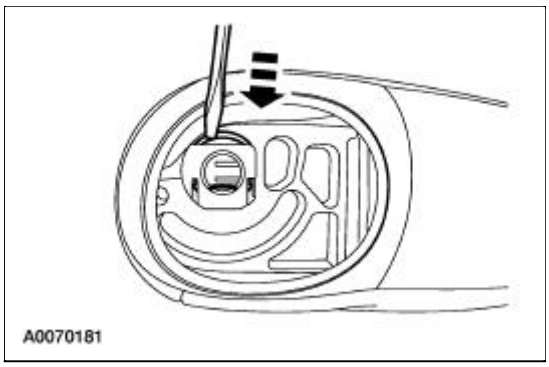
Removal and Installation

1. To access the armrest locking metal clip, pull the armrest material back on the top side of the armrest for access to the release clip.

2. **CAUTION: To remove armrests, do not pull them off with force. The locking metal clip will be damaged and a new armrest will need to be installed.**

   NOTE: Armrest removed to show detail of release button mechanism.

   Use a tool such as a flat-bladed screwdriver to push the release button at the hinge point. The clip will release and the armrest will slide off the pin.



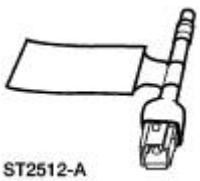
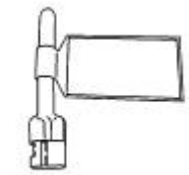
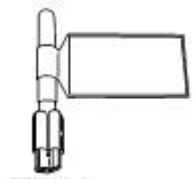
3. **CAUTION: To install armrests, do not push them on with force. The locking metal clip will be damaged and a new armrest will need to be installed.**

   To install, reverse the removal procedure.

   - To install the armrest, push the release button and slide the armrest on the pin.

Front Seat Backrest —60 Percent

Special Tool(s)

 ST2512-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F403
 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395 (014-R1079)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F088 (105-00012)

Removal

WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe pretensioner electrical connectors. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

   The second row side impact sensors (if equipped) are located at or near the base of the

C-pillars.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

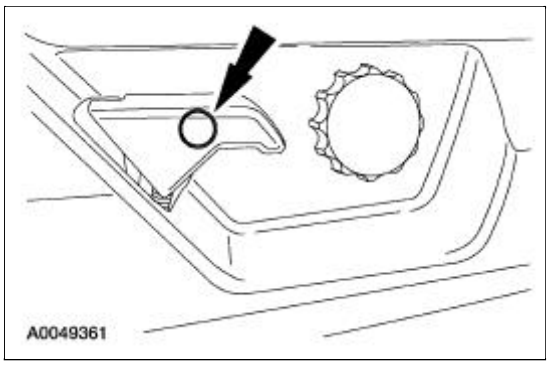
2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

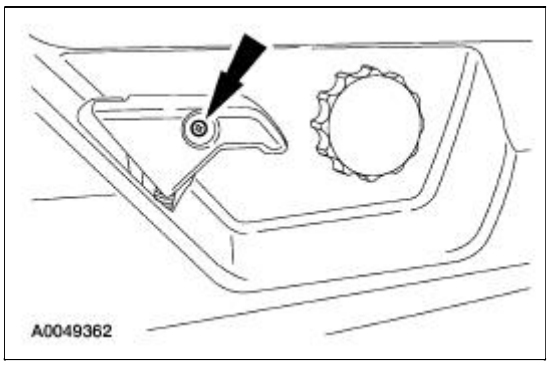
3. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the front seat removal and installation procedure.**

   Remove the 60 percent seat. For additional information, refer to Front Seat—60 Percent in this section.

4. Remove the cover on the recliner handle.

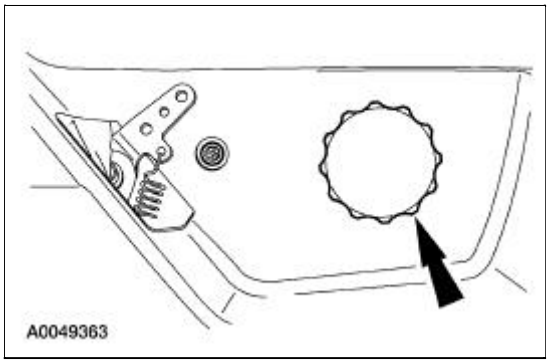


5. Remove the screw from the recliner handle.

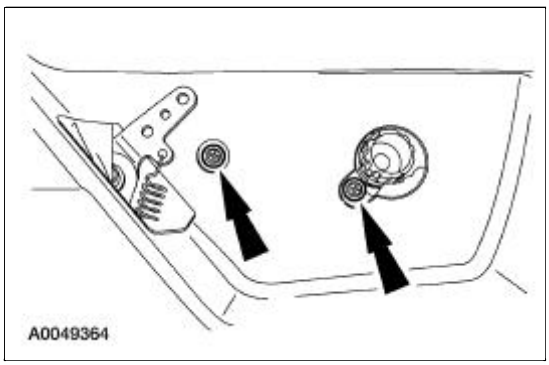


6. **CAUTION: Use care when removing the lumbar knob. Using both hands, pull with even pressure on both sides of the knob to remove.**

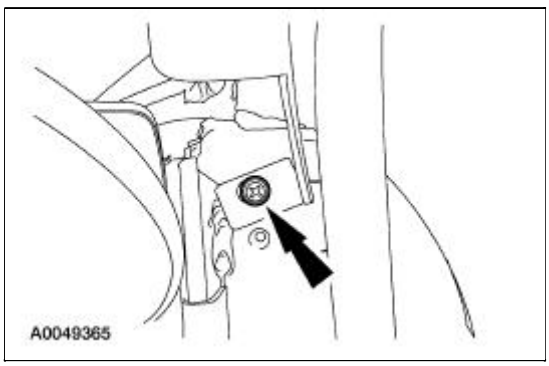
   Remove the lumbar control knob.



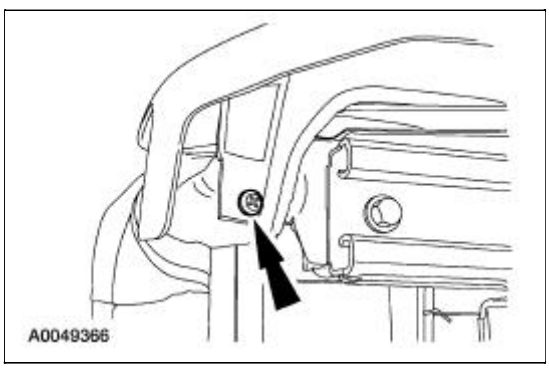
7. Remove the two screws from the side shield.



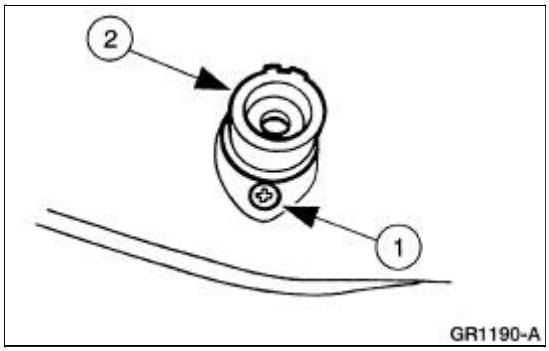
8. Remove the screw from front side of shield.



9. Remove the screw from rear side of shield.

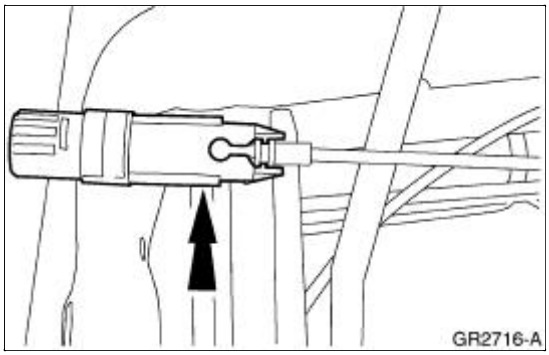


10. Remove the front seat back pad adjuster.
    1. Remove the two screws.
    2. Remove the front seat back pad adjuster.

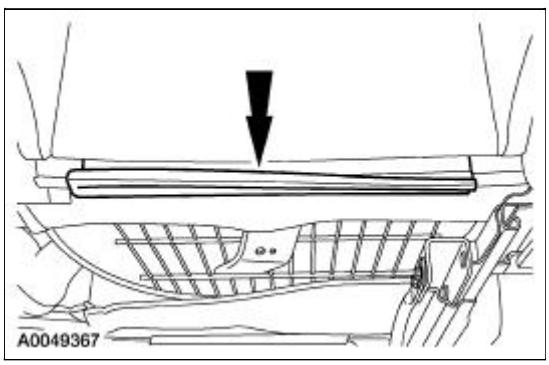


11. **NOTE:** The lumbar support assembly must be fully relaxed.

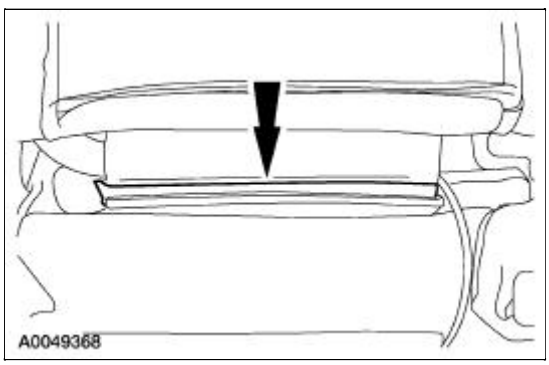
    Separate the lumbar support adjuster from the adjuster cable.



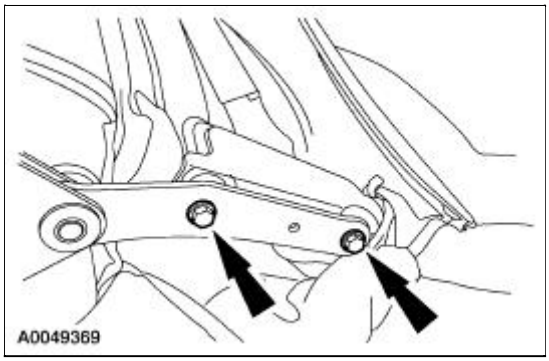
12. Release the J-clip.



13. Release the inner J-clip.

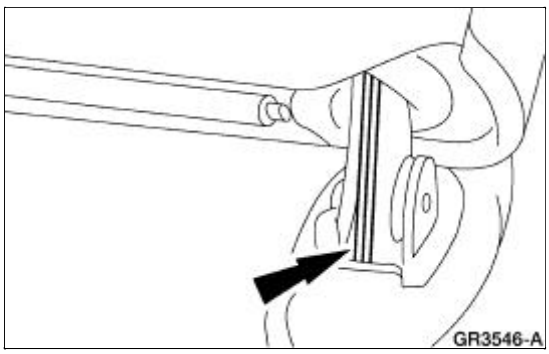


14. Invert the seat backrest cover to expose the bolts and remove the outboard seat back bolts.



15. **CAUTION: Do not damage the plastic pivot bushing when removing the seat back frame.**

    Pull the front seat back frame away from the inboard front seat hinge, and feed the lumbar support cable through the seat cushion opening to remove the front seat back.

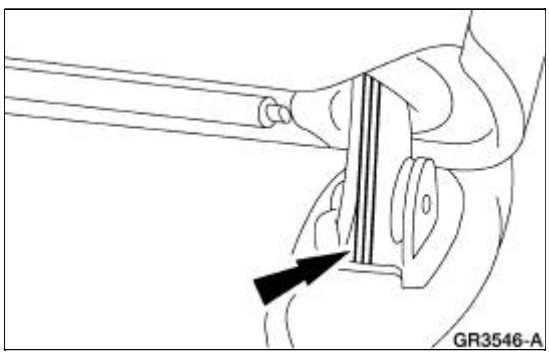


Installation

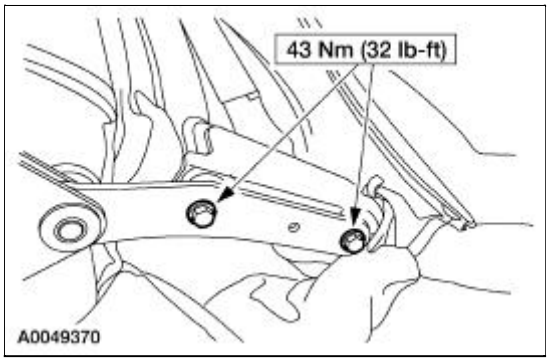
WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the removal procedure.

1. **CAUTION: Do not damage the plastic pivot bushing when installing the seat back frame.**

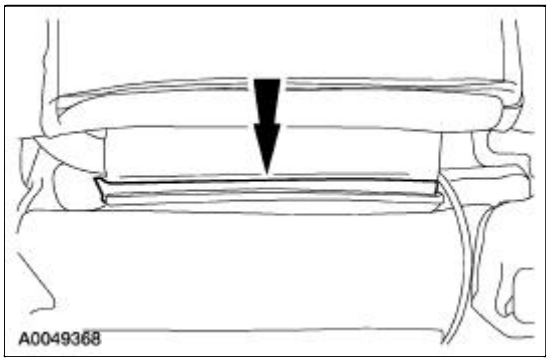
   Install the front seat back frame into the inboard front seat hinge and feed the lumbar support cable through the seat cushion opening to install the front seat back.



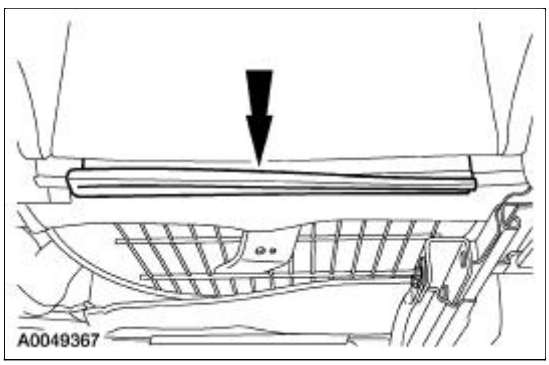
2. Install the seat backrest bolts.



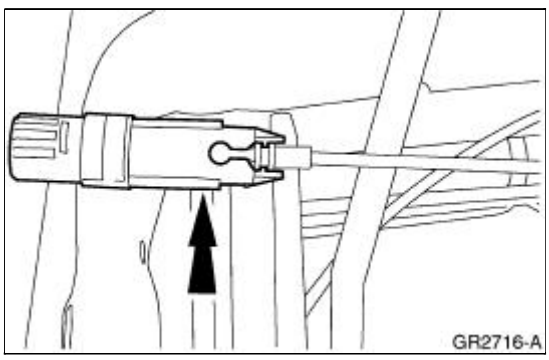
3. Connect the inner J-clip.



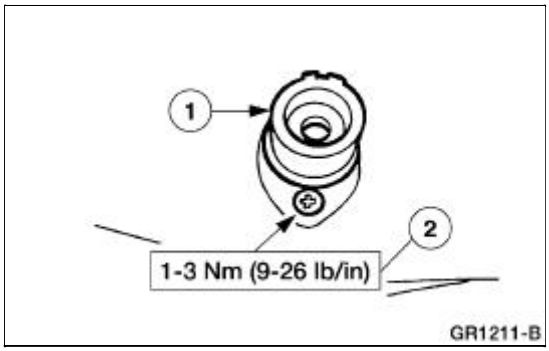
4. Connect the J-clip.



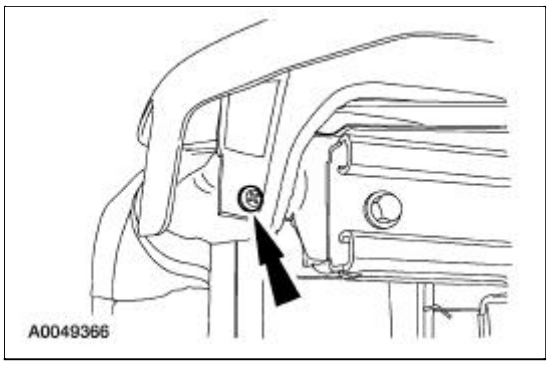
5. Connect the lumbar support adjuster to the adjuster cable.



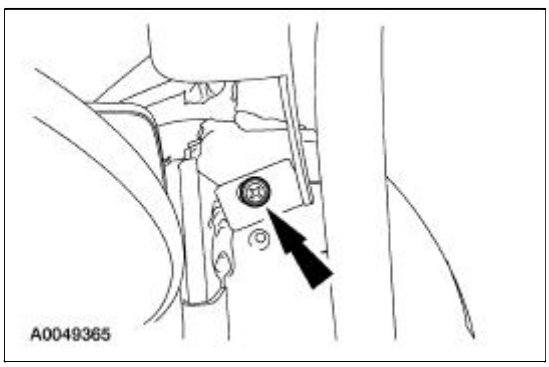
6. Install the front seat back pad adjuster.
    1. Position the front seat back pad adjuster.
    2. Install the two screws.



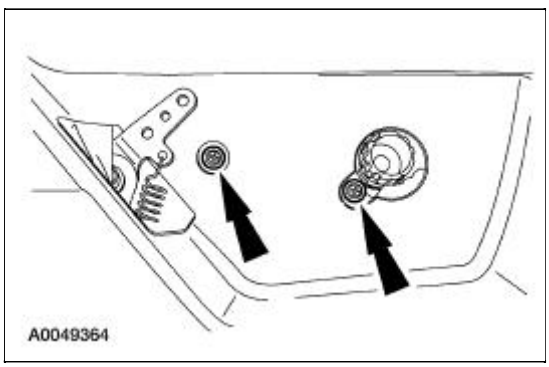
7. Install the rear side shield screw.



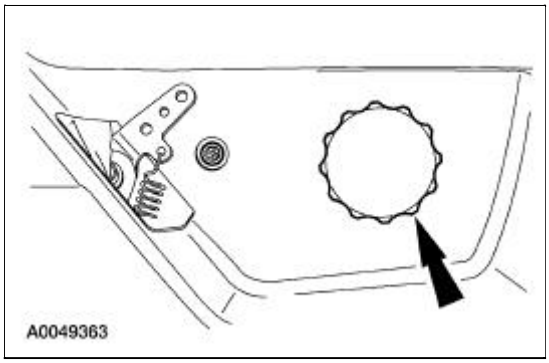
8. Install the front side shield screw.



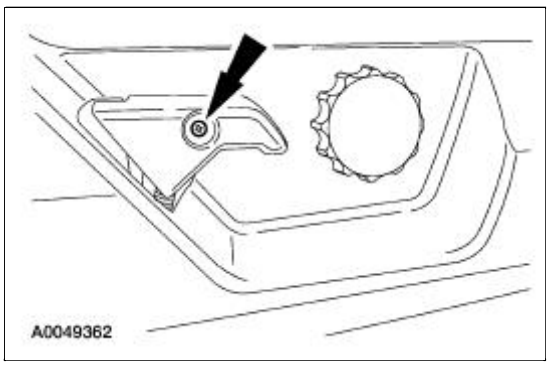
9. Install the two side shield screws.



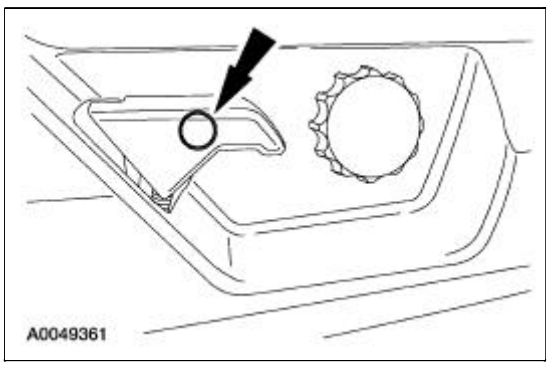
10. Align and install the lumbar control knob.



11. Install the recliner handle screw.



12. Install the recliner handle screw cover.



13. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the front seat removal and installation procedure.**

    Install the 60 percent seat. For additional information, refer to Front Seat—60 Percent in this section.

14. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

    Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation .

15. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and**

possible violation of vehicle safety standards.

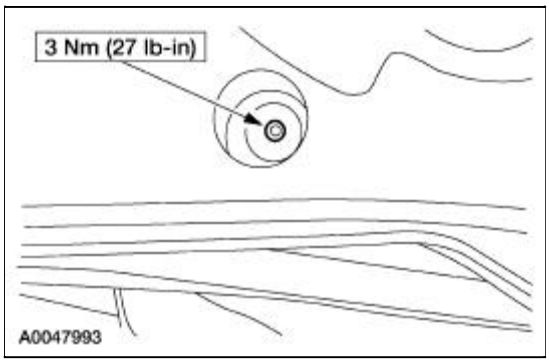
With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .

Rear Seat Backrest —Second Row, 20 Percent

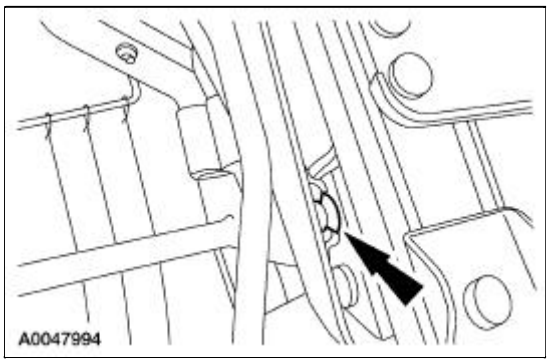
Removal and Installation

1. Remove the 20 percent seat from the vehicle. For additional information, refer to Rear Seat—Second Row, 20 Percent in this section.

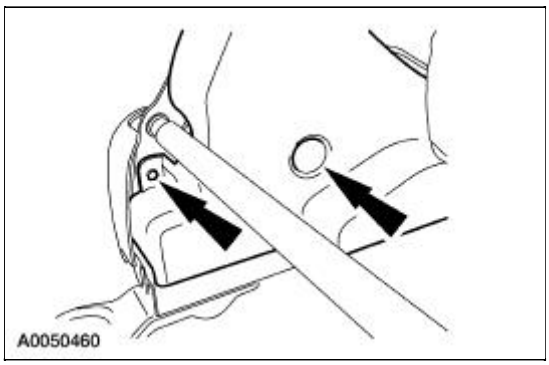
2. Remove the two screws (one shown) from inside of the right side shield.



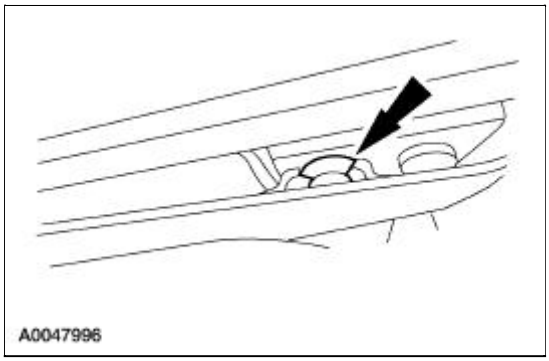
3. Release the pin-type retainer and remove the side shields.



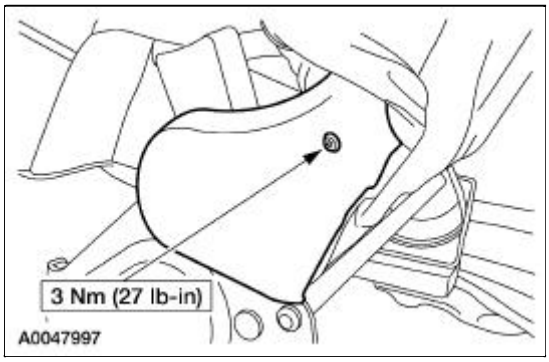
4. Remove the two screws (one shown) from inside of the left side shield.



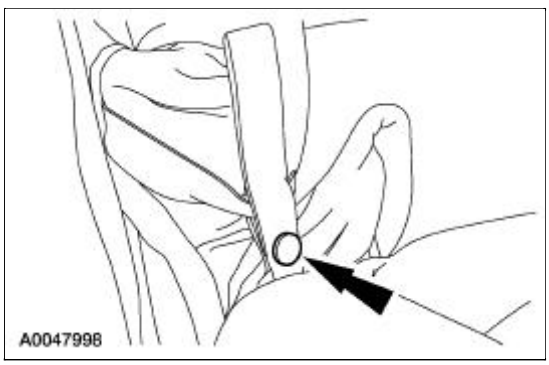
5. Release the pin-type retainer and remove the side shields.



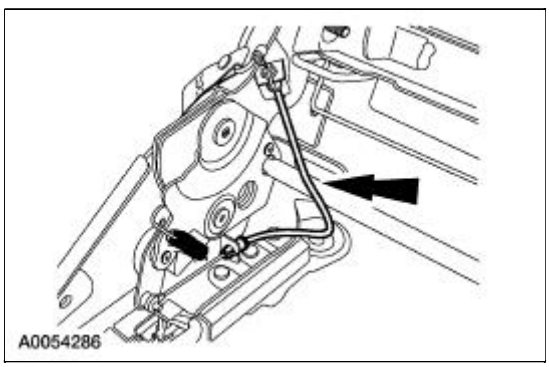
6. Remove the left hinge side shield screw and remove the side shield.



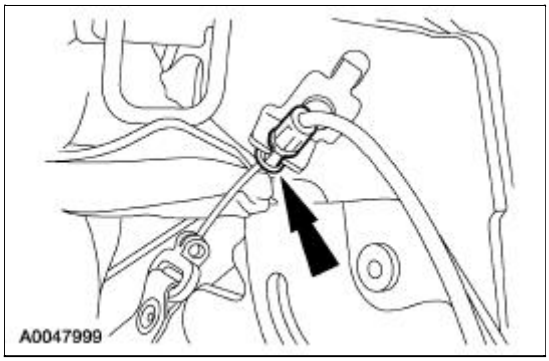
7. Unsnap the recliner pull strap handle and pull the handle through the seat.



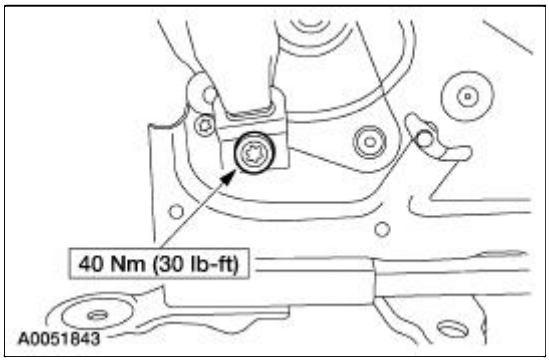
8. Note the location and routing of the recliner cable for installation. The cable needs to be routed in front of the crosstube.



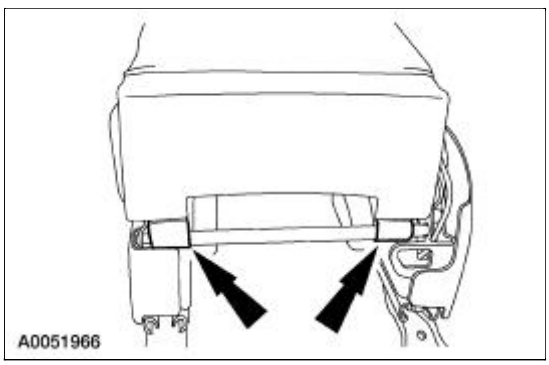
9. Pinch the tabs on the recliner cable end and release the cable from the retainer.



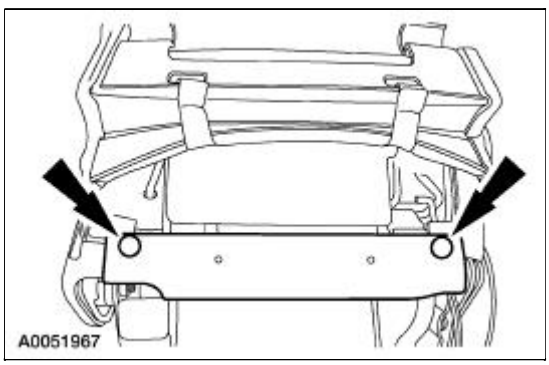
10. Remove the safety belt anchor bolt.



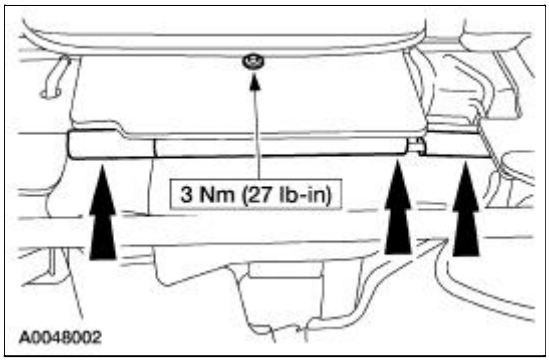
11. Release the J-clips.



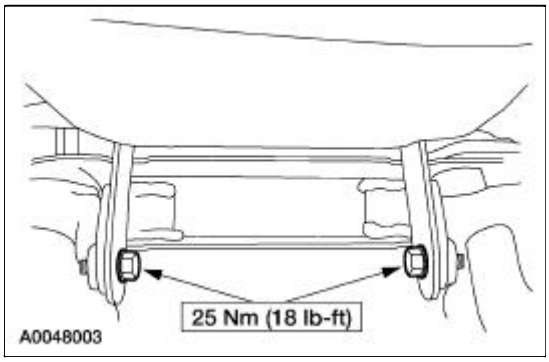
12. Remove the two pin-type retainers and remove the panel.



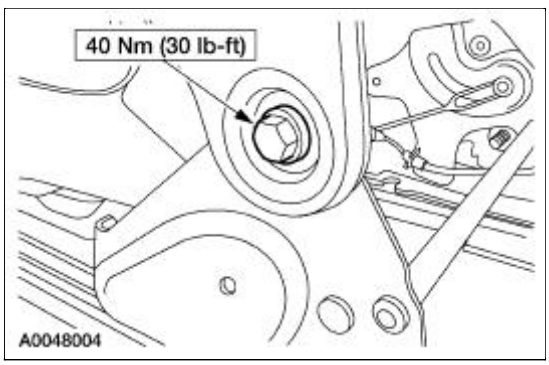
13. Remove the screw from the seat backrest support panel and release the J-clips under seat backrest support panel.



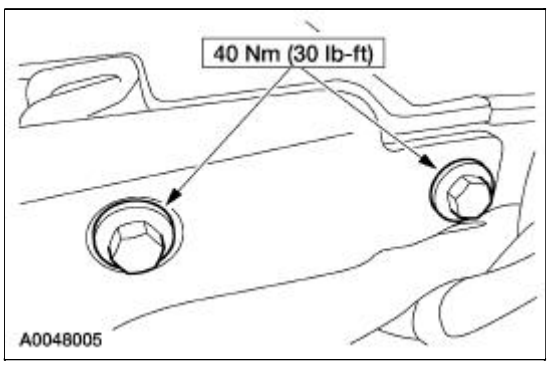
14. Invert the seat backrest cover up to expose the inner swivel bolts and remove the swivel bolts.



15. Remove the left-side pivot bolt.



16. Remove the right-side bolts.



17. Remove the seat backrest.

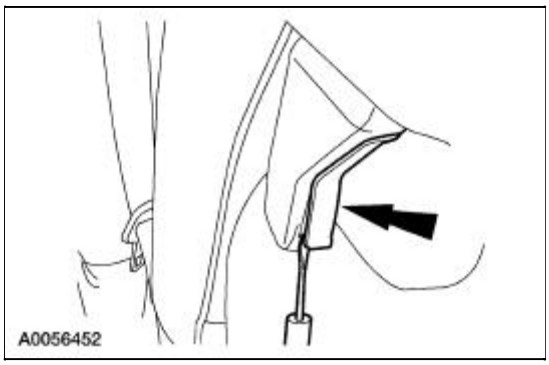
18. To install, reverse the removal procedure.

Rear Seat Backrest —Second Row, 40 Percent

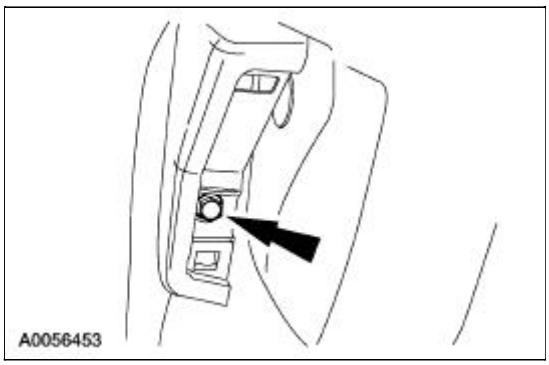
Removal and Installation

1. Remove the 40 percent seat from the vehicle. For additional information, refer to Rear Seat—Second Row, 40 Percent in this section.

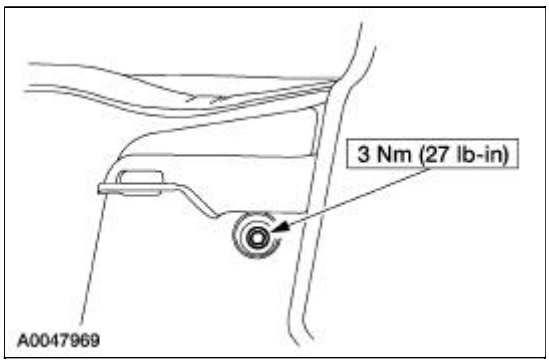
2. Remove the recliner handle screw cover.



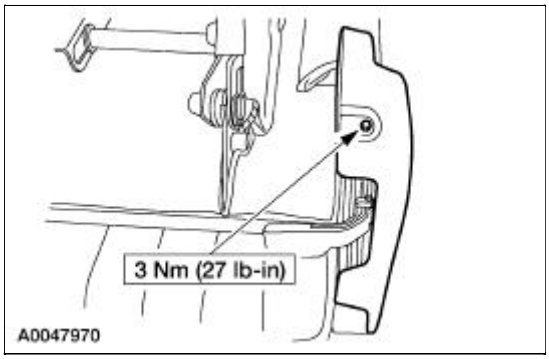
3. Remove the recliner handle screw and the recliner handle.



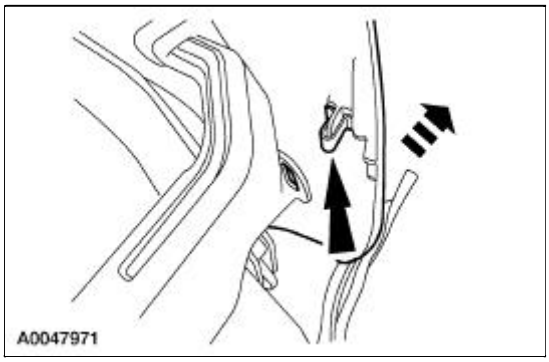
4. Remove the screw from the side shield.



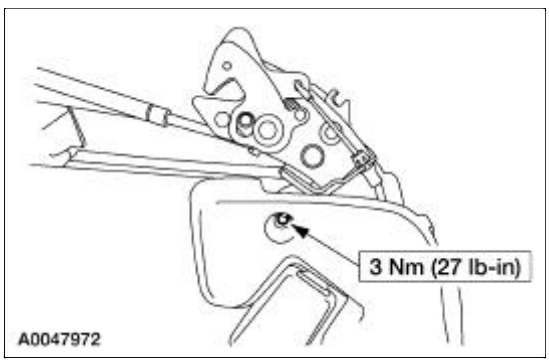
5. Remove the screw from bottom of the side shield.



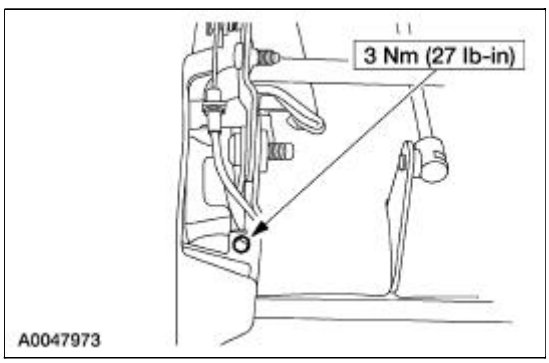
6. Release the retainer on the side shield and remove the side shield.



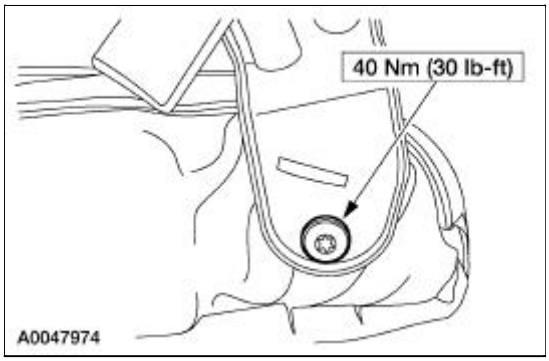
7. Remove the screw from the side of the side shield.



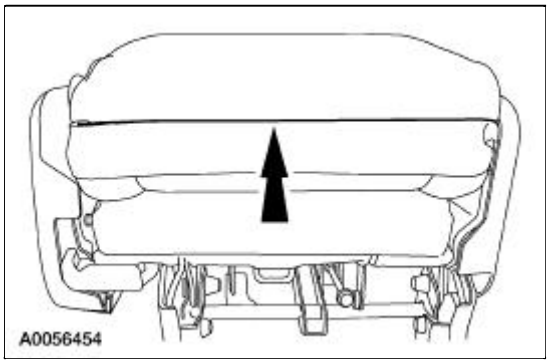
8. Remove the screw from bottom of the side shield.



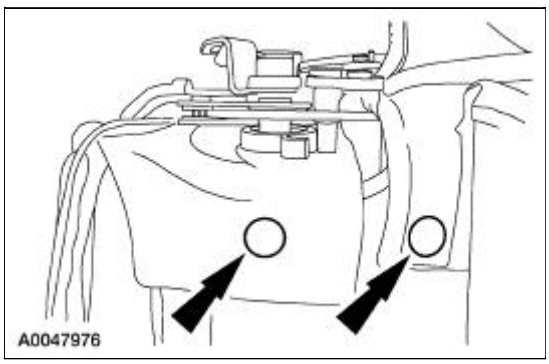
9. Remove the backrest bolt.



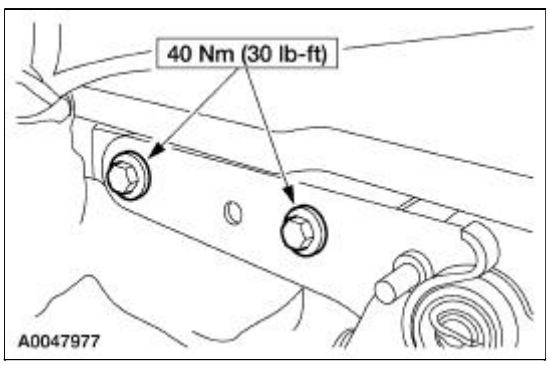
10. Release the J-clip and invert the seat backrest cover to expose the pin-type retainers.



11. Remove the four pin-type retainers (two shown).



12. Invert the seat backrest cover to expose the seat backrest bolts and remove the bolts.



13. Remove the seat backrest from the cushion.

14. To install, reverse the removal procedure.

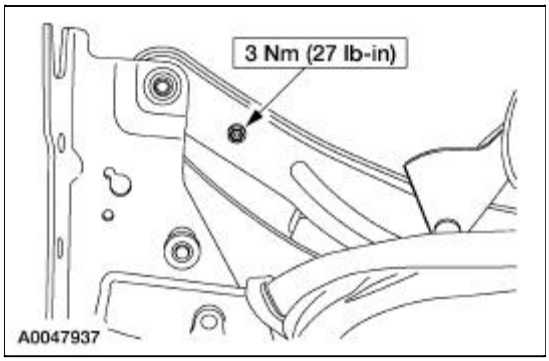
Rear Seat Backrest —Third Row, 40 Percent

Removal and Installation

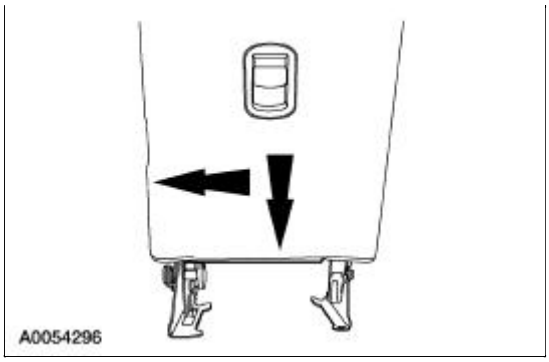
All vehicles

1. Remove the third row 40 percent seat. For additional information, refer to Rear Seat—Third Row in this section.

2. Remove the screws from the outboard and inboard side shields and remove the side shields (outboard shown).

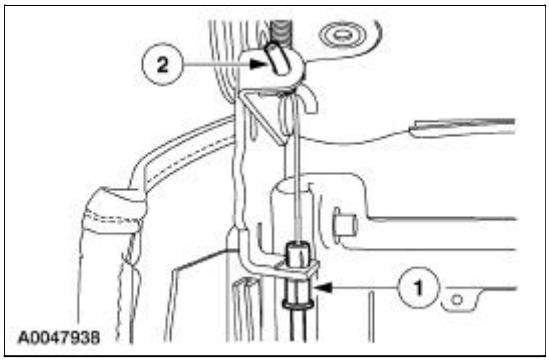


3. Release the J-clips.



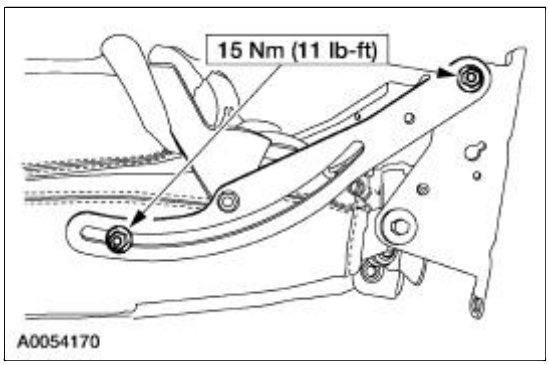
Manual fold seat

4. Remove the manual seat cable.
    1. Pinch the cable end and remove the cable from the retainer.
    2. Release the cable end hook from the retaining hole.

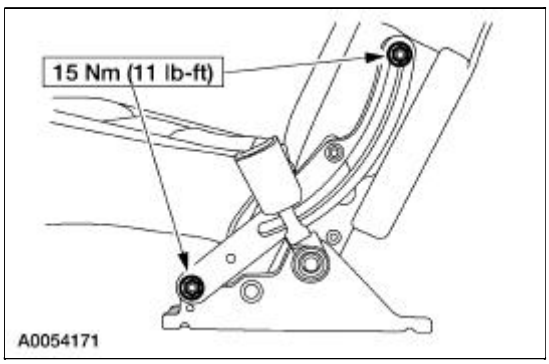


All vehicles

5. Remove the outboard slide bracket nuts.



6. Remove the inboard slide bracket nuts.



7. Remove the rear seat backrest from the cushion.

8. To install, reverse the removal procedure.

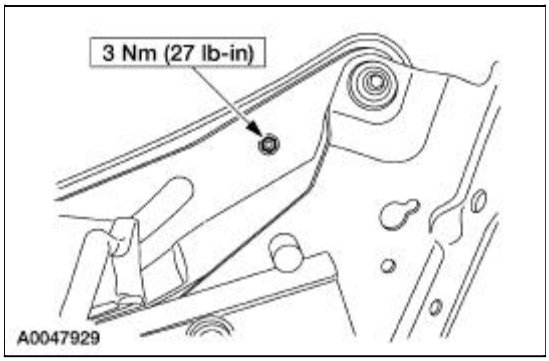
Rear Seat Backrest —Third Row, 60 Percent

Removal and Installation

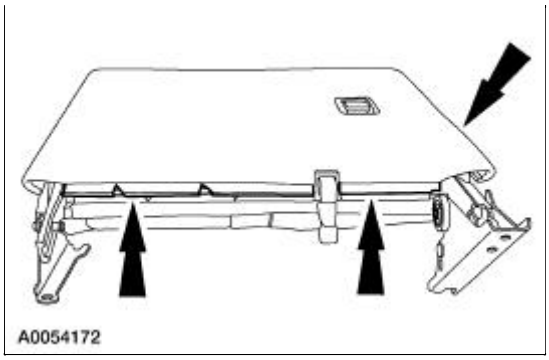
All vehicles

1. Remove the third row 60 percent seat. For additional information, refer to Rear Seat—Third Row in this section.

2. Remove the screws from the outboard and inboard side shields and remove the side shields (outboard shown).

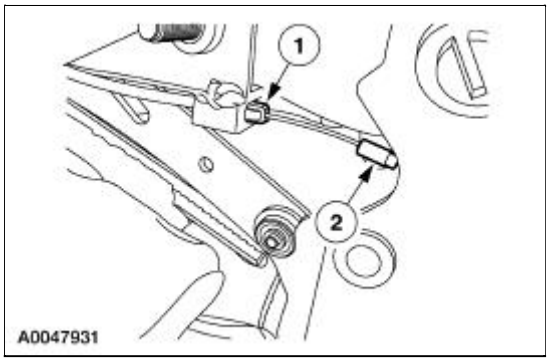


3. Release the J-clips.



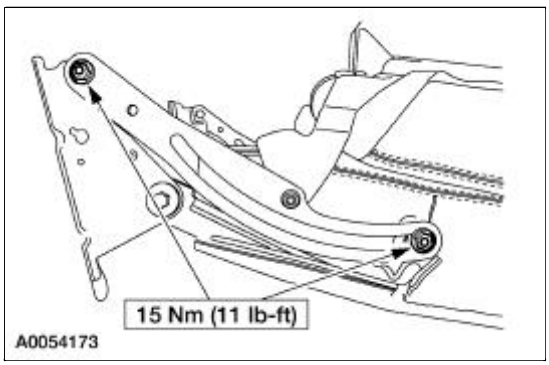
Manual fold seats

4. Remove the manual seat cable.
    1. Pinch the cable end and remove the cable from retainer.
    2. Release the cable end hook from the retaining hole.

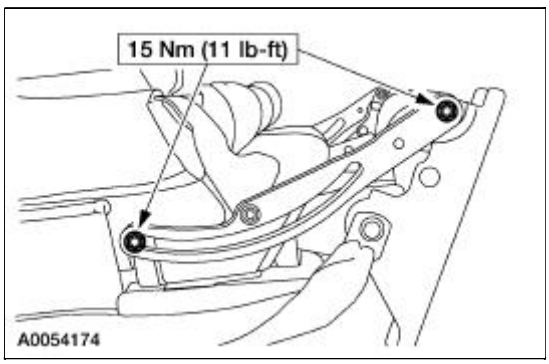


All vehicles

5. Remove the outboard slide bracket nuts.



6. Remove the inboard slide bracket nuts.

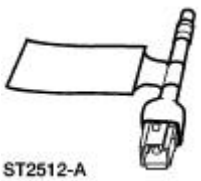
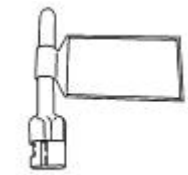
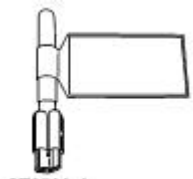


7. Remove the rear seat backrest from the cushion.

8. To install, reverse the removal procedure.

Seat Backrest Thermo-Electric Device

Special Tool(s)

 ST2512-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F403
 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395 (014-R1079)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F088 (105-00012)

Removal

WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe pretensioner electrical connectors. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

   The second row side impact sensors (if equipped) are located at or near the base of the

C-pillars.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

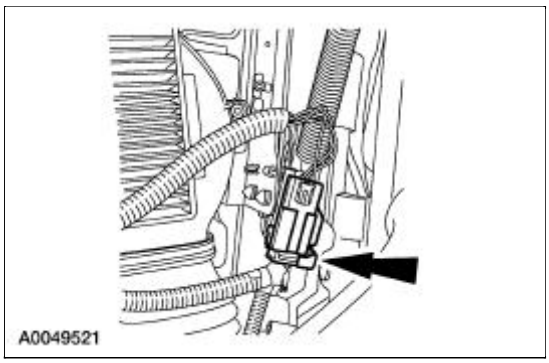
2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

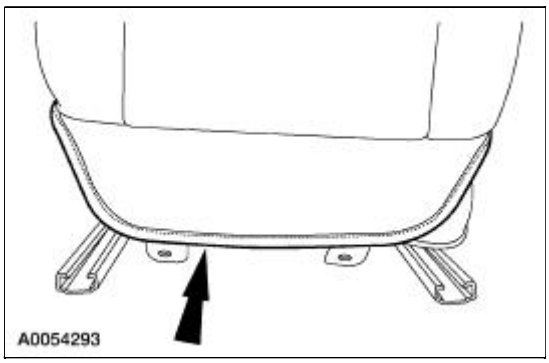
3. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the front seat removal and installation procedure.**

   Remove the 40 percent seat. For additional information, refer to Front Seat—40 Percent in this section.

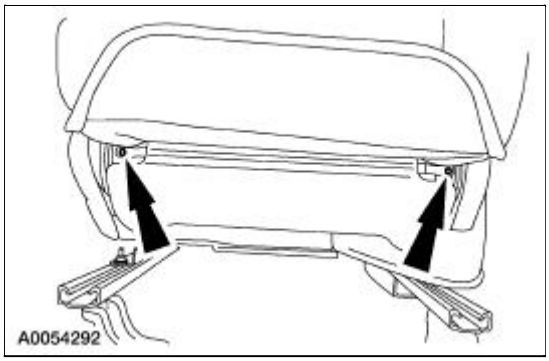
4. Disconnect the seat backrest thermo-electric device (TED) electrical connector at the seat cushion frame.



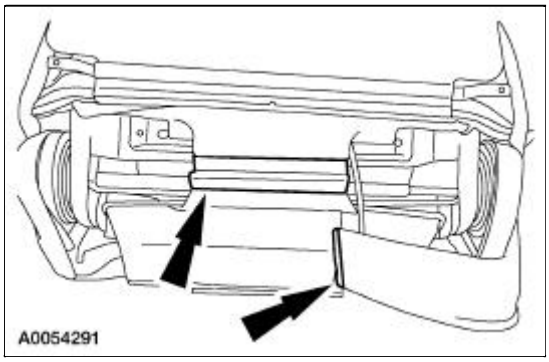
5. Remove lower seat backrest cover.



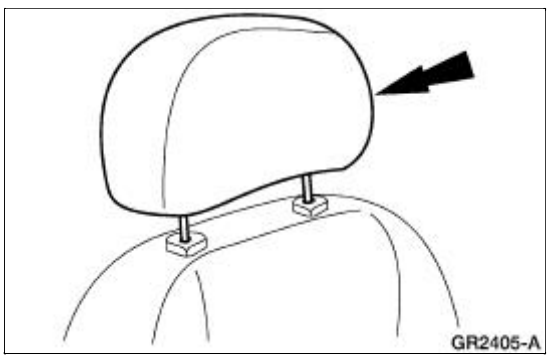
6. Remove the two screws from support rod.



7. Release the one hook-and-loop strip and the one J-clip.

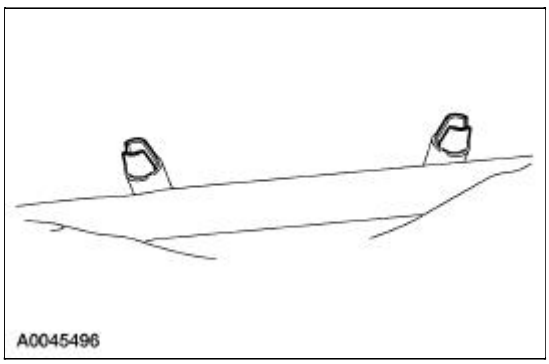


8. Depress tab and remove the head restraint.



9. **NOTE:** The head restraint sleeve pins are not interchangeable. Note location for installation.

   Reach up into the seat backrest and squeeze the head restraint sleeve ends together to release the sleeves and pull the head restraint sleeves out.



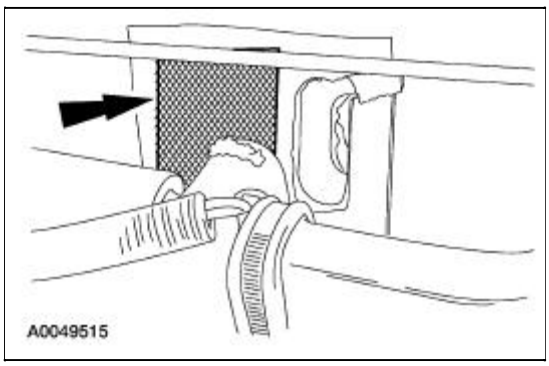
10. **CAUTION: Use care when separating the seat backrest trim cover from the hook-**

and-loop strip, or the hook-and-loop strip can be torn from the seat backrest foam.

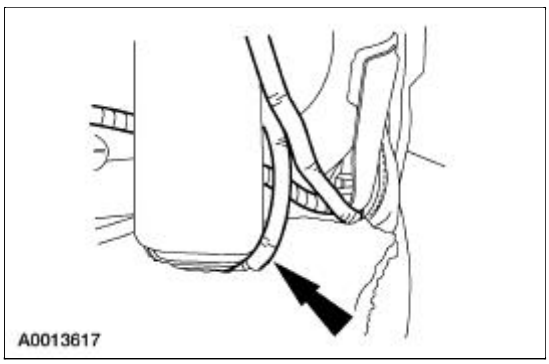
Invert the seat backrest trim cover and remove.

11. **CAUTION: Use care when removing the seat backrest foam pad from the frame. The foam pad has hook and loop fasteners holding the TED to the seat backrest foam pad.**

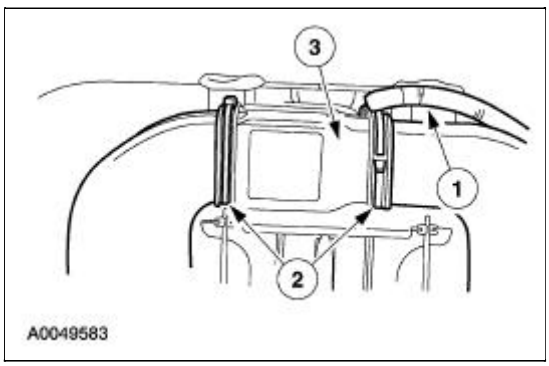
    Remove the seat backrest foam pad from the TED and remove the seat backrest foam pad.



12. Route the seat backrest TED wire harness back through the seat cushion and trim cover.



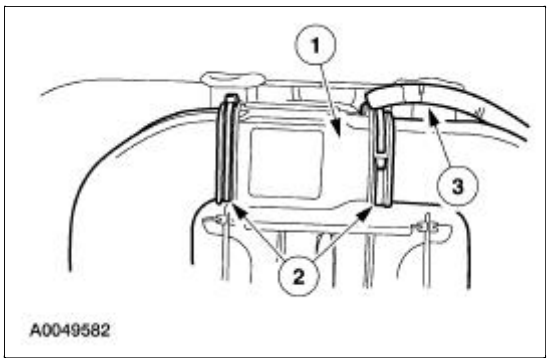
13. Remove the seat backrest TED.
    1. Remove the seat backrest TED wire harness pin-type retainers.
    2. Cut the zip-ties and separate the ducts from the seat backrest TED.
    3. Remove the seat backrest TED.



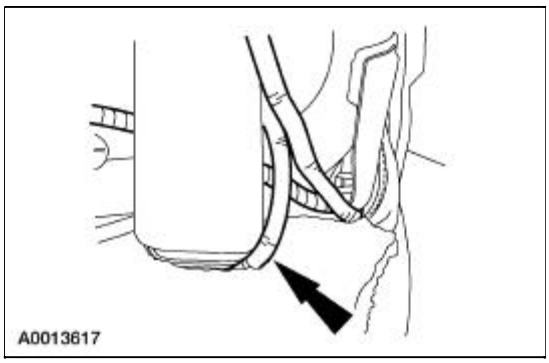
Installation

WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the removal procedure.

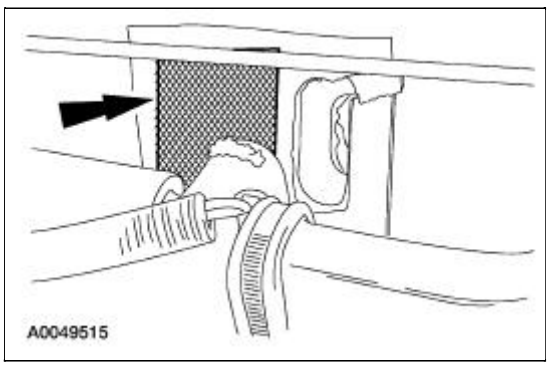
1. Install the seat backrest TED.
    1. Install the seat backrest TED.
    2. Install the seat backrest TED to the ducts and install the zip-ties.
    3. Attach the pin-type retainer for the seat backrest TED wire harness.



2. Route the seat backrest TED wire harness through the seat cushion and trim cover.



3. Install the seat backrest foam pad and attach the seat backrest TED to the foam pad.

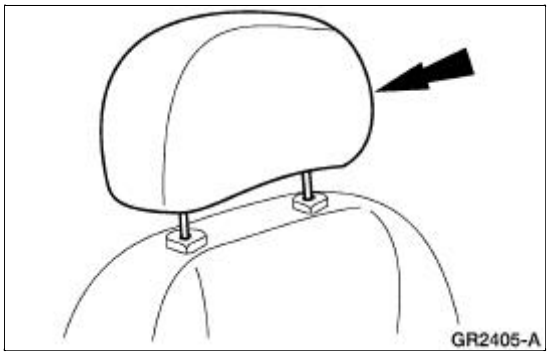


4. Install the seat backrest trim cover and attach the hook and loop fasteners.

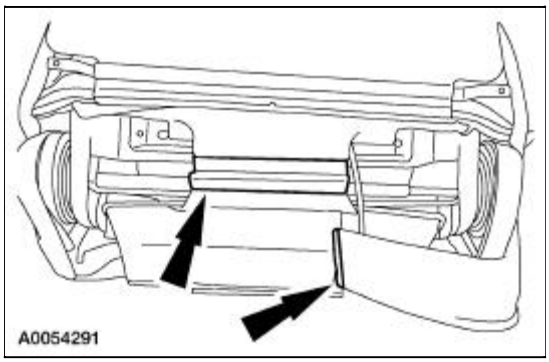
5. **NOTE:** The head restraint sleeve pins are not interchangeable.

   Install the head restraint sleeves.

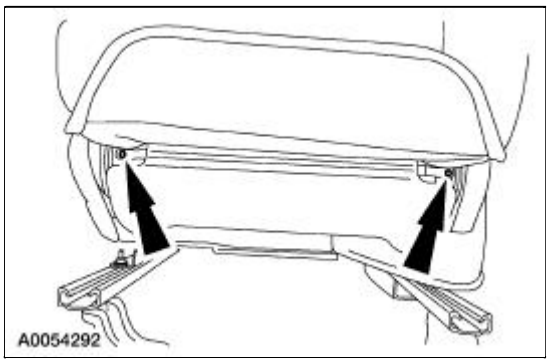
6. Install the head restraint.



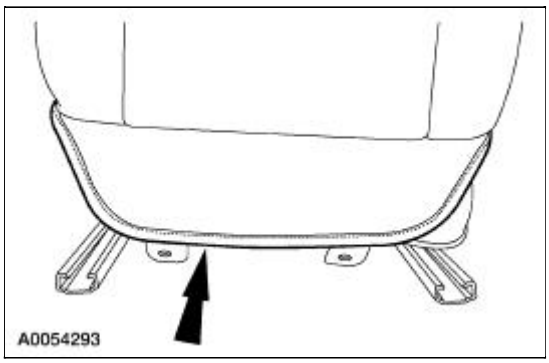
7. Connect the one hook-and-loop strip and the one J-clip.



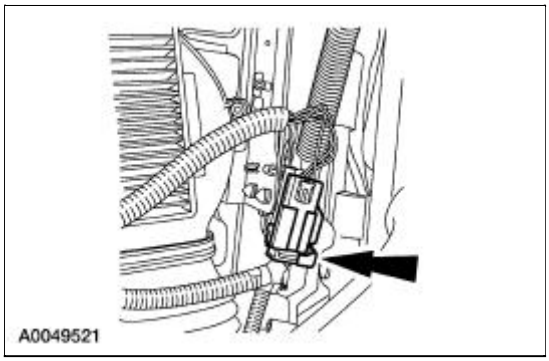
8. Install the two screws in support rod.



9. Install the lower backrest cover.



10. Connect the seat backrest TED electrical connector.



11. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the front seat removal and installation procedure.**

    Install the 40 percent seat. For additional information, refer to Front Seat—40 Percent in this section.

12. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

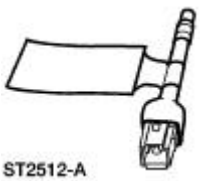
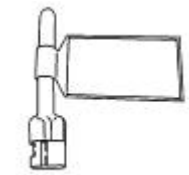
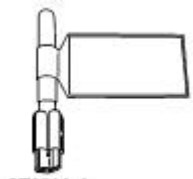
    Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation .

13. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

    With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .

Seat Cushion Thermo-Electric Device

Special Tool(s)

 ST2512-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F403
 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395 (014-R1079)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F088 (105-00012)

Removal

WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe pretensioner electrical connectors. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

   The second row side impact sensors (if equipped) are located at or near the base of the

C-pillars.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

3. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the front seat removal and installation procedure.**

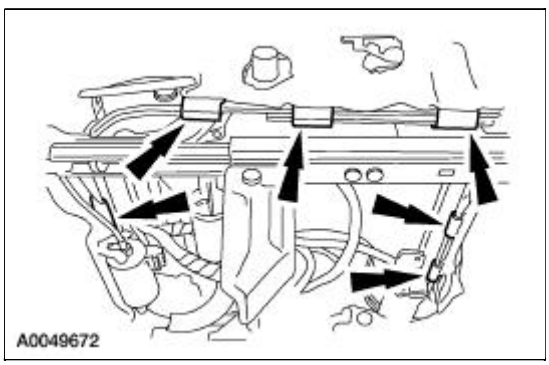
   Remove the 40 percent seat. For additional information, refer to Front Seat—40 Percent in this section.

4. Remove the seat side shield. For additional information, refer to Seat Control Switch—8-Way or Seat Control Switch—6-Way in this section.

5. Remove the seat fan motor. For additional information, refer to Seat Fan Motor in this section.

6. Remove the front height power seat motor. For additional information, refer to Front Seat Track Motor in this section.

7. Release the J-clips (six shown).

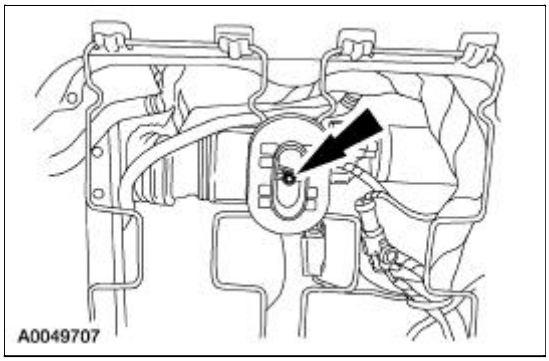


8. **CAUTION: Use care when separating the seat cushion trim cover from the hook-and-loop strip, or the hook-and-loop strip can be torn from the seat cushion.**

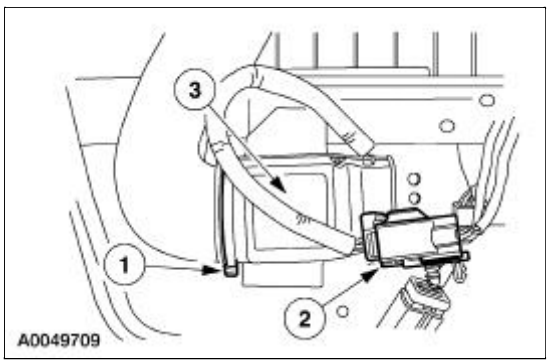
   Remove the seat cushion trim cover.

9. Remove the seat cushion foam pad.

10. Remove the screw and separate the seat cushion thermo-electric device (TED) from the mounting bezel.



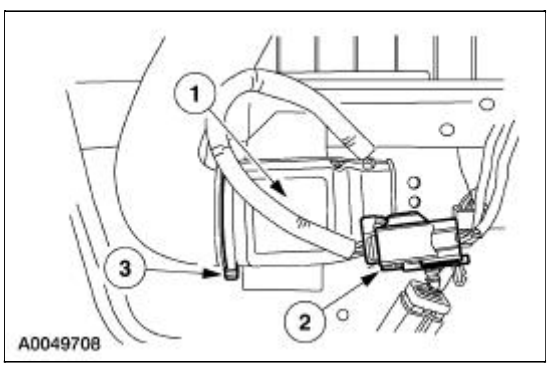
11. Remove the seat cushion TED.
    1. Cut the zip-tie, separate and remove the duct.
    2. Disconnect the seat cushion TED electrical connector.
    3. Remove the seat cushion TED.



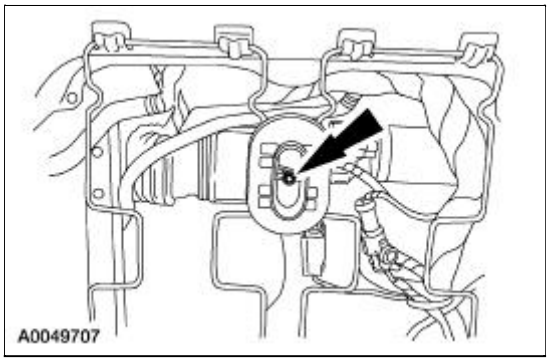
Installation

WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the removal procedure.

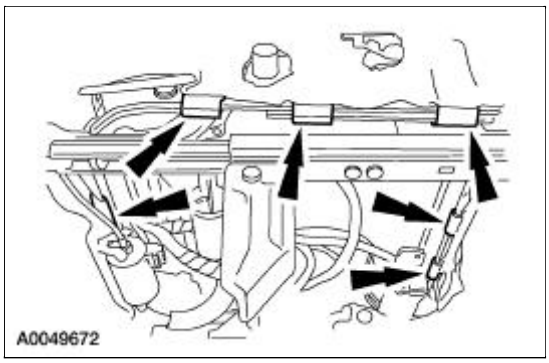
1. Install the seat cushion TED.
    1. Install the seat cushion TED.
    2. Connect the seat cushion TED electrical connector.
    3. Install the duct and zip-tie the duct to the TED.



2. Install the TED to the mounting bezel, and install the screw.



3. Install the seat cushion foam pad.
4. Install the seat cushion trim cover.
5. Attach the J-clips (six shown).



6. Install the front height power seat motor. For additional information, refer to Front Seat Track Motor in this section.
7. Install the seat fan motor. For additional information, refer to Seat Fan Motor in this section.
8. Install the seat side shield. For additional information, refer to Seat Control Switch—8-Way or Seat Control Switch—6-Way in this section.
9. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the front seat removal and installation procedure.**

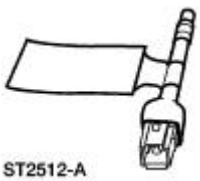
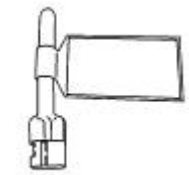
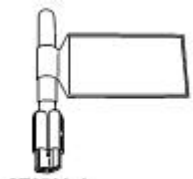
   Install the 40 percent seat. For additional information, refer to Front Seat—40 Percent in this section.
10. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

    Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation .
11. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .

Seat Track —Power

Special Tool(s)

 ST2512-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F403
 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395 (014-R1079)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (40-009)
 ST2506-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F088 (105-00012)

Removal

WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe pretensioner electrical connectors. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

Inboard and outboard seat tracks

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

The second row side impact sensors (if equipped) are located at or near the base of the C-pillars.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

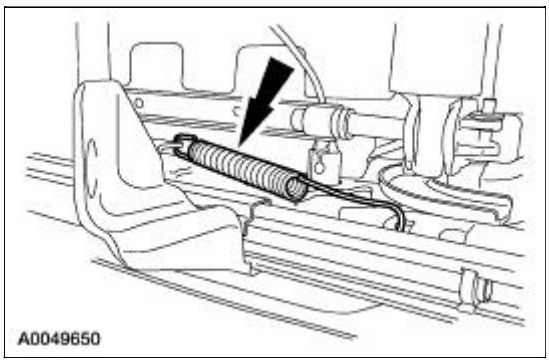
2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

3. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the front seat removal and installation procedure.**

   Remove the 40 percent seat. For additional information, refer to Front Seat—40 Percent in this section.

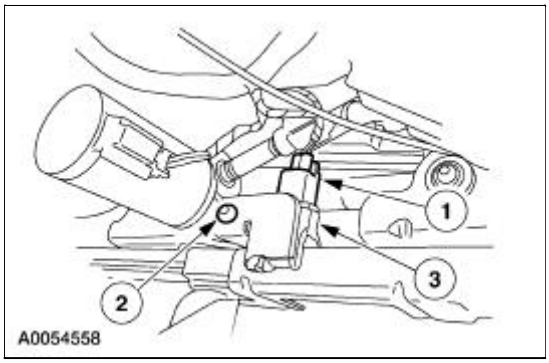
4. Remove the spring.



Driver seat

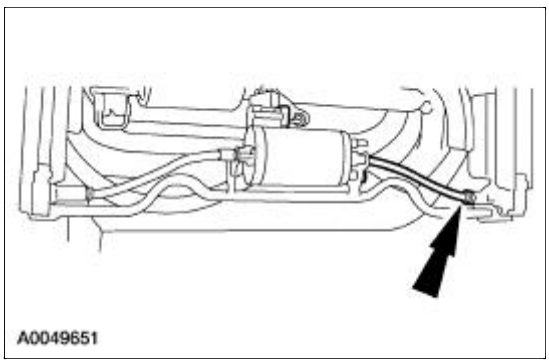
5. **CAUTION: Make sure to remove all metal chips from seat position sensor and surrounding areas after drilling out rivet.**

   Remove the seat position sensor.
   1. Disconnect the seat position sensor electrical connector.
   2. Drill out rivet.
   3. Remove the seat position sensor.



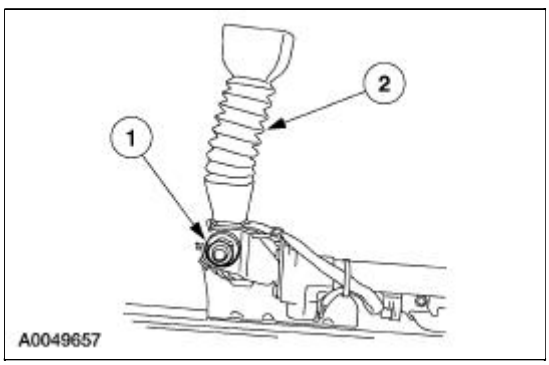
Inboard seat track

6. Pull to remove the inboard forward/reverse motor drive cable from inboard seat track.

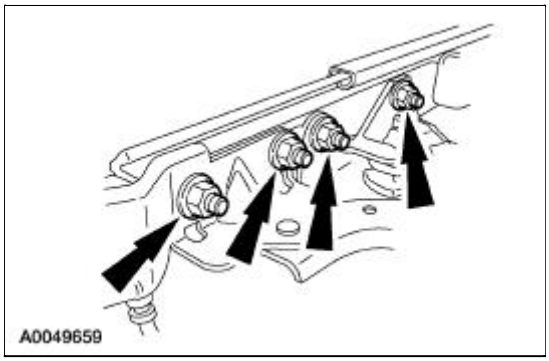


7. Disconnect the safety belt buckle pretensioner and usage detection electrical connectors.

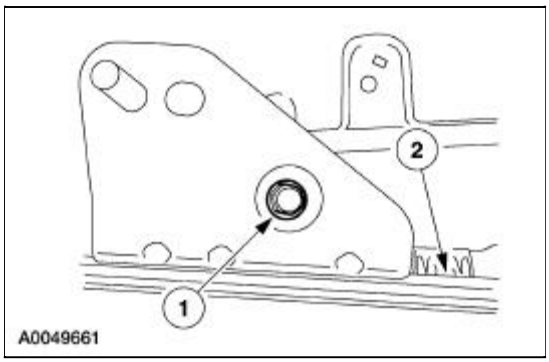
8. Remove the safety belt buckle pretensioner.
    1. Remove the nut.
    2. Remove the safety belt buckle pretensioner.



9. Remove the four inboard seat track nuts.

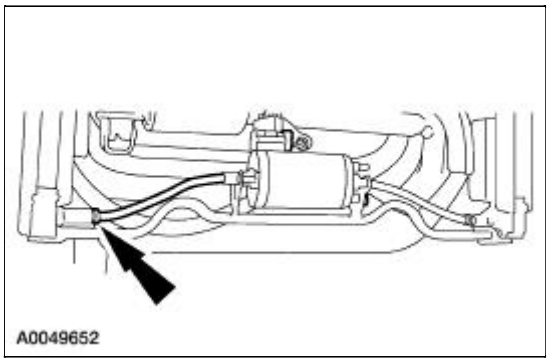


10. Remove the rear inboard seat track and bracket.
    1. Remove the bolt.
    2. Remove the seat track and bracket.
       - Remove the two remaining nuts (not shown) that hold the bracket to seat track.



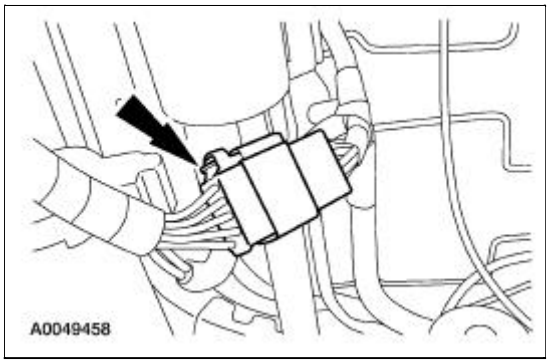
Outboard seat track

11. Pull to remove the outboard forward/reverse motor drive cable from outboard seat track.

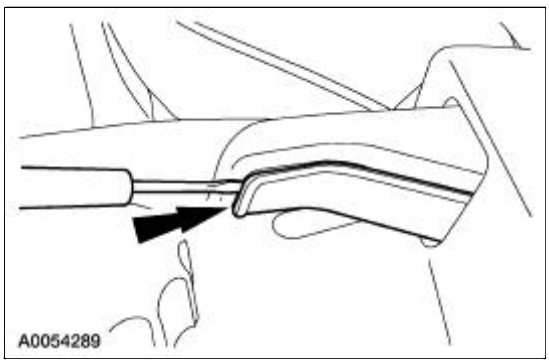


Vehicles with 6-way power seat

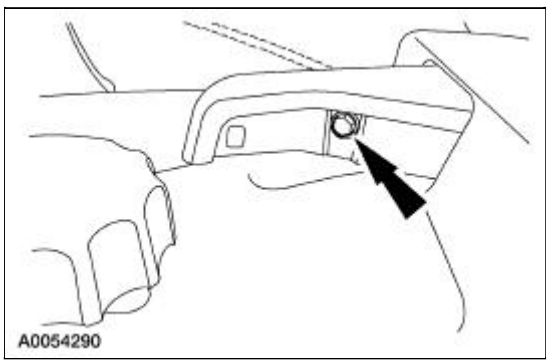
12. Disconnect the 6-way power seat switch electrical connector.



13. Remove recliner handle cover.

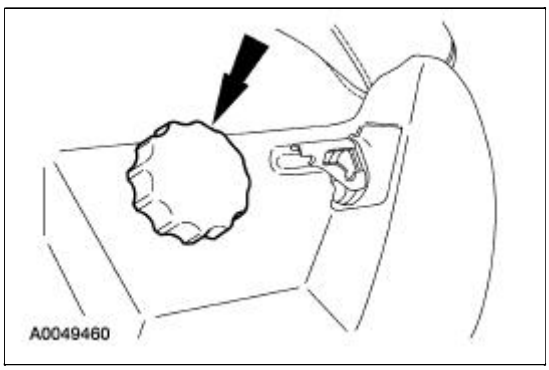


14. Remove the recliner handle screw and remove handle.

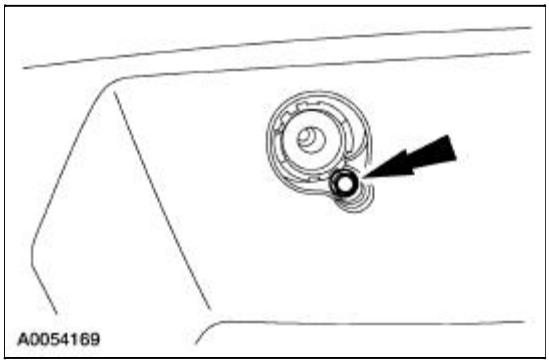


15. **CAUTION: Use care when removing the lumbar knob. Using both hands, pull with even pressure on both sides of the knob to remove.**

    Remove the lumbar knob.

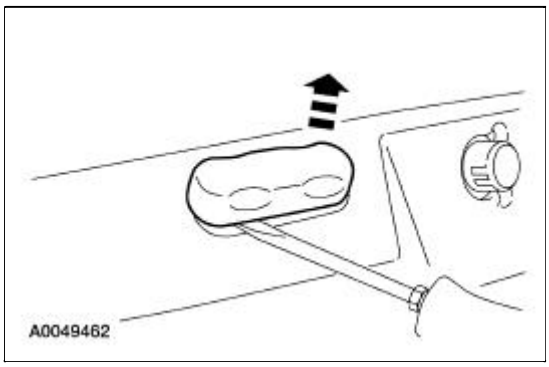


16. Remove the screw from side shield under the lumbar knob.

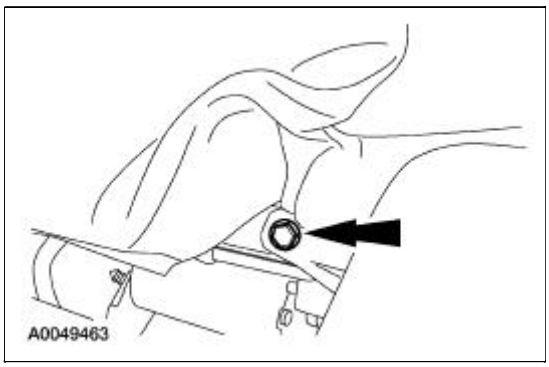


17. **CAUTION: Use care not to scratch the side shield when removing the power seat knob.**

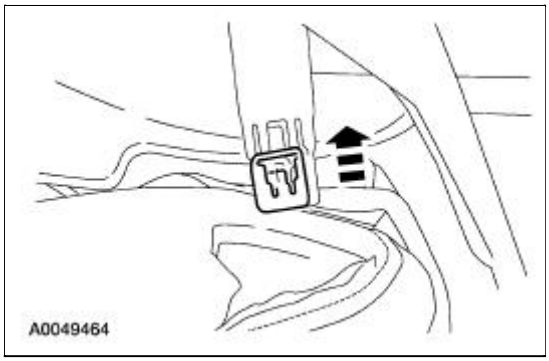
    Pry the power seat knob off.



18. Access and remove the front side shield screw.



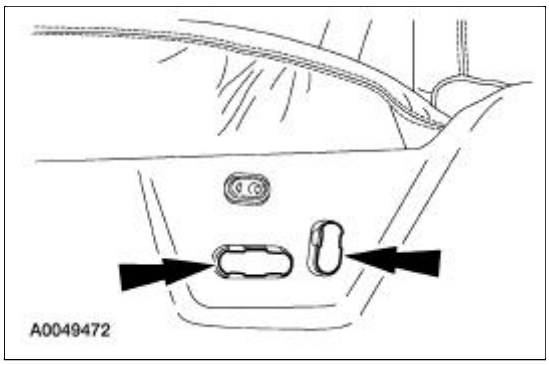
19. Pull to release the retainer clip on the rear of side shield.



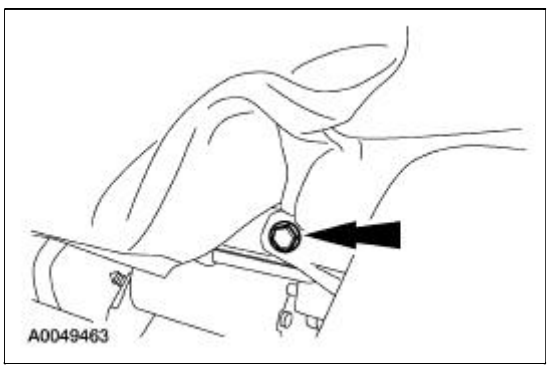
20. Remove the side shield from the seat.

Vehicles with 8-way power seat

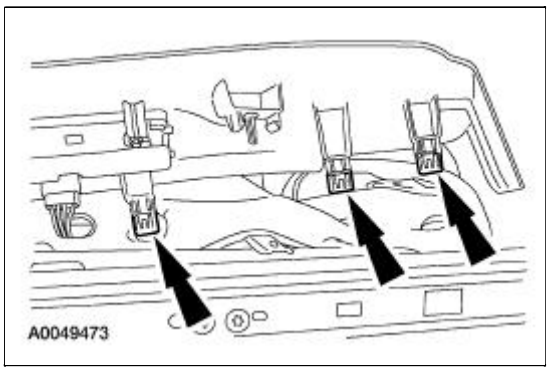
21. Pry to remove the two power seat knobs and remove the knobs.



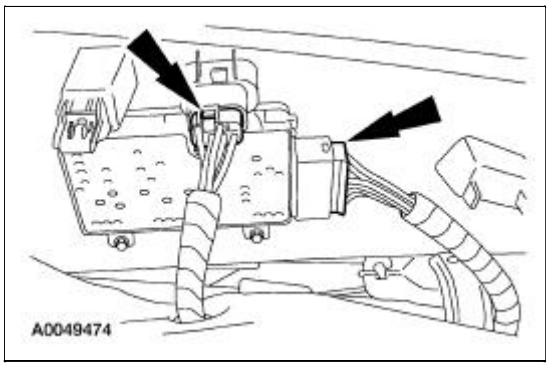
22. Access and remove the front side shield screw.



23. Pull out from the bottom and rear side of side shield to release the three retainer clips.

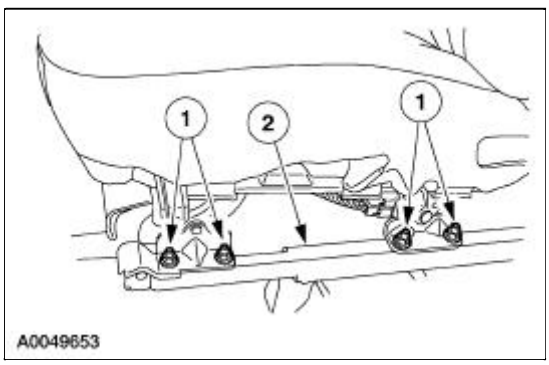


24. Disconnect the power lumbar switch and 8-way power seat switch electrical connectors and remove the side shield.



Outboard seat track

25. Remove the outboard seat track.
    1. Remove the nuts.
    2. Remove the seat track.

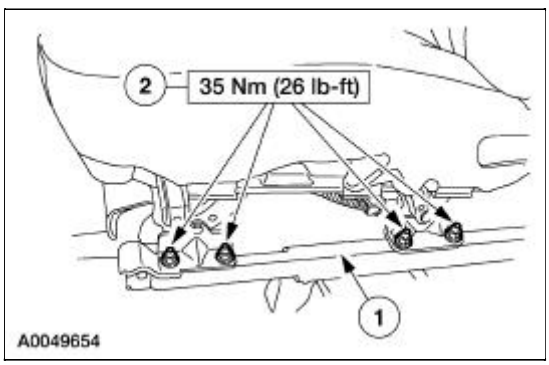


Installation

WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the removal procedure.

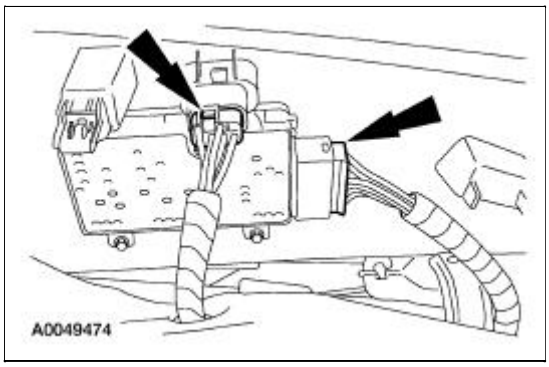
Outboard seat track

1. Install the outboard seat track.
    1. Install the seat track.
    2. Install the nuts.

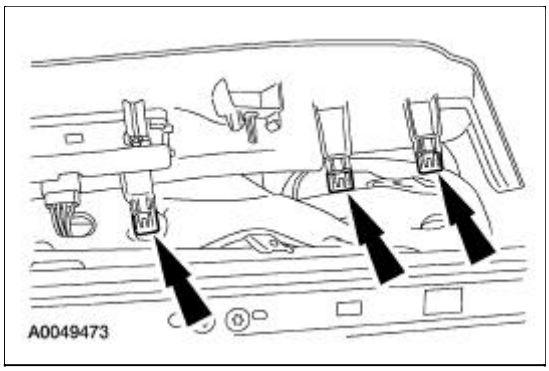


Vehicles with 8-way power seat

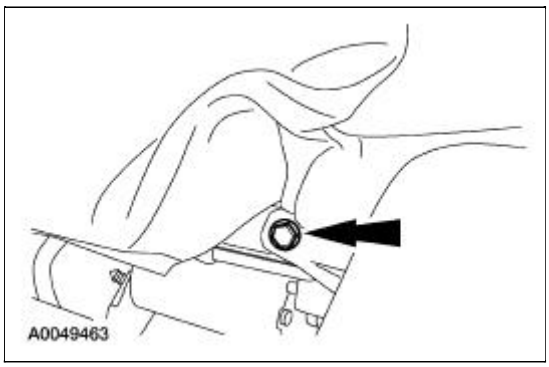
2. Install side shield and connect the 8-way power seat and power lumbar switch electrical connectors.



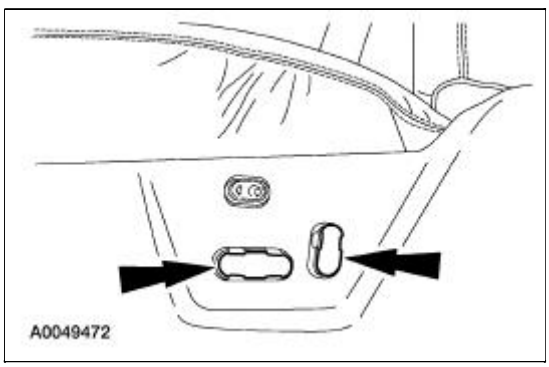
3. Push to install the three side shield retainers onto the seat frame.



4. Access and install the front side shield screw.

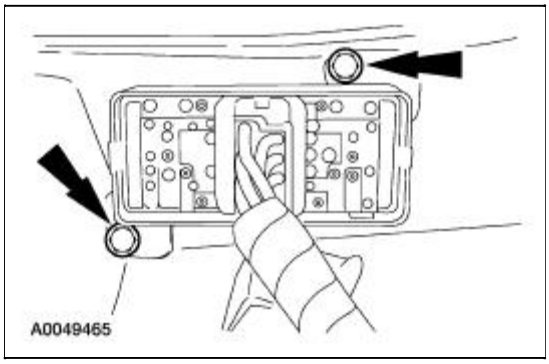


5. Install the two power seat knobs.

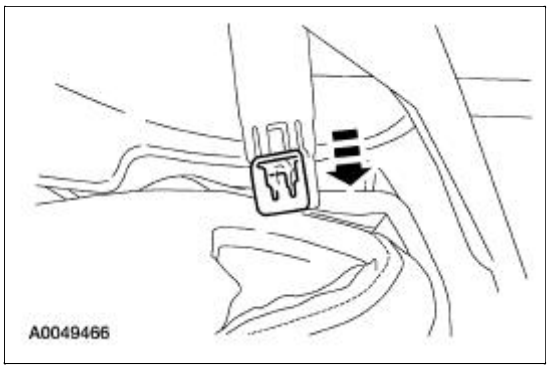


Vehicles with 6-way power seat

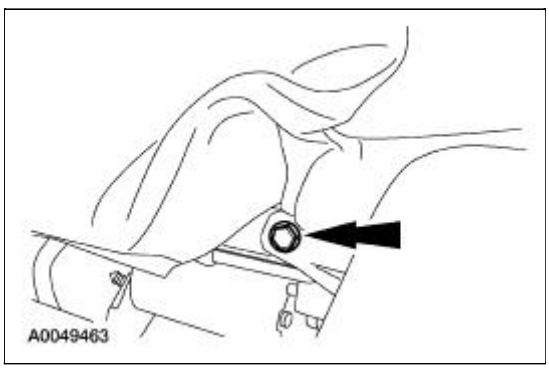
6. Install the 6-way power seat switch on the side shield and install the two screws.



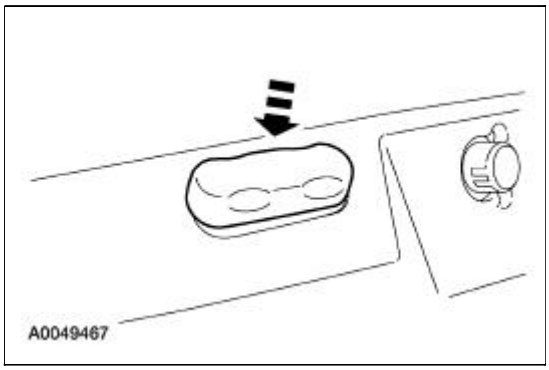
7. Install the side shield on the seat
8. Push to install the rear side shield retainer onto the seat frame.



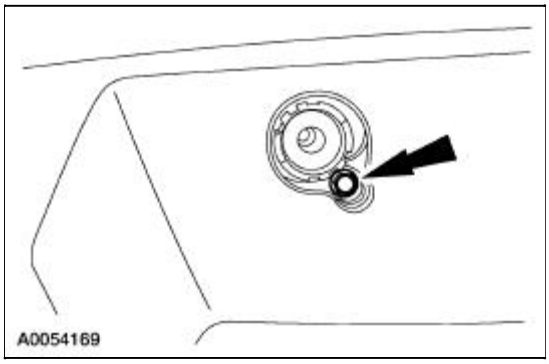
9. Access and install the front side shield screw.



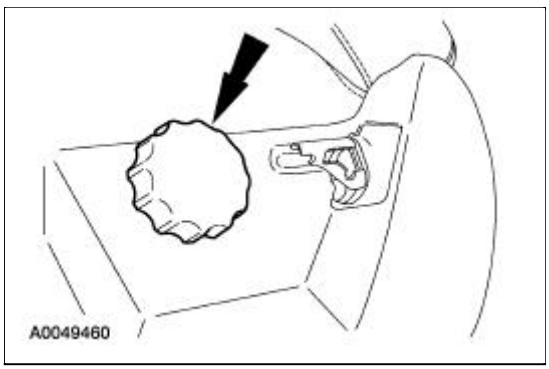
10. Install the 6-way power seat knob.



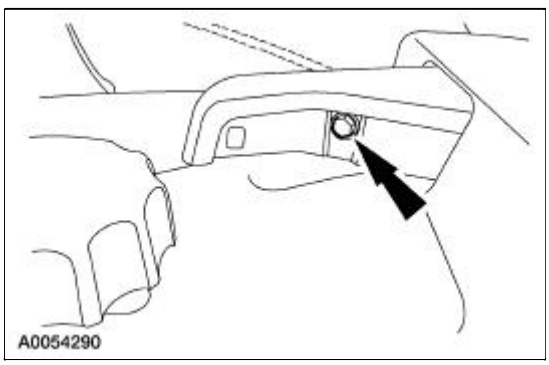
11. Install the screw on the side shield.



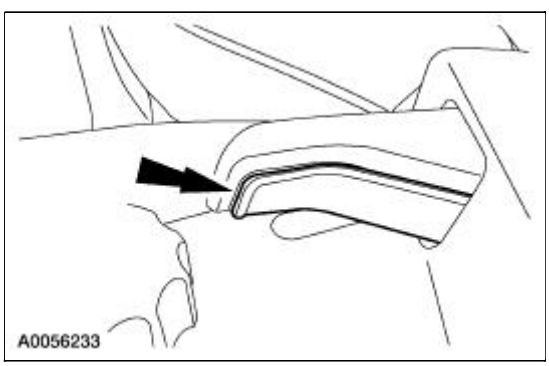
12. Align and install the lumbar knob.



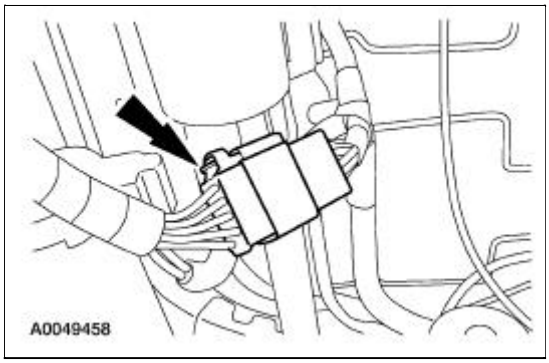
13. Install recliner handle and install the screw.



14. Install the recliner handle cover.

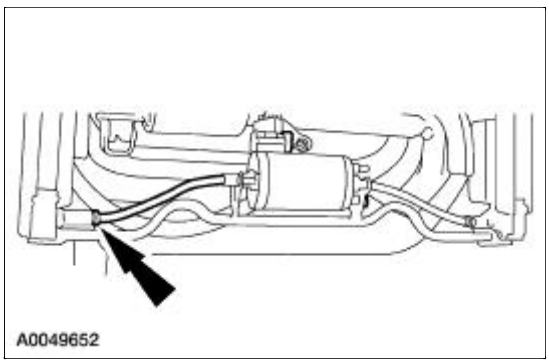


15. Connect the 6-way power seat switch electrical connector.



Outboard seat track

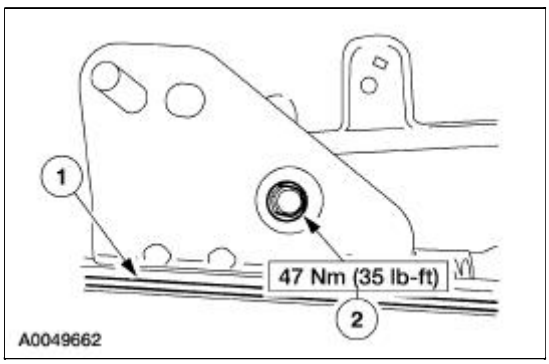
16. Install the outboard forward/reverse motor drive cable to outboard seat track.



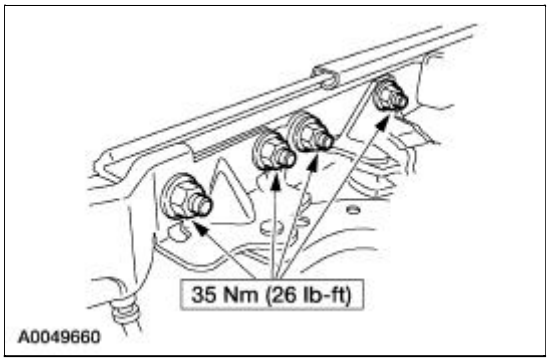
Inboard seat track

17. Install the bracket to the seat track and install the two nuts.

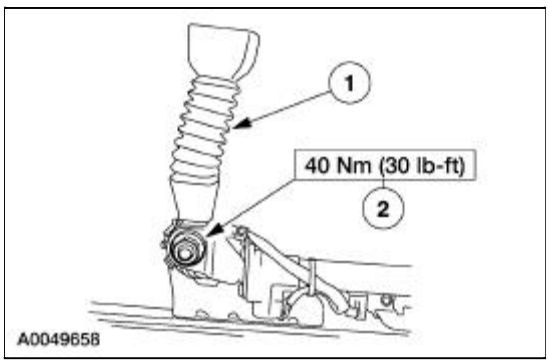
18. Install the rear inboard seat track and bracket.
    1. Install the seat track and bracket.
    2. Install the bolt.



19. Install the four inboard seat track nuts.

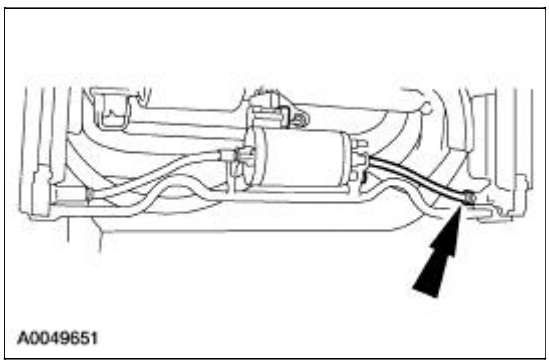


20. Install the safety belt buckle pretensioner.
    1. Install the safety belt buckle pretensioner.
    2. Install the nut.



21. Connect the safety belt buckle pretensioner and usage detection electrical connectors.

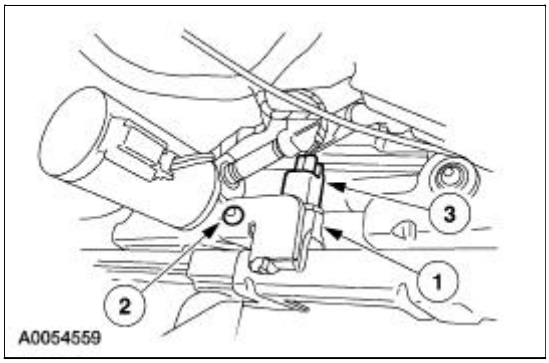
22. Install the inboard forward/reverse motor drive cable to seat track.



Driver seat

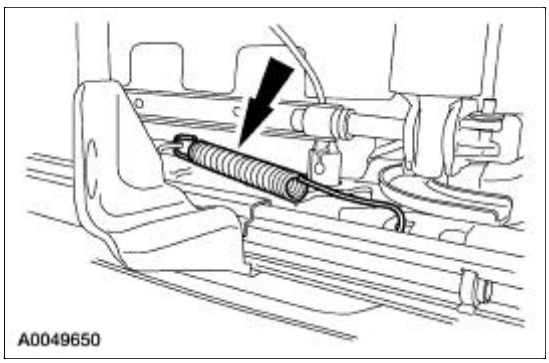
23. **CAUTION: Make sure to remove all metal chips from seat position sensor and surrounding areas.**

    Install the seat position sensor.
    1. Install the seat position sensor.
    2. Install the rivet.
    3. Connect the seat position sensor electrical connector.



Inboard and outboard seat tracks

24. Install the spring.



25. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the front seat removal and installation procedure.**

    Install the 40 percent seat. For additional information, refer to Front Seat—40 Percent in this section.

26. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

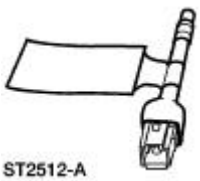
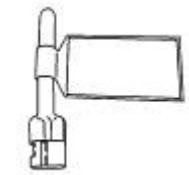
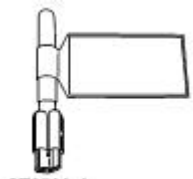
    Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation .

27. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

    With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .

Seat Track —Manual

Special Tool(s)

 ST2512-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F403
 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395 (014-R1079)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (40-009)
 ST2506-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F088 (105-00012)

Removal

WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe pretensioner electrical connectors. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

   The second row side impact sensors (if equipped) are located at or near the base of the

C-pillars.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

NOTE: Before disconnecting the battery in vehicles with power seats, adjust the seat position to allow for access to the necessary components.

Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

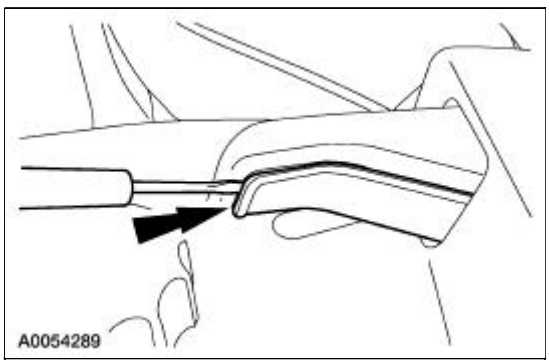
   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

3. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the front seat removal and installation procedure.**

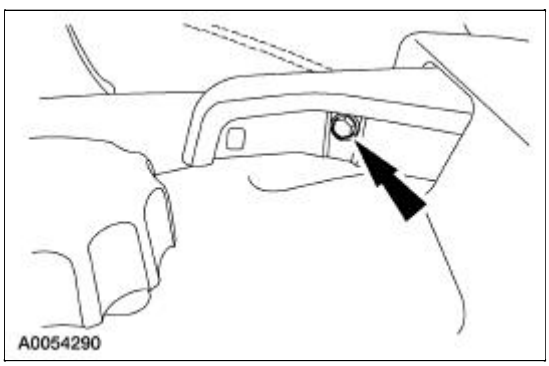
   NOTE: 60 percent seat shown, the 40 percent seat similar.

   Remove the affected seat. For additional information, refer to Front Seat—60 Percent or Front Seat—40 Percent in this section.

4. Remove recliner handle cover.

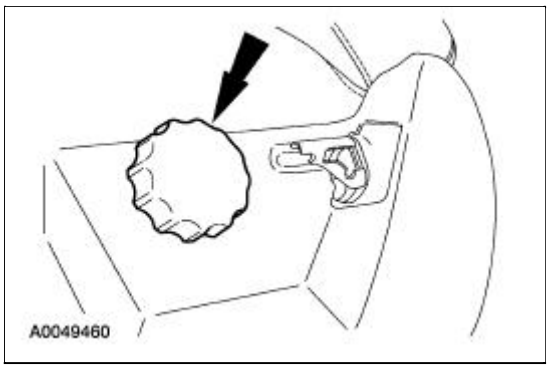


5. Remove the recliner handle screw and remove handle.

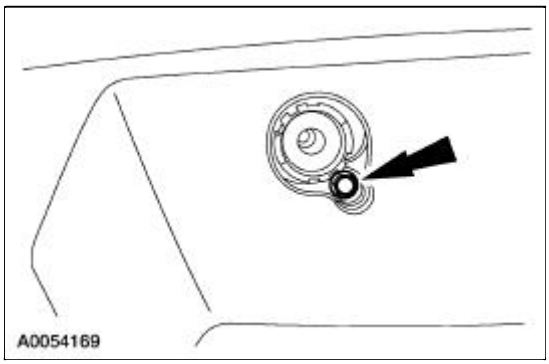


6. **CAUTION: Use care when removing the lumbar knob. Using both hands, pull with even pressure on both sides of the knob to remove.**

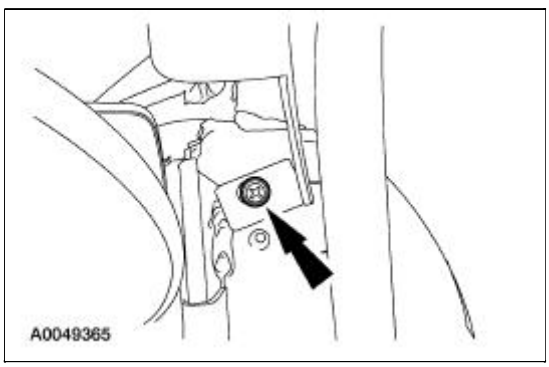
   Remove the lumbar knob.



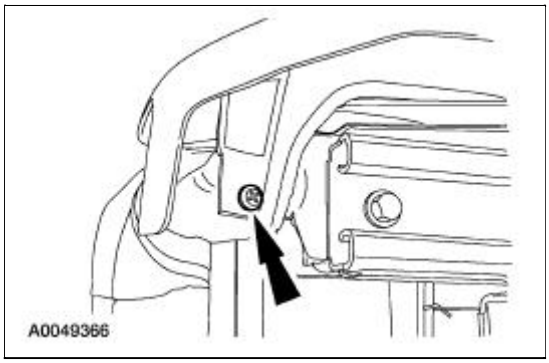
7. Remove the screw from the side shield under lumbar knob.



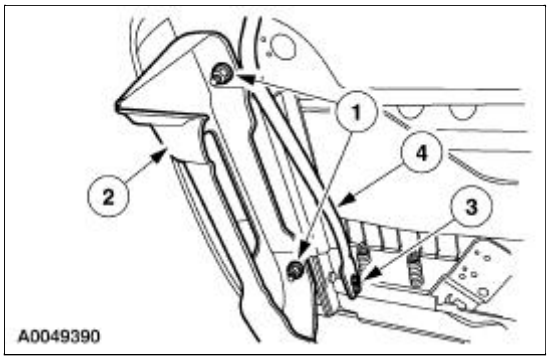
8. Remove the screw from the front of the side shield.



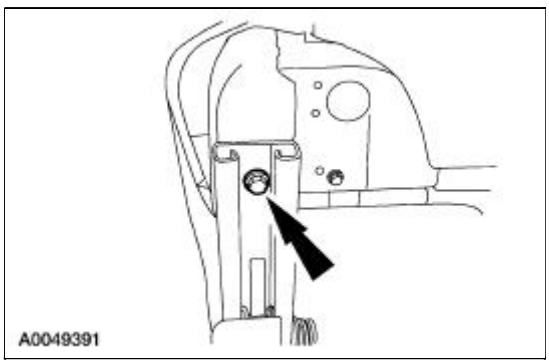
9. Remove the screw from the back of the side shield.



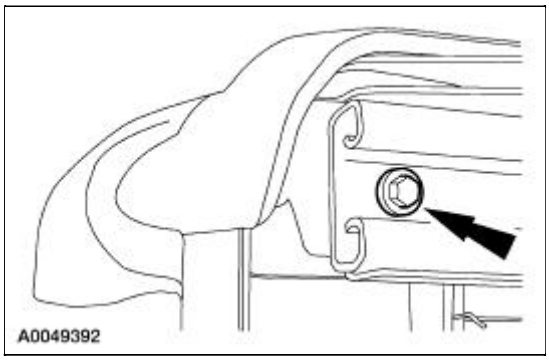
10. Remove the manual seat track riser and adjust handle.
    1. Remove the four seat riser nuts (two shown).
    2. Remove the seat riser.
    3. Remove the four adjust handle bolts (two shown).
    4. Remove the manual seat track handle.



11. Remove the two front manual seat track-to-cushion frame bolts (one shown).



12. Remove the two rear manual seat track-to-cushion frame bolts (one shown).

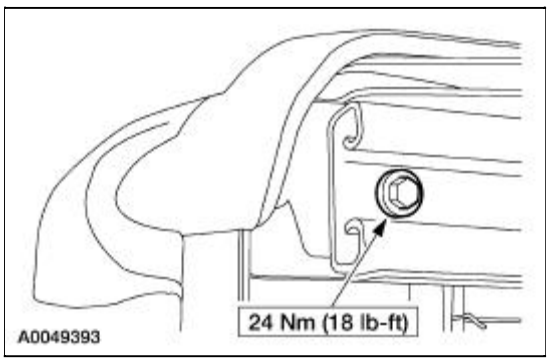


13. Remove the manual seat track.

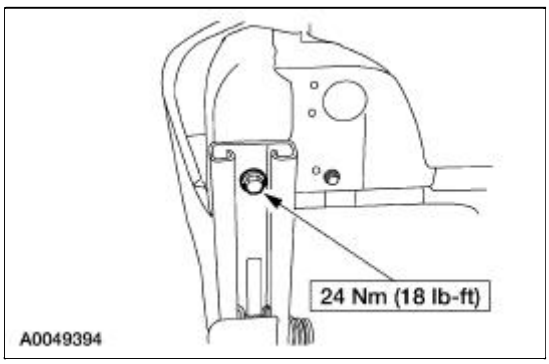
Installation

WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the removal procedure.

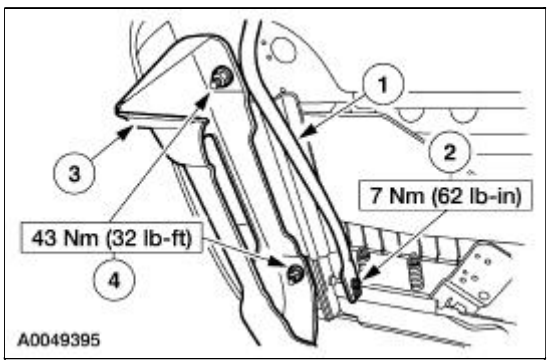
1. Install the manual seat track.
2. Install the two rear manual seat track-to-cushion frame bolts (one shown).



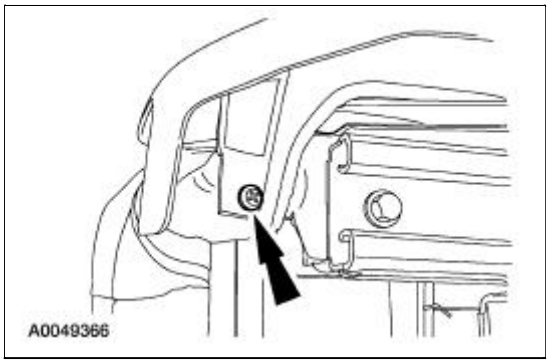
3. Install the two front manual seat track-to-cushion frame bolts (one shown).



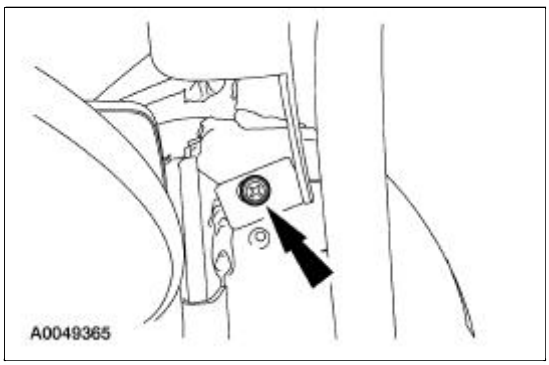
4. Install the seat track riser and adjust handle.
    1. Install the manual seat track adjust handle.
    2. Install the four seat track adjust handle bolts (two shown).
    3. Install the manual seat track risers.
    4. Install the four seat riser to seat track nuts (two shown).



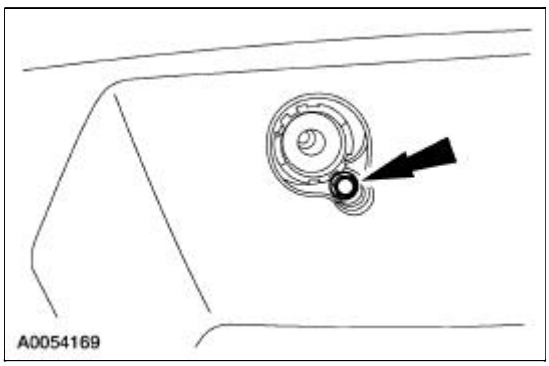
5. Install the screws on the back of the side shield.



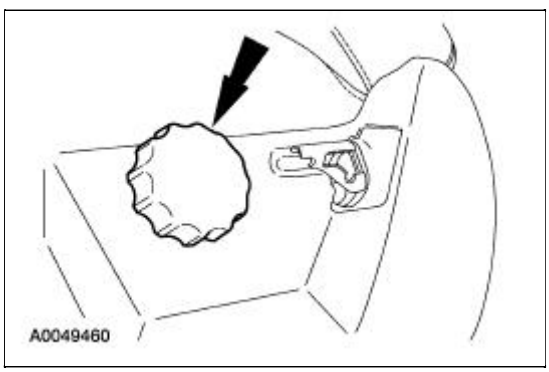
6. Install the screw on the front of side shield.



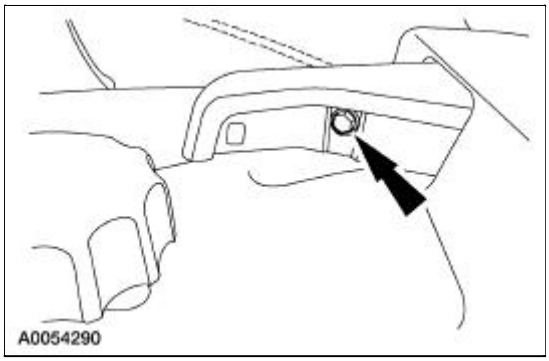
7. Install the screw on side shield.



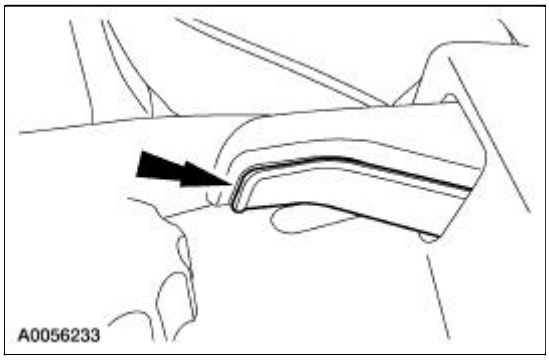
8. Align and install the lumbar knob.



9. Install recliner handle and install the screw.



10. Install the recliner handle cover.



11. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the front seat removal and installation procedure.**

    Install the affected seat. For additional information, refer to Front Seat—40 Percent or Front Seat—60 Percent in this section.

12. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

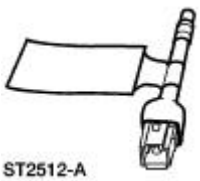
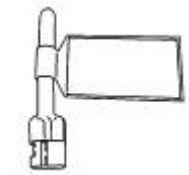
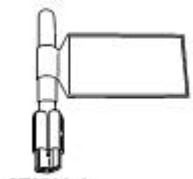
    Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation .

13. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

    With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .

Front Seat Track Motor

Special Tool(s)

 ST2512-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F403
 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395 (014-R1079)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F088 (105-00012)

Removal

WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe pretensioner electrical connectors. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

All motors

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

The second row side impact sensors (if equipped) are located at or near the base of the C-pillars.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

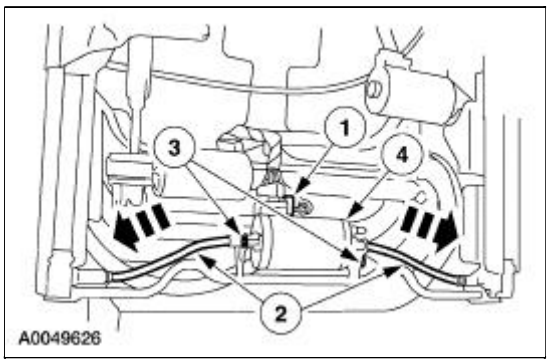
3. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the front seat removal and installation procedure.**

   Remove the 40 percent seat. For additional information, refer to Front Seat—40 Percent in this section.

Forward/Reverse motor

4. **NOTE:** If equipped with memory seat, disconnect the memory seat motor sensor electrical connector and remove sensor from the motor.

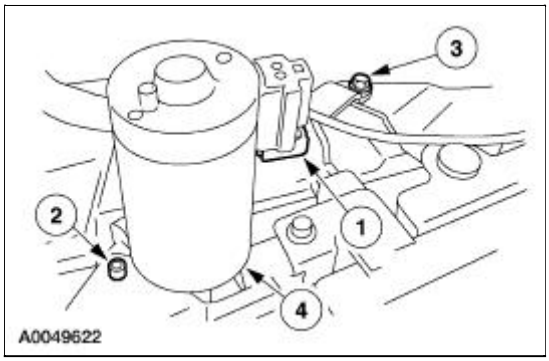
   Remove the forward/reverse motor.
   1. Disconnect the electrical connector.
   2. Pull to release the power seat drive cables from the motor.
   3. Remove the four screws (two shown).
   4. Remove the power seat motor.



Rear height motor

5. **NOTE:** If equipped with memory seat, disconnect the memory seat motor sensor electrical connector and remove sensor from the motor.

   Remove the rear height motor.
   1. Disconnect the rear height motor electrical connector.
   2. Remove the roll pin.
   3. Remove the bolt and nut.
   4. Remove the rear height power seat motor.

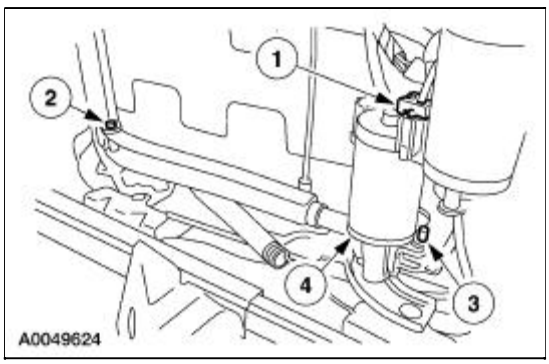


Front height motor

6. If equipped, remove the temperature controlled seat fan motor. For additional information, refer to Seat Fan Motor in this section.

7. **NOTE:** If equipped with memory seat, disconnect the memory seat motor sensor electrical connector and remove sensor from the motor.

   Remove the front height motor.
   1. Disconnect the front height motor electrical connector.
   2. Remove the roll pin.
   3. Remove the roll pin
   4. Remove the front height power seat motor.



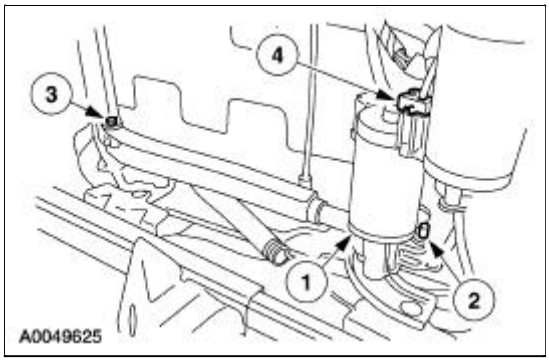
Installation

WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the removal procedure.

Front height motor

1. **NOTE:** If equipped with memory seat, install the sensor to the motor and connect the memory seat motor sensor electrical connector.

   Install the front height motor.
   1. Install the front height motor.
   2. Install the roll pin.
   3. Install the roll pin.
   4. Connect the front height motor electrical connector.

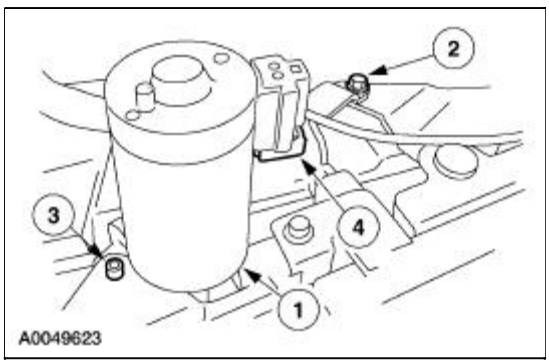


2. If equipped, install the temperature controlled seat fan motor. For additional information, refer to Seat Fan Motor in this section.

Rear height motor

3. **NOTE:** If equipped with memory seat, install sensor to the motor and connect the memory seat motor sensor electrical connector .

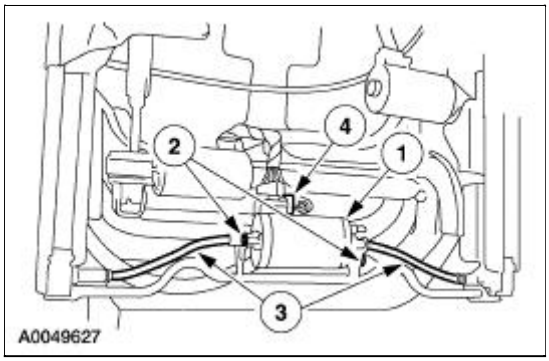
   Install the rear height motor.
   1. Install the rear power seat motor.
   2. Install the bolt and nut.
   3. Install the roll pin.
   4. Connect the rear height motor electrical connector.



Forward/Reverse motor

4. **NOTE:** If equipped with memory seat, install sensor to the motor and connect the memory seat motor sensor electrical connector .

   Install the forward/reverse motor.
   1. Install the forward/reverse power seat motor.
   2. Install the four screws (two shown).
   3. Install the power seat motor cables.
   4. Connect the forward/reverse motor electrical connector.



All motors

5. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the front seat removal and installation procedure.**

   Install the 40 percent seat. For additional information, refer to Front Seat—40 Percent in this section.

6. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

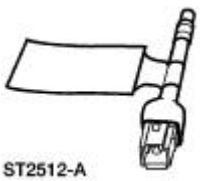
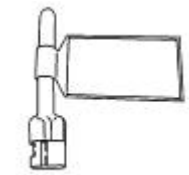
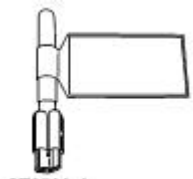
   Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation .

7. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

   With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .

Front Seat Recliner Motor

Special Tool(s)

 ST2512-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F403
 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395 (014-R1079)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F088 (105-00012)

Removal

WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe pretensioner electrical connectors. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

   The second row side impact sensors (if equipped) are located at or near the base of the

C-pillars.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

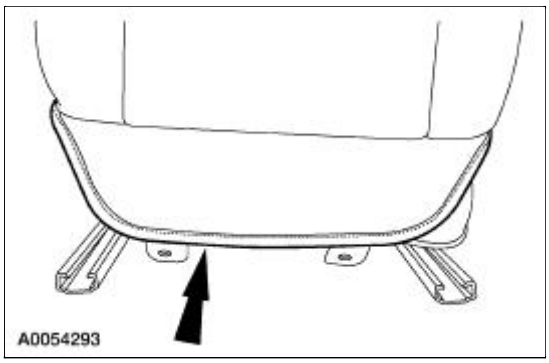
2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

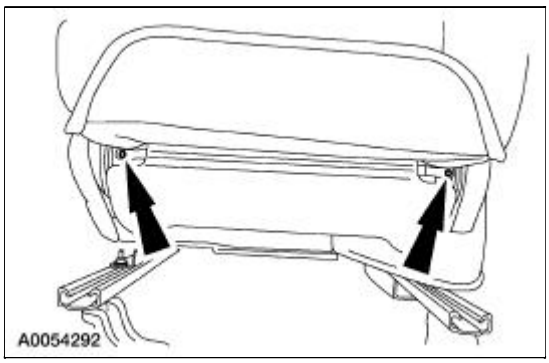
3. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the front seat removal and installation procedure.**

   Remove the 40 percent seat. For additional information, refer to Front Seat—40 Percent in this section.

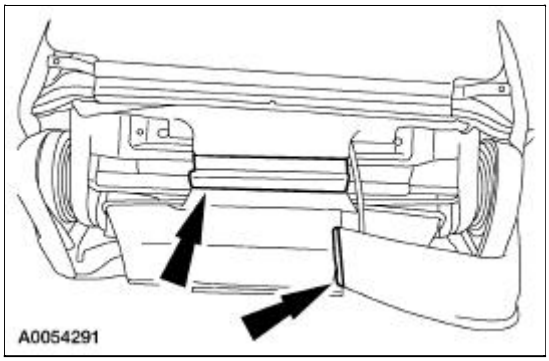
4. Remove lower seat backrest cover.



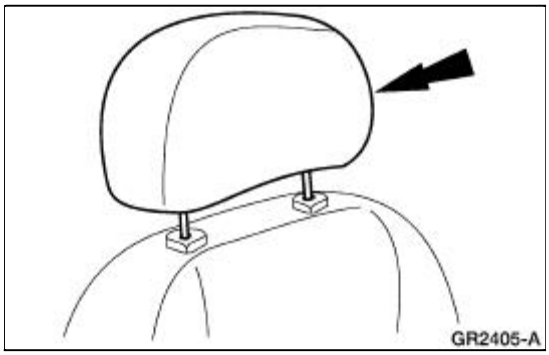
5. Remove the two screws from support rod.



6. Release the one hook-and-loop strip and the one J-clip.

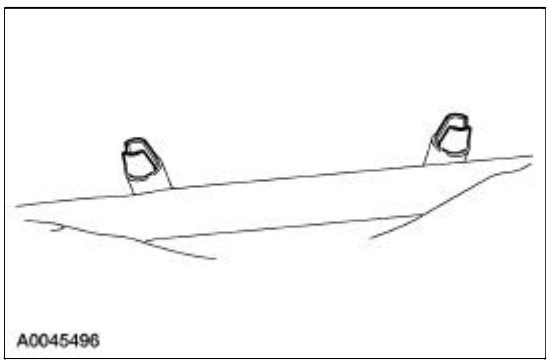


7. Depress tab and remove the head restraint.



8. **NOTE:** The head restraint sleeve pins are not interchangeable. Note location for installation.

   Reach up into seat backrest and squeeze the head restraint sleeve ends together to release the sleeves, and pull the head restraint sleeves out.

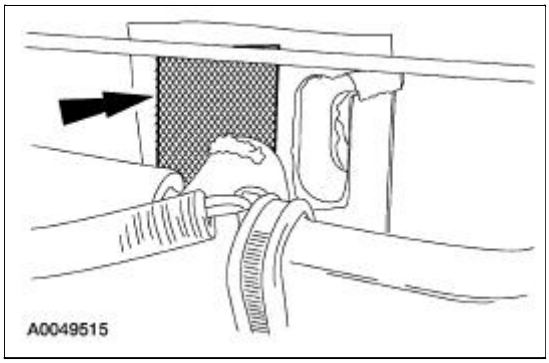


9. **CAUTION: Use care when separating the seat backrest trim cover from the hook-and-loop strip, or the hook-and-loop strip can be torn from the seat backrest foam.**

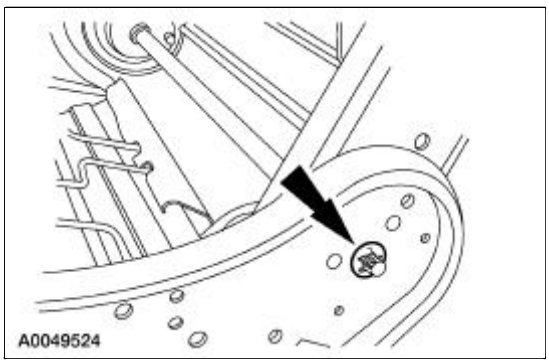
   Invert the seat backrest trim cover and remove.

10. **CAUTION: Use care when removing the seat backrest foam pad from the frame. The foam pad has hook and loop fasteners holding the thermo-electric device to the seat backrest foam pad.**

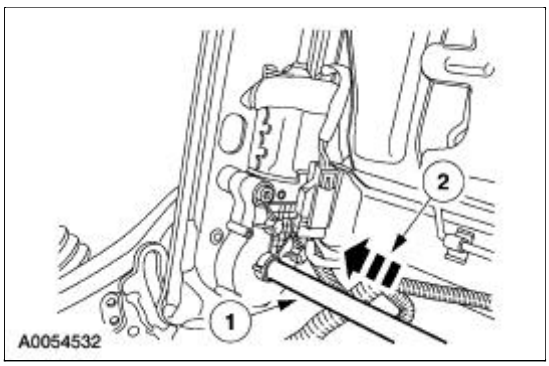
    Remove the seat backrest foam pad from the thermo-electric device and remove the seat backrest foam pad.



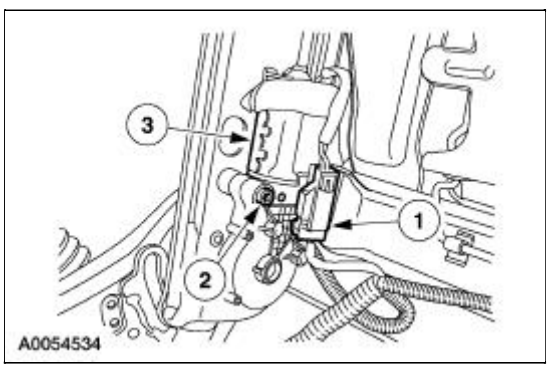
11. Remove the retainer clip on the end of the power recliner motor shaft.



12. Remove the power recliner motor shaft.
    1. Remove the power recliner motor shaft cover.
    2. Slide the power recliner motor shaft out from the power recliner motor.



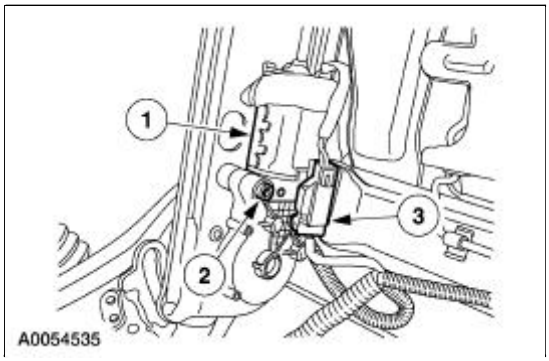
13. Remove the power recliner motor.
    1. Disconnect the power recliner motor electrical connector.
    2. Remove the power recliner motor bolt.
    3. Remove the power recliner motor.



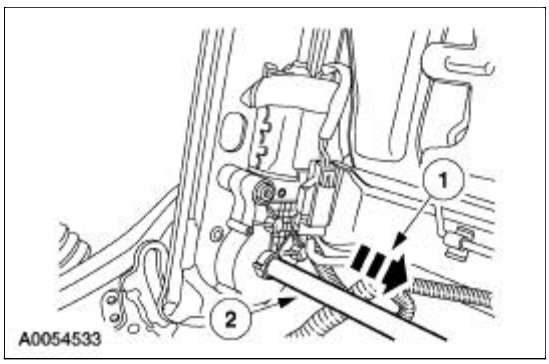
Installation

WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the removal procedure.

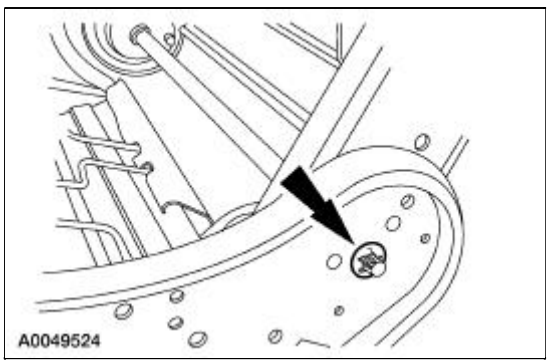
1. Install the power recliner motor.
    1. Install the power recliner motor.
    2. Install the power recliner motor bolt.
    3. Connect the power recliner motor electrical connector.



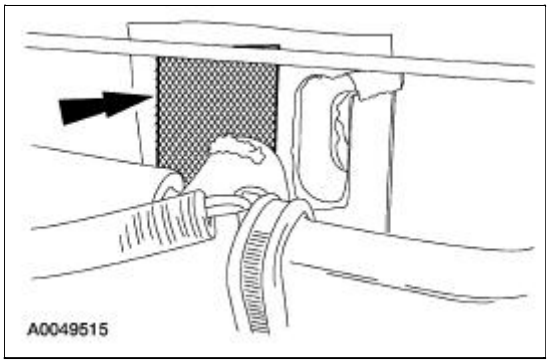
2. Install the power recliner shaft.
    1. Slide the power recliner shaft into the motor and through the seat.
    2. Install the power recliner shaft cover.



3. Install the retainer clip onto the end of the power recliner shaft.

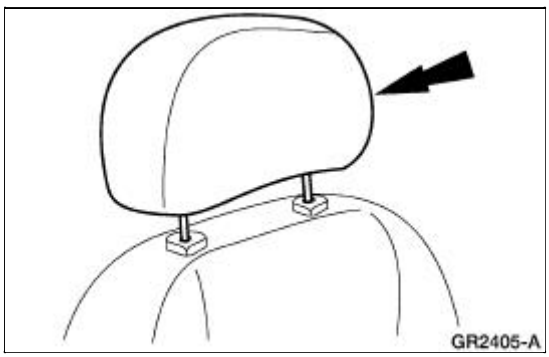


4. Install the seat backrest foam pad and attach the seat backrest thermo-electric device to the foam pad

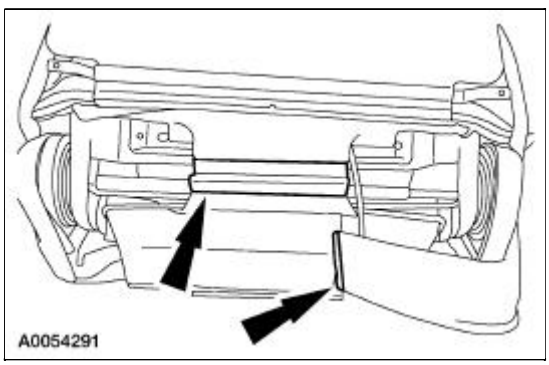


5. Install the seat backrest trim cover and attach the hook-and-loop fasteners.
6. **NOTE:** The head restraint sleeve pins are not interchangeable.

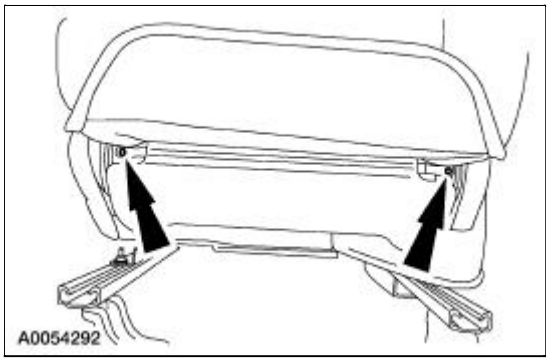
   Install the head restraint sleeves.
7. Install the head restraint.



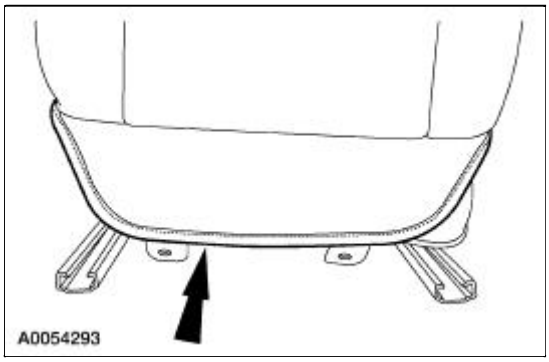
8. Connect the one hook-and-loop strip and the one J-clip.



9. Install the two screws in support rod.



10. Install the lower backrest cover.



11. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the front seat removal and installation procedure.**

    Install the 40 percent seat. For additional information, refer to Front Seat—40 Percent in this section.

12. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

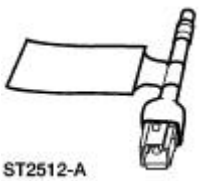
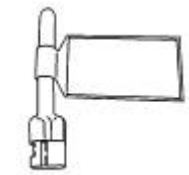
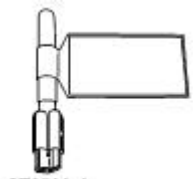
    Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation .

13. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

    With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .

Climate Controlled Seat Module

Special Tool(s)

 ST2512-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F403
 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395 (014-R1079)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (40-009)
 ST2506-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F088 (105-00012)

Removal

WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe pretensioner electrical connectors. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The side impact sensors (if equipped) are located at or near the base of the B-pillars and C-pillars.

   To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

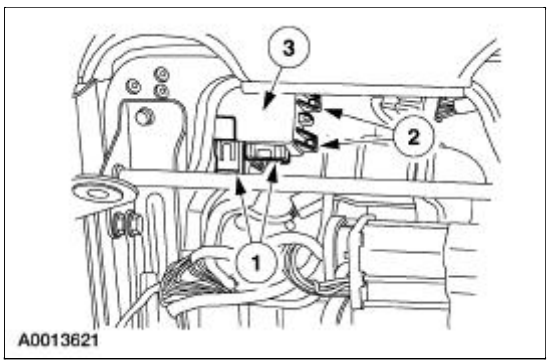
2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

3. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the front seat removal and installation procedure.**

   Remove the 40 percent seat. For additional information, refer to Front Seat—40 Percent in this section.

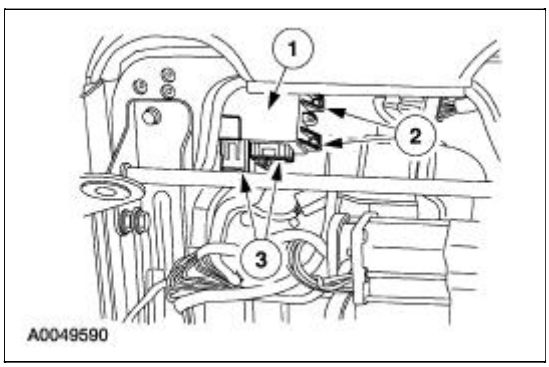
4. Remove the temperature controlled seat module.
   1. Disconnect the temperature controlled seat module electrical connectors.
   2. Remove the screws.
   3. Remove the temperature controlled seat module.



Installation

WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the removal procedure.

1. Install the temperature controlled seat module.
   1. Install the temperature controlled seat module.
   2. Install the screws.
   3. Connect the temperature controlled seat module electrical connectors.



2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the front seat removal and installation procedure.**

   Install the 40 percent seat. For additional information, refer to Front Seat—40 Percent in this section.

3. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

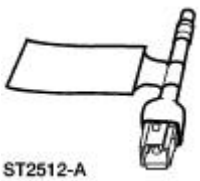
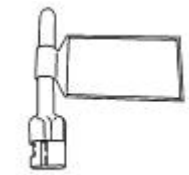
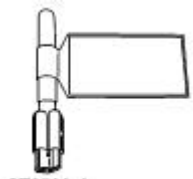
   Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation .

4. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

   With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .

Lumbar Motor

Special Tool(s)

 ST2512-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F403
 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395 (014-R1079)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F088 (105-00012)

Removal

WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe pretensioner electrical connectors. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

   The second row side impact sensors (if equipped) are located at or near the base of the

C-pillars.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

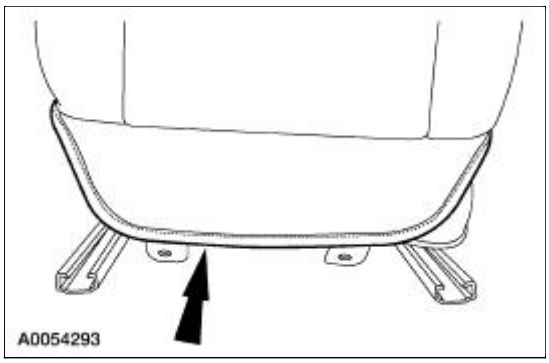
2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

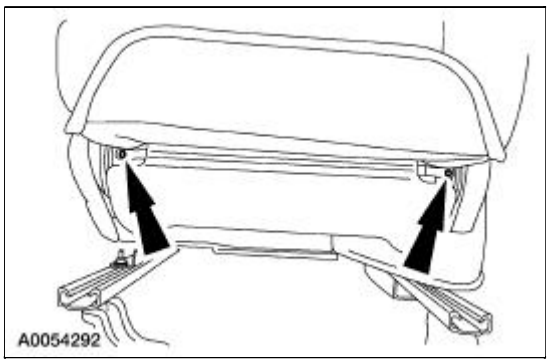
3. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the front seat removal and installation procedure.**

   Remove the 40 percent seat. For additional information, refer to Front Seat—40 Percent in this section.

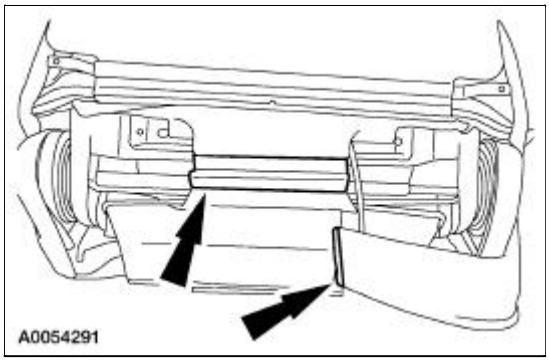
4. Remove lower seat backrest cover.



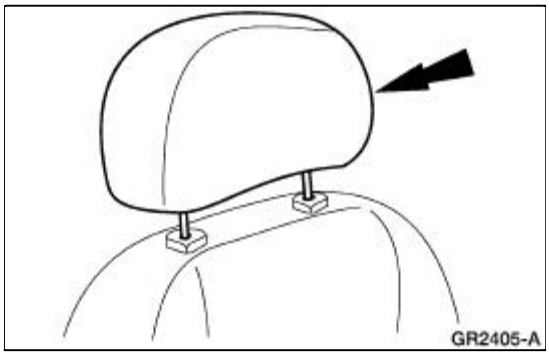
5. Remove the two screws from support rod.



6. Release the one hook-and-loop strip and the one J-clip.

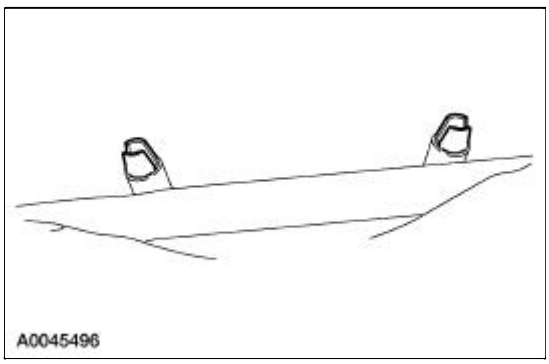


7. Depress tab and remove the head restraint.



8. **NOTE:** The head restraint sleeve pins are not interchangeable. Note location for installation.

   Reach up into seat backrest and squeeze the head restraint sleeve ends together to release the sleeves and pull the head restraint sleeves out.



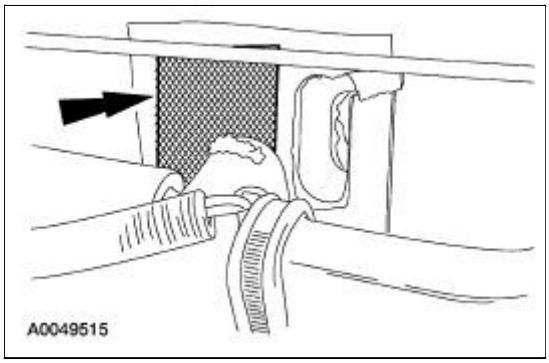
9. **CAUTION: Use care when separating the seat backrest trim cover from the hook-and-loop strip, or the hook-and-loop strip can be torn from the seat backrest foam.**

   Invert the seat backrest trim cover and remove.

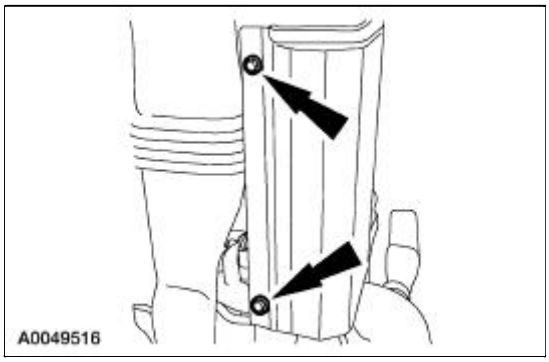
10. **CAUTION: Use care when removing the seat backrest foam pad from the frame. The foam pad has hook-and-loop fasteners holding the thermo-electric device to the seat backrest foam pad.**

    NOTE:

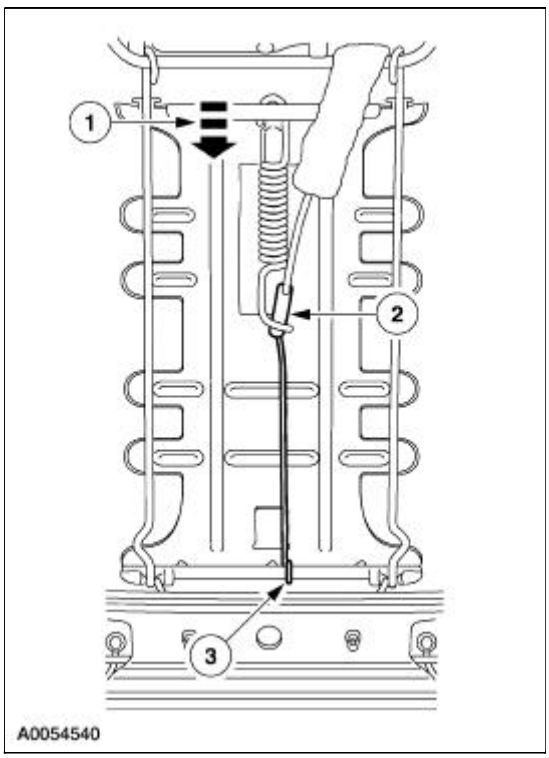
    Remove the seat backrest foam pad from the thermo-electric device (TED) and remove the seat backrest foam pad.



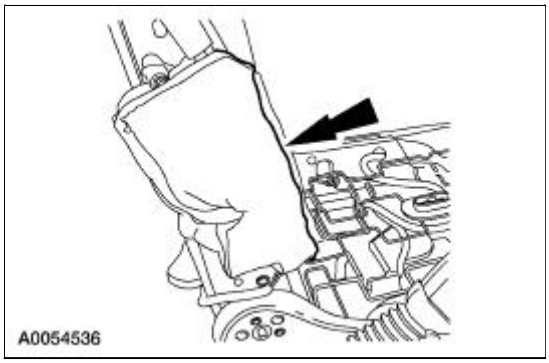
11. Remove the screws from the lumbar motor support cover and remove support cover (two shown).



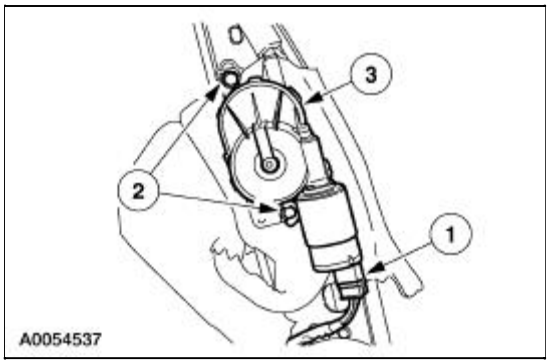
12. Remove the lumbar motor cable from the lumbar support.
    1. Flex the lumbar support.
    2. Separate the lumbar support adjusting cable from the positioning spring.
    3. Unhook the lumbar support adjusting cable from the lumbar support.



13. Remove the staples and open dampening bag.



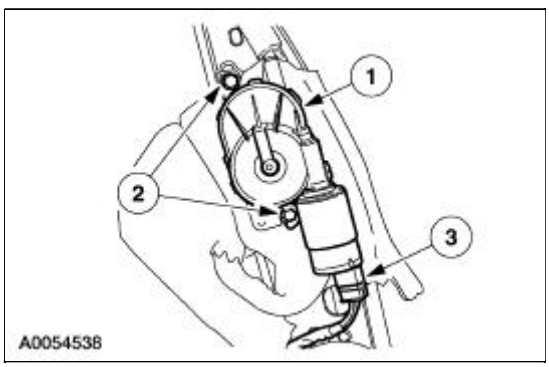
14. Remove the power lumbar support motor.
    1. Disconnect the power lumbar motor electrical connector.
    2. Remove the screws.
    3. Remove the power lumbar support motor.



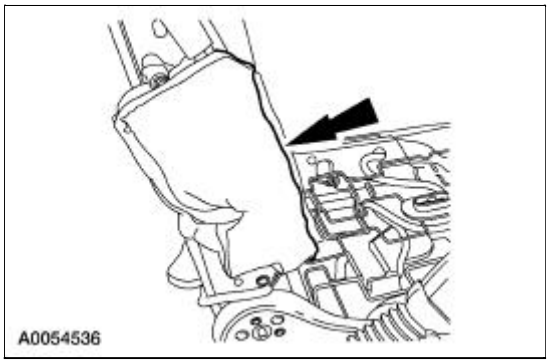
Installation

WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the removal procedure.

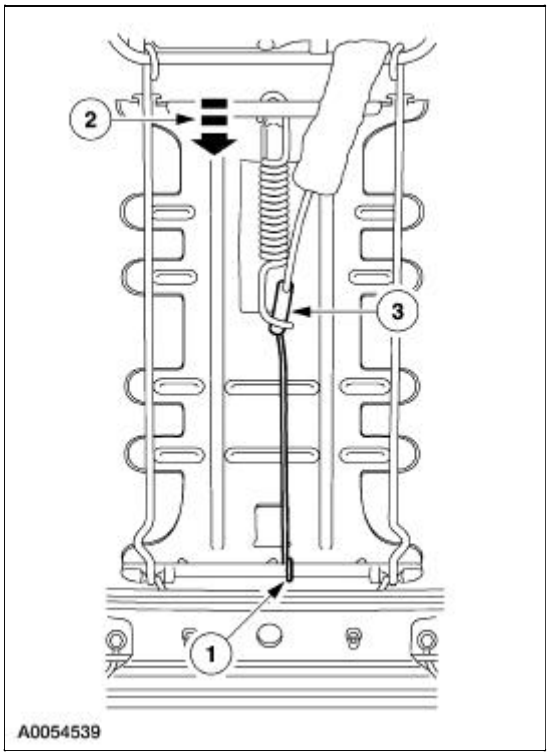
1. Install the power lumbar support motor.
    1. Install the dampening bag and install the power lumbar support motor.
    2. Install the screws.
    3. Connect the power lumbar electrical connector.



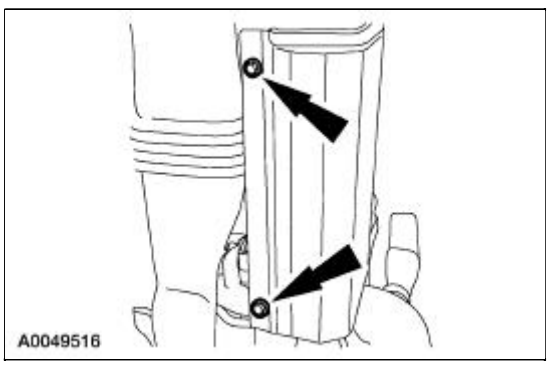
2. Close the dampening bag and staple.



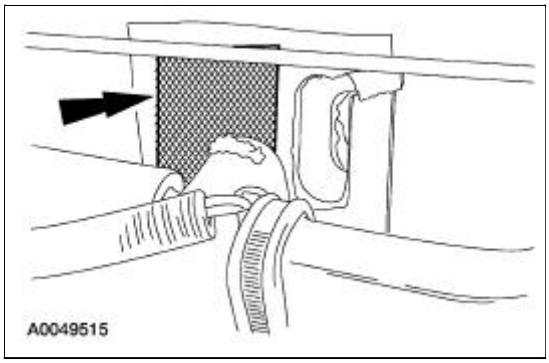
3. Install the lumbar motor cable to the lumbar support.
    1. Hook the lumbar support adjusting cable to the lumbar support.
    2. Flex the lumbar support.
    3. Install the lumbar support adjusting cable to the positioning spring.



4. Install the lumbar motor support cover and install the screws for the support cover (two shown).

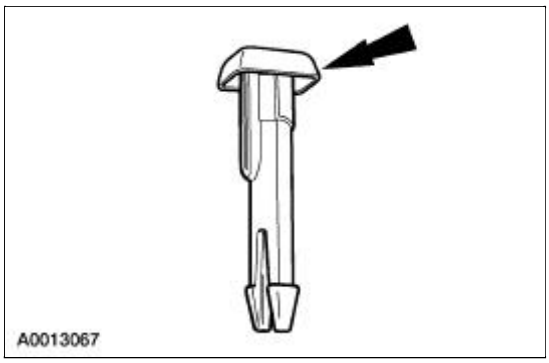


5. Install the seat backrest foam pad and attach the seat backrest TED to the foam pad.

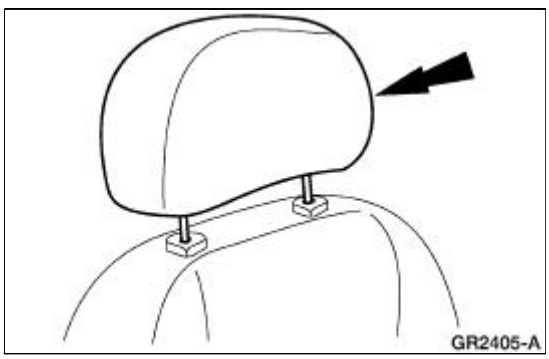


6. Install the seat backrest trim cover and attach the hook-and-loop fasteners to the foam pad.
7. **NOTE:** The head restraint sleeve pins are not interchangeable.

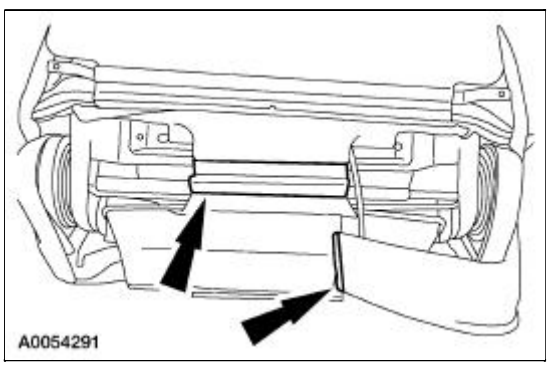
   Install the head restraint sleeves.



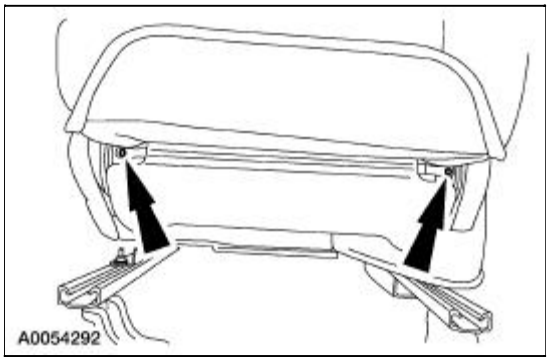
8. Install the head restraint.



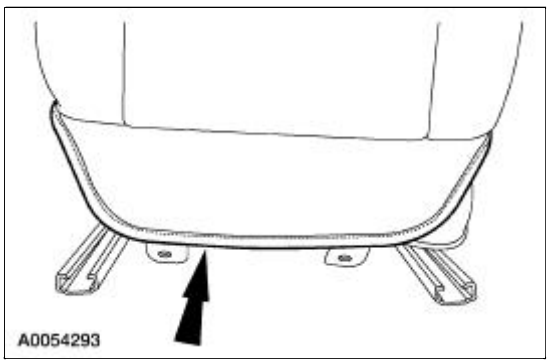
9. Connect the one hook-and-loop strip and the one J-clip.



10. Install the two screws in the support rod.



11. Install the lower backrest cover.



12. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the front seat removal and installation procedure.**

    Install the 40 percent seat. For additional information, refer to Front Seat—40 Percent in this section.

13. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

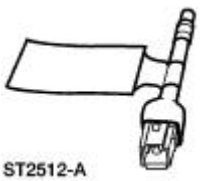
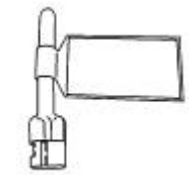
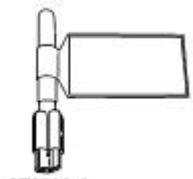
    Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation .

14. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

    With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .

Seat Fan Motor

Special Tool(s)

 ST2512-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F403
 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395 (014-R1079)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F088 (105-00012)

Removal

WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe pretensioner electrical connectors. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

   The second row side impact sensors (if equipped) are located at or near the base of the

C-pillars.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

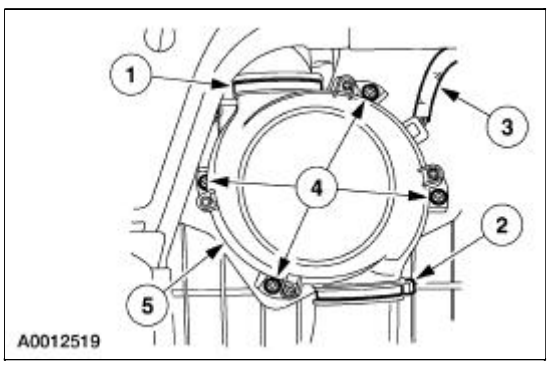
2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

3. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the front seat removal and installation procedure.**

   Remove the 40 percent seat. For additional information, refer to Front Seat—40 Percent in this section.

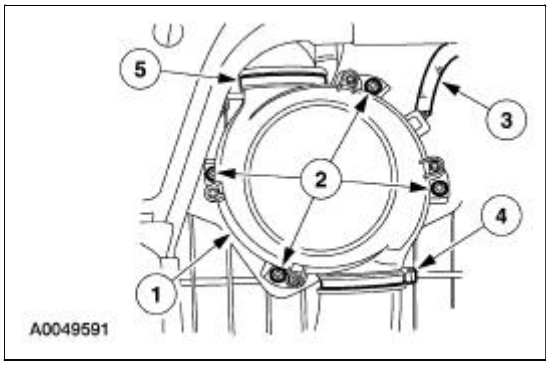
4. Remove the seat fan motor.
   1. Cut the zip-tie and separate the duct from the seat fan motor.
   2. Cut the zip-tie and separate the duct from the seat fan motor.
   3. Disconnect the seat fan motor wire harness electrical connector.
   4. Remove the screws.
   5. Remove the fan motor.



Installation

WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the removal procedure.

1. Install the seat fan motor.
   1. Install the seat fan motor.
   2. Install the screws.
   3. Connect the seat fan motor wire harness electrical connector.
   4. Install the duct to seat fan motor and install zip-tie.
   5. Install the duct to seat fan motor and install zip-tie.



2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the front seat removal and installation procedure.**

   Install the 40 percent seat. For additional information, refer to Front Seat—40 Percent in this section.

3. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation .

4. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

   With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .

Power-Fold Seat Motor

Removal

CAUTION: To prevent possible damage to the third row seat or the safety belts, make sure that the safety belts are not fastened when moving the seat to the load floor position.

CAUTION: Make sure that no objects such as books, purses or briefcases are on the floor in front of the third row seats or on the seat cushion before lowering the backrest(s).

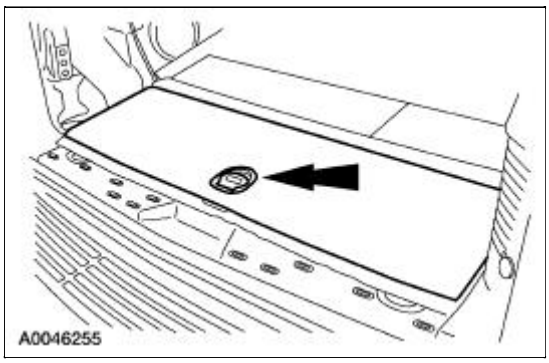
NOTE: The third row seat backrests need to be in the raised position for removal of the third row seats.

NOTE: Their are two service kits available for the third row power-fold seat motor. One kit contains one motor, one drive cable, two bushings and two attachment nuts and bolts. The other kit contains one drive cable, two bushings and two attachment nuts and bolts.

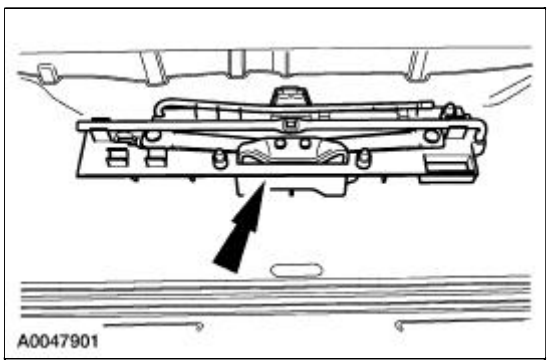
NOTE: 60 percent seat shown, 40 percent similar.

All vehicles

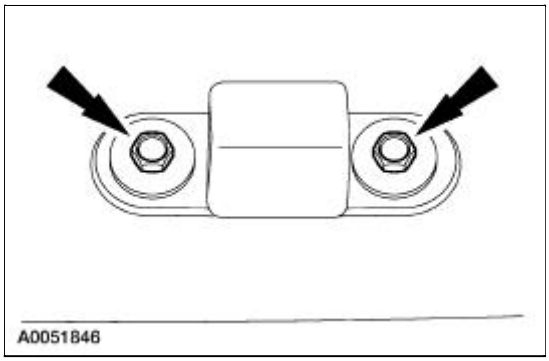
1. Remove the rear load floor panel.



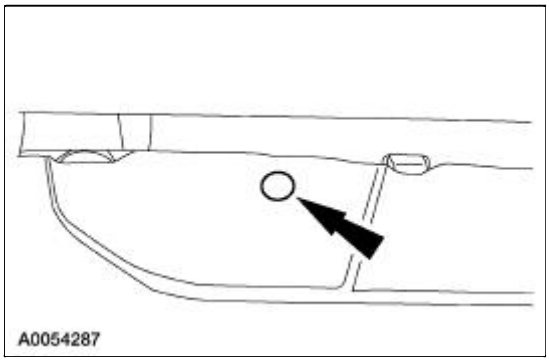
2. Remove the jack assembly.



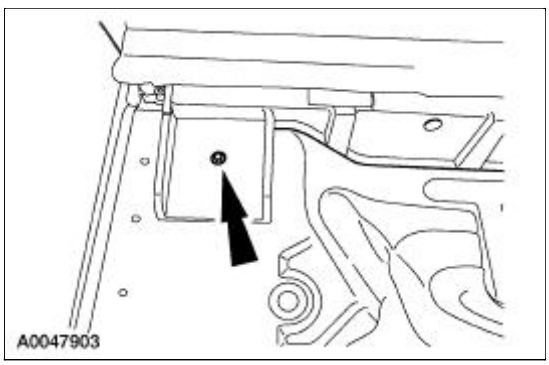
3. Remove the load floor panel latch striker bolts and latch.



4. Remove the three pin-type retainers (one shown) and the jack storage compartment liner.



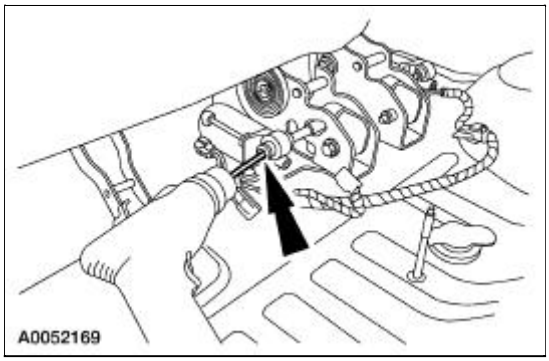
5. Remove the two bolts in mid-floor support (one shown).



6. Lift on the front of the mid-floor panel support to release the three retainer clips and remove the support panel.

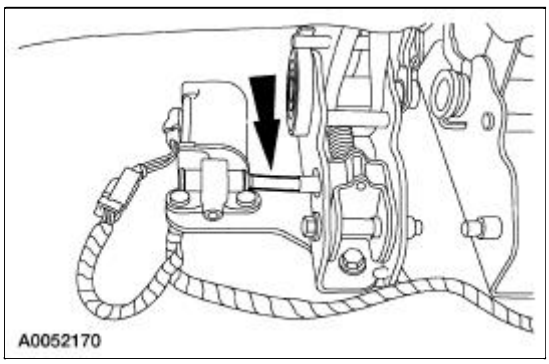
Vehicles with inoperative motor, backrest in down position

7. Using the drive cable supplied in the service kit, install the drive cable into a suitable tool and insert in the outboard side of the third row power seat motor. Raise the seat backrest.

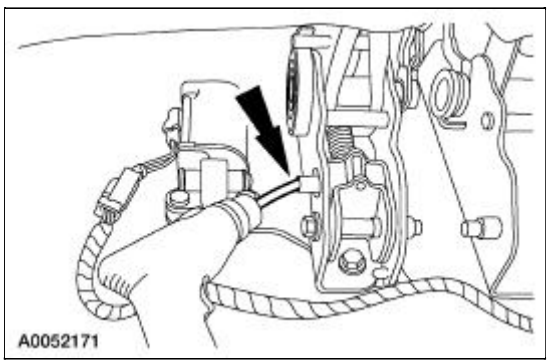


Vehicles with inoperative motor, backrest in down position and motor seized or drive cable damaged

8. Cut the power seat drive cable and discard the cut cable.



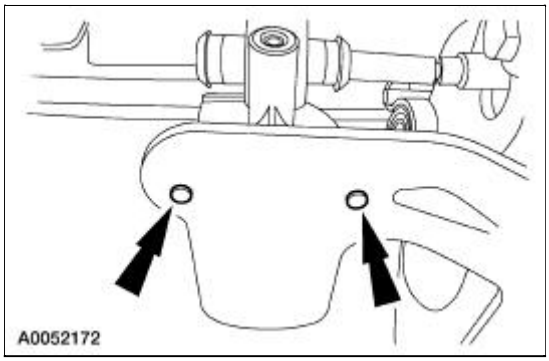
9. Using the drive cable supplied in the service kit, install the drive cable into a suitable tool and insert into the drive gear assembly. Raise the seat backrest.



All vehicles

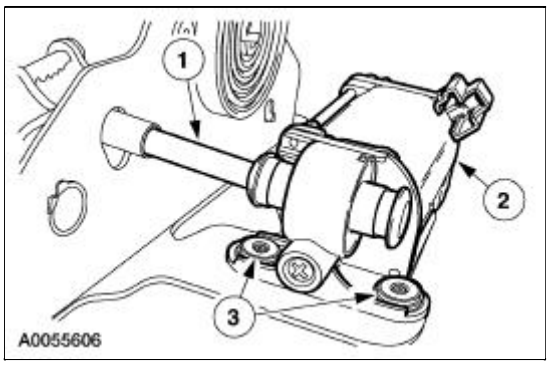
10. Remove the affected third row seat. For additional information, refer to Rear Seat—Third Row in this section.

11. Turn the affected seat over to expose the rivets on the bottom of the seat. Grind off the bottom of the rivets, or drill and punch out the rivets. Remove the power-fold seat motor.

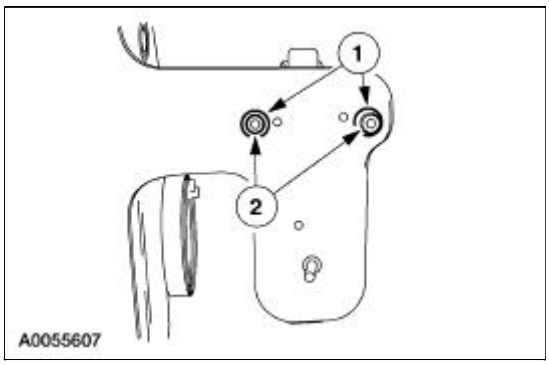


Installation

1. Install the power fold motor.
    1. Align and install the drive cable and sleeve.
    2. Align and install the power fold motor.
    3. Install the sleeved nuts.



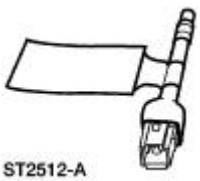
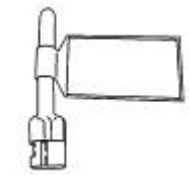
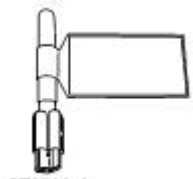
2. Install the power fold motor bolts.
    1. Install the two washers on the two bolts.
    2. Install the bolts and tighten.



3. Install the affected third row seat. For additional information, refer to Rear Seat—Third Row in this section.

Front Seat Cushion —40 Percent

Special Tool(s)

 ST2512-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F403
 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395 (014-R1079)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F088 (105-00012)

Disassembly

WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe pretensioner electrical connectors. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

All vehicles

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

The second row side impact sensors (if equipped) are located at or near the base of the C-pillars.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

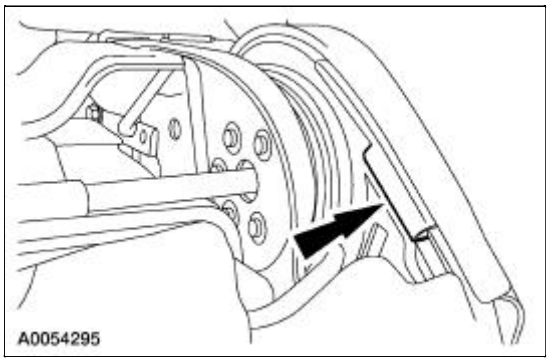
   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

3. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the front seat removal and installation procedure.**

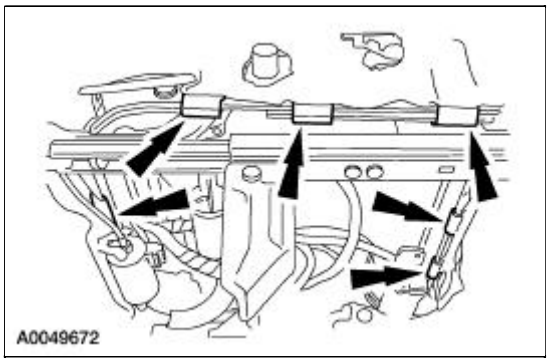
   Remove the 40 percent seat. For additional information, refer to Front Seat—40 Percent in this section.

4. Remove the side shield. For additional information, refer to Seat Control Switch—8-Way or Seat Control Switch—6-Way in this section.

5. Release the J-clips on the pivot covers (inboard shown, outboard similar).



6. Release the J-clips (six shown).



7. **CAUTION: Use care when separating the seat cushion trim cover from the hook-**

and-loop strip, or the hook-and-loop strip can be torn from the seat cushion.

Remove the seat cushion cover.

8. Remove the seat cushion foam pad.

Vehicles with power seats

9. Remove the power seat motors. For additional information, refer to Front Seat Track Motor in this section.

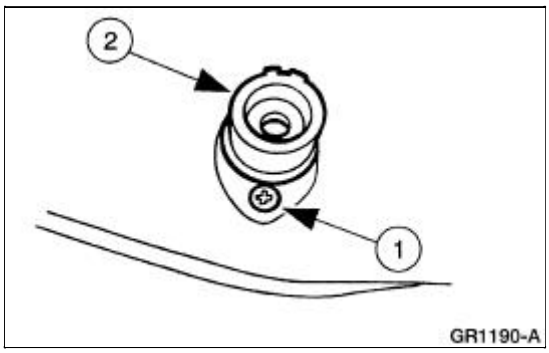
10. Remove the power seat tracks. For additional information, refer to Seat Track—Power in this section.

Vehicles with manual seat

11. Remove the manual seat track. For additional information, refer to Seat Track—Manual in this section.

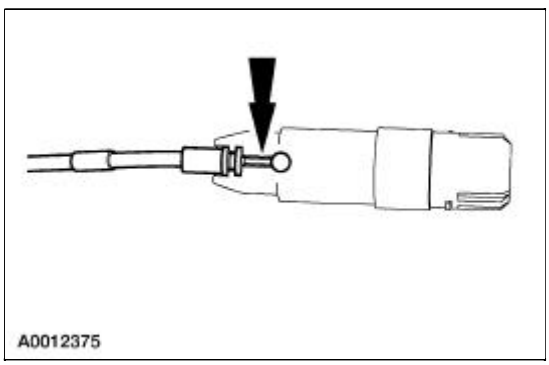
Vehicles with manual lumbar

12. Remove the front seat back lumbar adjuster.
    1. Remove the two screws.
    2. Remove the front seat back lumbar adjuster.



13. **NOTE:** The lumbar support assembly must be fully relaxed.

    Separate the lumbar support adjuster from the adjuster cable.

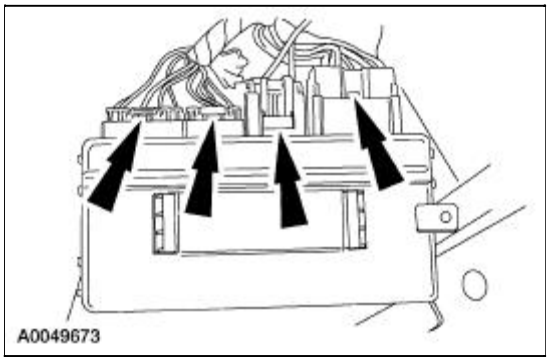


Vehicles with memory seats

14. Slide the memory seat module from the seat frame bracket.

15. Disconnect the memory seat module electrical connectors and remove the memory seat

module.



Vehicles with climate controlled seats

16. Remove the seat fan motor. For additional information, refer to Seat Fan Motor in this section.
17. Remove the climate controlled seat module. For additional information, refer to Climate Controlled Seat Module in this section.
18. Remove the seat cushion thermo-electric device. For additional information, refer to Seat Cushion Thermo-Electric Device in this section.
19. Remove the climate controlled seat cushion ducts.
20. Unclip and remove the TED mounting bezel

Assembly

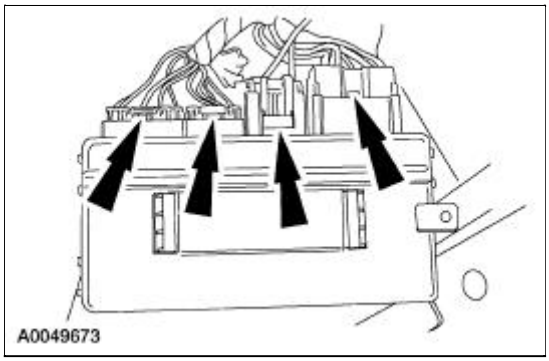
WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the removal procedure.

Vehicles with climate controlled seats

1. Clip the TED mounting bezel to the seat cushion support.
2. Install the climate controlled seat cushion ducts.
3. Install the seat cushion thermo-electric device. For additional information, refer to Seat Cushion Thermo-Electric Device in this section.
4. Install the climate controlled seat module. For additional information, refer to Climate Controlled Seat Module in this section.
5. Install the seat fan motor. For additional information, refer to Seat Fan Motor in this section.

Vehicles with memory seats

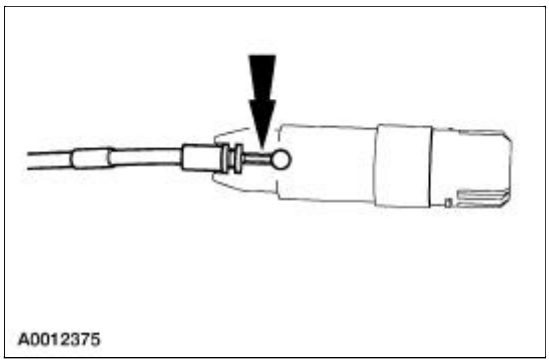
6. Connect the memory seat module electrical connectors and install the memory seat module.



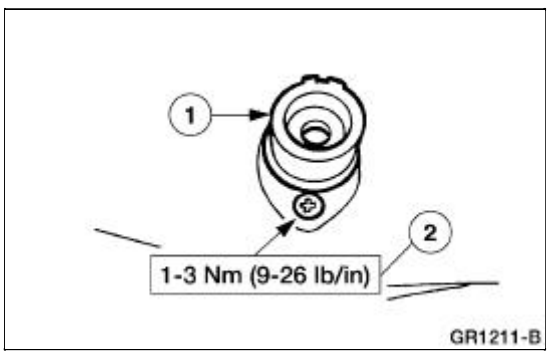
7. Slide the memory seat module onto the seat frame bracket.

Vehicles with manual lumbar

8. Connect the lumbar support adjuster from the adjuster cable.



9. Install the front seat back lumbar adjuster.
    1. Install the front seat back lumbar adjuster.
    2. Install the two screws.



Vehicles with manual seat

10. Install the manual seat track. For additional information, refer to Seat Track—Manual in this section.

Vehicles with power seats

11. Install the power seat tracks. For additional information, refer to Seat Track—Power in this section.

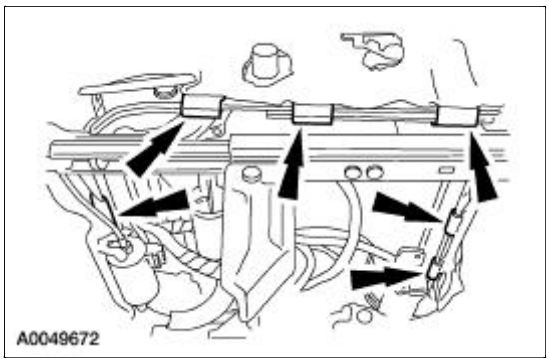
12. Install the power seat motors. For additional information, refer to Front Seat Track Motor in this section.

All vehicles

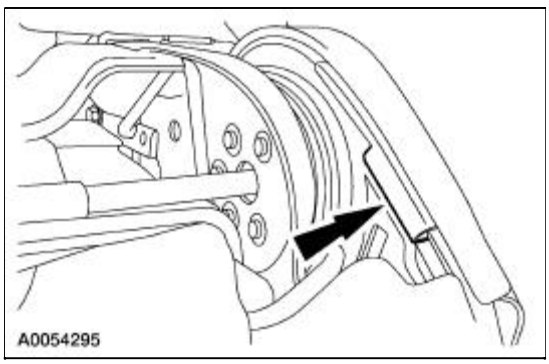
13. Install the seat cushion foam pad.

14. Install the seat cushion cover.

15. Attach the J-clips (six shown).



16. Install the J-clips on the pivot covers (inboard shown, outboard similar).



17. Install the side shield. For additional information, refer to Seat Control Switch—8-Way or Seat Control Switch—6-Way in this section.

18. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the front seat removal and installation procedure.**

    Install the 40 percent seat. For additional information, refer to Front Seat—40 Percent in this section.

19. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

    Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation .

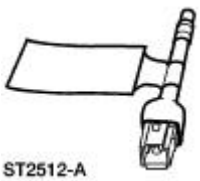
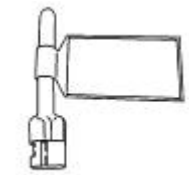
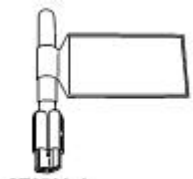
20. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

    With all the restraint system diagnostic tools removed, prove out the supplemental restraint

system (SRS). For additional information, refer to Section 501-20B .

Front Seat Cushion —60 Percent

Special Tool(s)

 ST2512-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F403
 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395 (014-R1079)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F088 (105-00012)

Disassembly

WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe pretensioner electrical connectors. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

   The second row side impact sensors (if equipped) are located at or near the base of the

C-pillars.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

NOTE: Before disconnecting the battery in vehicles with power seats, adjust the seat position to allow for access to the necessary components.

Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

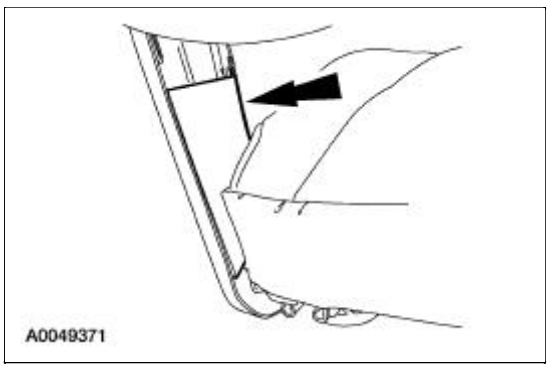
2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

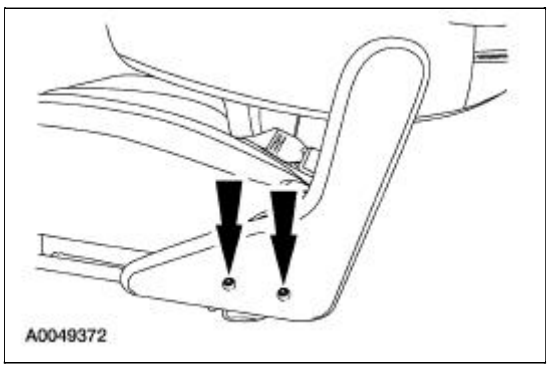
3. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the seat removal and installation procedure.**

   Remove the 60 percent seat backrest. For additional information, refer to Front Seat Backrest—60 Percent in this section.

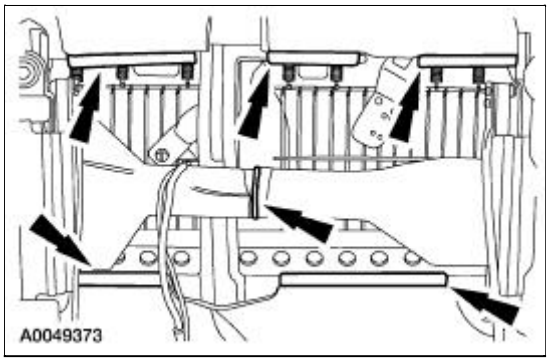
4. Remove the inner side shield.



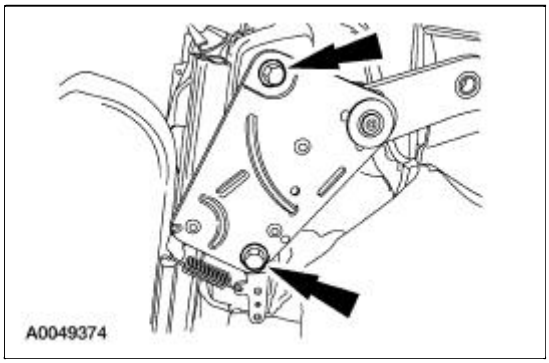
5. Remove the two side shield screws.



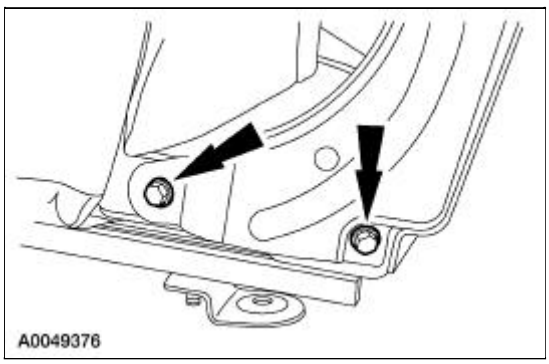
6. Release the front seat cushion cover J-clips.



7. Remove the two recliner bolts.



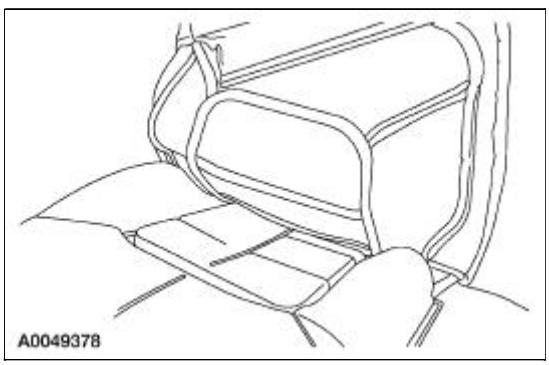
8. Remove the bolts.



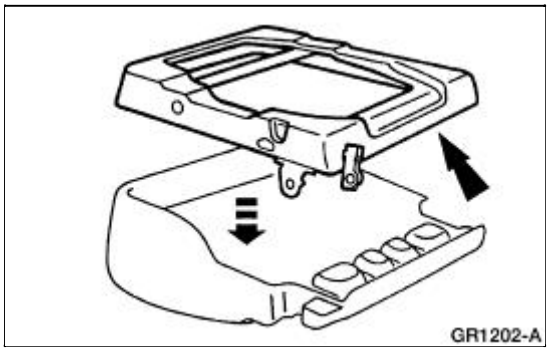
9. Remove the seat track. For additional information, refer to Seat Track—Manual in this section.

10. **CAUTION: Use care when separating the seat cushion trim cover from the hook-and-loop strip, or the hook-and-loop strip can be torn from the seat cushion foam.**

    Invert the seat cushion cover and remove from the cushion foam pad.



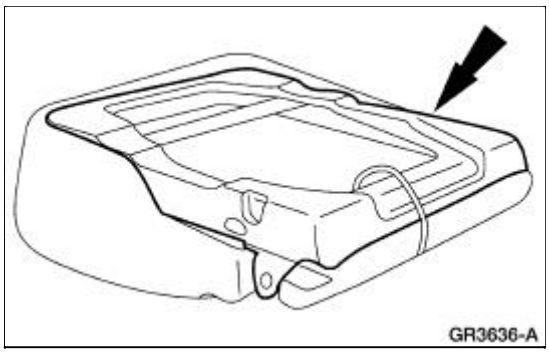
11. Remove the front seat cushion foam pad from the front seat cushion frame.



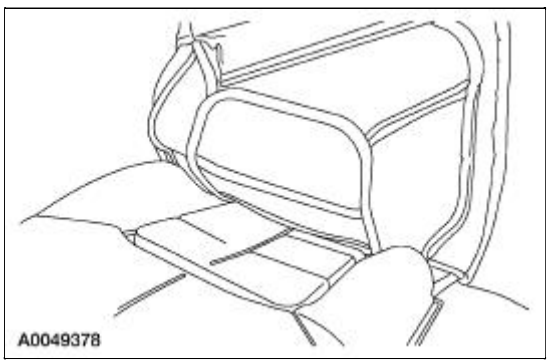
Assembly

WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the removal procedure.

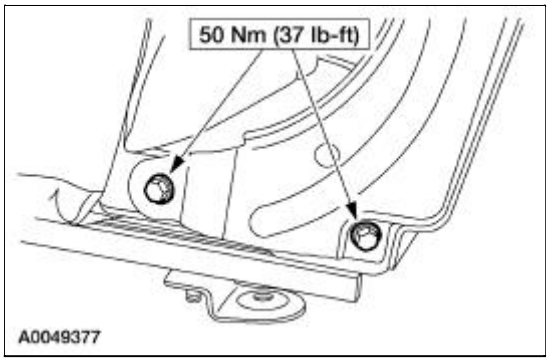
1. Insert the front seat cushion foam pad into the front seat cushion frame.



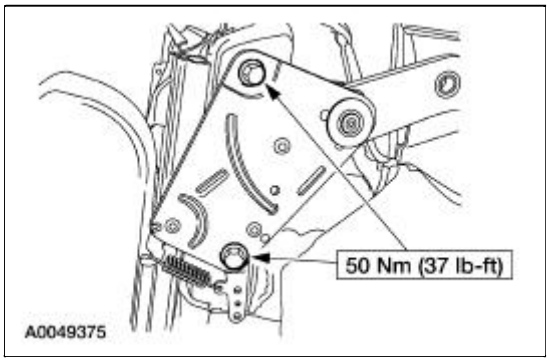
2. Install the seat cushion cover on the seat cushion foam pad.



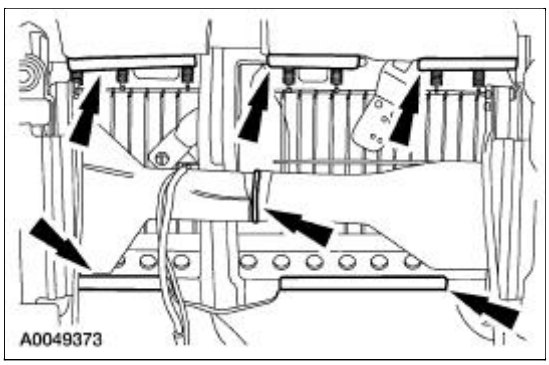
3. Install the seat track. For additional information, refer to Seat Track—Manual in this section.
4. Install the bolts.



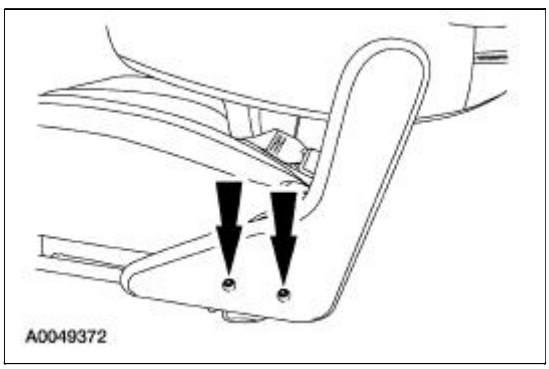
5. Install the recliner bolts.



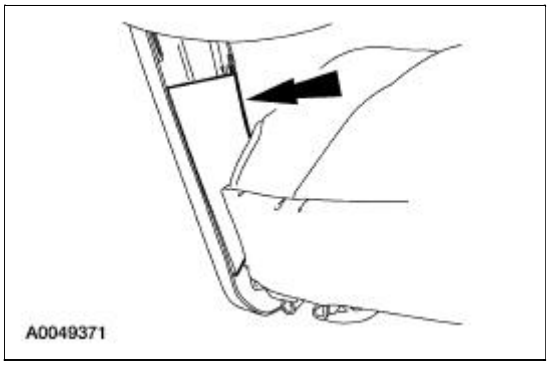
6. Fasten the seat cushion cover J-clips.



7. Install the two screws in the side shield.



8. Install the inner side shield.



9. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the seat removal and installation procedure.**

   Install the 60 percent seat backrest. for additional information, refer to Front Seat Backrest—60 Percent in this section.

10. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

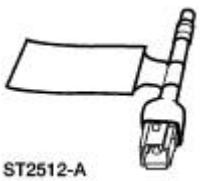
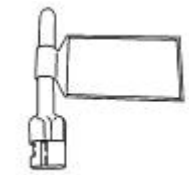
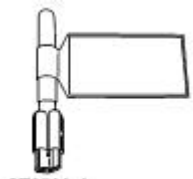
    Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation .

11. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

    With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .

Front Seat Backrest —40 Percent

Special Tool(s)

 ST2512-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F403
 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395 (014-R1079)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F088 (105-00012)

Disassembly

WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe pretensioner electrical connectors. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

All vehicles

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

The second row side impact sensors (if equipped) are located at or near the base of the C-pillars.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

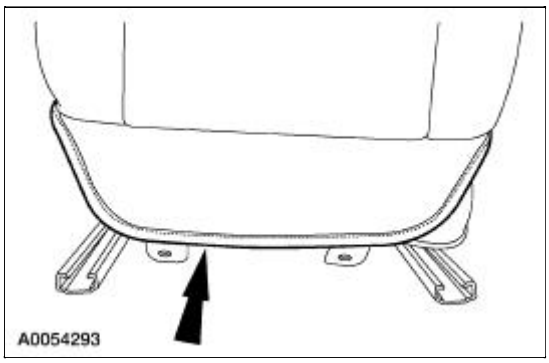
2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

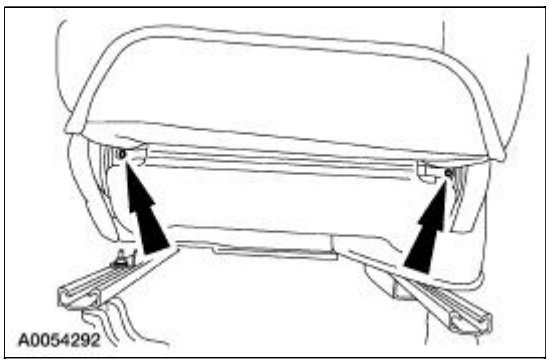
3. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the front seat removal and installation procedure.**

   Remove the 40 percent seat. For additional information, refer to Front Seat—40 Percent in this section.

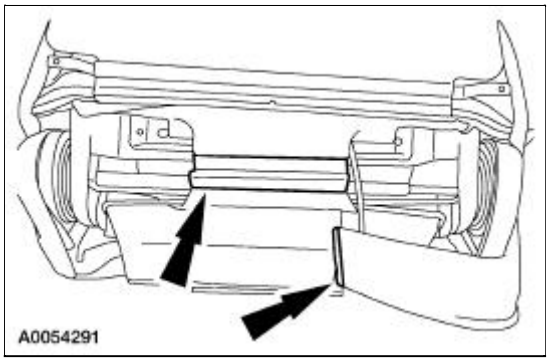
4. Remove lower seat backrest cover.



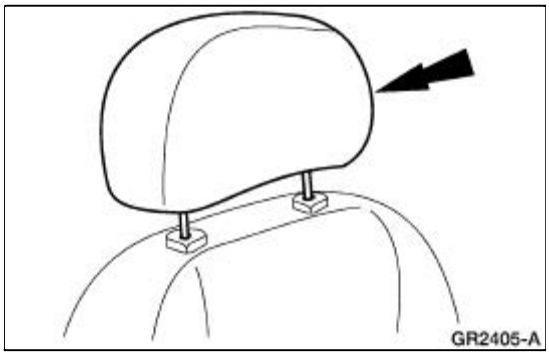
5. Remove the two screws from the support rod.



6. Release the one hook-and-loop strip and the one J-clip.

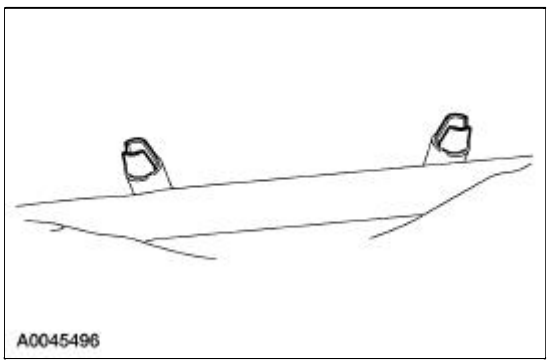


7. Depress tab and remove the head restraint.



8. **NOTE:** The head restraint sleeve pins are not interchangeable. Note location for installation.

   Reach up into seat backrest and squeeze the head restraint sleeve ends together to release the sleeves and pull the head restraint sleeves out.



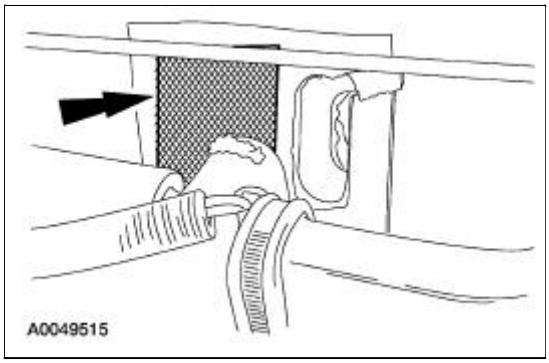
9. **CAUTION: Use care when separating the seat backrest trim cover from the hook-and-loop strip, or the hook-and-loop strip can be torn from the seat backrest foam.**

   Invert the seat backrest trim cover and remove.

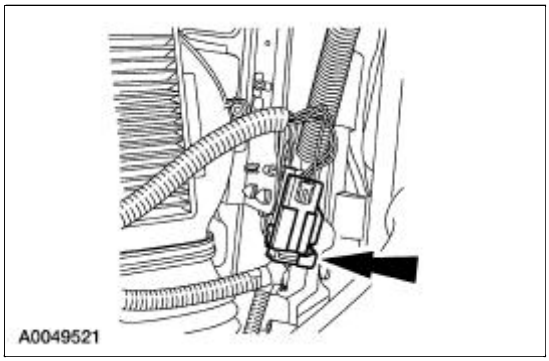
Vehicles with temperature controlled seats

10. **CAUTION: Use care when removing the seat backrest foam pad from the frame. The foam pad has hook and loop fasteners holding the thermo-electric device (TED) to the seat backrest foam pad.**

    Remove the seat backrest foam pad from the thermo-electric device (TED).



11. Disconnect the seat backrest TED electrical connector.



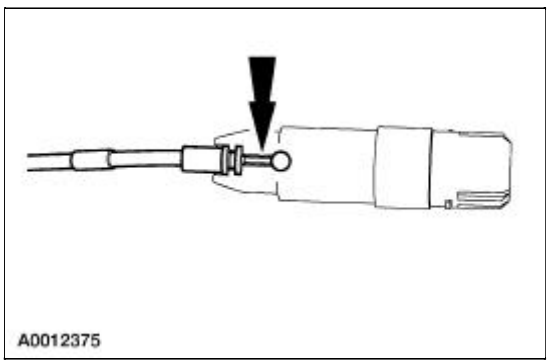
All vehicles

12. Remove the seat backrest foam pad from the frame.

Vehicles with manual lumbar

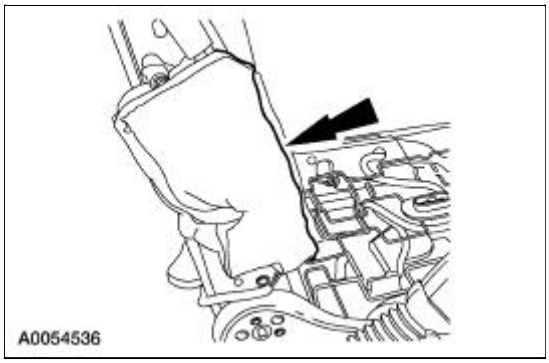
13. **NOTE:** The lumbar support assembly must be fully relaxed.

    Separate the adjuster cable from the lumbar support adjuster.

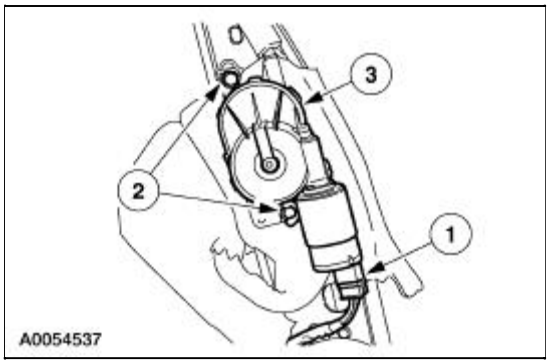


Vehicles with power lumbar

14. Remove the staples and open dampening bag.

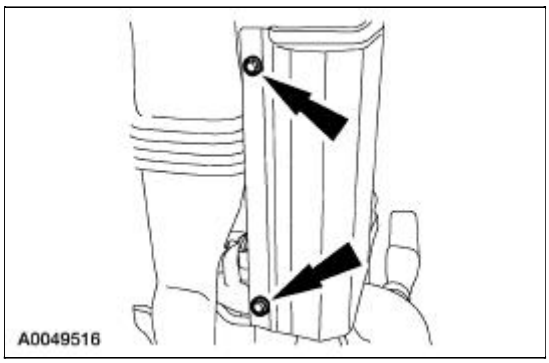


15. Remove the power lumbar support motor.
    1. Disconnect the power lumbar motor electrical connector.
    2. Remove the screws.
    3. Remove the power lumbar support motor.

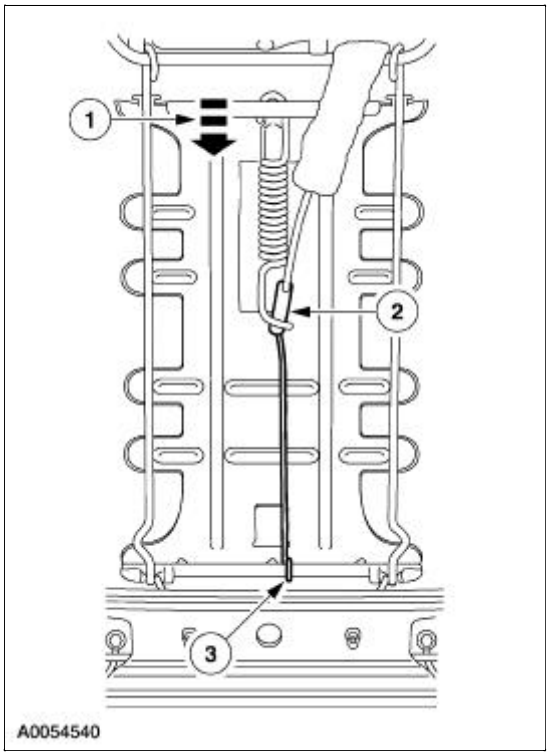


All vehicles

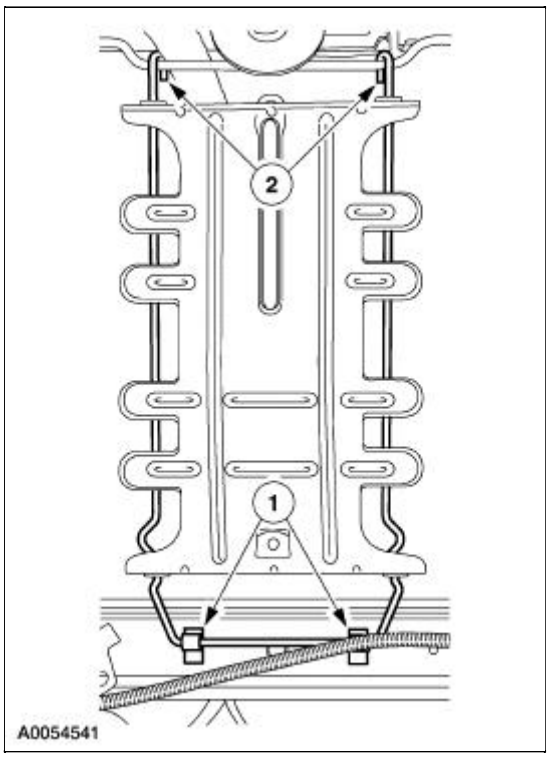
16. Remove the screws from the two support covers (one side shown) and remove support covers (two shown).



17. Remove the lumbar motor cable from the lumbar support.
    1. Flex the lumbar support.
    2. Separate the lumbar support adjusting cable from the positioning spring.
    3. Unhook the lumbar support adjusting cable from the lumbar support.

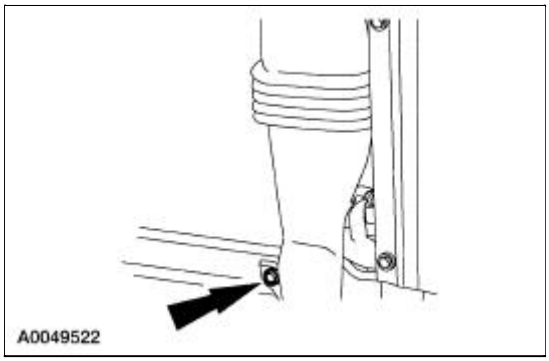


18. Remove the lumbar support.
    1. Remove the pin-type retainers.
    2. Unhook the upper lumbar support bracket.

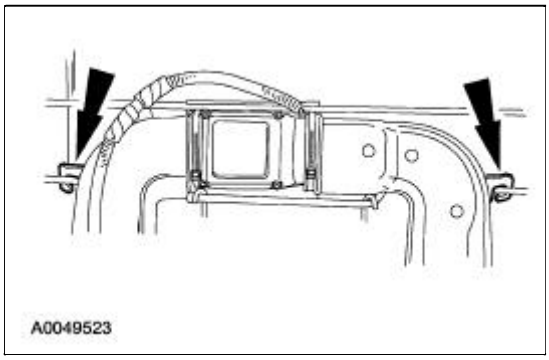


Vehicles with temperature controlled seats

19. Remove the screw at bottom of the two TED ducts (one shown).

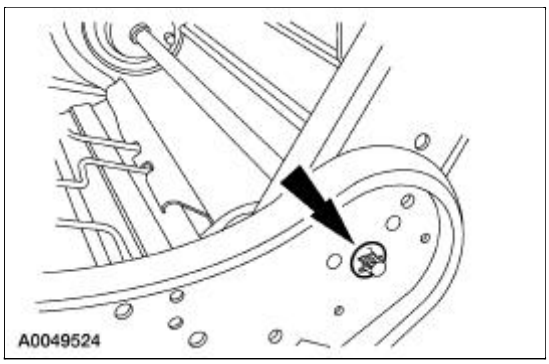


20. Unhook the TED and ducts from support rod.

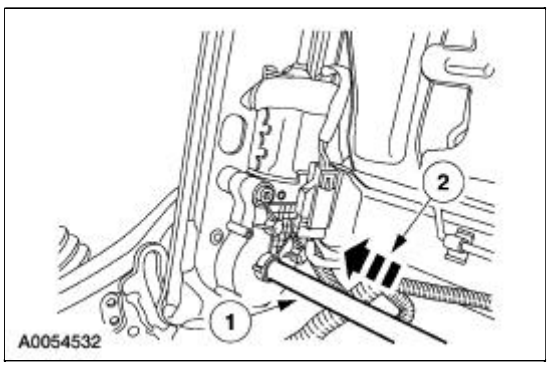


Vehicles with power recliner

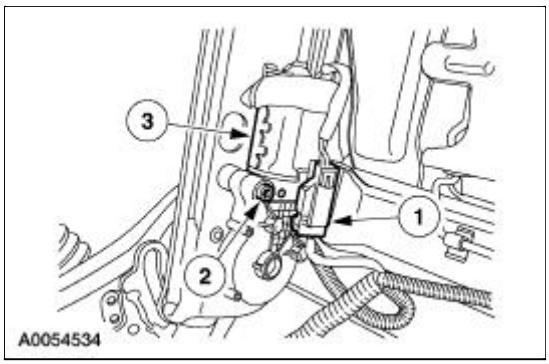
21. Remove the retainer clip on the end of power recliner motor shaft.



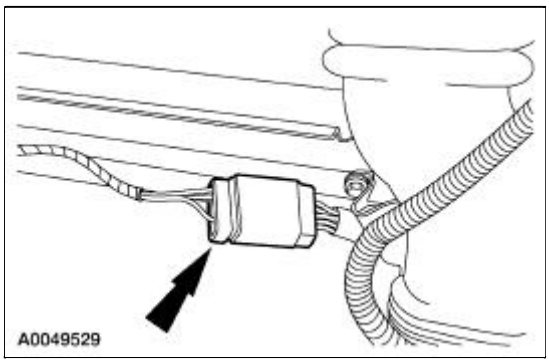
22. Remove the power recliner motor shaft.
    1. Remove the power recliner motor shaft cover.
    2. Slide the power recliner motor shaft out from the power recliner motor.



23. Remove power recliner motor.
    1. Disconnect the power recliner motor electrical connector.
    2. Remove the power recliner motor bolt.
    3. Remove the power recliner motor.

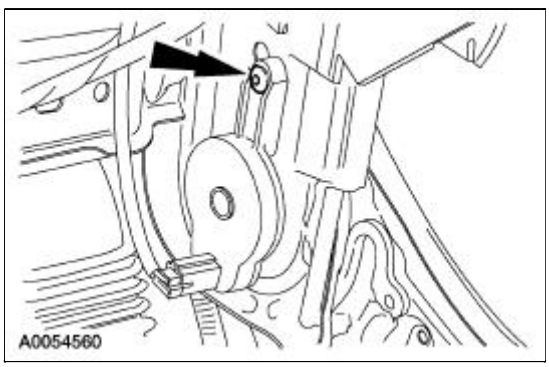


24. Disconnect the power recliner position sensor electrical connector.



25. **CAUTION: Make sure to remove all the rivet metal chips from sensor and surrounding areas.**

    Remove the rivet and remove the power recliner position sensor.



Assembly

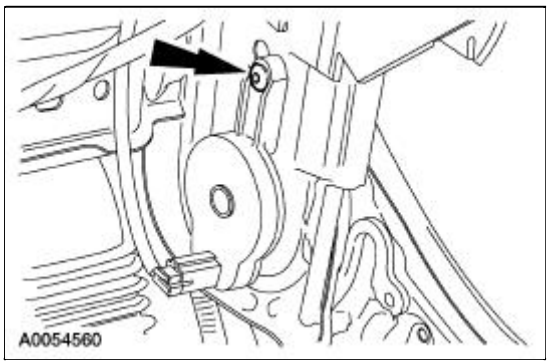
WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the removal procedure.

Vehicles with power recliner

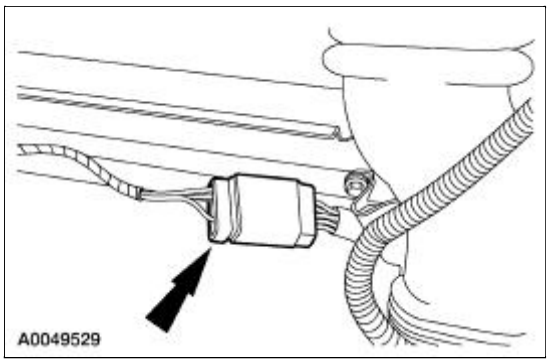
1. **CAUTION: Make sure to remove all the rivet metal chips from sensor and**

surrounding areas.

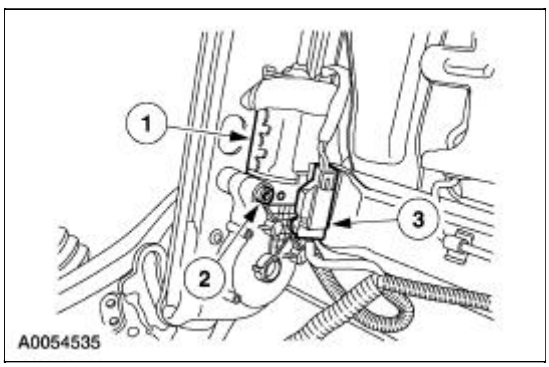
Install the power recliner position sensor and install the rivet.



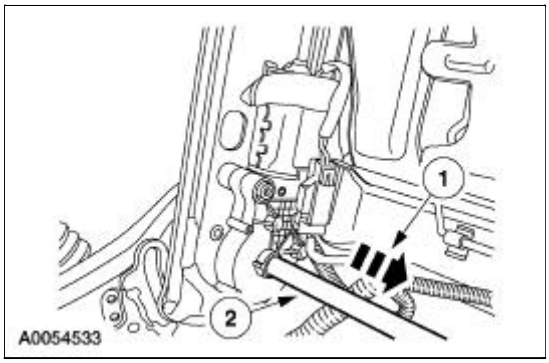
2. Connect the power recliner position sensor electrical connector.



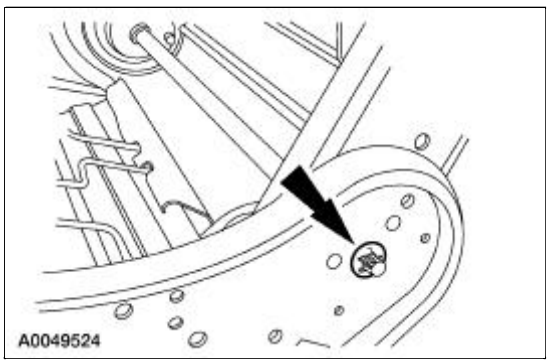
3. Install the power recliner motor.
    1. Install the power recliner motor.
    2. Install the power recliner motor bolt.
    3. Connect the power recliner motor electrical connector.



4. Install the power recliner shaft.
    1. Slide the power recliner shaft into the motor and through the seat.
    2. Install the power recliner shaft cover.

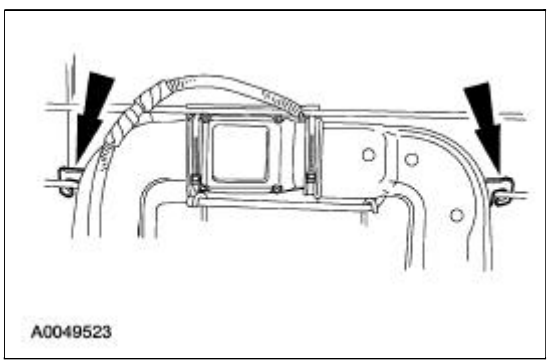


5. Install the retainer clip on end of power recliner shaft.

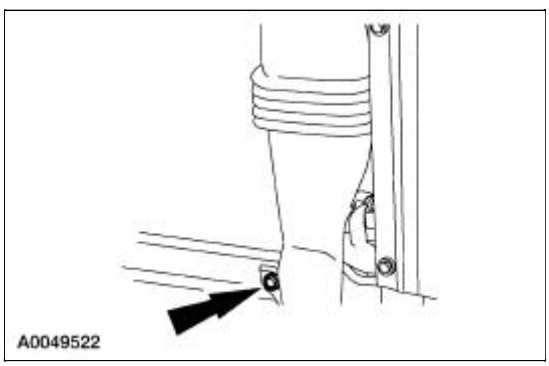


Vehicles with temperature controlled seats

6. Install the TED and ducts on support rod.

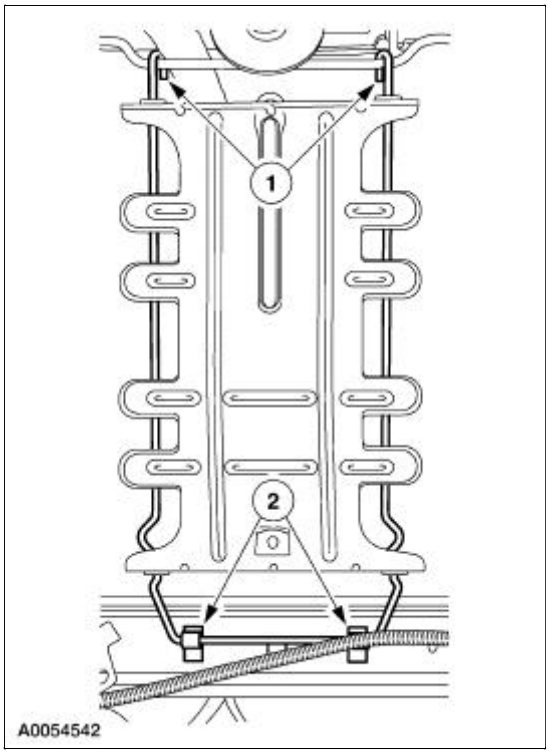


7. Install the screw at the bottom of the two TED ducts (one shown).



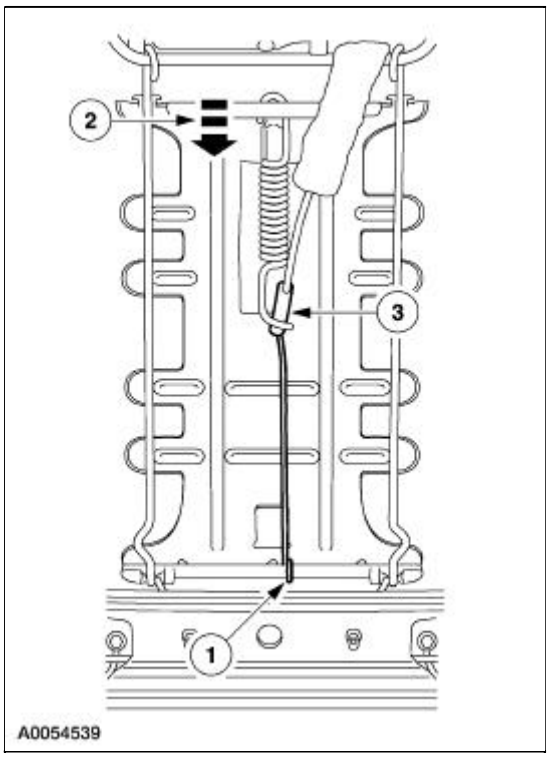
All vehicles

8. Install the lumbar support.
    1. Hook the upper lumbar support bracket.
    2. Install the pin-type retainers.



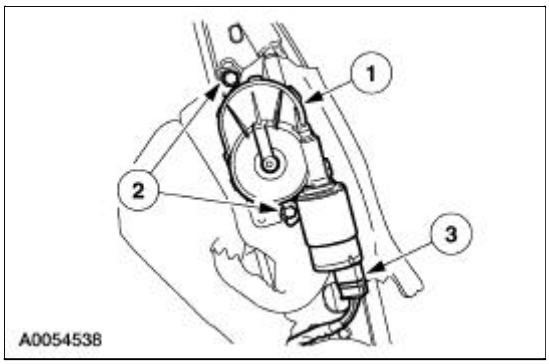
9. **NOTE:** The lumbar support assembly must be fully relaxed.

    Install the lumbar motor cable to the lumbar support.
    1. Hook the lumbar support adjusting cable to the lumbar support.
    2. Flex the lumbar support.
    3. Install the lumbar support adjusting cable to the positioning spring.

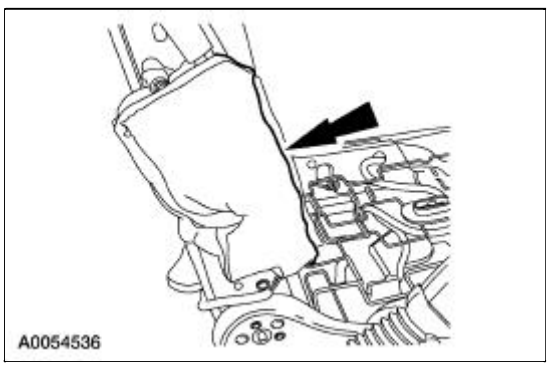


Vehicles with power lumbar

10. Install the power lumbar support motor.
    1. Install the power lumbar support motor.
    2. Install the screws.
    3. Connect the power lumbar electrical connector.



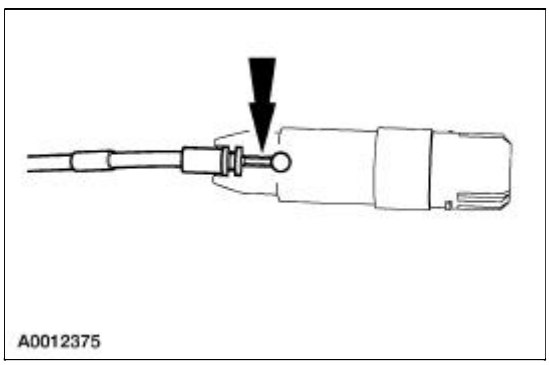
11. Close the dampening bag and staple.



Vehicles with manual lumbar

12. **NOTE:** The lumbar support assembly must be fully relaxed.

    Install the adjuster cable to the lumbar support adjuster.

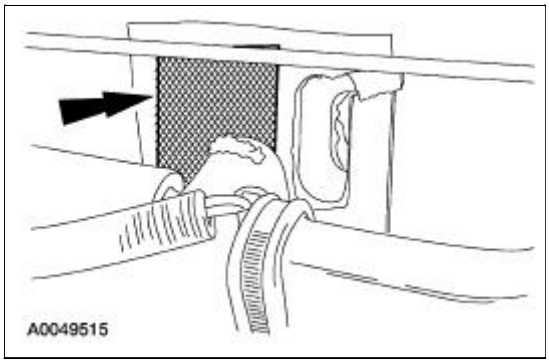


All vehicles

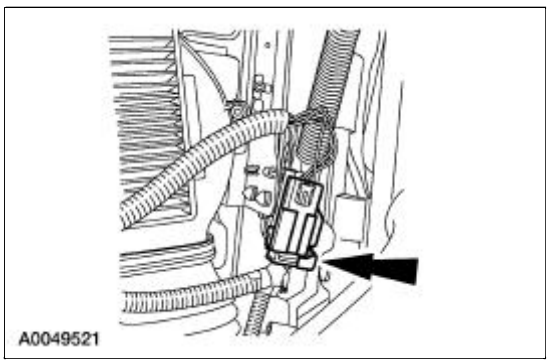
13. Install the seat backrest foam pad.

Vehicles with temperature controlled seats

14. Attach the seat backrest TED to the foam pad

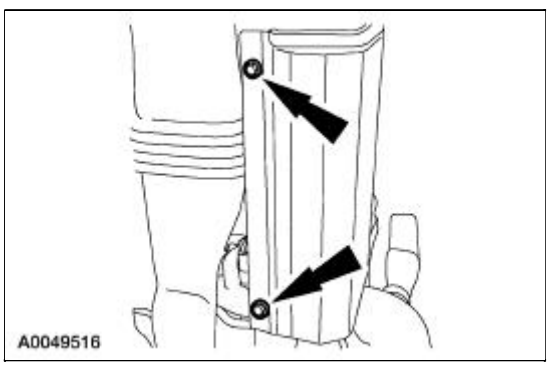


15. Connect the seat backrest TED electrical connector.



All vehicles

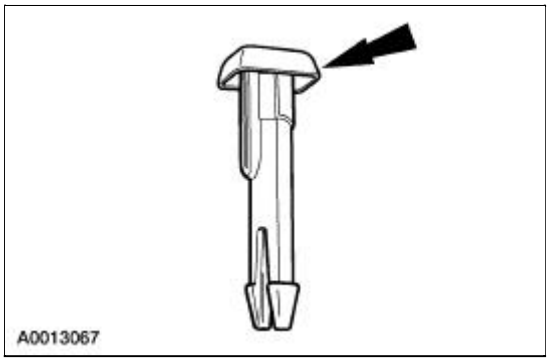
16. Install the two support covers and install the screws for the support covers (one side shown).



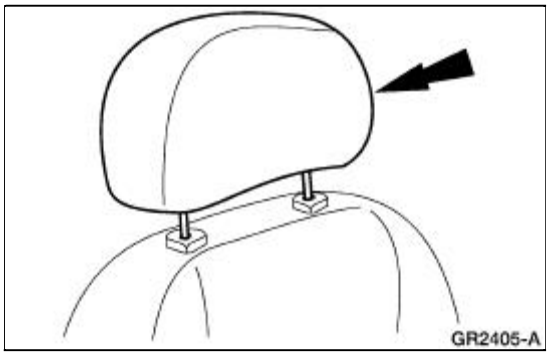
17. Install the seat backrest trim cover and attach the hook-and-loop fasteners.

18. **NOTE:** The head restraint sleeve pins are not interchangeable.

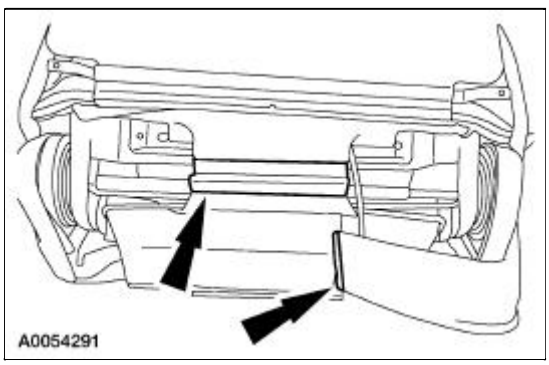
    Install the head restraint sleeves.



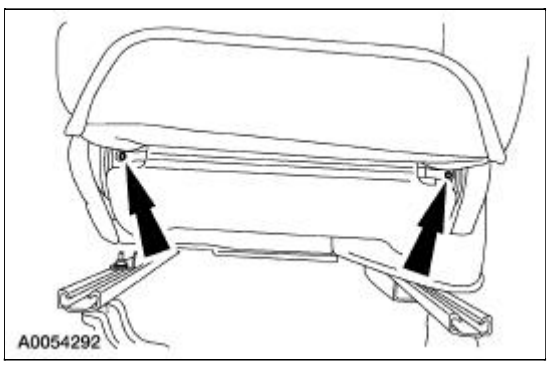
19. Install the head restraint.



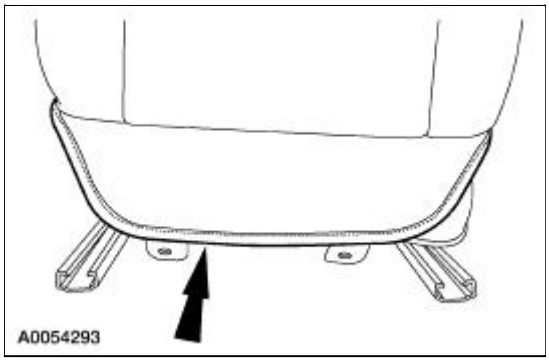
20. Connect the one hook-and-loop strip and the one J-clip.



21. Install the two screws in the support rod.



22. Install the lower backrest cover.



23. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the front seat removal and installation procedure.**

    Install the 40 percent seat. For additional information, refer to Front Seat—40 Percent in this section.

24. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

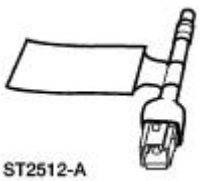
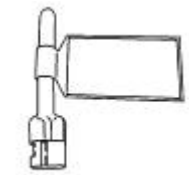
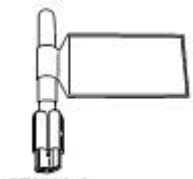
    Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation .

25. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

    With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .

Front Seat Backrest —60 Percent

Special Tool(s)

 ST2512-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F403
 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395 (014-R1079)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F088 (105-00012)

Disassembly

WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe pretensioner electrical connectors. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

   The second row side impact sensors (if equipped) are located at or near the base of the

C-pillars.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

NOTE: Before disconnecting the battery in vehicles with power seats, adjust the seat position to allow for access to the necessary components.

Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

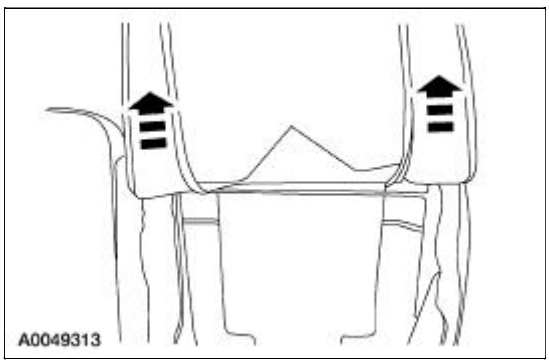
   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

3. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the seat removal and installation procedure.**

   Remove the 60 percent seat backrest. For additional information, refer to Front Seat Backrest—60 Percent in this section.

4. **CAUTION: Use care when separating the seat backrest covering from the hook-and-loop fasteners to avoid tearing the fastener off the seat foam.**

   Invert the seat backrest trim cover and remove.

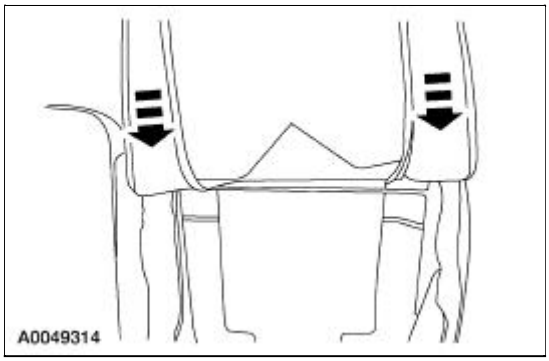


5. Remove the seat backrest foam pad.

Assembly

WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the disassembly procedure.

1. Install the seat backrest foam pad.
2. Install the seat backrest trim cover.



3. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the seat removal and installation procedure.**

   Install the 60 percent seat backrest. For additional information, refer to Front Seat Backrest—60 Percent in this section.

4. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation .

5. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

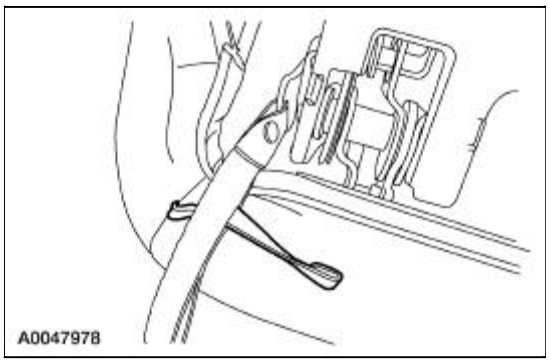
   With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .

Rear Seat Cushion —Second Row, 40 Percent

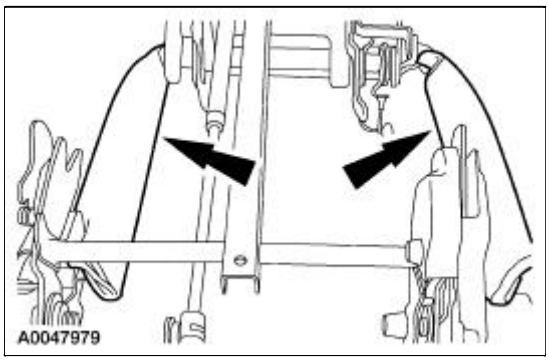
Disassembly and Assembly

1. Remove the 40 percent seat backrest. For additional information, refer to Rear Seat Backrest—Second Row, 40 Percent in this section.

2. Unsnap the pull strap retainer.



3. Release the four J-clips (two shown).

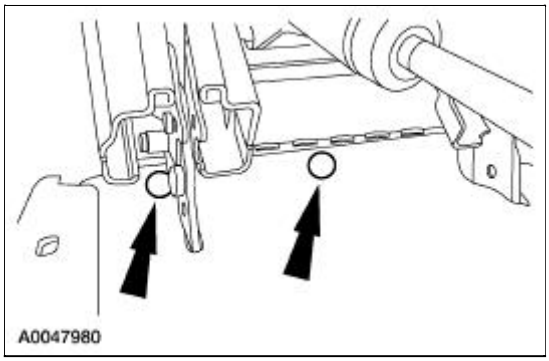


4. Remove the seat cushion cover and cushion foam pad from the seat cushion frame.

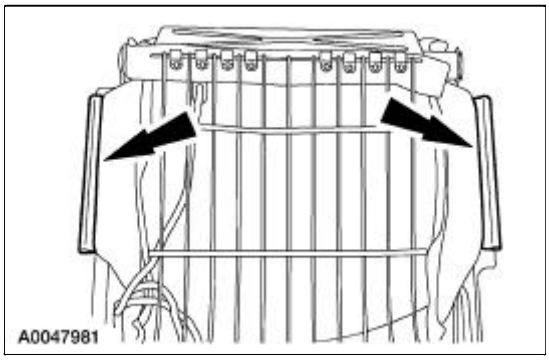
5. **CAUTION: Use care when separating the seat cushion trim cover from the hook-and-loop strip, or the hook-and-loop strip can be torn from the seat cushion foam.**

   Remove the seat cushion cover from the seat cushion foam pad.

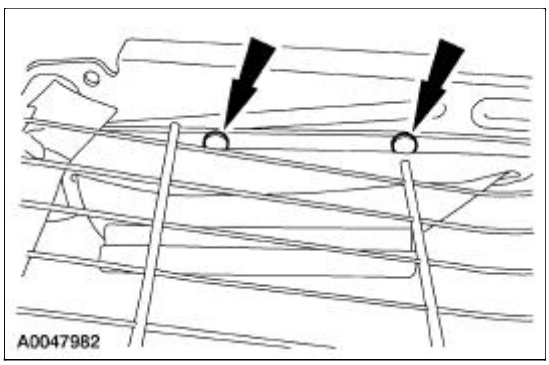
6. Remove the three pin-type retainers from the seat bottom cover (two shown).



7. Release the two J-clips for the bottom cover.

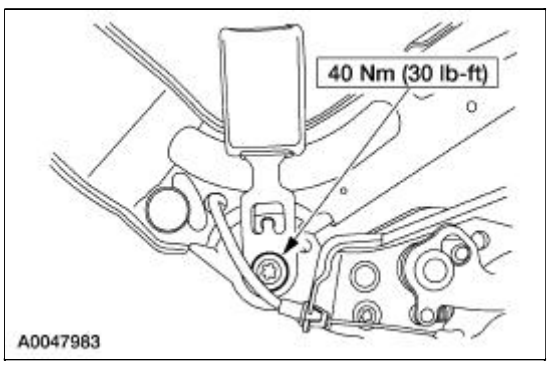


8. Remove the four pin-type retainers from the sides of bottom cover (two shown).



9. Remove the bottom cover.

10. Remove the seat belt buckle bolt and remove the seat belt buckle.
    - To aid installation, note the location of locating tab.



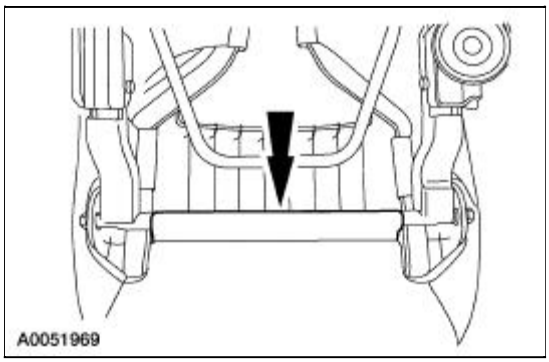
11. To assemble, reverse the disassembly procedure.

Rear Seat Cushion —Second Row, 20 Percent

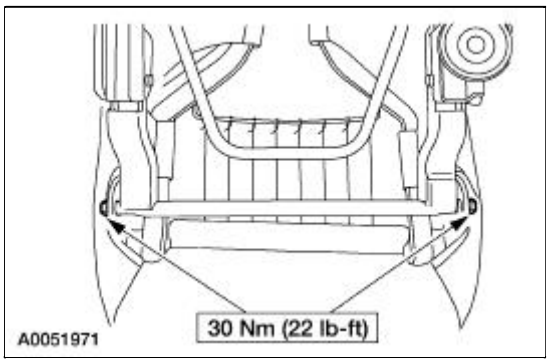
Disassembly and Assembly

1. Remove the 20 percent seat backrest. For additional information, refer to Rear Seat Backrest—Second Row, 20 Percent in this section.

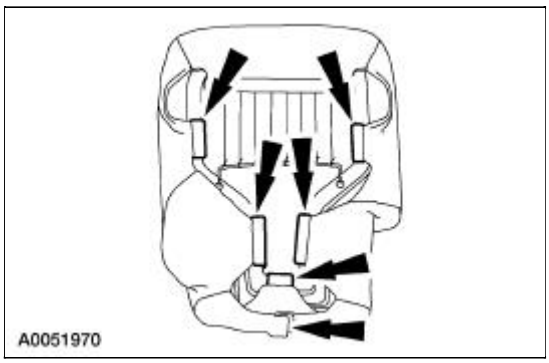
2. Release the J-clip.



3. Remove the two seat riser-to-cushion bolts.



4. Release the J-clips.



5. Remove the seat cushion frame from the foam pad.

6. **CAUTION: Use care when separating the seat cushion trim cover from the hook-and-loop strip, or the hook-and-loop strip can be torn from the seat cushion foam.**

Remove the seat cushion cover from the foam pad.

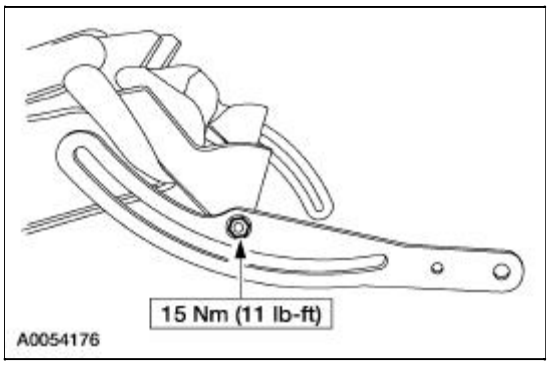
7. To assemble, reverse the disassembly procedure.

Rear Seat Cushion —Third Row, 40 Percent

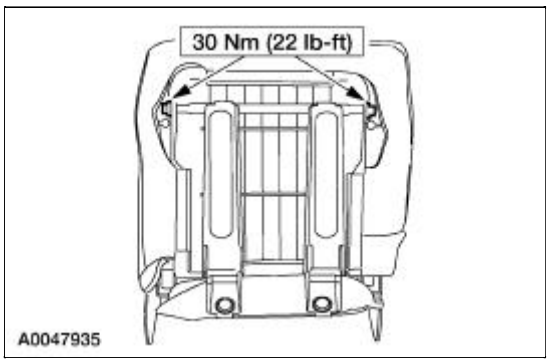
Disassembly and Assembly

1. Remove the third row 40 percent seat backrest. For additional information, refer to Rear Seat Backrest—Third Row, 40 Percent in this section.

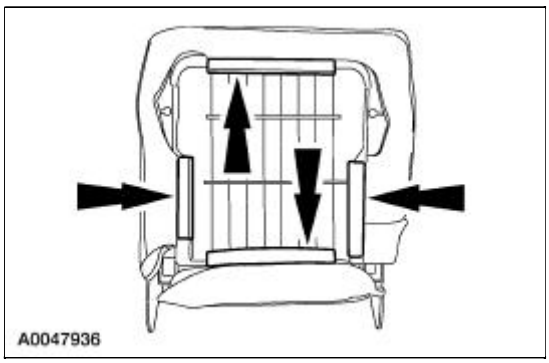
2. Remove the nut from slide bracket from both sides of the seat cushion.



3. Remove the bolts from seat riser to cushion.



4. Release the J-clips.



5. Remove the frame from the seat cushion foam.

6. **CAUTION: Use care when separating the seat cushion trim cover from the hook and loop strip, or the hook and loop strip can be torn from the seat cushion foam.**

Remove the cushion trim cover from the foam pad.

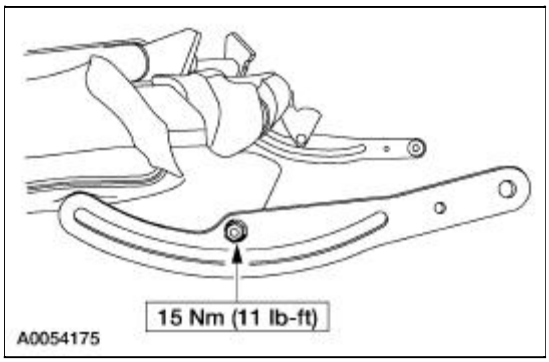
7. To assemble, reverse the disassembly procedure.

Rear Seat Cushion —Third Row, 60 Percent

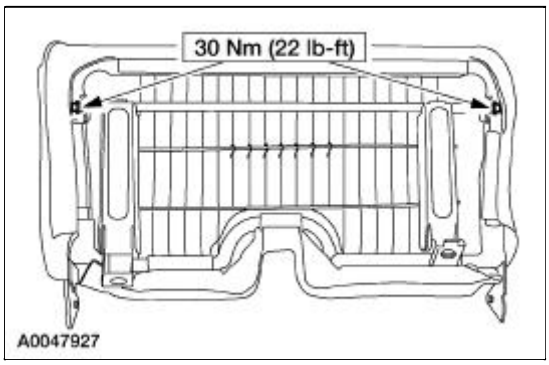
Disassembly and Assembly

1. Remove the third row 60 percent seat backrest. For additional information, refer to Rear Seat Backrest—Third Row, 60 Percent in this section.

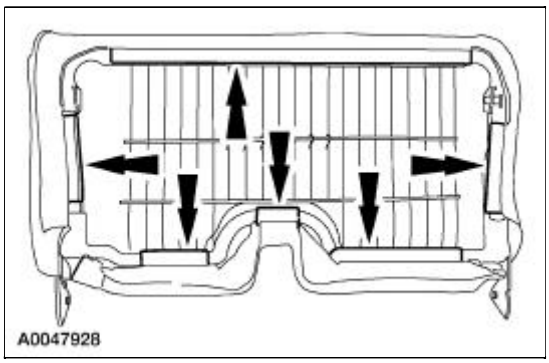
2. Remove the nut from the slide bracket on both sides of the seat cushion.



3. Remove the bolts from seat riser to cushion.



4. Release the J-clips.



5. Remove the frame from the seat cushion foam.

6. **CAUTION: Use care when separating the seat cushion trim cover from the hook-and-loop strip, or the hook-and-loop strip can be torn from the seat cushion foam.**

Remove the cushion trim cover from the foam pad.

7. To assemble, reverse the disassembly procedure.

Rear Seat Backrest —Second Row, 40 Percent

Disassembly and Assembly

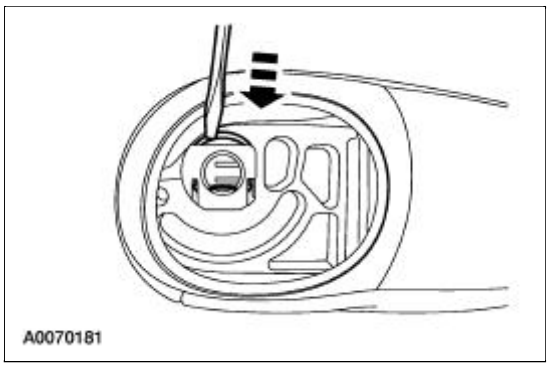
1. Remove the 40 percent seat backrest. For additional information, refer to Rear Seat Backrest—Second Row, 40 Percent in this section.

2. To access the armrest locking metal clip, pull the armrest material back on the top side of the armrest for access to the release clip.

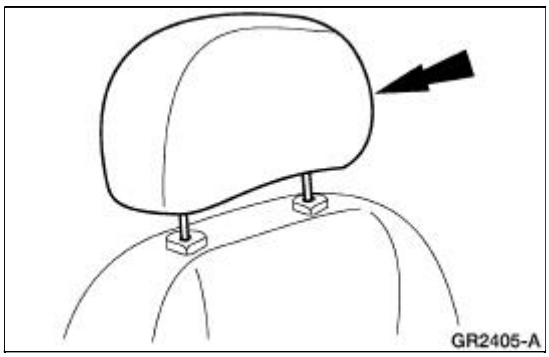
3. **CAUTION: To remove armrests, do not pull them off with force. The locking metal clip will be damaged and a new armrest will need to be installed.**

   NOTE: Armrest removed to show detail of release button mechanism.

   If equipped, use a tool such as a flat-bladed screwdriver to push the release button at the hinge point. The clip will release and the armrest will slide off the pin.

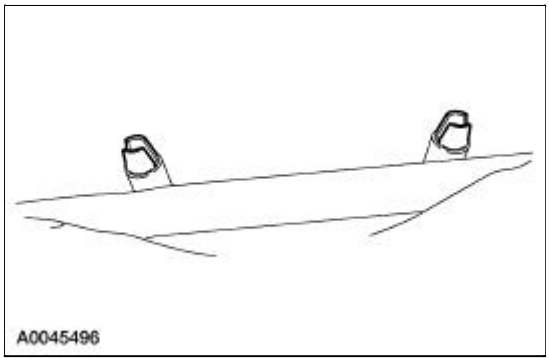


4. Depress the tab and remove the head restraint.



5. **NOTE:** The head restraint sleeve pins are not interchangeable, note location for installation.

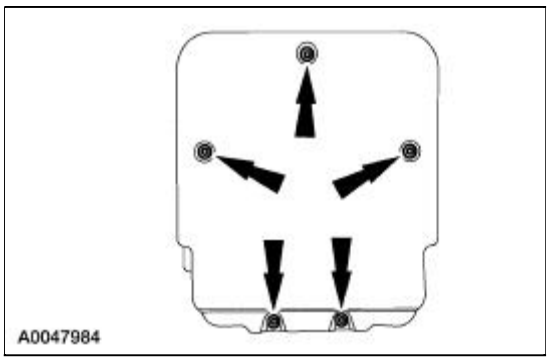
   Reach up into seat backrest and squeeze the head restraint sleeve ends together to release the sleeves and pull the head restraint sleeves out.



6. **CAUTION: Use care when separating the seat backrest trim cover from the hook-and-loop strip, or the hook-and-loop strip can be torn from the seat backrest foam.**

   Invert the seat backrest trim cover and remove.

7. Remove the screws from the rear seat backrest support panel.



8. **CAUTION: To install armrests, do not push them on with force. The locking metal clip will be damaged and a new armrest will need to be installed.**

   To assemble, reverse the disassembly procedure.

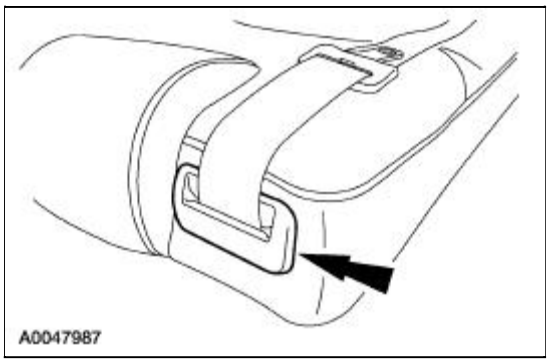
   - To install the armrest, push the release button and slide the armrest on the pin.

Rear Seat Backrest —Second Row, 20 Percent

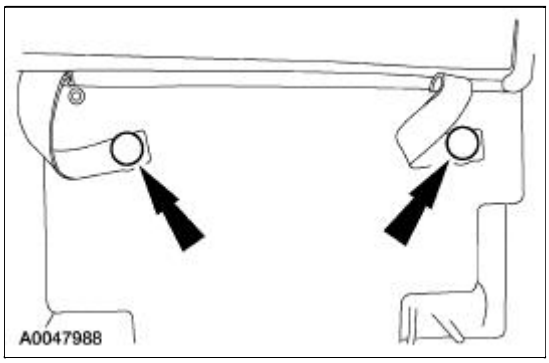
Disassembly and Assembly

1. Remove the 20 percent seat backrest. For additional information, refer to Rear Seat Backrest—Second Row, 20 Percent in this section.

2. Remove the seat belt guide cover.



3. Invert the seat backrest cover and remove the two pin-type retainers.

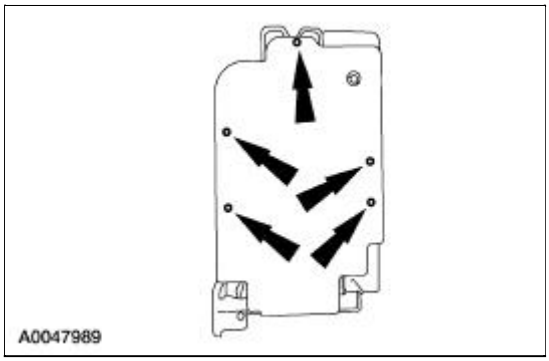


4. **CAUTION: Use care when separating the seat backrest trim cover from the hook-and-loop strip, or the hook-and-loop strip can be torn from the seat backrest foam.**

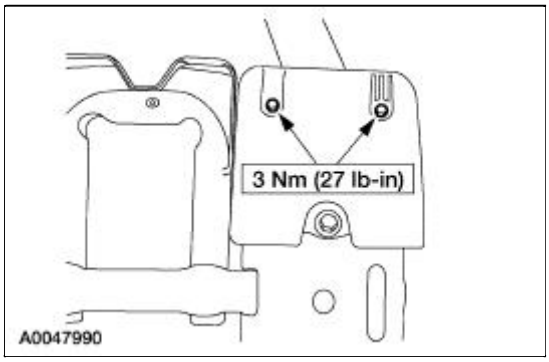
   Remove the seat backrest cover.

5. Remove the seat backrest foam pad.

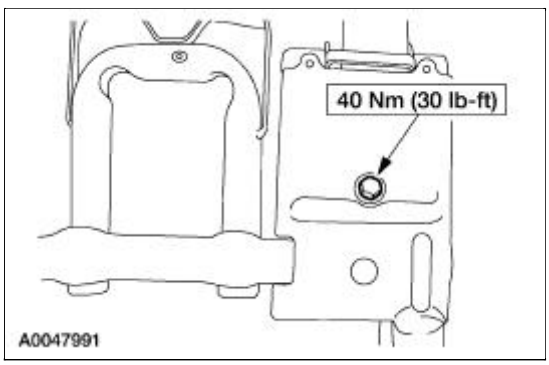
6. Remove the seat backrest support panel screws.



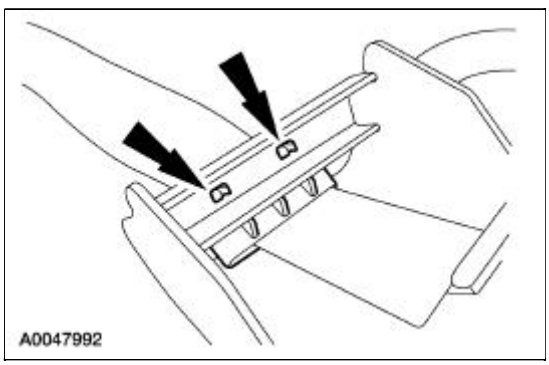
7. Remove the seat belt retractor cover screws and remove the cover.



8. Remove the seat belt retractor bolt.



9. Pinch and release the seat belt retractor guide from the seat backrest frame and remove the seat belt retractor.



10. To assemble, reverse the disassembly procedure.

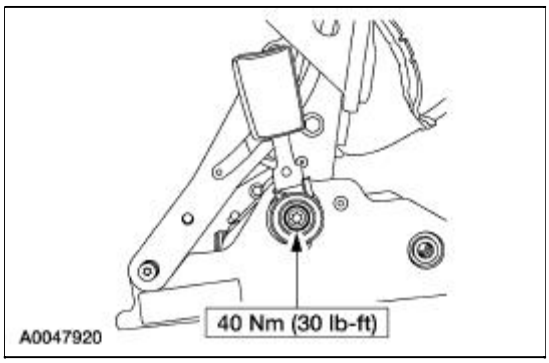
Rear Seat Backrest —Third Row, 40 Percent

Disassembly and Assembly

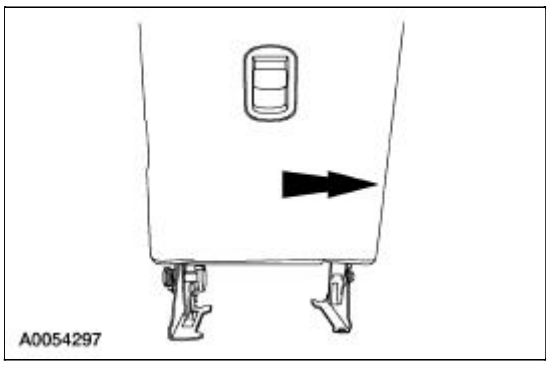
All vehicles

1. Remove the third row 40 percent seat backrest. For additional information, refer to Rear Seat Backrest—Third Row, 40 Percent in this section.

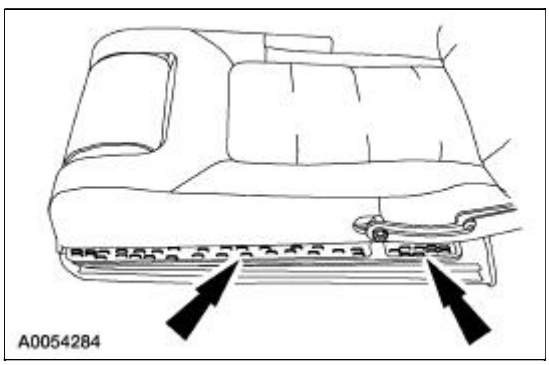
2. Remove the safety belt buckle bolt and remove the safety belt buckle.
   - During assembly make sure anti-rotation tab is engaged into seat locator.



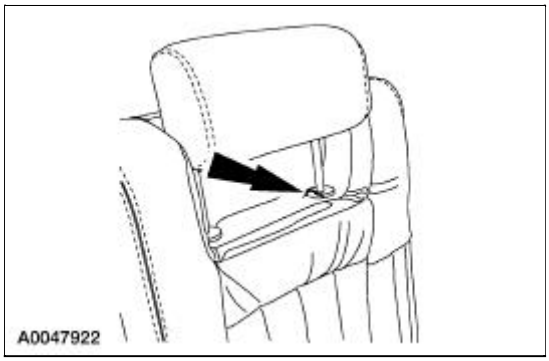
3. Release the J-clip.



4. Remove all the staples.

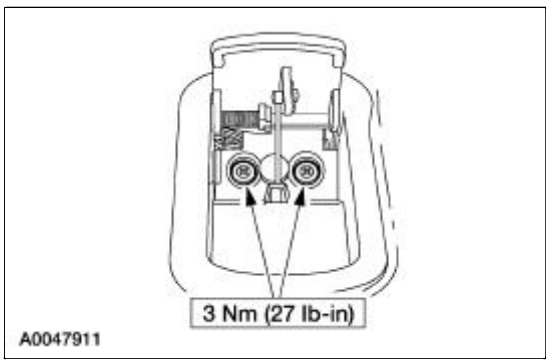


5. Depress the tab for head restraint and remove the head restraint.



Manual seat

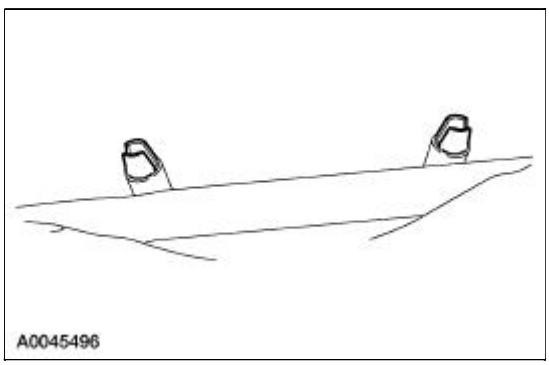
6. Remove the seat backrest release handle screws and remove the handle and cable assembly.



All vehicles

7. **NOTE:** The head restraint sleeve pins are not interchangeable. Note location for installation.

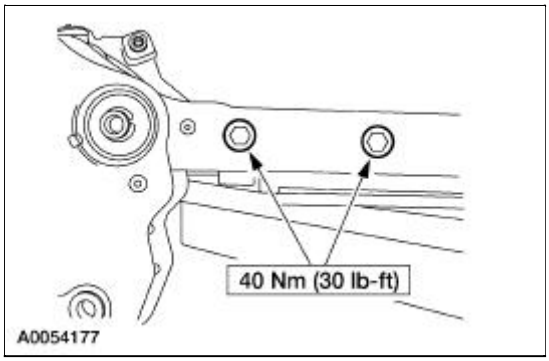
   Reach up into seat backrest and squeeze the head restraint sleeve ends together to release the sleeves and pull the head restraint sleeves out.



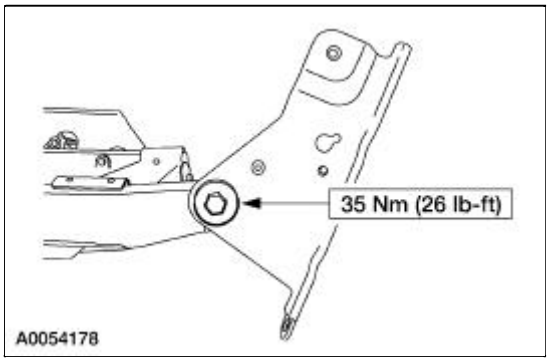
8. **CAUTION: Use care when separating the seat backrest trim cover from the hook-and-loop strip, or the hook-and-loop strip can be torn from the seat backrest foam.**

   Invert the seat backrest trim cover and remove.

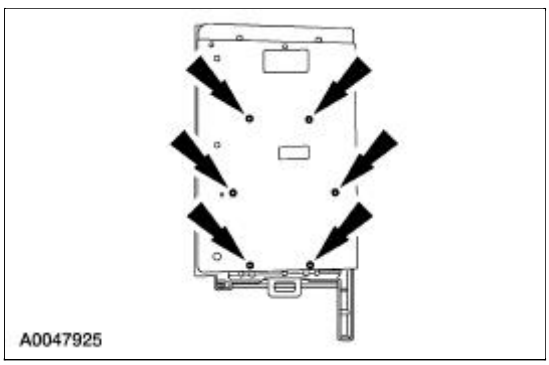
9. Remove the two bolts and remove the seat base.



10. Remove the bolt and remove the seat base.



11. Remove the screws from the rear seat backrest support panel.



12. To assemble, reverse the disassembly procedure.

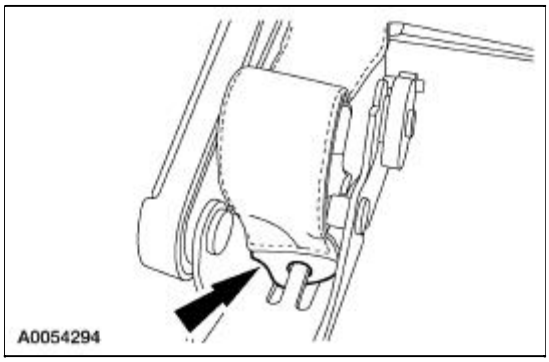
Rear Seat Backrest —Third Row, 60 Percent

Disassembly and Assembly

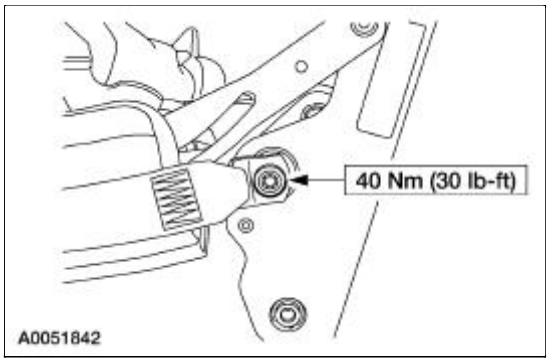
All vehicles

1. Remove the third row 60 percent seat backrest. For additional information, refer to Rear Seat Backrest—Third Row, 60 Percent in this section.

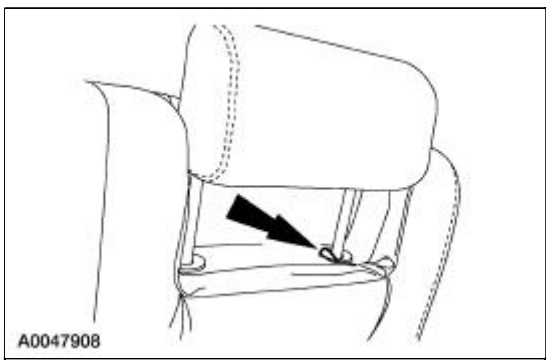
2. Remove latch trim cover (inboard side).



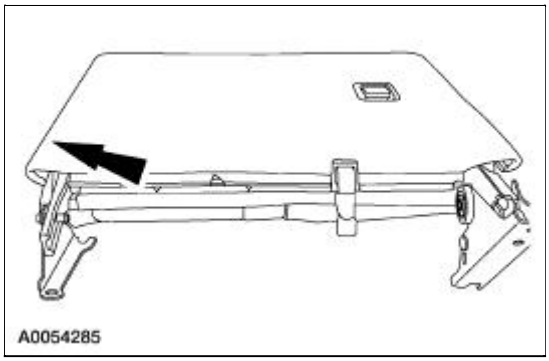
3. Remove the safety belt anchor bolt.



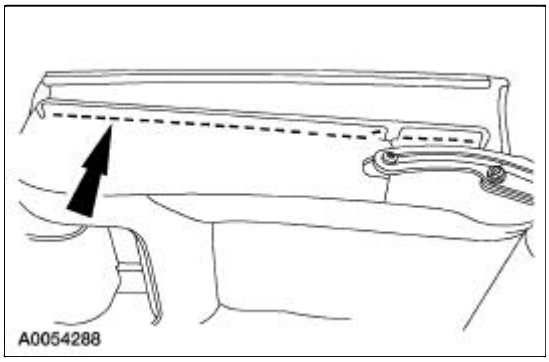
4. Depress the tab and remove the head restraint.



5. Release the J-clip.

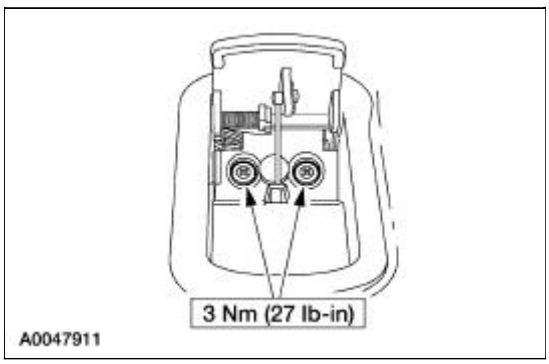


6. Remove all the staples.



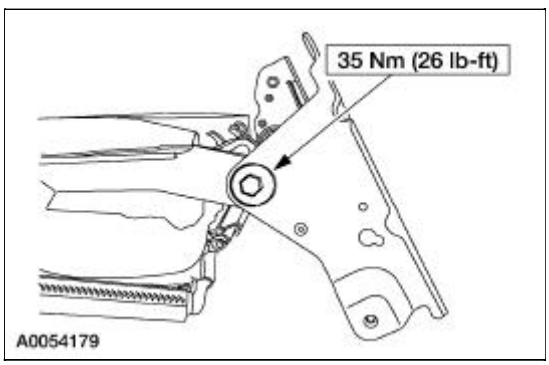
Manual seat

7. Remove the seat backrest release handle screws and remove the handle and cable assembly.

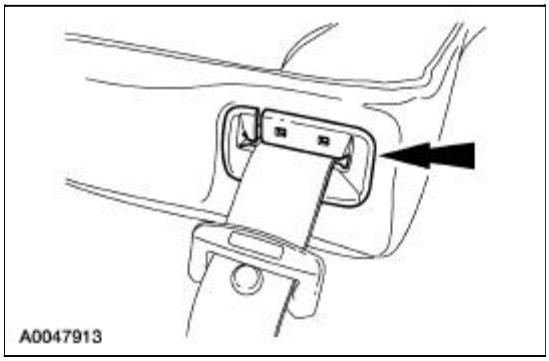


All vehicles

8. Remove the bolt and remove the seat base.

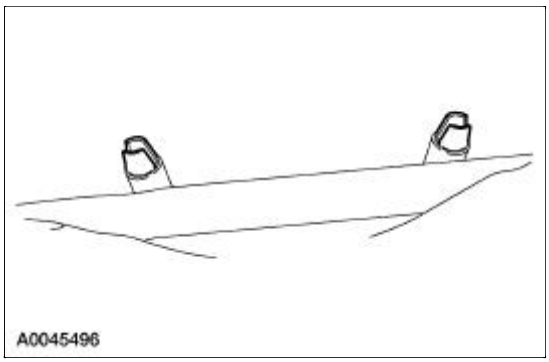


9. Remove the safety belt guide.



10. **NOTE:** The head restraint sleeve pins are not interchangeable. Note location for installation.

    Reach up into seat backrest and squeeze the head restraint sleeve ends together to release the sleeves and pull the head restraint sleeves out.

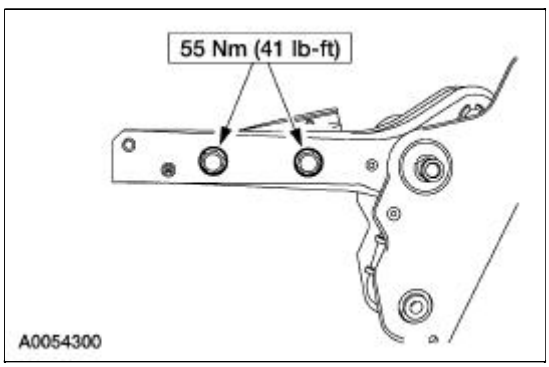


11. **CAUTION: Use care when separating the seat backrest trim cover from the hook-and-loop strip, or the hook-and-loop strip can be torn from the seat backrest foam.**

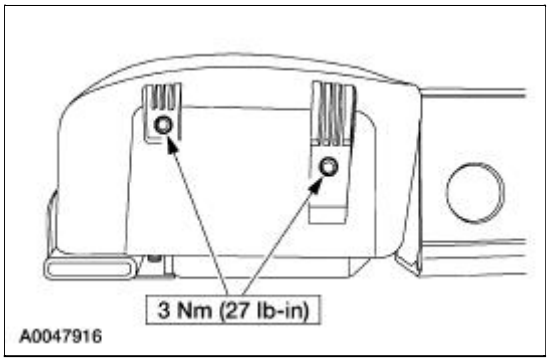
    Invert the seat backrest trim cover and remove.

12. Remove the seat backrest foam pad.

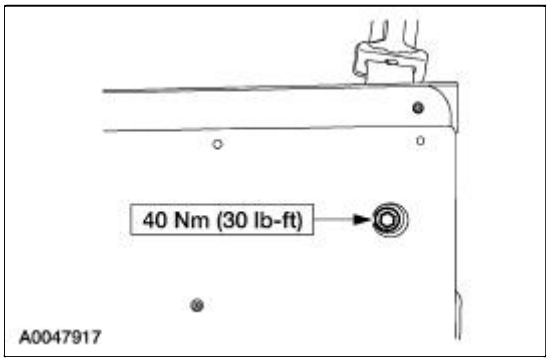
13. Remove the two bolts and remove the seat base.



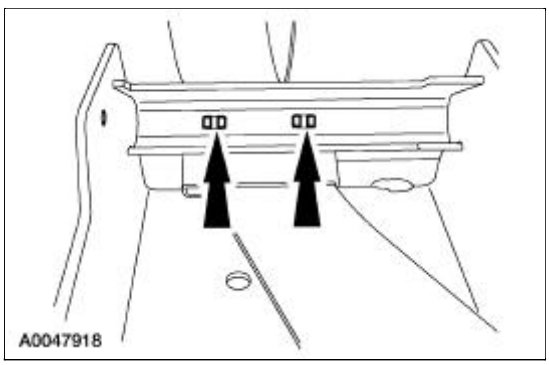
14. Remove the four screws in seat belt cover (two shown).



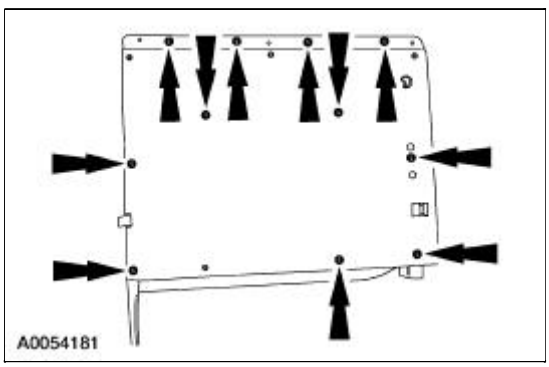
15. Remove the seat belt bolt.



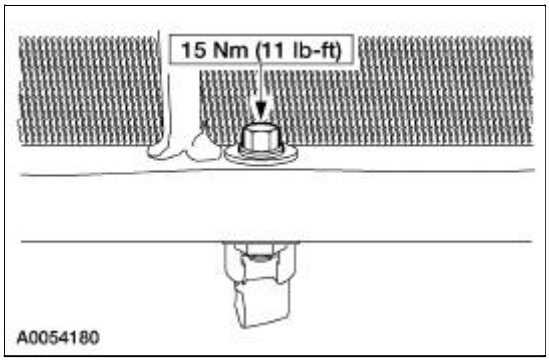
16. Pinch to release the seat belt guide and remove the seat belt assembly.



17. Remove the screws in the rear seat backrest support panel.



18. Remove the seat backrest tether anchor bolt.



19. To assemble, reverse the disassembly procedure.

General Specifications

Item	Specification
Sealers and Primers	
8 mm Foam Butyl	WSB-M4GB45-A
Urethane Glass Prep Essex U-401	WSB-M2G314-B
Urethane Metal Primer Essex U-413	WSB-M2G234-C
Urethane Adhesive Essex 400-HV	WSB-M2G316-B
Urethane Adhesive Essex U-216	WSB-M2G316-B
Urethane Glass Primer Essex U-402	WSB-M5B280-C
Rear Window Defroster Repair D8AZ-19562-AA	WSB-M4J58-B

Torque Specifications

Description	Nm	lb-ft	lb-in
Front door glass channel bolt	11	8	—
Front door glass bolts	11	8	—
Power window motor bolts	7	—	62
Rear door glass channel bolts	11	8	—
Rear door glass bolts	10	—	89
Rear quarter window glass nuts	2	—	18
Rear quarter window regulator motor bolts	9	—	80
Rear door stationary glass screw	5	—	44
Window regulator bolts	11	8	—

Glass, Frames and Mechanisms

The glass, frames and mechanisms consists of:

- front door window glass
- front door window motor
- front door window regulator
- rear quarter window glass
- rear quarter window glass frame
- rear quarter motor and window regulator
- rear door window glass
- rear door window motor
- rear door window regulator
- liftgate glass
- windshield glass

The glass, frames and mechanisms include:

- standard plastic and laminate safety glass
- liftgate glass which houses the rear defrost grid and rear wiper arm
- windshield glass which is bonded to the opening flange with a urethane sealant
- on Expedition, standard power windows which include one-touch down (LF only) and lock out feature
- on Navigator, standard power windows which include one-touch up/down (LF only) and lock out feature
- power vented rear quarter windows
- fixed rear quarter windows (Expedition only)
- RH quarter window glass antenna

The window regulator control switch:

- on Expedition, is located on each door trim panel.
- on Navigator, is located in the center floor console for front seats and on each door panel for the rear doors.
- may be used to raise or lower all windows from the master control on the driver side, or the individual side window from the individual door switch.
- includes a double detent feature (LF only).
- can manually lower the driver side window when the master control is depressed halfway (first detent).
- will completely lower the driver side window when the master control is fully depressed and then released (second detent).
- on Navigator, will completely raise the driver side window when the master control is pulled up

and then released (second detent).

- can lock out passenger front (Expedition only) and rear control switches.

The rear quarter glass regulator control switches:

- are located in the overhead console.
- may be used to open and close the RH or LH rear quarter windows.
- stop the rear quarter glass in any position when released.

The power window system will operate if the ignition switch is in the RUN or ACC position, or the delayed accessory feature is active.

Passenger windows may be raised or lowered using the LF master control switches or the appropriate passenger window switch. Passenger window switches receive power when the delayed accessory relay is active and the LF remote lock-out switch is in the UNLOCK position. When in the LOCK-OUT position, the passenger windows are deactivated.

The delayed accessory relay provides power for the operation of the power windows and the power moon roof. The delayed accessory feature is active when the ignition switch is in the RUN or the ACC position, or when the ignition switch is changed from RUN or ACC to the OFF/LOCK position and the LF and RF doors are closed.

The delayed accessory feature will deactivate when:

- the LF door is ajar and the ignition switch is in the OFF/LOCK or KEY-OUT position.
- the RF door is ajar and the ignition switch is in the OFF/LOCK or KEY-OUT position.
- 10 minutes have elapsed since the ignition switch was changed from ACC or RUN to the OFF/LOCK position.

Feature inputs:

- LF door open warning switch (open circuit with door closed, grounded with door ajar)
- RF door open warning switch (open circuit with door closed, grounded with door ajar)
- ignition switch RUN position (battery potential on both the RUN and RUN/ACC inputs)
- ignition switch ACC position (battery potential on the RUN/ACC input)
- ignition switch OFF/LOCK position (absence of battery potential on the RUN, RUN/ACC, and START inputs)

Feature outputs:

- delayed accessory relay (grounded when activated, open circuit when deactivated)

The instrument cluster module (ICM) controls the rear window defrost grid and heated mirrors by controlling the state of the rear window defrost/mirror relay. When the rear window defrost switch is pressed, the ICM will activate the heated grid relay. When the heated grid relay is active, both the rear window defrost grid and heated mirror elements will be energized.

The ICM will deactivate the heated grid relay when one of the following conditions is met:

- The rear window defrost switch is pressed when the feature is active.
- Ignition switch state is changed from RUN to OFF/LOCK.

- The 10 minute timing function is completed.

Feature inputs:

- ignition switch RUN position (12V on both RUN and RUN/ACC inputs)
- rear window defrost switch (momentary contact to ground when switch is pressed)

Feature outputs:

- rear window defrost relay control (grounded when activated, open circuit when deactivated)

Glass, Frames and Mechanisms

Refer to Wiring Diagrams Cell 59 , Generic Electronic Module (GEM) for schematic and connector information.

Refer to Wiring Diagrams Cell 100 , Power Windows for schematic and connector information.

Refer to Wiring Diagrams Cell 101 , Power Moonroof/Vent Windows for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool

Principles of Operation

Navigator — One Touch Up/Down

NOTE: The LF window motor is not on the multiplex link.

The LF window motor is an eight-pin motor with integral electronics. The front window control switch sends three separate signals to the LF window motor: up, down and AUTO. The front window control switch provides a 12-volt signal to the motor to request an up or down operation. When AUTO up or AUTO down are requested, the front window control switch provides a 12-volt signal on the up or down line and a ground signal on the AUTO line simultaneously. The up and down contacts are tied to ground and the AUTO contact is floating within the front window control switch when the switch is in the neutral position. The up, down and AUTO feeds to the motor are all low current.

The LF window motor plastic pinion gear is mated to the drum housing of a dual rail drum and cable window regulator. The motor is attached to the drum housing (plastic) by three screws. The motor uses internal Hall-effect sensor feedback coupled to the microprocessor to determine window position and operate the window. If the Hall-effect pulses are not being received by the microprocessor, the motor will run for approximately 1/10 second each switch press. The motor contains a thermal breaker to protect the motor windings from overcurrent/overtemperature operation. Continued successive operation of the motor will cause the thermal breaker to open, causing a loss of function until the motor cools.

The LF window motor operates with the ignition switch in the RUN/ACC positions only (and delayed accessory) and is sensed via the delayed accessory and logic ground inputs. The motor is supplied

with B+ power and draws a key-off load of approximately 3/4 mA. All of the high current required to move the window is supplied through the B+ and motor ground inputs. The loss of either logic or motor ground will cause this system to become inoperative. For correct functionality, both power feeds and both ground feeds must be intact at the motor.

During an AUTO up or AUTO down function, movement of the window can be stopped by actuating the switch to any position (up, down, AUTO up, AUTO down). The switch must then be released before the window will perform the next commanded movement.

When an obstacle has been detected in the window opening as the window is moving upward, the window will automatically reverse direction and move toward the fully open position (in both proportional up and one-touch up modes). This is known as "bounce-back". Once the window stops at its bounce-back position, and within 2 seconds the switch is released, then held in the AUTO up position, the window will travel up with no bounce-back protection (security override). If the switch is released before the window reaches fully closed, the window will stop with bounce-back automatically re-enabled for the next window up movement. If the ignition switch is turned to OFF or START (without delayed accessory), the window will stop. The only exception is when an obstacle is detected while delayed accessory is lost. In this case the window will bounce back, then stop. Ice, contaminant buildup, and environmentally induced tight spots in the window seals are all possible uses for the security override feature. If an obstruction occurs between 4 and 200 mm (0.15 - 7.9 inch) of window opening, the bounce-back position will be 250 mm (9.8 inch) of window opening. If an obstruction occurs at a position greater than 200 mm (7.9 inch) of window opening, the bounce-back position will be 50 mm (2 inch) below where the obstruction occurred.

The LF window motor will retain its initialization (memory) if power (B+) is removed while the window is not in motion. If power (B+) is disconnected from the LF window motor while the window is in motion, the motor will enter position recovery mode when power is restored (AUTO up and AUTO down functions are disabled). Position recovery mode allows proportional up (and down) movement of the window until the LF window motor stalls the window glass into the upper header seal. If no internal or external faults are present, the motor will automatically resume normal (full) operation.

The front window control switch is supplied with illumination and illumination ground inputs used to illuminate the switch when the headlamp switch is turned to the PARK or ON position (the AUTOLAMP position may also energize this input). These switch inputs do not directly affect operation of the LF window. The front window control switch uses the delayed accessory power input which is transferred to the up or down outputs via closing of a switch contact. The front window control switch uses the main switch ground input which is transferred to the AUTO output via closing of a switch contact. If the delayed accessory feed to the front window control switch is missing, none of the windows will function. If the main ground signal is missing, the LF AUTO functions will be inoperative and the remaining three windows will also be inoperative.

If the front window control switch, or its associated wiring, develops an open circuit, that function will become inoperative. If the up contact or associated wiring develops an open circuit, the LF window will only move down or one touch down. If the down contact or associated wiring develops an open circuit, the LF window will only move up or one touch up. If the auto contact or associated wiring develops an open circuit, the LF window will only move proportionally up or down.

The LF window motor will suspend window operation if a switch error exists. A switch error is defined as up and down, AUTO without up or down, or up and down and AUTO energized at the same time. The LF window will appear to be inoperative if a switch error is present.

A new LF window motor will be in proportional up/down mode prior to initialization. The motor will respond to a proportional up or down switch actuation only and bounce back is disabled. If the switch is actuated to the AUTO up or AUTO down position and released, window movement will stop when the up or down contact in the front window control switch is released. If the LF window motor is removed from the window regulator drum housing, or if a new LF window motor is installed, the LF window motor must be initialized. Refer to Door Window Motor Initialization in the General Procedures portion of this section.

The LF window motor will automatically adjust to system changes throughout its life: changes in seal drag and slight changes in the fully open position will occur and are automatically compensated for. Once initialized, for the most part, the LF window motor will soft stall into the upper and lower positions

contributing to extended durability of the system. If the LF window does not seal completely in the full up position (very small gaps/non bounce-back events only), the LF window switch can be actuated to the proportional up position and the window will be energized long enough to fully seal (for a small fraction of a second) and this new position will be learned.

Expedition — One Touch Down

The one touch down feature for the Expedition is controlled by the driver window control switch.

Rear Window Defrost

The instrument cluster module (ICM) receives a signal from the rear window defrost switch. The ICM then grounds the rear window defrost relay to turn ON and time the rear window defrost grid.

Inspection and Verification

1. Verify the customer concern by operating the power window system.

2. Visually inspect for obvious signs of mechanical and electrical damage. Refer to the following chart:

Visual Inspection Chart

Mechanical	Electrical
● Window regulator assembly ● Window glass ● Window control switch	● Fuse(s) ● Circuitry ● Window control switch ● Relay(s)

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

4. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

5. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool manual.

6. Carry out the DATA LINK DIAGNOSTICS test. If the diagnostic tool responds with:
   - CKT930 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for instrument cluster module (ICM), refer to Section 419-10 .
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the ICM.

7. If the DTCs retrieved are related to the concern, refer to power ICM Diagnostic Trouble Code (DTC) Index to continue diagnostics.

8. If DTCs are retrieved that are not found in the following ICM Diagnostic Trouble Code (DTC) Index, refer to the master ICM Diagnostics Trouble Code (DTC) index in Section 419-10 .

9. If no DTCs related to the concern are retrieved, GO to Symptom Chart to continue diagnostics.

Instrument Cluster Module (ICM) Diagnostic Trouble Code (DTC) Index

Instrument Cluster Module (ICM) Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1345	Heated Backlite Input Short To Ground	Instrument Cluster Module (ICM)	Go To Pinpoint Test K.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• All power windows are inoperative	• Central junction box (CJB) circuit breaker 401 (30A). • CJB fuse 22 (10A). • Delayed accessory relay. • Circuitry. • LF/front window control switch.	• Go To Pinpoint Test A .
• The LF power window is inoperative — Expedition	• Circuitry. • LF window control switch. • LF power window motor.	• Go To Pinpoint Test B .
• The LF power window is inoperative — Navigator	• CJB fuse 22 (10A). • CJB fuse 30 (30A). • Circuitry. • Front window control switch. • LF power window motor.	• Go To Pinpoint Test C .
• The LF power window will not close (bounces back) — Navigator	• The window system was repaired and the LF motor was not reinitialized. • Glass runs are not fully seated.	• REINITIALIZE the LF motor. REFER to Door Window Motor Initialization . • Carefully use a rubber mallet to reseat the glass runs, then REINITIALIZE the LF motor. REFER to Door Window Motor Initialization .

	• Dirt or contaminants are present in the glass runs or beltline moulding.	• REMOVE/CLEAN the glass runs or beltlines, then REINITIALIZE the LF motor. REFER to Door Window Motor Initialization .
	• Binding in the inner/outer beltline moulding.	• REMOVE and REINSTALL the inner/outer beltlines, INSTALL new if necessary, then REINITIALIZE the LF motor. REFER to Door Window Motor Initialization .
	• Window regulator is out of position.	• Using the security override function, POSITION the glass in the full up position. REFER to the Description and Operation portion of this section. LOOSEN the four window regulator rail bolts. TIGHTEN the four window regulator rail bolts. REINITIALIZE the LF motor. REFER to Door Window Motor Initialization .
	• Front glass channel (lower portion) is out of position.	• LOWER the glass to the full down position. LOOSEN the glass channel bolt. TIGHTEN the glass channel bolt. REINITIALIZE the LF motor. REFER to Door Window Motor Initialization .
	• Window system components are loose.	• CHECK the torque on the LF motor screws, window glass to regulator bolts, regulator rail bolts, glass channel bolt, and the door carrier fasteners. REINITIALIZE the LF motor. REFER to Door Window Motor Initialization .
• The RF power window is inoperative — Expedition	• Circuitry. • LF window control switch. • RF window control switch. • RF power window motor.	• Go To Pinpoint Test D .
• The RF power window is inoperative — Navigator	• Circuitry. • Front window control switch. • RF power window motor.	• Go To Pinpoint Test E .
• The LR or RR power window is inoperative — Expedition	• Circuitry. • LF window control switch. • LR window control switch. • LR power window motor. • RR window control switch. • RR power window motor.	• Go To Pinpoint Test F .
• The LR or RR	• Circuitry.	• Go To Pinpoint Test G .

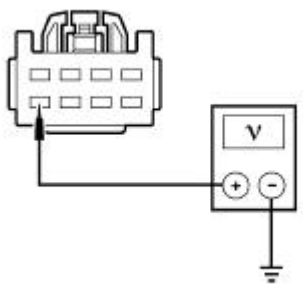
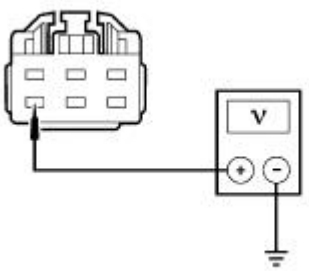
power window is inoperative — Navigator	• Front window control switch. • LR window control switch. • LR power window motor. • RR window control switch. • RR power window motor.	
• The one-touch down (OTD) feature is inoperative — Expedition	• LF window control switch.	• INSTALL a new LF window control switch. REFER to Window Control Switch in this section.
• The one-touch up/down feature is inoperative — Navigator	• LF power window motor. • Circuitry. • LF power window motor is not initialized. • Power (B+) was lost while LF window was moving.	• Go To Pinpoint Test H.
• The vent power windows are inoperative — Expedition	• Fuse. • Power vent window motor. • Power vent window switch. • Circuitry.	• Go To Pinpoint Test I.
• The vent power windows are inoperative — Navigator	• Fuse. • Relay. • Power vent window motor. • Power vent window switch. • Circuitry.	• Go To Pinpoint Test J.
• The defrost system is inoperative	• Fuse(s). • Circuitry. • Rear window defrost switch. • Rear window defrost relay. • Instrument cluster module (ICM).	• Go To Pinpoint Test K.
• The defrost system will not shut off automatically	• Circuitry. • Rear window defrost switch. • Rear window defrost relay. • Instrument cluster module (ICM).	• Go To Pinpoint Test L.
• The delayed accessory is inoperative	• CJB circuit breaker 401 (30A). • CJB fuse 22	• Go To Pinpoint Test M.

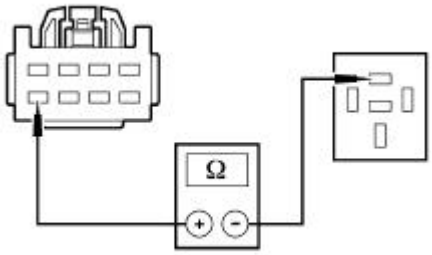
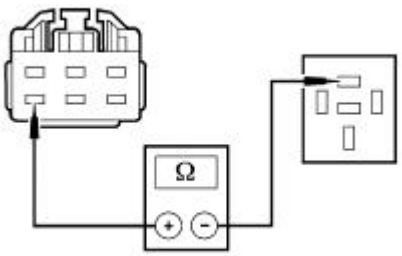
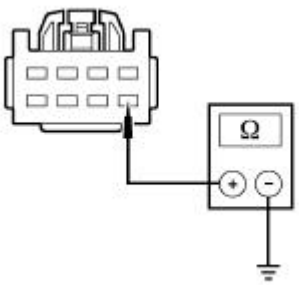
	(10A). ● CJB. ● Circuitry. ● Delayed accessory relay. ● Instrument cluster module (ICM).	

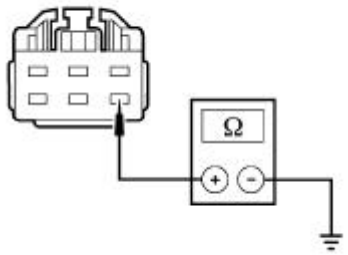
Pinpoint Tests

CAUTION: Be careful when probing the CJB, battery junction box or any connectors. Damage will result to the connector receptacle if the probe being used is too large.

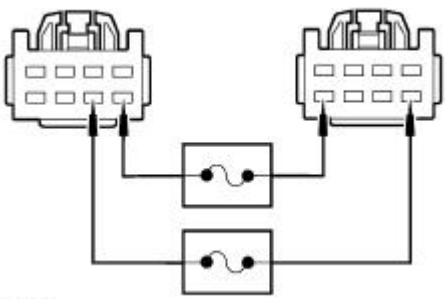
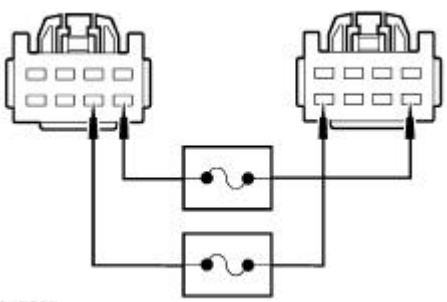
PINPOINT TEST A: ALL POWER WINDOWS ARE INOPERATIVE

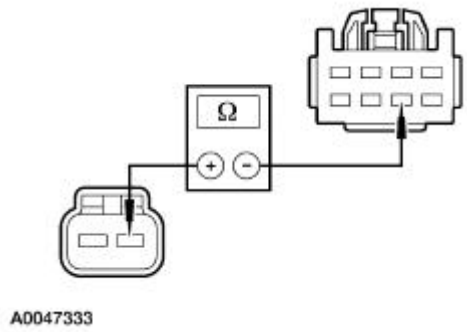
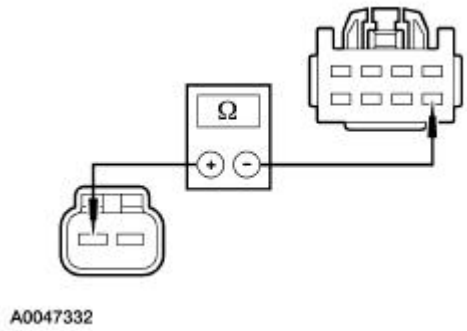
Test Step	Result / Action to Take
A1 CHECK CIRCUIT 400 (LB/BK) FOR VOLTAGE	
● Disconnect: LF Window Control Switch C504b (Expedition) or C3193a (Navigator). ● Key in ON position. ● **NOTE:** Expedition only. ● Measure the voltage between LF window control switch C504b-8, circuit 400 (LB/BK) and ground.  A0047329 ● **NOTE:** Navigator only. ● Measure the voltage between front window control switch C3193a-6, circuit 400 (LB/BK) and ground.  A0047391 ● **Is the voltage greater than 10 volts?**	**Yes** GO to A3 . **No** GO to A2 .
A2 CHECK CIRCUIT 400 (LB/BK) FOR AN OPEN	
● Key in OFF position. ● Disconnect: Accessory Delay Relay.	**Yes** Go To Pinpoint Test M

• **NOTE:** Expedition only. • Measure the resistance between LF window control switch C504b-8, circuit 400 (LB/BK) and accessory delay relay socket pin 87.  A0047330 • **NOTE:** Navigator only. • Measure the resistance between LF window control switch C3193a-6, circuit 400 (LB/BK) and accessory delay relay socket pin 87, circuit 400 (LB/BK).  A0047392 • **Is the resistance less than 5 ohms?**	to diagnose the accessory delay relay system. **No** REPAIR circuit 400 (LB/BK) for an open. TEST the system for normal operation.
A3 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
• Key in OFF position. • **NOTE:** Expedition only. • Measure the resistance between LF window control switch C504b-5, circuit 57 (BK) and ground.  A0047331 • **NOTE:** Navigator only. • Measure the resistance between LF window control switch C3193a-4, circuit 57 (BK) and ground.	**Yes** INSTALL a new LF window control switch. REFER to Window Control Switch in this section. **No** REPAIR circuit 57 (BK) for an open. TEST the system for normal operation.

 A0054332 ● **Is the resistance less than 5 ohms?**	

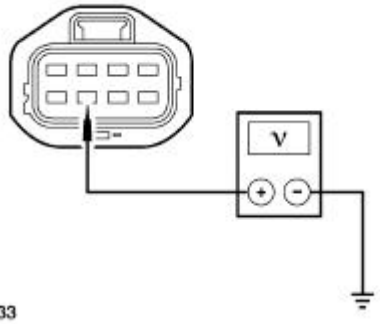
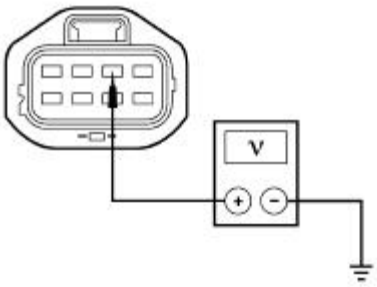
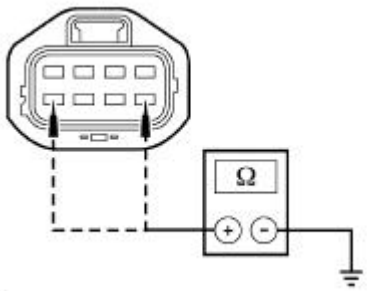
PINPOINT TEST B: THE LF POWER WINDOW IS INOPERATIVE — EXPEDITION

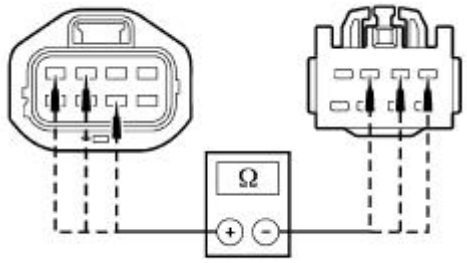
Test Step	Result / Action to Take
B1 CHECK THE POWER WINDOW SWITCH	
● Key in ON position. ● Disconnect: LF Window Control Switch C504a/C504b. ● Connect a fused jumper wire between C504b-5, circuit 57 (BK) and C504a-6, circuit 991 (TN/LB) and connect a second fused jumper wire between C504b-8, circuit 400 (LB/BK) and C504a-5, circuit 992 (WH/BK). The window should operate in the up direction.  A0047334 ● Connect a fused jumper wire between C504b-5, circuit 57 (BK) and C504a-5, circuit 992 (WH/BK) and connect a second fused jumper wire between C504b-8, circuit 400 (LB/BK) and C504a-6, circuit 991 (TN/LB). The window should operate in the down direction.  A0047335 ● **Does the window operate correctly?**	**Yes** INSTALL a new LF window control switch. REFER to Window Control Switch in this section. **No** GO to B2 .
B2 CHECK CIRCUIT 991 (TN/LB) FOR AN OPEN	

• Key in OFF position. • Disconnect: LF Power Window Motor C518. • Measure the resistance between power window motor C518-1, circuit 991 (TN/LB) harness side, and LF window control switch C504a-6, circuit 991 (TN/LB) harness side.  A0047333 • **Is the resistance less than 5 ohms?**	**Yes** GO to B3 . **No** REPAIR circuit 991 (TN/LB) for an open. TEST the system for normal operation.
B3 CHECK CIRCUIT 992 (WH/BK) FOR AN OPEN	
• Measure the resistance between LF power window motor C518-2, circuit 992 (WH/BK) harness side, and LF window control switch C504a-5, circuit 992 (WH/BK) harness side.  A0047332 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new LF window regulator motor. REFER to Front Door Window Regulator Motor . TEST the system for normal operation. **No** REPAIR the circuit 992 (WH/BK) for an open. TEST the system for normal operation.

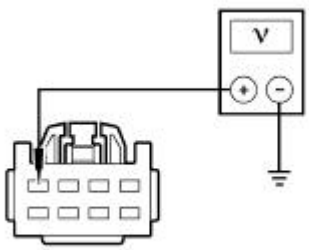
PINPOINT TEST C: THE LF POWER WINDOW IS INOPERATIVE — NAVIGATOR

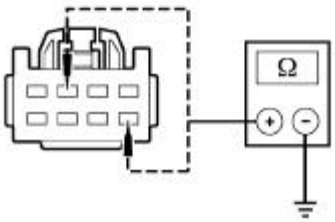
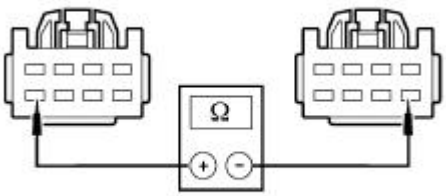
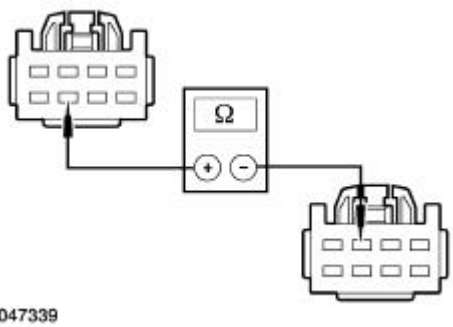
Test Step	Result / Action to Take
NOTE: The LF power window motor is not on the multiplex link.	
NOTE: A new LF power window motor will be in proportional up/down mode until initialized. Refer to Door Window Motor Initialization in this section.	
NOTE: The LF power window motor must be reinitialized whenever: the motor is removed from the window regulator drum housing, a new motor is installed, a new window regulator is installed, a new window glass is installed, a new top run is installed, and any operation in which grease or lubricants are applied to the window system.	
C1 CHECK THE POWER TO THE WINDOW MOTOR	
• Key in OFF position. • Disconnect: LF Window Power Window Motor C540. • Measure the voltage between LF power window motor C540-7, circuit 1523 (DG) harness side and ground.	**Yes** GO to C2 . **No** REPAIR circuit 1523 (DG) for an open. REINITIALIZE the LF power window motor. REFER to Door Window Motor Initialization

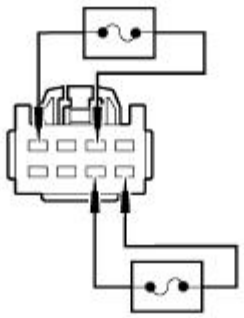
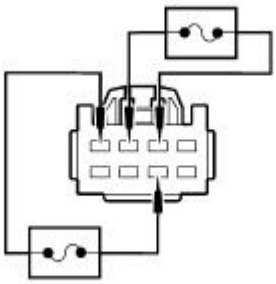
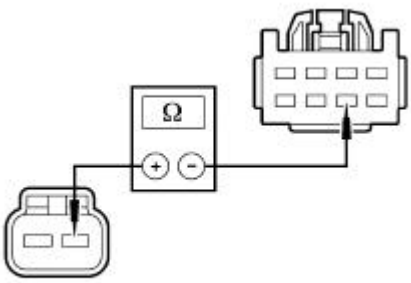
 A0054333 ● **Is the voltage greater than 10 volts?**	in this section. TEST the system for normal operation.
C2 CHECK THE LF WINDOW MOTOR DELAYED ACCESSORY FEED	
● Key in ON position. ● Measure the voltage between LF power window motor C540-2, circuit 194 (PK) harness side and ground.  A0054334 ● **Is the voltage greater than 10 volts?**	**Yes** GO to C3 . **No** REPAIR circuit 194 (PK) for an open. REINITIALIZE the LF power window motor. REFER to Door Window Motor Initialization in this section. TEST the system for normal operation.
C3 CHECK THE LF MOTOR GROUNDS	
● Key in OFF position. ● Measure the resistance between LF power window motor C540-5, circuit 875 (BK/LB) and C540-8, circuit 57 (BK) harness side and ground.  A0054335 ● **Are the resistances less than 5 ohms?**	**Yes** GO to C4 . **No** REPAIR circuit 57 (BK) or circuit 875 (BK/LB) for an open. REINITIALIZE the LF power window motor. REFER to Door Window Motor Initialization in this section. TEST the system for normal operation.
C4 CHECK THE FRONT WINDOW SWITCH TO LF MOTOR FEEDS	
● Disconnect: Front Window Control Switch C3193b. ● Measure the resistance between LF power window motor C540-3, circuit 992 (WH/BK) and front window control switch C3193b-3, circuit 992 (WH/BK); C540-4, circuit 991 (TN/LB) and C3193b-2, circuit 991 (TN/LB); C540-6, circuit 2018 (OG/YE) or (LG/OG) and C3193b-1, circuit 2018 (OG/YE)/ (LG/OG) or 1007 (YE/RD) harness side.	**Yes** GO to C5 . **No** REPAIR circuit 992 (WH/BK), circuit 991 (TN/LB), circuit 2018 (OG/YE)/(LG/OG) or 1007 (YE/RD) for an open.

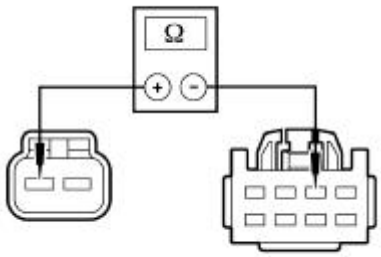
 A0054336 ● **Are the resistances less than 5 ohms?**	REINITIALIZE the LF power window motor. REFER to Door Window Motor Initialization in this section. TEST the system for normal operation.
C5 CHECK THE FRONT WINDOW CONTROL SWITCH ● Carry out the window control switch component test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. ● **Did the window control switch pass the component test?**	**Yes** INSTALL a new LF power window motor. REFER to Front Door Window Regulator Motor in this section. REINITIALIZE the LF door window motor. REFER to Door Window Motor Initialization in this section. TEST the system for normal operation. **No** INSTALL a new front window control switch. REFER to Window Control Switch in this section. TEST the system for normal operation.

PINPOINT TEST D: THE RF POWER WINDOW IS INOPERATIVE — EXPEDITION

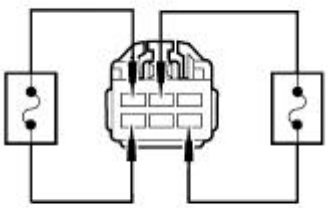
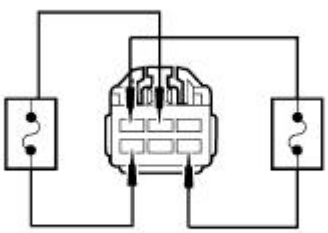
Test Step	Result / Action to Take
D1 CHECK THE VOLTAGE TO THE PASSENGER WINDOW REGULATOR CONTROL SWITCH ● Disconnect: RF Window Control Switch C624. ● Key in ON position. ● **NOTE:** Set the window lock switch to the UNLOCK position. ● Measure the voltage between RF window control switch C624-4, circuit 193 (YE/LG) and ground.  A0047336	**Yes** GO to D2. **No** REPAIR circuit 193 (YE/LG) for an open. TEST the system for normal operation.

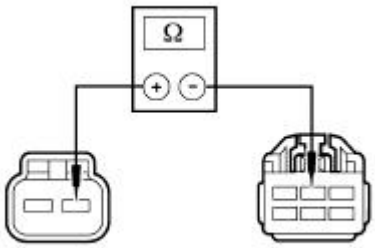
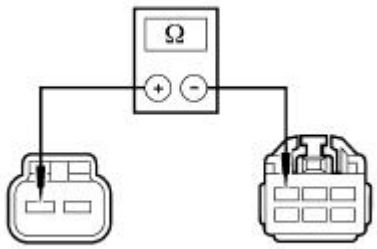
• **Is the voltage greater than 10 volts?**	
D2 CHECK CIRCUITS 313 (WH/YE) AND 314 (TN/LB) FOR CONTINUITY TO GROUND	
• Key in OFF position. • Measure the resistance between ground and RF window control switch C624: ■ pin 5, circuit 313 (WH/YE). ■ pin 3, circuit 314 (TN/LB)  A0047337 • **Are the resistances less than 5 ohms?**	**Yes** GO to D4 . **No** GO to D3 .
D3 CHECK CIRCUITS 313 (WH/YE) AND 314 (TN/LB) FOR AN OPEN	
• Disconnect: LF Window Control Switch C504a. • Measure the resistance between LF window control switch C504a-8, circuit 313 (WH/YE) and RF window control switch C624-5, circuit 313 (WH/YE) harness side.  A0047338 • Measure the resistance between LF window control switch C504a-7, circuit 314 (TN/LB) and RF window control switch C624-3, circuit 314 (TN/LB) harness side.  A0047339 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new LF window control switch. REFER to Window Control Switch . TEST the system for normal operation. **No** REPAIR circuit 313 (WH/YE) or 314 (TN/LB) for an open. TEST the system for normal operation.
D4 CHECK THE RF POWER WINDOW SWITCH	
• Key in ON position. • Connect a fused jumper wire between C624-5, circuit 313 (WH/YE) and C624-6, circuit 333 (YE/RD) and connect a second fused jumper wire between C624-4, circuit 193 (YE/LG) and C624-	**Yes** INSTALL a new RF window regulator control switch.

2, circuit 334 (RD/YE). The window should operate in the up direction.  A0047340 • Connect a fused jumper wire between C624-3, circuit 314 (TN/LB) and C624-2, circuit 334 (RD/YE) and connect a second fused jumper wire between C624-4, circuit 193 (YE/LG) and C624-6, circuit 333 (YE/RD). The window should operate in the down direction.  A0047341 • **Does the window operate correctly?**	REFER to Window Control Switch . TEST the system for normal operation. **No** GO to D5 .
D5 CHECK CIRCUITS 333 (YE/RD) AND 334 (RD/YE) FOR AN OPEN	
• Key in OFF position. • Disconnect: RF Window Motor C608. • Measure the resistance between RF window control switch C624-6, circuit 333 (YE/RD) harness side, and between and RF window motor C608-1, circuit 333 (YE/RD) harness side.  A0047333 • Measure the resistance between RF window control switch C624-2, circuit 334 (RD/YE) harness side, and between and RF window motor C608-2, circuit 334 (RD/YE) harness side.	**Yes** INSTALL a new RF window regulator motor. REFER to Front Door Window Regulator Motor . TEST the system for normal operation. **No** REPAIR circuit 333 (YE/RD) or 334 (RD/YE) for an open. TEST the system for normal operation.

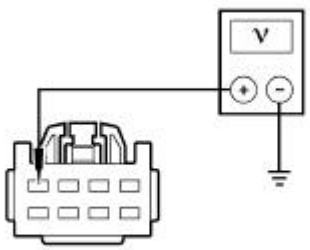
 A0047342 ● **Are the resistances less than 5 ohms?**	

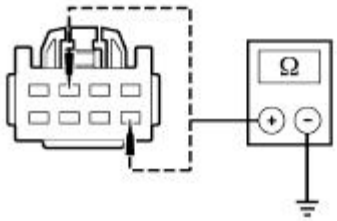
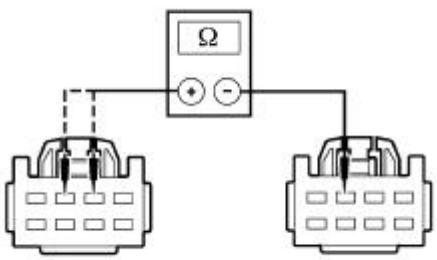
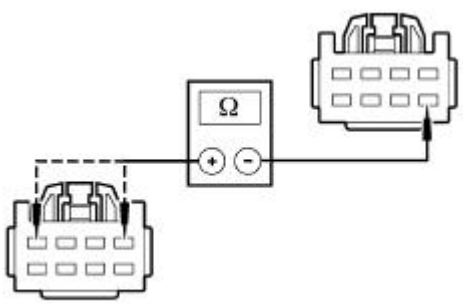
PINPOINT TEST E: THE RF POWER WINDOW IS INOPERATIVE — NAVIGATOR

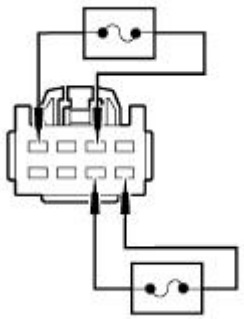
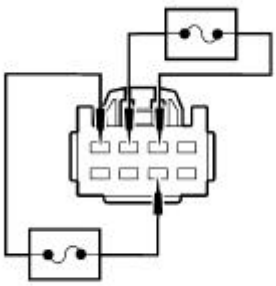
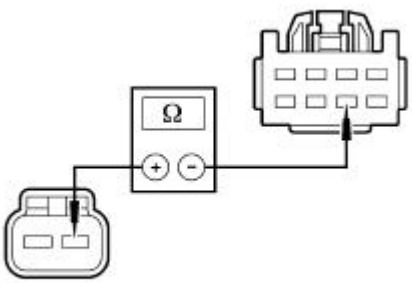
Test Step	Result / Action to Take
E1 CHECK THE RF POWER WINDOW MOTOR	
● Disconnect: Window Control Switch C3193a and 3193b. ● Key in ON position. ● Connect a fused jumper wire between C3193a-2, circuit 313 (WH/YE) and C3193a-4, circuit 57 (BK) and connect a second fused jumper wire between C3193a-6, circuit 400 (LB/BK) and C3193a-3, circuit 314 (TN/LB). The window should operate in the up direction.  A0047349 ● Connect a fused jumper wire between C3193a-3, circuit 314 (TN/LB) and C3193a-4, circuit 57 (BK) and connect a second fused jumper wire between C3193a-6, circuit 400 (LB/BK) and C3193a-2, circuit 313 (WH/YE). The window should operate in the down direction.  A0047350 ● **Does the window operate correctly?**	**Yes** INSTALL a new front window regulator control switch. REFER to Window Control Switch . TEST the system for normal operation. **No** GO to E2 .
E2 CHECK CIRCUITS 313 (WH/YE), 333 (YE/RD), 314 (TN/LB) AND 334 (RD/YE) FOR AN OPEN	

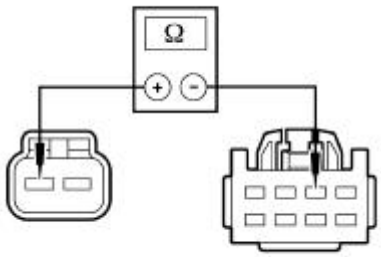
• Key in OFF position. • Disconnect: RF Window Motor C608. • Measure the resistance between front window control switch C3193a-2, circuit 313 (WH/YE) and between and RF window motor C608-1, circuit 333 (YE/RD) harness side.  A0047351 • Measure the resistance between RF power window control switch C3193a-3, circuit 314 (TN/LB) and between and RF window motor C608-2, circuit 334 (RD/YE) harness side.  A0047352 • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new RF window regulator motor. REFER to Front Door Window Regulator Motor . TEST the system for normal operation. **No** REPAIR circuit 313 (WH/YE), 314 (TN/LB), 333 (YE/RD) or 334 (RD/YE) for an open. TEST the system for normal operation.

PINPOINT TEST F: THE LR OR RR POWER WINDOW IS INOPERATIVE — EXPEDITION

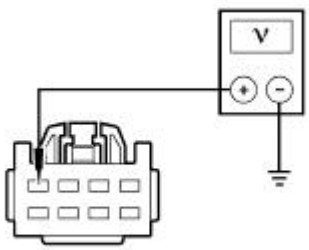
Test Step	Result / Action to Take
F1 CHECK THE VOLTAGE TO THE LR OR RR WINDOW CONTROL SWITCH	
• Disconnect: Inoperative Rear Window Control Switch C701/C801. • Key in ON position. • **NOTE:** Set the window lock switch to the UNLOCK position. • Measure the voltage between the inoperative rear window connector pin 4, circuit 193 (YE/LG) and ground.  A0047336 • **Is the voltage greater than 10 volts?**	**Yes** GO to F2 . **No** REPAIR circuit 193 (YE/LG) for an open. TEST the system for normal operation.

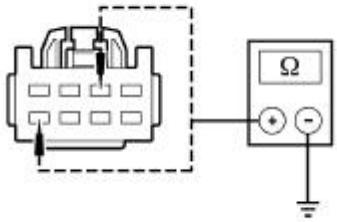
F2 CHECK THE GROUNDS TO THE INOPERATIVE REAR WINDOW CONTROL SWITCH	
• Key in OFF position. • Measure the resistance between ground and the inoperative window control switch C701/C801: ■ pin 3, circuit 320 (RD/BK). ■ pin 5, circuit 319 (YE/BK).  A0047337 • **Are the resistances less than 5 ohms?**	**Yes** GO to F4 . **No** GO to F3 .
F3 CHECK THE CIRCUITS TO THE INOPERATIVE REAR WINDOW CONTROL SWITCH FOR AN OPEN	
• Key in OFF position. • Disconnect: LF Window Control Switch C504a. • Measure the resistance between LF window control switch C504a-2, circuit 316 (YE/LB) and LR window control switch C701-3, circuit 320 (RD/BK) or, between LF window control switch C504a-3, circuit 320 (RD/BK) and RR window control switch C801-3, circuit 320 (RD/BK) harness side.  A0047343 • Measure the resistance between LF window control switch C504a-1, circuit 317 (GY/OG) and LR window control switch C701-5, circuit 319 (YE/BK) or, between LF window control switch C504a-4, circuit 319 (YE/BK) and RR window control switch C801-5, circuit 319 (YE/BK) harness side.  A0047344 • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new LF window control switch. REFER to Window Control Switch . TEST the system for normal operation. **No** REPAIR circuit 316 (YE/LB), 317 (GY/OG), 319 (YE/BK) or 320 (RD/BK) for an open. TEST the system for normal operation.
F4 CHECK THE INOPERATIVE WINDOW CONTROL SWITCH	

• Connect: LF Window Control Switch C504a. • Key in ON position. • Connect a fused jumper wire between inoperative power window switch C701/C801-5, circuit 319 (YE/BK) and C701/C801-6, circuit 881 (BN) and connect a second fused jumper wire between C701/C801-4, circuit 193 (YE/LG) and C701/C801-2, circuit 882 (BN/YE). The window should operate in the up direction.  A0047340 • Connect a jumper wire between inoperative power window switch C701/C801-3, circuit 320 (RD/BK) and C701/C801-2, circuit 882 (BN/YE) and connect a second fused jumper wire between C701/C801-4, circuit 193 (YE/LG) and C701/C801-6, circuit 881 (BN). The window should operate in the down direction.  A0047341 • **Does the window operate correctly?**	**Yes** INSTALL a new rear window regulator control switch. REFER to Window Control Switch . TEST the system for normal operation. **No** GO to F5 .
F5 CHECK POWER WINDOW MOTOR CIRCUITS	
• Key in OFF position. • Disconnect: Inoperative Power Window Motor C703/C803. • Measure the resistance between inoperative window control switch C701/C801-6, circuit 881 (BN), and inoperative power window motor C703/C803-1, circuit 881 (BN) harness side.  A0047333 • Measure the resistance between inoperative window control switch C701/C801-2, circuit 882 (BN/YE), and inoperative power window motor C703/C803-2, circuit 882 (BN/YE) harness side.	**Yes** INSTALL a new rear window regulator motor. REFER to Rear Door Window Regulator Motor . TEST the system for normal operation. **No** REPAIR the circuit (s) for an open. TEST the system for normal operation.

 A0047342 ● **Are the resistances less than 5 ohms?**	

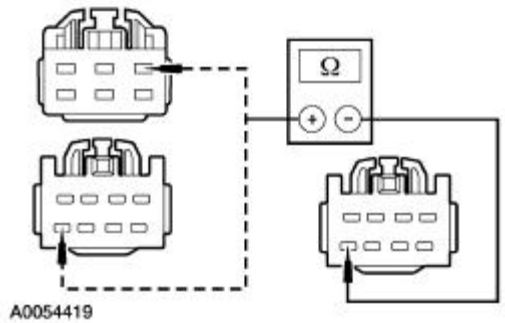
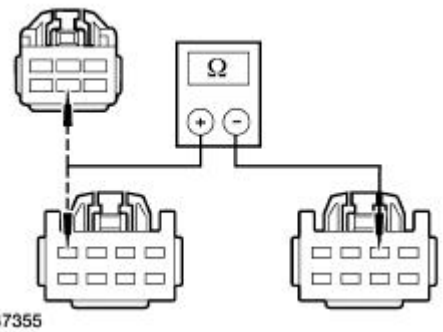
PINPOINT TEST G: THE LR OR RR POWER WINDOW IS INOPERATIVE — NAVIGATOR

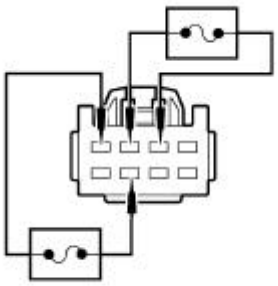
Test Step	Result / Action to Take
G1 CHECK THE VOLTAGE TO THE LR OR RR WINDOW CONTROL SWITCH	
● Disconnect: Inoperative Rear Window Control Switch C717/C819. ● Key in ON position. ● **NOTE:** Set the window lock switch to the UNLOCK position. ● Measure the voltage between the inoperative rear window connector pin 4, circuit 193 (YE/LG) and ground.  A0047336 ● **Is the voltage greater than 10 volts?**	**Yes** GO to G2 . **No** REPAIR circuit 193 (YE/LG) for an open. TEST the system for normal operation.
G2 CHECK THE GROUNDS TO THE INOPERATIVE REAR WINDOW CONTROL SWITCH	
● Key in OFF position. ● Measure the resistance between ground and inoperative window control switch C717/C819: ■ pin 8, circuit 320 (RD/BK). ■ pin 2, circuit 319 (YE/BK).	**Yes** GO to G4 . **No** GO to G3 .



A0047353

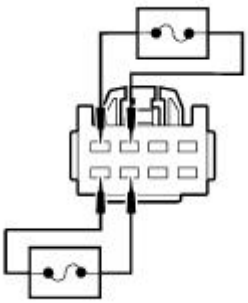
- **Are the resistances less than 5 ohms?**

G3 CHECK THE CIRCUITS TO THE INOPERATIVE REAR WINDOW CONTROL SWITCH FOR AN OPEN	
• Key in OFF position. • Disconnect: Front Window Control Switch C3193a/C3193b. • Measure the resistance between front window control switch C3193b-8, circuit 316 (YE/LB) and LR window control switch C717-8, circuit 320 (RD/BK) or, between front window control switch C3193a-1, circuit 320 (RD/BK) and RR window control switch C819-8, circuit 320 (RD/BK) harness side.  A0054419 • Measure the resistance between front window control switch C3193b-4, circuit 317 (GY/OG) and LR window control switch C717-2, circuit 319 (YE/BK) or, between front window control switch C3193a-5, circuit 319 (YE/BK) and RR window control switch C819-2, circuit 319 (YE/BK) harness side.  A0047355 • **Are the resistances less than 5 ohms?**	**Yes** INSTALL a new front window control switch. REFER to Window Control Switch . TEST the system for normal operation. **No** REPAIR the circuit (s) for an open. TEST the system for normal operation.
G4 CHECK THE INOPERATIVE WINDOW CONTROL SWITCH	
• Connect: Front Window Control Switch C3193a/C3193b. • Key in ON position. • Connect a fused jumper wire between inoperative power window switch C717/C819-2, circuit 319 (YE/BK) and C717/C819-3, circuit 881 (BN) and connect a second fused jumper wire between C717/C819-4, circuit 193 (YE/LG) and C717/C819-7, circuit 882 (BN/YE). The window should operate in the up direction.	**Yes** INSTALL a new rear window regulator control switch. REFER to Window Control Switch . TEST the system for normal



A0047356

- Connect a fused jumper wire between inoperative power window switch C717/C819-8, circuit 320 (RD/BK) and C717/C819-7, circuit 882 (BN/YE) and connect a second fused jumper wire between C717/C819-4, circuit 193 (YE/LG) and C717/C819-3, circuit 881 (BN). The window should operate in the down direction.



A0047357

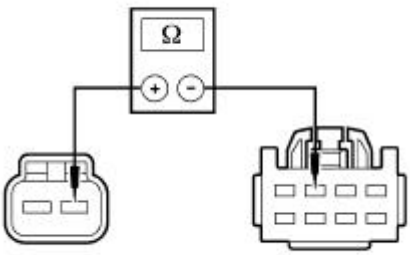
- **Does the window operate correctly?**

operation.

No
GO to G5 .

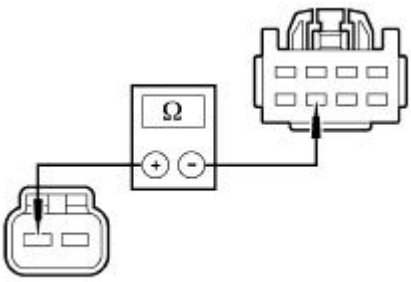
G5 CHECK THE POWER WINDOW MOTOR CIRCUITS

- Key in OFF position.
- Disconnect: Inoperative Power Window Motor C703/C803.
- Measure the resistance between inoperative window control switch C717/C819-3, circuit 881 (BN), and inoperative power window motor C703/C803-1, circuit 881 (BN) harness side.



A0047358

- Measure the resistance between inoperative window control switch C717/C819-7, circuit 882 (BN/YE), and inoperative power window motor C703/C803-2, circuit 882 (BN/YE) harness side.



A0047359

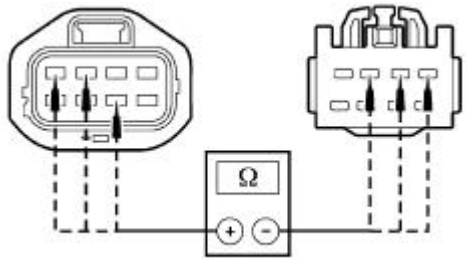
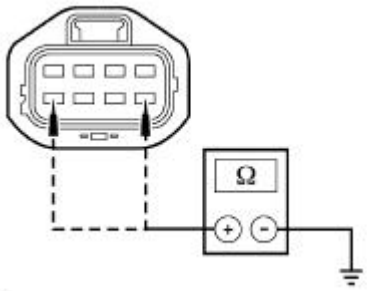
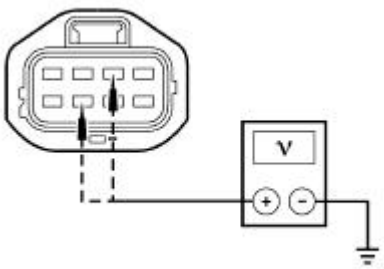
Yes
INSTALL a new window motor. REFER to Front Door Window Regulator Motor . TEST the system for normal operation.

No
REPAIR circuit 881 (BN) or 882 (BN/YE) for an open. TEST the system for normal operation.

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

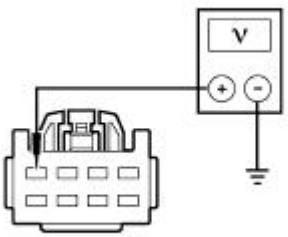
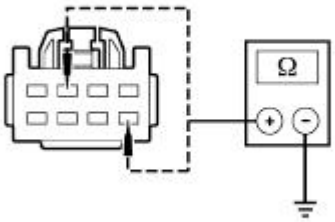
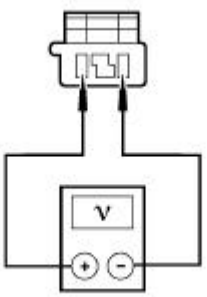
PINPOINT TEST H: THE ONE-TOUCH UP/DOWN FEATURE IS INOPERATIVE — NAVIGATOR

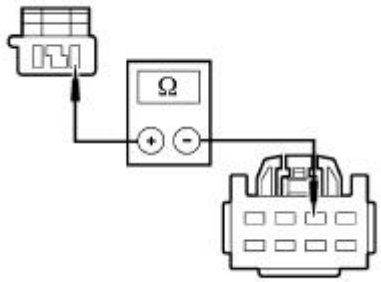
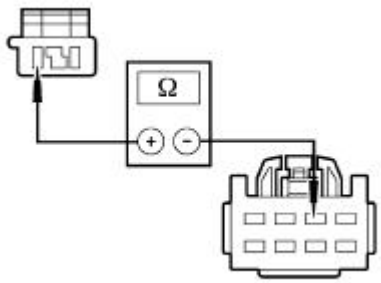
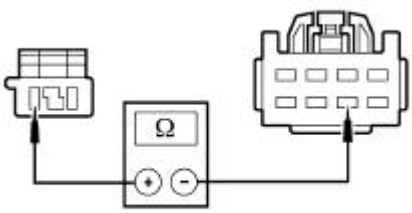
Test Step	Result / Action to Take
NOTE: The LF power window motor is not on the multiplex link.	
NOTE: A new LF power window motor will be in proportional up/down mode until initialized. Refer to Door Window Motor Initialization in this section.	
NOTE: The LF power window motor must be reinitialized whenever: the motor is removed from the window regulator drum housing, a new motor is installed, a new window regulator is installed, a new window glass is installed, a new top run is installed, and when carrying out any operation in which grease or lubricants are applied to the window system.	
H1 CHECK FOR POWER (B+) LOSS DURING LF WINDOW OPERATION	
• Verify if power (B+) was lost during LF window operation. • **Was power (B+) lost while LF window was in operation?**	**Yes** RAISE the LF window to the fully closed position. MAKE SURE the window glass stalls into the upper header seal. Normal functionality should resume. TEST the system for normal operation. **No** GO to H2.
H2 INITIALIZE THE LF MOTOR	
• Carry out the LF window motor initialization procedure. Refer to Door Window Motor Initialization in this section. • **Are the one-touch up/down functions operating correctly?**	**Yes** Repair is complete. TEST the system for normal operation. **No** GO to H3.
H3 CHECK THE FRONT WINDOW CONTROL SWITCH	
• Carry out the front window switch component test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. • **Did the front window switch pass the component test?**	**Yes** GO to H4. **No** INSTALL a new front window control switch. REFER to Window Control Switch in this section. TEST the system for normal operation.
H4 CHECK THE FRONT WINDOW SWITCH TO LF MOTOR FEEDS	
• Key in OFF position. • Disconnect: Power Window Switch C3193b. • Disconnect: LF Power Window Motor C540. • Measure the resistance between LF power window motor C540-3, circuit 992 (WH/BK) and front window control switch C3193b-3, circuit 992 (WH/BK); C540-4, circuit 991 (TN/LB)	**Yes** GO to H5. **No** REPAIR circuit 992 (WH/BK), circuit 991

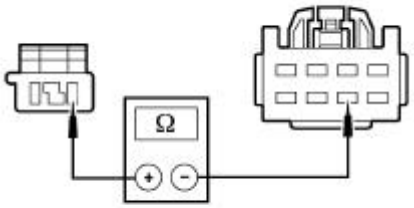
and C3193b-2, circuit 991 (TN/LB); C540-6, circuit 2018 (OG/YE) or (LG/OG) and C3193b-1, circuit 2018 (OG/YE)/ (LG/OG) or 1007 (YE/RD) harness side.  A0054336 ● **Are the resistances less than 5 ohms?**	(TN/LB), circuit 2018 (OG/YE)/(LG/OG) or 1007 (YE/RD) for an open. REINITIALIZE the LF power window motor. REFER to Door Window Motor Initialization in this section. TEST the system for normal operation.
H5 CHECK FOR INTERMITTENT GROUND CONNECTIONS	
● Key in OFF position. ● Measure the resistance between LF power window motor C540-5, circuit 875 (BK/LB) and C540-8, circuit 57 (BK) harness side and ground.  A0054335 ● Wiggle the harness while measuring the resistances. ● **Are the resistances less than 5 ohms?**	**Yes** GO to H6 . **No** REPAIR circuit 875 (BK/LB) or circuit 57 (BK) for an open. REINITIALIZE the LF power window motor. REFER to Door Window Motor Initialization Initialization in this section. TEST the system for normal operation.
H6 CHECK FOR INTERMITTENT POWER CONNECTIONS	
● Key in ON position. ● Measure the voltage between LF power window motor C540-7, circuit 1523 (DG) and C540-2, circuit 194 (PK) harness side and ground.  A0054422 ● Wiggle the harness while measuring the voltages. ● **Are the voltages greater than 10 volts?**	**Yes** INSTALL a new LF power window motor. REFER to Front Door Window Regulator Motor in this section. REINITIALIZE the LF power window motor. REFER to Door Window Motor Initialization in this section. TEST the system for normal operation. **No** REPAIR circuit 1523 (DG) or circuit 194 (PK) for an open. REINITIALIZE the LF power window motor. REFER to Door Window Motor Initialization in this section. TEST the system for normal operation.

PINPOINT TEST I: THE VENT POWER WINDOWS ARE

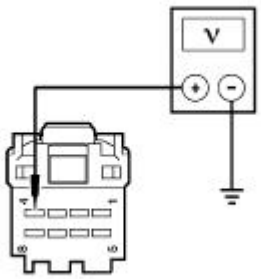
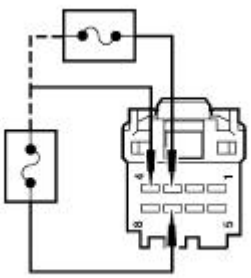
INOPERATIVE — EXPEDITION

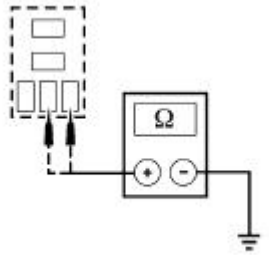
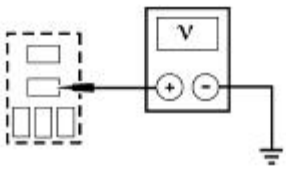
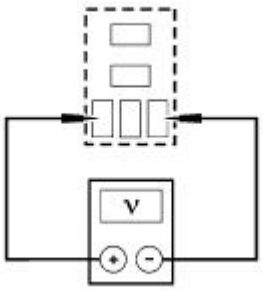
Test Step	Result / Action to Take
I1 CHECK FOR POWER TO THE VENT WINDOW SWITCH	
• Disconnect: Power Vent Window Switch C998. • Key in ON position. • Measure the voltage between power vent window switch C998-4, circuit 194 (PK) and ground.  A0047360 • **Is the voltage greater than 10 volts?**	**Yes** GO to I2 . **No** REPAIR circuit 194 (PK) for an open. TEST the system for normal operation.
I2 CHECK THE POWER VENT WINDOW SWITCH GROUND	
• Key in OFF position. • Measure the resistance between inoperative power vent window switch C998-3 and C998-1, circuit 57 (BK) and ground.  A0047337 • **Are the resistances less than 5 ohms?**	**Yes** GO to I3 . **No** REPAIR circuit 57 (BK) for an open. TEST the system for normal operation.
I3 CHECK THE POWER VENT WINDOW SWITCH OPERATION	
• Connect: Power Vent Window Switch C998. • Disconnect: Power Vent Window Motor C4047 (LH)/C4090 (RH). • Measure the voltage between inoperative power vent window motor C4047-1, circuit 1942 (RD/YE) and C4047-2, circuit 1941 (YE/LB) for the LH; or between inoperative power vent window motor C4090-1, circuit 1941 (YE/LB) and C4090-2, circuit 1942 (RD/YE) for the RH while activating the power vent window switch from OPEN to CLOSE.  A0043665	**Yes** INSTALL a new power vent window regulator motor. REFER to Rear Quarter Window Regulator Motor . TEST the system for normal operation. **No** GO to I4 .

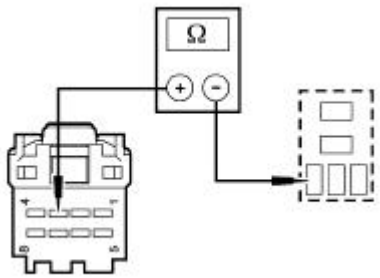
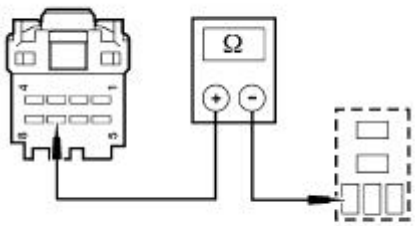
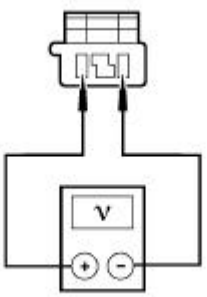
• **Did the voltage change from greater than +10 volts to -10 volts?**	
I4 CHECK CIRCUIT 1942 (RD/YE) FOR AN OPEN	
• **NOTE:** For LH side. • Measure the resistance between power vent window motor C4047-1, circuit 1942 (RD/YE) and power vent window switch C998-2, circuit 1942 (RD/YE).  A0047363 • **NOTE:** For RH side. • Measure the resistance between power vent window motor C4090-2, circuit 1942 (RD/YE) and power vent window switch C998-2, circuit 1942 (RD/YE).  A0047364 • **Is the resistance less than 5 ohms?**	**Yes** GO to I5 . **No** REPAIR circuit 1942 (RD/YE) for an open. TEST the system for normal operation.
I5 CHECK CIRCUIT 1941 (YE/LB) FOR AN OPEN	
• **NOTE:** For LH side. • Measure the resistance between power vent window motor C4047-2, circuit 1941 (YE/LB) and power vent window switch C998-6, circuit 1941 (YE/LB).  A0047361 • **NOTE:** For RH side. • Measure the resistance between power vent window motor C4090-1, circuit 1941 (YE/LB) and power vent window switch C998-6, circuit 1941 (YE/LB).	**Yes** INSTALL a new vent power window switch. REFER to Window Control Switch . TEST the system for normal operation. **No** REPAIR circuit 1941 (YE/LB) for an open. TEST the system for normal operation.

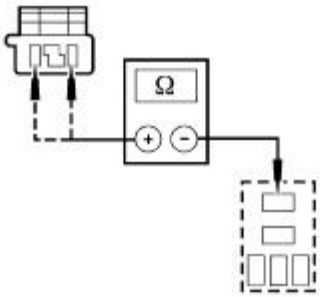
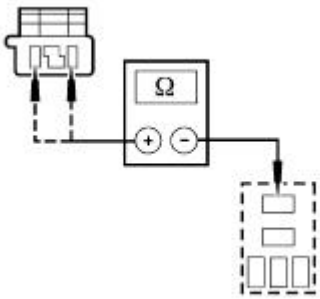
 A0047362 ● **Is the resistance less than 5 ohms?**	

PINPOINT TEST J: THE VENT POWER WINDOWS ARE INOPERATIVE — NAVIGATOR

Test Step	Result / Action to Take
J1 CHECK FOR POWER TO THE VENT WINDOW SWITCH	
● Disconnect: Power Vent Window Switch C999. ● Key in ON position. ● Measure the voltage between power vent window switch C999-4, circuit 194 (PK) and ground.  A0047365 ● **Is the voltage greater than 10 volts?**	**Yes** GO to J2 . **No** REPAIR circuit 194 (PK) for an open. TEST the system for normal operation.
J2 CHECK THE POWER VENT WINDOW SWITCH	
● Connect a fused jumper wire between power vent window switch C999-4, circuit 194 (PK) and C999-3, circuit 1942 (RD/YE). Remove the fused jumper wire and connect it between power vent window switch C999-4, circuit 194 (PK) and C999-7, circuit 1941 (YE/LB). The vent power window should operate open and closed.  A0047366 ● **Did the vent power window operate correctly?**	**Yes** INSTALL a new power vent window switch. REFER to Window Control Switch . TEST the system for normal operation. **No** GO to J3 .
J3 CHECK THE POWER VENT WINDOW RELAY GROUND CIRCUITS	

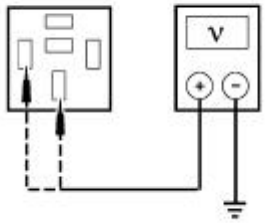
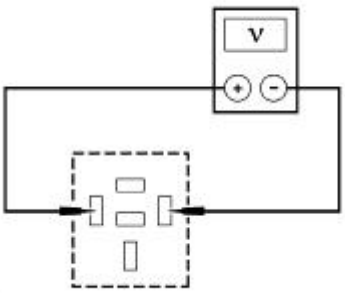
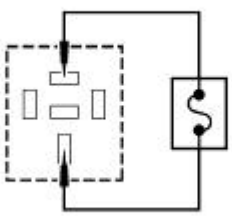
• Key in OFF position. • Disconnect: Power Vent Window Relays C4175 and C4176. • Measure the resistance between power vent window relays C4175/C4176-2, and C4175/C4176-4, circuit 57 (BK) and ground.  A0047367 • **Are the resistances less than 5 ohms?**	**Yes** GO to J4 . **No** REPAIR circuit 57 (BK) for an open. TEST the system for normal operation.
J4 CHECK THE POWER VENT WINDOW RELAY POWER CIRCUITS	
• Key in ON position. • Measure the voltage between power vent window relays C4175/C4176-5, circuit 194 (PK) and ground.  A0047368 • **Is the voltage greater than 10 volts?**	**Yes** GO to J5 . **No** REPAIR circuit 194 (PK) for an open. TEST the system for normal operation.
J5 CHECK THE POWER VENT WINDOW RELAY POWER CIRCUITS	
• Key in OFF position. • Connect: Power Vent Window Switch C999. • Key in ON position. • While switching the power vent window switch from open to close, measure the voltage between power vent window relay: ■ C4176-1, circuit 1942 (RD/YE) and C4176-2, circuit 57 (BK). ■ C4175-1, circuit 1941 (YE/LB) and C4175-2, circuit 57 (BK).  A0040189 • **Is the voltage greater than 10 volts?**	**Yes** GO to J7 . **No** GO to J6 .
J6 CHECK CIRCUIT 1942 (RD/YE) AND CIRCUIT 1941 (YE/LB) FOR AN OPEN	
• Key in OFF position. • Disconnect: Power Vent Window Switch C999.	**Yes** INSTALL a new

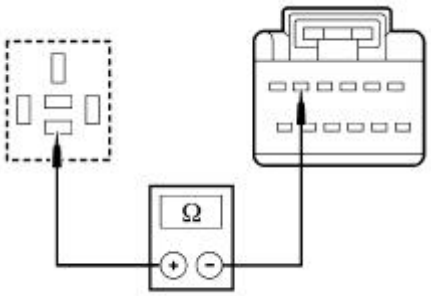
• Measure the resistance between power vent window relay C4176-1, circuit 1942 (RD/YE) and power vent window switch C999-3, circuit 1942 (RD/YE).  A0047369 • Measure the resistance between power vent window motor C4175-1, circuit 1941 (YE/LB) and power vent window switch C999-7, circuit 1941 (YE/LB).  A0047370 • **Are the resistances less than 5 ohms?**	vent power window switch. REFER to Window Control Switch . TEST the system for normal operation. **No** REPAIR circuit 1941 (YE/LB) for an open. TEST the system for normal operation.
J7 CHECK THE VOLTAGE TO THE MOTOR • Key in OFF position. • Connect: Power Vent Window Relays C4175 and C4176. • Disconnect: Power Vent Window Motor C4047 (LH)/C4090 (RH). • Key in ON position. • Measure the voltage between inoperative power vent window motor C4047-1, circuit 1157 (WH/LB) and C4047-2, circuit 1156 (YE/RD) for the LH; or between inoperative power vent window motor C4090-1, circuit 1156 (YE/RD) and C4090-2, circuit 1157 (WH/LB) for the RH while activating the power vent window switch from OPEN to CLOSE.  A0043665 • **Did the voltage change from greater than +10 volts to -10 volts?**	**Yes** INSTALL a new power vent window regulator motor. REFER to Rear Quarter Window Regulator Motor . TEST the system for normal operation. **No** GO to J8 .
J8 CHECK THE MOTOR CIRCUITS • Key in OFF position. • Disconnect: Power Vent Window Relays C4175 and C4176. • Measure the resistance between power vent window relay C4175-3, circuit 1156 (YE/RD) and power vent window motor: ▪ (RH) C4090-1, circuit 1156 (YE/RD).	**Yes** INSTALL a new power vent window relay. TEST the system for normal

■ (LH) C4047-2, circuit 1156 (YE/RD).  A0047371 ● Measure the resistance between power vent window relay C4176-3, circuit 1157 (WH/RD) and power vent window motor: ■ (RH) C4090-2, circuit 1157 (WH/RD). ■ (LH) C4047-1, circuit 1157 (WH/RD).  A0047371 ● **Are the resistances less than 5 ohms?**	operation. **No** REPAIR circuit(s). TEST the system for normal operation.

PINPOINT TEST K: THE DEFROST SYSTEM IS INOPERATIVE

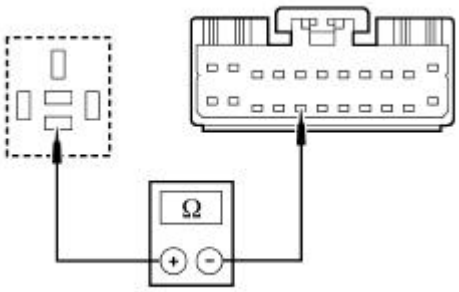
Test Step	Result / Action to Take
K1 CHECK THE POWER TO THE INDICATOR LIGHT	
● Key in ON position. ● Depress the rear window defrost switch to ON. ● **Is the rear window defrost switch indicator ON?**	**Yes** GO to K11 . **No** GO to K2 .
K2 CHECK THE DIAGNOSTIC TROUBLE CODES (DTCS)	
● Refer to the results from the previous instrument cluster module (ICM) self-test. ● **Was DTC B1345 retrieved?**	**Yes** GO to K13 . **No** GO to K3 .
K3 CHECK THE POWER TO THE RELAY	
● Key in OFF position. ● Disconnect: Rear Window Defrost Relay. ● Key in ON position. ● Measure the voltage between rear window defrost relay socket pin 85 and pin 30 harness side and ground.	**Yes** GO to K4 . **No** REPAIR the circuit(s). TEST the system for normal operation.

 A0043704 ● **Is the voltage greater than 10 volts?**	
K4 CHECK THE ICM OUTPUT	
● Measure the voltage between rear window defrost relay socket pin 85 and pin 86, circuit 1009 (OG/YE).  A0038291 ● **Is the voltage greater than 10 volts?**	**Yes** GO to K5 . **No** GO to K7 .
K5 CHECK THE RELAY	
● Connect a fused jumper between rear window defrost relay socket pin 30 and pin 87, circuit 59 (DG/VT).  A0032587 ● **Is the rear window defrost switch indicator ON?**	**Yes** INSTALL a new rear window defrost relay. TEST the system for normal operation. **No** GO to K6 .
K6 CHECK CIRCUIT 59 (DG/VT)	
● Key in OFF position. ● Disconnect: Mode Switch C294c or EATC Module C228b. ● **NOTE:** Manual climate control only. ● Measure the resistance between rear window defrost relay socket pin 87, circuit 59 (DG/VT) and mode switch C294c-5, circuit 59 (DG/VT).	**Yes** INSTALL a new mode switch or EATC module. REFER to Section 412-04 . TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.



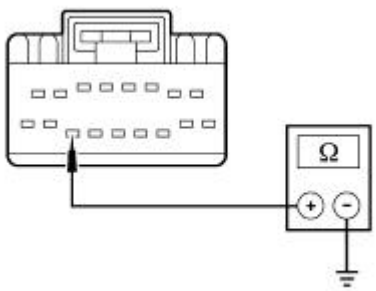
A0047428

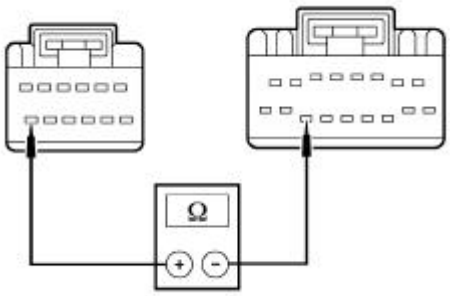
- **NOTE:** EATC only.
- Measure the resistance between rear window defrost relay socket pin 87, circuit 59 (DG/VT) and EATC module C228b-16, circuit 59 (DG/VT).



A0047429

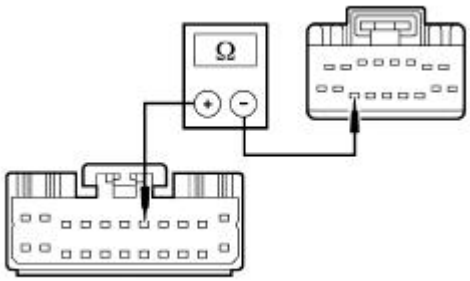
- **Is the resistance less than 5 ohms?**

K7 CHECK THE REAR WINDOW DEFROST SWITCH	
• Key in OFF position. • Disconnect: ICM C220b. • Depress the rear window defrost switch to ON. • Measure the resistance between ICM C220b-15, circuit 1010 (DB/OG) harness side and ground.  A0047594 • **Is the resistance less than 5 ohms when the switch is depressed?**	**Yes** GO to K10 . **No** GO to K8 .
K8 CHECK CIRCUIT 1010 (DB/OG) FOR AN OPEN	
• Disconnect: Mode Switch C294c or EATC Module C228a/C228b. • **NOTE:** Manual climate control only. • Measure the resistance between ICM C220b-15, circuit 1010 (DB/OG) and mode switch C294c-12, circuit 1010 (DB/OG).	**Yes** GO to K9 . **No** REPAIR the circuit. TEST the system for normal operation.



A0047433

- **NOTE:** EATC only.
- Measure the resistance between ICM C220b-15, circuit 1010 (DB/OG) and EATC module C228b-7, circuit 1010 (DB/OG).

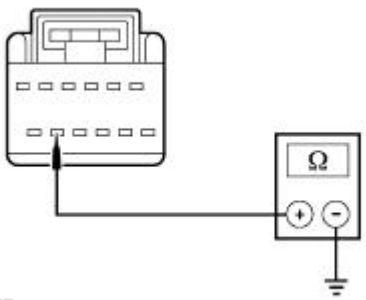


A0047434

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

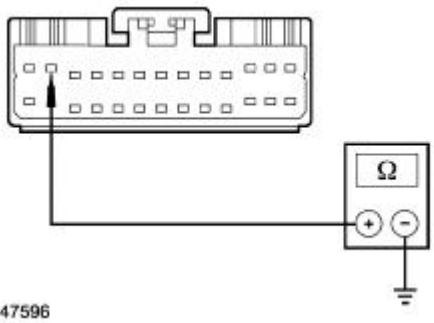
K9 CHECK THE REAR WINDOW DEFROST SWITCH GROUND

- **NOTE:** Manual climate control only.
- Measure the resistance between mode switch C294c-11, circuit 875 (BK/LB) harness side and ground.



A0067637

- **NOTE:** EATC only.
- Measure the resistance between EATC module C228a-2, circuit 875 (BK/LB) harness side and ground.

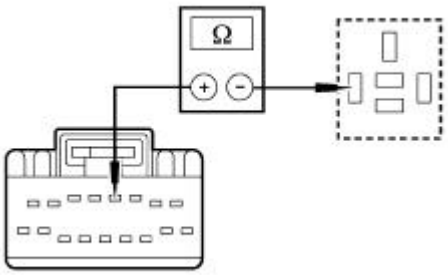
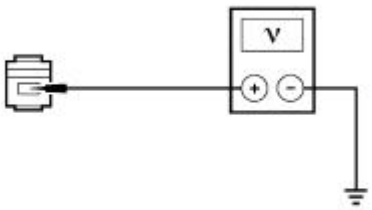
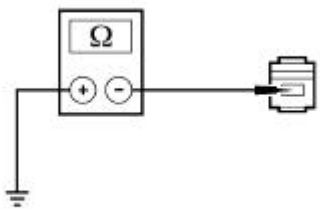


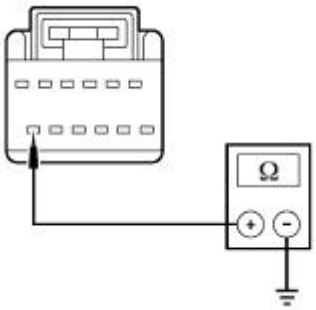
A0047596

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

Yes
INSTALL a new mode switch or EATC module. REFER to Section 412-04 . TEST the system for normal operation.

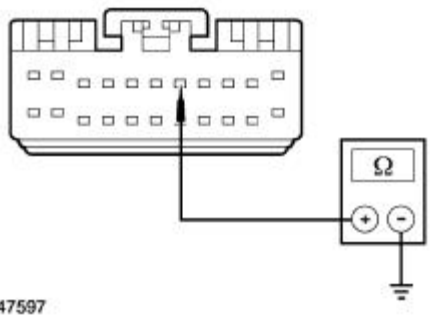
No
REPAIR the circuit. TEST the system for normal operation.

K10 CHECK CIRCUIT 1009 (OG/YE) FOR AN OPEN	
• Measure the resistance between ICM C220b-4, circuit 1009 (OG/YE) and rear window defrost relay socket pin 85, circuit 1009 (OG/YE).  A0047432 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new ICM. REFER to Section 413-01 . TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
K11 CHECK THE REAR WINDOW DEFROST GRID VOLTAGE	
• Disconnect: Rear Window Defrost Grid Power C402a. • Key in ON position. • Measure the voltage between rear window defrost grid power C402a, circuit 186 (BR/LB) and ground.  A0010207 • **Is the voltage greater than 10 volts?**	**Yes** GO to K12 . **No** REPAIR the circuit. TEST the system for normal operation.
K12 CHECK THE REAR WINDOW DEFROST GRID GROUND	
• Key in OFF position. • Disconnect: Rear Window Defrost Grid Ground C402b. • Measure the resistance between rear window defrost grid ground C402b, circuit 57 (BK) and ground.  A0010216 • **Is the resistance less than 5 ohms?**	**Yes** REPAIR the rear window defrost grid or INSTALL a new liftgate glass. REFER to Heated Window Grid Wire Repair . TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
K13 CHECK THE ICM INPUT FOR A SHORT TO GROUND	
• Disconnect: Mode Switch C294c or EATC Module C228b. • **NOTE:** Manual climate control only. • Measure the resistance between mode switch C294c-12, circuit 1010 (DB/OG) harness side and ground.	**Yes** INSTALL a new mode switch or EATC module. REFER to Section 412-04 . TEST the system for normal operation.



A0047598

- **NOTE:** EATC only.
- Measure the resistance between EATC module C228b-7, circuit 1010 (DB/OG) harness side and ground.



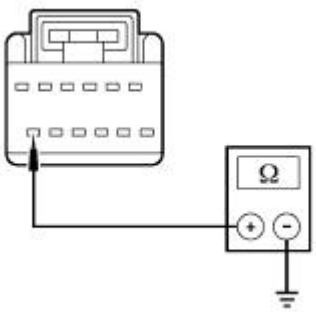
A0047597

- **Is the resistance greater than 10,000 ohms?**

No
GO to K14 .

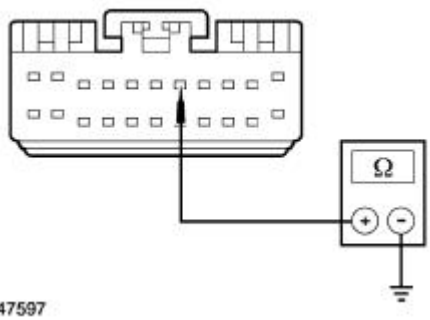
K14 CHECK THE ICM FOR AN INTERNAL SHORT

- Disconnect: ICM C220b.
- **NOTE:** Manual climate control only.
- Measure the resistance between mode switch C294c-12, circuit 1010 (DB/OG) harness side and ground.



A0047598

- **NOTE:** EATC only.
- Measure the resistance between EATC module C228b-7, circuit 1010 (DB/OG) harness side and ground.



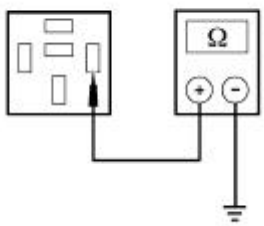
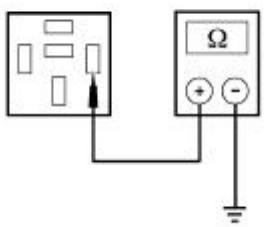
A0047597

- **Is the resistance greater than 10,000 ohms?**

Yes
INSTALL a new ICM. REFER to Section 413-01 . TEST the system for normal operation.

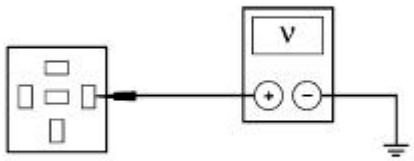
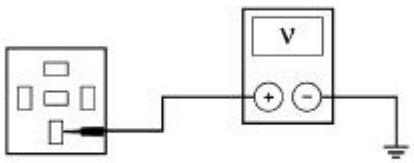
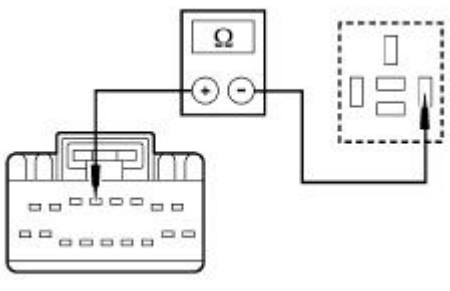
No
REPAIR the circuit. TEST the system for normal operation.

PINPOINT TEST L: THE DEFROST SYSTEM WILL NOT SHUT OFF AUTOMATICALLY

Test Step	Result / Action to Take
L1 CHECK CIRCUIT 186 (BN/LB) FOR A SHORT TO VOLTAGE	
• Disconnect: Rear Window Defrost Relay. • Key in ON position. • **Is the rear window defrost ON?**	**Yes** REPAIR circuit 186 (BN/LB) for a short to voltage. TEST the system for normal operation. **No** GO to L2 .
L2 CHECK THE REAR WINDOW DEFROST RELAY	
• Key in OFF position. • Measure the resistance between rear window defrost relay socket pin 85, circuit 1009 (OG/YE) and ground.  A0043703 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new rear window defrost relay. TEST the system for normal operation. **No** GO to L3 .
L3 CHECK THE INSTRUMENT CLUSTER MODULE (ICM)	
• Disconnect: ICM C220b. • Measure the resistance between rear window defrost relay socket pin 85, circuit 1009 (OG/YE) and ground.  A0043703 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new ICM. REFER to Section 413-01 . TEST the system for normal operation. **No** REPAIR circuit 1009 (OG/YE) for an open. TEST the system for normal operation.

PINPOINT TEST M: THE DELAYED ACCESSORY IS INOPERATIVE

Test Step	Result / Action to Take
M1 CHECK THE DELAYED ACCESSORY RELAY	
• Disconnect: Delayed Accessory Relay. • Carry out the delayed accessory relay component test. Refer to wiring Diagrams Cell 149 for schematic and connector	**Yes** GO to M2 .

information. ● **Did the delayed accessory relay pass the component test?**	**No** INSTALL a new delayed accessory relay. TEST the system for normal operation.
M2 CHECK THE POWER TO THE RELAY COIL ● Key in ON position. ● Measure the voltage between ground and delayed accessory relay socket pin 86  GN1438-A ● **Is the voltage greater than 10 volts?**	**Yes** GO to M3 . **No** REPAIR the central junction box (CJB). TEST the system for normal operation.
M3 CHECK THE POWER TO THE RELAY ● Measure the voltage between accessory delay relay socket pin 30 and ground.  GN1437-A ● **Is the voltage greater than 10 volts?**	**Yes** GO to M4 . **No** REPAIR the CJB. TEST the system for normal operation.
M4 CHECK CIRCUIT 1332 (LB) FOR AN OPEN ● Key in OFF position. ● Disconnect: Instrument Cluster Module (ICM) C220b. ● Measure the resistance between accessory delay relay socket pin 85, and ICM C220b-5, circuit 1332 (LB).  A0055245 ● **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new ICM. REFER to Section 413-01 . TEST the system for normal operation. **No** REPAIR circuit 1332 (LB) for an open. TEST the system for normal operation.

Door Window Motor Initialization

CAUTION: Make sure that no obstructions are present in the window system when carrying out this procedure.

NOTE: The LF window motor is in error mode when shipped and will be inoperative until initialized.

NOTE: The LF window motor must be reinitialized whenever: the motor is removed from window regulator drum housing, a new motor is installed, a new window regulator is installed, new window glass is installed, glass top run removal or installation, or when carrying out any operation in which grease or lubricants are applied to the window system.

NOTE: All LF window components (window glass, window regulator, window motor, and glass top run) must be installed and tightened to specification before carrying out this procedure.

NOTE: If this procedure is only partially completed, the LF window motor will remain un-initialized and only the proportional up/down functions will operate.

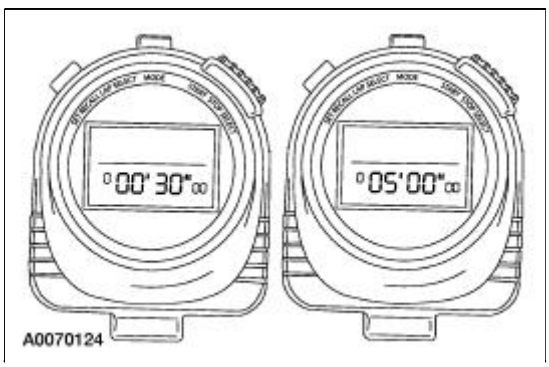
NOTE: Once the ignition key is turned to the ON position in Step 6, it must remain on until the entire procedure is completed.

NOTE: Step 7 requires that the master control switch (LF) be held in the UP position until the LF window motor stalls the window glass into the upper header seal. Step 8 requires that the master control switch (LF) be momentarily actuated to the DOWN position.

NOTE: Step 9 requires that the master control switch (LF) be held in the UP position until the LF window motor stalls the window glass into the upper header seal and the window carries out its down-up sequence, indicating successful completion of initialization.

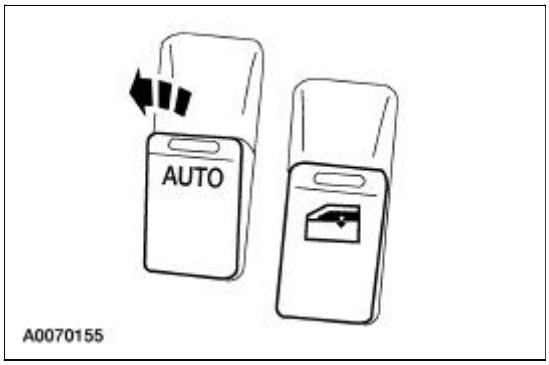
1. **NOTE:** Steps 1 through 6 must be completed within 30 seconds. The entire procedure must be completed within five minutes.

   Start with the ignition key in the OFF position with the LF door open.

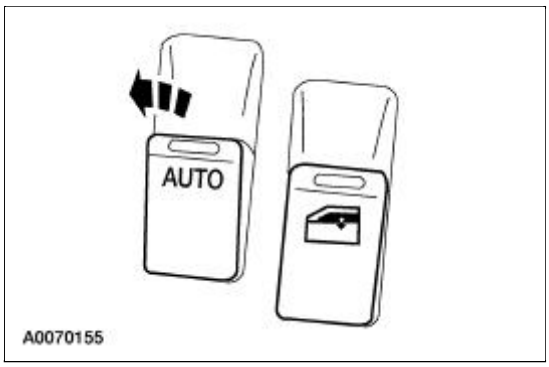
2. Turn the ignition key to the ON position.

3. Press the front window control switch (LF) to the AUTO position six times (AUTO up or AUTO down).



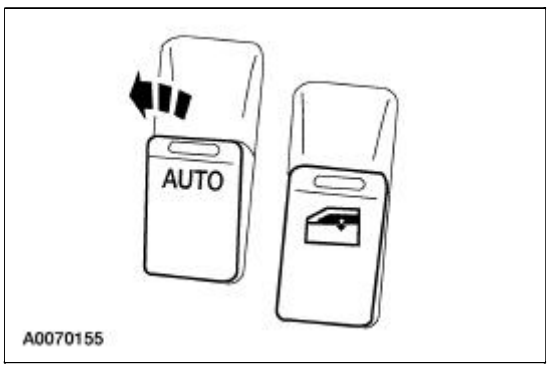
4. Turn the ignition key to the OFF position and make sure the LF door is open.

5. Press the front window control switch (LF) to the AUTO position six times (AUTO up or AUTO down).

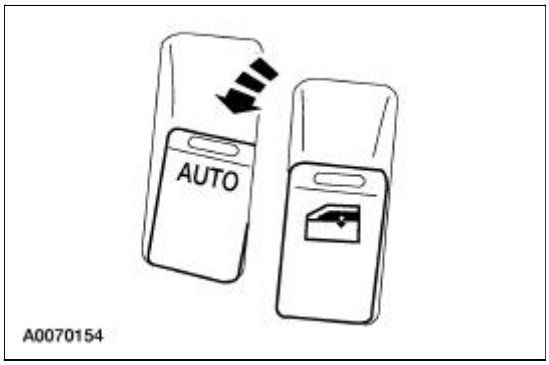


6. Turn the ignition key to the ON position and close the LF door. The LF window glass will move down-up-down-up approximately 2-3 mm (0.1 in). This down-up-down-up movement indicates that the LF window motor has entered initialization mode.

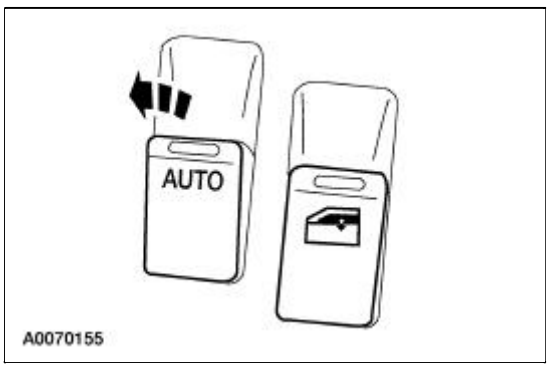
7. Pull and hold the front window control switch (LF) to the UP position until the window glass stalls into the upper header seal.



8. Momentarily press the front window control switch (LF) to the DOWN position and release. The window will carry out a one-touch down operation until the window glass stalls at the bottom of travel stop designed into the window regulator.



9. Pull and hold the front window control switch (LF) to the UP position. Continue to hold the switch until after the window glass stalls into the upper header seal and carries out the down-up movement. This down-up movement approximately 2-3 mm (0.1 in.) indicates that the LF window motor has been successfully initialized.



10. Verify correct operation of the LF window by carrying out a one-touch down, one-touch up, proportional down, and proportional up. If the window does not operate correctly, carefully repeat this procedure.

Heated Window Grid Wire Repair

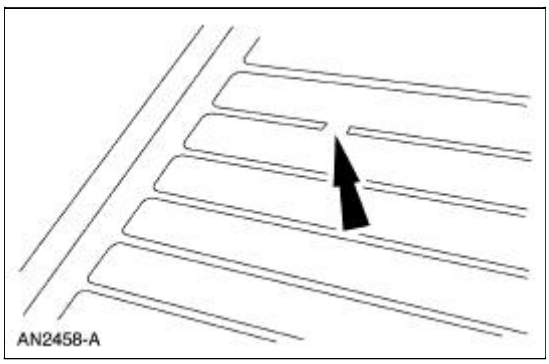
Material

Item	Specification
Dark Walnut Metallic Acrylic Lacquer Touch-up Paint ALBZ-19500-5858A or equivalent	—
Rear Window Defroster Repair D8AZ-19562-AA or equivalent	ESB-M4J58-B

1. **NOTE:** A single break or any breaks which exceed 25 mm (1 inch) in one grid cannot be repaired. Install a new rear window glass.

   NOTE: If the first layer of the heated rear window grid (brown) is damaged or missing, it will be necessary to apply touch-up paint on the glass prior to applying the silver rear window defroster repair.

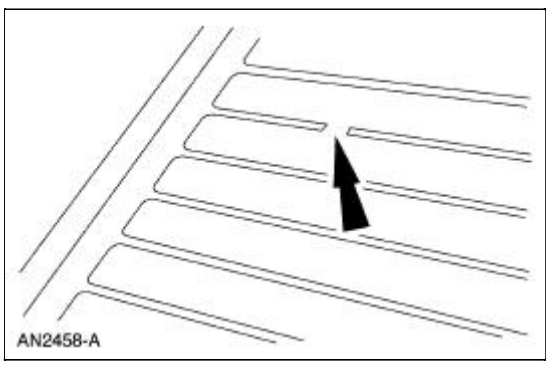
   Repair any inoperative grid wires using rear window defroster repair.



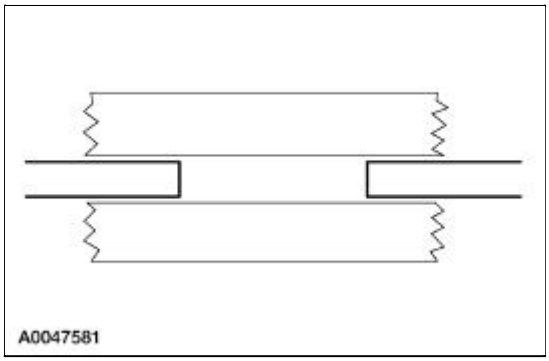
2. Bring the vehicle up to room temperature of at least 16° C (60° F) or above.

3. Clean the entire grid line repair area with a non-alcohol based window cleaner.

4. Mark the location of the grid break on the exterior of the rear window glass.



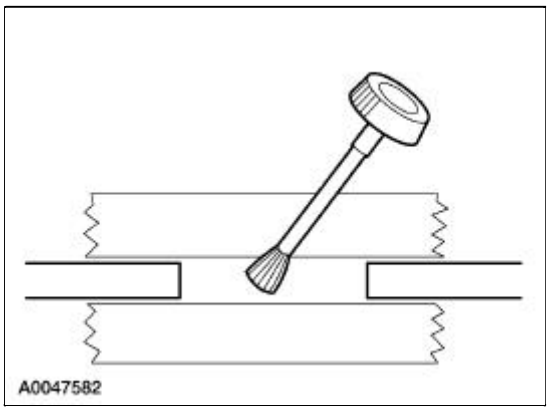
5. Using cellulose tape, mask the area directly above and below the grid break. The break area should be at the center of the mask.



6. **NOTE:** If the brown layer is not broken or missing, apply only the silver grid repair compound to the break.

   NOTE: Allow at least five minutes of drying time between applications.

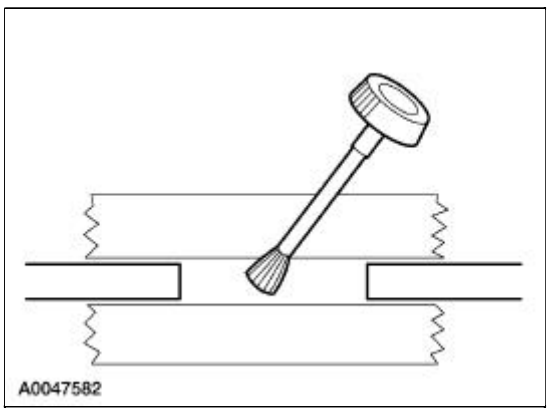
   Apply the repair coating to the grid break area in several smooth, continuous strokes. Extend the repair coating at least 6.35 mm (0.25 inch) on both sides of the break area.



7. **NOTE:** If both the brown and silver layers of the grid are broken or missing, apply a coating of the brown touch-up paint across the break area first. Several applications may be necessary to achieve a color match.

   NOTE: Extend the repair coating at least 6.35 mm (0.25 inch) on both sides of the break area.

   Apply three applications of the grid repair compound.



8. After five minutes or after the repair area has dried completely, remove the mask.

9. **CAUTION: Be careful not to damage the grid line with the razor blade. If this occurs,**

additional repair may be necessary.

Remove any excess repair compound above or below the grid line with a razor blade.

10. **NOTE:** The repair coating will air-dry in approximately one minute and can be energized within three minutes.

    NOTE: Optimum adhesion occurs after approximately 24 hours.

    After optimum hardness is achieved, clean the repaired area with a non-alcohol based window cleaner.

Lead Terminal Repair

Special Tool(s)

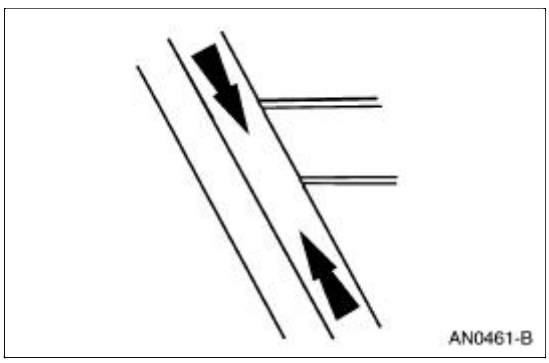
 ST1110-A	Heat Gun 107-R0300 or equivalent

Material

Item	Specification
Rear Window Defroster Repair D8AZ-19562-AA or equivalent	ESB-M4J58-B

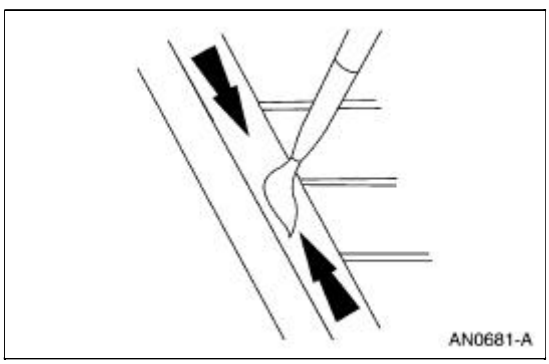
1. **NOTE:** The rear window glass must be at room temperature at the time of the repair.

   Clean the bus bar in the area to be serviced with steel wool (3/0 to 4/0 grade).



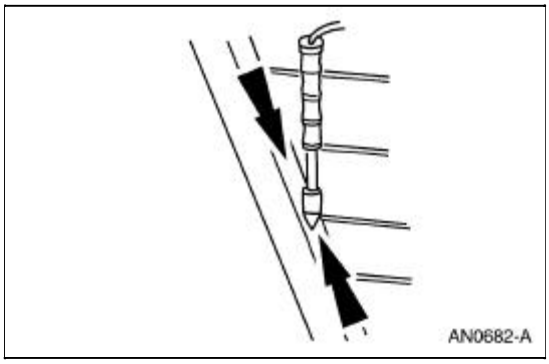
2. **NOTE:** Allow 10 minutes of drying time between the coats.

   Apply three coats of rear window defroster repair.



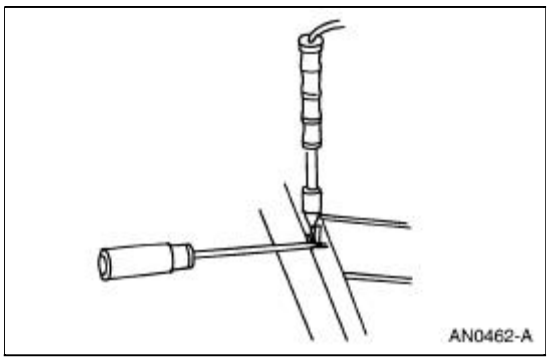
3. **CAUTION: Do not overheat the rear window glass or damage to the rear window glass may occur.**

Tin the bus bar repair area with solder.



4. **CAUTION: To prevent overheating the rear window glass, remove the soldering gun as soon as the solder flows.**

   Preheat the rear window glass in the area to be serviced using the special tool and solder the terminal to the bus bar.



5. **NOTE:** Turn the heated rear window switch ON for five minutes prior to the final inspection of the repair.

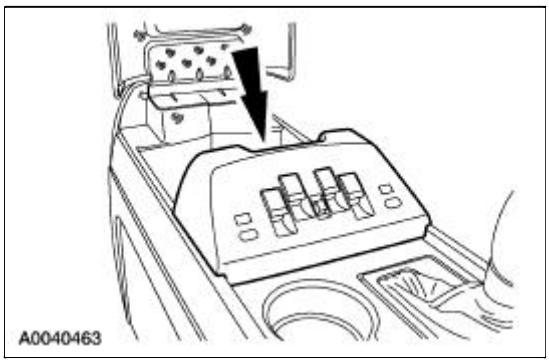
   Apply rear window defroster repair to the repair area as needed.

Window Control Switch

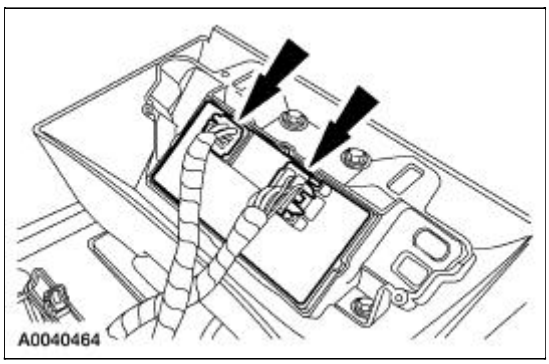
Removal

Navigator front

1. Lift up on the center console armrest.
2. Remove the center console window control switch panel.
   - Remove the pin-type retainer.



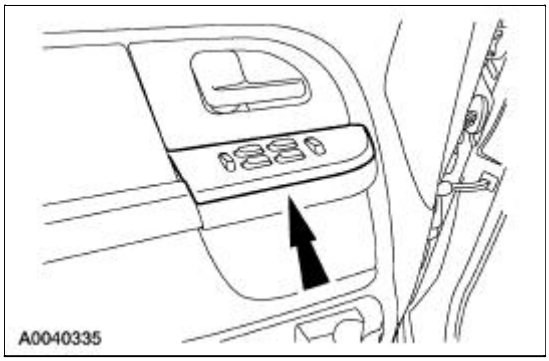
3. Disconnect the electrical connectors and remove the window control switch.
   - Release the locking tabs.



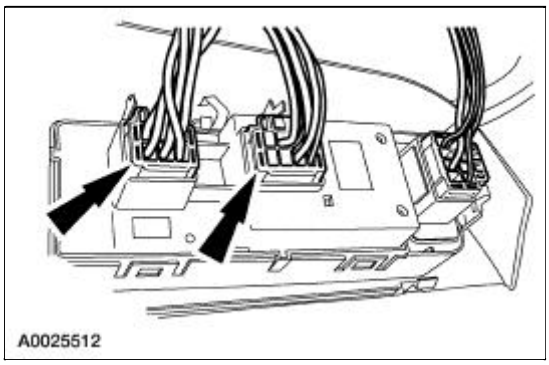
Expedition front and Expedition passenger rear

NOTE: Driver side Expedition shown, all others similar.

4. Remove the window control switch panel.



5. Disconnect the electrical connector(s) and remove the window control switch.
    - Release the locking tabs.



Navigator passenger rear

6. Remove the rear door trim panel. For additional information, refer to Section 501-05 .
7. Remove the window control switch from the door trim panel.

All vehicles

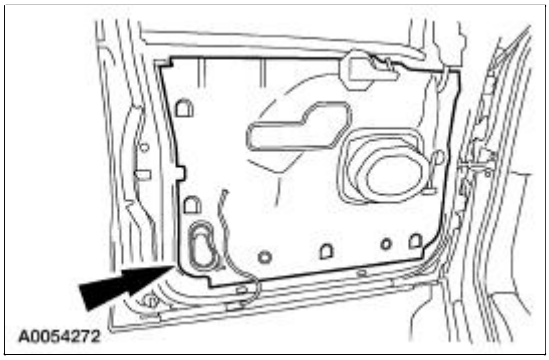
8. To install, reverse removal procedure.

Front Door Window Glass

Removal and Installation

All vehicles

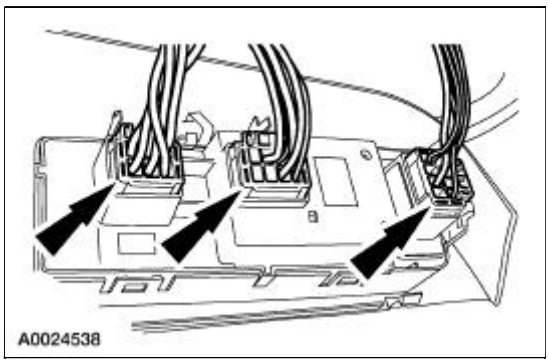
1. Remove the front door trim panel. For additional information, refer to Section 501-05 .
2. Remove the front door weathershield.



Expedition

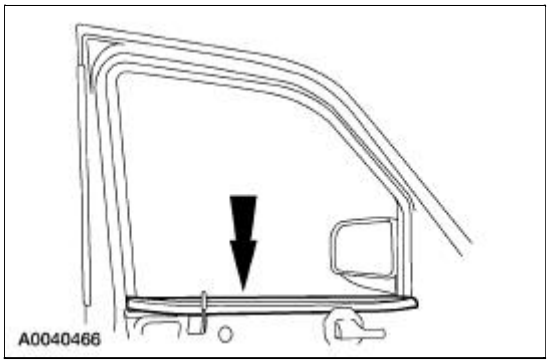
3. **NOTE:** Driver side shown, passenger side similar.

   Connect the window control switch.

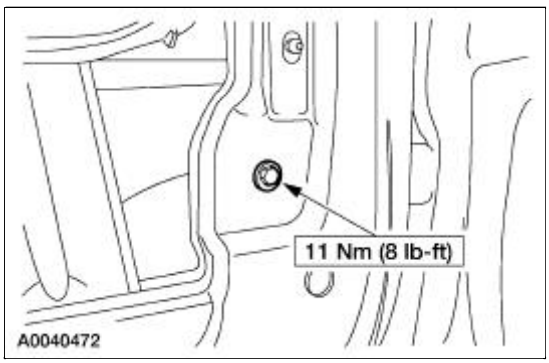


All vehicles

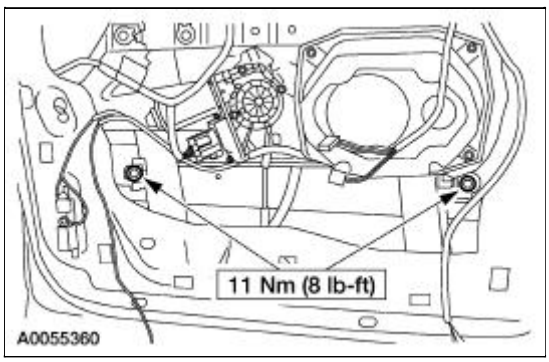
4. Lower the window glass to access the two window glass to regulator bolts.
5. Remove the inside glass weatherstrip.



6. Remove the front door glass channel bolt and position aside the channel.



7. Remove the window glass to regulator bolts and front door window glass.

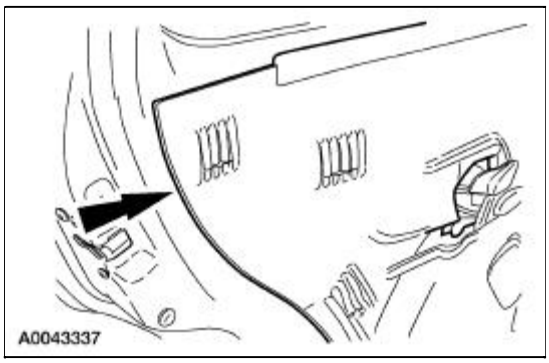


8. To install, reverse the removal procedure.

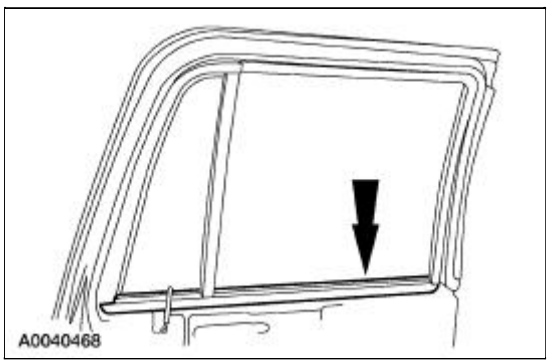
Rear Door Window Glass

Removal and Installation

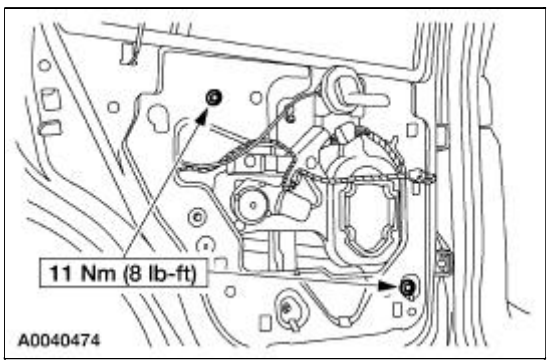
1. Remove the rear door trim panel. For additional information, refer to Section 501-05 .
2. Position back the rear door weathershield.



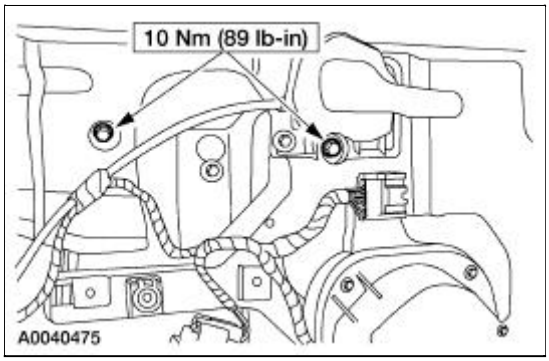
3. Connect the window control switch.
4. Lower the window glass to access the two window glass to regulator bolts.
5. Remove the inside glass weatherstrip.



6. Remove the rear door glass channel bolts.



7. Remove the window glass to regulator bolts and rear door window glass.

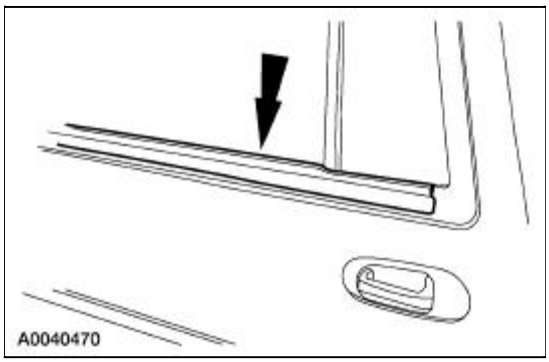


8. To install, reverse the removal procedure.

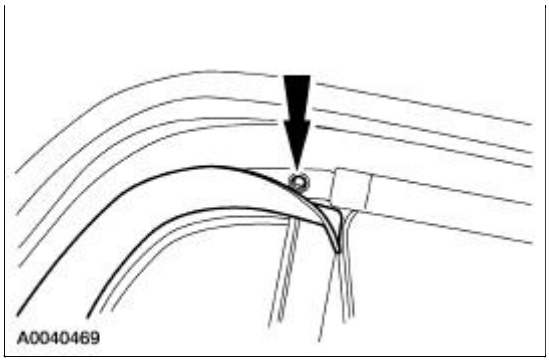
Rear Door Window Glass —Stationary

Removal and Installation

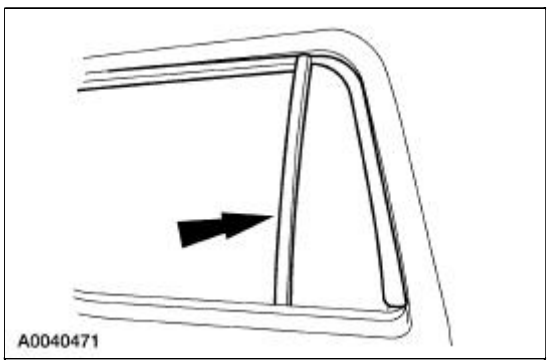
1. Remove the rear door window glass. For additional information, refer to Rear Door Window Glass in this section.
2. Remove the rear door exterior glass moulding.



3. Remove the rear door glass top run. For additional information, refer to Rear Door Glass Top Run in this section.
4. Remove the rear door stationary glass screw.



5. Remove the stationary rear door glass.



6. To install, reverse the removal procedure.

Rear Quarter Window Glass

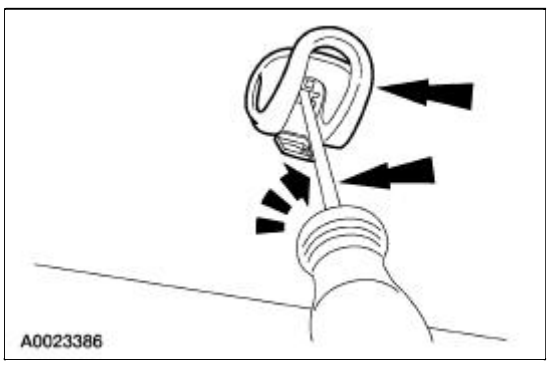
Removal

All vehicles

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

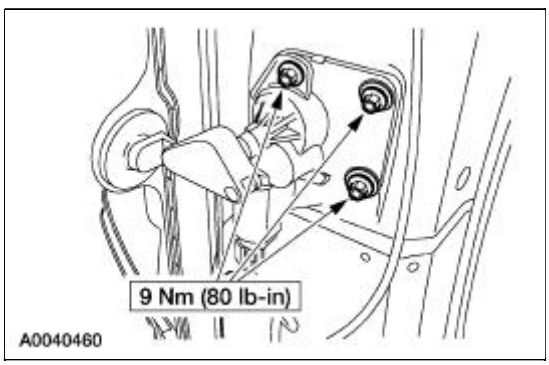
2. **CAUTION: To prevent damage to the coat hanger retainer, use a 3/16-inch flat-blade screwdriver for this step.**

   Remove the front and rear coat hooks and lower the headliner over the rear quarter window glass.
   - Open the access cover.
   - Insert a screwdriver into the coat hook slot and turn the screwdriver 90 degrees so that it engages in the plastic component slot. This will spread the steal attachment clip wings to allow the plastic component to disengage.



Vehicles with power vent window

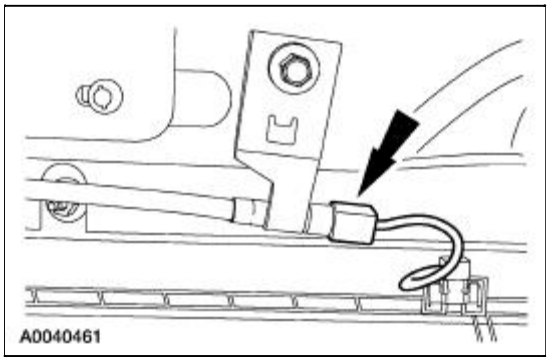
3. Remove the bolts and rear quarter window regulator motor.
   - Disconnect the electrical connector.



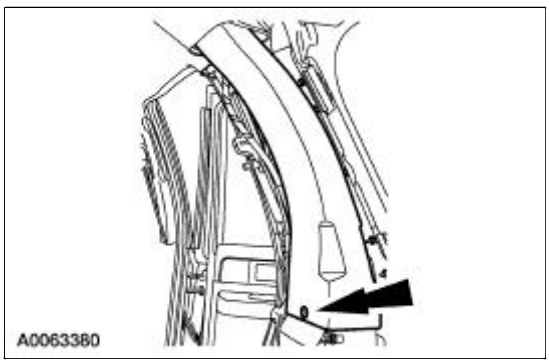
4. Disconnect the rear quarter window regulator.

All vehicles

5. Disconnect the audio antenna.

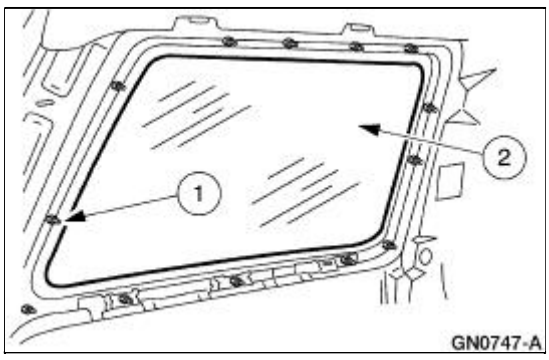


6. If equipped, remove the air duct.
    - Remove the pin-type retainer.

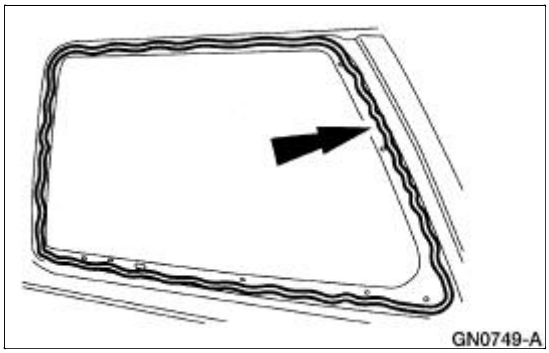


7. **CAUTION: Have an assistant hold the rear quarter window glass.**

    Remove the rear quarter window glass.
    1. Remove the nuts.
    2. Remove the rear quarter window glass.



8. Remove the excess foam butyl from the window opening.

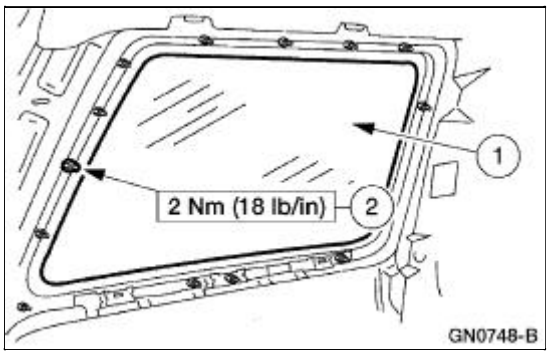


Installation

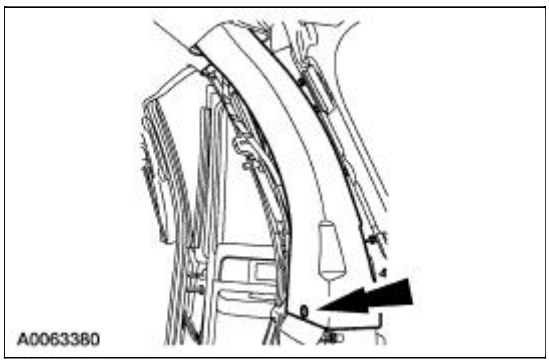
All vehicles

1. Apply 8 mm (0.32 in) Foam Butyl of equivalent meeting Ford specification WSB-M4GB45-A to the rear quarter window glass frame.
    - Start at the bottom middle and work around the frame.

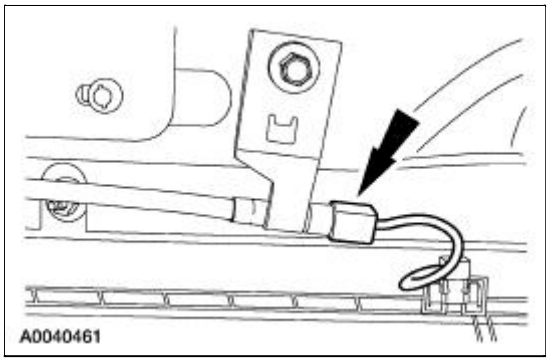
2. Install the rear quarter window glass.
    1. Position the rear quarter window glass.
    2. Install the rear quarter window glass nuts.



3. If equipped, install the air duct.
    - Install the pin-type retainer.

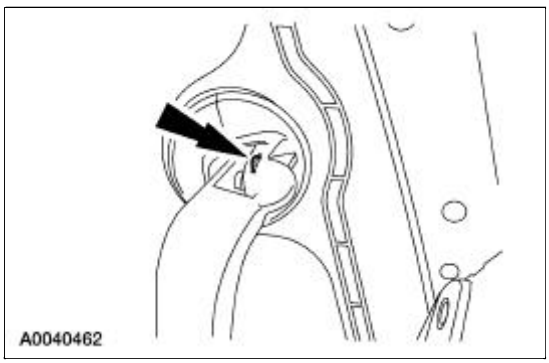


4. Connect the audio antenna.

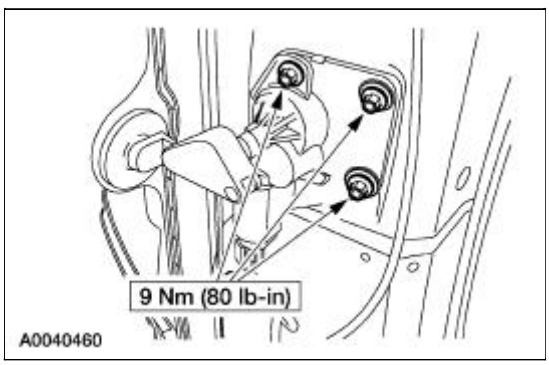


Vehicles with power vent windows

5. Install the rear quarter window regulator.



6. Install the bolts and rear quarter window regulator motor.
    - Connect the electrical connector.



All vehicles

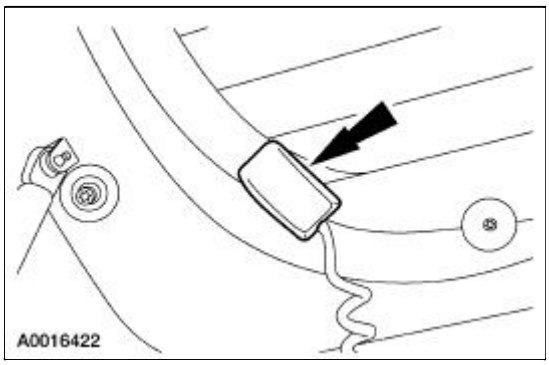
7. Position the headliner and install the coat hooks.

8. Install the rear quarter trim panel. For additional information, refer to Section 501-05 .

Liftgate Window Glass

Removal and Installation

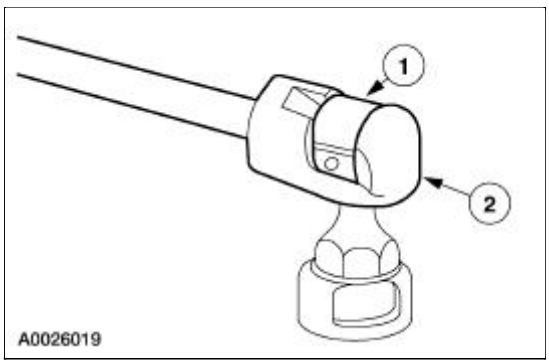
1. Remove the liftgate wiper motor arm. For additional information, refer to Section 501-16 .
2. Disconnect the rear window defrost electrical connectors.



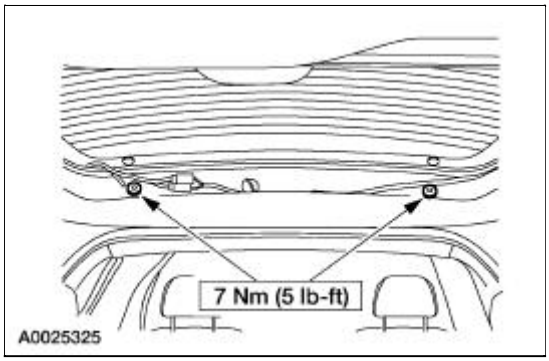
3. **CAUTION: The liftgate must be supported when removing and installing the liftgate assist cylinders.**

   CAUTION: Do not extend the socket clips more than 2.0 mm (0.08 in) or failure of the socket can occur.

   Disconnect the two liftgate glass assist cylinders.
   1. Insert a screwdriver blade under the socket clip and lift.
   2. Gently pull the socket off the ball stud.



4. Remove the liftgate hinge bolts and remove the glass.

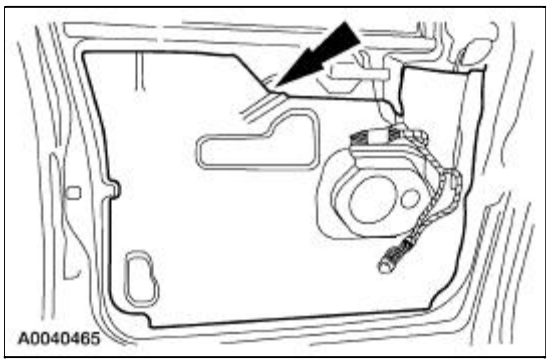


5. To install, reverse the removal procedure.

Front Door Window Regulator Motor

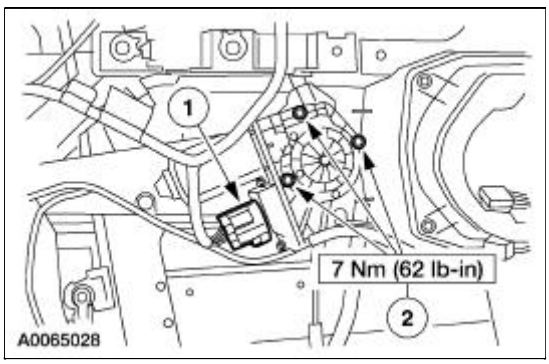
Removal and Installation

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



3. **NOTE:** Use a flat-blade screwdriver between the window regulator motor and window regulator assembly to hold the window regulator assembly drum in place.

   Remove the bolts and the front door window regulator motor.
   1. Disconnect the electrical connector.
   2. Remove the bolts.

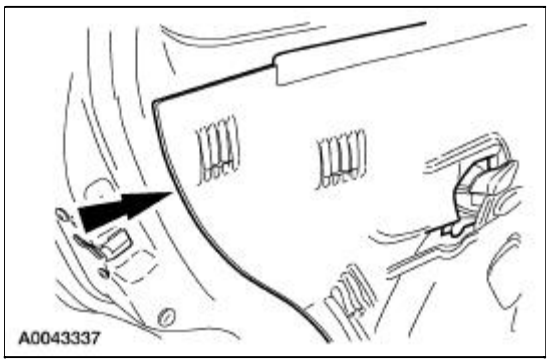


4. To install, reverse the removal procedure.
   - Cycle the window glass to make sure the gears engage.

Rear Door Window Regulator Motor

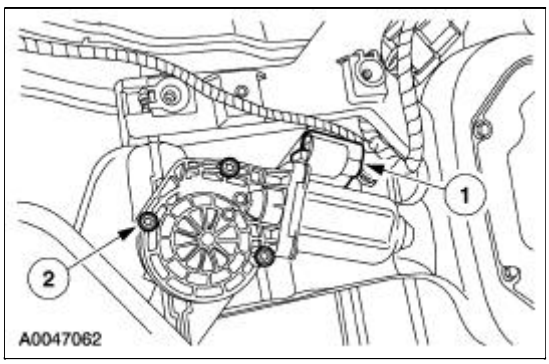
Removal and Installation

1. Remove the rear door trim panel. For additional information, refer to Section 501-05 .
2. Position the rear door weathershield aside.



3. **NOTE:** Use a flat-blade screwdriver between the window regulator motor and the window regulator assembly to hold the window regulator assembly drum in place.

   Remove the rear door window regulator motor.
   1. Disconnect the electrical connector.
   2. Remove the bolts.

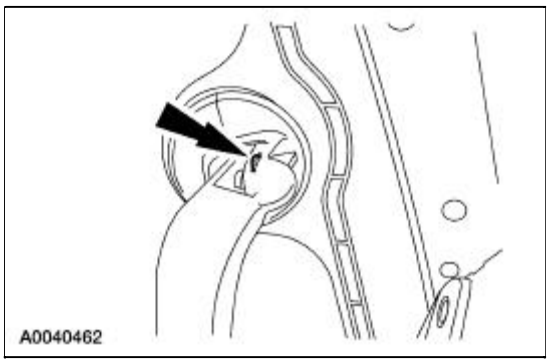


4. To install, reverse the removal procedure.
   - Cycle the door glass to make sure of gear engagement.

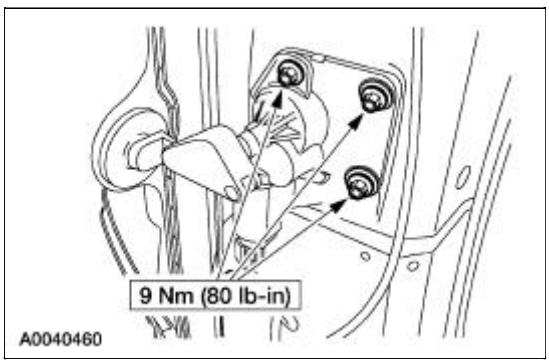
Rear Quarter Window Regulator Motor

Removal

1. Remove the D-pillar trim panel. For additional information, refer to Section 501-05 .
2. Disconnect the rear quarter window regulator motor.
   - Remove the retaining clip.



3. Remove the bolts and rear quarter window regulator motor.
   - Disconnect the electrical connector.



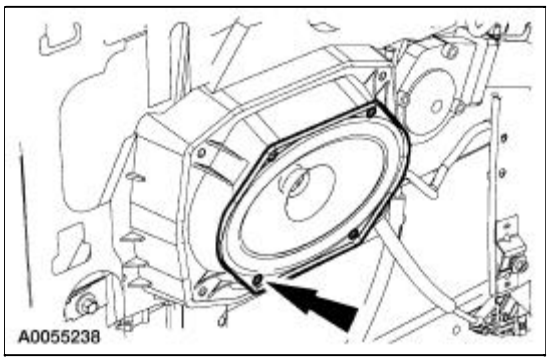
4. To install, reverse the removal procedure.

Front Door Window Regulator

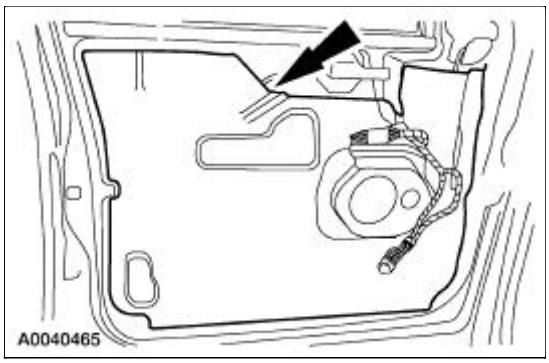
Removal and Installation

All vehicles

1. Remove the front door trim panel. For additional information, refer to Section 501-05 .
2. Remove the screws and the front door speaker.
   - Disconnect the electrical connector.



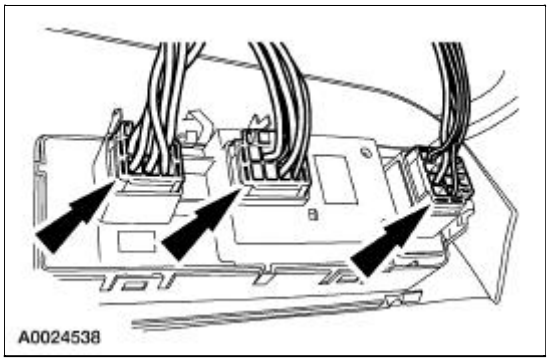
3. Remove the front door weathershield.



Expedition

4. **NOTE:** Driver side shown, passenger side similar.

   Connect the window control switch.



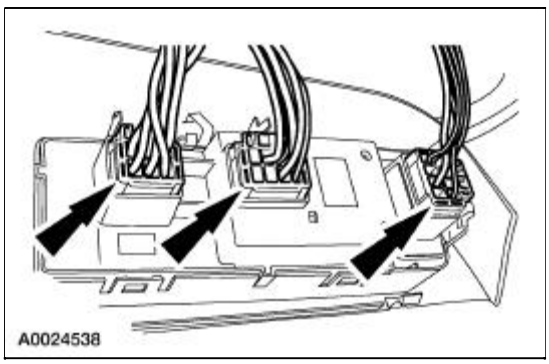
All vehicles

5. Lower the window glass to access the two window glass-to-regulator bolts.

Expedition

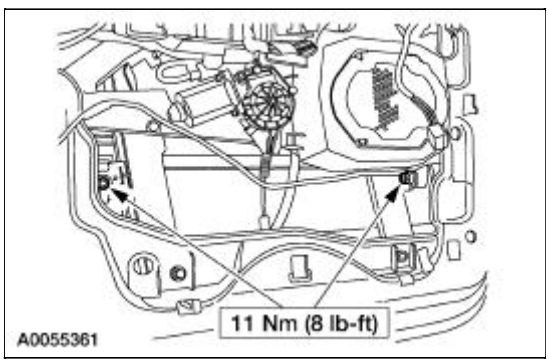
6. **NOTE:** Driver side shown, passenger side similar.

   Disconnect the window control switch.



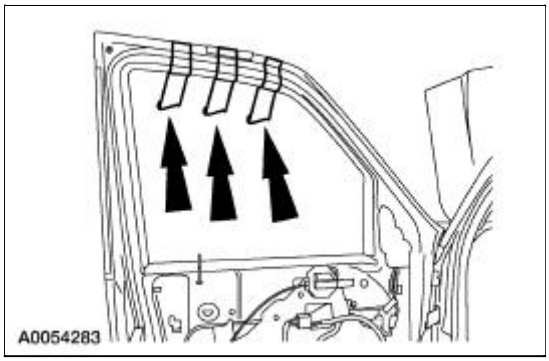
All vehicles

7. Remove the window glass-to-regulator bolts and front door window glass.

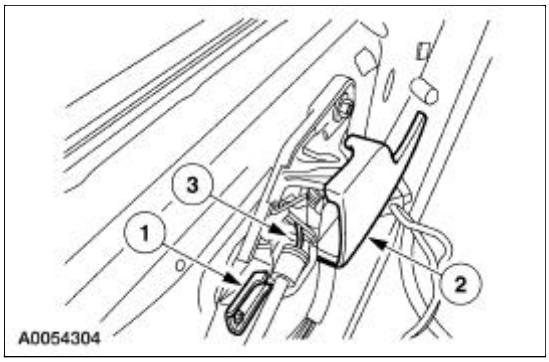


8. **NOTE:** Secure the front window glass in the full up position.

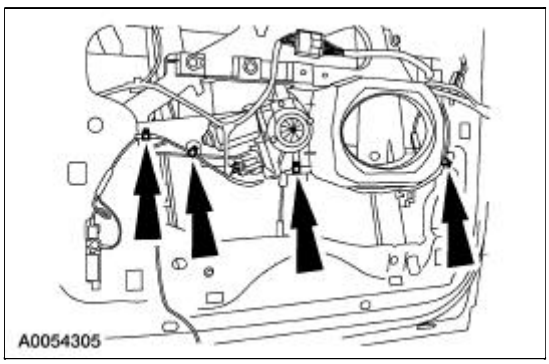
   Secure the front window glass with tape to the front door frame.



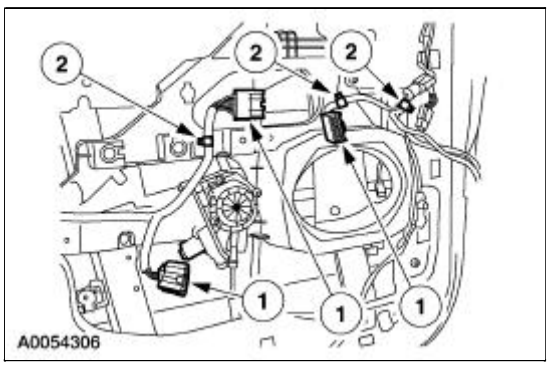
9. Position the interior door handle aside.
    1. Remove the cable conduit fitting from the carrier assembly.
    2. Lift upward on the interior door handle retaining bracket and pivot the interior door handle out of the bracket.
    3. Remove the cable from the door handle.



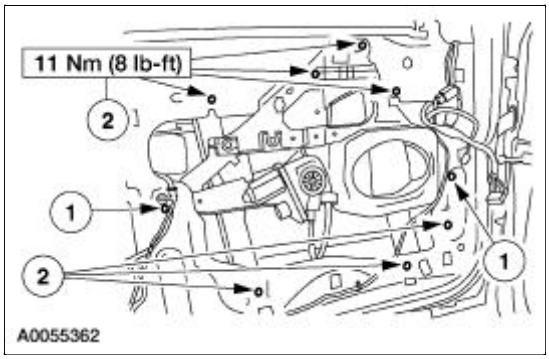
10. Release the crash sensor harness pin-type retainers.



11. Position the front door window regulator harness aside.
    1. Disconnect the electrical connectors.
    2. Release the pin-type retainers.



12. Remove the front window regulator.
    1. Loosen the two hanger bolts.
    2. Remove the front window regulator bolts and front top run channel bolt.

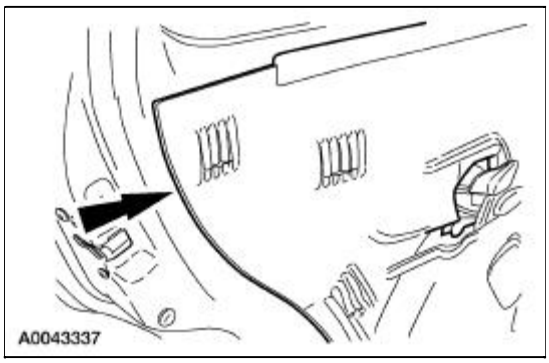


13. To install, reverse the removal procedure.

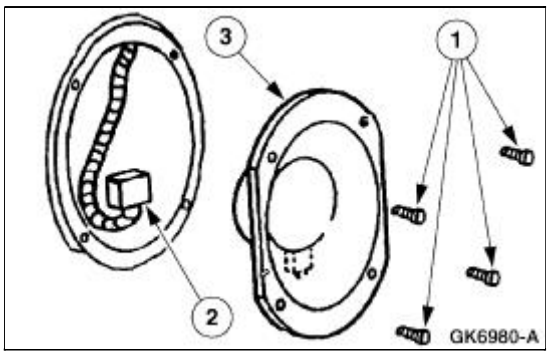
Rear Door Window Regulator

Removal and Installation

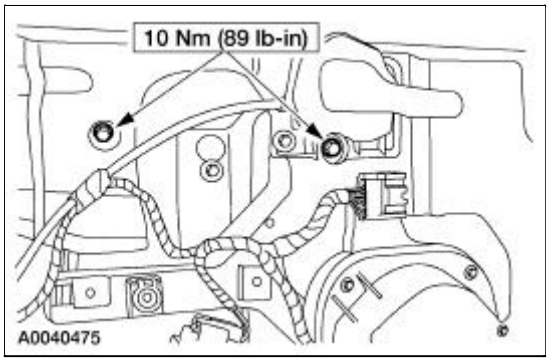
1. Remove the rear door trim panel. For additional information, refer to Section 501-05 .
2. Remove the rear door weathershield.



3. Remove the rear door speaker.
    1. Remove the screws.
    2. Disconnect the electrical connector.
    3. Remove the speaker.



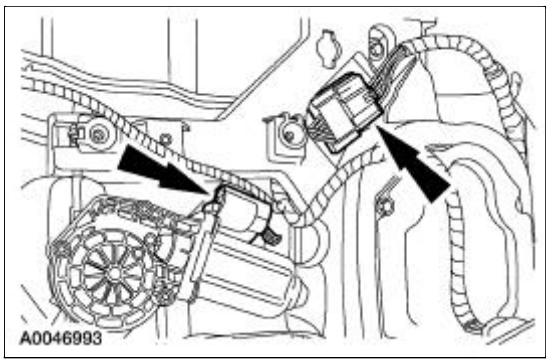
4. Connect the window control switch.
5. Lower the window glass to access the two window glass-to-regulator bolts.
6. Disconnect the window control switch.
7. Remove the window glass-to-regulator bolts and rear door window glass.



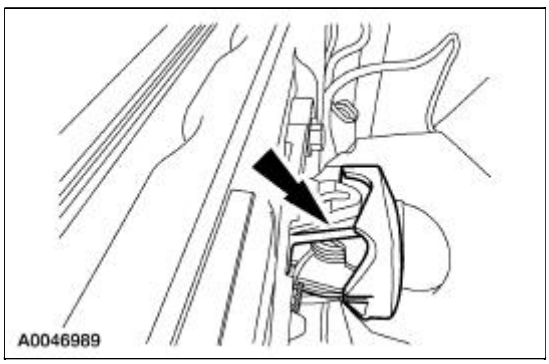
8. **NOTE:** Secure the rear window glass in the full up position.

   Secure the rear window glass with tape to the front door frame.

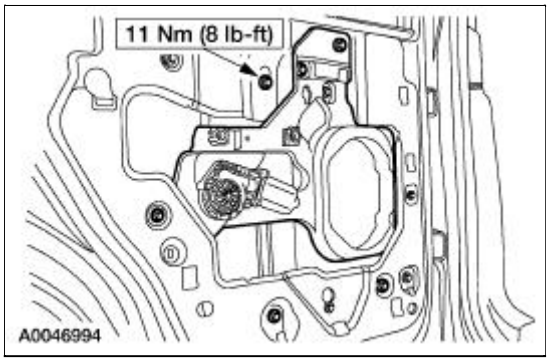
9. Disconnect the rear door window regulator electrical connectors.



10. Position the interior door handle aside.
    - Lift upward on the interior door handle retaining bracket and pivot the interior door handle out of the bracket.



11. Remove the rear door window regulator assembly.
    - Remove the bolts.



12. To install, reverse the removal procedure.

Windshield Glass

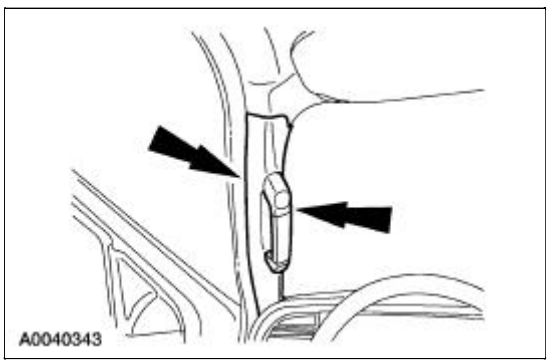
Special Tool(s)

 ST1109-A	Rotunda Pneumatic Knife with Offset Blade 107-R1511 or equivalent
 ST2085-A	The Pumper 164-R2459 or equivalent
 ST1320-A	Rotunda Interior Auto Glass Cut-Out Knife Kit 164-R2450 or equivalent

Removal

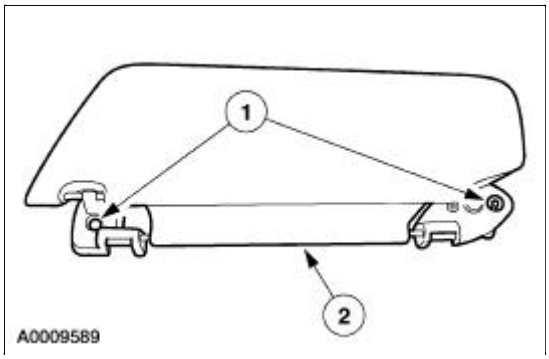
WARNING: To prevent glass splinters from entering eyes or cutting hands, wear safety glasses and heavy gloves when cutting glass from the vehicle.

1. Remove the cowl grille. For additional information, refer to Section 501-02 .
2. Remove the A-pillar trim panels.
   - Remove the bolt covers and bolts.



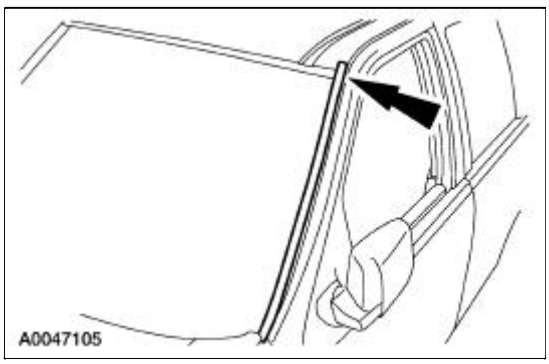
3. If equipped, remove the overhead console.
4. Remove the interior rear view mirror (17700). For additional information, refer to Section 501-09 .

5. Remove the sun visors.
    1. Remove the four screws
    2. Remove the two sun visor and visor arm clips
        - If equipped, disconnect the electrical connectors.

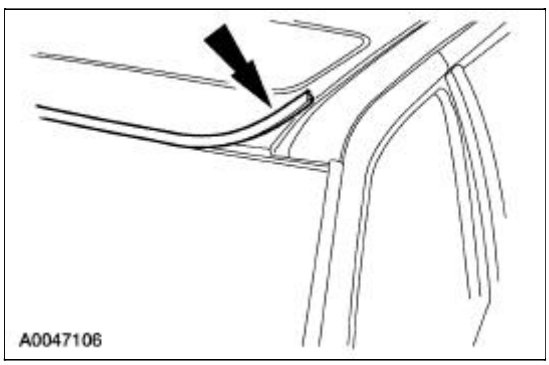


6. Lower the front portion of the headliner.

7. Remove the windshield side mouldings.
    - Pull out starting at the top corner.



8. Remove the upper windshield weatherstrip.
    - Pull out starting at the corner.



9. Mark the outside of the windshield glass with a wax pencil to avoid damaging the glass stops when cutting the urethane.

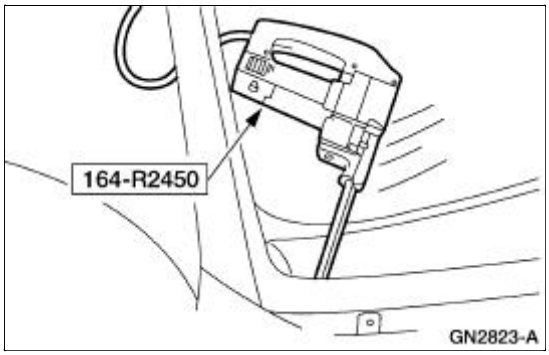
10. Using a soft brush or vacuum, remove any dirt and foreign material from the pinch weld.

11. **CAUTION: Care must be taken to avoid scratching the pinchweld.**

NOTE: Lubricate the urethane adhesive with water to aid the special tool while cutting.

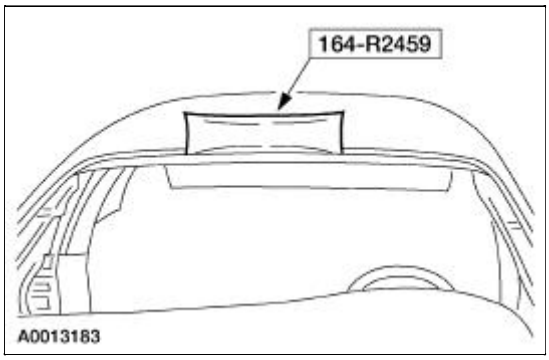
Using the special tool, cut the urethane adhesive from the windshield glass.

- Insert the blade into the urethane at the top middle of the glass and work toward the top corners.
- Insert the blade at the top corners and work down each side of the glass toward the bottom.



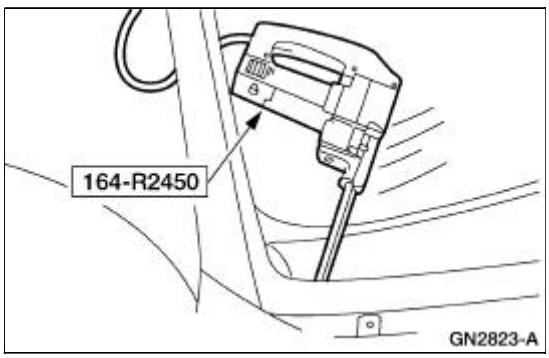
12. **CAUTION: Pump special tool 164-R2459 or equivalent slowly as cowl adhesive is cut to avoid breaking glass.**

    Using the special tool, distance the windshield from the body.



13. **NOTE:** Removing the windshield glass requires an assistant.

    Using the special tool, cut the remaining urethane adhesive and remove the windshield glass.



14. Using a soft brush or vacuum, remove any dirt and foreign material from the pinch weld.

Installation

CAUTION: Do not drive the vehicle after installing windshield glass until the urethane adhesive has cured. Inadequate curing of the urethane adhesive adversely affects the strength of the urethane adhesive bond.

CAUTION: If using Urethane Adhesive Essex 400, the curing time at temperatures above 13°C (55°F) and relative humidity above 50% is 12-24 hours. Curing time decreases at higher temperatures and/or lower humidities.

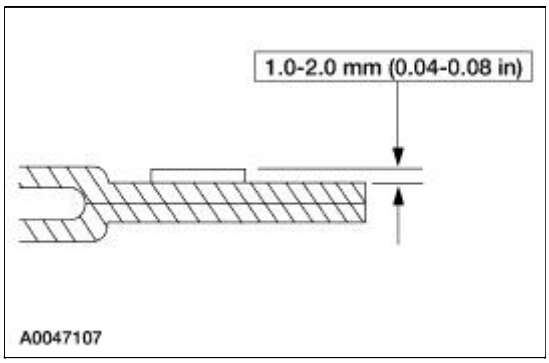
CAUTION: If a vehicle is to be driven within 24 hours of urethane adhesive application, Urethane Adhesive Essex U-216 meeting Ford specification WSB-M2G316-B must be used, due to its one hour cure time.

1. Dry-fit the windshield glass by centering it side-to-side and by adjusting the setting blocks (if equipped) to get the correct position of the part top to bottom. Make the alignment marks with tape or non-staining grease pencil on both the glass and the vehicle body.

2. **CAUTION: Care must be taken to avoid scratching the pinch weld.**

   Trim the remaining urethane adhesive on the pinch weld to within specification.

   - The old urethane surface should be smooth and free of cuts and contamination.



3. Use the wool applicator to apply Urethane Metal Primer Essex U-413, meeting Ford specification WSB-M2G234-C to any exposed metal on the pinch weld. Allow six to ten minutes to dry.

4. If reinstalling the original windshield, remove excess urethane adhesive from the windshield glass.

5. If installing a new windshield glass, clean the inside of the glass surface with an alcohol-free cleaner to make sure the ceramic-coated area is clean.

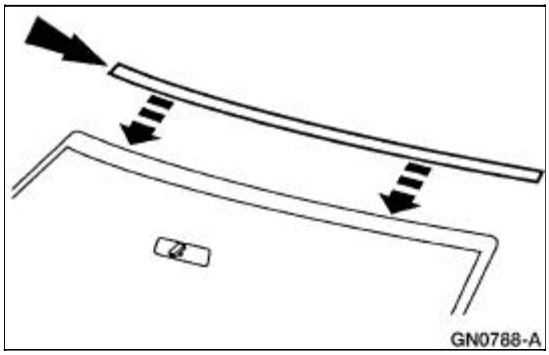
6. **CAUTION: Wipe off Urethane Glass Prep Essex U-401 immediately after each application because it flash dries.**

   NOTE: Apply with deliberate strokes, making sure not to overlap applied area.

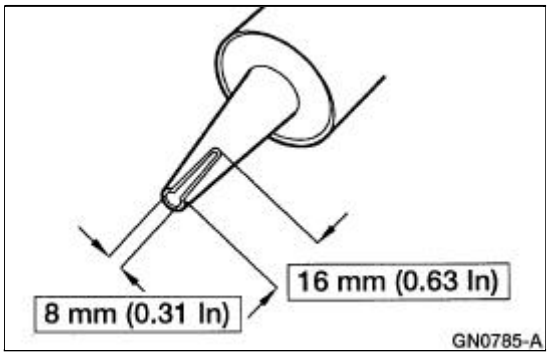
   Apply Urethane Glass Prep Essex U-401 or equivalent meeting Ford specification WSB-M2G314-B twice around the glass surface to be prepped.

7. Apply Urethane Glass Primer Essex U-402 meeting Ford specification WSB-M5B280-C to the same area that was in the previous step. Allow five minutes to dry.

8. Install the upper windshield weatherstrip.



9. Cut the urethane applicator tip to specification.

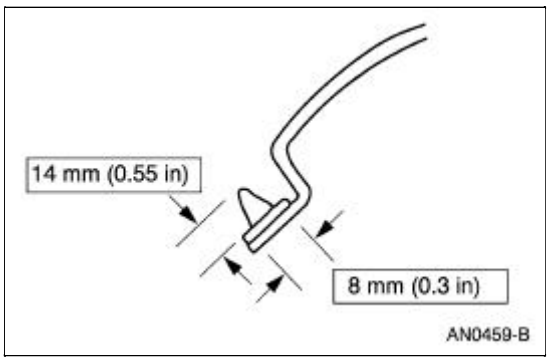


10. **CAUTION: Do not drive the vehicle after installing windshield glass until the urethane adhesive has cured. Inadequate curing of the urethane adhesive adversely affects the strength of the urethane adhesive bond.**

CAUTION: If using Urethane Adhesive Essex 400-HV, the curing time at temperatures above 13°C (55°F) and relative humidity above 50% is 12-24 hours. Curing time decreases at higher temperatures and/or lower humidities.

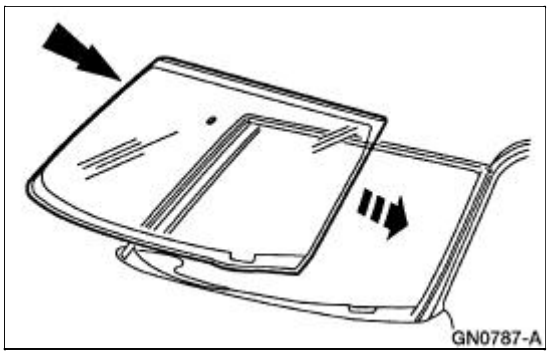
CAUTION: If a vehicle is to be driven within 24 hours of urethane adhesive application, Urethane Adhesive Essex U-216 meeting Ford specification WSB-M2G316-B must be used, due to its one hour cure time.

Apply a bead of Urethane Adhesive Essex 400-HV or Essex U-216 meeting Ford specification WSB-M2G316-B to the pinch weld just outside the foam butyl dam over the top of the existing urethane bed.



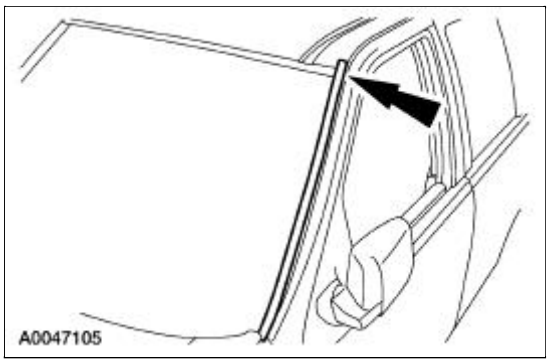
11. **CAUTION: Open the windows to prevent the windshield glass from being pushed out by air pressure if a door is closed.**

    Using the alignment marks, install the windshield glass.



12. Install the windshield side mouldings.

    NOTE: Be sure the moldings seat completely.

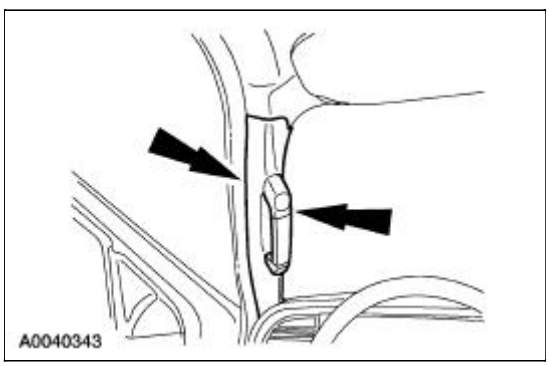


13. Install the headliner.

14. Install the interior rear view mirror. For additional information, refer to Section 501-09 .

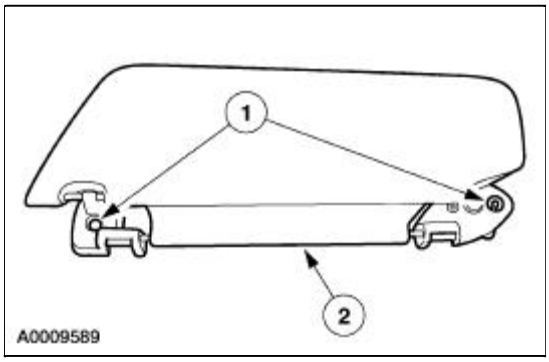
15. Install the overhead console.

16. Install the A-pillar trim panels.
    - Install the bolts and covers.



17. Install the sun visors.
    1. Position the sun visors.
    2. Install the four screws.

- If equipped, connect the electrical connectors.



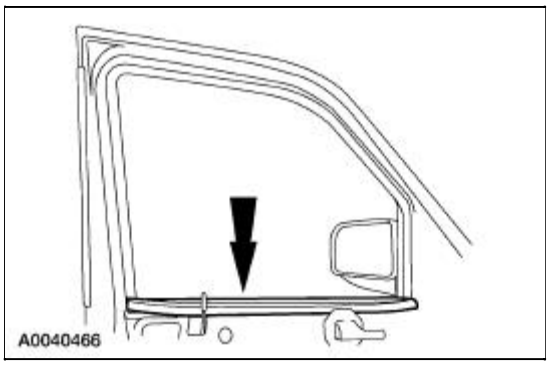
18. Install the cowl grille. For additional information, refer to Section 501-02 .

19. Run the blower motor on defrost HIGH to check for glass that may have fallen into the defroster vents.

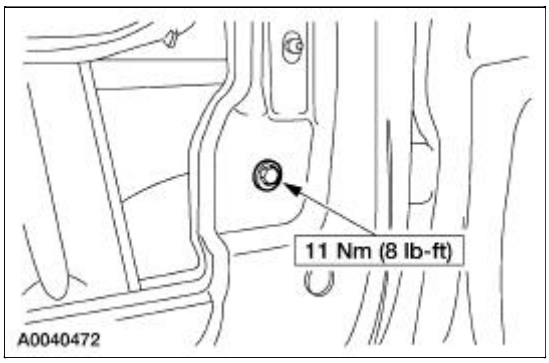
Front Door Glass Top Run

Removal and Installation

1. Remove the front door window glass. For additional information, refer to Front Door Window Glass in this section.
2. Remove the inside glass weatherstrip.



3. Remove the front door glass channel bolt and front door glass top run.

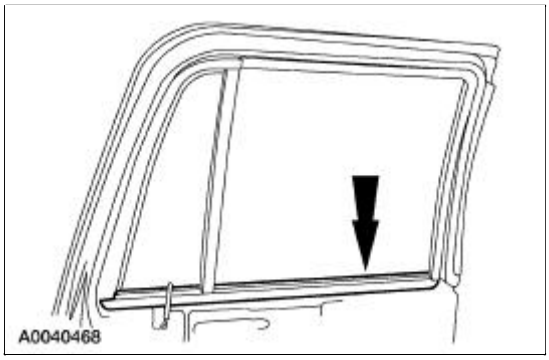


4. To install, reverse the removal procedure.

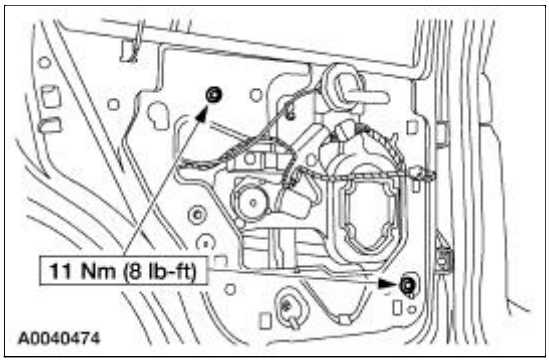
Rear Door Glass Top Run

Removal and Installation

1. Lower the rear door window glass.
2. Remove the rear door trim panel. For additional information, refer to Section 501-05 .
3. Remove the inside glass weatherstrip.



4. Remove the rear door glass channel bolts.



5. Remove the rear door glass top run.
6. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-ft	lb-in
Assist handle bolts	6	—	53
Bulkhead electrical connector bolts	5	—	44
Front floor console bracket bolts (Navigator)	20	15	—
Front floor console bolts (Navigator)	7	—	62
Glove compartment bolts	3	—	27
Ground wire bolts	3	—	27
Hood release handle bolts	9	—	80
Instrument panel bolts	30	22	—
Instrument panel finish panel screws	2	—	18
Front floor console bolts (Expedition)	12	9	—
Instrument panel floor brace bolts	9	—	80
Instrument panel steering column cover screws	3	—	27
Steering column reinforcement panel bolts	9	—	80
Parking brake release handle bolts	9	—	80
Rear floor console bolts	12	9	—
Intermediate shaft pinch bolt	30	22	—
Front floor console mounting bracket bolts	55	41	—
Rear floor console mounting bracket bolts	47	35	—
Front console screws (Navigator)	3	—	27

Instrument Panel

The instrument panel consists of the following components:

- instrument panel cluster finish panel
- instrument panel defroster grille (Navigator)
- instrument panel side finish panels
- glove compartment
- instrument panel center finish panel (Navigator)
- instrument panel steering column cover
- instrument panel fuse door
- steering column reinforcement panel
- instrument panel upper covers (Expedition)

Console —Floor, Front

The front floor console may consist of the following components:

- A/C integral control assembly
- A/C register (upper)
- auxiliary A/C controls
- auxiliary power point
- center console finish panel
- console finish panel mat
- compact disc player mounting bracket
- compact disc player compartment trim panel
- digital audio compact disc player
- shift lever (Navigator)
- window control switch panel (Navigator)
- navigation system display module
- navigation system module
- video cassette player

Console —Floor, Rear

The rear console consists of the following components:

- armrest
- cup holders
- storage bin

Console —Overhead

There are two versions of the overhead console, with and without the roof opening panel.

The overhead console with the roof opening panel may contain the following:

- climate controls (optional)
- map lamps/switches
- roof opening panel switch
- rear quarter window switches (optional)

The overhead console without the roof opening panel may contain the following:

- climate controls (optional)
- glasses storage bin
- map lamps/switches
- rear quarter window switches (optional)
- storage bin

Instrument Panel

Removal

CAUTION: Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage may result.

All vehicles

1. If equipped with adjustable pedals, move the pedals to the full forward position.
2. If equipped, remove the front floor console. For additional information, refer to Floor Console—Front, Navigator or Floor Console—Front, Expedition in this section.

Navigator only

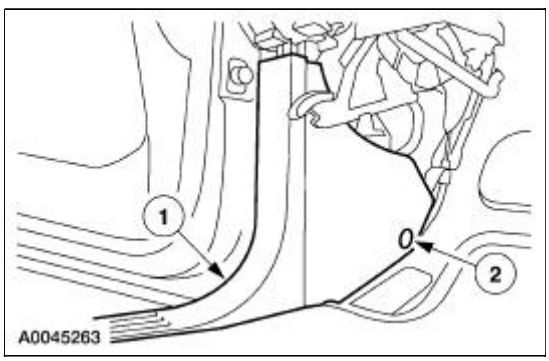
3. Remove the driver air bag module. For additional information, refer to Section 501-20B .

Expedition only

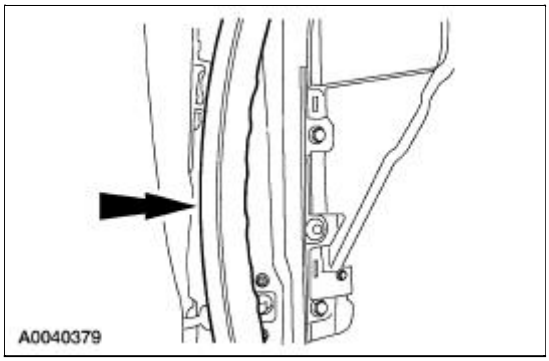
4. Remove the steering wheel. For additional information, refer to Section 211-04 .

All vehicles

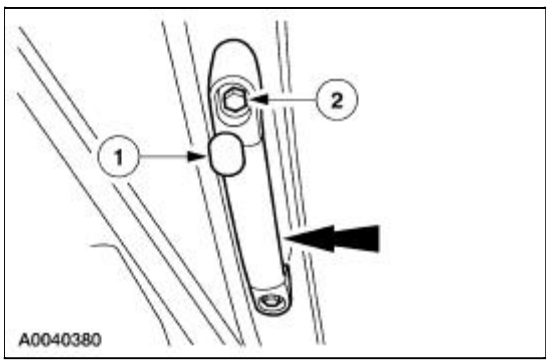
5. Remove the passenger air bag module. For additional information, refer to Section 501-20B .
6. If equipped, remove the RH instrument panel insulator.
   - Disconnect the instrument panel insulator lamp.
7. Remove the LH and RH A-pillar lower trim panels.
   1. Remove the scuff plate.
   2. Remove the pin-type retainer.



8. Position the LH and RH door weatherstrip seals aside.

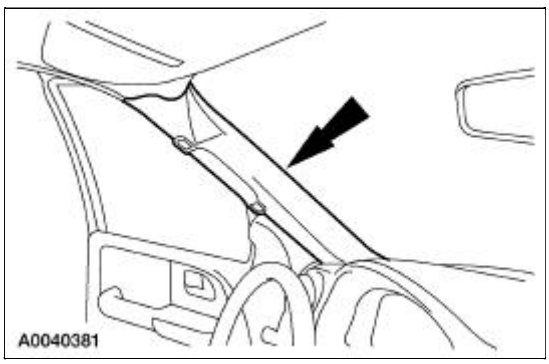


9. Remove the LH and RH assist handles.
    1. Remove the covers.
    2. Remove the bolts.

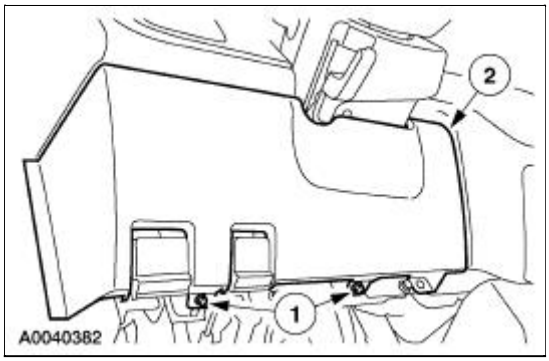


10. **NOTE:** Release the top attachments by pulling inboard first and then upward to release the lower hook.

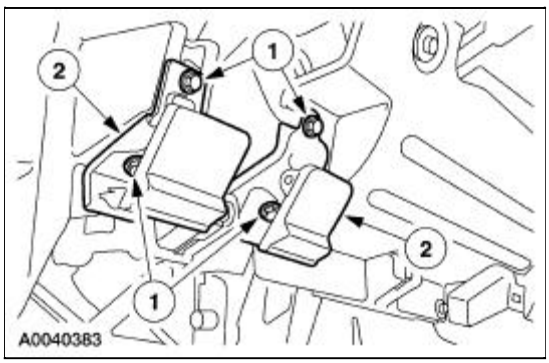
    Remove the LH and RH windshield side garnish mouldings.



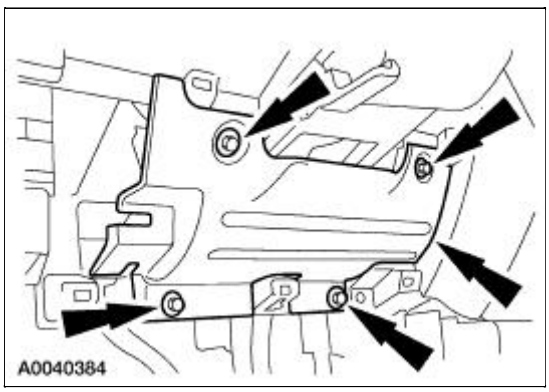
11. Remove the instrument panel steering column cover.
    1. Remove the screws.
    2. Release the cover from the instrument panel.



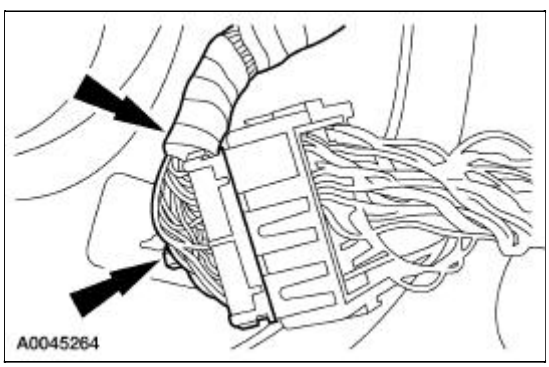
12. Position the hood release and parking brake release handles aside.
    1. Remove the bolts.
    2. Position the release handles aside.



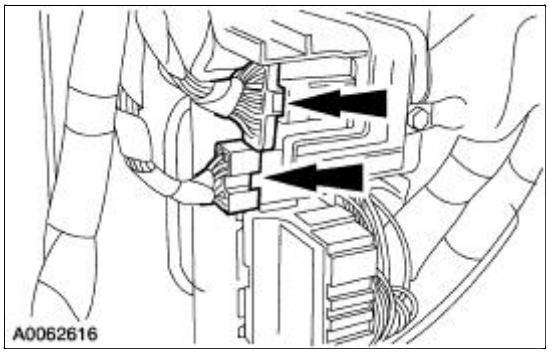
13. Remove the bolts and the steering column reinforcement panel.



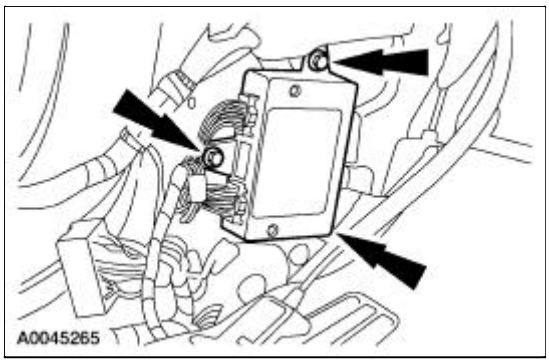
14. Loosen the bolt and disconnect the LH instrument panel bulkhead connector.



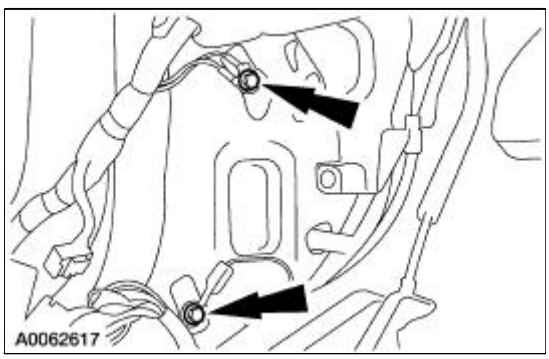
15. Disconnect the LH electrical connectors.



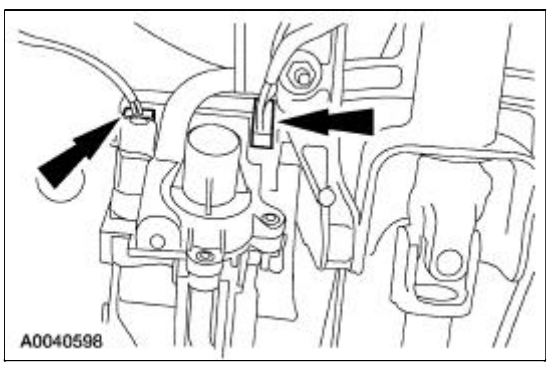
16. Remove the bolts and position the vehicle security module aside.



17. Remove the bolt and position the ground wires aside.



18. Disconnect the cruise control deactivator and the brake on/off switch electrical connectors.

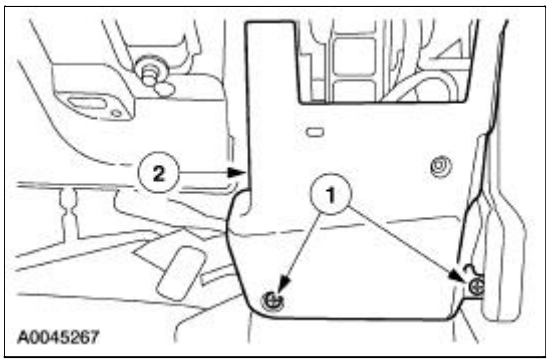


19. If equipped, disconnect the adjustable pedal motor connector.

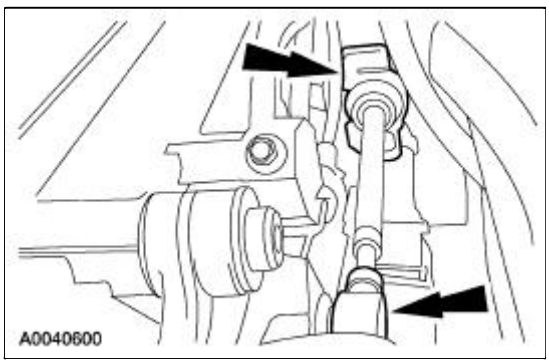
Expedition only

20. Remove the steering column shrouds.

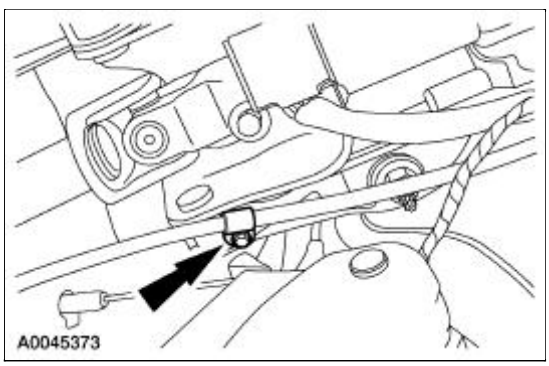
1. Remove the screws.
2. Remove the upper and lower shrouds.



21. Disconnect the steering column shift cable.



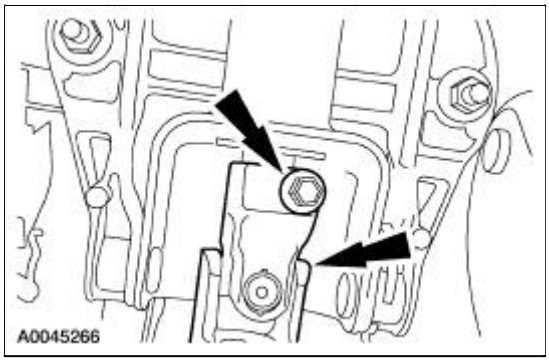
22. Remove the screw and position the steering column shift cable bracket aside.



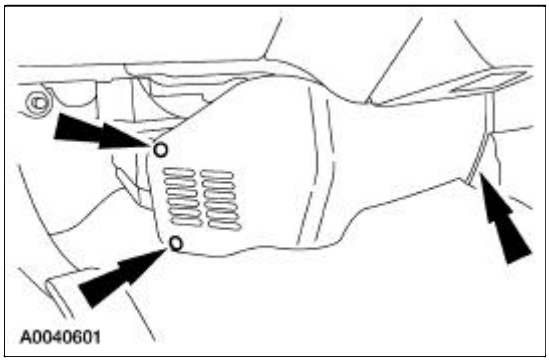
All vehicles

23. **CAUTION: Secure the steering wheel to prevent any rotation or damage to the clockspring.**

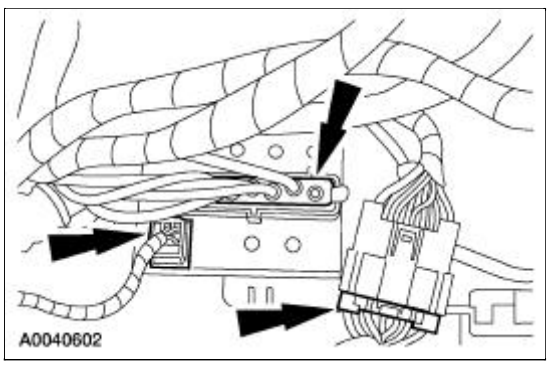
    Remove the pinch bolt and separate the intermediate shaft from the steering column.



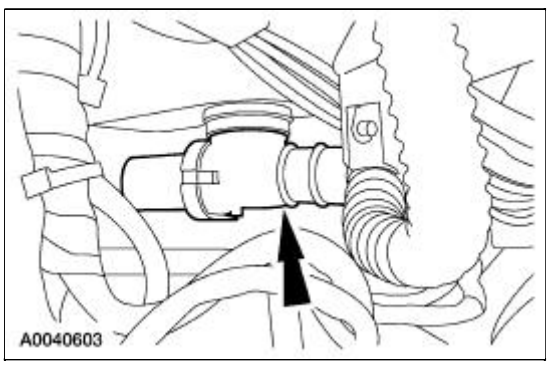
24. If equipped, remove the three pin-type retainers and the valance panel.



25. Disconnect the climate control head vacuum harness and the electrical connector.

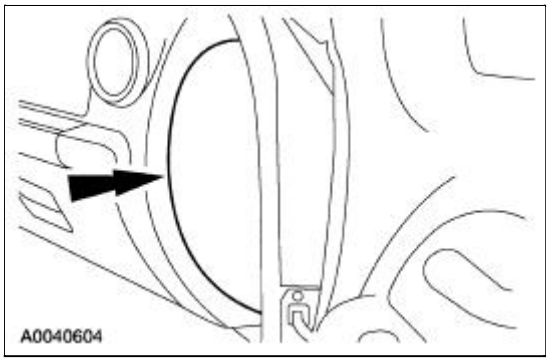


26. If equipped, disconnect the electronic automatic temperature control (EATC) hose from the evaporator case.

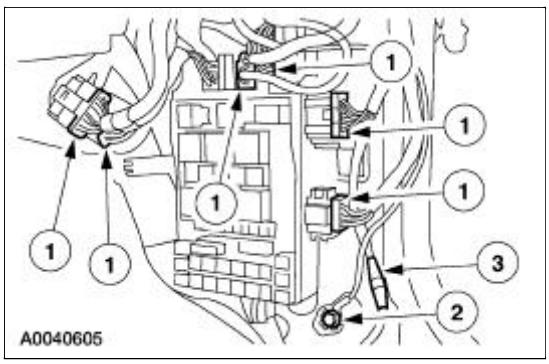


27. **NOTE:** Expedition shown; Navigator similar.

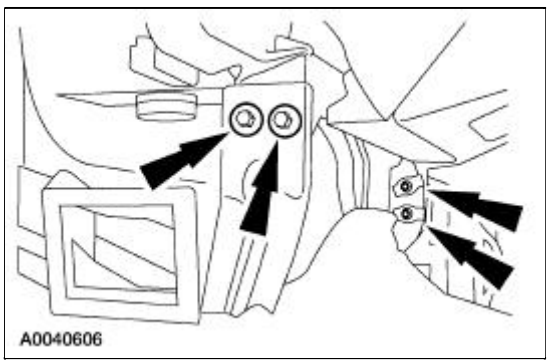
    Remove the RH instrument panel side finish panel.



28. Disconnect the RH instrument panel electrical connectors.
    1. Disconnect the electrical connectors
    2. Remove the RH ground bolt.
    3. Disconnect the in-line antenna connector.

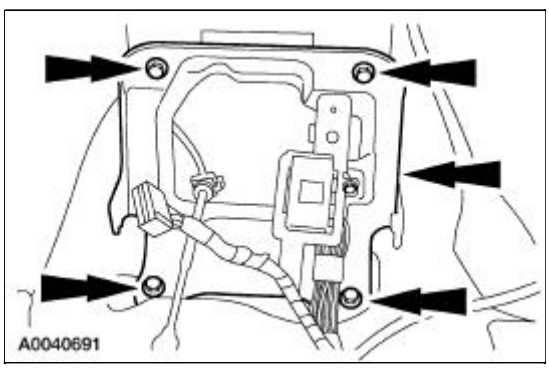


29. Remove the instrument panel floor brace bolts.



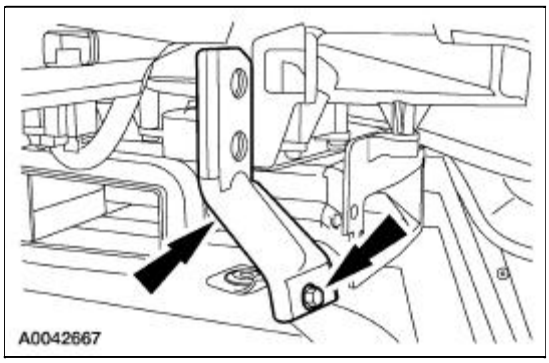
Navigator only

30. Remove the bolts and position the floor console bracket aside.

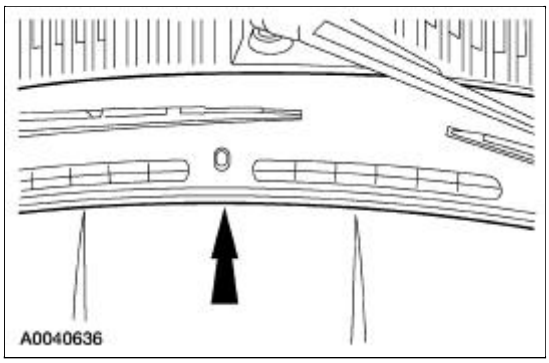


31. **NOTE:** The LH brace is similar to Expedition; RH brace shown.

    Position the carpet aside, remove the bolts and the instrument panel floor braces.

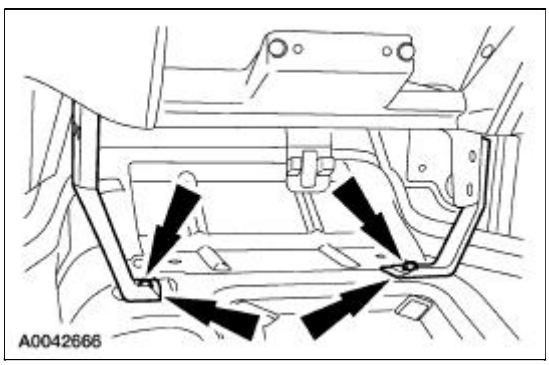


32. Remove the instrument panel defroster grille.

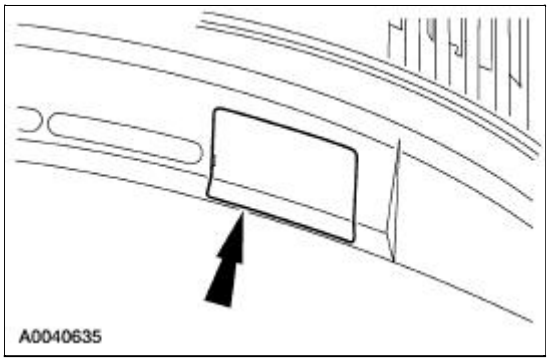


Expedition only

33. Position the carpet aside, remove the bolts and the instrument panel floor brace.

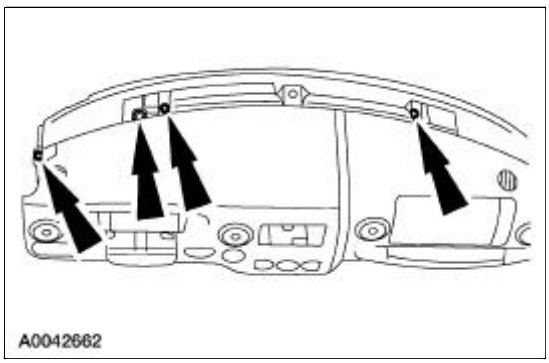


34. Remove the instrument panel cowl top bolts covers.

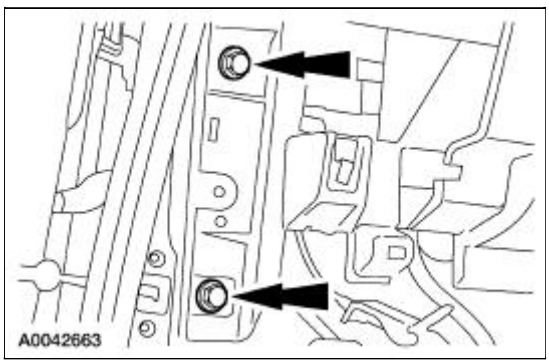


All vehicles

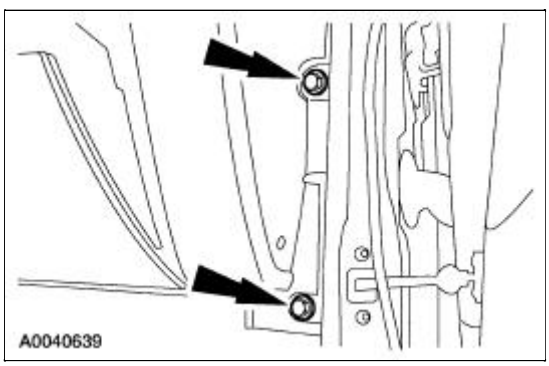
35. Remove the instrument panel bolts.



36. Remove the LH instrument panel bolts.



37. Remove the RH instrument panel bolts.



38. **NOTE:** This step requires an assistant.

NOTE: Two bullet connectors align the instrument panel to the bulkhead.

Remove the instrument panel.

Installation

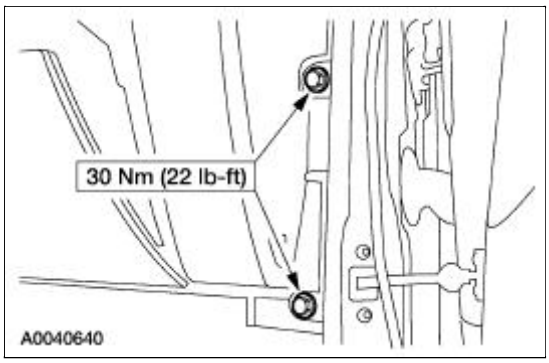
CAUTION: Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage may result.

All vehicles

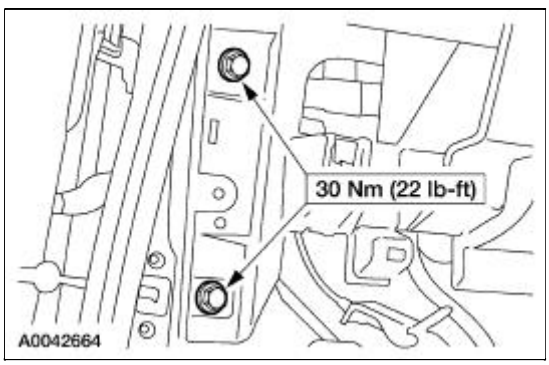
1. **NOTE:** This step requires an assistant.

   Align and position the instrument panel in the vehicle.

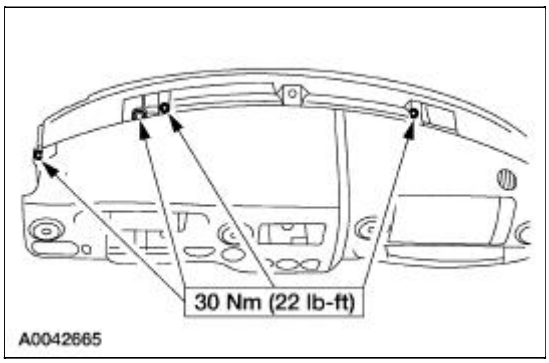
2. Install the RH instrument panel bolts.



3. Install the LH instrument panel bolts.

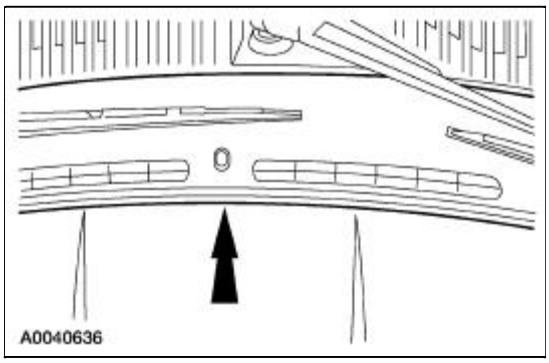


4. Install the instrument panel bolts.



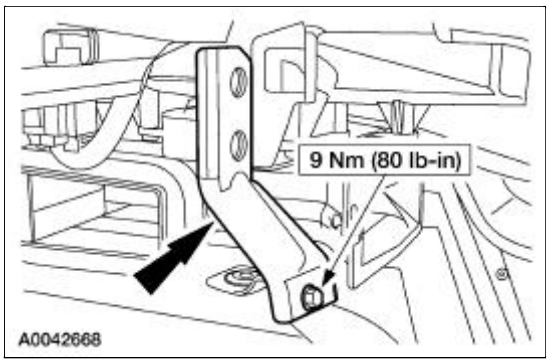
Navigator only

5. Install the instrument panel defroster grille.

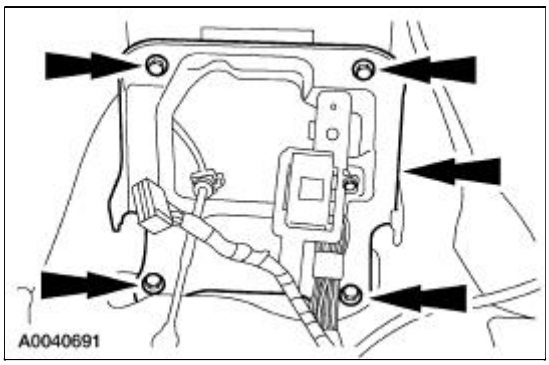


6. **NOTE:** The LH brace is similar to Expedition; RH brace shown.

   Position the instrument panel floor braces and install the bolts.
   - Position the carpet aside.

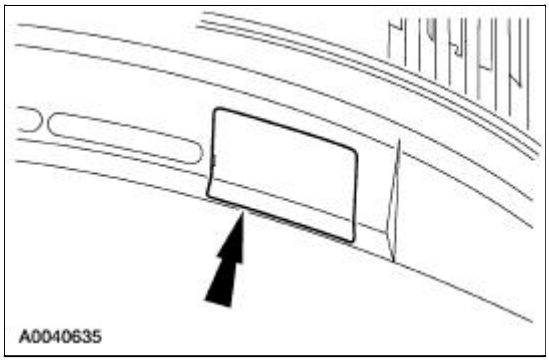


7. Position the floor console bracket and loosley install the bolts.

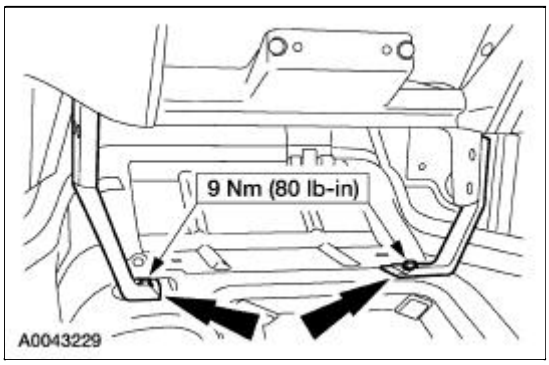


Expedition only

8. Install the instrument panel cowl top bolt covers.

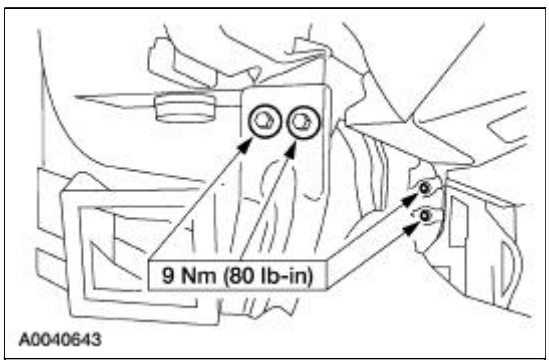


9. Position the instrument panel floor braces and the install bolts.
    - Position the carpet aside.

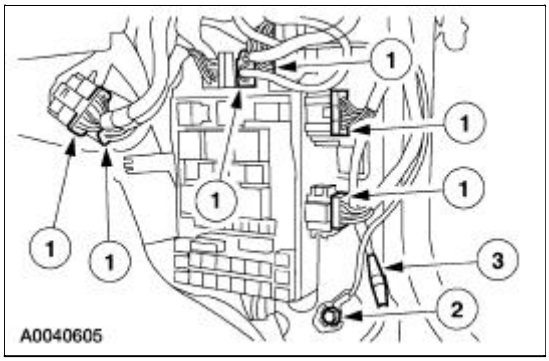


All vehicles

10. Install the instrument panel floor brace bolts.

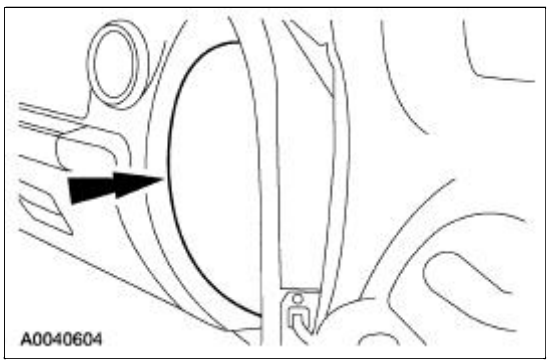


11. Connect the RH instrument panel electrical connectors.
    1. Connect the electrical connectors.
    2. Install the RH ground wire and bolt.
    3. Connect the in-line antenna connector.

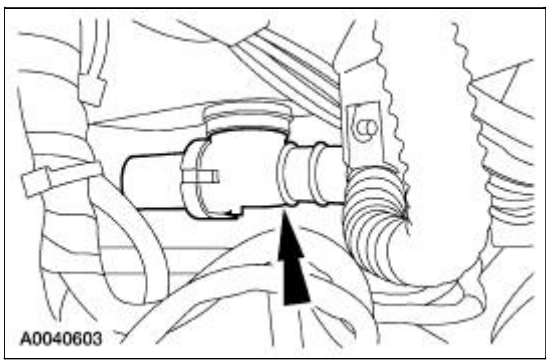


12. **NOTE:** Expedition shown; Navigator similar.

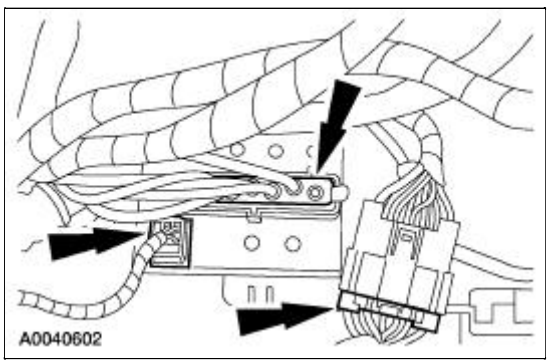
    Install the RH instrument panel side finish panel.



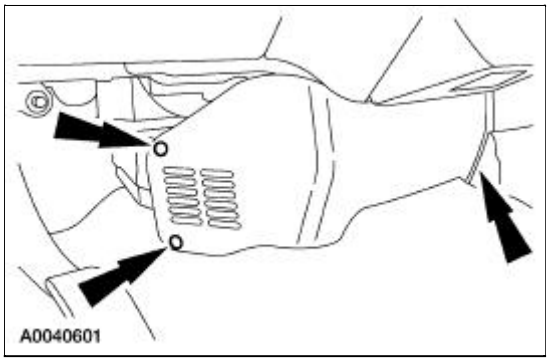
13. If equipped, connect the EATC hose to the evaporator case.



14. Connect the climate control head vacuum harness and the electrical connector.

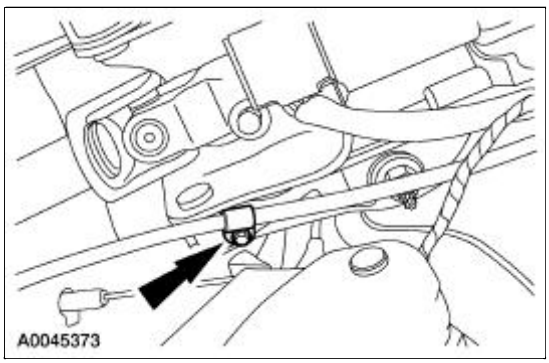


15. If equipped, position the valance panel and install the three pin-type retainers.

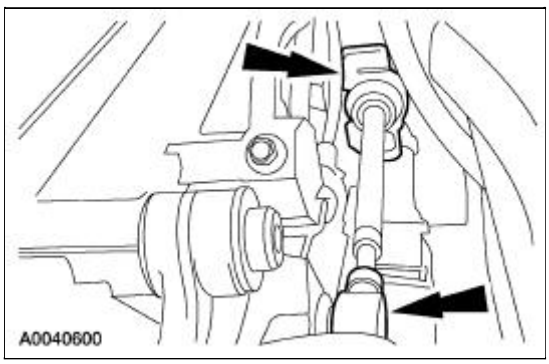


Expedition only

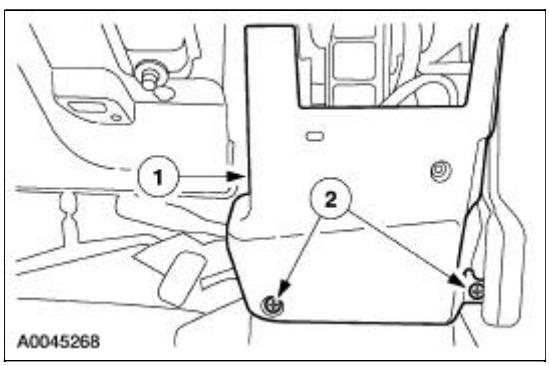
16. Position the steering column shift cable bracket and install the screw.



17. Connect the steering column shift cable.

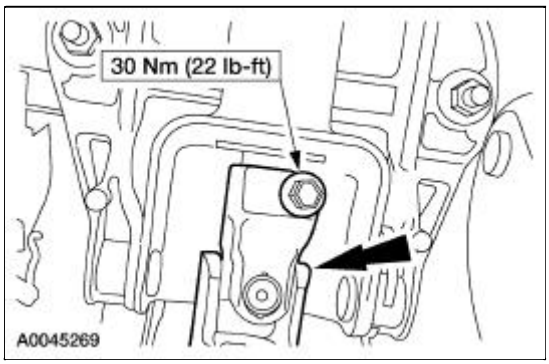


18. Install the steering column shrouds.
    1. Position the upper and lower shrouds on the column.
    2. Install the screws.

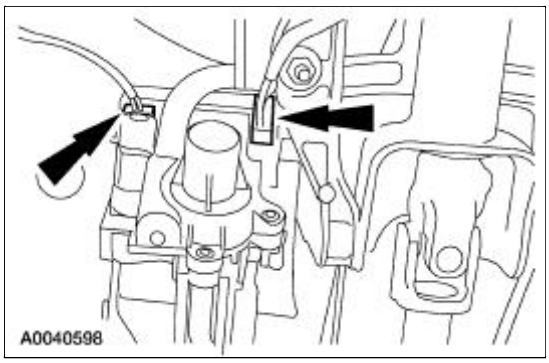


All vehicles

19. Connect the intermediate shaft to the steering column and install the pinch bolt.

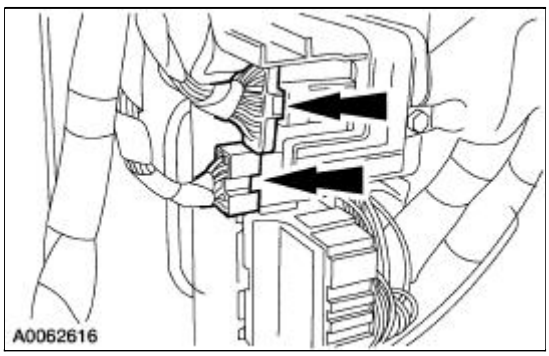


20. Connect the cruise control deactivator and the brake on/off switch electrical connectors.

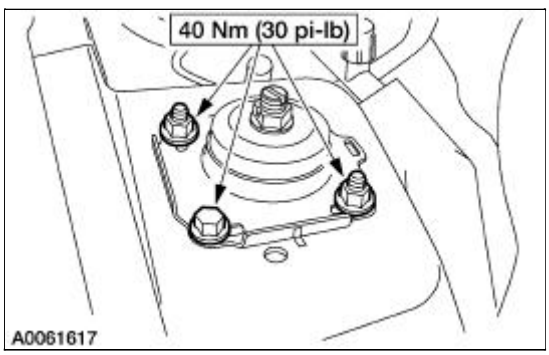


21. If equipped, connect the adjustable pedal motor harness electrical connector.

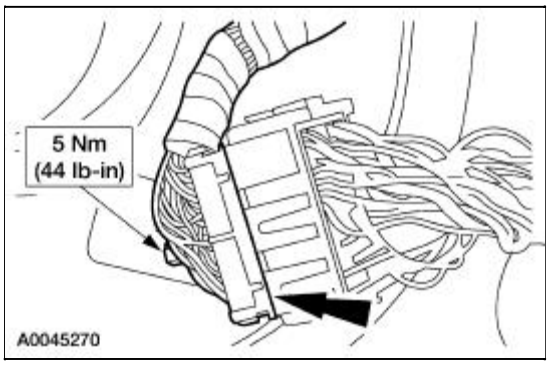
22. Install the RH ground wire and bolt.



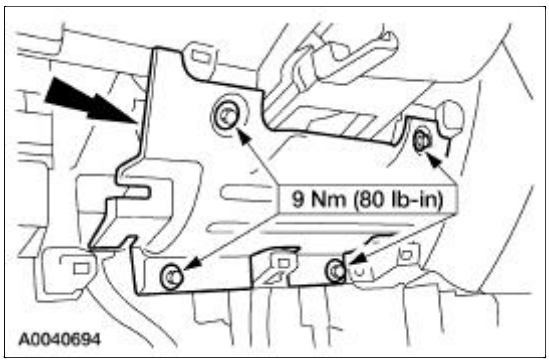
23. Connect the two electrical connectors.



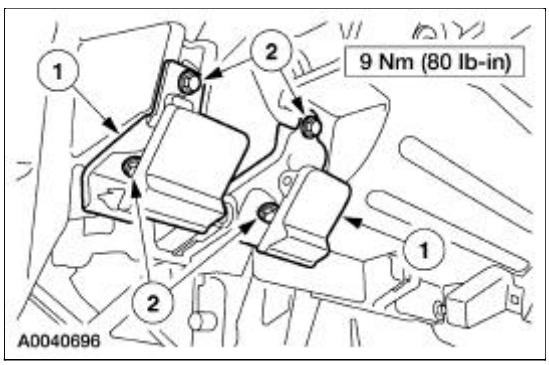
24. Connect the LH instrument panel electrical connectors and the bulkhead connector.
    - Tighten the bolt.
    - Insert the main wiring harness locators.



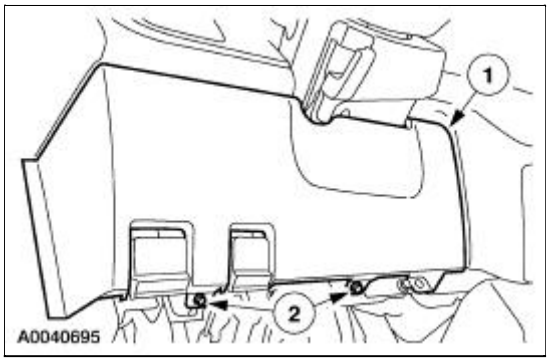
25. Position the steering column reinforcement panel and install the bolts.



26. Install the hood release and parking brake release handle.
    1. Position the release handles.
    2. Install the bolts.

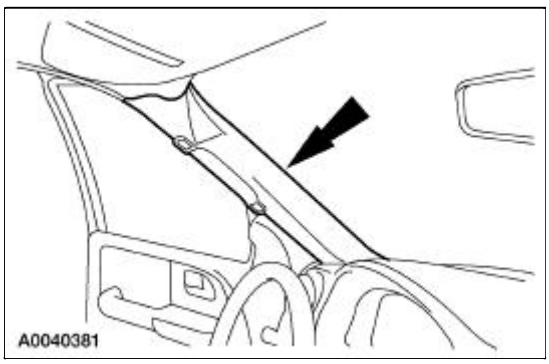


27. Install the instrument panel steering column cover.
    1. Position the cover on the instrument panel.
    2. Install the screws.

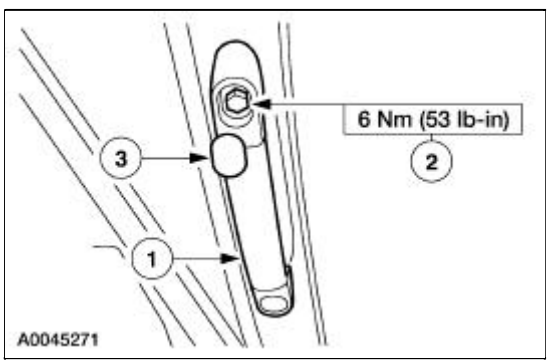


28. **NOTE:** Make sure that the locator tabs on the windshield side garnish mouldings locate in the slots on the instrument panel.

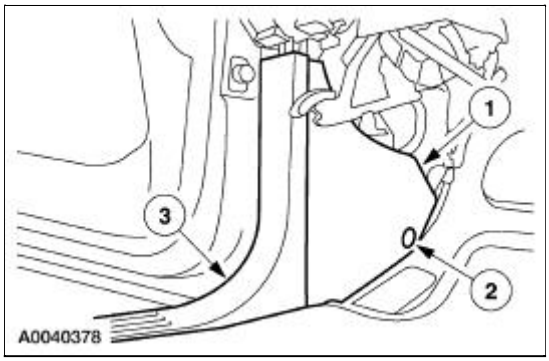
    Install the LH and RH windshield side garnish mouldings.



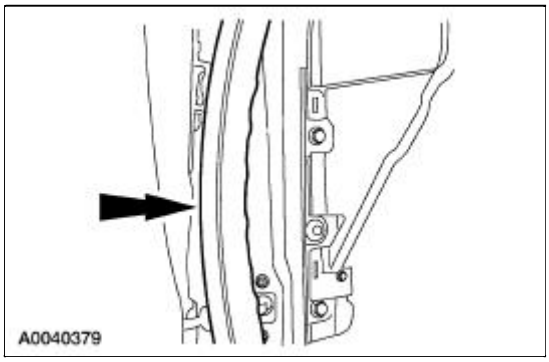
29. Install the LH and RH assist handles.
    1. Position the assist handle.
    2. Install the bolts.
    3. Install the covers.



30. Install the LH and RH A-pillar lower trim panels.
    1. Position the A-pillar lower trim panel.
    2. Install the pin-type retainer.
    3. Install the scuff plate.



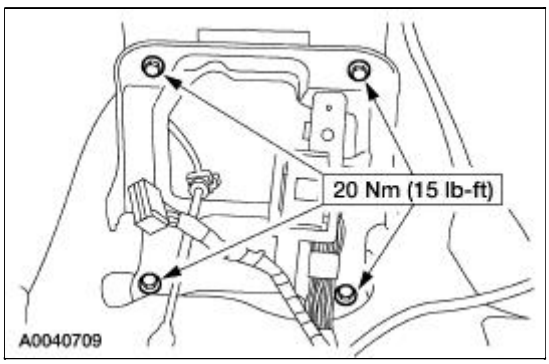
31. Install the LH and RH door weatherstrip seals.



32. If equipped, install the RH instrument panel insulator.
    - Connect the instrument panel insulator lamp.

Navigator only

33. Tighten the floor console bracket bolts.



All vehicles

34. Install the passenger air bag module. For additional information, refer to Section 501-20B .

Navigator only

35. Install the driver airbag module. For additional information, refer to Section 501-20B .

Expedition only

36. Install the steering wheel. For additional information, refer to Section 211-04 .

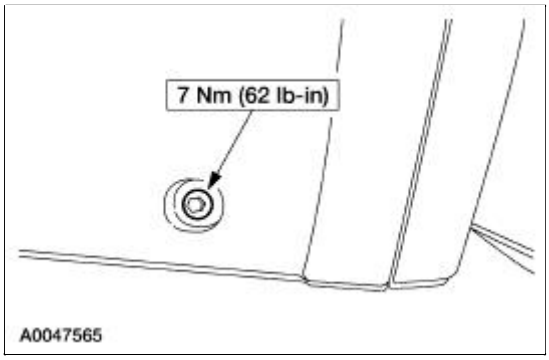
All vehicles

37. If equipped, install the floor console. For additional information, refer to Floor Console—Front, Navigator or Floor Console—Front, Expedition in this section.

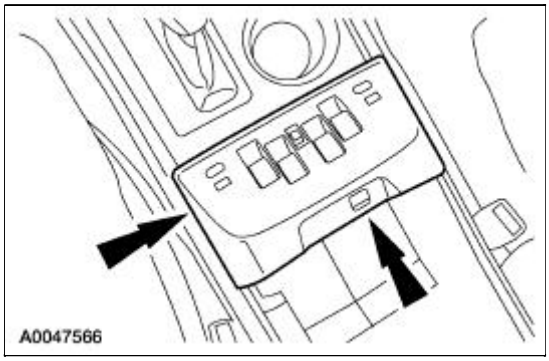
Floor Console —Front, Navigator

Removal and Installation

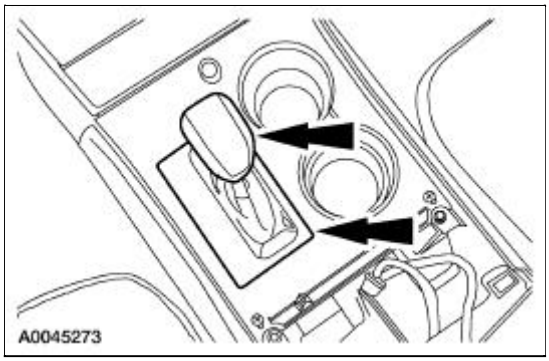
1. Apply the parking brake.
2. Position the front seat forward.
3. Remove the two front floor console rear bolts.



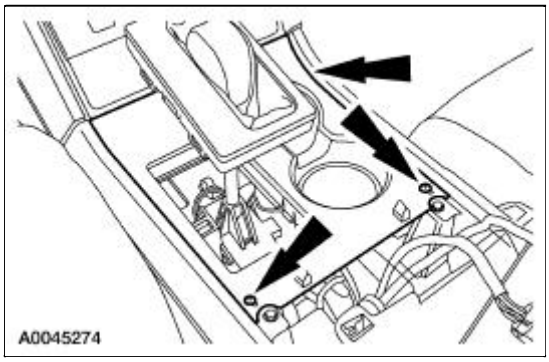
4. Position the front seats rearward.
5. Disconnect the battery. For additional information, refer to Section 414-01 .
6. Remove the pin-type retainer and the window control switch panel.
   - Disconnect the electrical connectors.



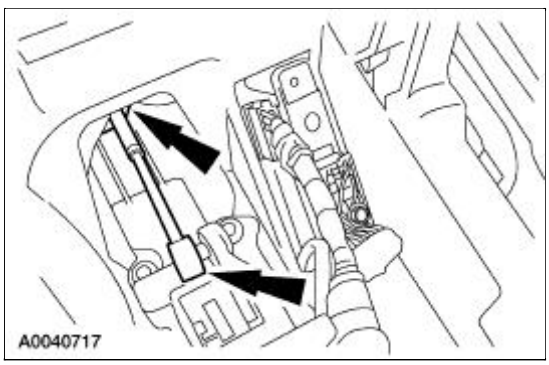
7. Move the shift lever to NEUTRAL and position the shift indicator bezel aside.



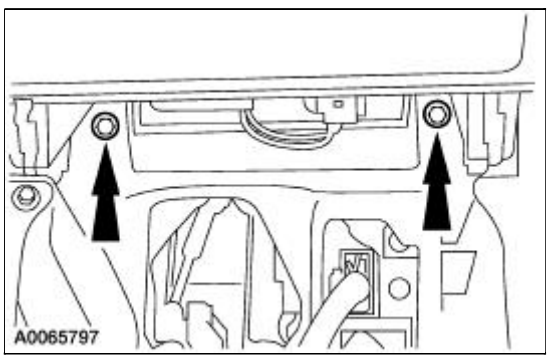
8. Remove the screws and the center console finish panel.



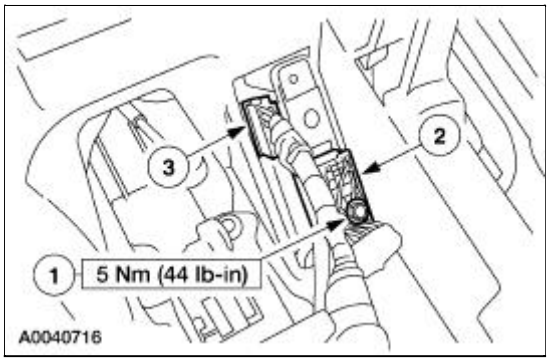
9. Disconnect the shift cable.



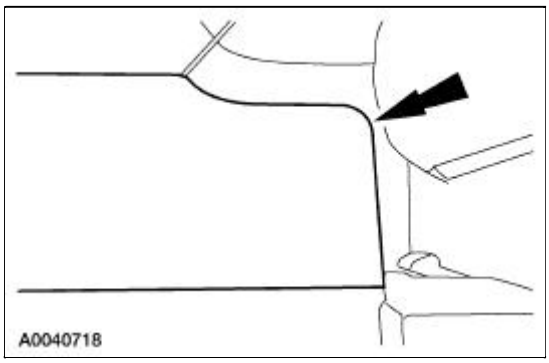
10. Remove the floor console front screws.



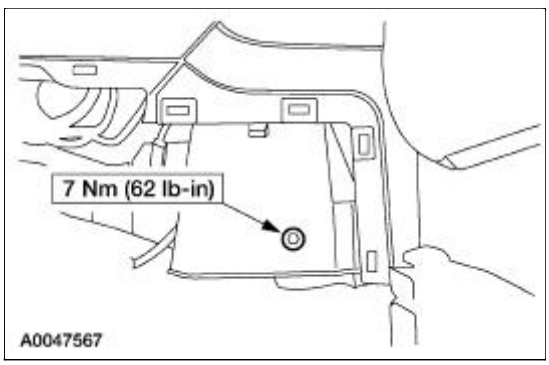
11. Disconnect the front floor console electrical connectors.
    1. Loosen the electrical connector bolt.
    2. Disconnect the connector.
    3. Disconnect the electrical connector.



12. Remove the LH and RH front floor console side finish panels.
    - If equipped, disconnect the electrical connector.



13. Remove the LH and RH front floor console front bolts and the floor console.

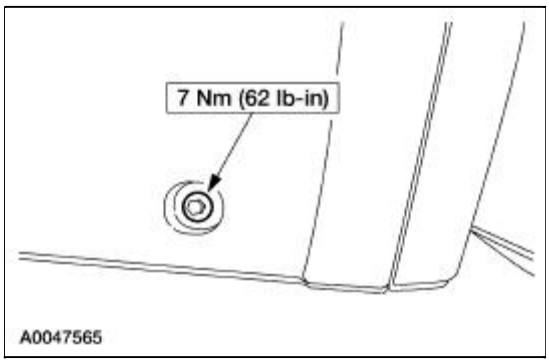


14. To install, reverse the removal procedure.

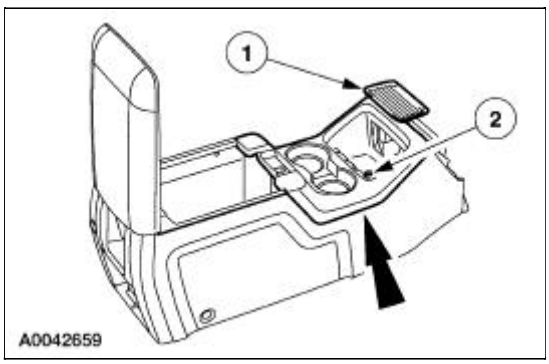
Floor Console —Front, Expedition

Removal and Installation

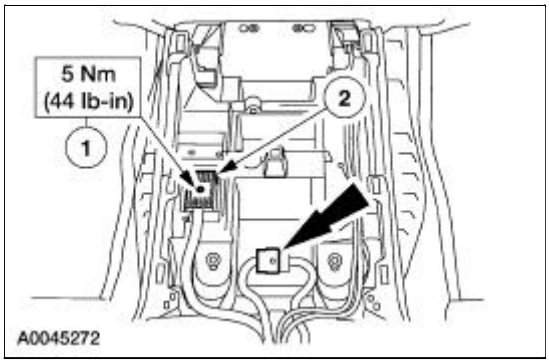
1. Position the front seat forward.
2. Remove the two front floor console rear bolts.



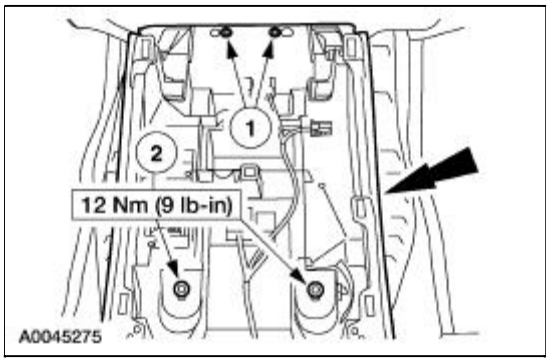
3. Position the front seats rearward.
4. Disconnect the battery. For additional information, refer to Section 414-01 .
5. Remove the console finish panel.
   1. Remove the mat.
   2. Remove the screw.
   - Disconnect the electrical connectors.



6. Disconnect the front floor console electrical connectors.
   1. Loosen the electrical connector bolt.
   2. Disconnect the electrical connector.



7. Remove the floor console.
    1. Remove the screws.
    2. Remove the bolts.

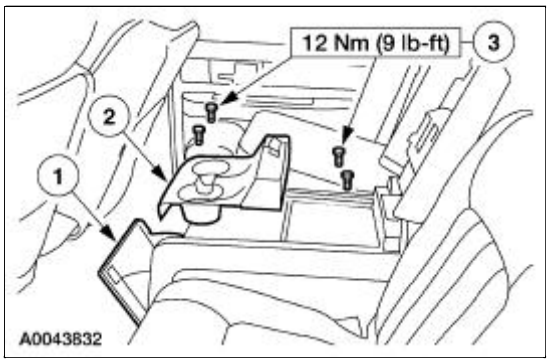


8. To install, reverse the removal procedure.

Floor Console —Rear

Removal and Installation

1. Remove the rear floor console.
    1. Open the front bin.
    2. Remove the cup holder.
    3. Remove the bolts.



2. To install, reverse the removal procedure.

Instrument Cluster Finish Panel

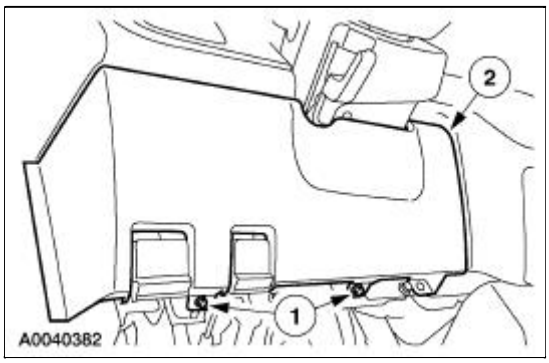
Removal and Installation

Vehicles with floor shift

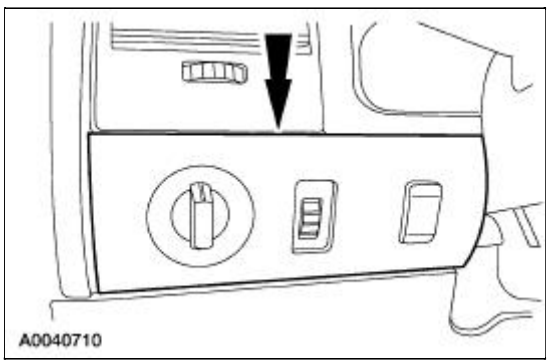
NOTE: Steering wheel removed for clarity.

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

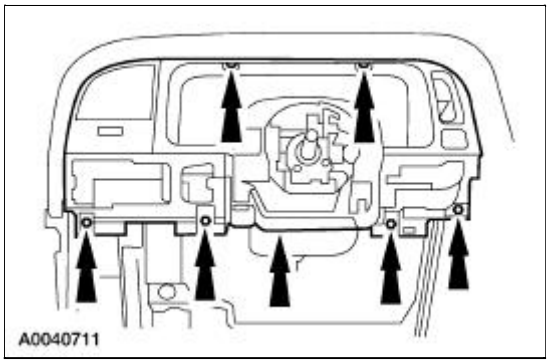
2. Remove the instrument panel steering column cover.
   1. Remove the screws.
   2. Release the cover from the instrument panel.



3. Remove the LH and RH instrument panel cluster finish panel trim panels.
   - Disconnect the electrical connectors.

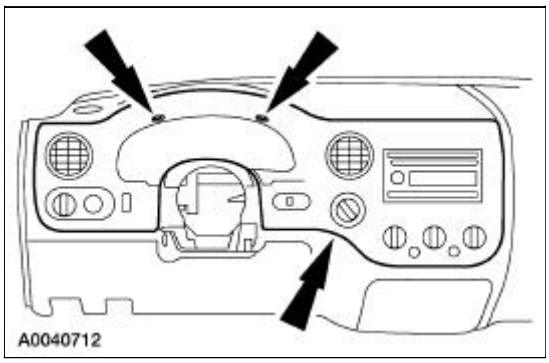


4. Remove the screws and the instrument cluster finish panel.
   - Disconnect the electrical connectors.



Vehicles with column shift

5. Apply the parking brake and move the shift lever to the 1 position.
6. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
7. Remove the screws and the instrument cluster finish panel.
   - Disconnect the electrical connectors.



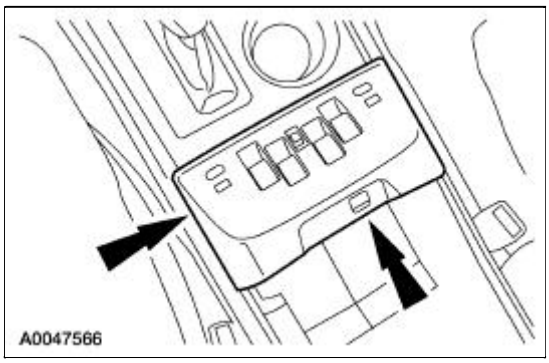
All vehicles

8. To install, reverse the removal procedure.

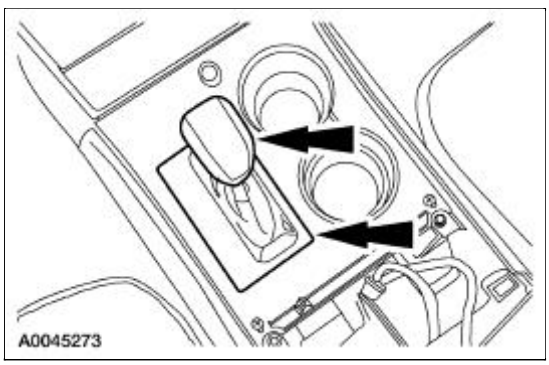
Instrument Cluster Center Finish Panel

Removal and Installation

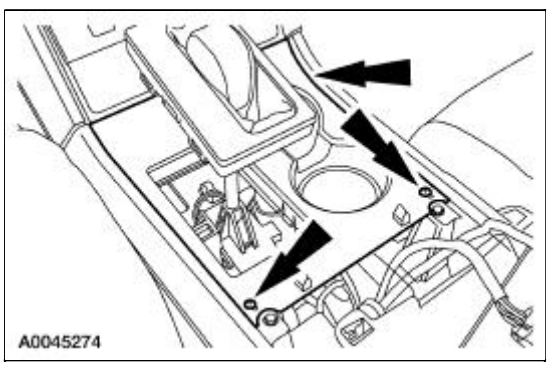
1. Apply the parking brake and move the shift lever to NEUTRAL.
2. Disconnect the battery. For additional information, refer to Section 414-01 .
3. Remove the pin-type retainer and the window control switch panel.
   - Disconnect the electrical connectors.



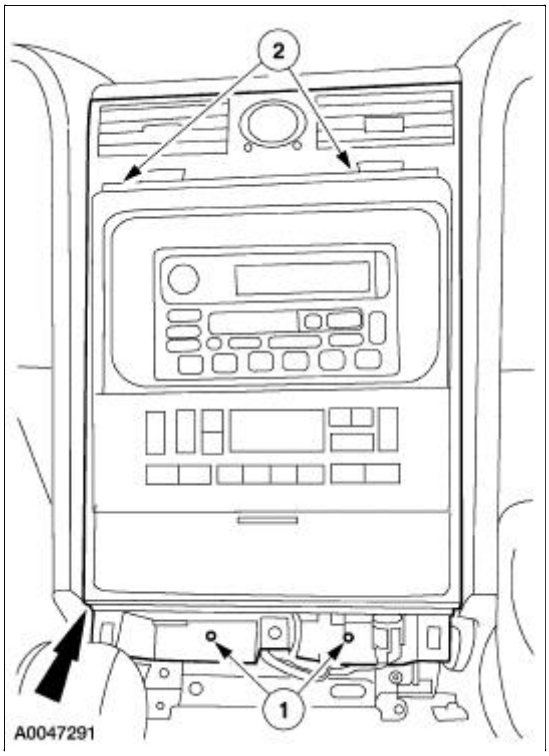
4. Position the shift indicator bezel aside.



5. Remove the screws and the center console finish panel.
   - Disconnect the electrical connectors.



6. Remove the instrument panel center finish panel.
    1. Remove the screws.
    2. Pull out on the panel under the air vents to disengage the clips.
    - Disconnect the electrical connectors.



7. To install, reverse the removal procedure.

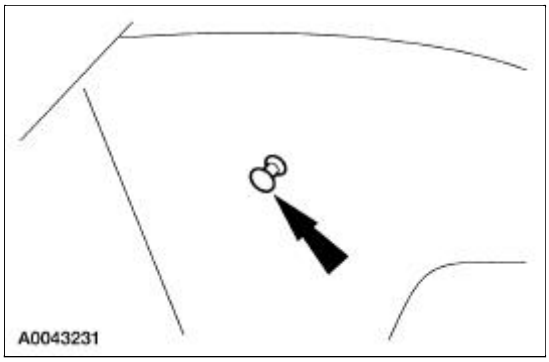
Glove Compartment

Removal and Installation

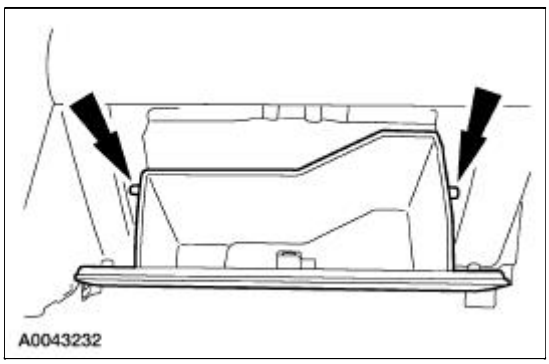
1. **CAUTION: Forcing the glove compartment past the stops will damage the dampener.**

   Open the glove compartment.

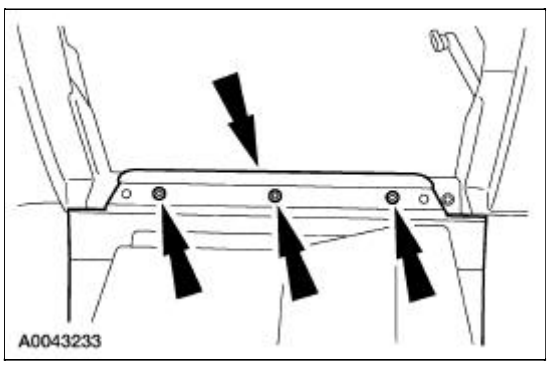
2. Disconnect the dampener.



3. Release the stops.



4. Remove the screws and the glove compartment.



5. To install, reverse the removal procedure.

General Specifications

Item	Specification
Multi-Purpose Grease Spray F5AZ-19G209-AA	ESR-M1C159-A

Lock Repair/Replacement Specifications

Part Number	Lock Repair Package Name
F85Z-11582-AA	Ignition Cylinder Kit
F85Z-1521990-BA	Door Lock Cylinder Kit

Torque Specifications

Description	Nm	lb-ft	lb-in
Exterior door handle nuts	9	—	80
Front door latch bolts	9	—	80
Hood latch bolts	12	9	—
Hood latch release handle screws	5	—	44
Liftgate remote control bolts	11	8	—
Liftgate latch ajar switch	8	—	71
Liftgate latch screws	12	9	—
Liftgate window glass latch bolts	8	—	71
Rear door latch bolts	9	—	80
Liftgate release handle nuts	5	—	44

Handles, Locks, Latches and Entry Systems

The hood consists of the following components:

- hood latch
- hood latch striker
- hood latch control handle and cable
- secondary hood latch release handle

The front doors consist of the following components:

- front door latch push button rods
- exterior door handles
- door lock cylinder
- front door latches
- door lock actuators
- door ajar switches
- front door carrier assembly
- interior door handles
- door lock control switches

The rear doors consist of the following components:

- exterior door handles
- rear door latches
- child lock bezels
- door lock actuators
- door ajar switches
- rear door carrier assembly
- interior door handles
- rear door latch push button rods

The liftgate consists of the following components:

- liftgate window glass latch
- door lock actuator (power liftgate only)
- liftgate latch
- liftgate handle
- liftgate latch remote control (power liftgate only)

- liftgate ajar switch
- chime module (power liftgate only)

The keyless entry system consists of the following components:

- vehicle security module
- keyless entry keypad
- keyless entry remote transmitter

The door locks are controlled by the vehicle security module.

The keyless entry remote transmitter initiates the following electronic door lock system functions:

- unlock the driver door
- unlock all doors
- lock all doors
- enable the panic alarm
- issue the interior lamps on (when unlocking) and off (when locking) commands to the vehicle security module
- sound the horn once when LOCK on keyless entry remote transmitter is pressed twice, and doors are closed
- sound the horn twice when LOCK on the keyless entry remote transmitter is pressed twice, and any door or the liftgate window is ajar
- allow up to four keyless entry remote transmitters to be programmed

NOTE: The remote entry features will not function when the ignition switch is in the RUN or ACC position.

The keyless entry remote transmitters are reprogrammable and must be set at the same time.

To confirm that the doors have been locked and that the anti-theft system has been armed, press the LOCK button again, within five seconds of the first press. The horn will sound once if the doors have locked and all doors are closed.

To activate the panic alarm:

- Press the red PANIC button on the keyless entry remote transmitter. The horn will sound and the parking lamps will flash for a maximum of 2 minutes and 45 seconds.

To deactivate the panic alarm:

- Press the red PANIC button again on the remote transmitter.
- Turn the ignition switch to RUN/ACC.

The keyless entry keypad can be used to unlock the driver door or lock and unlock all the doors and the liftgate. It also lights the keypad lamp, allows one user code to be programmed and issues illuminated entry on/off requests to the vehicle security module when locking and unlocking.

The system (permanent) entry code is located on the owner's wallet card in the glove box; it is also electronically accessible using a diagnostic tool, and it is on the receiver assembly housing.

The receiver assembly is programmed at the factory with a five-digit entry code. A new receiver assembly includes a new owner's code card.

To turn on the interior lamps and light all illuminated components, press any button on the keyless entry keypad.

Locks, Latches and Entry Systems

Refer to Wiring Diagrams Cell 117 for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418–F224, New Generation STAR (NGS) Tester 418–F052, or equivalent diagnostic tool

Principles of Operation

Power Lock

The power lock/unlock feature requests all of the vehicle doors, including the liftgate, be locked or unlocked upon a customer request from any interior door lock switch in the vehicle. The power door locking system functions independently of ignition status or vehicle speed. When the vehicle security module receives an unlock/lock command from any door lock control switch, the vehicle security module will activate relays internal to the module to supply the correct power and grounds for the door lock actuators.

Power Unlock Inhibit

With the ignition off, 20 seconds after electrically locked (remote transmitter, keypad, door lock control switch locked with door ajar) and all doors are closed, the door unlock switch will be inhibited if this feature is enabled. (The lock function will still operate.)

Deactivating/Activating Power Door Unlock Switch Inhibit

This is customer configurable. Steps one through three must be completed within 30 seconds.

1. Turn the key to ON, then press UNLOCK three times.
2. Turn the key to OFF, then press UNLOCK three times.
3. Turn the key to ON, within five seconds press LOCK two times.

The user should receive two horn chirps to indicate the system has been disabled or two chirps followed by a horn honk to indicate the system has been enabled.

Pressing LOCK two times again will toggle the door lock control switch inhibit feature state.

Turn the key to OFF to exit programming mode.

This feature can also be enabled/disabled using a diagnostic tool.

Auto-locking

The auto-locking feature locks all doors when all doors, including the liftgate, are closed, the brake pedal was pressed with the key in ON, then vehicle speed of 8 kph (5 mph) or higher was achieved. This feature relocks the doors (if any doors were open) after the brake pedal is pressed, once all doors are read as closed and vehicle speed exceeds 8 kph (5 mph). Door ajar switches are wired directly to the vehicle security module. The auto-locking feature can be enabled/disabled through module configuration, diagnostics, keyless entry keypad and the ignition switch.

Auto-lock Enable/Disable — Using the keypad

A manual enable/disable mode allows the auto-lock feature to be turned off and on.

To enable or disable auto-lock using the keyless entry keypad:

1. Enter the five-digit permanent entry code into the keyless entry keypad.
2. Within five seconds of entering the code, press and hold the 7/8 button on the keypad.
3. Within five seconds of Step 2, and while holding the 7/8 button, press the 3/4 button on the keypad and release it.
4. Within five seconds of Step 3, release the 7/8 button on the keypad.

If the auto-lock feature is disabled, the horn will chirp once. If the auto-lock feature is enabled, the horn will chirp once shortly and then sound a second time for a longer sound of the horn once the above sequence is completed.

Auto-lock Enable/Disable — Using the Ignition Switch

Another way to turn the auto-lock feature off/on is by following this series of steps:

1. Close all doors.
2. Confirm that the key is in the OFF position.
3. Turn the key from OFF to ON.
4. **NOTE:** Steps 4 through 8 must be carried out within 30 seconds.

   Press UNLOCK three times.
5. Turn the key from ON to OFF.
6. Press UNLOCK three times.
7. Turn the ignition switch from OFF to ON.
8. Verify that the horn chirps. This indicates the enable/disable mode and now is ready to accept program changes.
9. Press UNLOCK once to command the vehicle security module to toggle the auto-lock/relock

feature OFF.

10. Press LOCK once to enter the command.

11. Verify that the horn chirps one time. There should only be one chirp indicating that the auto-lock/relock feature has been disabled. If one chirp is heard followed by a longer sound of the horn, the auto-lock/relock feature has just been enabled. Return to Step 10.

12. Turn the key to the OFF position to exit the enable/disable mode.

13. Exit the vehicle and verify that the horn chirps once to indicate that a feature has been changed and that auto-lock/relock has been disabled.

Smart Unlock

The smart unlock feature prevents the driver door from locking with the key in the ignition lock cylinder. When the vehicle security module receives a LOCK command from a door lock switch with the key in the ignition lock cylinder and the driver door open the vehicle security module will command the driver door to UNLOCK.

Remote Transmitter Lock/Unlock Control — Unlock

The remote control feature provides lock/unlock functions independently of ignition status, vehicle speed or transmission position. The remote control feature provides a two-step process for unlocking the doors. Upon receipt of the first requests for unlocking the doors, the remote control feature requests the vehicle security module to unlock the driver door only. If another unlock request is received within three seconds of the first, the remote control feature will request that all doors be unlocked.

Remote Transmitter Lock/Unlock Control — Lock

The remote control feature requests that all the doors be locked when the LOCK button is pressed. On any press of the lock button with all doors closed, the remote control feature will request one flash of the parking lamps. If any door is ajar, no flash will occur, indicating it locked all the doors but one or more doors are ajar. As soon as the last door is closed, one flash of the parking lamps occurs. If two presses of the lock button are received within two seconds, the horn will chirp once, the parking lamps will flash twice to indicate that all the doors are closed and locked. If any door is ajar when the second lock request is received within three seconds of the first, the remote control feature will request the horn chirp twice without flashing the parking lamps to indicate it locked all the doors but one or more doors are ajar. When the ignition is in the ON or START position, no parking lamp flashes or horn chirp confirmations will occur.

Panic Alarm

The panic alarm feature controls activation of the panic alarm providing audible and visual alarms which are evident from the exterior of the vehicle. The panic alarm feature requests that the parking lamps and horn are flashed until deactivation. The flashing of the outputs occurs synchronously. Activation of the panic alarm is accomplished by pressing the PANIC button on a remote transmitter whenever the key is OFF. At all other times this feature is disabled. Deactivation of an active PANIC alarm is accomplished by: a second press of the remote transmitter PANIC button, the ignition is switched out of the OFF or ACC position or a period of 2.75 minutes has elapsed since the initial activation.

Keyless Entry Keypad

The keyless entry keypad, located on the exterior of the driver door, provides a method for the customer to access their vehicle without a key or remote transmitter. The keyless entry keypad feature:

- locks all doors and inhibits the door lock control switch UNLOCK capability after 20 seconds (if

the inhibit feature is enabled).

- unlocks only the driver door.
- unlocks all doors.
- programs/erases customer key code.
- enables/disables auto-locking.

The keyless entry keypad feature operates independently of ignition status, vehicle speed, or transmission position. When a keypad button is depressed, the keypad buttons illuminate to provide better visibility. If 7/8 and 9/0 are pressed or five seconds have elapsed since the last button press, the illumination is turned off.

Each vehicle equipped with a keyless entry keypad is programmed with a five-digit entry code. This code is provided to the customer on a wallet card in the Owner literature package. In addition, this code is available through a diagnostic tool and is also printed on the vehicle security module label. When entering codes each digit must be entered within five seconds of the previous button press.

Programming/Erasing Personal Code

A unique personal five-digit code can be programmed by following these steps:

1. Enter the factory set five-digit code (the keypad will illuminate when pressed).
2. Press 1/2 within five seconds of Step 1.
3. Enter the unique five-digit code.

The personal code does not substitute for the permanent factory set code. Either code can be used to access the vehicle. In addition, if a second personal code is programmed, it will simply overwrite the previous personal code. To erase a personal code, carry out the following procedure:

4. Enter factory set five-digit code.
5. Press 1/2 within five seconds of Step 1.
6. Press 7/8 and 9/0 at the same time within five seconds of Step 2.

The system will now only respond to the factory set code.

Anti-Scan Feature

To provide added security, the keyless entry pad is disabled for one minute after 35 button presses without a valid entry code being entered. The keypad will flash during this one-minute mode with all functionality disabled except for 7/8 and 9/0 still being allowed to lock the vehicle.

Anti-Scan will be turned off after any of the following events:

- one minute of keypad inactivity
- the remote transmitter UNLOCK button is pressed
- the key is turned to the ON position.

Unlocking the Doors with the Keyless Entry Keypad System

To unlock the driver door, enter either the factory set code or the personal code (each digit must be pressed within five seconds of the prior digit). The interior lamps will illuminate.

To unlock all doors, enter either the factory set code or the personal code (driver door unlocks) and press the 3/4 button within five seconds.

Locking the Doors with the Keyless Entry Keypad System

It is not necessary to enter the factory set or personal code prior to locking all doors. To lock all doors, press the 7/8 and 9/0 buttons at the same time.

Inspection and Verification

1. Verify the customer concern by operating the system.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
● Binding latches	● Central junction box (CJB) fuse(s): ■ 5 (7.5A) ■ 30 (30A) ● Circuitry ● Damaged relays ● Remote transmitter ● Keyless entry keypad ● Vehicle security module

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the diagnostic tool does not power up, refer to the diagnostic tool manual.
5. Carry out the DATA LINK DIAGNOSTICS test. If the diagnostic tool responds with:
   - CKT693 (OG), CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for vehicle security module, refer to Section 419-10 .
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs, and carry out the self-test diagnostics for the vehicle security module.
6. If the DTCs retrieved are related to the concern, go to the Vehicle Security Module Diagnostic Trouble Code (DTC) Index to continue diagnostics.
7. If DTCs are retrieved that are not found in the following Vehicle Security Module Diagnostic Trouble Code (DTC) Index, refer to the Master Vehicle Security Module Diagnostic Trouble Code (DTC) Index in Section 419-10 .
8. If no DTCs related to the concern are retrieved, proceed to the Symptom Chart to continue diagnostics.

Vehicle Security Module Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1300	Power Door Lock Circuit Failure	Vehicle Security Module	Go To Pinpoint Test A .
B1311	Power Door Unlock Circuit Failure	Vehicle Security Module	Go To Pinpoint Test A .
B1321	Driver Door Ajar Circuit Short to Battery	Vehicle Security Module	Go To Pinpoint Test D .
B1333	Liftgate Ajar Circuit Short to Battery	Vehicle Security Module	Go To Pinpoint Test D .
B1337	Door Ajar RR Circuit Short to Battery	Vehicle Security Module	Go To Pinpoint Test D .
B1573	Door Ajar LR Circuit Short to Battery	Vehicle Security Module	Go To Pinpoint Test D .
B2425	Remote Transmitter Out of Sync	Vehicle Security Module	Go To Pinpoint Test E .
B2675	Keypad_B Switch Circuit Failure	Vehicle Security Module	Go To Pinpoint Test B .
B2676	Keypad _C Switch Circuit Failure	Vehicle Security Module	Go To Pinpoint Test B .
B2695	Keypad_A Switch Circuit Failure	Vehicle Security Module	Go To Pinpoint Test B .

Symptom Chart

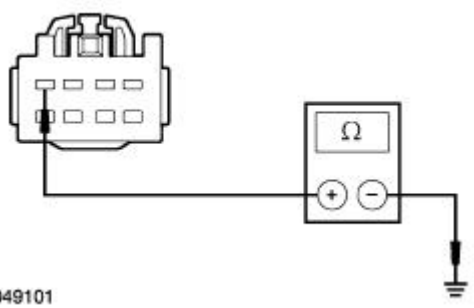
Symptom Chart

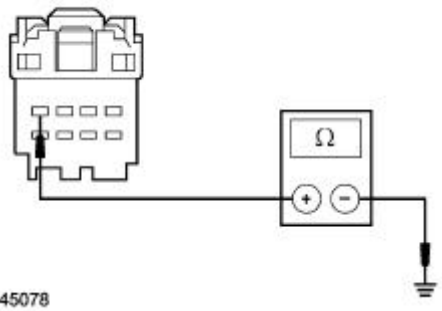
Condition	Possible Sources	Action
• A single/more than one door lock is inoperative	• Door lock control switches (trim panel switches). • Door lock motor. • Door lock hardware. • Circuitry. • Vehicle security module.	• Go To Pinpoint Test A .
• The doors do not lock/unlock using the keyless entry keypad	• Keyless entry keypad. • Remote transmitter. • Vehicle security module.	• Go To Pinpoint Test B .
• The doors do not lock/unlock using the remote transmitter	• Remote transmitter battery. • Remote transmitter. • Vehicle security module.	• Go To Pinpoint Test C .
• The auto-lock does not operate correctly	• Door ajar switches. • UART based protocol (UBP) communications network. • Vehicle security module.	• Go To Pinpoint Test D
• Remote keyless entry transmitter out of synchronization	• Remote transmitter. • Vehicle security module.	• Go To Pinpoint Test E .
• Panic feature is inoperative/does not operate correctly	• Remote transmitter. • Circuitry. • Vehicle security module.	• Go To Pinpoint Test F .
• The keyless entry keypad illumination is	• Keyless entry keypad. • Remote transmitter.	• Go To Pinpoint Test G .

inoperative	• Vehicle security module.	
• The power door unlock inhibit feature is inoperative	• Feature not enabled. • Vehicle security module.	• Install a new vehicle security module. Refer to Section 419-10 .
• The smart unlock does not operate correctly	• Door lock control switches. • Driver door ajar switch • UBP communications network. • Vehicle security module.	• Go To Pinpoint Test H .

Pinpoint Tests

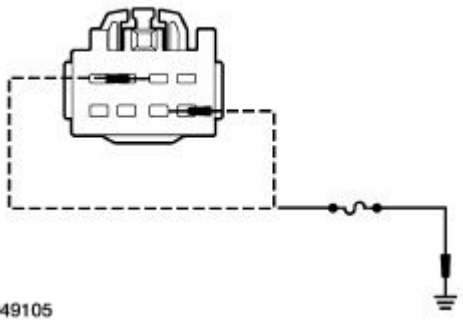
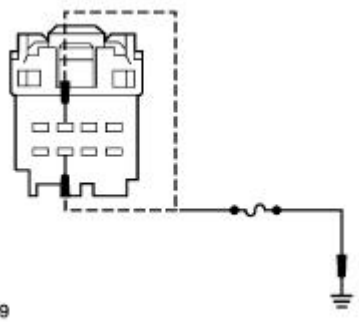
PINPOINT TEST A: A SINGLE/MORE THAN ONE DOOR LOCK IS INOPERATIVE

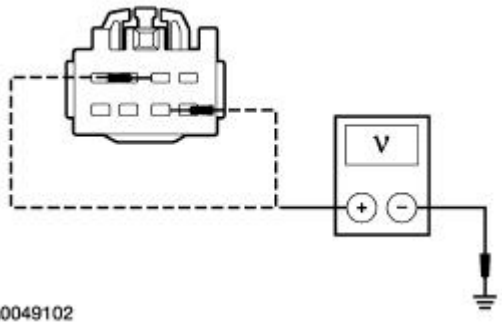
Test Step	Result / Action to Take
A1 CHECK THE DOOR LOCK ACTUATOR OPERATION	
• Verify the power door unlock inhibit feature is disabled. • Activate the door lock and unlock active commands. • **Do all doors lock and unlock correctly?**	**Yes** GO to A2 . **No** GO to A13 .
A2 ISOLATE DRIVER OR PASSENGER CONTROL SWITCH FAULT	
• Operate the door locks using the driver door lock control switch. • **Do all doors lock with the driver door lock control switch?**	**Yes** GO to A3 . **No** GO to A8 .
A3 CHECK GROUND CIRCUIT 57 (BK)	
• Disconnect: Passenger Door Lock Control Switch C605 (Expedition) C632 (Navigator). • For Expedition, measure the resistance between the passenger door lock control switch C605 pin 4, circuit 57 (BK), harness side and ground.  A0049101 • For Navigator, measure the resistance between the passenger door lock control switch C632 pin 4, circuit 57 (BK), harness side and ground.	**Yes** GO to A4 . **No** REPAIR the circuit. TEST the system for normal operation.



A0045078

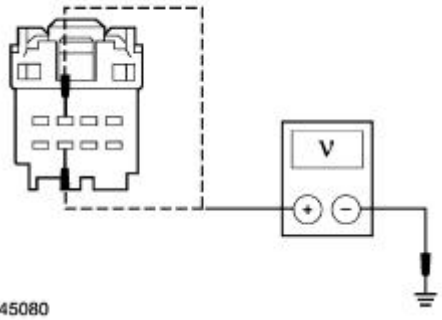
- **Is the resistance less than 5 ohms?**

A4 CHECK CIRCUITS 120 (PK/LG) AND 119 (PK/YE) TO VEHICLE SECURITY MODULE	
• For Expedition, connect a 5A fused jumper wire between the passenger door lock control switch C605 pin 6, circuit 120 (PK/LG), harness and ground; and between the passenger door lock control switch C605 pin 2, circuit 119 (PK/YE), harness side and ground.  A0049105 • For Navigator, connect a 5A fused jumper wire between the passenger door lock control switch C632 pin 7, circuit 120 (PK/LG), harness side and ground; and between the passenger door lock control switch C632 pin 3, circuit 119 (PK/YE), harness side and ground.  A0045079 • **Do the door locks unlock and lock?**	**Yes** INSTALL a new passenger door lock control switch. TEST the system for normal operation. **No** GO to A5 .
A5 CHECK CIRCUITS 120 (PK/LG) AND 119 (PK/YE) FOR SHORT TO BATTERY	
• Key in OFF position. • Disconnect: Vehicle Security Module C2113a. • For Expedition, measure the voltage between the passenger door lock control switch C605 pin 6, circuit 120 (PK/LG), harness side and ground; and between the passenger door lock control switch C605 pin 2, circuit 119 (PK/YE), harness side and ground.	**Yes** REPAIR the circuit in question. TEST the system for normal operation. **No** GO to A6 .



A0049102

- For Navigator, measure the voltage between the passenger door lock control switch C632 pin 7, circuit 120 (PK/LG), harness side and ground; and between the passenger door lock control switch C632 pin 3, circuit 119 (PK/YE), harness side and ground.

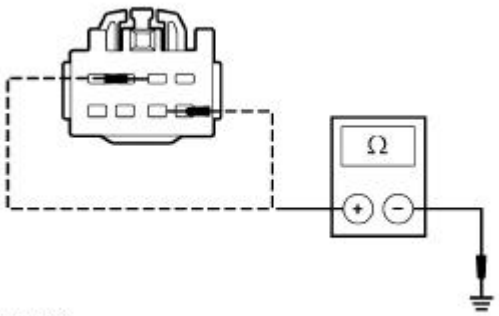


A0045080

- **Is the voltage greater than 10 volts?**

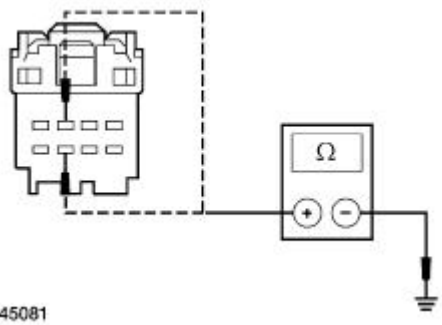
A6 CHECK CIRCUITS 120 (PK/LG) AND 119 (PK/YE) FOR SHORT TO GROUND

- For Expedition, measure the resistance between the passenger door lock control switch C605 pin 6, circuit 120 (PK/LG), harness side and ground; and between the passenger door lock control switch C605 pin 2, circuit 119 (PK/YE), harness side and ground.



A0049103

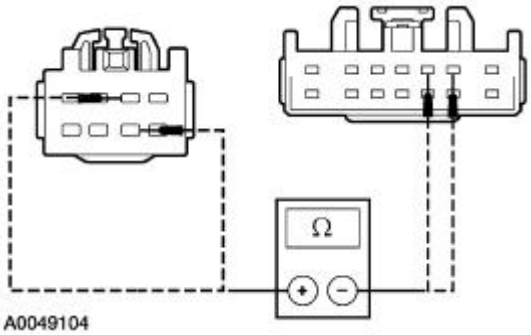
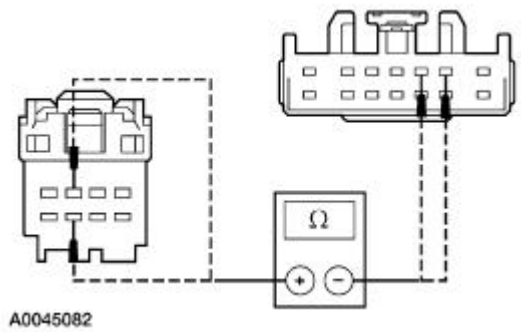
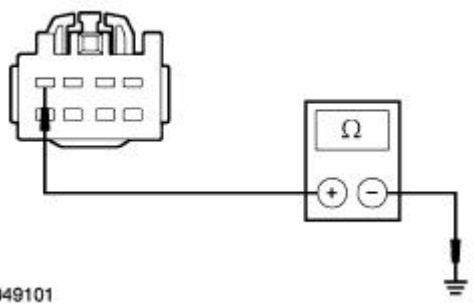
- For Navigator, measure the resistance between the passenger door lock control switch C632 pin 7, circuit 120 (PK/LG), harness side and ground; and between the passenger door lock control switch C632 pin 3, circuit 119 (PK/YE), harness side and ground.

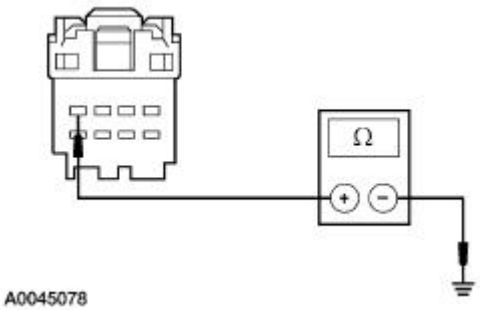
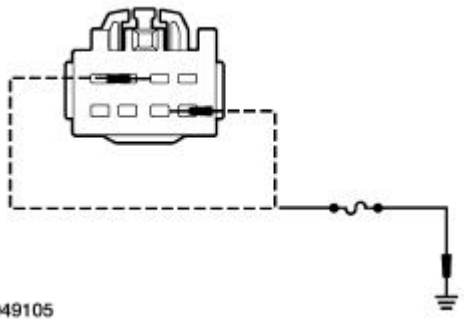
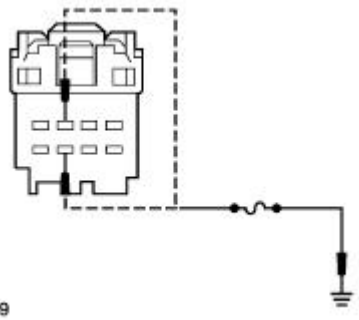


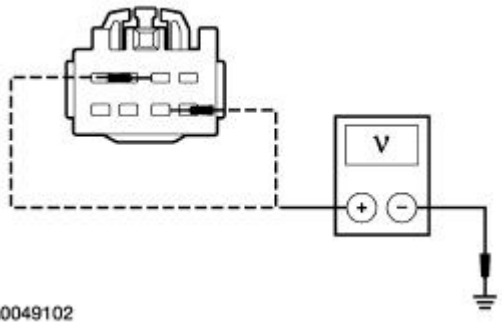
A0045081

Yes
GO to A7 .

No
REPAIR the circuit in question. TEST the system for normal operation.

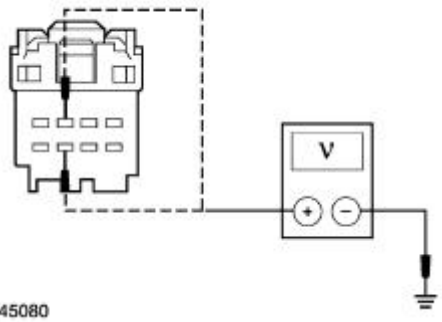
• **Are the resistances greater than 10,000 ohms?**	
A7 CHECK CIRCUIT 120 (PK/LG) AND 119 (PK/YE) FOR OPEN CIRCUIT	
• For Expedition, measure the resistance between the passenger door lock control switch C605 pin 6, circuit 120 (PK/LG), harness side and the vehicle security module C2113a pin 2, circuit 120 (PK/LG), harness side; and between the passenger door lock control switch C605 pin 2, circuit 119 (PK/YE), harness side and the vehicle security module C2113a pin 3, circuit 119 (PK/YE), harness side.  A0049104 • For Navigator, measure the resistance between the passenger door lock control switch C632 pin 7, circuit 120 (PK/LG), harness side and the vehicle security module C2113a pin 2, circuit 120 (PK/LG), harness side; and between the passenger door lock control switch C632 pin 3, circuit 119 (PK/YE), harness side and the vehicle security module C2113a pin 3, circuit 119 (PK/YE), harness side.  A0045082 • **Are the resistances less than 5 ohms?**	**Yes** GO to A16 . **No** REPAIR the circuit in question. TEST the system for normal operation.
A8 CHECK CIRCUIT 57 (BK) FOR OPEN	
• Disconnect: Driver Door Lock Control Switch C505 (Expedition) C541 (Navigator). • For Expedition, measure the resistance between the driver door lock control switch C505 pin 4, circuit 57 (BK), harness side and ground.  A0049101 • For Navigator, measure the resistance between the driver door lock control switch C541 pin 4, circuit 57 (BK), harness side and	**Yes** GO to A9 . **No** REPAIR the circuit. TEST the system for normal operation.

ground.  A0045078 ● **Is the resistance less than 5 ohms?**	
A9 CHECK CIRCUITS 120 (PK/LG) AND 119 (PK/YE) TO THE VEHICLE SECURITY MODULE	
● For Expedition, connect a 5A fused jumper wire between the driver door lock control switch C505 pin 6, circuit 120 (PK/LG), harness side and ground; and between the driver door lock control switch C505 pin 2, circuit 119 (PK/YE), harness side and ground.  A0049105 ● For Navigator, connect a 5A fused jumper wire between the driver door lock control switch C541 pin 7, circuit 120 (PK/LG), harness side and ground; and between the driver door lock control switch C541 pin 3, circuit 119 (PK/YE), harness side and ground.  A0045079 ● **Do the door locks unlock and lock?**	**Yes** INSTALL a new driver door lock control switch. TEST the system for normal operation. **No** GO to A10 .
A10 CHECK CIRCUITS 120 (PK/LG) AND 119 (PK/YE) FOR SHORT TO POWER	
● Disconnect: Vehicle Security Module C2113a. ● For Expedition, measure the voltage between the driver door lock control switch C505 pin 6, circuit 120 (PK/LG), harness side and ground, and between the driver door lock control switch C505 pin 2, circuit 119 (PK/YE), harness side and ground.	**Yes** REPAIR the circuit in question. TEST the system for normal operation. **No** GO to A11 .



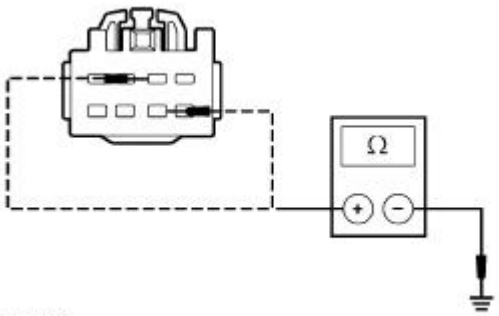
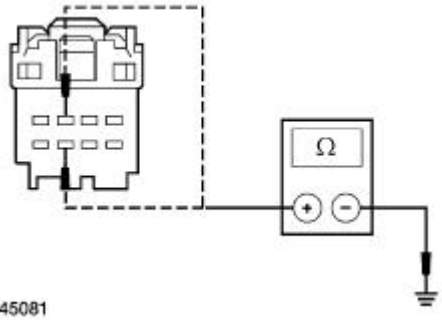
A0049102

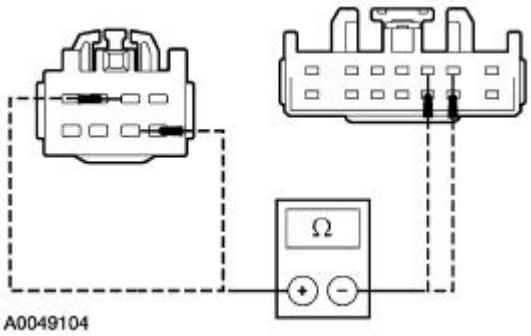
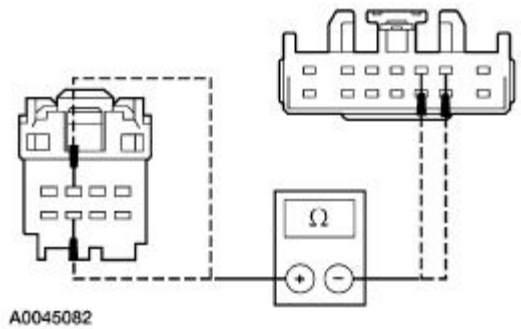
- For Navigator, measure the voltage between the driver door lock control switch C541 pin 7, circuit 120 (PK/LG), harness side and ground; and between the driver door lock control switch C541 pin 3, circuit 119 (PK/YE), harness side and ground.

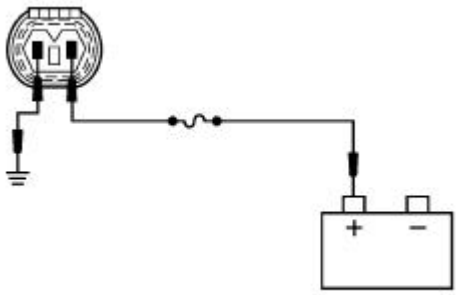


A0045080

- **Is the voltage greater than 10 volts?**

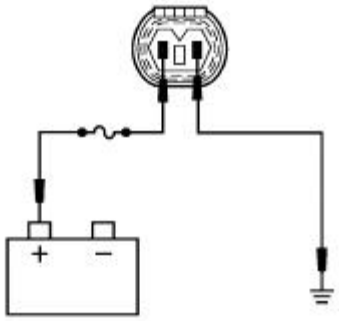
A11 CHECK CIRCUITS 120 (PK/LG) AND 119 (PK/YE) FOR SHORT	
- For Expedition, measure the resistance between the driver door lock control switch C505 pin 6, circuit 120 (PK/LG), harness side and ground; and between the driver door lock control switch C505 pin 2, circuit 119 (PK/YE), harness side and ground.  A0049103 - For Navigator, measure the resistance between the driver door lock control switch C541 pin 7, circuit 120 (PK/LG), harness side and ground; and between the driver door lock control switch C541 pin 3, circuit 119 (PK/YE), harness side and ground.  A0045081 - **Are the resistances greater than 10,000 ohms?**	**Yes** GO to A12 . **No** REPAIR the circuit in question. TEST the system for normal operation.

A12 CHECK CIRCUIT 120 (PK/LG) AND 119 (PK/YE) FOR AN OPEN	
• For Expedition, measure the resistance between the driver door lock control switch C505 pin 6, circuit 120 (PK/LG), harness side and the vehicle security module C2113a pin 2; and between the driver door lock control switch C505 pin 2, circuit 119 (PK/YE), harness side and the vehicle security module C2113a pin 2, circuit 119 (PK/YE), harness side.  A0049104 • For Navigator, measure the resistance between the driver door lock control switch C541 pin 7, circuit 120 (PK/LG), harness side and the vehicle security module C2113a pin 2, circuit 120 (PK/LG), harness side; and between the driver door lock control switch C541 pin 3, circuit 119 (PK/LG), harness side and vehicle security module C2113a pin 3, circuit 119 (PK/YE), harness side.  A0045082 • **Are the resistances less than 5 ohms?**	**Yes** GO to A16 . **No** REPAIR the circuit in question. TEST the system for normal operation.
A13 CHECK THE MANUAL OPERATION OF THE SUSPECT DOOR LOCK	
• Manually operate the suspect door lock while checking for a binding or stuck condition. • **Is the lock stuck or binding?**	**Yes** REPAIR the binding components. TEST the system for normal operation. **No** GO to A14 .
A14 CHECK SUSPECT DOOR LOCK ACTUATOR	
• Disconnect: Suspect Door Lock Actuator Connector. • Connect a 5A fused jumper wire between the suspect door lock actuator connector pin 1, component side and the battery positive terminal; and between the suspect door lock actuator connector pin 2, component side and ground.	**Yes** GO to A15 . **No** INSTALL a new door lock actuator. REFER to Front Door Lock Actuator in this section. TEST the system for normal operation.



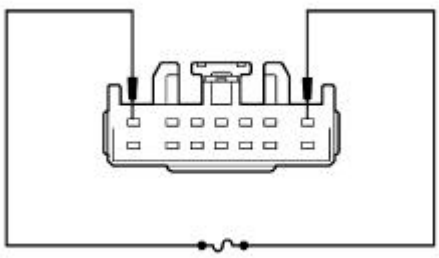
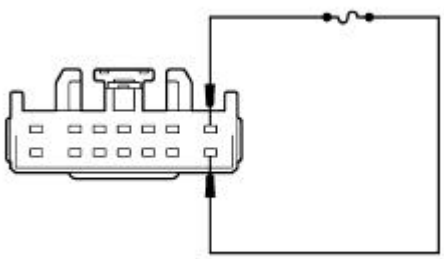
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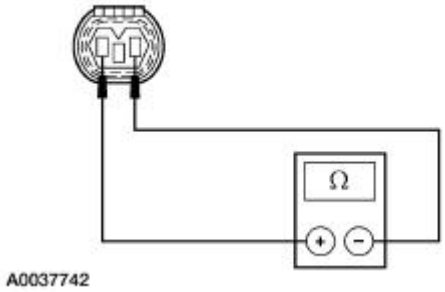
- Connect a 5A fused jumper wire between the suspect door lock actuator connector pin 2, component side and the battery positive terminal; and between the suspect door lock actuator connector pin 1, component side and ground.



A0051368

- **Does the door lock actuator operate correctly?**

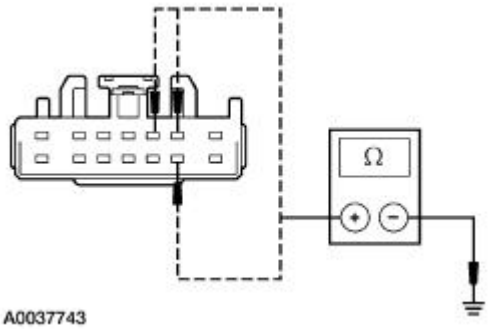
A15 CHECK DOOR LOCK ACTUATOR CIRCUITS	
• Disconnect: Vehicle Security Module C2113a. • If the driver door lock is inoperative, connect a 15A fused jumper wire between the vehicle security module C2113a pin 1, circuit 117 (PK/BK), harness side and the vehicle security module 2113a pin 7, circuit 163 (RD/OG), harness side.  A0037740 • If any door lock is inoperative other than the driver door, connect a 15A fused jumper wire between the vehicle security module C2113a pin 1, circuit 117 (PK/BK), harness side and the vehicle security module 2113a pin 8, circuit 118 (PK/OG), harness side.  A0037741	**Yes** GO to A16 . **No** REPAIR the circuit in question. TEST the system for normal operation.

• Measure the resistance between the suspect door lock actuator connector pin 1, harness side and the suspect door lock actuator connector pin 2, circuit 117 (PK/BK), harness side.  A0037742 • **Is the resistance less than 5 ohms?**	
A16 CHECK FOR CORRECT VEHICLE SECURITY MODULE OPERATION	
• Disconnect all vehicle security module connectors. • Check for: • corrosion • pushed-out pins • Connect all vehicle security module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new vehicle security module. REFER to Section 419-10 . TEST the system for normal operation. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. TEST the system for normal operation.

PINPOINT TEST B: THE DOORS DO NOT LOCK/UNLOCK USING THE KEYLESS ENTRY KEYPAD

Test Step	Result / Action to Take
B1 CHECK THE VEHICLE SECURITY MODULE KEYPAD SWITCH PIDS	
• Enter the following diagnostic mode on the diagnostic tool: Vehicle Security Module KEYPAD PIDS. • Press each keypad button while viewing vehicle security module KEYPAD PIDS. • **Do the PID values agree with the keypad button positions?**	**Yes** GO to B5 . **No** GO to B2 .
B2 CHECK CIRCUITS 78 (LB/YE), 79 (LG/RD) AND 121 (YE/BK) FOR RESISTANCE TO GROUND	
• Key in OFF position. • Disconnect: Vehicle Security Module C2113c. • Using the following table, measure the resistance between the vehicle security module C2113c harness side and ground:	**Yes** GO to B3 . **No** GO to B4 .

Vehicle Security Module C2113c	Circuit
pin 2	78 (LB/YE)
pin 3	121 (YE/BK)
pin 9	79 (LG/RD)

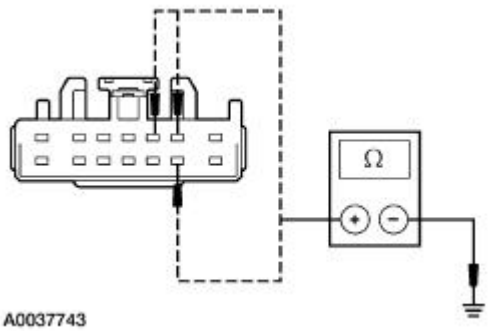


- **Is any resistance less than 10,000 ohms?**

B3 CHECK CIRCUITS 78 (LB/YE), 79 (LG/RD) AND 121 (YE/BK) FOR A SHORT TO GROUND

- Disconnect: Keyless Entry Keypad C500.
- Using the following table, measure the resistance between the vehicle security module C2113c harness side and ground:

Vehicle Security Module C2113c	Circuit
pin 2	78 (LB/YE)
pin 3	121 (YE/BK)
pin 9	79 (LG/RD)



- **Is any resistance less than 10,000 ohms?**

Yes
REPAIR the circuit(s). CLEAR the DTCs. REPEAT the self-test.

No
INSTALL a new keyless entry keypad. REFER to Keyless Entry Keypad in this section. TEST the system for normal operation.

B4 CHECK CIRCUITS 121 (YE/BK), 78 (LB/YE), 79 (LG/RD) AND 124 (BR) FOR AN OPEN

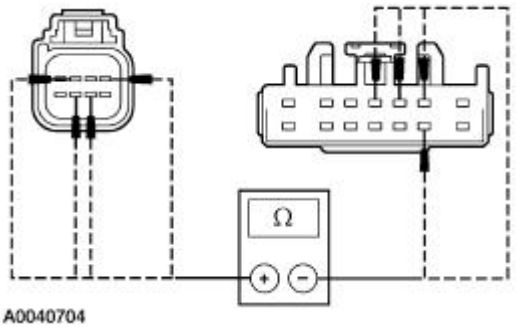
- Disconnect: Keyless Entry Keypad C500.
- Using the following table, measure the resistance between the vehicle security module C2113c, harness side and keyless entry keypad C500 harness side:

Vehicle Security Module C2113c	Circuit	Keyless entry keypad C500
pin 2	78	pin 1

Yes
INSTALL a new keyless entry keypad. REFER to Keyless Entry Keypad in this section. TEST the system for normal operation.

No
REPAIR the circuit(s). CLEAR the DTCs. REPEAT

	(LB/YE)	
pin 3	121 (YE/BK)	pin 7
pin 4	124 (BR)	pin 6
pin 9	79 (LG/RD)	pin 3



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

the self-test.

B5 CHECK FOR CORRECT VEHICLE SECURITY MODULE OPERATION	
• Disconnect all vehicle security module connectors. • Check for: • corrosion • pushed-out pins • Connect all vehicle security module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new vehicle security module. REFER to Section 419-10 . CLEAR the DTCs. REPEAT the vehicle security module self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

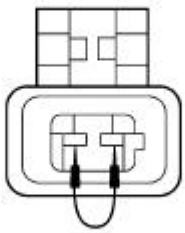
PINPOINT TEST C: THE DOORS DO NOT LOCK/UNLOCK USING THE REMOTE TRANSMITTER

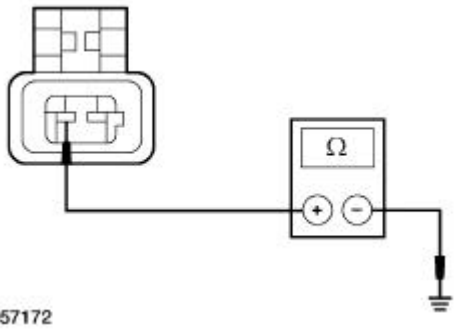
Test Step	Result / Action to Take
C1 VERIFY CORRECT OPERATION OF POWER LOCKING FUNCTION	
• Operate the door locks using the driver door lock control switch. • **Do all the doors lock and unlock correctly?**	**Yes** GO to C2 . **No** Go To Pinpoint Test A .
C2 CHECK REMOTE TRANSMITTER INPUT TO VEHICLE SECURITY MODULE	
• Unlock all the doors. • Monitor vehicle security module remote transmitter lock and unlock PIDS while	**Yes** GO to C5 .

pressing remote transmitter lock and unlock button. ● **Do the PID values agree with button presses?**	**No** GO to C3 .
C3 CHECK REMOTE TRANSMITTER BATTERY	
● Check the remote transmitter battery. ● **Is the battery OK?**	**Yes** GO to C4 . **No** INSTALL a new battery. TEST the system for normal operation.
C4 CHECK THE TRANSMITTER IDENTIFICATION CODE (TIC)/DATA FOR TIC MATCH	
● From the diagnostic tool FUNCTION TEST, monitor the vehicle security module LAST TIC RECEIVED while pressing and releasing the remote transmitter lock and unlock buttons. ● **Does TIC under LAST TIC RECEIVED match TIC 1, TIC 2, TIC 3 or TIC 4?**	**Yes** GO to C5 . **No** PROGRAM all the remote transmitters. REFER to Remote Transmitter Programming in this section. CLEAR the DTCs. REPEAT the self-test. If still not working, INSTALL a new remote transmitter. TEST the system for normal operation.
C5 CHECK FOR CORRECT VEHICLE SECURITY MODULE OPERATION	
● Disconnect all vehicle security module connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all vehicle security module connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new vehicle security module. REFER to Section 419-10 . CLEAR the DTCs. REPEAT the vehicle security module self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST D: THE AUTO-LOCK DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
D1 VERIFY THE AUTO-LOCK FEATURE IS ENABLED	
● Verify auto-lock feature is enabled. ● **Is the auto-lock/relock feature enabled?**	**Yes** GO to D2 . **No** Turn feature ON with any configuration method.
D2 CHECK THE DOOR LOCK CONTROL SWITCH	
● Disconnect: Door Lock Control Switch. ● Carry out the door lock control switch component test. Refer to Wiring Diagrams Cell 149 for schematic and	**Yes** GO to D3 . **No**

connector information. ● **Is the door lock control switch OK?**	INSTALL a new door lock control switch. TEST the system for normal operation.
D3 CHECK ALL THE VEHICLE SECURITY MODULE DOOR AJAR PIDS FOR CORRECT READINGS ● Key in ON position. ● Monitor all vehicle security module door ajar PIDS while opening and closing all doors. ● **Do the PID values agree with the door positions?**	**Yes** GO to D15 . **No** If the liftgate ajar circuit PID does not agree with the liftgate status, GO to D7 . For all others, GO to D4 .
D4 CHECK THE SUSPECT DOOR AJAR SWITCH CIRCUIT ● Key in OFF position. ● Disconnect: Suspect Door Ajar Switch Connector. ● Connect a jumper wire between the pins of the suspect door ajar switch. Refer to the following chart: **Door** / **Connector** LF / C526 RF / C602 LR / C715 RR / C820  GK2923-A ● **Do the courtesy lamps turn off?**	**Yes** INSTALL a new door ajar switch. REFER to Door Ajar Switch in this section. TEST the system for normal operation. **No** GO to D5 .
D5 CHECK THE SUSPECT DOOR AJAR SWITCH CIRCUIT 57 (BK) FOR AN OPEN ● Measure the resistance between the suspect door ajar switch connector, harness side and ground. Refer to the following chart: **Door Ajar Switch** / **Circuit** C526 (LF) / 57 (BK) C602 (RF) / 57 (BK) C715 (LR) / 57 (BK) C820 (RR) / 57 (BK)	**Yes** GO to D6 . **No** REPAIR the circuit in question. TEST the system for normal operation.



A0057172

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

D6 CHECK THE CIRCUIT BETWEEN THE VEHICLE SECURITY MODULE AND THE SUSPECT DOOR AJAR SWITCH FOR AN OPEN

- Disconnect: Vehicle Security Module C2113a.
- Measure the resistance between the suspect door ajar switch connector, harness side and the vehicle security module C2113a, harness side. Refer to the following chart:

Door Ajar Switch	Vehicle Security Module	Circuit
C526 (LF)	C2113a-4	344 (BK/YE)
C602 (RF)	C2113a-5	345 (BK/PK)
C715 (LR)	C2113a-11	346 (BK/WH)
C820 (RR)	C2113a-6	346 (BK/WH)/363 (BK/LB)

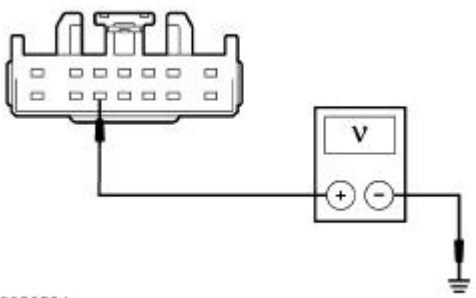
- **Is the resistance less than 5 ohms?**

Yes
GO to D15 .

No
REPAIR the circuit in question. TEST the system for normal operation.

D7 CHECK CIRCUIT 700 (WH/VT) FOR SHORT TO VOLTAGE

- Key in OFF position.
- Disconnect: Vehicle Security Module C2113a.
- Key in ON position.
- Measure the voltage between the vehicle security module C2113a pin 12, circuit 700 (WH/VT), harness side and ground.



A0056594

- **Is any voltage present?**

Yes
GO to D8 .

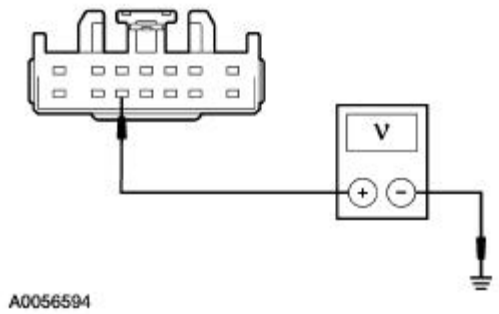
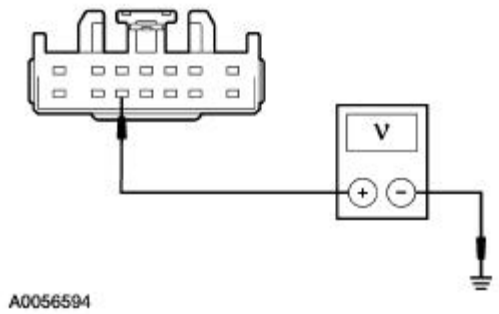
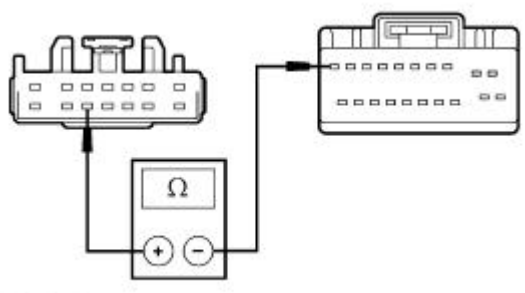
No
GO to D10 .

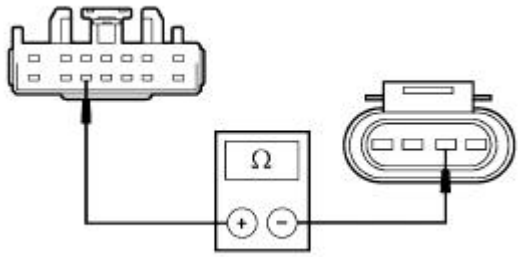
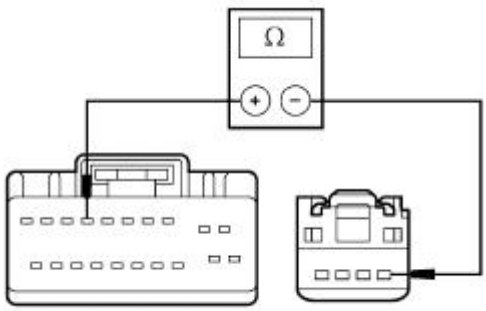
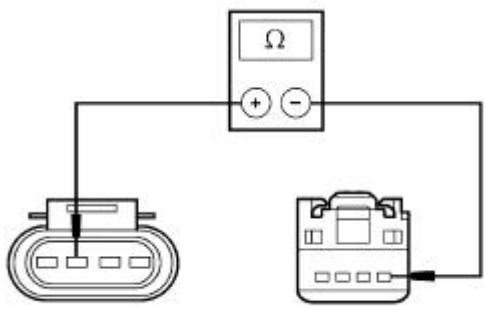
D8 ISOLATE THE SHORT TO VOLTAGE

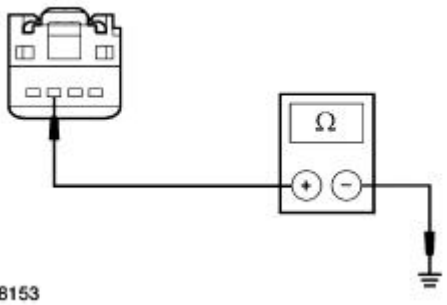
- Key in OFF position.
- Disconnect: Power Liftgate Module C4174d (if equipped with power liftgate).
- Disconnect: Liftgate Ajar Switch C479 (if not equipped with power liftgate).
- Key in ON position.
- Measure the voltage between the vehicle security module

Yes
REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

No
If the vehicle is equipped

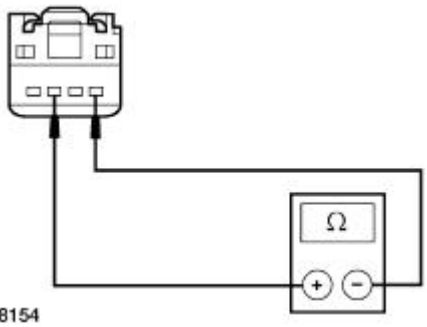
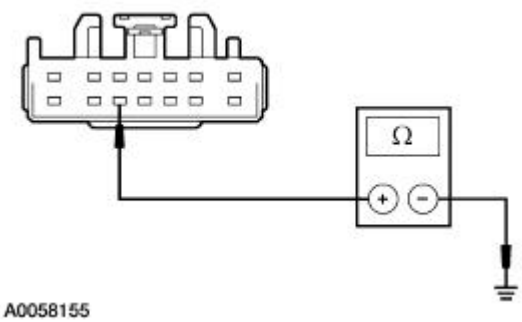
C2113a pin 12, circuit 700 (WH/VT), harness side and ground.  A0056594 ● **Is any voltage present?**	with a power liftgate, INSTALL a new power liftgate module. REFER to Section 501-03 . TEST the system for normal operation. If the vehicle is not equipped with a power liftgate, GO to D9 .
D9 CHECK THE LIFTGATE GLASS RELEASE ACTUATOR FOR SHORT TO VOLTAGE	
● Key in OFF position. ● Connect: Liftgate Ajar Switch C479. ● Disconnect: Liftgate Glass Release Actuator C4040. ● Measure the voltage between the vehicle security module C2113a pin 12, circuit 700 (WH/VT), harness side and ground.  A0056594 ● **Is any voltage present?**	**Yes** REPAIR circuit 1961 (BU/LB). CLEAR the DTCs. REPEAT the self-test. **No** INSTALL a new liftgate glass release actuator. REFER to Liftgate Latch—Window Glass . CLEAR the DTCs. REPEAT the self-test.
D10 CHECK CIRCUIT 700 (WH/VT) FOR AN OPEN	
● Key in OFF position. ● Disconnect: Power Liftgate Module C4174d (if equipped with power liftgate). ● Disconnect: Liftgate Ajar Switch C479 (if not equipped with power liftgate). ● If the vehicle is equipped with a power liftgate, measure the resistance between the vehicle security module C2113a pin 12, circuit 700 (WH/VT), harness side and the power liftgate module C4174d pin 10, circuit 700 (WH/VT), harness side.  A0058156 ● If the vehicle is not equipped with a power liftgate, measure the resistance between the vehicle security module C2113a pin 12, circuit 700 (WH/VT), harness side and the liftgate	**Yes** GO to D11 . **No** REPAIR the circuit. TEST the system for normal operation.

ajar switch C479 pin B, circuit 700 (WH/VT), harness side.  A0058157 ● **Is the resistance less than 5 ohms?**	
D11 CHECK CIRCUIT 1961 (BU/LB) FOR AN OPEN	
● Disconnect: Liftgate Glass Release Actuator C4040. ● If the vehicle is equipped with a power liftgate, measure the resistance between the power liftgate module C4174d pin 7, circuit 1961 (BU/LB), harness side and the liftgate glass release actuator C4040 pin 1, circuit 1961 (BU/LB), harness side.  A0053295 ● If the vehicle is not equipped with a power liftgate, measure the resistance between the liftgate ajar switch C479 pin C, circuit 1961 (BU/LB), harness side and the liftgate glass release actuator C4040 pin 1, circuit 1961 (BU/LB), harness side.  A0053296 ● **Is the resistance less than 5 ohms?**	**Yes** GO to D12 . **No** REPAIR the circuit. TEST the system for normal operation.
D12 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
● Measure the resistance between the liftgate glass release actuator C4040 pin 3, circuit 57 (BK), harness side and ground.	**Yes** GO to D13 . **No** REPAIR the circuit. TEST the system for normal operation.



A0058153

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

D13 CHECK THE LIFTGATE GLASS RELEASE ACTUATOR	
• Measure the resistance between the liftgate glass release actuator C4040 pin 1, component side and the liftgate glass release actuator C4040 pin 3, component side while opening and closing the liftgate glass.  A0058154 • **Does the resistance switch between less than 5 ohms to greater than 10,000 ohms?**	**Yes** GO to D14 . **No** INSTALL a new liftgate glass release actuator. REFER to Liftgate Latch—Window Glass . CLEAR the DTCs. REPEAT the selft-test.
D14 CHECK THE VEHICLE SECURITY MODULE	
• Connect: Liftgate Glass Release Actuator C4040. • Connect: Power Liftgate Module C4174d (if equipped with power liftgate). • Connect: Liftgate Ajar Switch C479 (if not equipped with power liftgate). • Key in ON position. • Measure the resistance between the vehicle security module C2113a pin 12, circuit 700 (WH/VT), harness side and ground while opening and closing the liftgate.  A0058155 • **Does the resistance switch from less than 5 ohms to greater than 10,000 ohms?**	**Yes** GO to D16 . **No** If the vehicle is equipped with a power liftgate, GO to D17 . If the vehicle is not equipped with a power liftgate, INSTALL a new liftgate ajar switch. TEST the system for normal operation.
D15 CHECK THE PCM, INSTRUMENT CLUSTER AND ABS PIDS	
• Enter the following diagnostic mode on the diagnostic tool: Monitor the PCM vehicle speed PID. • Enter the following diagnostic mode on the diagnostic tool:	**Yes** GO to D16 .

Monitor the instrument cluster ignition switch status PID. ● Enter the following diagnostic mode on the diagnostic tool: Monitor the anti-lock brake system (ABS) module brake ON/OFF PID. ● **Are the correct values received?**	**No** To diagnose for an incorrect vehicle speed PID, REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual. To diagnose for an incorrect ignition switch status PID, REFER to Section 413-09 . To diagnose for an incorrect brake ON/OFF PID, REFER to Section 206-09A .
D16 CHECK FOR CORRECT VEHICLE SECURITY MODULE OPERATION	
● Disconnect all vehicle security module connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all vehicle security module connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new vehicle security module. REFER to Section 419-10 . CLEAR the DTCs. REPEAT the vehicle security module self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
D17 CHECK FOR CORRECT POWER LIFTGATE MODULE OPERATION	
● Disconnect all power liftgate module connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all power liftgate module connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new power liftgate module. REFER to Section 501-03 . CLEAR the DTCs. REPEAT the power liftgate module self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

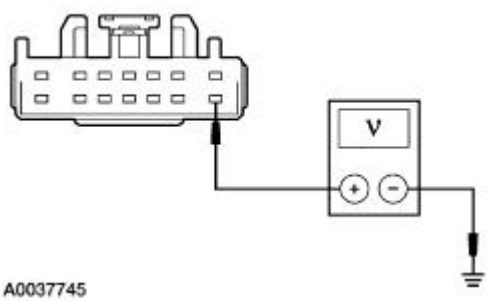
PINPOINT TEST E: REMOTE KEYLESS ENTRY TRANSMITTER OUT OF SYNCHRONIZATION

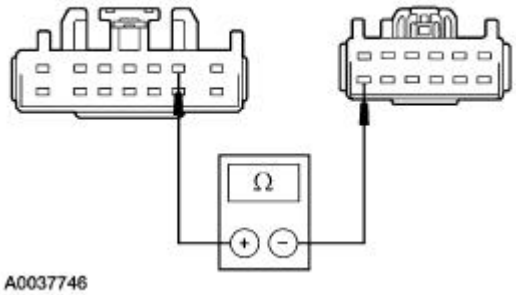
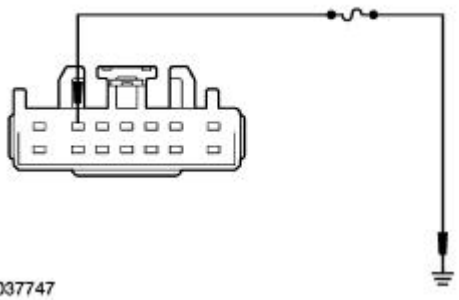
Test Step	Result / Action to Take
E1 CHECK THE DIAGNOSTIC TROUBLE CODES (DTCS)	
● Refer to the recorded results from the previous self-test.	**Yes** GO to E4 .

• **Was DTC B2425 retrieved?**	**No** GO to E2 .
E2 RESYNCHRONIZE THE REMOTE TRANSMITTER	
• Press any button on the inoperative remote transmitter four times consecutively. • **Does the keyless entry transmitter operate correctly?**	**Yes** CLEAR the DTCs. REPEAT the self-test. **No** GO to E3 .
E3 CHECK FOR THE SECOND REMOTE TRANSMITTER	
• Check for another remote transmitter that works with the vehicle. • **Is there another remote transmitter that works with the vehicle?**	**Yes** GO to E4 . **No** GO to E5 .
E4 RESYNCHRONIZE THE INOPERATIVE REMOTE TRANSMITTER USING THE SECOND REMOTE TRANSMITTER.	
• Press any button on the operational remote transmitter. • Within 30 seconds press a button on the inoperative remote transmitter. • Check the inoperative remote transmitter for correct operation. • **Does the remote transmitter in question operate correctly?**	**Yes** TEST the system for normal operation. **No** GO to E5 .
E5 REPROGRAM THE INOPERATIVE REMOTE TRANSMITTER	
• Reprogram all remote transmitters. Refer to Remote Transmitter Programming in this section. • **Does the remote transmitter operate correctly?**	**Yes** INFORM the customer that any additional remote transmitters not present during the programming mode will not operate with the vehicle. All remote transmitters must be programmed at the same time. TEST the system for normal operation. **No** Go To Pinpoint Test C .

PINPOINT TEST F: PANIC FEATURE IS INOPERATIVE/DOES NOT OPERATE CORRECTLY

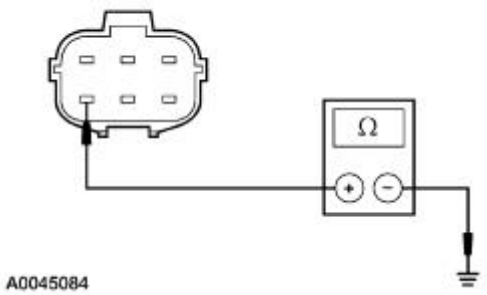
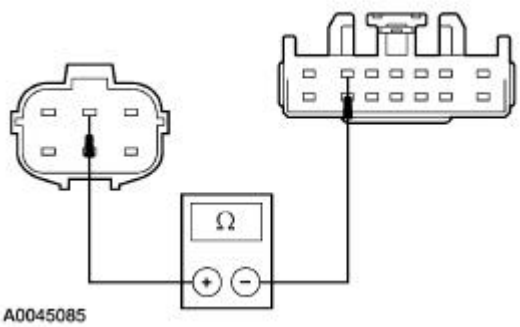
Test Step	Result / Action to Take
F1 VERIFY OPERATION OF THE HORN	
• Key in ON position. • Operate the horn through the steering wheel switch. • **Does the horn operate correctly?**	**Yes** GO to F2 . **No** REFER to Section 413-06 .

F2 VERIFY THE PARKING LAMP OPERATION • Key in ON position. • Turn on the parking lamps with headlamp switch. • **Do the parking lamps operate correctly?**	**Yes** GO to F3 . **No** REFER to Section 417-01 .
F3 CHECK THE HORN OPERATION FROM THE VEHICLE SECURITY MODULE • Key in ON position. • Activate the horn active command for one second. • **Does the horn operate?**	**Yes** GO to F4 . **No** GO to F9 .
F4 CHECK THE PARKING LAMP OPERATION FROM THE VEHICLE SECURITY MODULE • Key in ON position. • Activate the parking lamps active command for five seconds. • **Do the parking lamps operate?**	**Yes** GO to F5 . **No** GO to F7 .
F5 CHECK THE REMOTE TRANSMITTER OPERATION • Key in ON position. • Unlock and lock the doors using the remote transmitter buttons. • **Do the doors lock and unlock correctly?**	**Yes** GO to F6 . **No** Go To Pinpoint Test C .
F6 CHECK THE REMOTE TRANSMITTER SIGNAL TO THE VEHICLE SECURITY MODULE • Read the vehicle security module remote transmitter panic button PID while pressing the PANIC button. • **Does the PID value agree with the button press?**	**Yes** GO to F10 . **No** INSTALL a new remote transmitter. TEST the system for normal operation.
F7 CHECK CIRCUIT 195 (TN/WH) FOR AN OPEN • Disconnect: Vehicle Security Module C2113b. • Measure the voltage between the vehicle security module C2113b pin 8, circuit 195 (TN/WH), harness side and ground.  • **Is the voltage greater than 10 volts?**	**Yes** GO to F8 . **No** REPAIR the circuit. TEST the system for normal operation.
F8 CHECK CIRCUIT 14 (BN) FOR AN OPEN • Disconnect: Vehicle Security Module C2113b. • Disconnect: Headlamp Switch C205a.	**Yes** GO to F10 .

• Measure the resistance between the vehicle security module C2113b pin 2, circuit 14 (BN), harness side and the headlamp switch C205a pin 12, circuit 14 (BN), harness side.  A0037746 • **Is the resistance less than 5 ohms?**	**No** REPAIR the circuit. TEST the system for normal operation.
F9 CHECK CIRCUIT 1 (DB) FOR AN OPEN	
• Disconnect: Vehicle Security Module C2113b. • Connect a 15A fused jumper wire between the vehicle security module C2113b pin 6, circuit 1 (DB), harness side and ground.  A0037747 • **Does the horn operate?**	**Yes** GO to F10 . **No** REPAIR the circuit. TEST the system for normal operation.
F10 CHECK FOR CORRECT VEHICLE SECURITY MODULE OPERATION	
• Disconnect all vehicle security module connectors. • Check for: ◦ corrosion ◦ pushed-out pins • Connect all vehicle security module connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** INSTALL a new vehicle security module. REFER to Section 419-10 . CLEAR the DTCs. REPEAT the vehicle security module self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST G: THE KEYLESS ENTRY KEYPAD ILLUMINATION IS INOPERATIVE

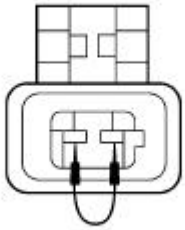
Test Step	Result / Action to Take

G1 CHECK THE KEYPAD SWITCH PIDS	
• Enter the following diagnostic mode on the diagnostic tool: Vehicle Security Module KEYPAD PIDS. • Press each keypad button while viewing vehicle security module KEYPAD PIDS. • **Do the PID values agree with the keypad button positions?**	**Yes** GO to G2 . **No** Go To Pinpoint Test B .
G2 CHECK THE VEHICLE SECURITY MODULE OUTPUT FUNCTION	
• Activate the keypad backlighting on and off active commands. • Trigger LIGHT ON then OFF. • **Does the keypad backlighting turn on and off when commanded?**	**Yes** GO to G5 . **No** GO to G3 .
G3 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
• Key in OFF position. • Disconnect: Keyless Entry Keypad C500. • Measure the resistance between the keyless entry keypad C500 pin 4, circuit 57 (BK), harness side and ground.  A0045084 • **Is the resistance less than 5 ohms?**	**Yes** GO to G4 . **No** REPAIR the circuit. TEST the system for normal operation.
G4 CHECK CIRCUIT 66 (LB) FOR AN OPEN	
• Key in OFF position. • Disconnect: Keyless Entry Keypad C500. • Disconnect: Vehicle Security Module C2113c. • Measure the resistance between the keyless entry keypad C500 pin 2, circuit 66 (LB), harness side and the vehicle security module C2113c pin 6, circuit 66 (LB), harness side.  A0045085 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new keyless entry keypad. REFER to Keyless Entry Keypad in this section. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.
G5 CHECK FOR CORRECT VEHICLE SECURITY MODULE OPERATION	
• Disconnect all vehicle security module connectors. • Check for: ◦ for corrosion ◦ for pushed-out pins • Connect all vehicle security module connectors and make	**Yes** INSTALL a new vehicle security module. REFER to Section 419-10 . CLEAR the DTCs. REPEAT the

sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	vehicle security module self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

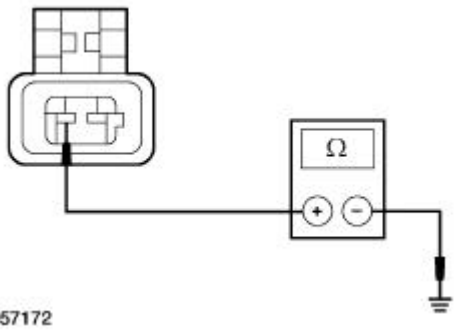
PINPOINT TEST H: THE SMART UNLOCK DOES NOT OPERATE CORRECTLY

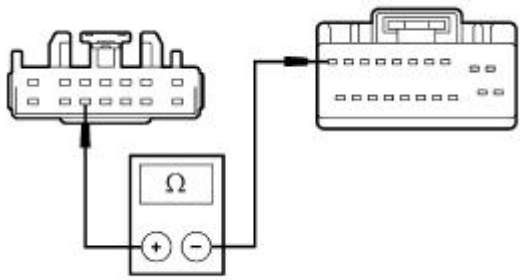
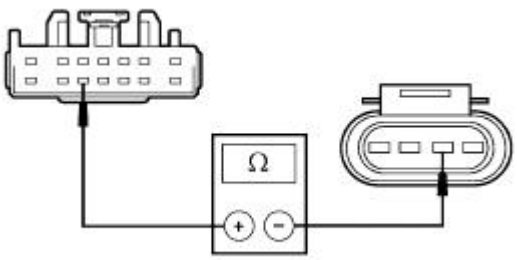
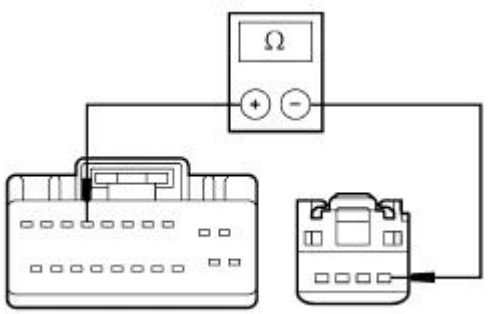
Test Step	Result / Action to Take
H1 CHECK THE DOOR LOCK CONTROL SWITCH	
● Disconnect: Door Lock Control Switch. ● Carry out the door lock control switch component test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. ● **Is the door lock control switch OK?**	**Yes** GO to H2 . **No** INSTALL a new door lock control switch. TEST the system for normal operation.
H2 CHECK ALL VEHICLE SECURITY MODULE DOOR AJAR PIDS FOR CORRECT READINGS	
● Key in ON position. ● Monitor all vehicle security module door ajar PIDS while opening and closing all doors. ● **Do the PID values agree with the door positions?**	**Yes** GO to H11 . **No** If the liftgate ajar circuit PID does not agree with the liftgate status, GO to H6 . For all others, GO to H3 .
H3 CHECK SUSPECT DOOR AJAR SWITCH CIRCUIT	
● Key in OFF position. ● Disconnect: Suspect Door Ajar Switch Connector. ● Connect a jumper wire between the pins of the suspect door ajar switch. Refer to the following chart: **Door** / **Connector** LF / C526 RF / C602 LR / C715 RR / C820	**Yes** INSTALL a new door ajar switch. REFER to Door Ajar Switch in this section. TEST the system for normal operation. **No** GO to H4 .

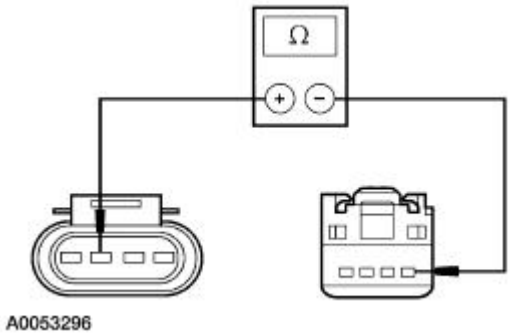
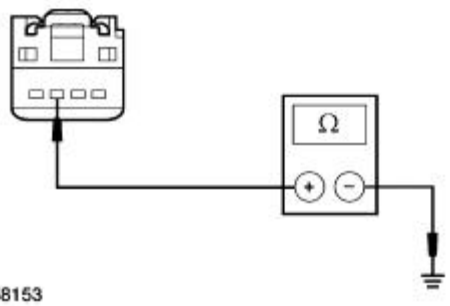
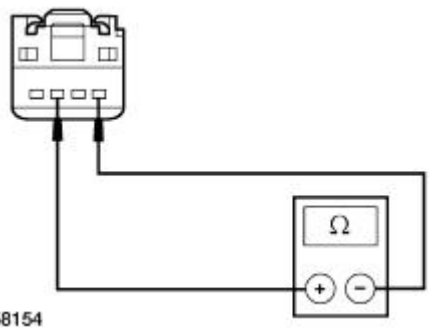


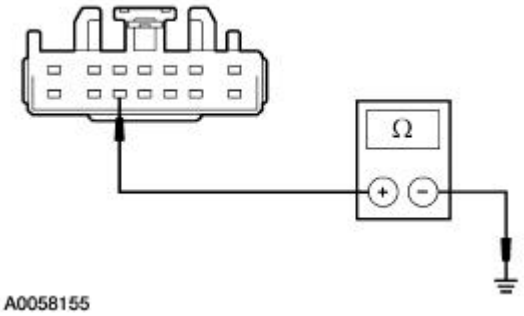
GK2923-A

- **Do the courtesy lamps turn off?**

H4 CHECK THE SUSPECT DOOR AJAR SWITCH CIRCUIT 57 (BK) FOR AN OPEN	
• Measure the resistance between the suspect door ajar switch connector, harness side and ground. Refer to the following chart: **Door Ajar Switch** / **Circuit** C526 (LF) / 57 (BK) C602 (RF) / 57 (BK) C715 (LR) / 57 (BK) C820 (RR) / 57 (BK)  A0057172 • **Is the resistance less than 5 ohms?**	**Yes** GO to H5 . **No** REPAIR the circuit in question. TEST the system for normal operation.
H5 CHECK THE CIRCUIT BETWEEN THE VEHICLE SECURITY MODULE AND THE SUSPECT DOOR AJAR SWITCH FOR AN OPEN	
• Disconnect: Vehicle Security Module C2113a. • Measure the resistance between the suspect door ajar switch connector, harness side and the vehicle security module C2113a, harness side. Refer to the following chart: **Door Ajar Switch** / **Vehicle Security Module** / **Circuit** C526 (LF) / C2113a-4 / 344 (BK/YE) C602 (RF) / C2113a-5 / 345 (BK/PK) C715 (LR) / C2113a-11 / 346 (BK/WH)/363 (BK/LB) C820 (RR) / C2113a-6 / 346 (BK/WH) • **Is the resistance less than 5 ohms?**	**Yes** GO to H11 . **No** REPAIR the circuit in question. TEST the system for normal operation.

H6 CHECK CIRCUIT 700 (WH/VT) FOR AN OPEN • Key in OFF position. • Disconnect: Power Liftgate Module C4174d (if equipped with power liftgate). • Disconnect: Liftgate Ajar Switch C479 (if not equipped with power liftgate). • If the vehicle is equipped with a power liftgate, measure the resistance between the vehicle security module C2113a pin 12, circuit 700 (WH/VT), harness side and the power liftgate module C4174d pin 10, circuit 700 (WH/VT), harness side.  A0058156 • If the vehicle is not equipped with a power liftgate, measure the resistance between the vehicle security module C2113a pin 12, circuit 700 (WH/VT), harness side and the liftgate ajar switch C479 pin B, circuit 700 (WH/VT), harness side.  A0058157 • **Is the resistance less than 5 ohms?**	**Yes** GO to H7 . **No** REPAIR the circuit. TEST the system for normal operation.
H7 CHECK CIRCUIT 1961 (BU/LB) FOR AN OPEN • Disconnect: Liftgate Glass Release Actuator C4040. • If the vehicle is equipped with a power liftgate, measure the resistance between the power liftgate module C4174d pin 7, circuit 1961 (BU/LB), harness side and the liftgate glass release actuator C4040 pin 1, circuit 1961 (BU/LB), harness side.  A0053295 • If the vehicle is not equipped with a power liftgate, measure the resistance between the liftgate ajar switch C479 pin C, circuit 1961 (BU/LB), harness side and the liftgate glass release actuator C4040 pin 1, circuit 1961 (BU/LB), harness	**Yes** GO to H8 . **No** REPAIR the circuit. TEST the system for normal operation.

side.  A0053296 ● **Is the resistance less than 5 ohms?**	
H8 CHECK CIRCUIT 57 (BK) FOR AN OPEN ● Measure the resistance between the liftgate glass release actuator C4040 pin 3, circuit 57 (BK), harness side and ground.  A0058153 ● **Is the resistance less than 5 ohms?**	**Yes** GO to H9 . **No** REPAIR the circuit. TEST the system for normal operation.
H9 CHECK THE LIFTGATE GLASS RELEASE ACTUATOR ● Measure the resistance between the liftgate glass release actuator C4040 pin 1, component side and the liftgate glass release actuator C4040 pin 3, component side while opening and closing the liftgate glass.  A0058154 ● **Does the resistance switch between less than 5 ohms to greater than 10,000 ohms?**	**Yes** GO to H10 . **No** INSTALL a new liftgate glass release actuator. REFER to Liftgate Latch—Window Glass . CLEAR the DTCs. REPEAT the self-test.
H10 CHECK THE VEHICLE SECURITY MODULE ● Connect: Liftgate Glass Release Actuator C4040. ● Connect: Power Liftgate Module C4174d (if equipped with power liftgate). ● Connect: Liftgate Ajar Switch C479 (if not equipped with power liftgate). ● Key in ON position. ● Measure the resistance between the vehicle security module C2113a pin 12, circuit 700 (WH/VT), harness side and ground while opening and closing the liftgate.	**Yes** GO to H12 . **No** If the vehicle is equipped with a power liftgate, GO to H13 . If the vehicle is not equipped with a power

 A0058155 ● **Does the resistance switch from less than 5 ohms to greater than 10,000 ohms?**	liftgate, INSTALL a new liftgate ajar switch. TEST the system for normal operation.
H11 CHECK THE PCM, INSTRUMENT CLUSTER AND ABS PIDS ● Enter the following diagnostic mode on the diagnostic tool: Monitor the PCM vehicle speed PID. ● Enter the following diagnostic mode on the diagnostic tool: Monitor the instrument cluster ignition switch status PID. ● Enter the following diagnostic mode on the diagnostic tool: Monitor the anti-lock brake system (ABS) module brake ON/OFF PID. ● **Are the correct values received?**	**Yes** GO to H12 . **No** To diagnose for an incorrect vehicle speed PID, REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual. To diagnose for an incorrect ignition switch status PID, REFER to Section 413-09 . To diagnose for an incorrect brake ON/OFF PID, REFER to Section 206-09A .
H12 CHECK FOR CORRECT VEHICLE SECURITY MODULE OPERATION ● Disconnect all vehicle security module connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all vehicle security module connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new vehicle security module. REFER to Section 419-10 . CLEAR the DTCs. REPEAT the vehicle security module self-test. **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
H13 CHECK FOR CORRECT POWER LIFTGATE MODULE OPERATION ● Disconnect all power liftgate module connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all power liftgate module connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** INSTALL a new power liftgate module. REFER to Section 501-03 . CLEAR the DTCs. REPEAT the power liftgate module self-test. **No**

	The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Remote Transmitter Programming

NOTE: All keyless entry remote transmitters must be programmed at the same time.

1. Turn the ignition switch from OFF to RUN 8 times within 10 seconds, ending in RUN. If the module has successfully entered program mode, it will lock and then unlock all doors.

2. Within 20 seconds, press any button on a keyless entry remote transmitter, and the doors will lock and then unlock to confirm that each keyless entry remote transmitter has been programmed. Repeat this step for each transmitter.

3. If the door locks do not respond for any keyless entry remote transmitter, wait several seconds and press the button again. If the door locks still fail to respond, refer to Inspection and Verification.

4. Turn the ignition switch to the OFF position, or wait up to 20 seconds after Step 2 to exit program mode. If a keyless entry remote transmitter has been programmed (or reprogrammed), the doors will lock and unlock one last time to confirm.

Keyless Entry Keypad Code Programming

1. Enter the permanent factory keyless entry keypad code.

2. Press the 1/2 button within five seconds to activate the programming mode. Holding the 1/2 button for more than two seconds after activation will erase the stored customer code. The door locks will lock, then unlock, confirming the code is erased. The existing code will not need to be erased to program new a code.

3. Within five seconds, enter the new five-digit keyless entry keypad code. The door locks will lock and unlock to confirm the new code is programmed.

Autolock and Horn Chirp Programming

1. Close all the doors.
2. Confirm that the ignition switch is in the OFF position.
3. Turn the ignition switch from OFF to RUN.
4. **NOTE:** Steps 4 through 8 must be carried out within 30 seconds.

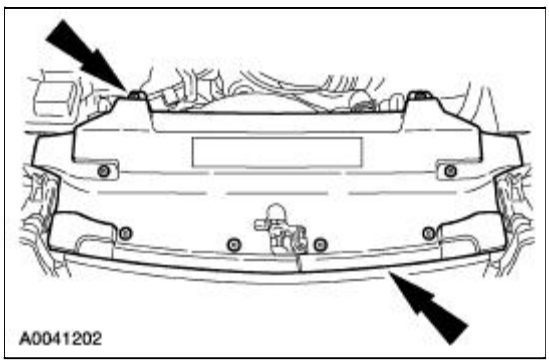
   Press the power door lock UNLOCK button three times.
5. Turn the ignition switch from RUN to OFF.
6. Press the power door lock UNLOCK button three times.
7. Turn the ignition switch from OFF to RUN.
8. Verify that the horn chirps. This indicates the system is in the enable/disable mode is ready to accept program changes.
9. Press the power door lock UNLOCK button one time to toggle the autolock/relock feature OFF.
10. Press the power door lock LOCK button once to enter the command.
11. Verify that the horn chirps one time. There should only be one chirp indicating that autolock/relock feature has been disabled. If one chirp is heard, followed by a longer sound of the horn, the autolock/relock feature has just been enabled. Return to Step 9.
12. Turn the ignition switch to the OFF position to exit the enable/disable mode.
13. Exit the vehicle and verify that the horn chirps once to indicate that a feature has been changed and that autolock/relock has been disabled.

Hood Latch

Removal and Installation

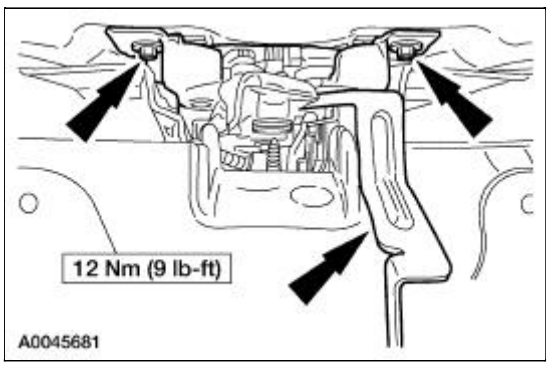
All vehicles

1. Raise and support the hood.
2. Remove the pin-type retainers and the upper radiator sight shield.

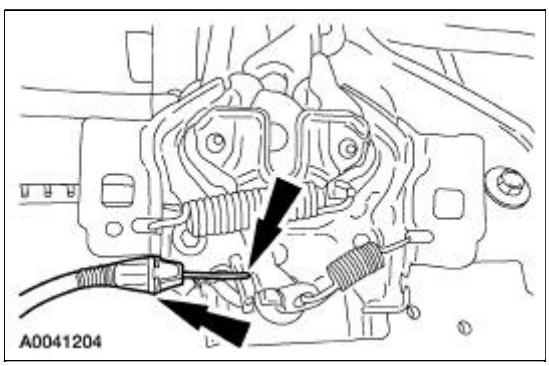


Expedition

3. Remove the bolts and the hood latch.

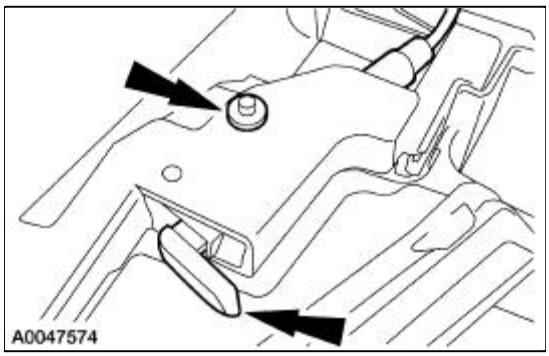


4. Release the hood latch cable from the hood latch.

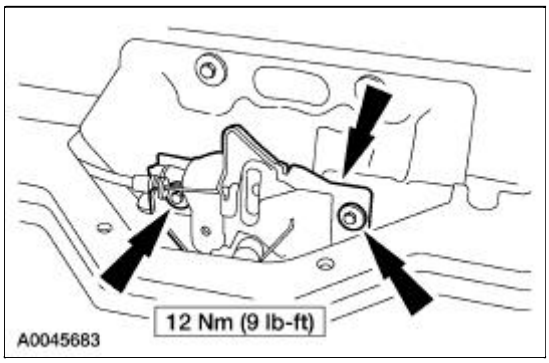


Navigator

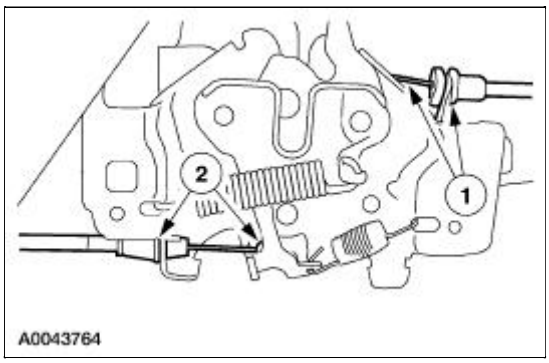
5. Remove the screw and secondary hood release cable.



6. Remove the bolts and the hood latch.



7. Remove the hood latch cables.
    1. Release the primary hood latch cable.
    2. Release the secondary hood latch cable.



All vehicles

8. To install, reverse the removal procedure.
    - Verify the hood latch engages the striker in the latched position (secondary).
    - Verify the hood latch engages the striker in the fully latched position (primary).
    - Adjust the hood latch as necessary.

Front Door Latch

Material

Item	Specification
Multi-Purpose Grease Spray F5AZ-19G209-AA	ESR-M1C159-A

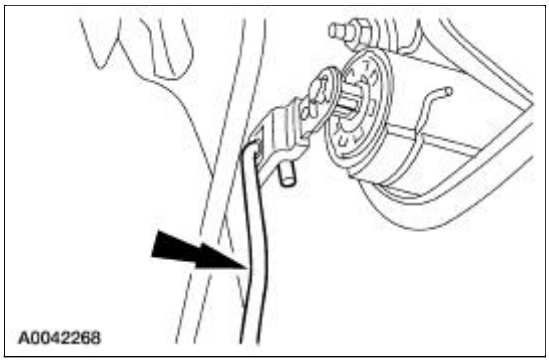
Removal and Installation

1. **NOTE:** The door glass must be completely raised.

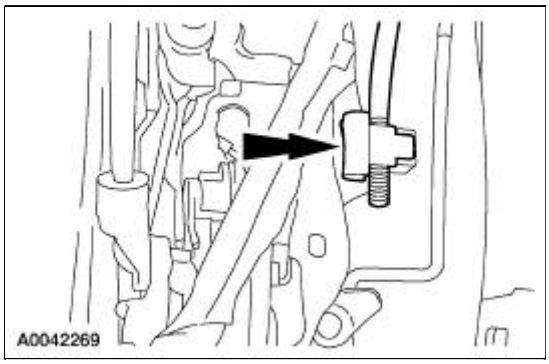
   Remove the front door trim panel. For additional information, refer to Section 501-05 .

2. Position the watershield aside.

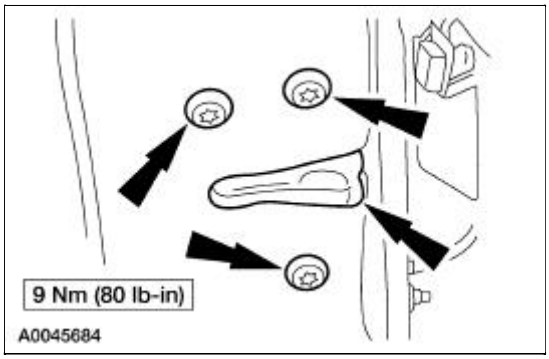
3. If equipped, disconnect the lock cylinder rod.



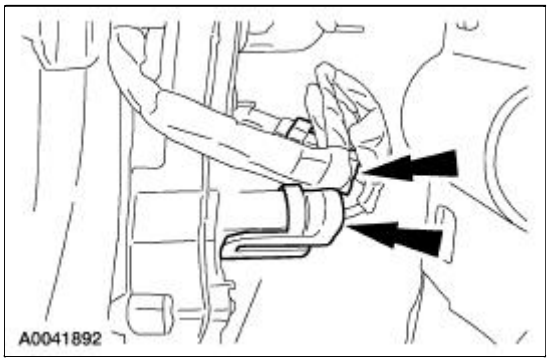
4. Disconnect the exterior door handle actuating rod.



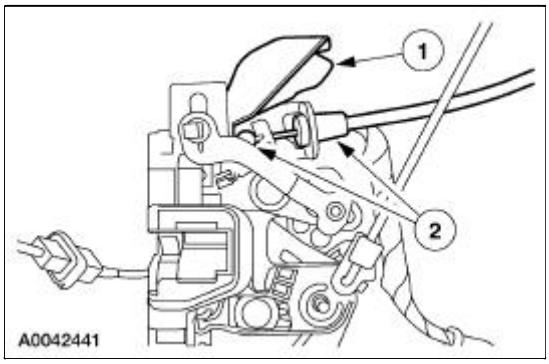
5. Remove the bolts and position the front door latch aside.
   - Discard the bolts.



6. Disconnect the electrical connectors.



7. Release the interior door handle cable and remove the front door latch.
    1. Position the cable cover aside.
    2. Release the conduit and the interior door handle cable.



8. To install, reverse the removal procedure.
    - Transfer parts as necessary.
    - If necessary, use multi-purpose grease to lubricate the latch.

Rear Door Latch

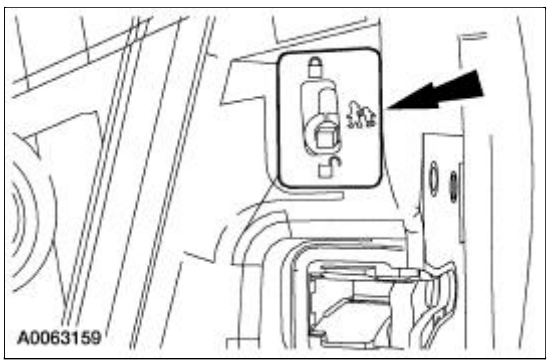
Material

Item	Specification
Multi-Purpose Grease Spray F5AZ-19G209-AA	ESR-M1C159-A

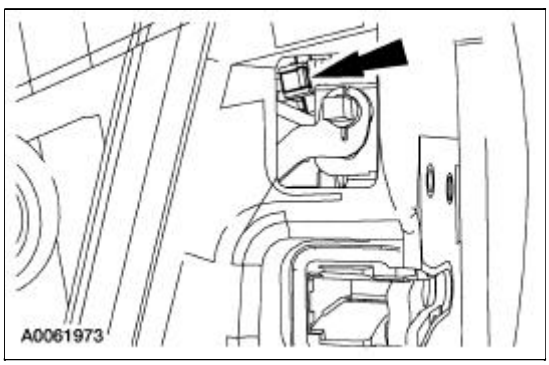
Removal and Installation

NOTE: The rear door window glass must be completely raised.

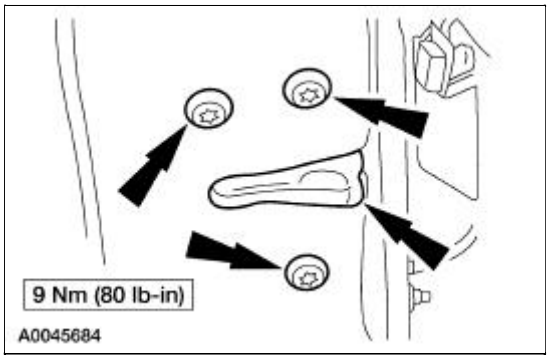
1. Remove rear door trim panel. For additional information, refer to Section 501-05 .
2. Position the watershield aside.
3. Remove the childproof door lock cover.



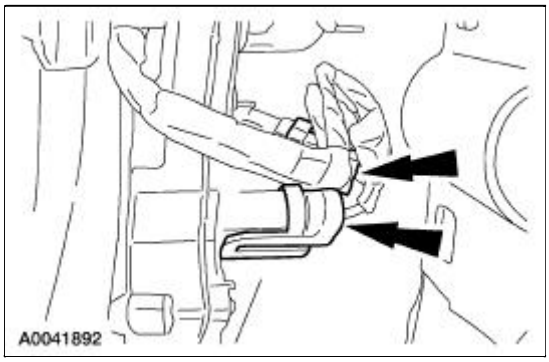
4. Disconnect the exterior door handle actuating rod.
   - Open the clip.



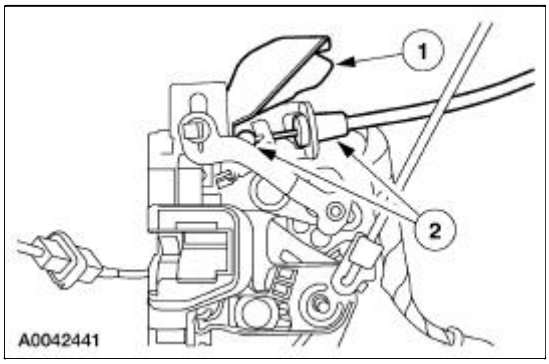
5. Remove the bolts and position the rear door latch aside.
   - Discard the bolts.



6. Disconnect the electrical connectors.



7. Release the interior door cable and remove the rear door latch.
    1. Position the cable cover aside.
    2. Release the conduit and the interior door cable.



8. To install, reverse the removal procedure.
    - Transfer parts as necessary.
    - If necessary, use multi-purpose grease to lubricate the latch.

Liftgate Latch

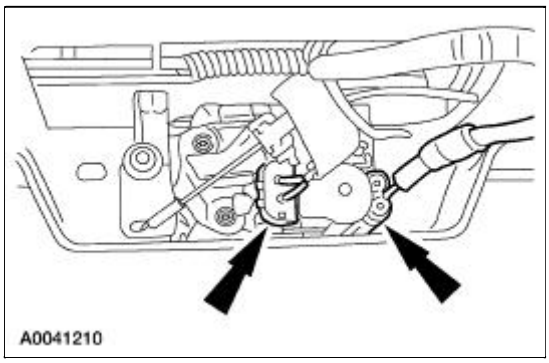
Removal and Installation

All vehicles

1. Remove the liftgate trim panel. For additional information, refer to Section 501-05 .
2. Position the watershield aside.

Vehicles with manual liftgate

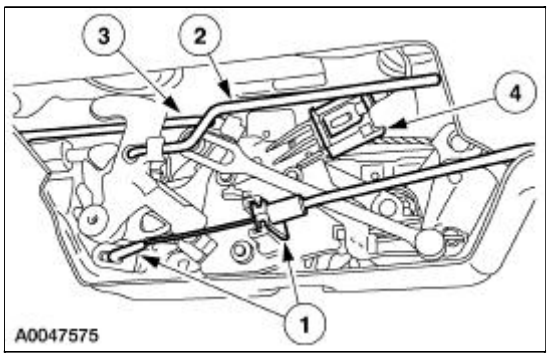
3. Disconnect the electrical connectors.



Vehicles with power liftgate

4. **CAUTION: Be careful not to kink the liftgate latch control cable while disconnecting it.**

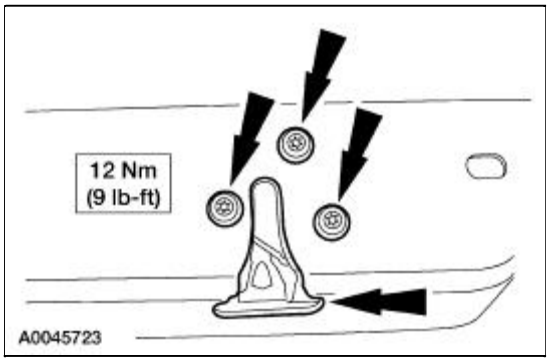
   Disconnect the liftgate latch.
   1. Disconnect the liftgate latch control cable.
   2. Release the door lock actuator rod.
   3. Release the actuating rod.
   4. Disconnect the electrical connector.



All vehicles

5. Remove the screws and position the liftgate latch aside.

- Discard the screws.

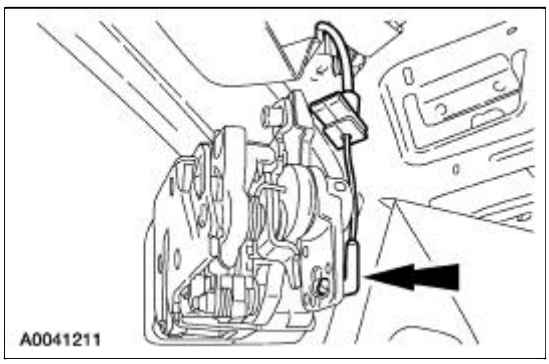


Vehicles with manual liftgate

6. **CAUTION: Be careful not to kink the liftgate latch control cable while disconnecting it from the latch.**

   Disconnect the liftgate latch control cable.

   - Remove the latch.

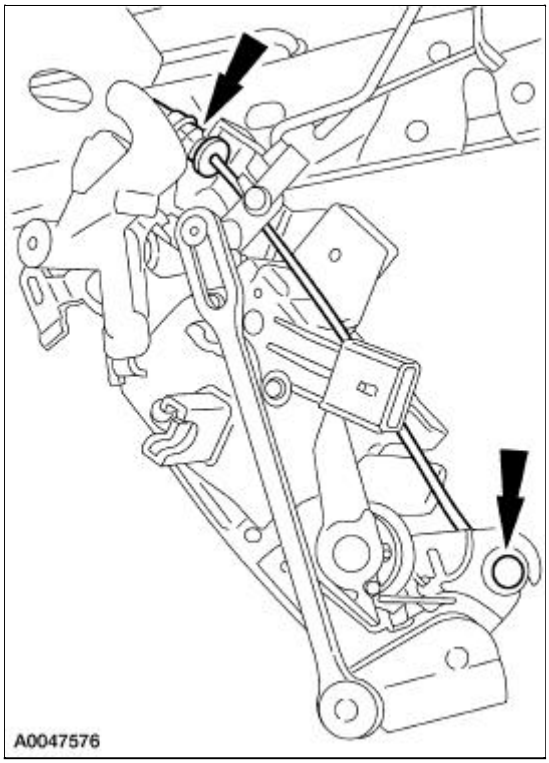


Vehicles with power liftgate

7. **CAUTION: Be careful not to kink the liftgate latch control cable while disconnecting it from the latch.**

   Disconnect the liftagte latch control cable.

   - Remove the liftgate latch.



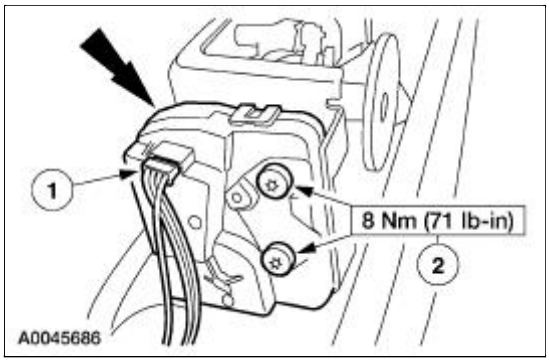
All vehicles

8. To install, reverse the removal procedure.

Liftgate Latch —Window Glass

Removal

1. Remove the liftgate trim panel. For additional information, refer to Section 501-05 .
2. Open the liftgate window glass.
3. Remove the liftgate window glass latch.
    1. Disconnect the electrical connector.
    2. Remove the bolts.



4. To install, reverse the removal procedure.

Exterior Front Door Handle

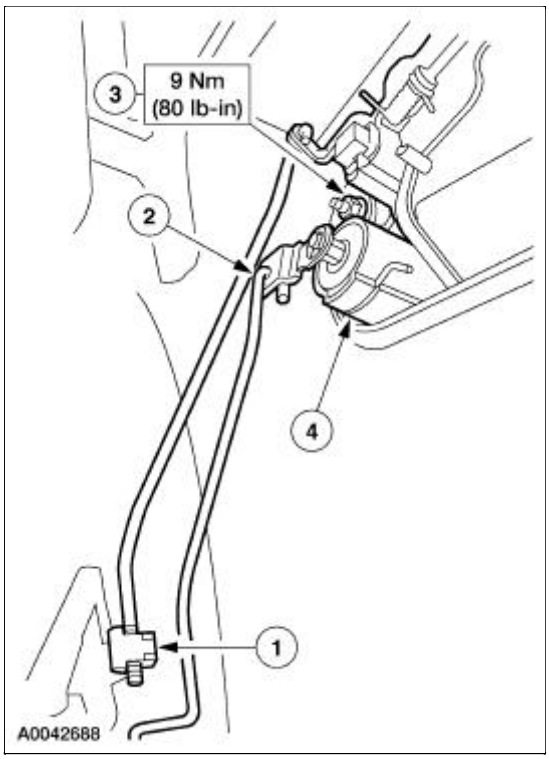
Removal and Installation

NOTE: The front door window glass must be completely raised.

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

2. Position the watershield aside.

3. Remove the exterior front door handle.
    1. Disconnect the exterior door handle actuating rod.
    2. If equipped, disconnect the door lock cylinder rod.
    3. Remove the two nuts.
    4. Push the exterior door handle out from the bottom surface of the handle.



4. **NOTE:** Make sure the door handle and the front door handle rod is in a relaxed position and that the front door handle rod is all the way up before closing the clips.

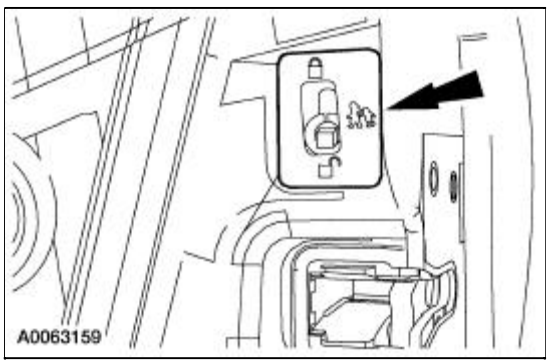
    To install, reverse the removal procedure.

Exterior Rear Door Handle

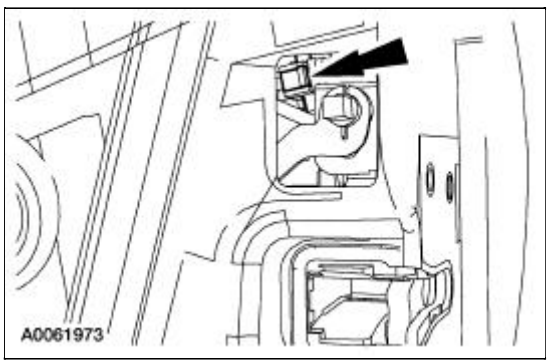
Removal and Installation

NOTE: The rear door window glass must be completely raised.

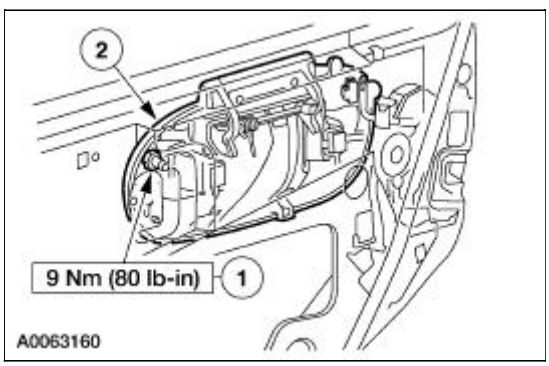
1. Remove the rear door trim panel. For additional information, refer to Section 501-05 .
2. Position the watershield aside.
3. Remove the childproof door lock cover.



4. Disconnect the exterior door handle actuation rod.



5. Remove the exterior rear door handle.
    1. Remove the two nuts.
    2. Push the exterior door handle out from the bottom surface of the handle.



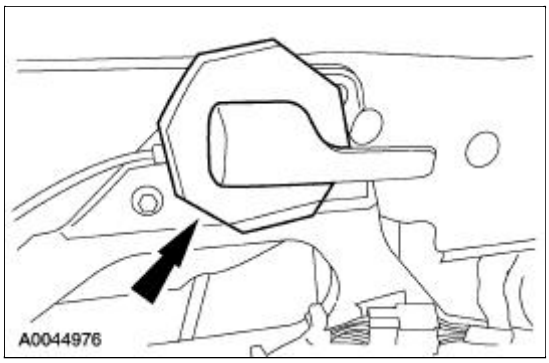
6. **NOTE:** Make sure the door handle and the rear door handle rod is in a relaxed position and that the rear door handle rod is all the way up before closing the clips.

   To install, reverse the removal procedure.

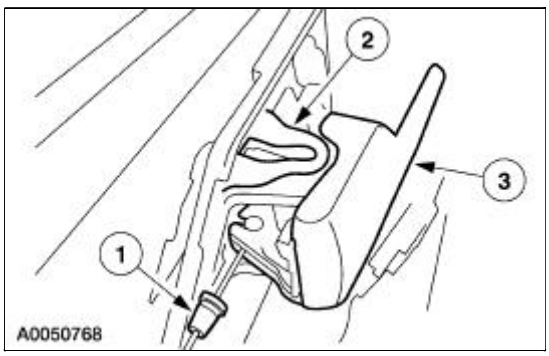
Interior Door Handle —Rear

Removal and Installation

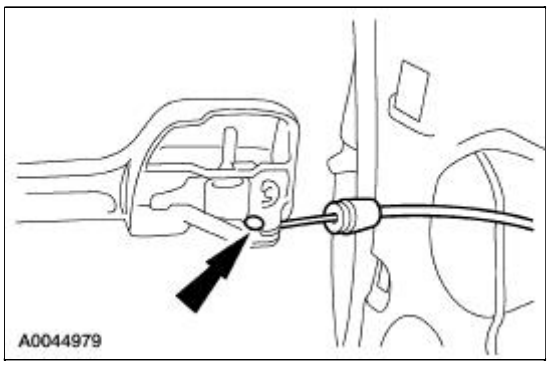
1. Remove the front or rear door trim panel. For additional information, refer to Section 501-05 .
2. Remove the door handle insulator.



3. Position the watershield aside.
4. Remove the interior door handle.
    1. Release the door handle cable from the door carrier.
    2. Release the door carrier retaining clip.
    3. Position aside the interior door handle.



5. Release the cable from the handle.



6. **NOTE:** Make sure the interior door handle spring has been realigned before installation of the door handle. Check for normal operation.

   To install, reverse the removal procedure.

Liftgate Release Handle

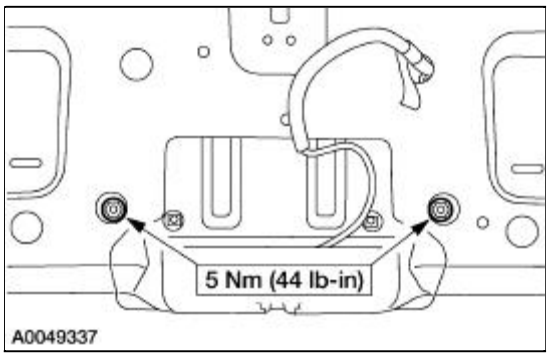
Removal and Installation

All Vehicles

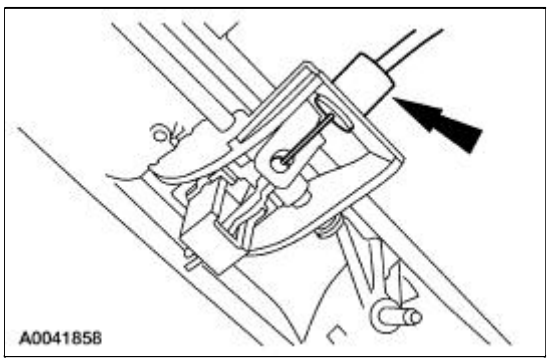
1. Remove the liftgate trim panel. For additional information, refer to Section 501-05 .
2. Position the watershield aside.

Expedition

3. Remove the nuts and position the liftgate release handle aside.

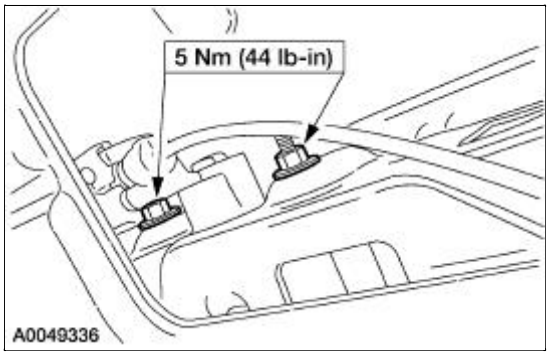


4. Release the cable from the liftgate release handle and remove the handle.



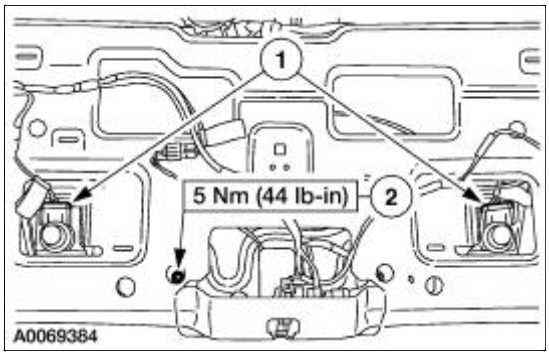
Navigator

5. Remove the liftgate release handle nuts.



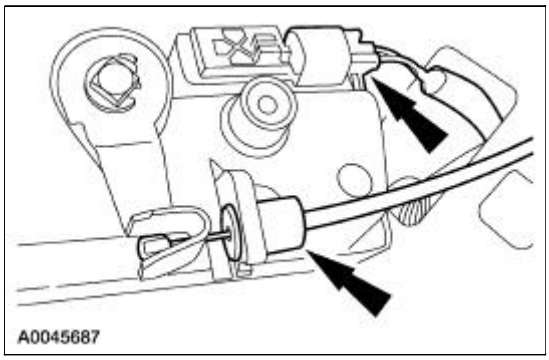
6. **NOTE:** Release the clips on the inside of license plate housing.

   Remove the license plate housing.
   1. Disconnect the electrical connectors.
   2. Remove the six nuts.



7. Release the liftgate release handle from the liftgate.

8. Disconnect the electrical connector and release the cable from the liftgate handle and remove the handle.



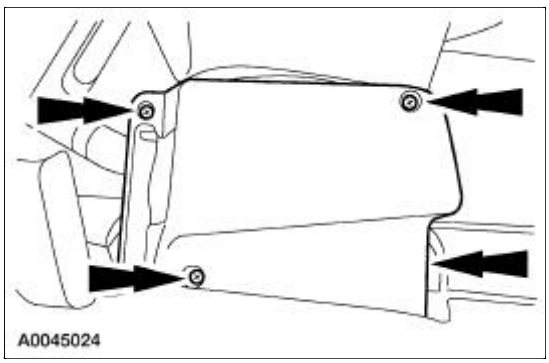
All vehicles

9. To install, reverse the removal procedure.

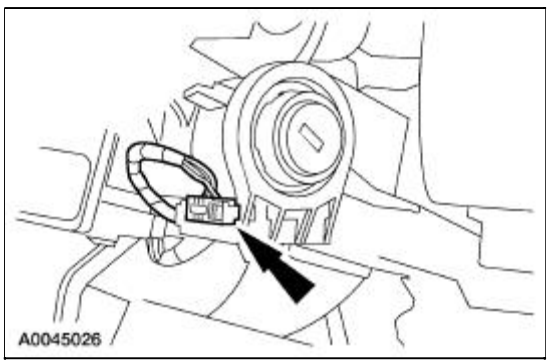
Ignition Lock Cylinder —Functional Lock Cylinder

Removal and Installation

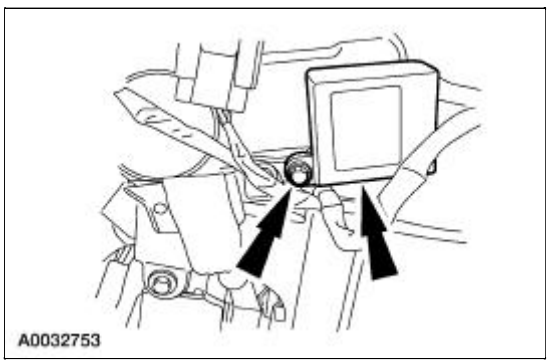
1. Remove the screws and the steering column cover.



2. Disconnect the PATS transceiver electrical connector.



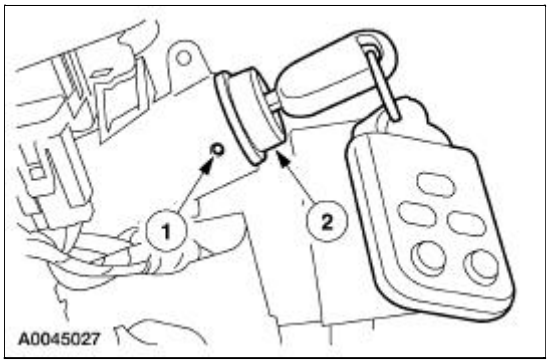
3. Remove the bolt and the PATS transceiver.



4. **NOTE:** The ignition lock cylinder must be in the accessory position.

   Remove the ignition lock cylinder.
   1. Depress the release pin.
   2. Remove the lock cylinder.

   - Verify the ignition switch lock operation.

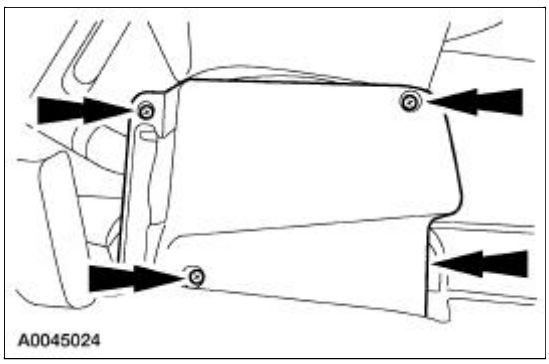


5. To install, reverse the removal procedure.

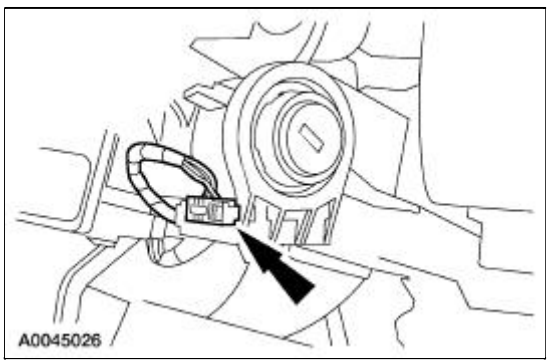
Ignition Lock Cylinder —Non-functional Lock Cylinder

Removal and Installation

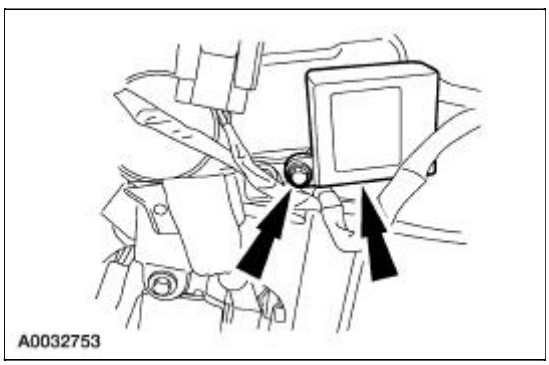
1. Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .
2. Remove the steering wheel. For additional information, refer to Section 211-04 .
3. Remove the screws and the steering column cover.



4. disconnect the PATS tranceiver electrical connector.



5. Remove the bolt and the PATS tranceiver.



6. Remove the ignition lock cylinder.

- Use a 1/8-inch diameter drill bit to drill out the lock cylinder retaining pin.
- Use a 3/8-inch diameter drill to drill down the middle of the ignition lock key slot until the ignition lock cylinder breaks loose.
- Remove and discard the ignition lock cylinder and drill shavings from the steering column.

7. Remove the bearing retainer.

8. Remove the steering column lock housing bearing and steering column lock gear.
   - Thoroughly clean all drill shavings from the steering column and inspect it for damage.

9. **NOTE:** Use a new ignition lock cylinder.

   To install, reverse the removal peocedure.
   - Verify ignition switch lock cylinder operation.

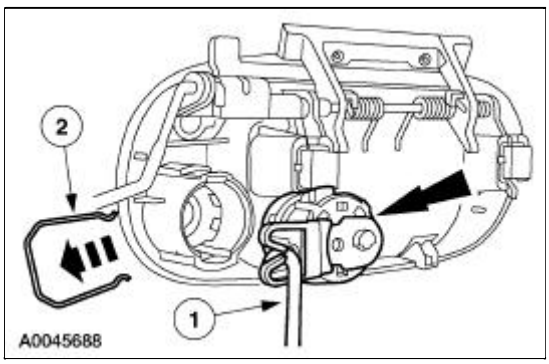
Door Lock Cylinder

Removal and Installation

NOTE: Individual lock cylinders are repaired by discarding the inoperative lock cylinder and building a new lock cylinder using the appropriate lock repair package. The lock repair package includes a detailed instruction sheet to build the new lock cylinder to the current code of the vehicle.

1. Remove the exterior front door handle. For additional information, refer to Exterior Front Door Handle in this section.

2. Remove the front door lock cylinder.
    1. Disconnect the lock cylinder rod.
    2. Remove the retainer.



3. To install, reverse the removal procedure.

Liftgate Latch Remote Control

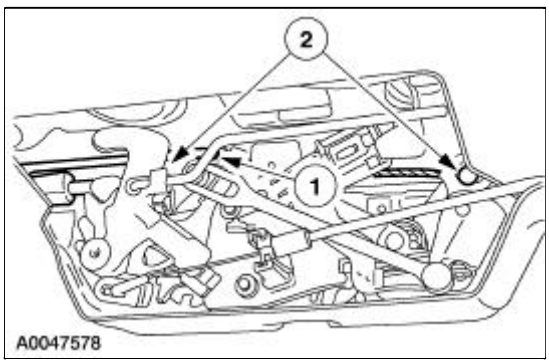
Removal and Installation

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

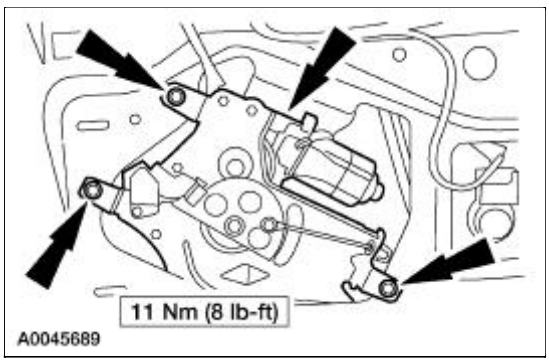
2. Position the watershield aside.

3. **CAUTION: Be careful not to kink the liftgate latch control cable while disconnecting it from the latch.**

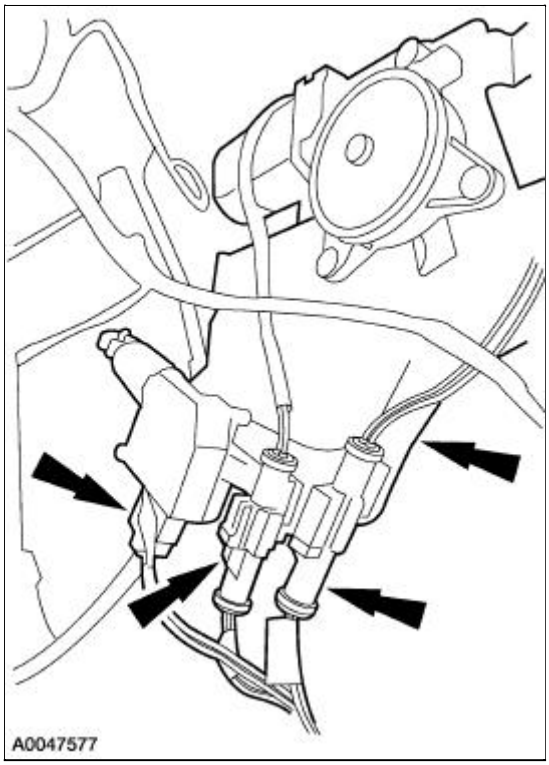
   Disconnect the liftgate latch.
   1. Release the actuating rod.
   2. Disconnect the liftgate latch control cable.



4. Remove bolts and postion the liftgate remote control aside.



5. Disconnect the electrical connectors and remove the liftgate latch remote control.

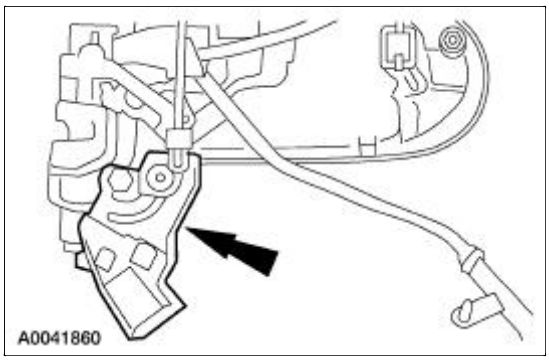


6. To install, reverse the removal procedure.

Front Door Lock Actuator

Removal and Installation

1. Remove the front door latch. For additional information, refer to Front Door Latch in this section.
2. Release the locking tab and remove the front door lock actuator.

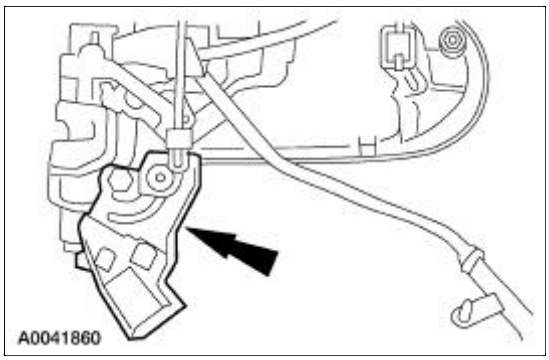


3. To install, reverse the removal procedure.

Rear Door Lock Actuator

Removal and Installation

1. Remove the rear door latch. For additional information, refer to Rear Door Latch in this section.
2. Release the locking tab and remove the rear door lock actuator.



3. To install, reverse the removal procedure.

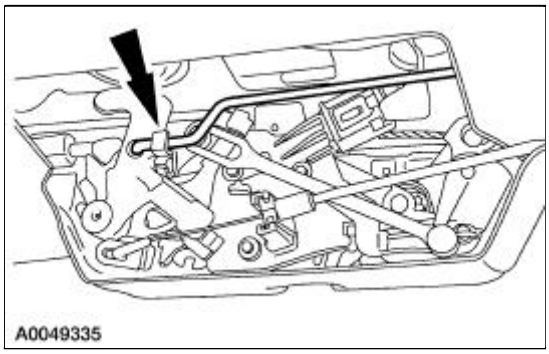
Liftgate Latch Actuator

Special Tool(s)

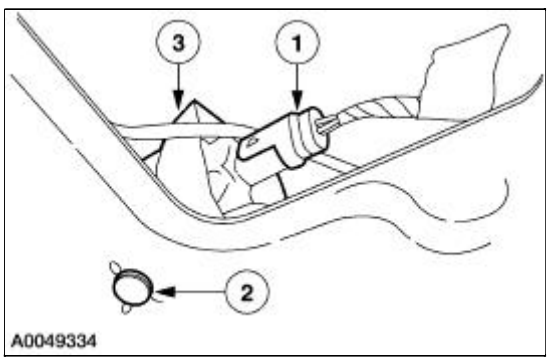
 ST1132-A	Heavy Duty Riveter 501-D011 (D80L-23200-A) or equivalent.

Removal and Installation

1. Remove the liftgate trim panel. For additional information, refer to Section 501-05 .
2. Position the watershield aside.
3. Releast the actuating rod.


A0049335

4. Remove the liftgate actuator.
    1. Disconnect the electrical connector.
    2. Remove the rivet.
    3. Remove the liftgate actuator.



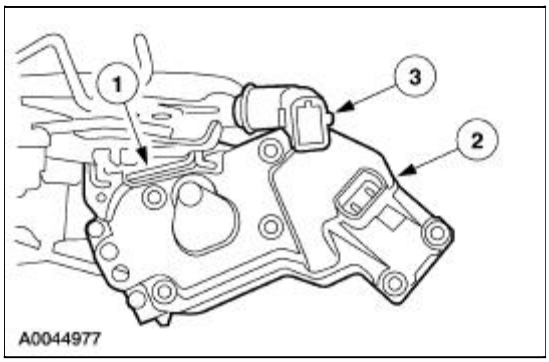
A0049334

5. To install, reverse the removal procedure.
    - Use the Heavy Duty Riveter to install the new rivet.

Door Ajar Switch

1. Remove the door latch. For additional information, refer to Front Door Latch or Rear Door Latch in this section.

2. Remove the door ajar switch.
    1. Release the door lock actuator locking tab.
    2. Remove the door lock actuator.
    3. Release the locking tab and remove the door ajar switch.

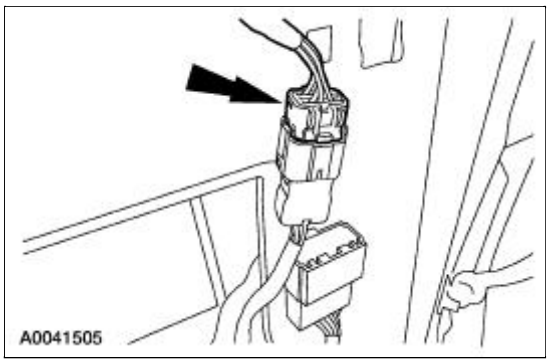


3. To install, reverse the removal procedure.

Keyless Entry Keypad

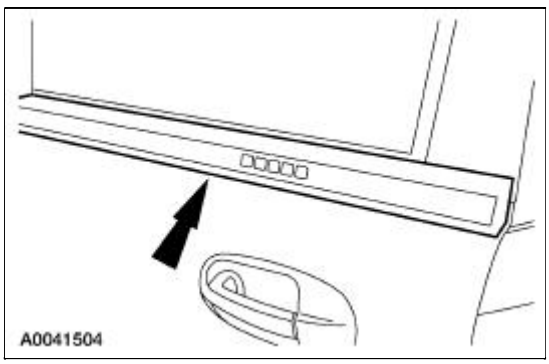
Removal and Installation

1. Remove the exterior mirror. For additional information, refer to Section 501-09 .
2. Disconnect the electrical connector.

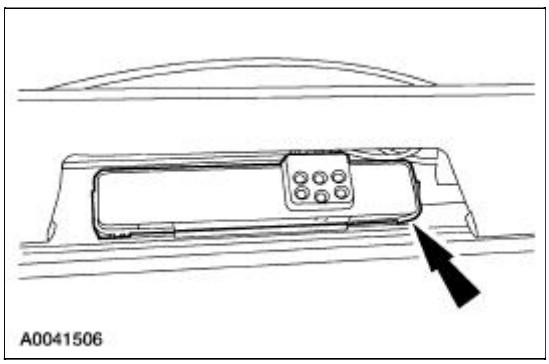


3. Remove the front door window glass. For additional information, refer to Section 501-11 .
4. **CAUTION: Damage to the base moulding may occur during the removal procedure.**

   Remove the front door window base molding.



5. Remove the keyless entry keypad.



6. To install, reverse the removal procedure.

General Specifications

Item	Specification
RH windshield wiper blade park measurement mm (inch)	50-70 (2.0-2.9)
LH windshield wiper blade park measurement mm (inch)	50-70 (2.0-2.9)
Rear window wiper blade park measurement mm (inch)	60-80 (2.4-3.2)
Fluid Specification	
Ultra-Clear Windshield Washer Concentrate F6AZ-19559-AA	ESR-M17P5-A

Torque Specifications

Description	Nm	lb-ft	lb-in
Windshield wiper mounting arm and pivot shaft bolts	8	—	71
Windshield wiper motor crank bolt	18	13	—
Windshield wiper motor bolts	15	11	—
Windshield wiper pivot arm nuts	35	26	—
Rear window wiper motor bolts	11	8	—
Rear window striker and wiper pivot shaft assembly nuts	6	—	53
Rear window glass handle nut	18	13	—
Rear window wiper pivot arm nut	15	11	—
Windshield washer reservoir screws	5	—	44
Liftgate window glass latch bolts	8	—	71

Wipers and Washers

The wiper and washer system consists of the following components:

- front windshield wiper motor
- windshield wiper blades
- windshield wiper pivot arms
- windshield wiper mounting arm and pivot shaft
- rear window wiper blade
- rear window wiper motor
- rear window wiper striker and wiper pivot shaft assembly
- rear window wiper pivot arm
- windshield washer fluid reservoir
- windshield washer fluid pump
- windshield wiper/washer switch (part of multifunction switch)

Windshield Wiper/Washer Switch

The windshield wiper/washer switch is an integral component of the steering column multifunction switch. For additional information, refer to Section 211-05 .

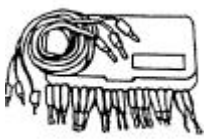
Wipers and Washers

Refer to Wiring Diagrams Cell 81 , Interval Wiper/Washer for schematic and connector information.

Refer to Wiring Diagrams Cell 82 , Liftgate Wiper/Washer for schematic and connector information.

Refer to Wiring Diagrams Cell 149 for schematic and connector information.

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool
 ST1137-A	73III Digital Multimeter or equivalent 105-R0051
 ST1138-A	Flex Probe Kit 105-R025B or equivalent
 ST1453-A	SABRE Premium Battery and Electrical System Tester 010-00736 or equivalent

Principles of Operation

The wiper motors receive inputs from the following:

- multifunction switch
- powertrain control module (PCM)
- ignition switch
- battery junction box (BJB)

The following components are integrated in the wiper motors:

- windshield wiper motor module
- hi/lo speed relay
- run/park sense (Hall effect)
- washer pump relay

High Speed Windshield Wipers

High speed is activated when the multifunction switch supplies ground to the windshield wiper motor module inputs. The windshield wiper motor module then supplies ground to the run/park sense and high/low relay coil, activating the relay with voltage supplied from the battery through the central junction box (CJB). When the windshield wiper motor module receives voltage from the run/park sense, it removes ground from the run/park sense, deactivating it. The windshield wiper motor continues to operate from voltage connected through the run/park sense until the Hall effect senses magnet in the motor. When the Hall effect senses magnet in the motor, the windshield wiper motor returns to the park position, the internal run/park sense grounds the windshield wiper motor module input and the windshield wiper motor module removes ground from the windshield wiper high/low relay coil, deactivating the high/low relay and windshield wiper motor. The windshield wiper motor module continues to cycle the windshield wipers until the inputs from the multifunction switch are changed from the high speed position.

Low Speed Windshield Wipers

Low speed is activated when the multifunction switch supplies a specific ground to the speed inputs of the windshield wiper motor module. The windshield wiper motor module then supplies ground to only the windshield wiper run/park relay coil, activating it. When the windshield wiper run/park relay is activated, the deactivated windshield high/low relay connects voltage to the windshield wiper motor low input, activating the wiper motor. The windshield wiper motor module continues to operate the windshield wiper motor in the same manner as in high speed, but in low speed with the wiper motor connected to the low speed input.

Intermittent Speed Windshield Wipers

The intermittent wiper speed is activated with grounds controlled by the multifunction switch inputs to the windshield wiper motor module. The windshield wiper motor module then activates the windshield wiper run/park relay coil and switches voltage through the windshield wiper high/low relay. The high/low relay remains deactivated, supplying the voltage to the wiper motor low speed input, and activates the windshield wiper motor. When the windshield wiper motor module receives the grounded input, the motor continues to operate until Hall effect senses magnet, which turns off the run/park sense output to the windshield wiper run/park software, deactivating the relay and disconnecting voltage to the wiper motor. The windshield wipers remain parked until the windshield wiper motor module completes a time-out and then repeats the intermittent windshield wiper cycle.

Speed-Dependent Windshield Wipers

The windshield wiper motor module responds to the windshield wiper control commands by interpreting inputs from the PCM system. The speed-dependent wipers will compensate for the extra moisture that accumulates on the windshield at higher speeds, except when the multifunction switch is in the INT 1 position. At higher speeds, the speed-dependent feature shortens the delay between wipes when using the variable interval wipers. Delays will automatically adjust at speeds between 16 and 105 km/h (10 and 65 mph).

Intermittent Rear Window Wiper System

The rear window wiper intermittent speed is activated when the rear window wiper motor module receives ground controlled by the multifunction switch inputs to the rear window wiper motor module. The rear window wiper motor module then activates the rear window wiper relay (internal). This activates the rear window wiper motor by providing voltage from the battery junction box (BJB). Once the rear window wiper motor is activated, its internal run/park switch connects voltage to the motor, keeping it operating. When the rear window wiper motor returns to the park position, the run/park

switch disconnects voltage internally from the wiper motor input. The rear window wiper remains parked until the rear window wiper motor module completes a time-out and then repeats the cycle.

Washer System

The windshield washer and the rear window washer are activated by the internal wiper motor modules when it receives a ground from the multifunction switch between the washer inputs. Depending on the correct ground, the internal wiper motor modules activate either the windshield washer or rear window washer relays (internal) by grounding the respective relay coil. When either module is activated, it connects voltage to the washer pump while the deactivated module provides ground to the washer pump. In this manner, voltage polarity is reversible to achieve directional change of the washer pump and washer fluid.

Default Mode

The windshield wiper motor defaults to this mode when the RUN/PARK sense does not sense the Hall effect magnet inside the wiper motor. This can be caused by obstruction of windshield wipers or binding linkage. The windshield wiper motor will continue to operate in a HI/LO speed condition for a period of 60 seconds.

Inspection and Verification

1. Verify the customer concern by operating the system.

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

Visual Inspection Chart

Mechanical	Electrical
● Windshield washer hoses ● Wiper linkage ● Multifunction switch	● CJB fuses: ■ 1 (10A) ■ 38 (25A) ■ 113 (30A) ● Circuitry ● Windshield wiper motor

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

4. If cause is not visually evident, verify the symptom and refer to the Symptom Chart

Symptom Chart

Symptom Chart

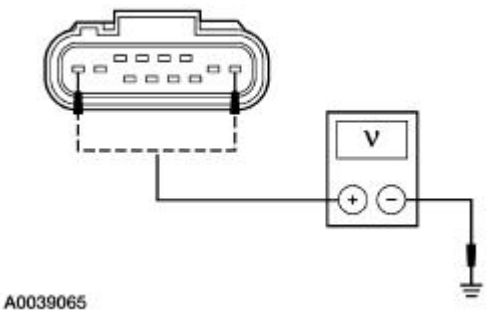
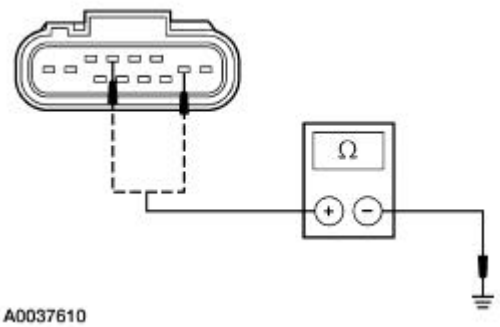
Condition	Possible Sources	Action
● The windshield wipers are inoperative	● Multifunction switch. ● Circuitry. ● Ignition switch. ● Windshield wiper motor.	● Go To Pinpoint Test A .

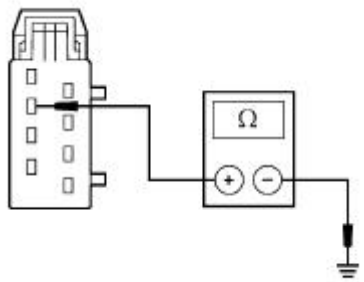
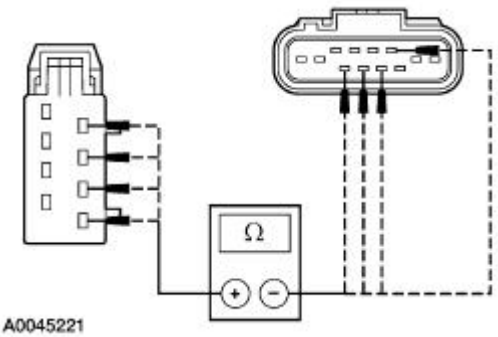
• The rear window wiper is inoperative	• Multifunction switch. • Circuitry. • Ignition switch. • Rear window wiper motor.	• Go To Pinpoint Test B .
• The windshield wipers stay on continuously	• Windshield wiper motor. • Multifunction switch. • Circuitry.	• Go To Pinpoint Test C .
• The rear window wiper stays on continuously	• Rear window wiper motor. • Multifunction switch. • Circuitry.	• Go To Pinpoint Test D .
• The high/low windshield wiper speeds do not operate correctly (intermittent wiper mode OK)	• Multifunction switch. • Circuitry. • Windshield wiper motor.	• Go To Pinpoint Test E .
• The intermittent windshield wiper speed does not operate correctly (high/low speeds OK)	• Multifunction switch. • Circuitry. • Windshield wiper motor.	• Go To Pinpoint Test F .
• The intermittent rear window wiper speed does not operate correctly	• Multifunction switch. • Circuitry. • Rear window wiper motor.	• Go To Pinpoint Test G .
• The windshield wipers do not operate correctly in the MIST position	• Multifunction switch. • Circuitry. • Washer pump. • Windshield wiper motor.	• Go To Pinpoint Test H .
• The rear window wiper wash and wipe function does not operate	• Multifunction switch. • Circuitry. • Washer pump. • Rear window wiper motor.	• Go To Pinpoint Test I .
• The washer pump is inoperative	• Washer pump. • Multifunction switch. • Windshield wiper motor. • Rear window wiper motor. • Circuitry.	• Go To Pinpoint Test J .
• The windshield wiper speed dependent interval mode does not operate correctly	• Windshield wiper motor. • Circuitry. • Powertrain control module (PCM).	• Go To Pinpoint Test K .
• The wipers will not park at	• Pivot arm	• REFER to Windshield

correct position	adjustment. ● Linkage.	Wiper Blade and Pivot Arm Adjustment in this section.

Pinpoint Tests

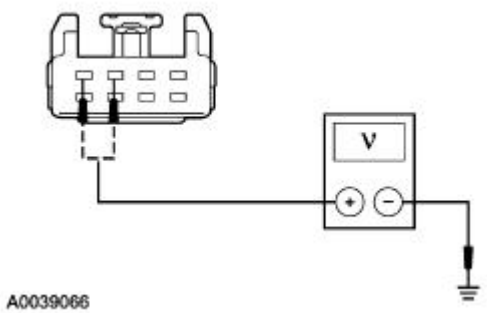
PINPOINT TEST A: THE WINDSHIELD WIPERS ARE INOPERATIVE

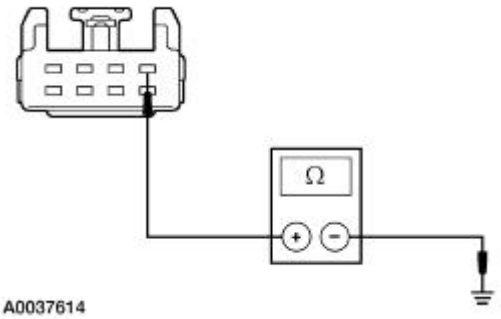
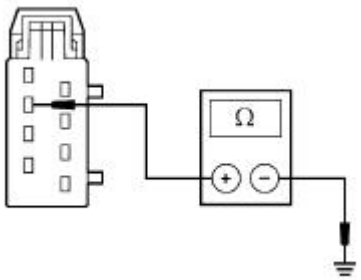
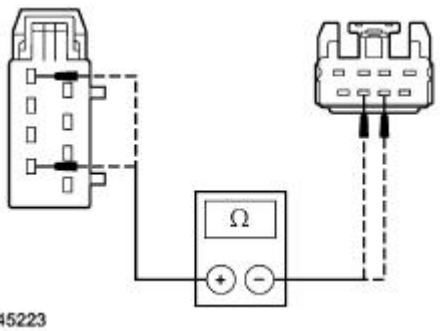
Test Step	Result / Action to Take
A1 CHECK CIRCUITS 65 (DG) AND 1002 (BK/PK) FOR VOLTAGE	
● Key in OFF position. ● Disconnect: Windshield Wiper Motor C125. ● Key in ON position. ● Measure the voltage between windshield wiper C125 pin 5, circuit 65 (DG), harness side and ground; and between windshield wiper motor C125 pin 8, circuit 1002 (BK/PK), harness side and ground.  A0039065 ● **Are the voltages greater than 10 volts?**	**Yes** GO to A2. **No** REPAIR the circuit(s) in question. TEST the system for normal operation.
A2 CHECK CIRCUITS 57 (BK) AND 875 (BK/LB) FOR OPENS	
● Key in OFF position. ● Measure the resistance between windshield wiper C125 pin 6, circuit 57 (BK), harness side and ground; and between windshield wiper motor C125 pin 3, circuit 875 (BK/LB), harness side and ground.  A0037610 ● **Are the resistances less than 5 ohms?**	**Yes** GO to A3. **No** REPAIR the circuit(s) in question. TEST the system for normal operation.
A3 CHECK THE MULTIFUNCTION SWITCH	
● Disconnect: Multifunction Switch C202a. ● Carry out the multifunction switch component test.	**Yes** GO to A4.

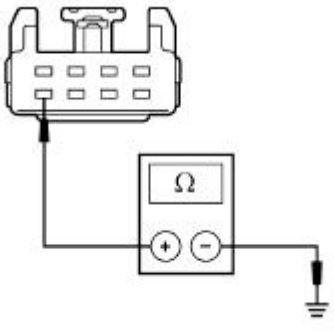
Refer to Wiring Diagrams Cell 149 for schematic and connector information. ● **Did the multifunction switch pass the component test?**	**No** INSTALL a new multifunction switch. REFER to Section 211-05 .
A4 CHECK CIRCUIT 57 (BK) FOR OPEN	
● Measure the resistance between C202a pin 4, circuit 57 (BK), harness side and ground.  A0045222 ● **Is the resistance less than 5 ohms?**	**Yes** GO to A5 . **No** REPAIR the circuit. TEST the system for normal operation.
A5 CHECK CIRCUITS 56 (DB/OG), 58 (WH), 61 (YE/RD), AND 63 (RD) FOR OPENS	
● Using the following table, measure the resistance between the multifunction switch C202a harness side and the windshield wiper motor C125 harness side: **Multifunction Switch C202a** / **Windshield Wiper Motor C125** pin 7, circuit 56 (DB/OG) / pin 10, circuit 56 (DB/OG) pin 3, circuit 58 (WH) / pin 11, circuit 58 (WH) pin 5, circuit 61 (YE/RD) / pin 1, circuit 61 (YE/RD) pin 1, circuit 63 (RD) / pin 9, circuit 63 (RD)  A0045221 ● **Is the resistance less than 5 ohms?**	**Yes** GO to A6 . **No** REPAIR the circuit(s) in question. TEST the system for normal operation.
A6 CHECK FOR CORRECT WIPER MOTOR OPERATION	
● Disconnect all wiper motor connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all wiper motor connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** GO to A7 . **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector.

	TEST the system for normal operation.
A7 CHECK THE WINDSHIELD WIPER MOTOR	
• Key in OFF position. • Disconnect: Windshield Wiper Motor C125. • Carry out the windshield wiper motor component test as described in this section. • **Did the windshield wiper motor pass the component test?**	**Yes** The system is operating correctly at this time. Concern may have been caused by binding or incorrect pivot arm adjustment. REFER to Windshield Wiper Blade and Pivot Arm Adjustment in this section. TEST the system for normal operation. **No** INSTALL a new windshield wiper motor. REFER to Windshield Wiper Motor in this section.

PINPOINT TEST B: THE REAR WIPER IS INOPERATIVE

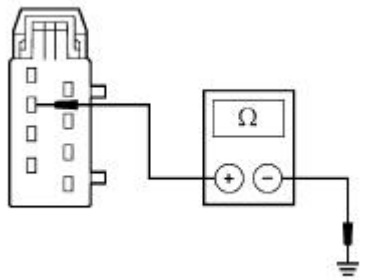
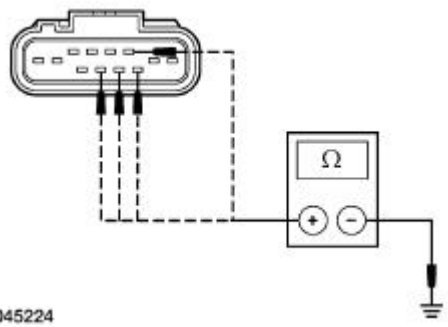
Test Step	Result / Action to Take
B1 CHECK CIRCUITS 1002 (BK/PK) AND 406 (BN/WH) FOR VOLTAGE	
• Key in OFF position. • Disconnect: Rear Wiper Motor C476. • Key in ON position. • Measure the voltage between rear wiper motor C476 pin 3, circuit 1002 (BK/PK), harness side and ground; and between rear wiper motor C476 pin 4, circuit 406 (BN/WH), harness side and ground.  A0039066 • **Are the voltages greater than 10 volts?**	**Yes** GO to B2. **No** REPAIR the circuit(s) in question. TEST the system for normal operation.
B2 CHECK CIRCUIT 57 (BK) FOR OPEN	
• Key in OFF position. • Measure the resistance between rear wiper C476 pin 1, circuit 57 (BK), harness side and ground.	**Yes** GO to B3. **No** REPAIR the circuit(s) in question. TEST the system for normal operation.

 A0037614 ● **Is the resistance less than 5 ohms?**	
B3 CHECK THE MULTIFUNCTION SWITCH ● Key in OFF position. ● Disconnect: Multifunction Switch C202a. ● Carry out the multifunction switch component test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. ● **Did the multifunction switch pass the component test?**	**Yes** GO to B4 . **No** INSTALL a new multifunction switch. REFER to Section 211-05 .
B4 CHECK CIRCUIT 57 (BK) FOR OPEN ● Measure the resistance between C202a pin 4, circuit 57 (BK), harness side and ground.  A0045222 ● **Is the resistance less than 5 ohms?**	**Yes** GO to B5 . **No** REPAIR the circuit. TEST the system for normal operation.
B5 CHECK CIRCUITS 485 (PK/BK) AND 1413 (VT/LB) FOR OPENS ● Measure the resistance between the multifunction switch C202a pin 8, circuit 485 (PK/BK) harness side and the rear wiper motor C476 pin 6, circuit 485 (PK/BK) harness side: and between the multifunction switch C202a pin 2, circuit 1413 (VT/LB) harness side and the rear wiper motor C476 pin 7, circuit 1413 (VT/LB) harness side.  A0045223 ● **Are the resistances less than 5 ohms?**	**Yes** GO to B6 . **No** REPAIR the circuit(s) in question. TEST the system for normal operation.

B6 CHECK CIRCUIT 586 (RD/PK) FOR OPEN	
• The lifgate glass must be closed. • Measure the resistance between C476 pin 8, circuit 586 (RD/PK), harness side and ground.  A0051365 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to B7 . **No** REPAIR the circuit. TEST the system for normal operation.
B7 CHECK FOR CORRECT WIPER MOTOR OPERATION	
• Disconnect all wiper motor connectors. • Check for: • liftgate glass open • corrosion • pushed-out pins • Connect all wiper motor connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** GO to B8 . **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. TEST the system for normal operation.
B8 CHECK THE REAR WINDOW WIPER MOTOR	
• Carry out the rear widow wiper motor component test as described in this section. • **Did the rear window wiper motor pass the component test?**	**Yes** The system is operating correctly at this time. Concern may have been caused by binding or incorrect pivot arm adjustment. REFER to Rear Window Wiper Blade and Pivot Arm Adjustment in this section. TEST the system for normal operation. **No** INSTALL a new rear window wiper motor. REFER to Rear Window Wiper Motor in this section.

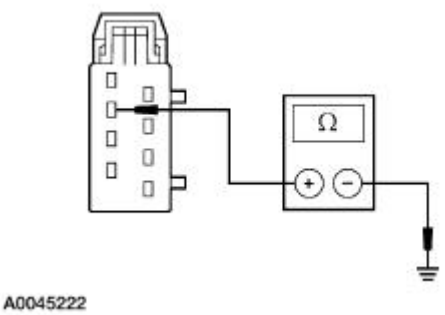
PINPOINT TEST C: THE WINDSHIELD WIPERS STAY ON CONTINUOUSLY

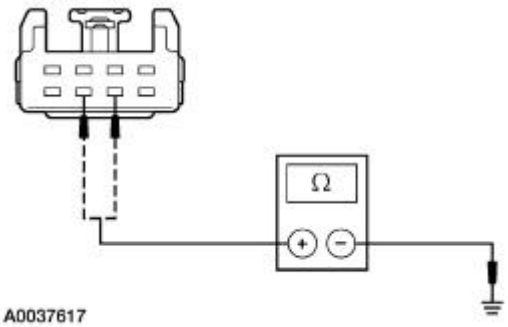
Test Step	Result / Action to Take
C1 CHECK THE MULTIFUNCTION SWITCH	
• Key in OFF position. • Disconnect: Multifunction Switch C202a.	**Yes** GO to C2 .

• Carry out the multifunction switch component test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. • **Did the multifunction switch pass the component test?**	**No** INSTALL a new multifunction switch. REFER to Section 211-05 .
C2 CHECK CIRCUIT 57 (BK) FOR OPEN	
• Measure the resistance between C202a pin 4, circuit 57 (BK), harness side and ground.  A0045222 • **Is the resistance less than 5 ohms?**	**Yes** GO to C3 . **No** REPAIR the circuit. TEST the system for normal operation.
C3 CHECK CIRCUITS 56 (DB/OG), 58 (WH), 61 (YE/RD), AND 63 (RD) FOR SHORTS	
• Disconnect: Windshield Wiper Motor C125. • Using the following table, measure the resistance between the windshield wiper motor C125 harness side and ground: **Windshield Wiper Motor C125** / **Ground** pin 10, circuit 56 (DB/OG) / ground pin 11, circuit 58 (WH) / ground pin 1, circuit 61 (YE/RD) / ground pin 9, circuit 63 (RD) / ground  A0045224 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to C4 . **No** REPAIR the circuit(s) in question. TEST the system for normal operation.
C4 CHECK FOR CORRECT WIPER MOTOR OPERATION	
• Disconnect all wiper motor connectors. • Check for: • corrosion • pushed-out pins • Connect all wiper motor connectors and make sure	**Yes** GO to C5 . **No** The system is operating correctly at

they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	this time. Concern may have been caused by a loose or corroded connector. TEST the system for normal operation.
C5 CHECK THE WINDSHIELD WIPER MOTOR ● Key in OFF position. ● Disconnect: Windshield Wiper Motor C125. ● Carry out the windshield wiper motor component test as described in this section. ● **Did the windshield wiper motor pass the component test?**	**Yes** The system is operating correctly at this time. Concern may have been caused by binding or incorrect pivot arm adjustment. REFER to Windshield Wiper Blade and Pivot Arm Adjustment in this section. TEST the system for normal operation. **No** INSTALL a new windshield wiper motor. REFER to Windshield Wiper Motor in this section.

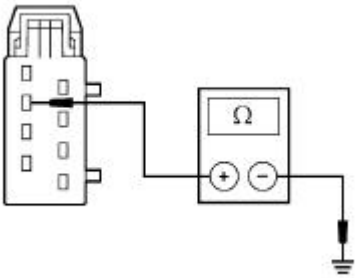
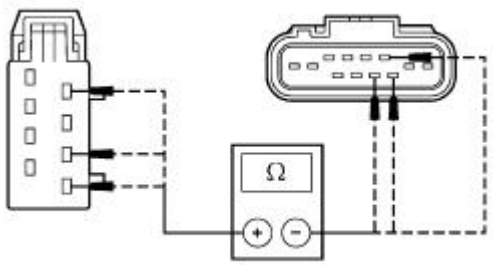
PINPOINT TEST D: THE REAR WIPER STAYS ON CONTINUOUSLY

Test Step	Result / Action to Take
D1 CHECK THE MULTIFUNCTION SWITCH ● Key in OFF position. ● Disconnect: Multifunction Switch C202a. ● Carry out the multifunction switch component test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. ● **Did the multifunction switch pass the component test?**	**Yes** GO to D2. **No** INSTALL a new multifunction switch. REFER to Section 211-05.
D2 CHECK CIRCUIT 57 (BK) FOR OPEN ● Measure the resistance between C202a pin 4, circuit 57 (BK), harness side and ground.  A0045222 ● **Is the resistance less than 5 ohms?**	**Yes** GO to D3. **No** REPAIR the circuit. TEST the system for normal operation.
D3 CHECK CIRCUITS 485 (PK/BK) AND 1413 (VT/LB) FOR SHORTS ● Disconnect: Rear Window Wiper Motor C476. ● Measure the resistance between the rear window wiper motor C476 pin 6, circuit 485 (PK/BK), harness side and ground; and between the rear wiper motor C476 pin 7, circuit 1413 (VT/LB), harness side and ground.	**Yes** GO to D4. **No** REPAIR the circuit(s) in

 ● **Are the resistances greater than 10,000 ohms?**	question. TEST the system for normal operation.
D4 CHECK FOR CORRECT WIPER MOTOR OPERATION	
● Disconnect all wiper motor connectors. ● Check for: ● liftgate glass open ● corrosion ● pushed-out pins ● Connect all wiper motor connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** GO to D5 . **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. TEST the system for normal operation.
D5 CHECK THE REAR WINDOW WIPER MOTOR	
● Carry out the rear widow wiper motor component test as described in this section. ● **Did the rear window wiper motor pass the component test?**	**Yes** The system is operating correctly at this time. Concern may have been caused by binding or incorrect pivot arm adjustment. REFER to Rear Window Wiper Blade and Pivot Arm Adjustment in this section. TEST the system for normal operation. **No** INSTALL a new rear window wiper motor. REFER to Rear Window Wiper Motor in this section.

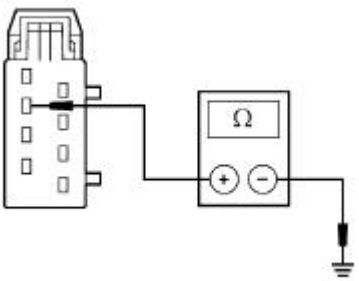
PINPOINT TEST E: THE HIGH/LOW WINDSHIELD WIPER SPEEDS DO NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
E1 CHECK THE MULTIFUNCTION SWITCH	
● Key in OFF position. ● Disconnect: Multifunction Switch C202a. ● Carry out the multifunction switch component test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. ● **Did the multifunction switch pass the component test?**	**Yes** GO to E2 . **No** INSTALL a new multifunction switch. REFER to Section 211-05 . TEST the system for normal operation.

E2 CHECK CIRCUIT 57 (BK) FOR OPEN ● Measure the resistance between C202a pin 4, circuit 57 (BK), harness side and ground.  A0045222 ● **Is the resistance less than 5 ohms?**	**Yes** GO to E3 . **No** REPAIR the circuit. TEST the system for normal operation.
E3 CHECK CIRCUITS 56 (DB/OG), 61 (YE/RD), AND 63 (RD) FOR OPENS ● Disconnect: Windshield Wiper Motor C125. ● Using the following table, measure the resistance between the multifunction switch C202a harness side and the windshield wiper motor C125 harness side: **Multifunction Switch C202a** / **Windshield Wiper Motor C125** pin 7, circuit 56 (DB/OG) / pin 10, circuit 56 (DB/OG) pin 5, circuit 61 (YE/RD) / pin 1, circuit 61 (YE/RD) pin 1, circuit 63 (RD) / pin 9, circuit 63 (RD)  A0045225 ● **Is the resistance less than 5 ohms?**	**Yes** GO to E4 . **No** REPAIR the circuit(s) in question. TEST the system for normal operation.
E4 CHECK FOR CORRECT WIPER MOTOR OPERATION ● Disconnect all wiper motor connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all wiper motor connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** GO to E5 . **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. TEST the system for normal operation.
E5 CHECK THE WINDSHIELD WIPER MOTOR ● Key in OFF position. ● Disconnect: Windshield Wiper Motor C125. ● Carry out the windshield wiper motor component test	**Yes** The system is operating correctly at this time. Concern may have

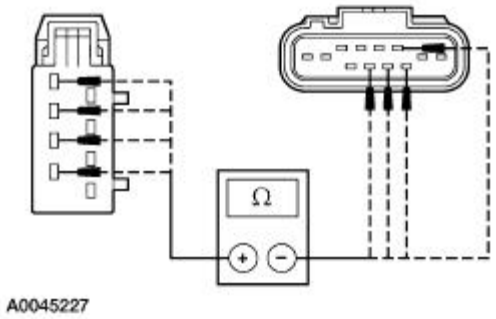
as described in this section. ● **Did the windshield wiper motor pass the component test?**	been caused by binding or incorrect pivot arm adjustment. REFER to Windshield Wiper Blade and Pivot Arm Adjustment in this section. TEST the system for normal operation. **No** INSTALL a new windshield wiper motor. REFER to Windshield Wiper Motor in this section.

PINPOINT TEST F: THE INTERMITTENT WINDSHIELD WIPER SPEED DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
F1 CHECK THE MULTIFUNCTION SWITCH	
● Key in OFF position. ● Disconnect: Multifunction Switch C202a. ● Carry out the multifunction switch component test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. ● **Did the multifunction switch pass the component test?**	**Yes** GO to F2. **No** INSTALL a new multifunction switch. REFER to Section 211-05. TEST the system for normal operation.
F2 CHECK CIRCUIT 57 (BK) FOR OPEN	
● Measure the resistance between C202a pin 4, circuit 57 (BK), harness side and ground.  A0045222 ● **Is the resistance less than 5 ohms?**	**Yes** GO to F3. **No** REPAIR the circuit. TEST the system for normal operation.
F3 CHECK CIRCUITS 56 (DB/OG), 61 (YE/RD), AND 63 (RD) FOR OPENS	
● Disconnect: Windshield Wiper Motor C125. ● Using the following table, measure the resistance between the multifunction switch C202a harness side and the windshield wiper motor C125 harness side:	**Yes** GO to F4. **No** REPAIR the circuit(s) in question. TEST the system for normal operation.

Multifunction Switch C202a	Windshield Wiper Motor C125
pin 7, circuit 56 (DB/OG)	pin 10, circuit 56 (DB/OG)
pin 5, circuit 61 (YE/RD)	pin 1, circuit 61 (YE/RD)
pin 1, circuit 63 (RD)	pin 9, circuit 63 (RD)

pin 3, circuit 58 (WH)	pin 11, circuit 58 (WH)

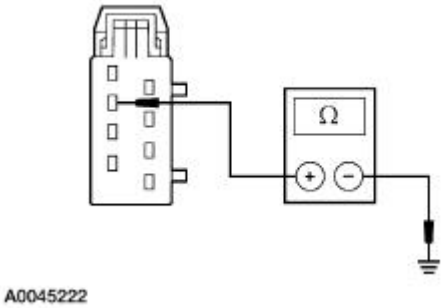
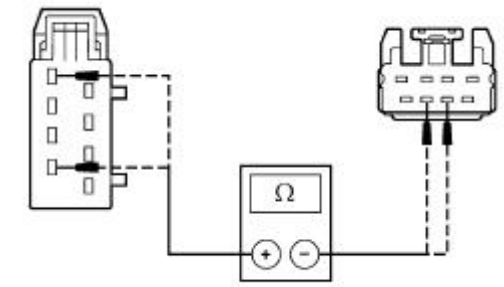


- **Is the resistance less than 5 ohms?**

F4 CHECK FOR CORRECT WIPER MOTOR OPERATION	
• Disconnect all wiper motor connectors. • Check for: • corrosion • pushed-out pins • Connect all wiper motor connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** GO to F5 . **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. TEST the system for normal operation.
F5 CHECK THE WINDSHIELD WIPER MOTOR	
• Key in OFF position. • Disconnect: Windshield Wiper Motor C125. • Carry out the windshield wiper motor component test as described in this section. • **Did the windshield wiper motor pass the component test?**	**Yes** The system is operating correctly at this time. Concern may have been caused by binding or incorrect pivot arm adjustment. REFER to Windshield Wiper Blade and Pivot Arm Adjustment in this section. TEST the system for normal operation. **No** INSTALL a new windshield wiper motor. REFER to Windshield Wiper Motor in this section.

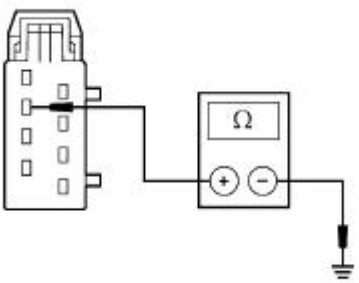
PINPOINT TEST G: THE INTERMITTENT REAR WIPER SPEED DOES NOT OPERATE CORRECTLY

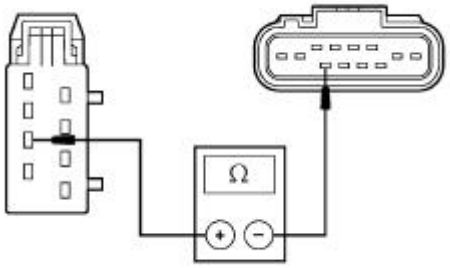
Test Step	Result / Action to Take
G1 CHECK THE MULTIFUNCTION SWITCH	
• Key in OFF position. • Disconnect: Multifunction Switch C202a. • Carry out the multifunction switch component test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. • **Did the multifunction switch pass the component test?**	**Yes** GO to G2 . **No** INSTALL a new multifunction switch. REFER to Section 211-05 .

G2 CHECK CIRCUIT 57 (BK) FOR OPEN	
• Measure the resistance between C202a pin 4, circuit 57 (BK), harness side and ground.  A0045222 • **Is the resistance less than 5 ohms?**	**Yes** GO to G3 . **No** REPAIR the circuit. TEST the system for normal operation.
G3 CHECK CIRCUITS 485 (PK/BK) AND 1413 (VT/LB) FOR OPENS	
• Disconnect: Rear Window Wiper Motor C476. • Measure the resistance between the multifunction switch C202a pin 8, circuit 485 (PK/BK) harness side and the rear wiper motor C476 pin 6, circuit 485 (PK/BK) harness side; and between the multifunction switch C202a pin 2, circuit 1413 (VT/LB) harness side and the rear wiper motor C476 pin 7, circuit 1413 (VT/LB) harness side.  A0045226 • **Are the resistances less than 5 ohms?**	**Yes** GO to G4 . **No** REPAIR the circuit(s) in question. TEST the system for normal operation.
G4 CHECK FOR CORRECT WIPER MOTOR OPERATION	
• Disconnect all wiper motor connectors. • Check for: • liftgate glass open • corrosion • pushed-out pins • Connect all wiper motor connectors and make sure they seat correctly. • Operate the system and verify the concern is still present. • **Is the concern still present?**	**Yes** GO to G5 . **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. TEST the system for normal operation.
G5 CHECK THE REAR WINDOW WIPER MOTOR	
• Carry out the rear widow wiper motor component test as described in this section. • **Did the rear window wiper motor pass the component test?**	**Yes** The system is operating correctly at this time. Concern may have been caused by binding or incorrect pivot arm adjustment. REFER to Rear Window Wiper Blade and Pivot Arm

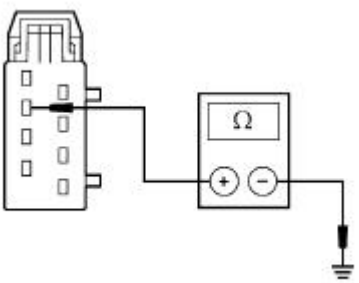
	Adjustment in this section. TEST the system for normal operation. **No** INSTALL a new rear window wiper motor. REFER to Rear Window Wiper Motor in this section.

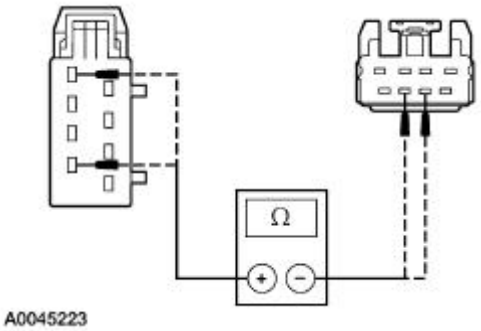
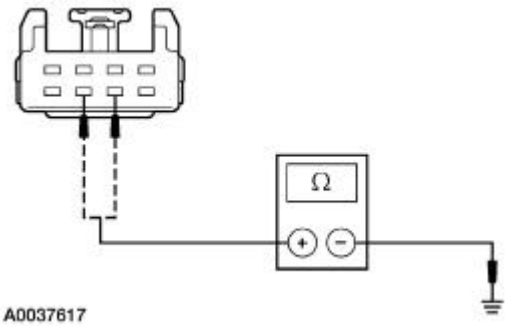
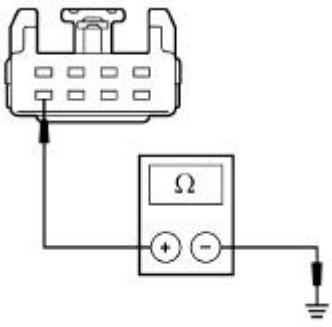
PINPOINT TEST H: THE WINDSHIELD WIPERS DO NOT OPERATE CORRECTLY IN THE MIST POSITION

Test Step	Result / Action to Take
H1 CHECK THE MULTIFUNCTION SWITCH	
• Key in OFF position. • Disconnect: Multifunction Switch C202a. • Carry out the multifunction switch component test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. • **Did the multifunction switch pass the component test?**	**Yes** GO to H2. **No** INSTALL a new multifunction switch. REFER to Section 211-05.
H2 CHECK CIRCUIT 57 (BK) FOR OPEN	
• Measure the resistance between C202a pin 4, circuit 57 (BK), harness side and ground.  A0045222 • **Is the resistance less than 5 ohms?**	**Yes** GO to H3. **No** REPAIR the circuit. TEST the system for normal operation.
H3 CHECK CIRCUIT 680 (LB/OG) FOR OPEN	
• Disconnect: Windshield Wiper Motor C125. • Measure the resistance between C202a pin 6, circuit 680 (LB/OG), harness side and C125 pin 12, circuit 680 (LB/OG), harness side.	**Yes** Go To Pinpoint Test K. **No** REPAIR the circuit. TEST the system for normal operation.

 A0045228 ● **Is the resistance less than 5 ohms?**	

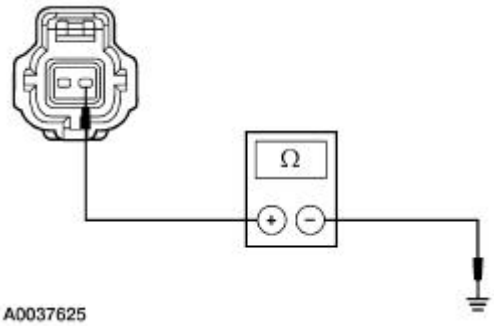
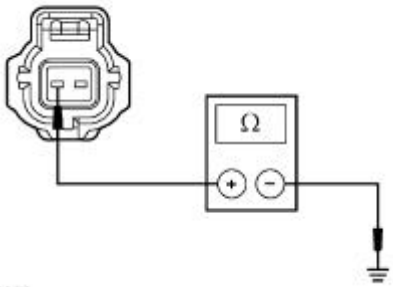
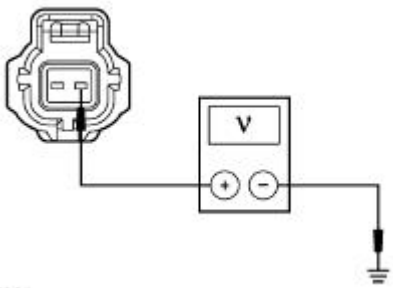
PINPOINT TEST I: THE REAR WINDOW WIPER WASH AND WIPE FUNCTION DOES NOT OPERATE

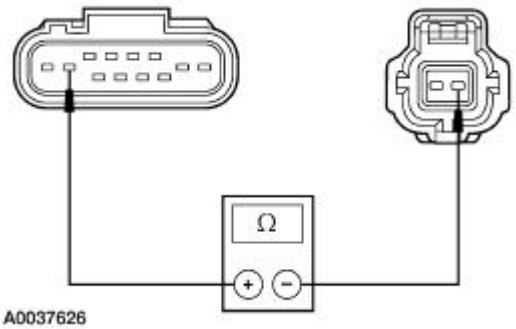
Test Step	Result / Action to Take
I1 CHECK THE MULTIFUNCTION SWITCH	
● Key in OFF position. ● Disconnect: Multifunction Switch C202a. ● Carry out the multifunction switch component test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. ● **Did the multifunction switch pass the component test?**	**Yes** GO to I2 . **No** INSTALL a new multifunction switch. REFER to Section 211-05 .
I2 CHECK CIRCUIT 57 (BK) FOR OPEN	
● Measure the resistance between C202a pin 4, circuit 57 (BK), harness side and ground.  A0045222 ● **Is the resistance less than 5 ohms?**	**Yes** GO to I3 . **No** REPAIR the circuit. TEST the system for normal operation.
I3 CHECK CIRCUITS 485 (PK/BK) AND 1413 (VT/LB) FOR OPENS	
● Key in OFF position. ● Disconnect: Rear Window Wiper Motor C476. ● Measure the resistance between the multifunction switch C202a pin 8, circuit 485 (PK/BK) harness side and the rear wiper motor C476 pin 6, circuit 485 (PK/BK) harness side: and between the multifunction switch C202a pin 2, circuit 1413 (VT/LB) harness side and the rear wiper motor C476 pin 7, circuit 1413 (VT/LB) harness side.	**Yes** GO to I4 . **No** REPAIR the circuit. TEST the system for normal operation.

 A0045223 ● **Are the resistances less than 5 ohms?**	
I4 CHECK CIRCUITS 485 (PK/BK) AND 1413 (VT/LB) FOR SHORTS	
● Disconnect: Rear Window Wiper Motor C476. ● Measure the resistance between the rear window wiper motor C476 pin 6, circuit 485 (PK/BK), harness side and ground; and between the rear wiper motor C476 pin 7, circuit 1413 (VT/LB), harness side and ground.  A0037617 ● **Are the resistances greater than 10,000 ohms?**	**Yes** GO to I5 . **No** REPAIR the circuit(s) in question. TEST the system for normal operation.
I5 CHECK CIRCUIT 586 (RD/PK) FOR OPEN	
● The lifgate glass must be closed. ● Measure the resistance between C476 pin 8, circuit 586 (RD/PK), harness side and ground.  A0051365 ● **Is the resistance greater than 10,000 ohms?**	**Yes** Go To Pinpoint Test J . **No** REPAIR the circuit. TEST the system for normal operation.

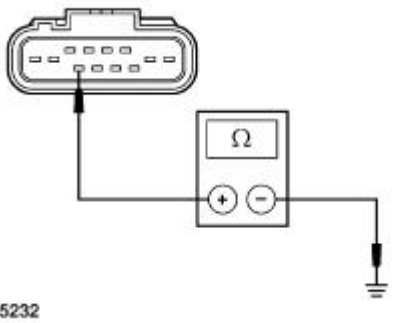
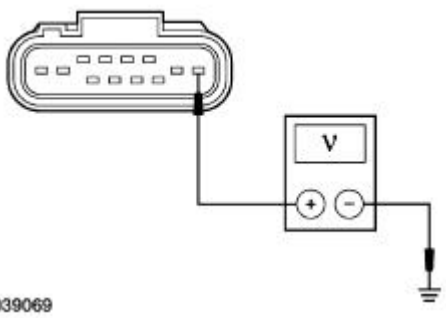
PINPOINT TEST J: THE WASHER PUMP IS IN OPERATIVE

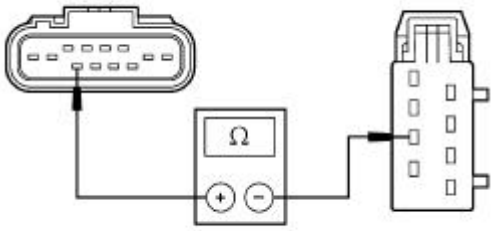
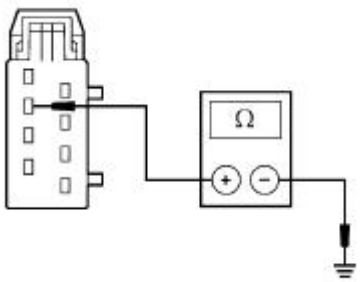
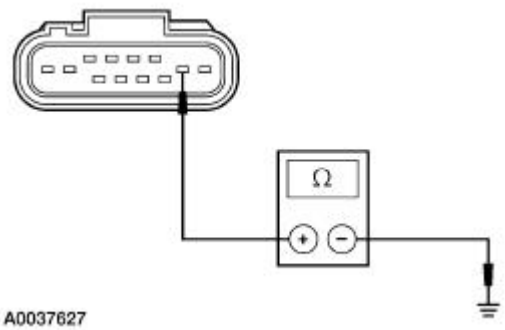
Test Step	Result / Action to Take
J1 CHECK CIRCUIT 941 (BK/WH) FOR GROUND	
● Key in OFF position. ● Disconnect: Washer Pump Motor C1357. ● Measure the resistance between C1357 pin 2, circuit 941 (BK/WH) harness side and ground.	**Yes** GO to J2 . **No**

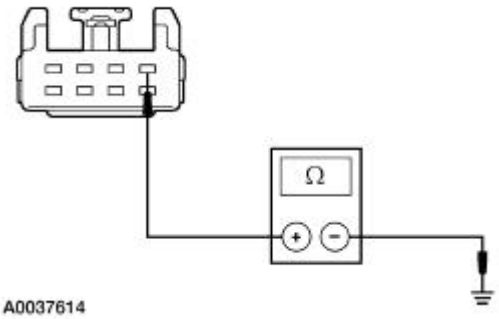
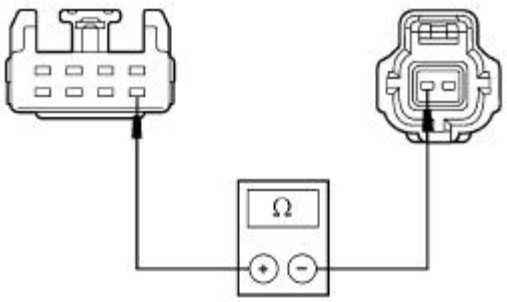
 A0037625 ● **Is the resistance less than 5 ohms?**	GO to J10 .
J2 CHECK CIRCUIT 941 (VT/LG) FOR GROUND ● Measure the resistance between C1357 pin 1, circuit 946 (VT/LG) harness side and ground.  A0045230 ● **Is the resistance less than 5 ohms?**	**Yes** GO to J3 . **No** GO to J11 .
J3 CHECK CIRCUIT 941 (BK/WH) FOR VOLTAGE ● Key in ON position. ● Measure the voltage between C1357 pin 2, circuit 941 (BK/WH) harness side and ground while depressing the multifunction switch to the wash position.  A0045231 ● **Is the voltage greater than 10 volts?**	**Yes** GO to J13 . **No** GO to J4 .
J4 CHECK CIRCUIT 941 (BK/WH) FOR OPEN ● Key in OFF position. ● Disconnect: Windshield Wiper Motor C125. ● Measure the resistance between C125 pin 7, circuit 941 (BK/WH), harness side and C1357 pin 2, circuit 941 (BK/WH), harness side.	**Yes** REPAIR the circuit. TEST the system for normal operation. **No** GO to J5 .



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

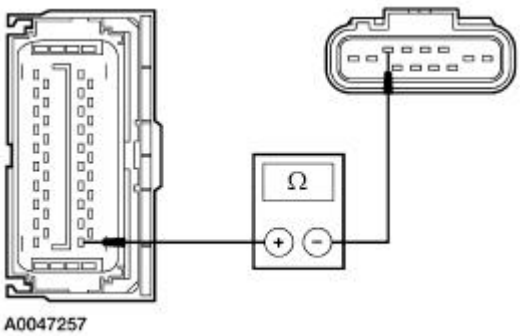
J5 CHECK CIRCUIT 680 (LB/OG) FOR GROUND - Key in ON position. - Measure the resistance between C125 pin 12, circuit 680 (LB/OG), harness side and ground while depressing the multifunction switch to the wash position  - **Is the resistance less than 5 ohms?**	**Yes** GO to J6 . **No** GO to J7 .
J6 CHECK CIRCUIT 65 (DG) FOR VOLTAGE - Measure the voltage between C125 pin 5, circuit 65 (DG) harness side and ground.  - **Is the voltage greater than 10 volts?**	**Yes** GO to J13 . **No** REPAIR the supply circuit. TEST the system for normal operation.
J7 CHECK CIRCUIT 680 (LB/OG) FOR OPEN - Key in OFF position. - Disconnect: Windshield Wiper Motor C125. - Disconnect: Multifunction Switch C202a. - Measure the resistance between C125 pin 12, circuit 680 (LB/OG), harness side and C202a pin 6, circuit 680 (LB/OG), harness side.	**Yes** GO to J8 . **No** REPAIR the circuit. TEST the system for normal operation.

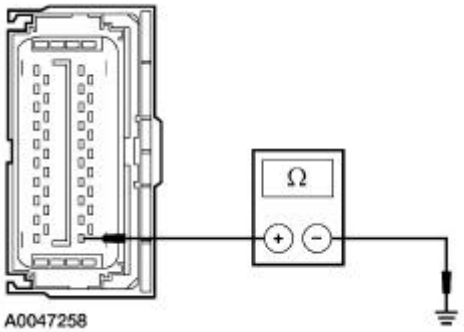
 A0045233 ● **Is the resistance less than 5 ohms?**	
J8 CHECK CIRCUIT 57 (BK) FOR OPEN	
● Measure the resistance between C202a pin 4, circuit 57 (BK), harness side and ground.  A0045222 ● **Is the resistance less than 5 ohms?**	**Yes** GO to J9 . **No** REPAIR the circuit. TEST the system for normal operation.
J9 CHECK THE MULTIFUNCTION SWITCH	
● Key in OFF position. ● Disconnect: Multifunction Switch C202a. ● Carry out the multifunction switch component test. Refer to Wiring Diagrams Cell 149 for schematic and connector information. ● **Did the multifunction switch pass the component test?**	**Yes** GO to J13 . **No** INSTALL a new multifunction switch. REFER to Section 211-05 .
J10 CHECK CIRCUIT 57 (BK) FOR OPEN	
● Measure the resistance between C125 pin 6, circuit 57 (BK) harness side and ground.  A0037627 ● **Is the resistance less than 5 ohms?**	**Yes** GO to J13 . **No** REPAIR the circuit. TEST the system for normal operation.
J11 CHECK CIRCUIT 57 (BK) FOR OPEN	
● Key in OFF position. ● Measure the resistance between C476 pin 1, circuit 57 (BK) harness side and ground.	**Yes** GO to J12 .

 A0037614 ● **Is the resistance less than 5 ohms?**	**No** REPAIR the circuit. TEST the system for normal operation.
J12 CHECK CIRCUIT 946 (PK/LG) FOR OPEN	
● Disconnect: Rear Window Wiper Motor C476. ● Measure the resistance between C476 pin 5, circuit 946 (VT/LG), harness side and C1357 pin 1, circuit 946 (VT/LG), harness side.  A0037624 ● **Is the resistance less than 5 ohms?**	**Yes** GO to J13 . **No** REPAIR the circuit. TEST the system for normal operation.
J13 CHECK FOR CORRECT WIPER MOTOR OPERATION	
● Disconnect all wiper motor connectors. ● Check for: ● liftgate glass open ● corrosion ● pushed-out pins ● Connect all wiper motor connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** For the windshield wiper motor GO to J14 . For the rear window wiper motor GO to J15 . **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. TEST the system for normal operation.
J14 CHECK THE WINDSHIELD WIPER MOTOR	
● Key in OFF position. ● Disconnect: Windshield Wiper Motor C125. ● Carry out the windshield wiper motor component test as described in this section. ● **Did the windshield wiper motor pass the component test?**	**Yes** The system is operating correctly at this time. Concern may have been caused by binding or incorrect pivot arm adjustment. REFER to Windshield Wiper Blade and Pivot Arm Adjustment in this section. TEST the system for normal operation. **No** INSTALL a new windshield wiper motor. REFER to Windshield Wiper Motor in this section.
J15 CHECK THE REAR WINDOW WIPER MOTOR	

• Carry out the rear widow wiper motor component test as described in this section. • **Did the rear window wiper motor pass the component test?**	**Yes** The system is operating correctly at this time. Concern may have been caused by binding or incorrect pivot arm adjustment. REFER to Rear Window Wiper Blade and Pivot Arm Adjustment in this section. TEST the system for normal operation. **No** INSTALL a new rear window wiper motor. REFER to Rear Window Wiper Motor in this section.

PINPOINT TEST K: THE WINDSHIELD WIPER SPEED DEPENDENT INTERVAL MODE DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
K1 CHECK THE PCM — MONITOR THE VSS	
• Monitor the VSS while driving the vehicle from 0 to 88.5 kph (55 mph). • **Does the VSS agree with the PCM PIDs?**	**Yes** GO to K2. **No** REFER to Section 206-09A.
K2 CHECK CIRCUIT 679 (GY/BK) FOR AN OPEN	
• Disconnect: PCM C175b. • Disconnect: Windshield Wiper Motor C125. • Measure the resistance between PCM C175b pin 13, circuit 679 (GY/BK), harness side and windshield wiper motor C125 pin 4, circuit 679 (GY/BK), harness side.  A0047257 • **Is the resistance less than 5 ohms?**	**Yes** GO to K3. **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
K3 CHECK CIRCUIT 679 (GY/BK) FOR A SHORT TO GROUND	
• Measure the resistance between PCM C175b pin 13, circuit 679 (GY/BK), harness side and ground.	**Yes** GO to K4. **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

 ● **Is the resistance greater than 10,000 ohms?**	
K4 CHECK FOR CORRECT WIPER MOTOR OPERATION	
● Disconnect all wiper motor connectors. ● Check for: ● corrosion ● pushed-out pins ● Connect all wiper motor connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● **Is the concern still present?**	**Yes** GO to K5 . **No** The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. TEST the system for normal operation.
K5 CHECK THE WINDSHIELD WIPER MOTOR	
● Key in OFF position. ● Disconnect: Windshield Wiper Motor C125. ● Carry out the windshield wiper motor component test as described in this section. ● **Did the windshield wiper motor pass the component test?**	**Yes** The system is operating correctly at this time. Concern may have been caused by binding or incorrect pivot arm adjustment. REFER to Windshield Wiper Blade and Pivot Arm Adjustment in this section. TEST the system for normal operation. **No** INSTALL a new windshield wiper motor. REFER to Windshield Wiper Motor in this section.

Component Test — Windshield Wiper Motor

CAUTION: Do not handle the windshield wiper motor abusively when diagnosing the wiper operations. Failure to follow this caution may result in damage to the motor magnets and will make the windshield wiper motor inoperative. Rough handling of new windshield wiper motors may also damage the motor magnets.

NOTE: Windshield wiper motor component test is carried out to determine if windshield wiper motor and module are functional and not in for default mode. Refer to Principles of Operation in this section.

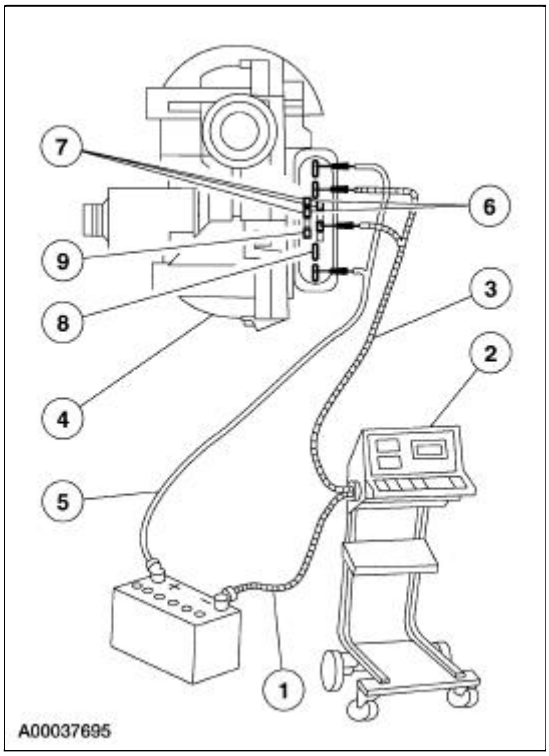
NOTE: Battery voltage must remain within 10 to 15 VDC to carry out test and keep windshield wiper motor from entering its software safe mode.

NOTE: When connecting the power and ground test leads to the windshield wiper motor terminals, care must be taken to not short terminals between power and ground, as well as making sure the logic ground, pin 3, is always securely connected to prevent permanent windshield wiper motor module

damage.

If the windshield wiper motor does not pass any of the following tests, install a new windshield wiper motor. Refer to Windshield Wiper Motor in this section.

Use SABRE Premium Battery and Electrical System Tester 010-00736 or equivalent to test the windshield wiper motor.



To test the windshield wiper motor, remove the windshield wiper mounting arm and pivot shaft from the windshield wiper motor. Refer to Windshield Wiper Blade and Pivot Arm Adjustment in this section.

Disconnect the wiper motor. Connect the (1) green lead from the (2) SABRE to the battery negative (-) post. Connect the red lead (3) from the SABRE to the wiper motor (4) component side connector ground and logic ground pins 6 and 3 (3). Connect battery positive cable (5) to windshield wiper motor (4) component side connector battery and logic positive pins 5 and 8 (5).

Low Speed

Test the low speed mode by connecting a separate set of test leads from battery ground (-) post to windshield wiper motor (4) component side pins 9 and 10 (6). When these pins are grounded, the windshield wiper motor operation should now be in low speed mode.

High Speed

Test the high speed mode by connecting a separate set of test leads from battery ground (-) post to windshield wiper motor (4) component side pins 1, 9, and 10 (7). When these pins are grounded, the windshield wiper motor operation should now be in high speed mode.

Washer Pump Relay (Integral)

Test the windshield wiper motor internal washer relay function by measuring the voltage between windshield wiper motor (4) component side pin 7 (8), and ground while grounding the windshield wiper motor (4) component side pin 12 (9). When wash command input pin 12 is grounded, measured

voltage should read 10 volts or greater.

Component Test — Rear Window Wiper Motor

CAUTION: Do not handle the rear window wiper motor abusively when diagnosing the wiper operations. Failure to follow this caution may result in damage to the motor magnets and will make the rear window wiper motor inoperative. Rough handling of new rear window wiper motors may also damage the motor magnets.

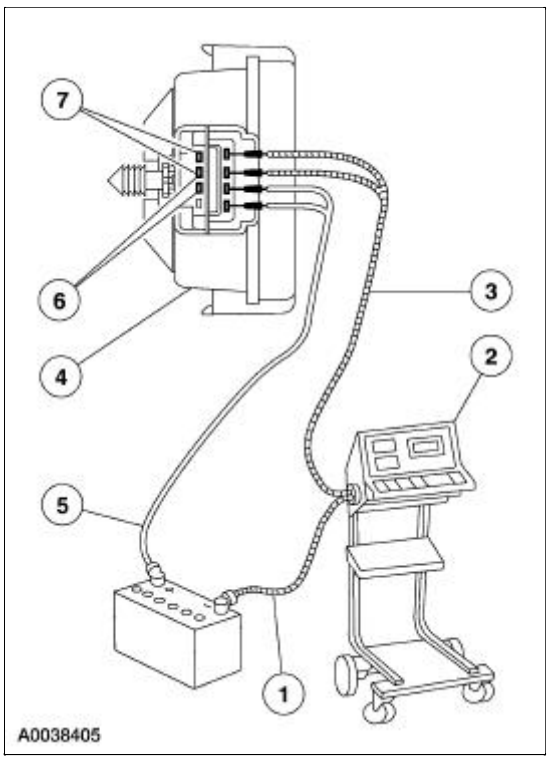
NOTE: The Rear window wiper motor component test is carried out to determine if wiper motor and module are functional.

NOTE: Battery voltage must remain within 10 to 15 VDC to carry out test and keep wiper motor from entering its software safe mode.

NOTE: When connecting the power and ground test leads to the rear wiper motor terminals, care must be taken to not short terminals between power and ground, as well as insuring the logic ground, pin 3, is always securely connected to prevent permanent rear window wiper motor module damage.

If the rear window wiper motor does not pass any of the following tests, install a new rear window wiper motor. Refer to Rear Window Wiper Motor in this section.

Use the SABRE Premium Battery and Electrical System Tester 010-00736 or equivalent to test the rear window wiper motor.



Disconnect the rear window wiper motor. Connect the (1) green lead from the (2) SABRE to the battery negative (-) post. Connect the red lead (3) from the SABRE to the wiper motor (4) component side connector ground pins 1 an 2 (3). Connect battery positive cable (5) to wiper motor (4) component side connector battery and logic positive pins 3 and 4 (5).

On Mode

Test the on mode by connecting a separate set of test leads from battery ground (-) post to windshield wiper motor (4) component side pins 6 and 7 (6). When these pins are grounded, the rear window wiper motor operation should now be in on mode.

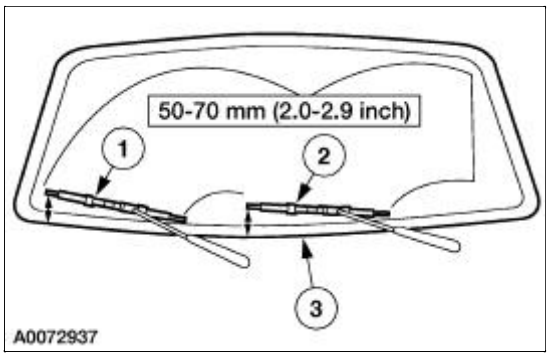
Washer Pump Relay (Integral)

Test the rear window wiper motor internal washer relay function by measuring the voltage between wiper motor (4) component side pin 5 (7), and ground. When wash command input pin 6 (7) is grounded, measured voltage should read 10 volts or greater.

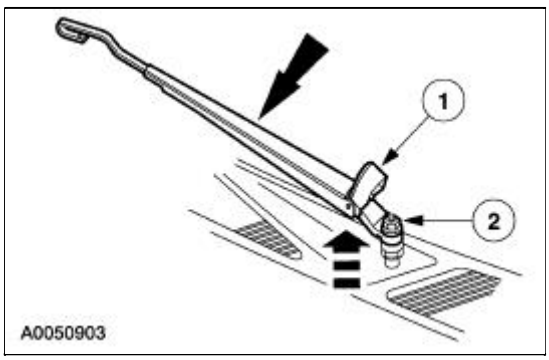
Windshield Wiper Blade and Pivot Arm Adjustment

1. Cycle and park the windshield wipers.

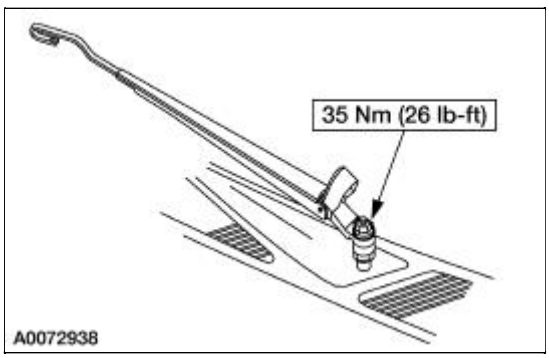
2. Verify the distance between the outer tip of the (1) RH windshield wiper blade and the (3) bottom of the windshield glass and between the outer tip of the (2) LH windshield wiper blade and the (3) bottom of the windshield glass are within specifications.



3. If the distance is not within specification, remove the windshield wiper pivot arm and reposition to specification.
    1. Lift the pivot arm nut cover.
    2. Remove the nut.



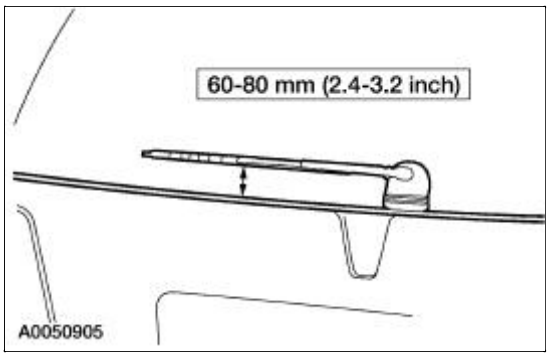
4. Tighten the windshield wiper pivot arm nuts.



Rear Window Wiper Blade and Pivot Arm Adjustment

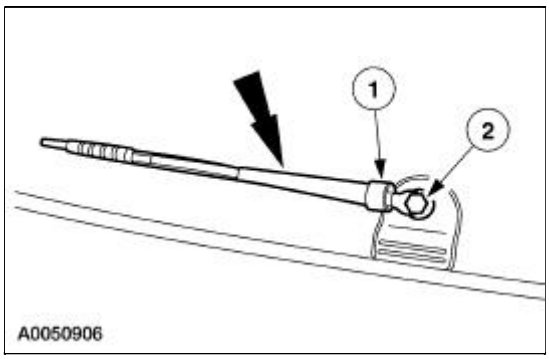
1. Cycle and park the rear window wiper pivot arm and blade.

2. Check the rear window wiper park measurement. If not within specification the rear window wiper pivot arm will need to be removed.



3. **CAUTION: Use a shop towel or similar device to protect the vehicle finish when carrying out the procedure.**

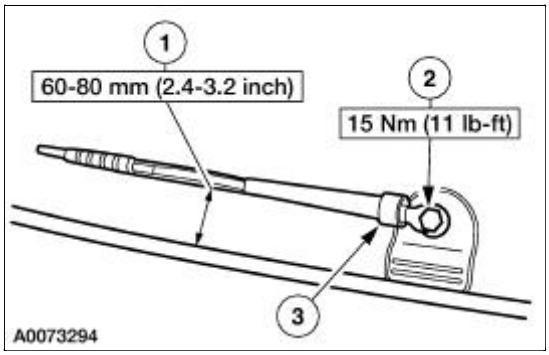
   Remove the rear window wiper pivot arm.
   1. Lift the pivot arm nut cover.
   2. Remove the nut.



4. **NOTE:** This step makes sure that the wiper motor is in the PARK position.

   Turn the rear window wiper switch on and allow the motor to operate for at least one cycle. Turn the rear window wiper switch to OFF.

5. Install the rear window wiper pivot arm onto the rear window wiper motor shaft.
   1. Position the wiper pivot arm within specification.
   2. Tighten the nut.
   3. Install the cover.

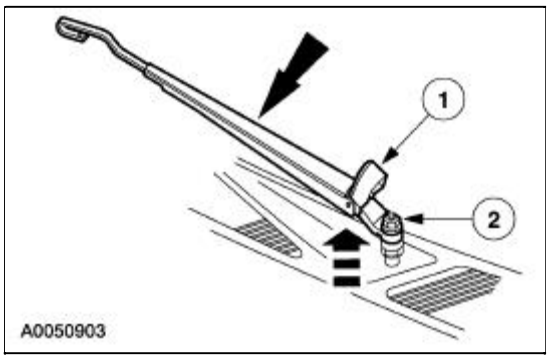

1
60-80 mm (2.4-3.2 inch)
2
15 Nm (11 lb-ft)
3
A0073294

Wiper Pivot Arm —Windshield Wiper

Removal

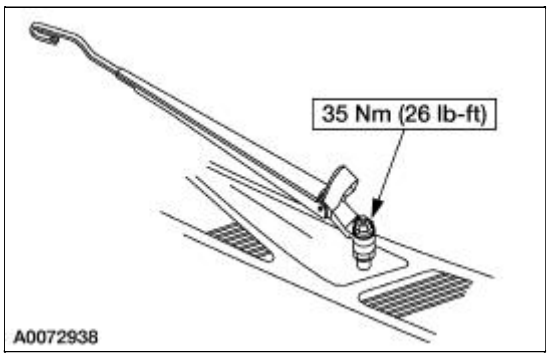
NOTE: The windshield wiper pivot arms must be in the highest position to remove them.

1. Turn the ignition switch to the ON position.
2. Turn the windshield wiper on.
3. Stop the windshield wiper pivot arms at the highest position by turning the ignition switch OFF.
4. Remove the windshield wiper pivot arm.
    1. Lift the pivot arm nut cover.
    2. Remove the nut.



Installation

1. To install, reverse the removal procedure.
    - Adjust the windshield wiper pivot arms. For additional information, refer to Windshield Wiper Blade and Pivot Arm Adjustment in this section.

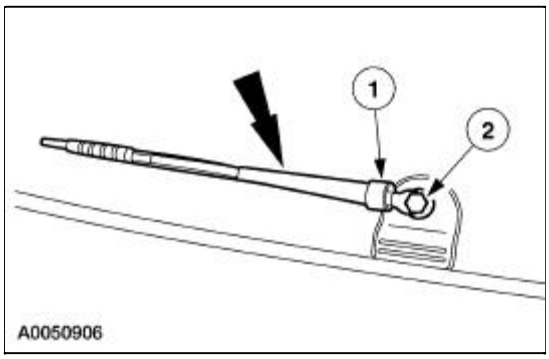


Wiper Pivot Arm —Rear

Removal

1. **CAUTION: Use a shop towel or similar device to protect the vehicle finish when carrying out the procedure.**

   Remove the rear window wiper pivot arm.
   1. Lift the pivot arm nut cover.
   2. Remove the nut.

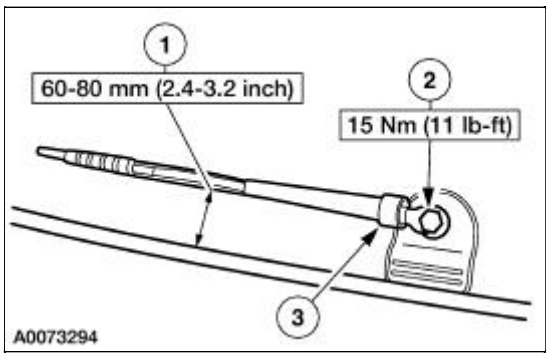


Installation

1. **NOTE:** This step makes sure that the wiper motor is in the PARK position.

   Turn the rear window wiper switch on and allow the motor to operate for at least one cycle. Turn the rear window wiper switch to OFF.

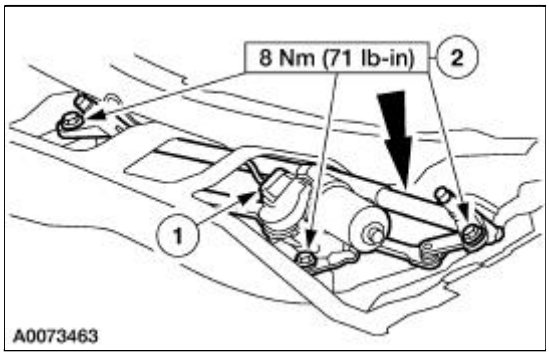
2. Install the rear window wiper pivot arm onto the rear window wiper motor shaft.
   1. Position the wiper pivot arm within specification.
   2. Tighten the nut.
   3. Install the cover.



Wiper Mounting Arm and Pivot Shaft —Windshield

Removal and Installation

1. Remove the cowl grille panel. For additional information, refer to Section 501-02 .
2. Disconnect and position the hood light harness aside.
3. Remove the hood struts.
   - Using a suitable tool support the hood.
4. Remove the mounting arm and pivot shaft assembly.
   1. Disconnect the electrical connector and position the wiring harness aside.
   2. Remove the bolts.

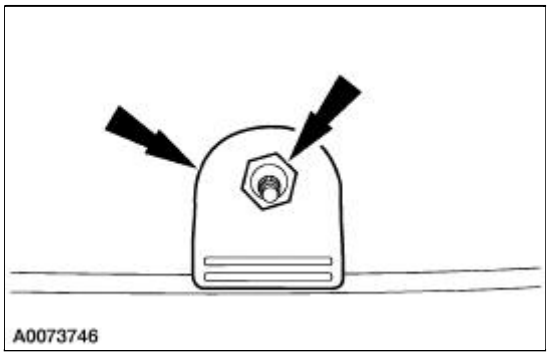


5. To install, reverse the removal procedure.

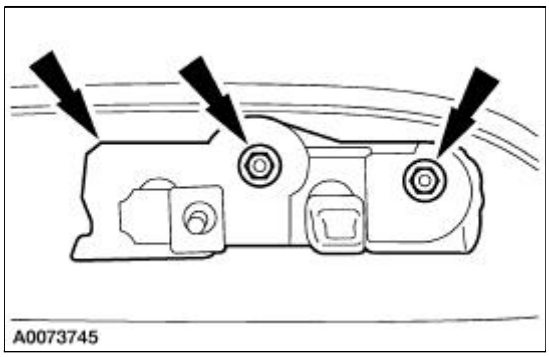
Rear Window Striker and Wiper Pivot Shaft Assembly

Removal

1. Remove the rear wiper pivot arm. For additional information, refer to Wiper Pivot Arm—Rear in this section.
2. Remove the dust boot cover.
3. Remove the nut and the rear window glass handle.



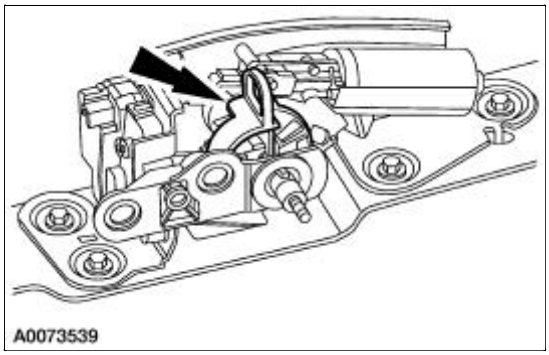
4. Remove the nuts and the rear window striker and wiper pivot shaft assembly.



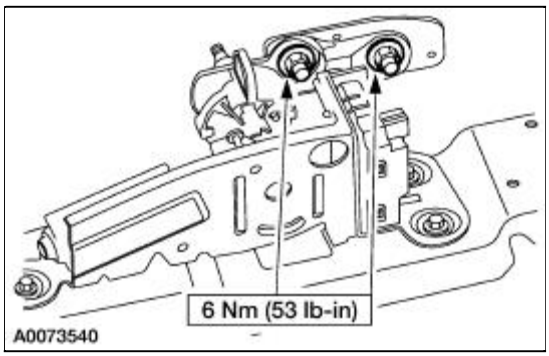
Installation

1. Remove the liftgate trim panel. For additional information, refer to Section 501-05 .
2. **NOTE:** An audible click should be heard as the striker engages the latch.

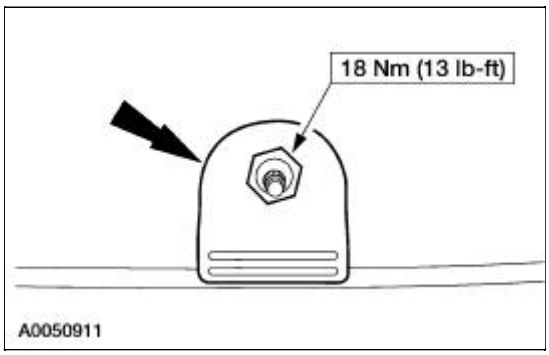
   Install the rear window striker and pivot shaft assembly into the wiper motor.
3. Install the alignment clip.



4. Slowly close liftgate window glass.
5. Open the liftgate.
6. Install the rear window striker and wiper pivot arm mounting assembly nuts.



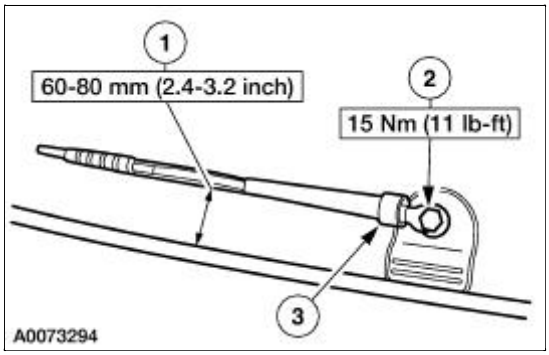
7. Remove the alignment clip.
8. Install the rear window glass handle and nut.



9. **NOTE:** This step makes sure that the wiper motor is in the PARK position.

   Turn the rear window wiper switch on and allow the motor to operate for at least one cycle. Turn the rear window wiper switch to OFF.

10. Install the rear window wiper pivot arm onto the rear window wiper motor shaft.
    1. Position the wiper pivot arm within specification.
    2. Tighten the nut.
    3. Install the cover.



11. Install the liftgate trim panel. For additional information refer to Section 501-05 .

Windshield Wiper Motor

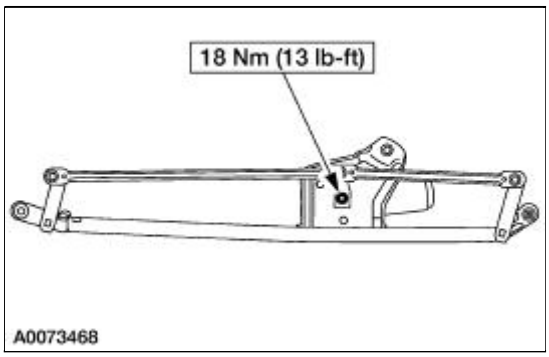
Removal and Installation

1. Remove the mounting arm and pivot shaft. For additional information, refer to Wiper Mounting Arm and Pivot Shaft—Windshield in this section.

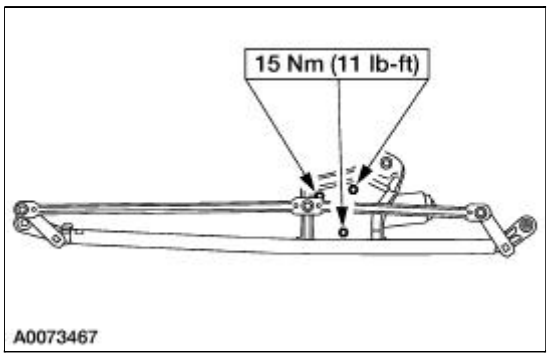
2. **NOTE:** Mark the position of the windshield wiper motor crank before it is disconnected.

   Disconnect the windshield wiper motor crank.

   - Remove the bolt.



3. Remove the bolts and the windshield wiper motor.



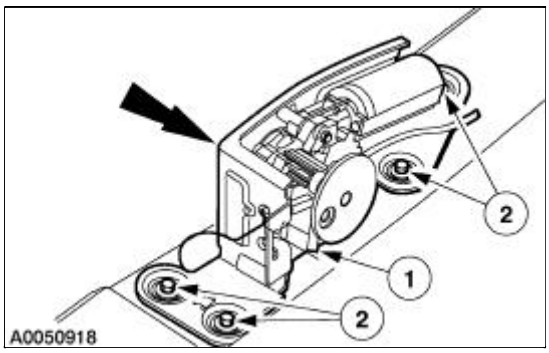
4. **NOTE:** The windshield wiper motor crank must be set to the same location for the windshield wiper mounting arm and pivot shaft to be installed properly. Refer to component test in this section.

   To install reverse the removal procedure.

Rear Window Wiper Motor

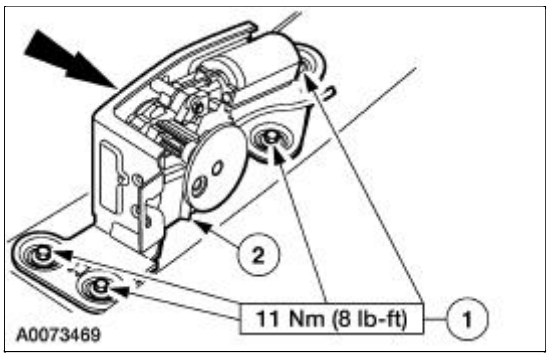
Removal

1. Remove the rear window striker and wiper pivot shaft assembly. For additional information, refer to Rear Window Striker and Wiper Pivot Shaft Assembly in this section.
2. Remove the liftgate window glass latch. For additional information refer to Section 501-14 .
3. Remove the liftgate watershield.
4. Remove the rear window wiper motor.
    1. Disconnect the electrical connector.
    2. Remove the bolts.

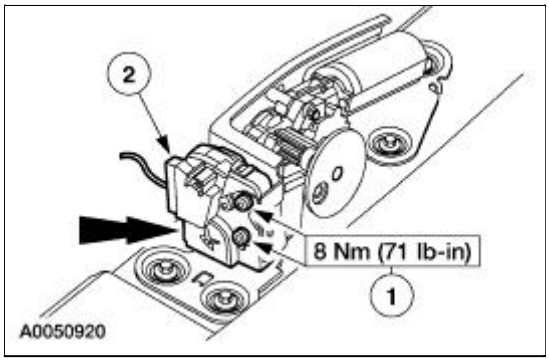


Installation

1. Install the rear window wiper motor.
    1. Install the bolts.
    2. Connect the electrical connector.

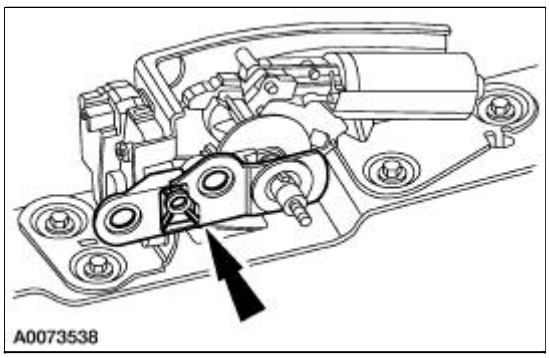


2. Install the liftgate window glass latch.
    1. Install the bolts.
    2. Connect the electrical connector.

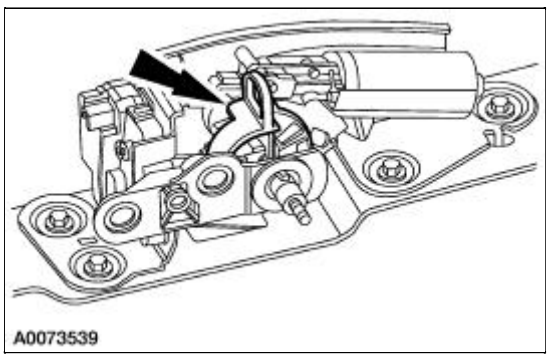


3. **NOTE:** An audible click should be heard as the striker engages the latch.

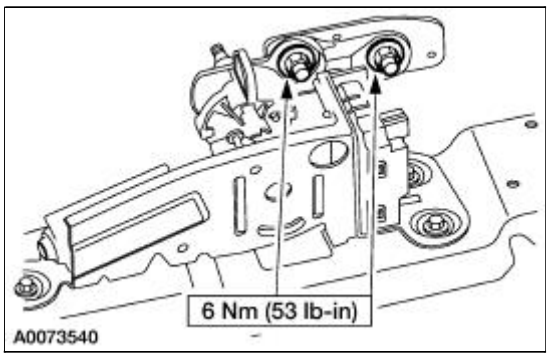
   Install the rear window wiper striker and pivot shaft assembly into the wiper motor.



4. Install the alignment clip provided with rear window wiper motor.

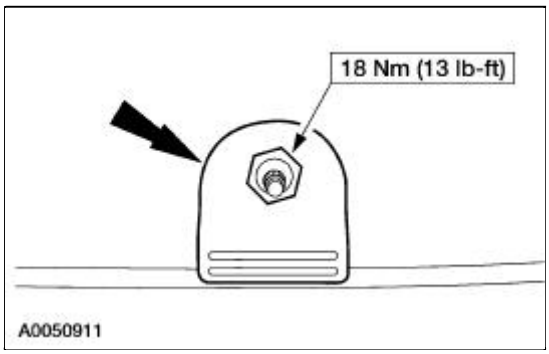


5. Slowly close liftgate window glass.
6. Open liftgate.
7. Install the rear window wiper striker and wiper pivot arm mounting assembly nuts.



8. Remove the alignment clip.

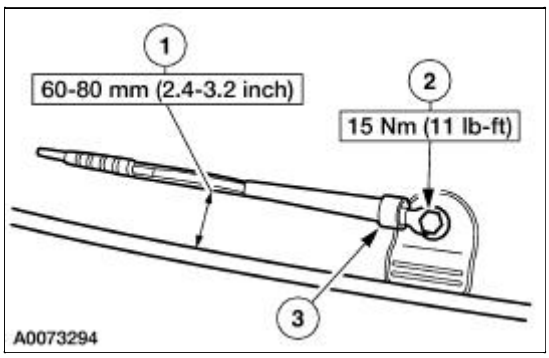
9. Install the rear window glass handle and nut.



10. **NOTE:** This step makes sure that the wiper motor is in the PARK position.

    Turn the rear window wiper switch on and allow the motor to operate for at least one cycle. Turn the rear window wiper switch to OFF.

11. Install the rear window wiper pivot arm onto the rear window wiper motor shaft.
    1. Position the wiper pivot arm within specification.
    2. Tighten the nut.
    3. Install the cover.



12. Install the liftgate watershield.

13. Install the liftgate trim panel. For additional information refer to Section 501-05 .

Windshield Washer Pump and Reservoir

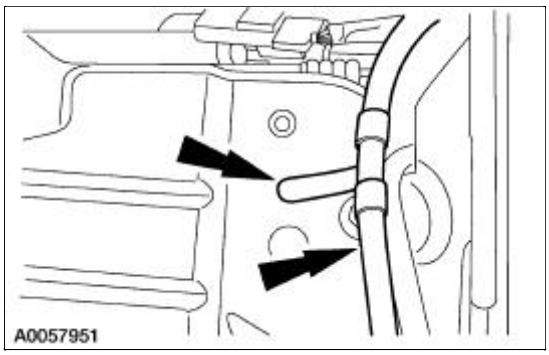
Material

Item	Specification
Ultra-Clear Windshield Washer Concentrate F6AZ-19550-AA	ESR-M17P5-A

Removal

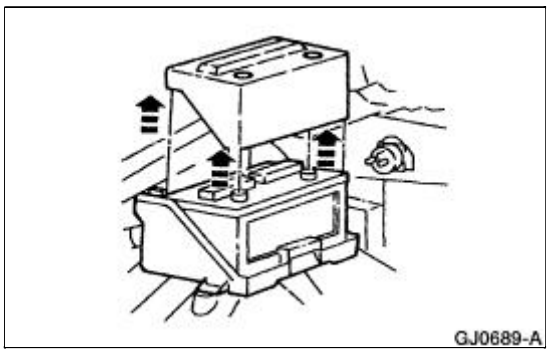
4x4 vehicles only

1. Remove the battery tray. For additional information, refer to Section 414-01 .
2. Position the front differential vent hose aside.
   - Release the retainer.



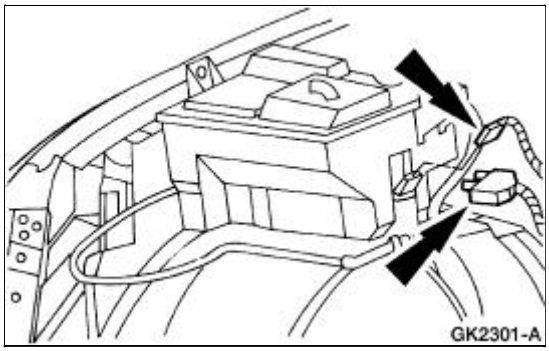
4x2 vehicles only

3. Disconnect the battery cables. For additional information, refer to Section 414-01 .
4. Remove the battery heat shield.

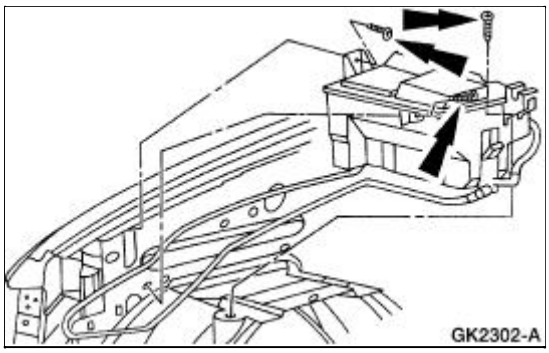


All vehicles

5. Disconnect the electrical connectors.

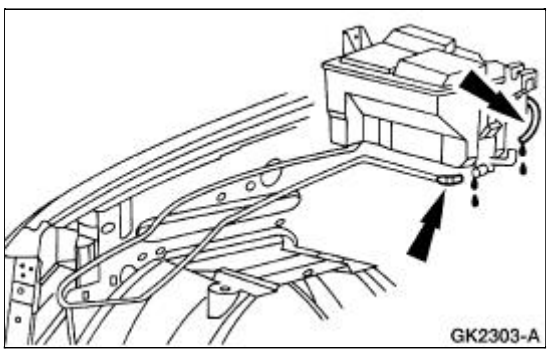


6. Remove the windshield washer reservoir screws.



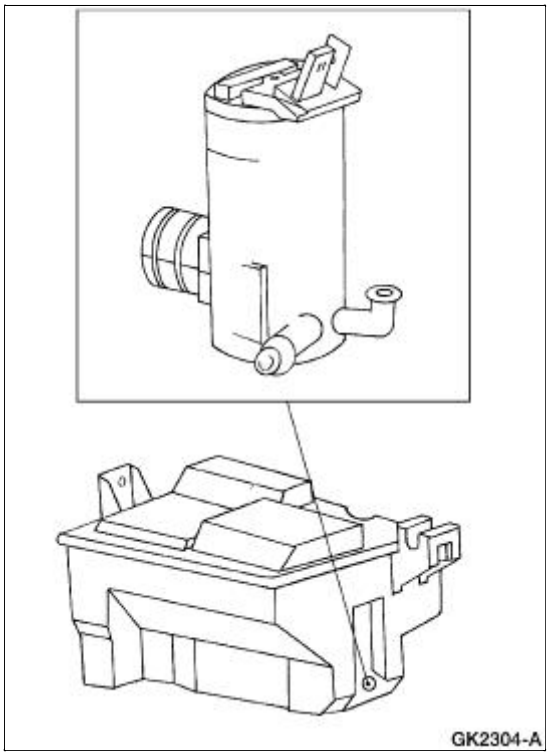
7. **NOTE:** Windshield washer fluid should be collected in a container after the windshield washer hoses are disconnected.

   Disconnect the windshield washer hoses.



8. Remove the windshield washer reservoir.

9. Remove the windshield washer pump if necessary.

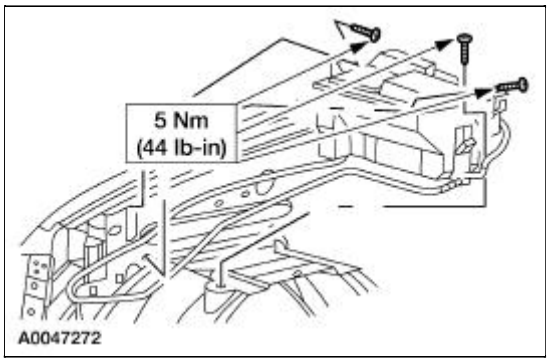


Installation

1. **CAUTION: Do not operate the windshield washer pump prior to filling the windshield washer reservoir.**

   To install, reverse the removal procedure.

   - Fill the windshield washer reservoir with windshield washer concentrate.



General Specifications

Item	Specification
Roof Opening Panel Alignment	
Height adjustment (front)	-1.5 - 0 mm (-0.059 - 0 in)
Height adjustment (rear)	0 - 1.5 mm (0 - 0.059 in)

Torque Specifications

Description	Nm	lb-in
Roof opening panel frame bolts	10	89
Roof opening panel bolts	5	44
Roof opening panel motor bolts	5	44
Roof opening panel water trough bolts	5	44

Roof Opening Panel

The roof opening panel system consists of:

- roof opening panel motor
- roof opening panel module
- roof opening panel
- overhead console
- roof opening panel frame
- roof opening panel frame drain hose
- roof opening panel water trough
- roof opening panel shield
- roof opening panel air deflector
- roof opening panel lifter assembly

Roof Opening Panel

Refer to Wiring Diagrams Cell 101 , Roof Opening Panel for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter or equivalent 105-R0057

Inspection and Verification

1. Verify the customer concern by operating the system.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
● Roof opening panel ● Roof opening panel frame ● Roof opening panel drain hoses ● Roof opening panel lifter assemblies ● Roof opening panel water trough ● Roof opening panel air deflector assembly ● Roof opening panel seal ● Roof opening panel shield	● Battery junction box (BJB) fuse ● Circuitry ● Accessory delay relay ● Roof opening panel switch

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the concern is not visually evident, verify the symptom and refer to Symptom Chart.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
● The roof opening panel has excessive wind noise	● Roof opening panel adjustment. ● Roof opening panel seal.	● Go To Pinpoint Test A .

• The roof opening panel leaks	• Roof opening panel adjustment. • Front rail seal. • Drain tube attachment points. • Roof opening panel water trough and seal. • Roof opening panel drain hose. • Roof opening panel seal. • Roof opening panel.	• Go To Pinpoint Test B .
• The roof opening panel rattles	• Roof opening panel. • Roof opening panel tracks. • Roof opening panel air deflector assembly. • Roof opening panel water trough. • Roof opening panel lifter assemblies. • Roof opening panel water trough guide. • Headliner. • Motor pad. • Rear side brackets.	• Go To Pinpoint Test C .
• The roof opening panel is noisy during operation	• Roof opening panel. • Roof opening panel tracks. • Roof opening panel lifter assemblies. • Roof opening panel adjustment. • Roof opening panel motor assembly.	• Go To Pinpoint Test D .
• The roof opening panel does not open or close	• Roof opening panel adjustment. • Battery junction box (BJB) fuse. • Circuitry. • Roof opening panel switch. • Roof opening panel motor assembly. • Roof opening panel lifter assemblies.	• Go To Pinpoint Test E .
• The express open is inoperative	• Circuitry. • Roof opening panel switch. • Roof opening panel motor assembly.	• Go To Pinpoint Test F .
• The roof opening panel does not open or close — one direction only	• Circuitry. • Roof opening panel switch. • Roof opening panel motor assembly.	• Go To Pinpoint Test F .

Pinpoint Tests

PINPOINT TEST A: THE ROOF OPENING PANEL HAS EXCESSIVE WIND NOISE

Test Step	Result / Action to Take
A1 CHECK THE ROOF OPENING PANEL SEAL ● **NOTE:** Make sure the seals are not loose, cracked, pinched or obstructed. ● Check the roof opening panel seal. ● **Is the roof opening panel seal OK?**	**Yes** GO to A2 . **No** REPAIR or INSTALL a new seal. TEST the system for normal operation.
A2 CHECK THE ROOF OPENING PANEL ADJUSTMENT ● Key in ON position. ● Open and close the roof opening panel. ● Check the adjustment when the roof opening panel closes. ● **Is the adjustment OK?**	**Yes** CHECK for correct installation of the roof opening panel motor. REFER to Roof Opening Panel Motor in this section. TEST the system for normal operation. **No** ADJUST the roof opening panel. REFER to Roof Opening Panel Alignment in this section. TEST the system for normal operation.

PINPOINT TEST B: THE ROOF OPENING PANEL LEAKS

Test Step	Result / Action to Take
B1 CHECK THE ADJUSTMENT OF THE ROOF OPENING PANEL ● **NOTE:** Make sure the roof opening panel seal is not cracked or loose. ● Check the roof opening panel seal. ● **Does the roof opening panel seal correctly?**	**Yes** GO to B2 . **No** ADJUST the roof opening panel. REFER to Roof Opening Panel Alignment in this section. TEST the system for normal operation.
B2 CHECK THE ROOF OPENING PANEL DRAIN HOSES ● **NOTE:** Make sure the roof opening panel drain hoses are not cracked, slit, pinched or obstructed. ● Check the four roof opening panel drain hoses for correct operation. ● **Are the roof opening panel drain hoses OK?**	**Yes** GO to B3 . **No** REPAIR or INSTALL a new roof opening panel drain hose(s). TEST the system for normal operation.
B3 CHECK THE ROOF OPENING PANEL DRAIN HOSE ATTACHMENT POINTS ● **NOTE:** Make sure the roof opening panel drain hose attachment points are not damaged or obstructed. ● Check the roof opening panel drain	**Yes** GO to B4 . **No**

hose attachment points for correct attachment. ● **Are the roof opening panel drain hose attachment points OK?**	REPAIR or INSTALL a new roof opening panel. REFER to Roof Opening Panel in this section. TEST the system for normal operation.
B4 CHECK THE ROOF OPENING PANEL WATER TROUGH CONDITION	
● Check the roof opening panel water trough and the roof opening panel water trough seal for damage. ● **Are the roof opening panel water trough and seal OK?**	**Yes** GO to B5 . **No** REPAIR the roof opening panel water trough and seal. TEST the system for normal operation.
B5 CHECK THE CONDITION OF THE ROOF SLIDING GLASS PANEL	
● Check the roof opening panel frame for damage that may cause the roof opening panel seal to seat incorrectly. ● **Is the roof opening panel frame OK?**	**Yes** INSTALL a new roof opening panel. REFER to Roof Opening Panel in this section. TEST the system for normal operation. **No** REPAIR or INSTALL a new roof opening panel frame. REFER to Roof Opening Panel Frame in this section. TEST the system for normal operation.

PINPOINT TEST C: THE ROOF OPENING PANEL RATTLES

Test Step	Result / Action to Take
C1 CHECK THE ROOF OPENING PANEL OPERATION	
● Check the roof opening panel during operation. ● **Is the roof opening panel loose?**	**Yes** ADJUST the roof opening panel. REFER to Roof Opening Panel Alignment in this section. TEST the system for normal operation. **No** GO to C2 .
C2 CHECK THE ROOF OPENING PANEL TRACKS	
● Open the roof opening panel. ● Check the roof opening panel tracks for obstructions and damage. ● **Are the roof opening panel tracks OK?**	**Yes** GO to C3 . **No** REMOVE all the roof opening panel track obstructions and REPAIR the roof opening panel tracks. TEST the system for normal operation.
C3 CHECK THE ROOF OPENING PANEL WATER TROUGH AND TROUGH GUIDES	
● Check the water roof opening panel water trough and trough guides for any loose fasteners or obstructions. ● **Are the roof opening panel water trough and trough guides**	**Yes** GO to C4 . **No** REMOVE all obstructions from the roof opening panel water trough and install securely. SECURE the trough

installed securely and free from obstructions?	guides or INSTALL new roof opening panel water trough guides if damaged. TEST the system for normal operation.
C4 CHECK THE ROOF OPENING PANEL SHIELD • Check the roof opening panel shield for correct installation. • **Is the roof opening panel shield installed correctly?**	**Yes** GO to C5 . **No** INSTALL the roof opening panel shield correctly. TEST the system for normal operation.
C5 CHECK THE ROOF OPENING PANEL AIR DEFLECTOR ASSEMBLY • Check the roof opening panel air deflector assembly for obstructions and damage. • **Is the roof opening panel air deflector assembly OK?**	**Yes** GO to C6 . **No** REMOVE all obstructions and REPAIR or INSTALL a new roof opening panel air deflector assembly. TEST the system for normal operation.
C6 CHECK THE ROOF OPENING PANEL • Verify the roof opening panel is free from obstruction and damage, and is securely fastened. • **Is the roof opening panel OK?**	**Yes** GO to C7 . **No** REPAIR or INSTALL a new roof opening panel. REFER to Roof Opening Panel in this section. TEST the system for normal operation.
C7 CHECK THE ROOF OPENING PANEL LIFTER ASSEMBLIES • Verify the roof opening panel lifter assemblies are free from obstructions and damage. • **Are the roof opening panel lifter assemblies OK?**	**Yes** INSTALL a new roof opening panel frame. REFER to Roof Opening Panel Frame in this section. TEST the system for normal operation. **No** REMOVE all obstructions from the roof opening panel lifter assemblies and REPAIR any damage. TEST the system for normal operation.

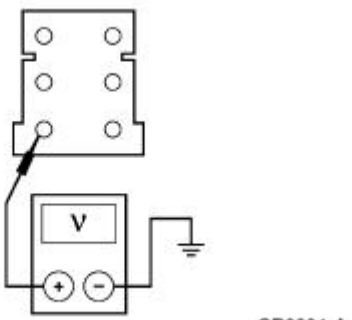
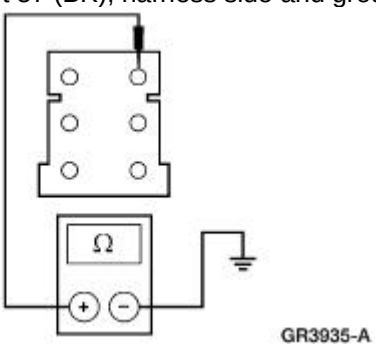
PINPOINT TEST D: THE ROOF OPENING PANEL IS NOISY DURING OPERATION

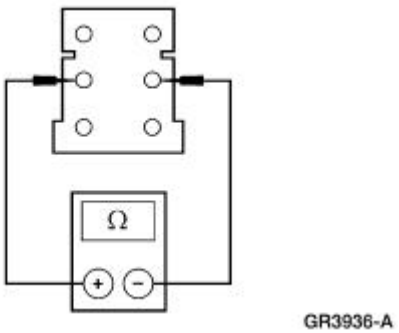
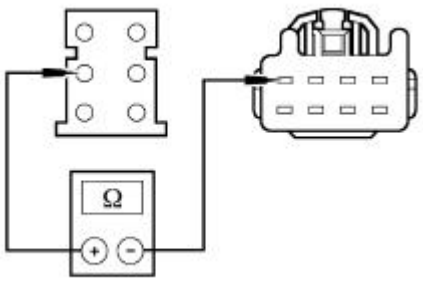
Test Step	Result / Action to Take
D1 CHECK THE ROOF OPENING PANEL FOR OBSTRUCTIONS OR DAMAGE • Check the roof opening panel for any obstructions and damage. • **Are there any obstructions and/or damage?**	**Yes** REMOVE all obstructions. REPAIR any damage or INSTALL a new roof opening panel. REFER to Roof Opening Panel in this section. TEST the system for normal operation. **No**

	GO to D2 .
D2 CHECK THE ROOF OPENING PANEL OPERATION	
• Check the roof opening panel during operation. • **Is the roof opening panel loose or incorrectly adjusted?**	**Yes** ADJUST the roof opening panel. REFER to Roof Opening Panel Alignment in this section. TEST the system for normal operation. **No** GO to D3 .
D3 CHECK THE ROOF OPENING PANEL TRACKS	
• Open the roof. • Check the roof opening panel tracks for obstructions and damage. • **Are the roof opening panel tracks OK?**	**Yes** GO to D4 . **No** REMOVE all obstructions and REPAIR any damage. TEST the system for normal operation.
D4 CHECK THE ROOF OPENING PANEL SHIELD	
• Check the roof opening panel shield for correct movement. • **Is the roof opening panel shield moving correctly?**	**Yes** GO to D5 . **No** REMOVE and REINSTALL the roof opening panel shield. REFER to Roof Opening Panel Shield in this section. TEST the system for normal operation.
D5 CHECK THE ROOF OPENING PANEL LIFTER ASSEMBLIES	
• Check the roof opening panel lifter assemblies for obstructions and damage. • **Are the roof opening panel lifter assemblies OK?**	**Yes** GO to D6 . **No** REMOVE all obstructions and REPAIR any damage. TEST the system for normal operation.
D6 CHECK THE ROOF OPENING PANEL MOTOR	
• Gain access to the roof opening panel motor. • Open the roof opening panel. • **Does the motor make excessive noise?**	**Yes** INSTALL a new roof opening panel motor. REFER to Roof Opening Panel Motor in this section. TEST the system for normal operation. **No** ADJUST the roof opening panel. REFER to Roof Opening Panel Alignment in this section. TEST the system for normal operation.

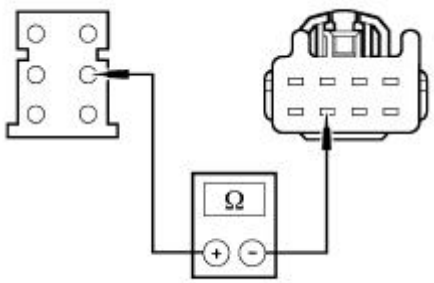
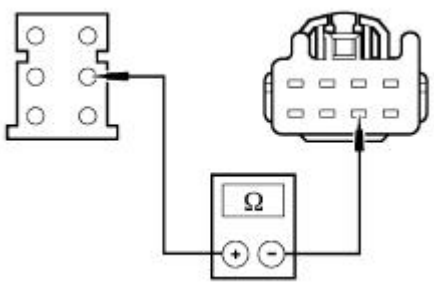
PINPOINT TEST E: THE ROOF OPENING PANEL DOES NOT OPEN OR CLOSE

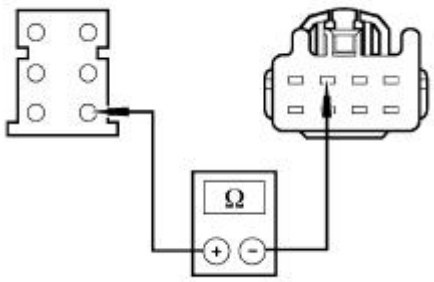
Test Step	Result / Action to Take
E1 VERIFY THE ROOF OPENING PANEL ADJUSTMENT	
• Verify the roof opening panel is adjusted correctly. • **Is the roof opening panel adjusted correctly?**	**Yes** GO to E2 .

	No ADJUST the roof opening panel. REFER to Roof Opening Panel Alignment in this section. TEST the system for normal operation.
E2 CHECK THE ROOF OPENING PANEL LIFTER ASSEMBLIES FOR OBSTRUCTIONS OR DAMAGE ● Check the roof opening panel lifter assemblies for obstructions and damage. ● **Are the roof opening panel lifter assemblies OK?**	**Yes** GO to E3 . **No** REMOVE all obstructions and REPAIR any damage. TEST the system for normal operation.
E3 VERIFY POWER WINDOWS ARE OPERATIONAL ● Operate the power windows. ● **Do the power windows operate?**	**Yes** GO to E4 . **No** REFER to Section 501-11 .
E4 CHECK CIRCUIT 400 (LB/BK) FOR VOLTAGE ● Key in OFF position. ● Disconnect: Roof Opening Panel Motor C920. ● Key in ON position. ● Measure the voltage between roof opening panel motor C920-4, circuit 400 (LB/BK), harness side and ground.  GR3934-A ● **Is the voltage greater than 10 volts?**	**Yes** GO to E5 . **No** REPAIR the circuit. TEST the system for normal operation.
E5 CHECK CIRCUIT 57 (BK) FOR AN OPEN ● Key in OFF position. ● Measure the resistance between roof opening panel motor C920-1, circuit 57 (BK), harness side and ground.  GR3935-A	**Yes** GO to E6 . **No** REPAIR the circuit. TEST the system for normal operation.

• **Is the resistance less than 5 ohms?**	
E6 CHECK ROOF OPENING PANEL MOTOR	
• Measure the resistance between roof opening panel motor C920-5, circuit 1173 (BN/OG), harness side and C920-2, circuit 1174 (WH/RD), harness side while depressing the open button.  GR3936-A • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new roof opening panel motor. REFER to Roof Opening Panel Motor in this section. TEST the system for normal operation. **No** GO to E7.
E7 CHECK CIRCUIT 1173 (BN/OG) FOR OPEN	
• Disconnect: Roof Opening Panel Switch C912 (Expedition)/C9001 (Navigator). • Measure the resistance between roof opening panel motor C920-5, circuit 1173 (BN/OG), harness side and roof opening panel switch C912/C9001-4, circuit 1173 (BN/OG), harness side.  A0040942 • **Is the resistance less than 5 ohms?**	**Yes** GO to E8. **No** REPAIR the circuit. TEST the system for normal operation.
E8 CHECK THE ROOF OPENING PANEL SWITCH	
• Test the roof opening panel switch. Refer to the component test in this section. • **Is the roof opening panel switch OK?**	**Yes** INSTALL a new roof opening panel motor. REFER to Roof Opening Panel Motor in this section. TEST the system for normal operation. **No** INSTALL a new roof opening panel switch. TEST the system for normal operation.

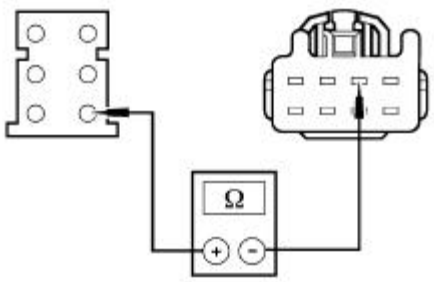
PINPOINT TEST F: THE ROOF OPENING PANEL DOES NOT OPEN OR CLOSE — ONE DIRECTION ONLY

Test Step	Result / Action to Take
F1 CHECK THE ROOF OPENING PANEL SWITCH	
• Disconnect: Roof Opening Panel Switch C912 (Expedition)/C9001 (Navigator). • Test the roof opening panel switch. Refer to the component test in this section. • **Is the roof opening panel switch OK?**	**Yes** GO to F2 . **No** INSTALL a new roof opening panel switch. TEST the system for normal operation.
F2 CHECK CIRCUIT 1174 (WH/RD) FOR AN OPEN	
• Disconnect: Roof Opening Panel Motor C920. • On Navigator, measure the resistance between roof opening panel motor C920-2, circuit 1174 (WH/RD), harness side and roof opening panel switch C9001-7, circuit 1174 (WH/RD), harness side.  A0040944 • On Expedition, measure the resistance between roof opening panel motor C920-2, circuit 1174 (WH/RD), harness side and roof opening panel switch C912-6, circuit 1174 (WH/RD), harness side.  A0040943 • **Is the resistance less than 5 ohms?**	**Yes** GO to F3 . **No** REPAIR the circuit. TEST the system for normal operation.
F3 CHECK CIRCUIT 1175 (TN/RD) FOR AN OPEN	
• On Navigator, measure the resistance between roof opening panel motor C920-3, circuit 1175 (TN/RD), harness side and roof opening panel switch C9001-3, circuit 1175 (TN/RD), harness side.	**Yes** INSTALL a new roof opening panel motor. TEST the system for normal operation. **No** REPAIR the circuit. TEST the system for normal operation.



A0040945

- On Expedition, measure the resistance between roof opening panel motor C920-3, circuit 1175 (TN/RD), harness side and roof opening panel switch C912-2, circuit 1175 (TN/RD), harness side.



A0040946

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

Component Test

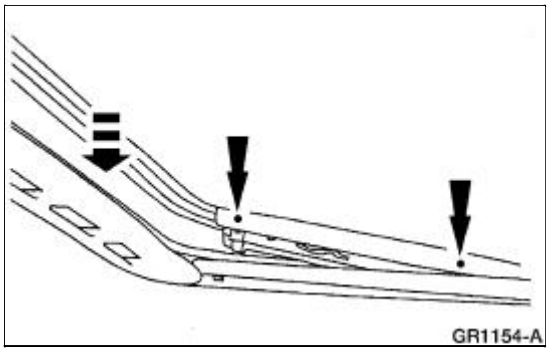
Switch

Measure the resistance between the following roof opening panel switch C912 (Expedition)/C9001 (Navigator) pins (component side) as follows:

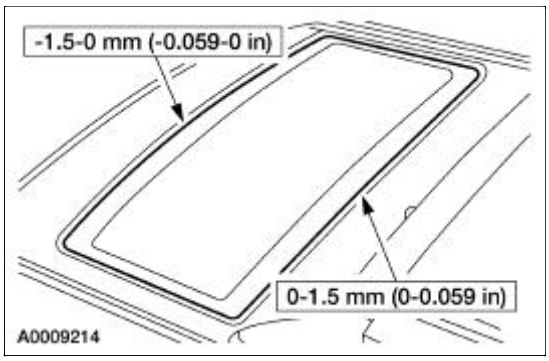
Switch position	Pin	Resistance value
Off	2 and 4, 4 and 6 for Expedition. 3 and 4, 4 and 7 for Navigator.	Greater than 10,000 ohms.
Up or Closed	4 and 2 for Expedition. 4 and 3 for Navigator.	Less than 5 ohms.
Down or Open	6 and 4 for Expedition. 7 and 4 for Navigator.	Less than 5 ohms.

Roof Opening Panel Alignment

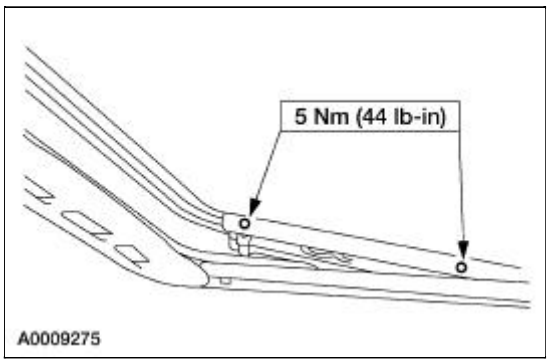
1. Loosen the four roof opening panel bolts.



2. Position the roof opening panel to the roof panel as specified.



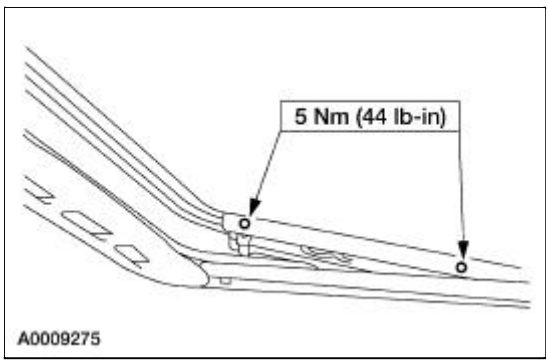
3. Maintain the roof opening panel position and tighten the four roof opening panel bolts.



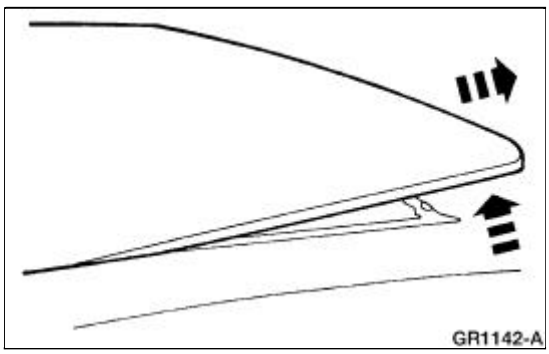
Roof Opening Panel

Removal and Installation

1. Remove the four roof opening panel bolts.



2. Remove the roof opening panel from the outside of the vehicle by lifting up and out.



3. To install, reverse the removal procedure.
    - If necessary, adjust the roof opening panel. For additional information, refer to Roof Opening Panel Alignment in this section.

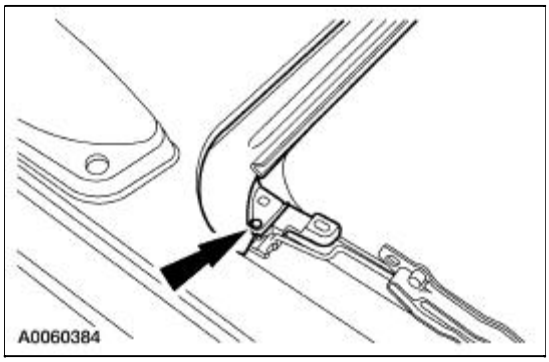
Roof Opening Panel Rear Trough Guide

Removal and Installation

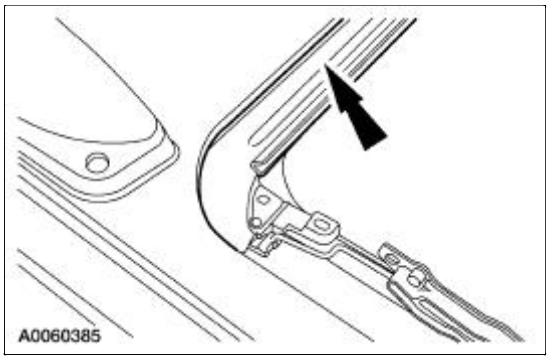
1. **NOTE:** This procedure does not pertain to vehicles built before October 1999.

   Remove the roof opening panel. For additional information, refer to Roof Opening Panel in this section.

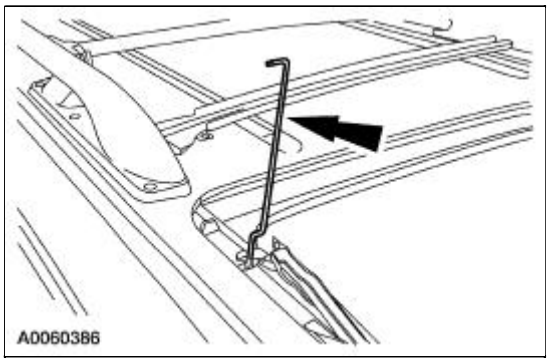
2. Remove the two trough guide retaining screws.



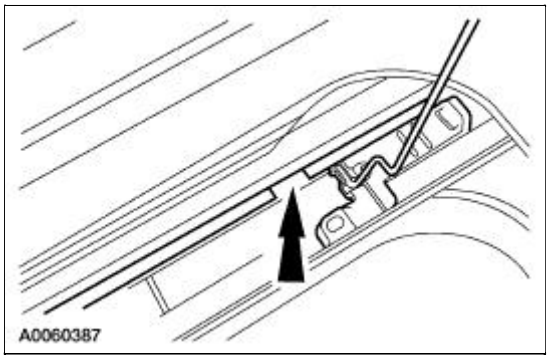
3. Remove the trough from the trough guide assembly.



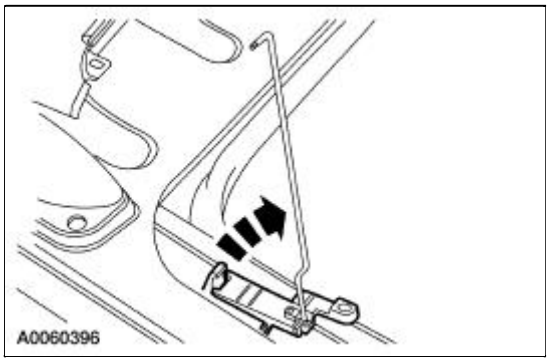
4. Disconnect the trough guide rods from the lifter arm assemblies.



5. Slide the trough guide back to the slot (approx. 15 mm [0.6 in]) cut in track.



6. Carefully twist trough guide through the slot in the track to remove.



7. Inspect the trough guide assembly for damage. If damage is found, inspect the track for broken pieces and remove them.

8. To install, reverse the removal procedure.

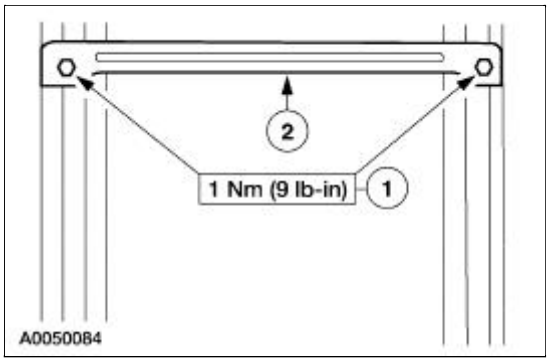
9. If necessary, adjust roof opening panel. For additional information, refer to Roof Opening Panel Alignment in this section.

Roof Opening Panel Shield

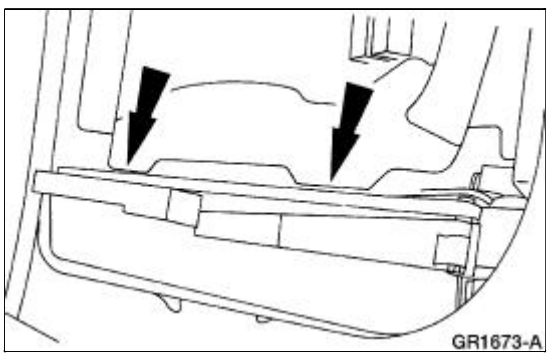
Removal and Installation

1. Remove the roof opening panel. For additional information, refer to Roof Opening Panel in this section.

2. Remove the water trough.
    1. Remove the bolts.
    2. Remove the water trough.



3. Flex the opening shield to remove the guides from the tracks and remove the roof opening panel shield.

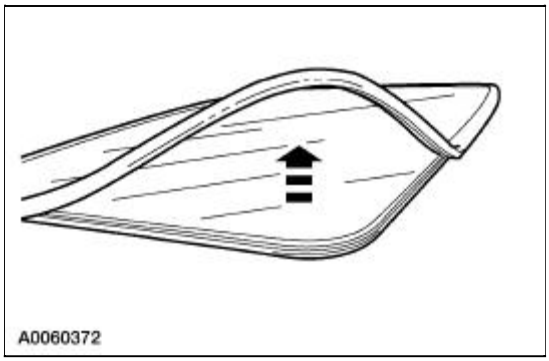


4. To install, reverse the removal procedure.

Roof Opening Panel Weatherstrip

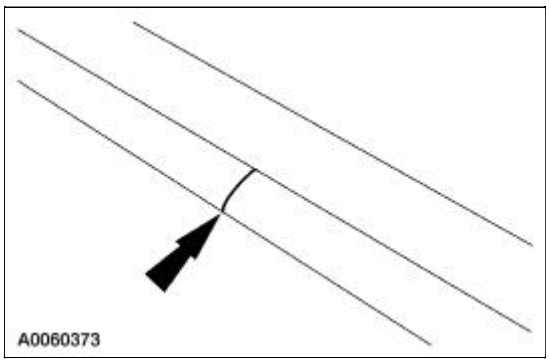
Removal

1. Remove the roof opening panel. For additional information, refer to Roof Opening Panel in this section.
2. Place roof opening panel, topside up, on a worktable. Take care to support the glass assembly from below to prevent damaging the mounting tabs.
3. Remove the old roof opening panel weatherstrip by pulling up on the weatherstrip.



Installation

1. Place a new weatherstrip into position on the glass assembly, with the splice (seam) on the passenger side.

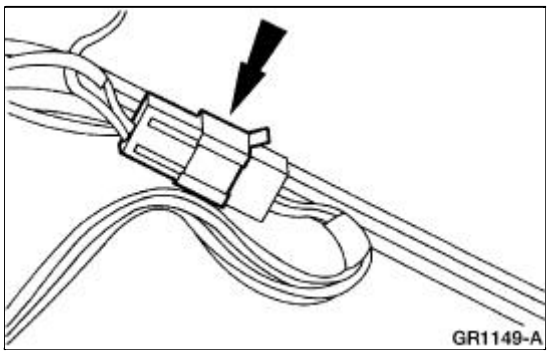


2. Starting with the corners, push the weatherstrip into position. Continue pushing the weatherstrip into position around the glass assembly until complete. Use a plastic or rubber hammer if necessary.
3. Install the roof opening panel. For additional information, refer to Roof Opening Panel in this section.
4. If necessary, adjust the roof panel. For additional information, refer to Roof Opening Panel Alignment in this section.

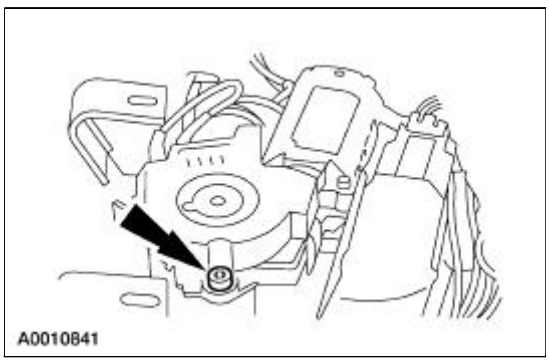
Roof Opening Panel Motor

Removal

1. Remove the headliner. For additional information, refer to Section 501-05 .
2. Disconnect the roof opening panel motor electrical connector.

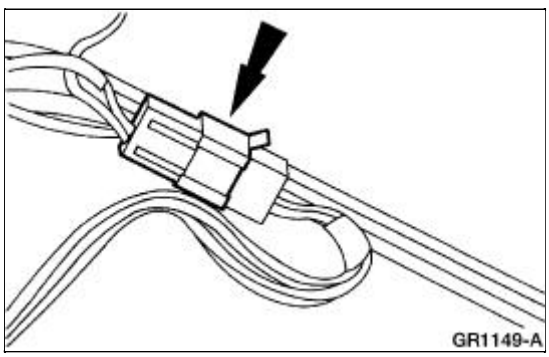


3. Remove the roof opening panel motor.
   - Remove the three bolts.

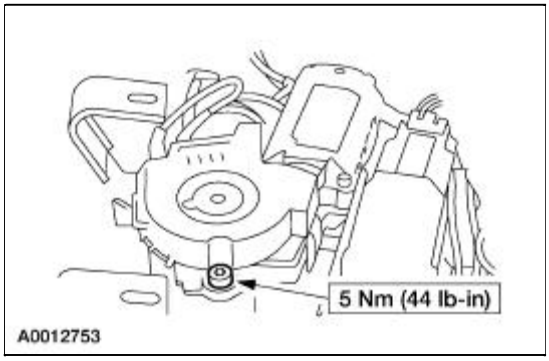


Installation

1. Make sure the roof opening panel is in the closed position.
2. Connect the roof opening panel motor electrical connector.



3. Cycle the roof opening panel motor until it stops in the closed position.
4. Install the roof opening panel motor.
    - Install the three bolts.

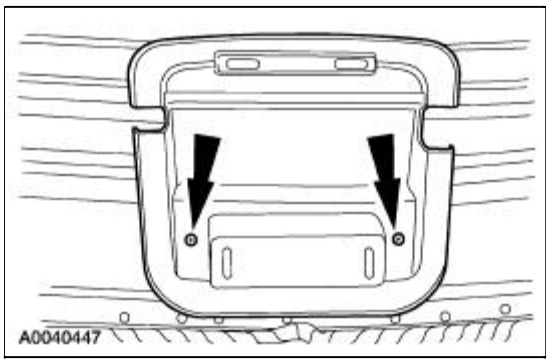


5. Install the headliner. For additional information, refer to Section 501-05 .

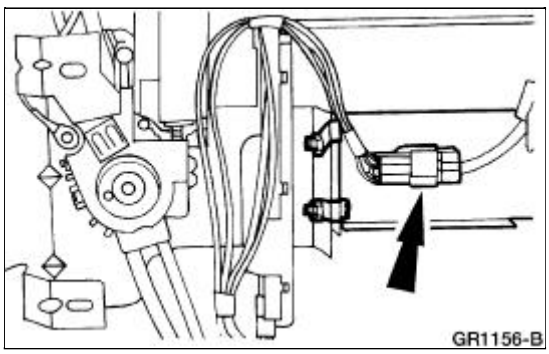
Roof Opening Panel Frame

Removal and Installation

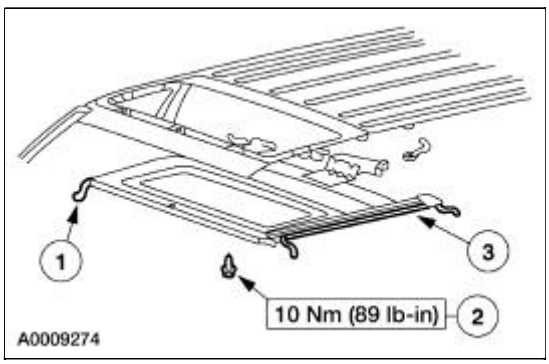
1. Remove the headliner. For additional information, refer to Section 501-05 .
2. Remove the overhead console bracket.
   - Remove the screws.



3. Disconnect the electrical connector.



4. Remove the roof opening panel frame.
   1. Disconnect the four roof opening panel drain hoses.
   2. Remove the nine bolts.
   3. Remove the roof opening panel frame.

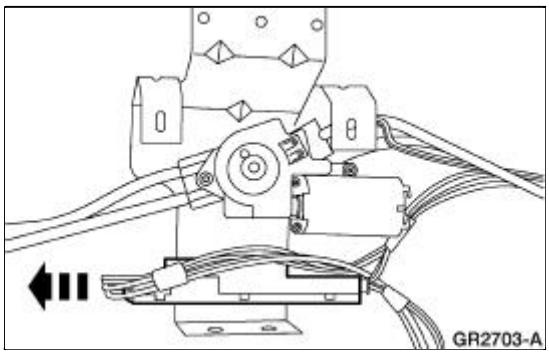


5. To install, reverse the removal procedure.

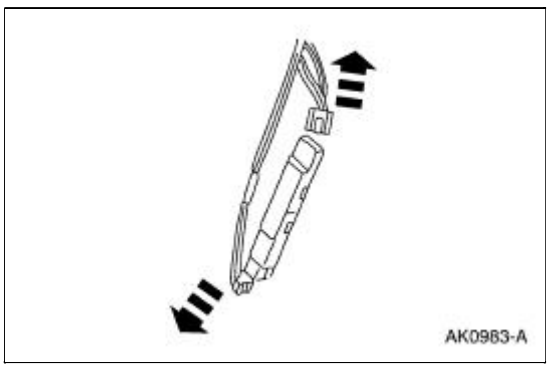
Roof Opening Panel Module

Removal and Installation

1. Remove the headliner. For additional information, refer to Section 501-05 .
2. Slide the roof opening panel module from the retaining bracket.



3. Disconnect the electrical connectors and remove the roof opening panel module.



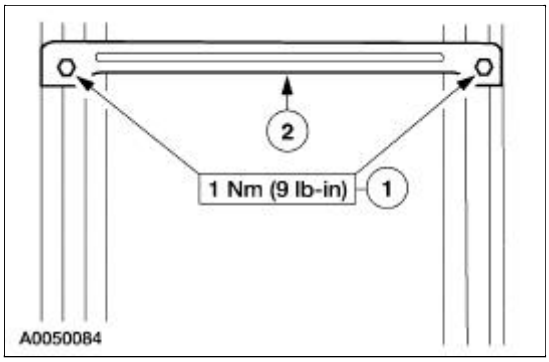
4. To install, reverse the removal procedure.

Drive Cables and Guide Rails

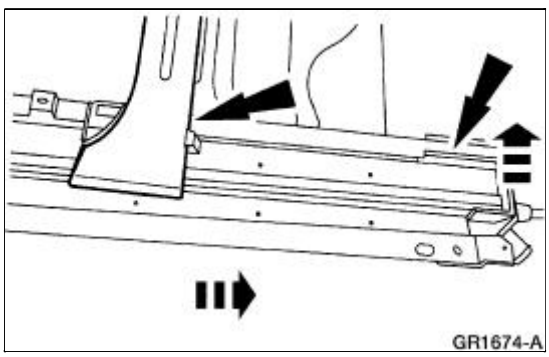
Disassembly and Assembly

1. Remove the roof opening panel frame. For additional information, refer to Roof Opening Panel Frame in this section.

2. Remove the roof opening panel water trough.
   1. Remove the bolts.
   2. Remove the roof opening panel water trough.



3. Remove the roof opening panel water trough guide by sliding it back and lifting it outward at the notch in the roof opening panel tracks.



4. To assemble, reverse the disassembly procedure.

Torque Specifications

Description	Nm	lb-ft	lb-in
Fender splash shield screws	3	—	27
Bumper cover to fender bolts	8	—	71
Bumper cover torx bolts	3	—	27
Rear bumper cover nuts and bolts	8	—	71
Front bumper nuts	90	66	—

Bumpers

The bumper components consist of the following:

- front bumper
- front bumper cover
- grille (Expedition)
- foam
- fog lamps (if equipped)
- rear bumper cover hitch cover
- rear bumper cover
- step pad

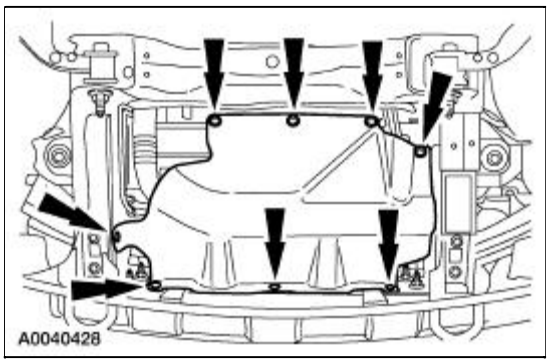
The trailer hitch is the rear bumper. For additional information on removal and installation, refer to Section 502-02 .

Front Bumper Cover

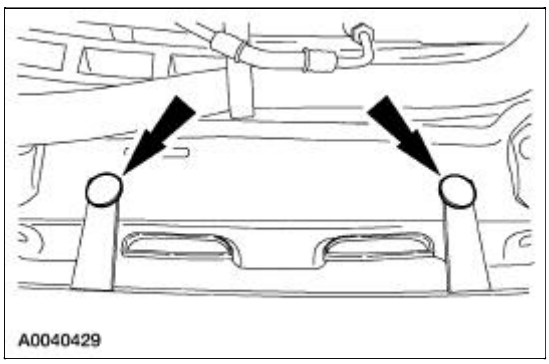
Removal and Installation

All vehicles

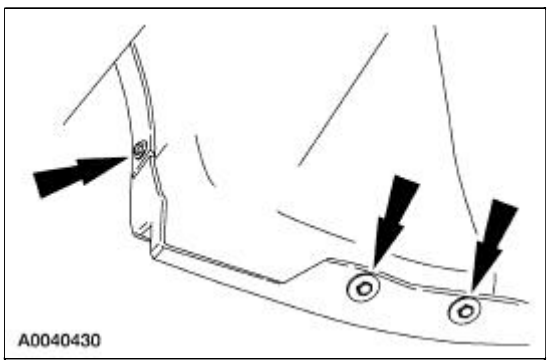
1. Remove the lower air deflector.
   - Remove the pin-type retainers.



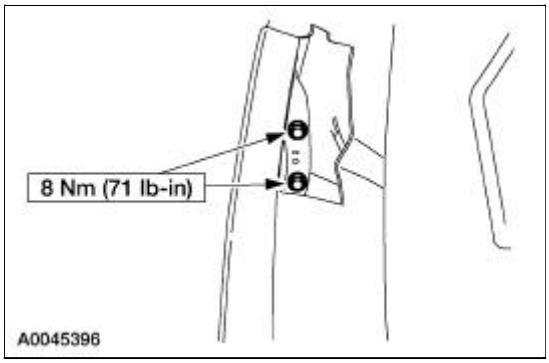
2. Remove the front bumper cover lower pin-type retainers.



3. Remove the front fender splash shield screws.

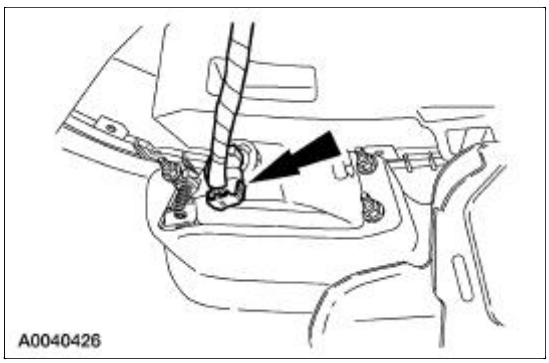


4. Remove the front fender to front bumper cover bolts.

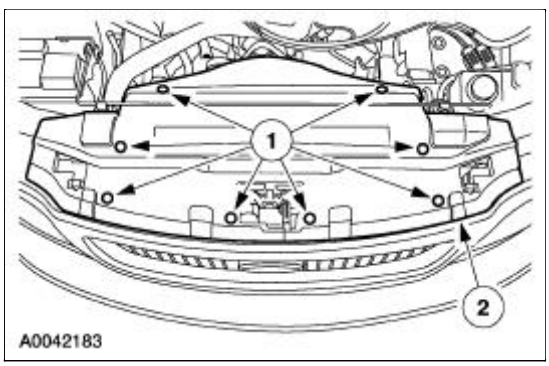


Expedition

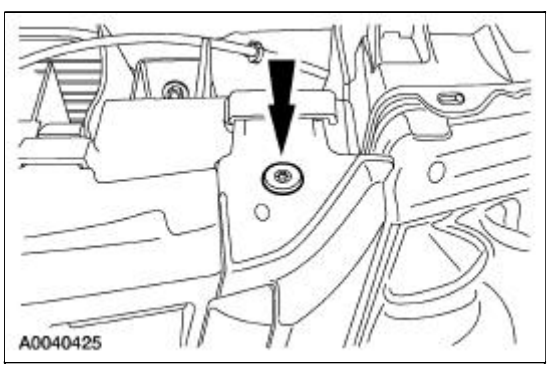
5. Disconnect the fog lamp electrical connectors.



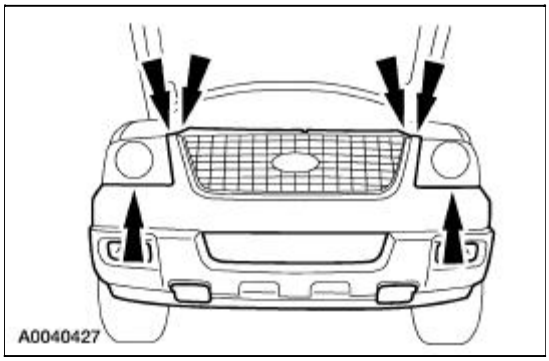
6. Remove the upper air deflector.
    1. Remove the pin-type retainers.
    2. Remove the upper air deflector.



7. Remove the two torx bolts.

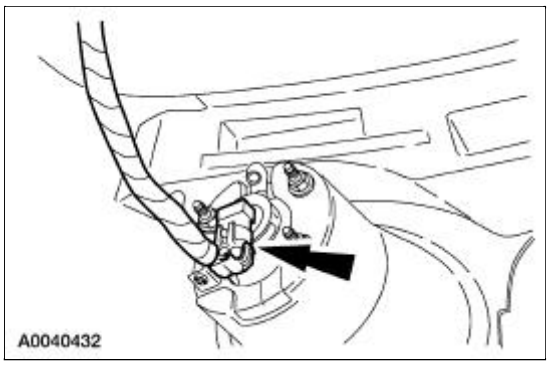


8. Release the front bumper cover clips and remove the front bumper cover.

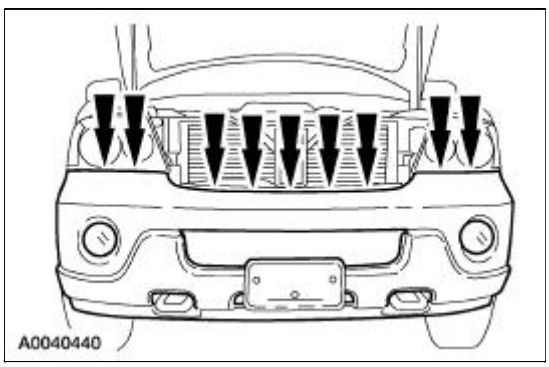


Navigator

9. Disconnect the fog lamp electrical connectors.



10. Release the front bumper cover clips and remove the front bumper.



All vehicles

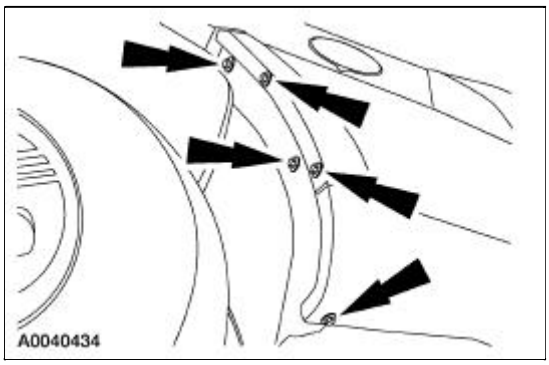
11. To install, reverse the removal procedure.

Rear Bumper Cover

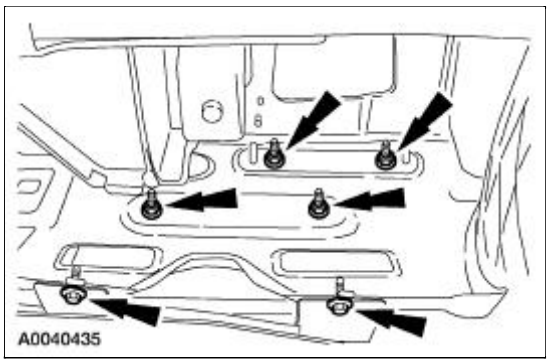
Removal and Installation

NOTE: Navigator shown, Expedition similar.

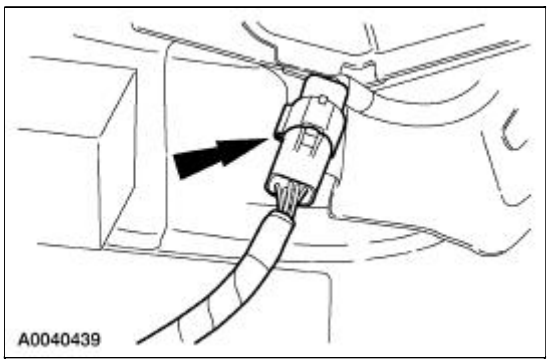
1. Remove the rear fender splash shield bolts.



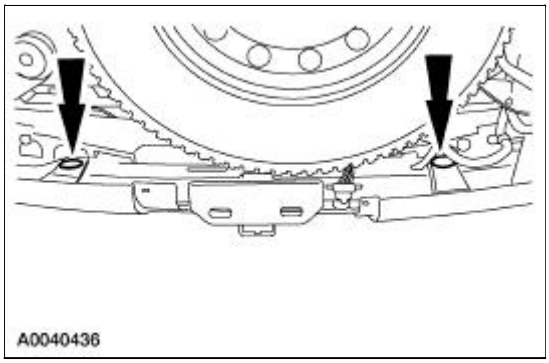
2. Remove the rear bumper cover nuts and bolts.



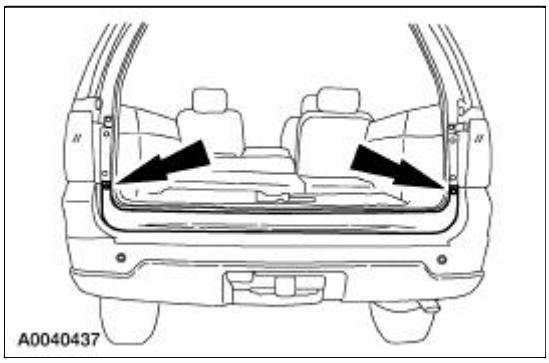
3. If equipped, disconnect the reverse parking aid electrical connector.



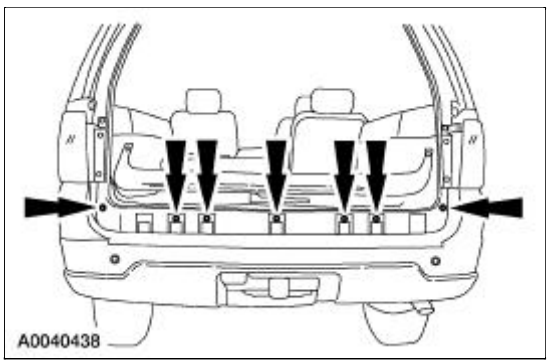
4. Remove the rear bumper cover lower pin-type retainers.



5. Remove the liftgate trim.
    - Remove the pin-type retainers.



6. Remove the rear bumper cover.
    - Remove the pin-type retainers and bolts.

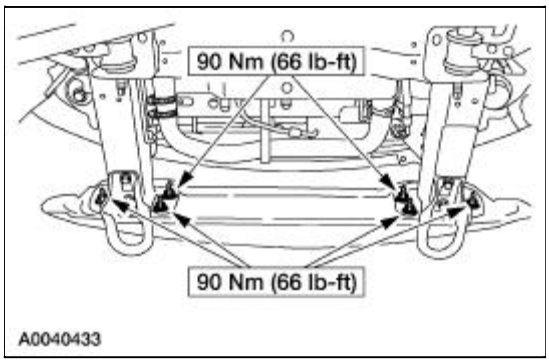


7. To install, reverse the removal procedure.

Bumper

Removal and Installation

1. Remove the front bumper cover. For additional information, refer to Front Bumper Cover in this section.
2. Remove the front bumper.
   - Remove the bolts.



3. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-ft	lb-in
Driver air bag module	9	—	80
Front center safety belt buckle-to-seat-riser bolt	51	38	—
Front center safety belt-to-floor bolt	40	30	—
Safety belt guide bolt	40	30	—
Safety belt guide nut	40	30	—
Safety belt retractor bolt	40	30	—
Second and third row seat screws	3	—	27
Second and third row center safety belt anchor bolt-to-seat	40	30	—
Safety belt shoulder height adjuster bolt	40	30	—
Safety belt buckle and pretensioner bolt	40	30	—
Safety belt buckle-to-seat bolts	40	30	—
Safety belt buckle-to-seat nuts	40	30	—
Safety belt anchor-to-floor	40	30	—
Third row 60 percent backrest handle release screws	3	—	27
Third row child safety seat tether anchor bolt	28	21	—

Safety Belt System

WARNING: All safety belt assemblies including retractors, buckles, front seat belt buckle support assemblies (slide bar), shoulder belt height adjusters, child safety seat tether attachments (if equipped), and attaching hardware should be inspected after any collision. All belt assemblies should be replaced unless a qualified technician finds that the assemblies show no damage and operate correctly. Belt assemblies not in use during a collision should also be inspected and replaced if either damage or incorrect operation is noted.

WARNING: Each seating position in the vehicle has a specific safety belt assembly which consists of one buckle and one tongue. The safety belt assembly is designed to be used as a pair and is not to be used across seating positions.

WARNING: Rear facing child seats or infant carriers should never be placed in the front seats. If you must use a forward facing child seat, move the seat all the way back.

All outboard safety belts, and second and third row center safety belts (if equipped) are continuous-loop, three-point systems. The combination lap and shoulder belt (continuous-loop) uses a common slip tongue and retractor.

The shoulder harness retractor is designed to let the webbing move freely in and out at all times, except during vehicle hard braking, hard cornering or impact of 8 km/h (5 mph) or more, when it is automatically locked by a mechanically actuated inertia sensor.

When replacing safety belt buckles and/or retractor assemblies, use only the replacement parts specified in the Ford Customer Service Division Master Parts and Accessories Catalog.

Active Restraint System Components

The active restraint system consists of the following components in the locations described.

- Driver and front row outboard passenger safety belt buckle pretensioners, attached to the front seats.
- Front row outboard safety belt retractor, attached to the B-pillar sheet metal behind the trim panel.
- Front row center safety belt, with 60/40 bench seat, attached on top of the rear inboard 60 percent seat riser.
- Front row center safety belt buckle, with 60/40 bench seat, attached to the floor pan behind the 60 percent seat.
- Front row safety belt shoulder height adjuster, attached to the B-pillar sheet metal behind the trim panel.
- Second row outboard safety belt retractor, attached to the quarter panel sheet metal behind the trim panel.
- Second row inboard safety belt retractor, with 20 percent seat, attached to the seat backrest frame.
- Second row inboard safety belt buckle, with 20 percent seat, attached to the side of the seat.

- Second row outboard safety belt buckle, attached to the side of the seat.
- Second row safety belt shoulder height adjuster, attached to the C-pillar sheet metal behind the trim panel.
- Second row 40/20/40 seating, having child safety seat tether anchors welded to the seat cushion frame at all seating positions.
- Second row 40 percent bucket seats, having child safety seat tether anchors welded to the seat cushion frame at both seating positions.
- Second row 40/20/40 seating, having LATCH welded to the seat at all three seating positions.
- Second row 40 percent bucket seats, having LATCH welded to the seat cushion frame at both seating positions.
- Third row outboard safety belt retractor, attached to the D-pillar sheet metal behind the trim panel.
- Third row inboard safety belt retractor, attached to the 60 percent seat backrest frame.
- Third row RH safety belt buckle, attached to the side of the seat.
- Third row LH and center safety belt buckle assembly, attached to the floor pan under the 60 percent third row seat.
- Third row center child safety seat tether anchor, bolted to the 60 percent seat backrest frame.

Pretensioner System

All Expeditions and Navigators have a pretensioner system used with the front outboard safety belt buckles. This works in conjunction with the front air bag system mounted in the steering wheel and instrument panel.

If the vehicle is involved in a collision that results in deployment of the front air bags and safety belt pretensioners, the driver and passenger seat belt system (including safety belt buckle and pretensioners, safety belt retractors, and height adjusters), must be replaced.

For diagnostic information, refer to Section 501-20B.

For pretensioner buckle disposal information, refer to Section 501-20B.

Safety Belt Buckle and Pretensioner

The safety belt buckle and pretensioners are for the front outboard occupants, located on the inboard side of the seats. This allows the front safety belt buckle end to move with the front seat.

The safety belt buckle and pretensioner is a pyrotechnic device that removes excess webbing from the safety belt system. When the front air bag system is deployed, the pretensioner in the buckle deploys, causing the buckle to move downward, pulling excess webbing from the lap and shoulder safety belts.

Dual Locking Mode Retractors

WARNING: After any vehicle collision, the safety belt system at all outboard seating positions (except driver, which has no "automatic locking retractor" feature) must be checked by a qualified technician to verify that the "automatic locking retractor" feature for child seats is still functioning correctly, in addition to other checks for correct safety belt system function.

A belt and retractor assembly must be replaced if the safety belt assembly's "automatic locking retractor" feature or any other safety belt function is not operating correctly when checked according to the procedures in the workshop manual. Failure to replace the Belt and Retractor assembly could increase the risk of injury in collisions.

NOTE: When replacing a dual locking mode retractor, the retractor should be checked to make sure it is not in the automatic locking retractor (ALR) mode after installation in the stowed position.

All outboard continuous-loop, three-point retractor systems, except the driver position, are equipped with the dual locking mode system.

The emergency locking retractor (ELR) mode will allow the occupant freedom of movement, locking tight only on hard braking, hard cornering, or an impact of approximately 8 km/h (5 mph). The ELR mode helps to reduce the forward movement of the driver and passengers. The ELR mode is continuously in operation at all seating positions.

The ALR portion of this system does not allow the occupant freedom of movement. The ALR mode is used when locking a child seat in at a seating position or when a tight belt fit is desired. The ALR mode is automatically engaged when the webbing is fully extracted from the retractor and then allowed to retract. As the webbing is retracted back onto the spool, an audible clicking sound is made, indicating that the retractor is in ALR mode. The ALR mode is automatically disengaged when most of the webbing is retracted back onto the spool.

The automatic locking mode must be used when installing a child safety seat in the front or rear passenger seating positions where dual locking mode retractors are provided.

Energy Management Retractor

This vehicle has a safety belt system with an energy management feature at the front seating positions to help further reduce the risk of injury in the event of a head-on collision.

The energy management retractor feature is designed to pay out webbing in a controlled manner. This feature is designed to help reduce the belt force acting on the occupant's chest.

Fastening Safety Belts

 **WARNING: Do not introduce slack into the safety belt system because the belt locks upon impact where it is positioned. Use the shoulder safety belt on the outside shoulder only. Never wear the shoulder safety belt under the arm. Never swing the shoulder safety belt around the neck over the inside shoulder. Never use a single belt for more than one person. Make sure the lap portion of the belt is fitted snugly and as low as possible around the hips, not the waist. Failure to follow these precautions could increase the chance and severity of injury in a collision.**

Always follow the preceding safety precautions when fastening the safety belts.

Safety Belt Extension Assembly

In certain cases, the safety belt may be too short, even when it is fully extended. About 20 cm (8 in) can be added to the belt length by using a safety belt extension. Safety belt extensions are available through any Ford or Lincoln Mercury dealer parts department at no cost. Safety belt extensions are only available with black webbing. There are two extension assemblies available, one for the front seating positions and one for the rear seating positions. They are not interchangeable. Only use

extensions manufactured by the same supplier as the safety belt. Manufacturer identification is located at the end of the webbing on the label. Also, use the safety belt extension only if the safety belt is too short for you when fully extended. Do not use the extension to change the fit of the shoulder belt across the torso.

Attaching Safety Seats With Tether Straps

Some manufacturers make child safety seats that include a tether strap that goes over the back of the vehicle seat and attaches to an anchoring point. Other manufacturers offer the tether strap as an accessory. Contact the manufacturer of the child safety seat for information about ordering a tether strap.

Child safety seat tether anchors are manufactured into the vehicle. See the active restraint system component location at the beginning of this section or the Owners Literature for locations.

For removal and installation of child safety seat tether anchors, refer to the appropriate procedure in this section or Section 501-10 for seat cushion frame replacement.

Lower Anchors and Tethers for Children (LATCH)

The lower anchors and tethers for children (LATCH) system is a standardized and uniform attachment system for installing child safety seats in passenger vehicles. LATCH-equipped child safety seats have two lower attachments that connect to the vehicle portion of the LATCH system.

The vehicle portion of the system consists of two attachment points (6mm wires) welded to the rear seat cushion frame. The attachment points protrude from the bite line between the seat cushion and seat backrest.

If a child safety seat was in use during a collision, inspect the vehicle portion of the system for damage. If any of the attachment points (6mm wires) are damaged, install a new seat cushion frame.

Warning System — Driver Safety Belt

The driver safety belt incorporates a safety belt warning indicator switch, warning indicator and chime. The warning indicator and chime are reminders to fasten the safety belt.

- If the driver safety belt is not buckled before the ignition key is turned to ON, the safety belt warning light illuminates for one to two minutes and the warning chime sounds for four to eight seconds.
- If the driver side safety belt is buckled while the indicator light is illuminated and the warning chime is sounding, the safety belt warning light and warning chime turn off.
- If the safety belt is buckled before the key is turned to the ON position, the warning indicator will come on for four to eight seconds with no chime.

Belt Minder (if equipped)

The Belt Minder feature is a supplemental warning to the safety belt warning function. This feature provides additional reminders to the driver that the driver's safety belt is unbuckled by intermittently sounding a chime and illuminating the safety belt warning lamp in the instrument cluster.

If...	Then...
The driver's safety belt is not buckled approximately 5 seconds after the safety belt warning light has turned off...	The Belt Minder feature is activated — the safety belt warning light illuminates and the warning chime sounds for 6 seconds every 30 seconds, repeating for approximately 5 minutes or until safety belt is buckled.
The driver's safety belt is buckled while the safety belt indicator light is illuminated and the safety belt warning chime is sounding...	The Belt Minder feature will not activate.
The driver's safety belt is buckled before the ignition switch is turned to the ON position...	The Belt Minder feature will not activate.

Safety Belt System

Inspection and Verification

1. Verify the customer's concern by operating the active restraint system to duplicate the condition.
2. Inspect to determine if any of the following mechanical or electrical concerns apply:

Visual Inspection Chart

Mechanical	Electrical
● Safety belt webbing integrity ● Safety belt buckle and tongue assembly ● Safety belt retractor	● Open fuse ● Bare, broken or disconnected wire ● Connector not tightly engaged ● Safety belt warning indicator lamp burned out or broken

3. If the inspection reveals an obvious concern(s) that can be readily identified, service as required. With the exception of removing a twist from the safety belt webbing, do not attempt to repair a component of the safety belt system; new components must be installed.
4. If the concern remains after the inspection, determine the symptom. GO to Symptom Chart .
5. To check the active restraint system for correct operation, carry out the appropriate Functional Test(s).

Symptom Chart

SYMPTOM CHART

Condition	Possible Sources	Action
● The safety belt warning indicator lamp does not operate, the safety belt warning chime is OK	● Burned-out bulb. ● Circuitry. ● Instrument cluster.	● REFER to Section 413-01 .
● Neither the safety belt warning chime nor the safety belt warning indicator lamp operates	● Safety belt switch. ● Lighting control module. ● Restraint control module. ● Circuitry.	● REFER to Section 501-20B .

• Excessive pressure on the occupant during normal wear, the webbing cannot be extracted, excessive slack in webbing does not retract	• Front safety belt retractor and tongue. • Rear safety belt retractor and tongue.	• CARRY out the component Functional Test in this section. INSTALL a new retractor if necessary.

Component Test

Carry out the appropriate Functional Test(s) as determined in Inspection and Verification.

Functional Test I (Buckle and Tongue)

The safety belt buckle and tongue assembly must operate freely during the latching and unlatching function. Fasten the safety belt by inserting the tongue (male portion) into the buckle (female portion).

1. Verify the following during the latching sequence:
   - Tongue insertion is not hindered by excessive effort.
   - A "click" is heard when the buckle latches the tongue.
2. Verify the system integrity by forcefully pulling on the belt webbing.
3. Unlatch the belt by fully depressing the buckle release button, and allowing the belt to release and retract.
4. Verify the following during the unlatching process:
   - Push-button depression does not require excessive effort.
   - Tongue can be removed easily from the buckle.
   - Repeat the above steps three times.
5. If the inspection reveals an obvious concern(s) that can be readily identified, service as required. Do not attempt to perform any repair on the buckle and tongue assembly. If a concern exists with either component, a new safety belt buckle and safety belt and retractor assembly must be installed.

Functional Test II (Retractor)

The safety belt and retractor assembly must be freely operational for extraction and retraction of the safety belt webbing between full extension and in-vehicle stowed positions.

1. Extract and retract the safety belt between the full extension and stowed positions.
2. Verify the retractor operates without excessive effort or binding.
3. Install a new safety belt buckle retractor and tongue assembly if no obvious concerns are noticed and the complaint has been verified.

Functional Test III (System Road Test Inspection)

1. **NOTE:** If the RH or the rear safety belts are to be tested, a passenger must be used.

   Fasten the safety belts and proceed to a safe area.

2. Attain a speed of 8 km/h (5 mph).

3. **WARNING: The driver and passenger must be prepared to brace themselves if the retractor does not lock.**

   Test the safety belts.
   1. Grasp the shoulder harness and prepare to lean forward.
   2. **WARNING: The maximum brake application should be on dry concrete or equivalent hard surface, NEVER on wet pavement or gravel.**

      WARNING: The driver and passenger must be prepared to brace themselves in the event the retractor does not lock.

      NOTE: Do not jerk on the safety belt webbing when carrying out this test. Lean forward slightly when the brake application is made.

      Make a maximum brake application without a skid.

4. The safety belts should lock up with minimum webbing extension.

5. If there is a lockup of both shoulder straps, the safety belt assemblies are functioning correctly. Should either or both retractors fail to lock up at the 8 km/h (5 mph) speed, repeat the test at a constant 24 km/h (15 mph) speed. (This test must be carried out with a RH front or rear passenger if the RH front or rear outboard safety belts are to be tested).

6. **CAUTION: Before installing a new safety belt assembly, inspect the mounting area for damage and distortion. If the retractor of a new safety belt assembly has been bolted into a damaged or distorted mounting area, the retractor could be warped and may not function. If this is the case, remove the retractor, return the sheet metal to the original configuration and install another complete safety belt assembly.**

   If either or both retractors do not lock up at the 24 km/h (15 mph) test, return the vehicle for service of malfunctioning safety belts.

Functional Test IV (Automatic Locking Retractor)

WARNING: After any vehicle collision, the safety belt system at all outboard seating positions (except driver, which has no "automatic locking retractor" feature) must be checked by a qualified technician to verify that the "automatic locking" feature for child seats is still functioning correctly, in addition to other checks for correct safety belt system function. A safety belt and retractor assembly must be replaced if the safety belt assembly's "automatic locking retractor" feature or any other safety belt function is not operating correctly when checked according to the procedures in the workshop manual. Failure to replace the safety belt and retractor assembly could increase the risk of injury in collisions.

1. Position the seat back into the full up position.

2. Position the height adjuster in the full down or up position.

3. Latch the seat belt buckle and tongue assembly.

4. Pull the shoulder belt out until the automatic locking retractor (ALR) feature is activated.

5. Release the shoulder belt and allow it to retract until it stops.

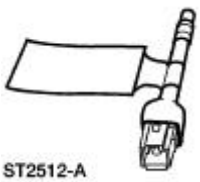
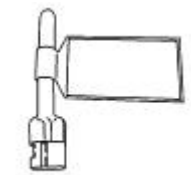
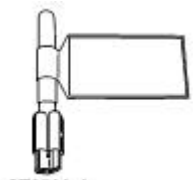
6. Pull on the shoulder belt to check that the belt has remained in the ALR mode. If the belt is not locked, install a new safety belt and retractor assembly.

7. Unlatch the safety belt tongue from the buckle and allow the safety belt to retract to its stowed position.

8. Pull the shoulder belt to verify the retractor assembly has converted automatically out of the ALR mode. If the shoulder belt remains locked in the stowed position, install a new safety belt and retractor assembly.

Supplemental Restraint System (SRS) Deactivation and Reactivation

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (2 req'd) 418-F395 (014-R1079)
 ST2512-A	Diagnostic Tool, Restraint System (1 req'd) 418-F403
 ST2507-A	Diagnostic Tool, Restraint System (2 req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 req'd) 418-F088 (105-R0012)

Deactivation

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Do not set a live air bag module down with the trim cover face down. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an airbag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

WARNING: Never probe the connectors on the safety canopy module. Doing so can result in safety canopy module deployment.

WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

WARNING: Restraint system diagnostic tools are for service only. Tools must be removed prior to operating the vehicle over the road. Failure to remove restraint system diagnostic tools could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side air bag and/or a safety belt pretensioner (if equipped) system is being serviced, **the air bag system must be deactivated.**

NOTE: Restraint system diagnostic tools **MUST** be installed under the seats in the seat side air bag (if equipped) and safety belt pretensioner (if equipped) to floor connectors.

NOTE: Diagnostics or repairs are not to be carried out on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road.**

NOTE: After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

All vehicles

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

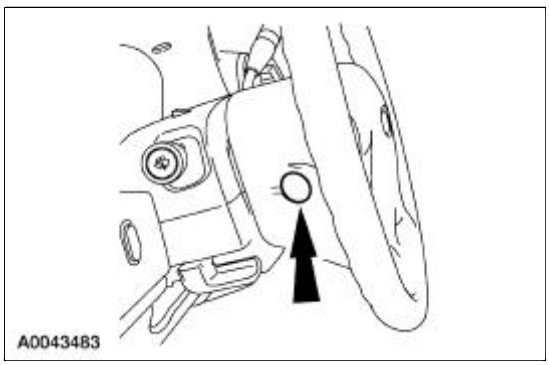
   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

The second row side impact sensors (if equipped) are located at or near the base of the C-pillars.

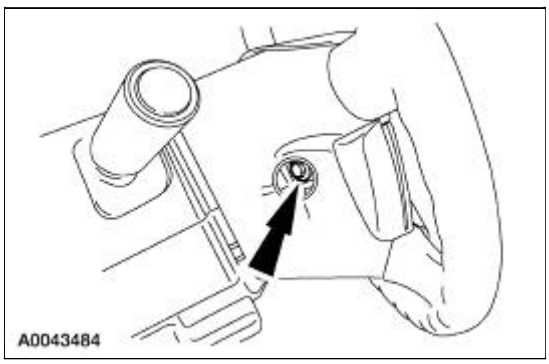
To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

2. Remove the two steering wheel back cover plugs (one shown).

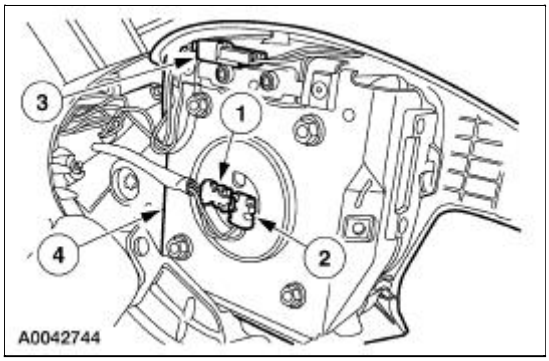


3. Remove the two driver air bag module bolts (one shown).



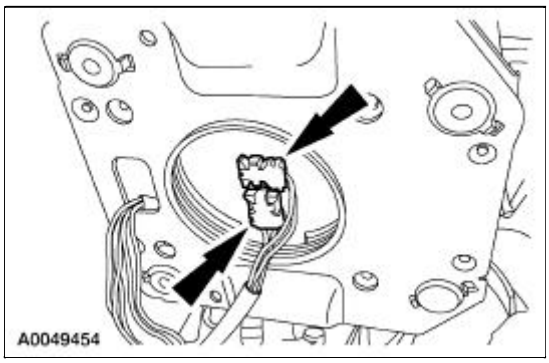
Expedition vehicles

4. Remove the driver air bag module.
    1. Release the two retaining tabs. Disconnect the driver air bag module electrical connector.
        - Label the driver air bag module squib number on the driver air bag module electrical connector before disconnecting.
    2. Release the two retaining tabs. Disconnect the driver air bag module electrical connector.
        - Label the driver air bag module squib number on the driver air bag module electrical connector before disconnecting.
    3. Disconnect the horn switch electrical connector.
    4. Remove the driver air bag module.

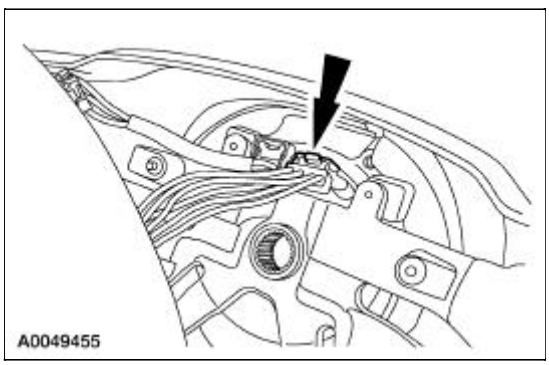


Navigator vehicles

5. Disconnect the driver air bag module
    - Release the two tabs on each driver air bag module electrical connector and disconnect them.
        - Label each driver air bag module electrical connector before disconnecting.

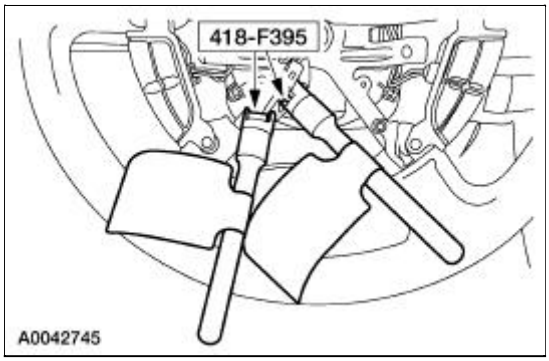


6. Release the tab and disconnect the driver air bag module accessories electrical connector at the top of the clockspring and remove the driver air bag module.

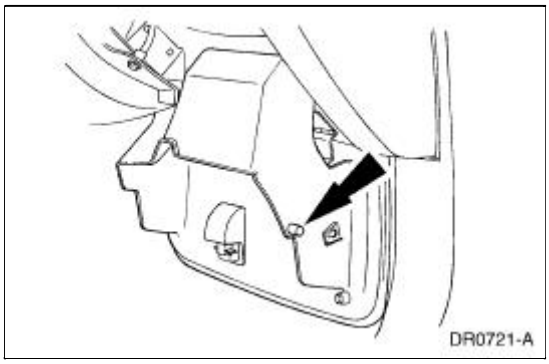


All vehicles

7. Attach the restraint system diagnostic tools to the clockspring electrical connectors at the top of the steering column.

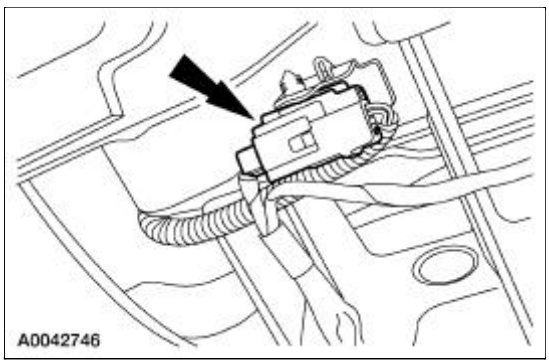


8. While pushing in on the two glove compartment door tabs, position the glove compartment downward.

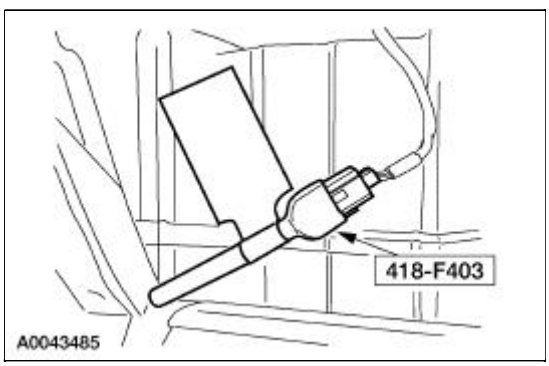


9. **NOTE:** The Expedition is shown, the Navigator is similar.

   Through the glove compartment opening, release the tab and disconnect the passenger air bag module electrical connector.



10. Attach the restraint system diagnostic tool to the vehicle harness side of the passenger air bag module electrical connector.



Vehicles without safety canopies

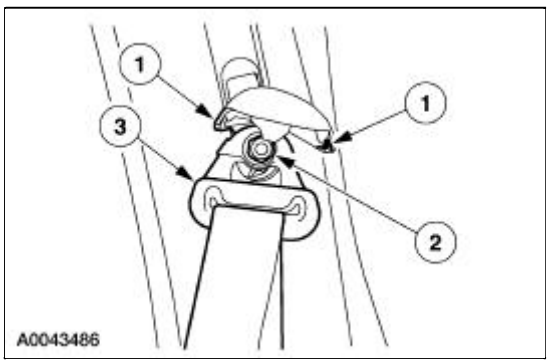
11. **CAUTION: Do not deactivate the safety canopy module circuit by removing the safety canopy bridge resistor from the safety canopy electrical connector.**

    If the safety canopy bridge resistor is removed, an open circuit fault will be generated by the restraints control module (RCM).
    If a restraint system diagnostic tool is installed at the safety canopy electrical connector, a low resistance fault will be generated by the RCM.

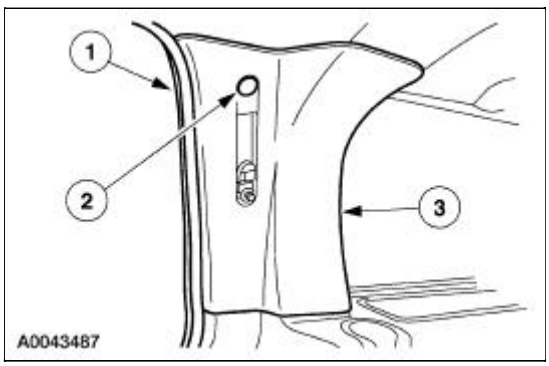
Vehicles with safety canopies

12. **NOTE:** Inspect the shoulder safety belt guide cover for damage. If the shoulder safety belt guide cover is damaged or if it does not remain closed, install a new shoulder safety belt guide cover.

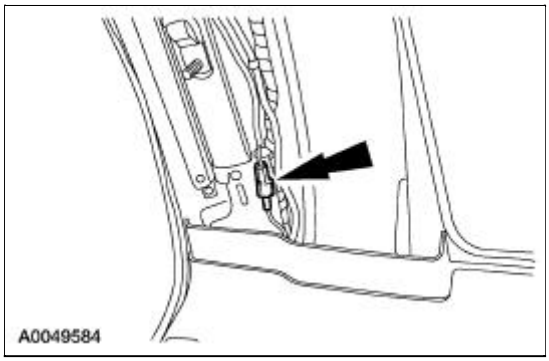
    Remove the second row passenger side safety belt guide.
    1. Release the retaining tab at each side and open the safety belt guide cover.
    2. Remove the nut.
    3. Remove the second row passenger side safety belt guide.



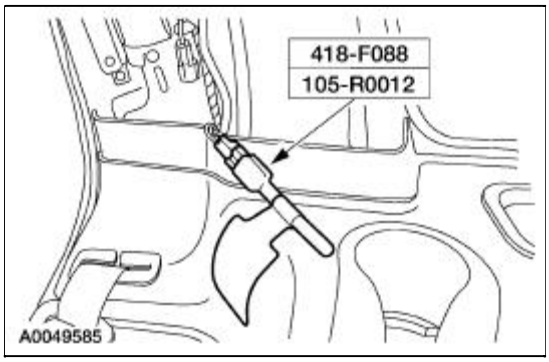
13. Remove the passenger side C-pillar trim panel.
    1. Separate the weather-stripping along the passenger side C-pillar trim panel.
    2. Remove the bolt cover and bolt.
    3. Pull out to release the retainers and remove the passenger side C-pillar trim panel.



14. Disconnect the passenger side safety canopy electrical connector.

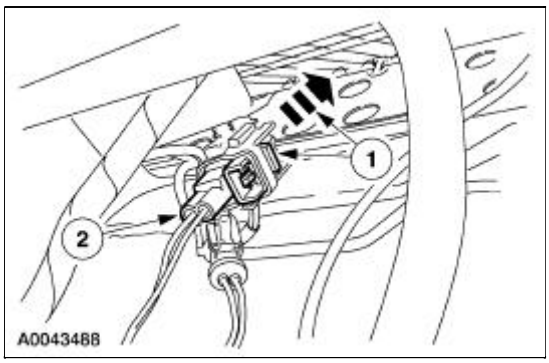


15. Attach the restraint system diagnostic tool to the vehicle harness side of the passenger side safety canopy electrical connector.

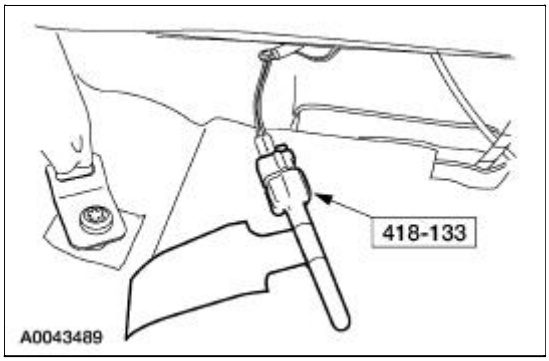


All vehicles

16. Disconnect the passenger seat safety belt buckle pretensioner electrical connector.
    1. Slide and disengage the passenger seat safety belt buckle pretensioner electrical connector locking clip.
    2. Push in to release the tab and disconnect the passenger seat safety belt buckle pretensioner electrical connector.



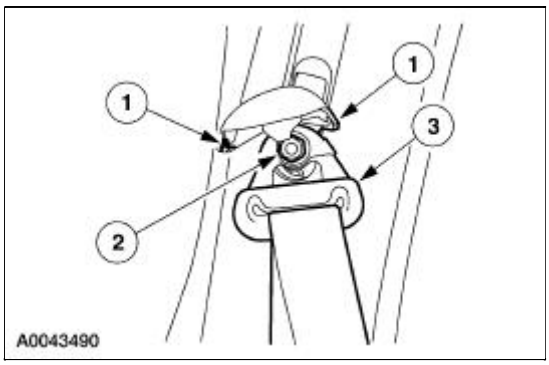
17. Attach the restraint system diagnostic tool to the passenger seat safety belt buckle pretensioner floor electrical connector.



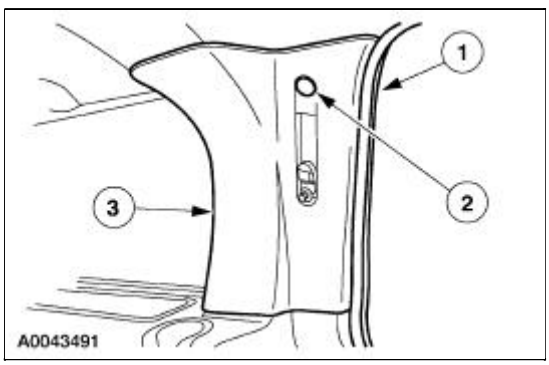
Vehicles with safety canopies

18. **NOTE:** Inspect the shoulder safety belt guide cover for damage. If the shoulder safety belt guide cover is damaged or if it does not remain closed, install a new shoulder safety belt guide cover.

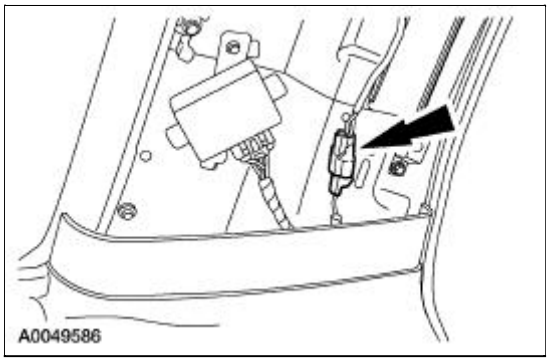
    Remove the second row driver side safety belt guide.
    1. Release the retaining tab at each side and open the safety belt guide cover.
    2. Remove the nut.
    3. Remove the second row driver side safety belt guide.



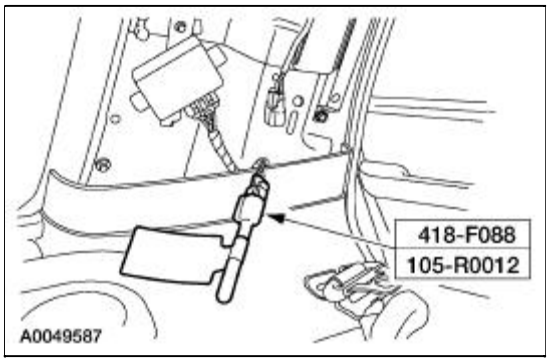
19. Remove the driver side C-pillar trim panel.
    1. Separate the weather-stripping along the driver side C-pillar trim panel.
    2. Remove the bolt cover and bolt.
    3. Pull out to release the retainers and remove the driver side C-pillar trim panel.



20. Disconnect the driver side safety canopy electrical connector.

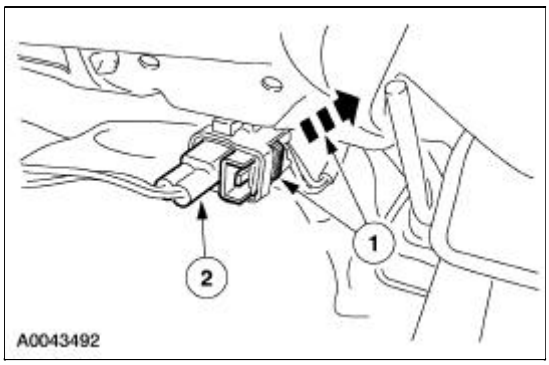


21. Attach the restraint system diagnostic tool to the vehicle harness side of the driver side safety canopy electrical connector.

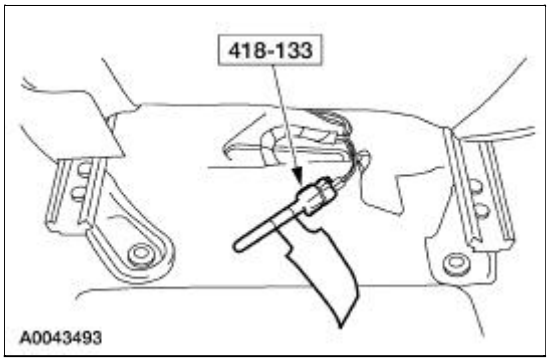


All vehicles

22. Disconnect the driver seat safety belt buckle pretensioner electrical connector.
    1. Slide and disengage the driver seat safety belt buckle pretensioner electrical connector locking clip.
    2. Push in to release the tab and disconnect the driver seat safety belt buckle pretensioner electrical connector.



23. Attach the restraint system diagnostic tool to the driver seat safety belt buckle pretensioner floor electrical connector.



24. Connect the battery ground cable. For additional information, refer to Section 414-01 .

25. With the restraint system diagnostic tools installed at all deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of Section 501-20B .

26. Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

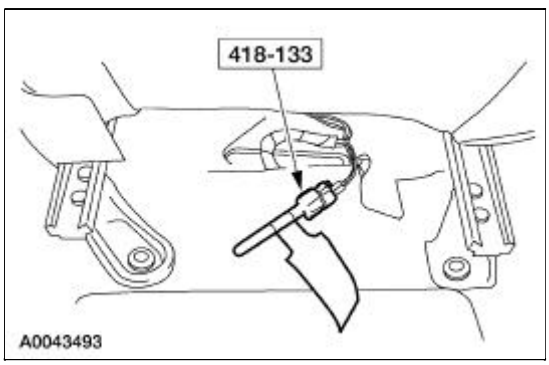
Reactivation

WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the deactivation procedure.

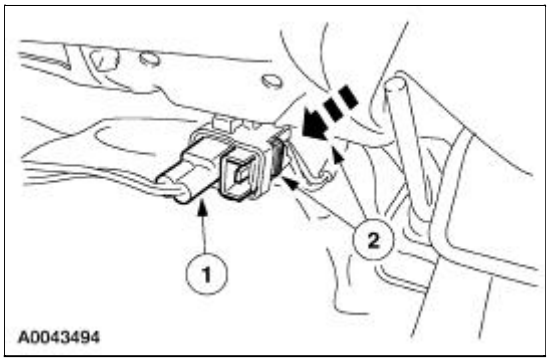
All vehicles

1. **NOTE:** Make sure the battery negative cable is still disconnected before proceeding with the reactivation portion of this procedure.

   Remove the restraint system diagnostic tool from the driver seat safety belt buckle pretensioner floor electrical connector.

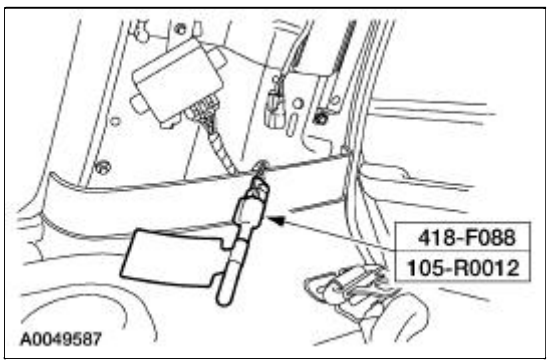


2. Connect the driver seat safety belt buckle pretensioner electrical connector.
   1. Connect the driver seat safety belt buckle pretensioner electrical connector.
   2. Slide and engage the driver seat safety belt buckle pretensioner electrical connector locking clip.

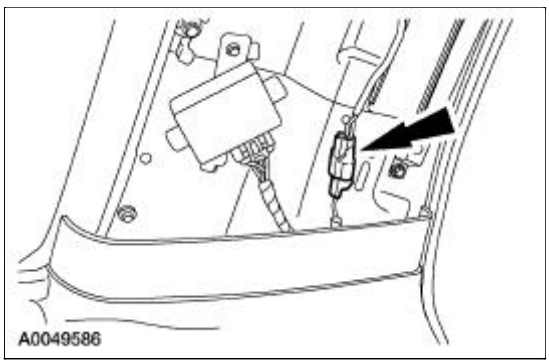


Vehicles with safety canopies

3. Remove the restraint system diagnostic tool from the vehicle harness side of the driver side safety canopy electrical connector.

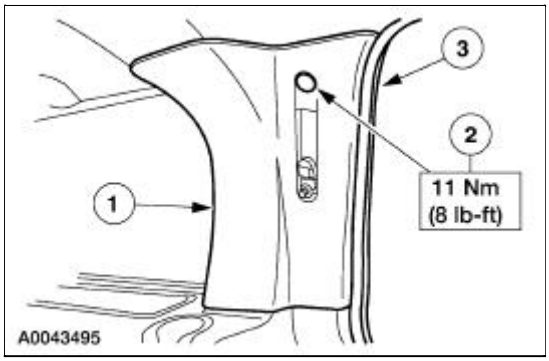


4. Connect the driver side safety canopy electrical connector.



5. **WARNING: Anytime the safety canopy module has deployed, the headliner, and all A, B, and C pillar upper trim panels and attaching hardware must be replaced along with any other damaged components and hardware. Failure to do so may result in personal injury in the event of a safety canopy module deployment.**

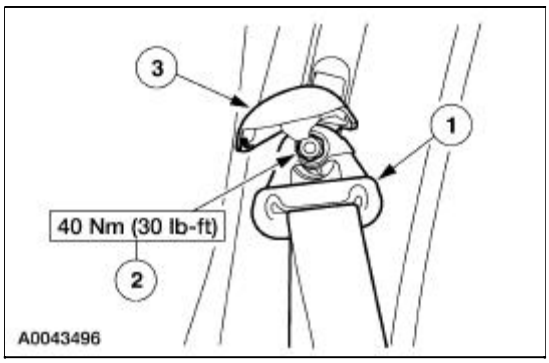
   Install the driver side C-pillar trim panel.
   1. Position the driver side C-pillar trim panel and push in, engaging the retainers.
   2. Install the bolt and bolt cover.
   3. Install the weather-stripping along the driver side C-pillar trim panel.



6. **NOTE:** Inspect the shoulder safety belt guide cover for damage. If the shoulder safety belt guide cover is damaged or if it does not remain closed, install a new shoulder safety belt guide cover.

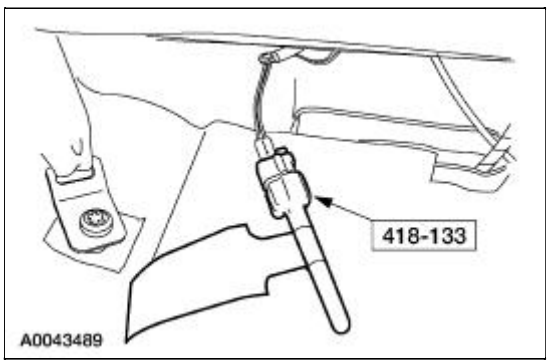
   NOTE: Make sure the safety belt is not twisted prior to installation.

   Install the second row driver side safety belt guide.
   1. Position the second row driver side safety belt guide.
   2. Install the nut.
   3. Close the safety belt guide cover.

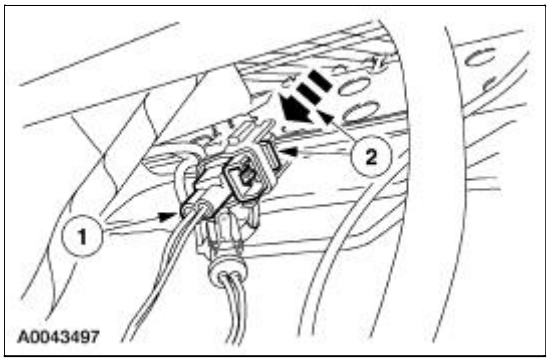


All vehicles

7. Remove the restraint system diagnostic tool from the passenger seat safety belt buckle pretensioner floor electrical connector.

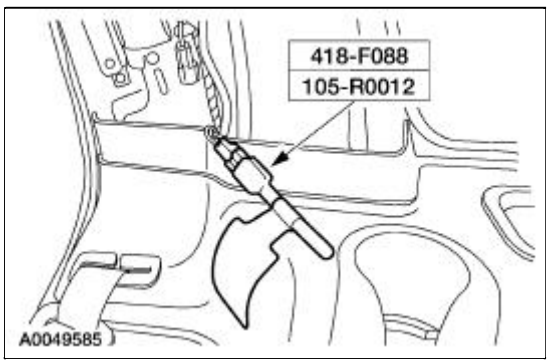


8. Connect the passenger seat safety belt buckle pretensioner electrical connector.
   1. Connect the passenger seat safety belt buckle pretensioner electrical connector.
   2. Slide and engage the passenger seat safety belt buckle pretensioner electrical connector locking clip.

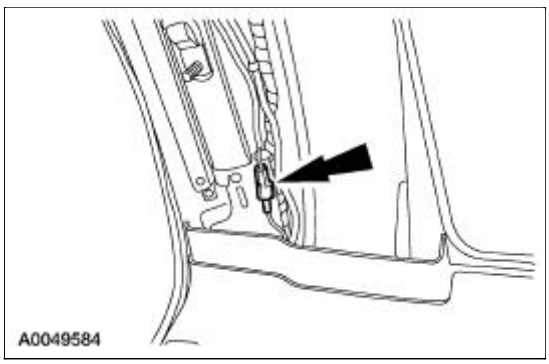


Vehicles with safety canopies

9. Remove the restraint system diagnostic tool from the vehicle harness side of the passenger side safety canopy electrical connector.

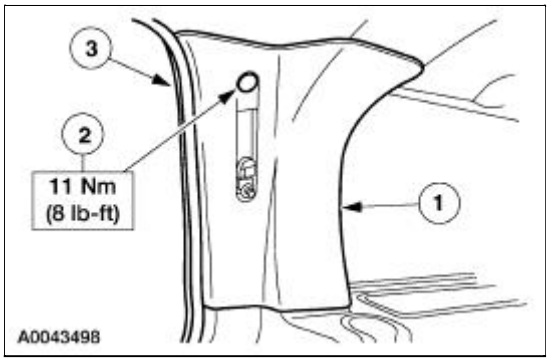


10. Connect the passenger side safety canopy electrical connector.



11. **WARNING: Anytime the safety canopy module has deployed, the headliner, and all A, B, and C pillar upper trim panels and attaching hardware must be replaced along with any other damaged components and hardware. Failure to do so may result in personal injury in the event of a safety canopy module deployment.**

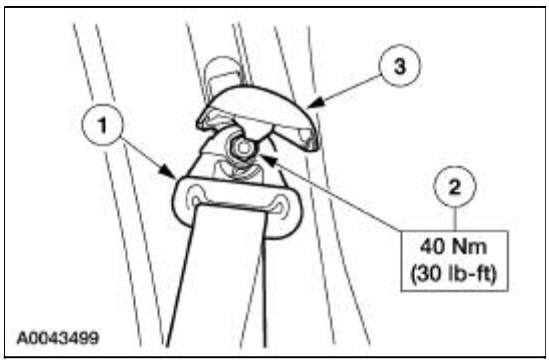
    Install the passenger C-pillar trim panel.
    1. Position the passenger side C-pillar trim panel and push in, engaging the retainers.
    2. Install the bolt and bolt cover.
    3. Install the weather-stripping along the passenger side C-pillar trim panel.



12. **NOTE:** Inspect the shoulder safety belt guide cover for damage. If the shoulder safety belt guide cover is damaged or if it does not remain closed, install a new shoulder safety belt guide cover.

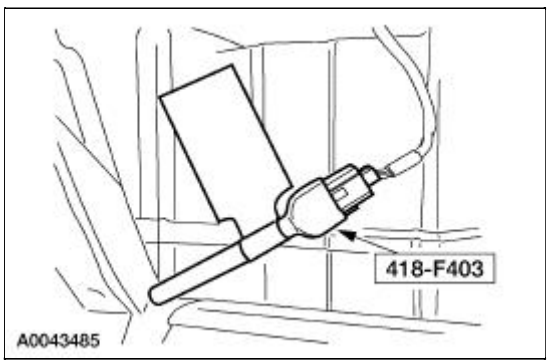
    NOTE: Make sure the safety belt is not twisted prior to installation.

    Install the second row passenger side safety belt guide.
    1. Position the second row passenger side safety belt guide.
    2. Install the nut.
    3. Close the safety belt guide cover.



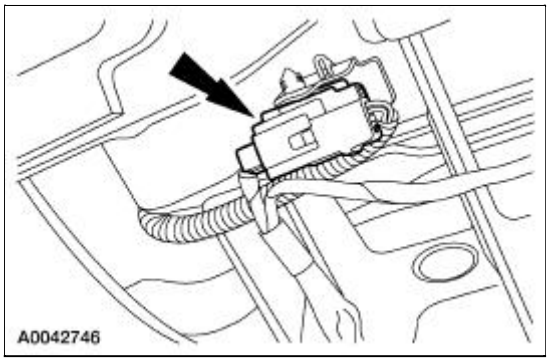
All vehicles

13. Remove the restraint system diagnostic tool from the vehicle harness side of the passenger air bag module electrical connector.



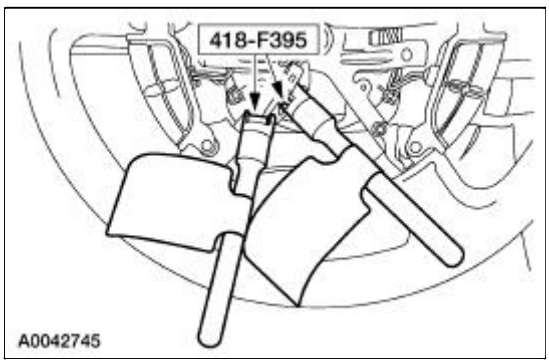
14. **NOTE:** The Expedition is shown, the Navigator is similar.

    Connect the passenger air bag module electrical connector.



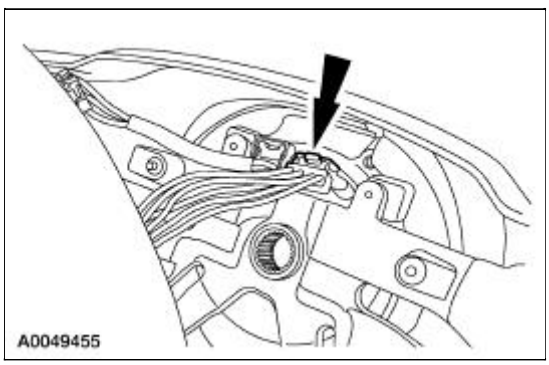
15. Close the glove compartment.

16. Remove the restraint system diagnostic tools from the clockspring electrical connector at the top of the steering column.



Navigator vehicles

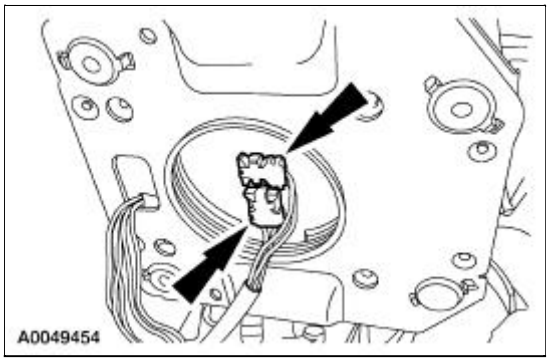
17. Connect the driver air bag module accessories electrical connector to the connector end at the top of the clockspring.



18. **CAUTION: The clockspring electrical connectors are unique and cannot be reversed when connected to the driver air bag module. Match the electrical connector key to the keyway in the driver air bag module. Do not force the electrical connectors into the driver air bag module.**

    Connect the driver air bag module electrical connectors as noted during removal.

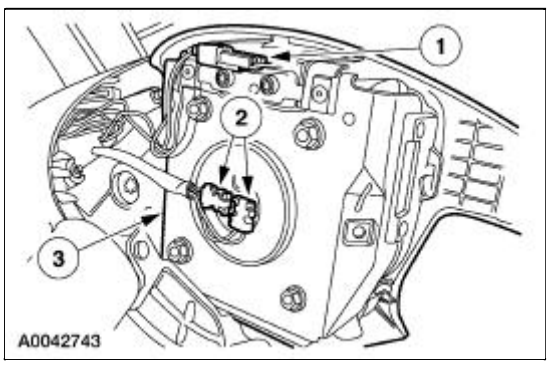
    - Position the driver air bag module to the steering wheel.



Expedition vehicles

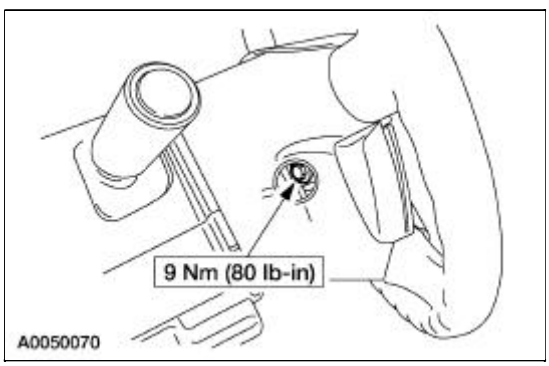
19. Position the driver air bag module to the steering wheel.
    1. Connect the horn switch electrical connector.
    2. **CAUTION: The clockspring electrical connectors are unique and cannot be reversed when connected to the driver air bag module. Match the electrical connector key to the keyway in the driver air bag module. Do not force the electrical connectors into the driver air bag module.**

       Connect the driver air bag module electrical connectors as noted during removal.
    3. Position the driver air bag module to the steering wheel.

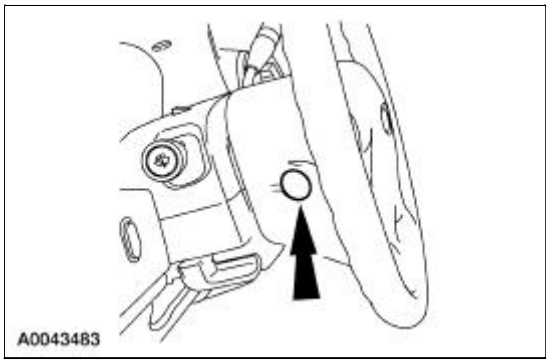


All vehicles

20. Install the two driver air bag module bolts (one shown).



21. Install the two steering wheel back cover plugs (one shown).



22. Connect the battery ground cable. For additional information, refer to Section 414-01 .

23. **WARNING: Restraint system diagnostic tools are for service only. Tools must be removed prior to operating the vehicle over the road. Failure to remove restraint system diagnostic tools could result in injury and possible violation of vehicle safety standards.**

    With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of Section 501-20B .

Vehicles with safety canopies

24. Check the active restraint system for correct operation. For additional information, refer to Section 501-20A .

Safety Belt Procedure After a Collision

1. **WARNING: All safety belt assemblies including retractors, buckles, front seat belt buckle support assemblies (slide bar), shoulder belt height adjusters, if so equipped, child safety seat tether attachments, and attaching hardware should be inspected after any collision. All belt assemblies should be replaced unless a qualified technician finds the assemblies show no damage and operate correctly. Belt assemblies not in use during a collision should also be inspected and replaced if either damage or improper operation is noted.**

   NOTE: Safety belt assemblies should be periodically inspected to make sure they have not become damaged and that they remain in correct operating condition, particularly if they have been subjected to severe stress.

   Before installing the new safety belt assembly, the safety belt attaching areas must be inspected for damage and distortion. If the attaching points are damaged and distorted, the sheet metal must be reworked back to its original shape and structural integrity.

   Install the new safety belt(s) using the appropriate instructions. Perform the Functional Test.

Safety Belt With Anchor Plate Thread Damage

1. Remove the broken or stripped bolt and discard.
2. Drill out the internal threads in the safety belt anchor plate with a 10.7 mm (27/64 in) drill.
3. Rethread the anchor plate with a 1/2-13 tap (seat belt).
4. Clean out the chips.
5. Install the attachment parts. Original parts are to be replaced with the repair parts indicated in the Safety Belt Parts Replacement Guidelines.
6. When repairing a multiple belt and attachment, install the nut to the bolt in the tunnel area from the underside of the floorpan.

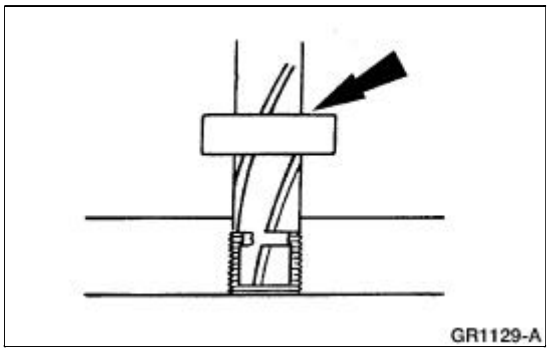
Safety Belt Shoulder Height Adjuster With Stripped Weld Nuts

Special Tool(s)

 ST1640-A	D-Ring Installation Kit or equivalent 100-F012 (134-00018)

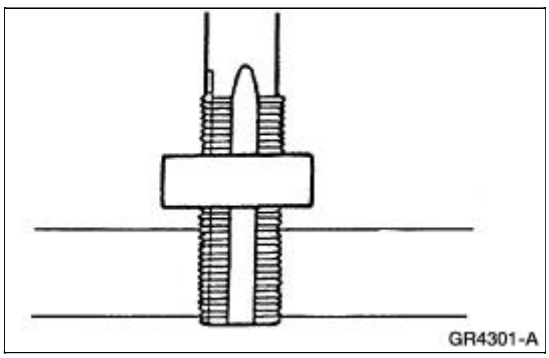
1. Remove the height adjuster; refer to Safety Belt Shoulder Height Adjuster—Front Row or Safety Belt Shoulder Height Adjuster—Second Row .

2. Use the half-inch drill with integral stop provided in D-Ring Installation Kit to drill out the damaged threads in the upper pillar structure.

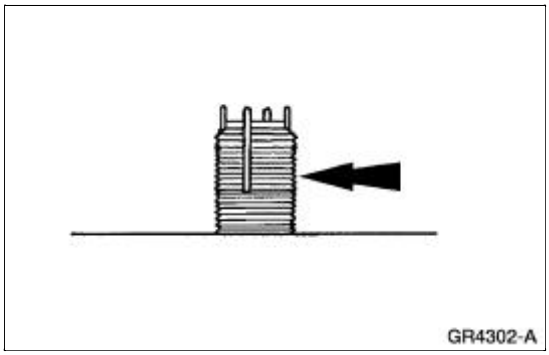


3. **NOTE:** After each rotation, back off tap slightly to remove new cuttings and be sure to blow out any chips before proceeding.

   Apply a suitable lubricant to the M14x1.5 tap with integral stop provided in D-Ring Installation Kit and tap new threads.

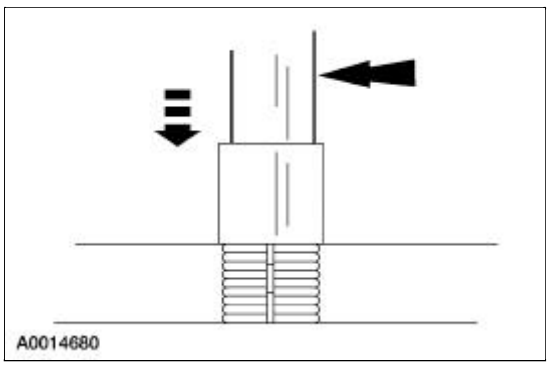


4. Use a threaded insert (part number N807170-5190) provided in D-Ring Installation Kit and screw it into the retapped hole until it is slightly below the surface.



5. **NOTE:** If the two bolts on the height adjuster are not stripped, refer to Safety Belt Shoulder Height Adjuster—Front Row or Safety Belt Shoulder Height Adjuster—Second Row . If the bolts are stripped, replace the height adjuster.

   Use a hammer to lightly tap the installation tool provided in D-Ring Installation Kit several times to seat the insert keys.

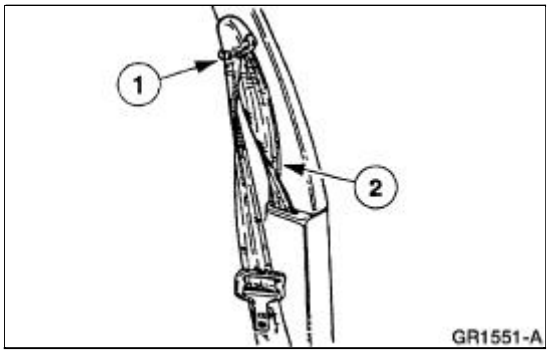


Replacement of the Weld Nut and Reinforcement

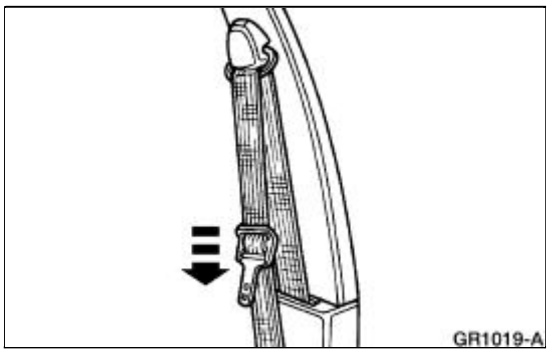
1. Remove the interior trim panel to expose the suspect anchor point. For additional information, refer to Section 501-05 .
2. Determine if the weld nut only or the weld nut and reinforcement and weld nut are missing. If the B- or C- or D-pillar safety belt anchor nuts or reinforcements are stripped or missing, a new nut or reinforcement should be installed. To install a missing weld nut only, proceed to Step 3.
3. Obtain the correct M12 weld nut and a standard washer to perform the procedure.
4. Drill out two 8 mm (5/16 in) diameter holes adjacent to the clearance hole.
5. Obtain a length of copper welding wire and feed through clearance hole in door frame opening until it becomes visible at the access hole.
6. Pull the wire through so that it may be secured to the weld nut and washer.
7. Pull the wire back up to the weld nut clearance hole.
8. Hold the weld nut securely in place. Use the MIG Wire Feed Welder 106-00053 to plug weld the nut in place at the two 8 mm (5/16 in) diameter holes previously drilled.
9. Metal finish as required.
10. Verify the nut is securely in place.

Safety Belt Twisted at the Safety Belt Guide —Outboard

1. Straighten the twisted belt webbing.
    1. Grasp webbing at the safety belt guide.
    2. Feed twisted portion of webbing up through safety belt guide.



2. Pull straightened belt downward to check for proper operation.



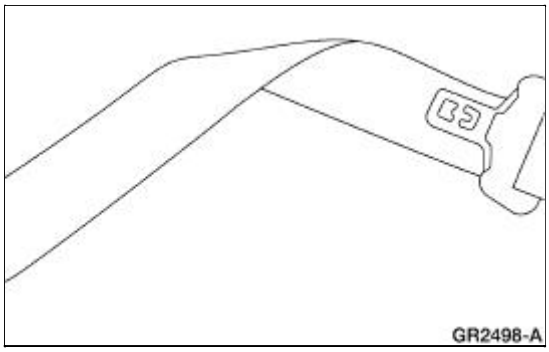
Safety Belt Cleaning

1.  **WARNING: Do not bleach or re-dye the webbing, as the webbing may weaken.**

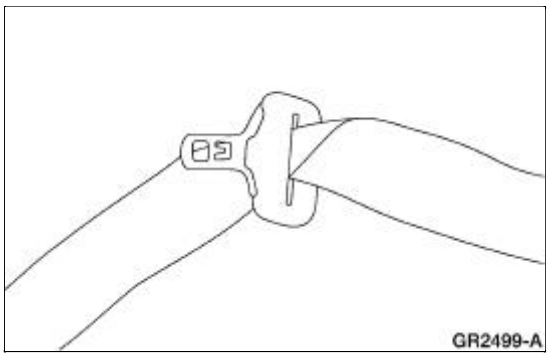
   Clean the safety belt webbing only with a mild soap solution recommended for cleaning upholstery or carpets. Follow the instructions provided with the soap.

Safety Belt Tongue Rotated on Belt

1. Fold the safety belt as indicated.

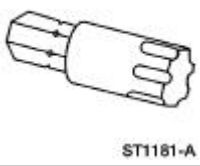


2. Pull the safety belt tongue over the fold in the safety belt.



Front Safety Belt Retractor

Special Tool(s)

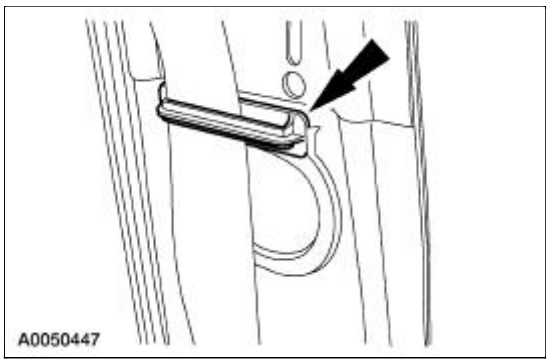
 ST1181-A	Torx Bit, Safety Belt Bolt 501-010 (T77L-2100-A)

Removal and Installation

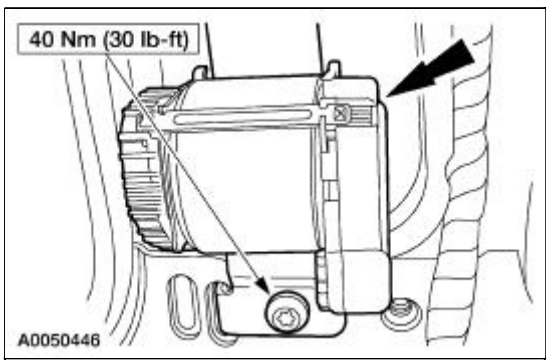
WARNING: All safety belt assemblies including retractors, buckles, front seat belt buckle support assemblies (slide bar), shoulder belt height adjusters (if so equipped) child safety seat tether attachments and attaching hardware should be inspected after any collision. All belt assemblies should be replaced unless a qualified technician finds the assemblies show no damage and operate correctly. Belt assemblies not in use during a collision should also be inspected and replaced if either damage or incorrect operation is noted.

NOTE: The RH side is shown, the LH side is similar.

1. Remove the B-pillar trim panel. For additional information, refer to Section 501-05 .
2. Release the two pin-type retainers and the safety belt guide.



3. Remove the bolt and the safety belt retractor.



4. **NOTE:** Make sure the safety belt webbing is not twisted prior to installation.

   NOTE: Make sure to tighten all nuts and bolts to specification.

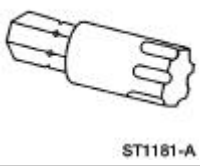
   To install, reverse the removal procedure.

   - When installing the safety belt retractor, make sure to engage the anti-rotation tab to the sheet metal.
   - Remove the shipping clip after safety belt retractor installation.

5. Check the active restraint system for correct operation.

Rear Safety Belt Retractor —Second and Third Row

Special Tool(s)

 ST1181-A	Torx Bit, Safety Belt Bolt 501-010 (T77L-2100-A)

Removal and Installation

WARNING: All safety belt assemblies including retractors, buckles, front seat belt buckle support assemblies (slide bar), shoulder belt height adjusters (if so equipped) child safety seat tether attachments and attaching hardware should be inspected after any collision. All belt assemblies should be replaced unless a qualified technician finds the assemblies show no damage and operate correctly. Belt assemblies not in use during a collision should also be inspected and replaced if either damage or incorrect operation is noted.

NOTE: The LH side is shown, the RH side is similar.

Both retractors

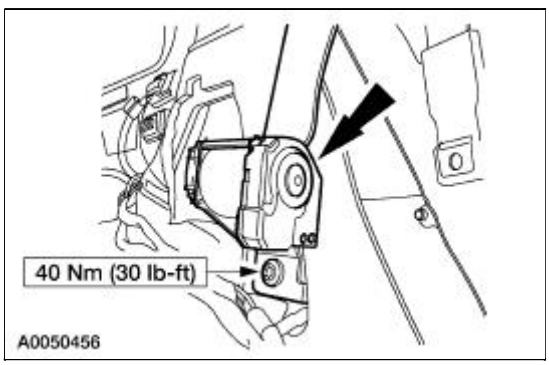
1. Remove the rear quarter trim panel. For additional information, refer to Section 501-05 .
   - Before installing the third row safety belt anchor, make sure the floor slotted plastic insert is still present. If it is not, another insert must be installed.

Third row retractor, driver side

2. Remove the vehicle jack.

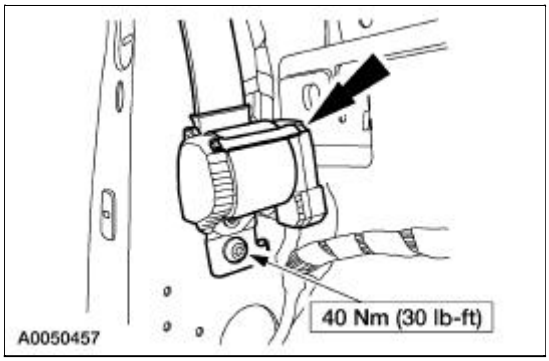
Second row retractor

3. Remove the bolt and the second row safety belt retractor.



Third row retractor

4. Remove the bolt and the third row safety belt retractor.



Both retractors

5. **NOTE:** Make sure the safety belt webbing is not twisted prior to installation.

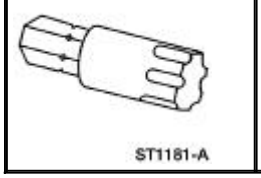
   NOTE: Make sure to tighten all nuts and bolts to specification.

   To install, reverse the removal procedure.
   1. When installing the safety belt retractor, make sure to engage the anti-rotation tab to the sheet metal.
   2. Remove the shipping clip after safety belt retractor installation.

6. Check the active restraint system for correct operation.

Rear Center Safety Belt Retractor —Second Row

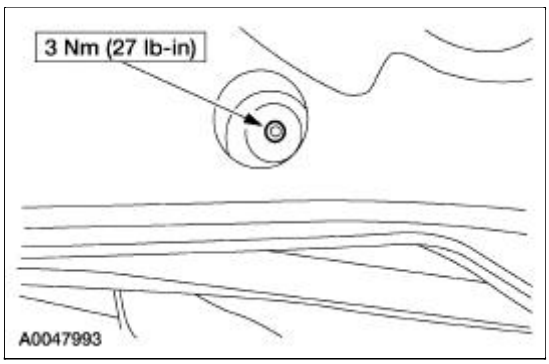
Special Tool(s)

 ST1181-A	Torx Bit, Safety Belt Bolt 501-010 (T77L-2100-A)

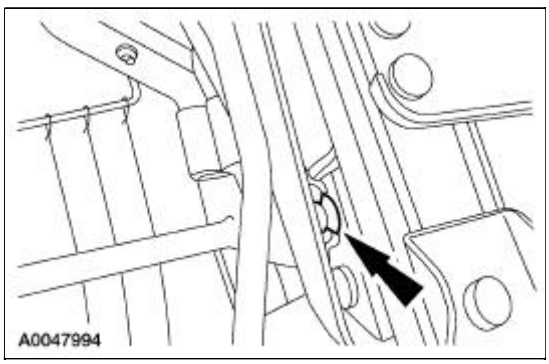
Removal and Installation

WARNING: All safety belt assemblies including retractors, buckles, front seat belt buckle support assemblies (slide bar), shoulder belt height adjusters (if so equipped) child safety seat tether attachments and attaching hardware should be inspected after any collision. All belt assemblies should be replaced unless a qualified technician finds the assemblies show no damage and operate correctly. Belt assemblies not in use during a collision should also be inspected and replaced if either damage or incorrect operation is noted.

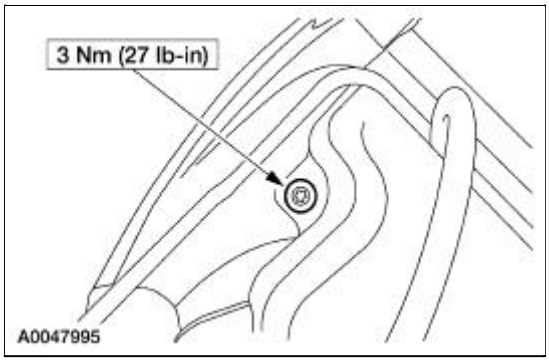
1. Remove the second row 20 percent seat. For additional information, refer to Section 501-10 .
2. Remove the two screws (one shown) on the inside of the RH side shield.



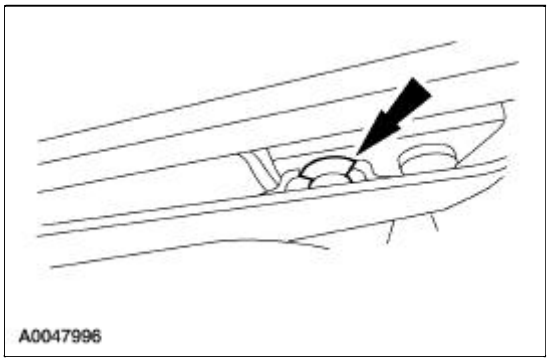
3. Release the pin-type retainer and remove the side shields.



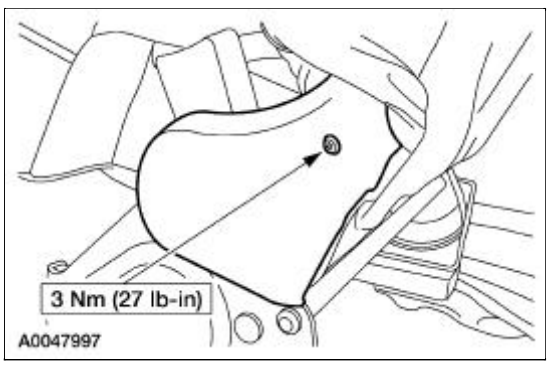
4. Remove the screw on the inside of the LH side shield.



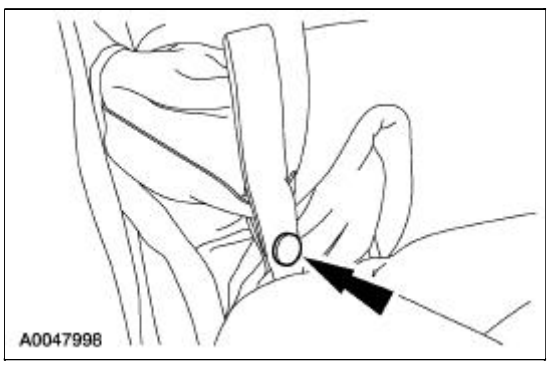
5. Release the pin-type retainer and remove the side shields.



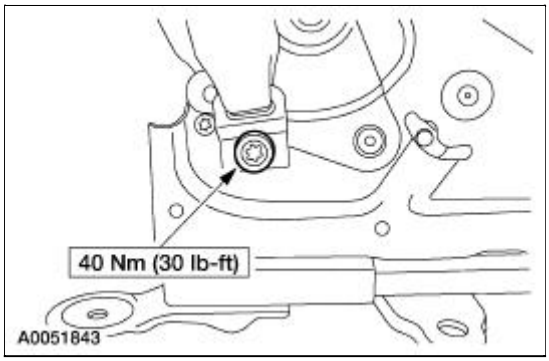
6. Remove the left hinge side shield screw and remove the side shield.



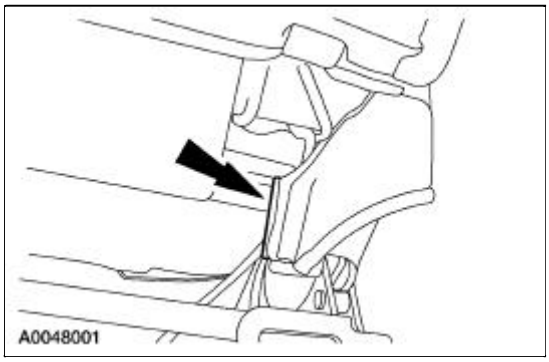
7. Unsnap the recliner pull strap handle and pull the handle through the seat.



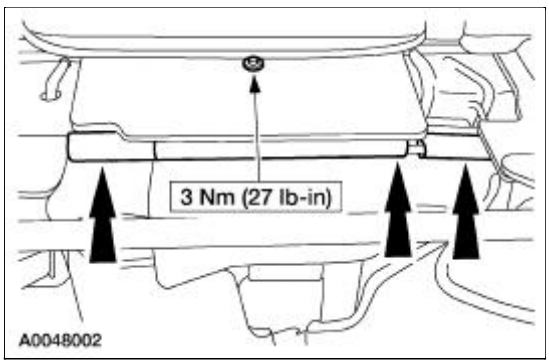
8. Remove the seat belt anchor bolt.



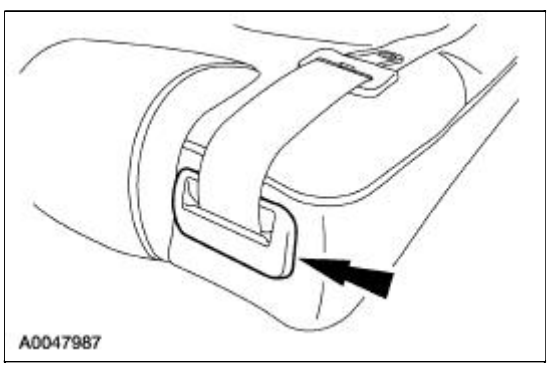
9. Release the J-clip.



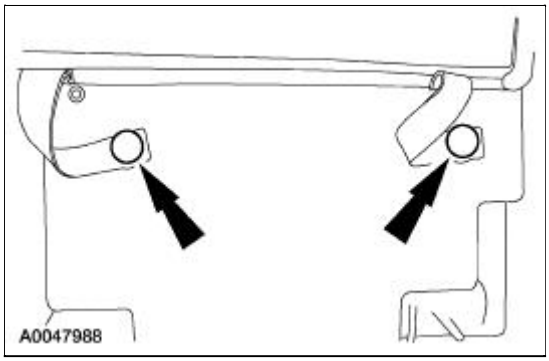
10. Remove the screw from the seat backrest support panel and release the J-clips under seat backrest support panel.



11. Remove the seat belt guide cover.



12. Invert the seat backrest cover and remove the two pin-type retainers.

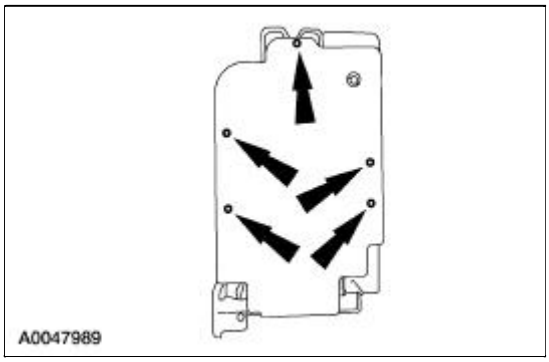


13. **CAUTION: Use care when separating the seat backrest trim cover from the hook-and-loop strip, or the hook-and-loop strip can be torn from the seat backrest foam.**

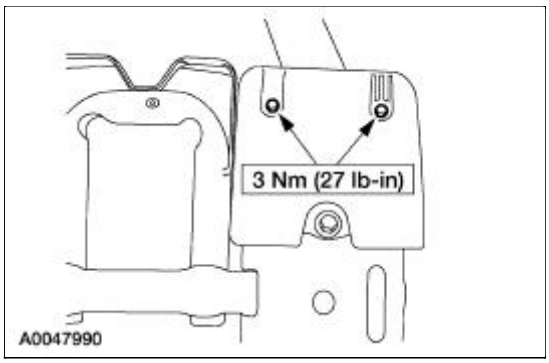
    Remove the seat backrest cover.

14. Remove the seat backrest foam pad.

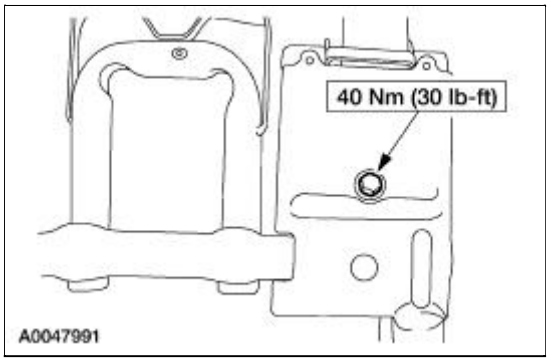
15. Remove the seat backrest support panel screws.



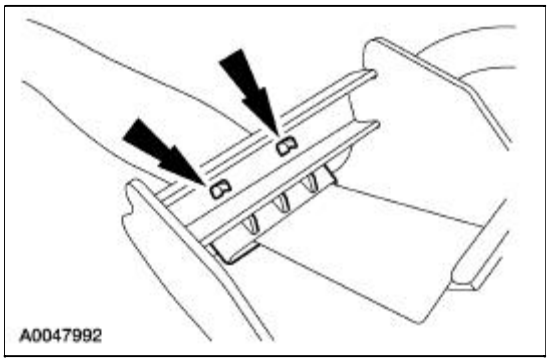
16. Remove the seat belt retractor cover screws and remove the cover.



17. Remove the seat belt retractor bolt.



18. Pinch and release the seat belt retractor guide from the seat backrest frame and remove the safety belt retractor.



19. **NOTE:** Make sure the safety belt webbing is not twisted prior to installation.

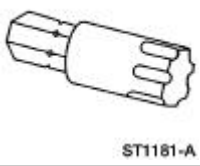
    NOTE: Make sure to tighten all nuts and bolts to specification.

    To install, reverse the removal procedure.
    1. When installing the safety belt retractor, make sure to engage the anti-rotation tab to the sheet metal.
    2. Remove the shipping clip after safety belt retractor installation.

20. Check the active restraint system for correct operation.

Rear Center Safety Belt Retractor —Third Row

Special Tool(s)

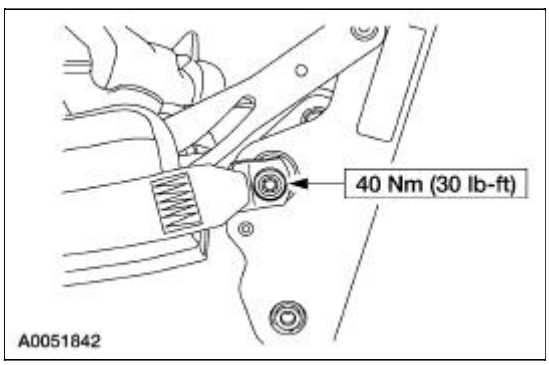
 ST1181-A	Torx Bit, Safety Belt Bolt 501-010 (T77L-2100-A)

Removal and Installation

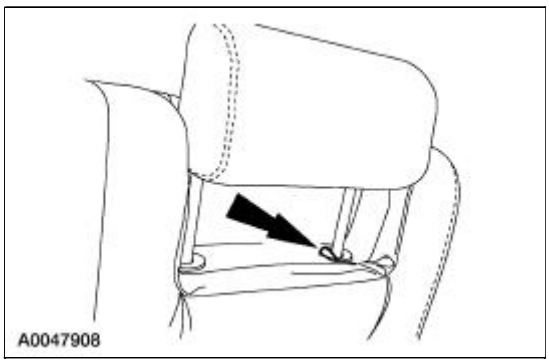
WARNING: All safety belt assemblies including retractors, buckles, front seat belt buckle support assemblies (slide bar), shoulder belt height adjusters (if so equipped) child safety seat tether attachments and attaching hardware should be inspected after any collision. All belt assemblies should be replaced unless a qualified technician finds the assemblies show no damage and operate correctly. Belt assemblies not in use during a collision should also be inspected and replaced if either damage or incorrect operation is noted.

All vehicles

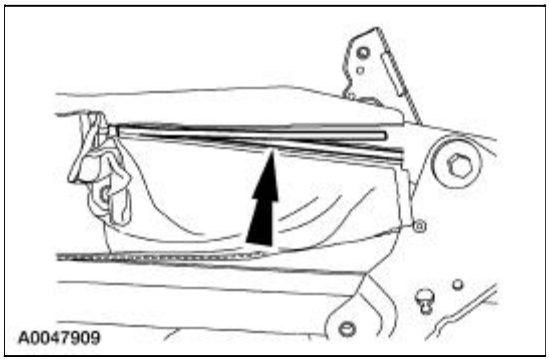
1. Remove the third row 60 percent seat backrest. For additional information, refer to Section 501-10 .
2. Remove the seat belt anchor bolt.



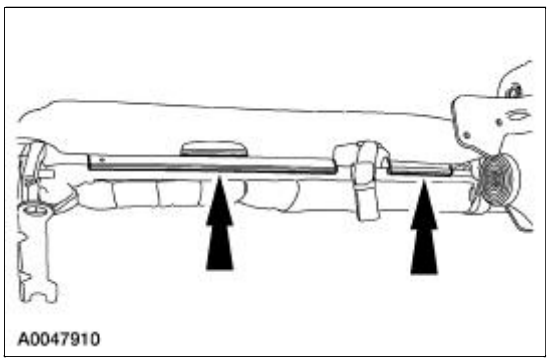
3. Depress the tab and remove the head restraint.



4. Release the J-clip.

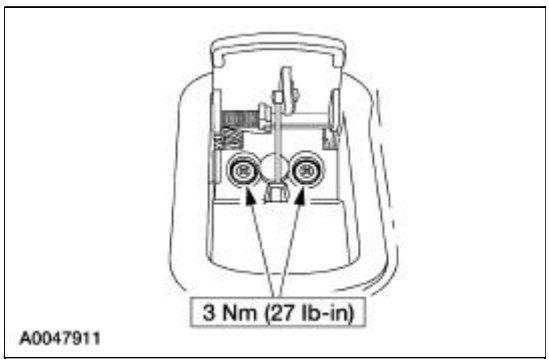


5. Release the two J-clips.



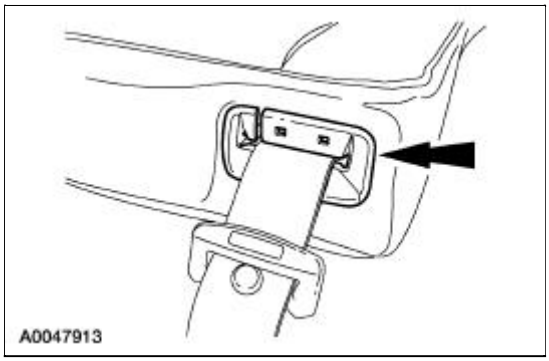
Manual seat

6. Remove the seat backrest release handle screws and remove the handle and cable assembly.



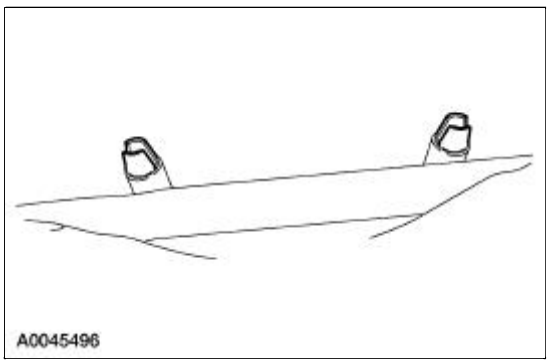
All vehicles

7. Remove the seat belt guide.



8. **NOTE:** The head restraint sleeve pins are not interchangeable, note location for installation.

   Reach up into seat backrest, squeeze, release, and remove the head restraint sleeves.

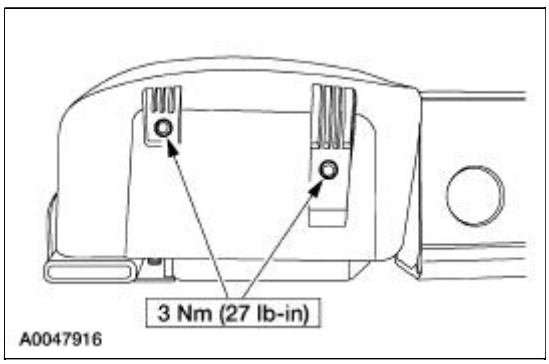


9. **CAUTION: Use care when separating the seat backrest trim cover from the hook-and-loop strip, or the hook-and-loop strip can be torn from the seat backrest foam.**

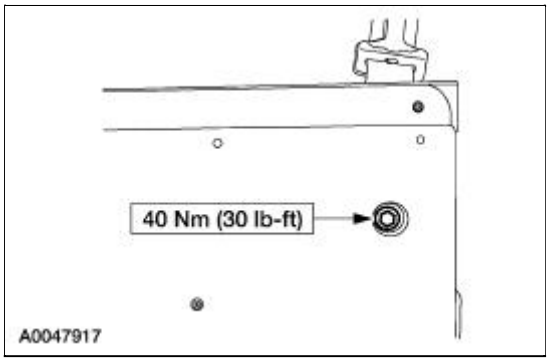
   Invert the seat backrest trim cover and remove.

10. Remove the seat backrest foam pad.

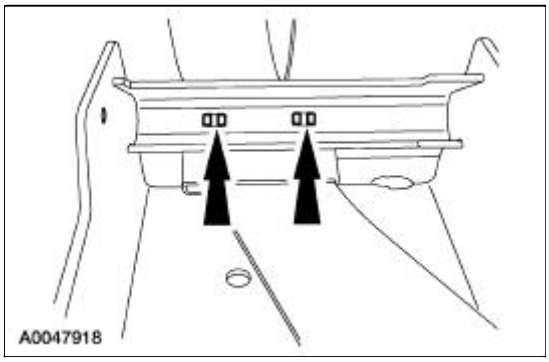
11. Remove the four screws from the seat belt cover (two shown).



12. Remove the safety belt retractor bolt.



13. Pinch to release the seat belt guide and remove the seat belt assembly.



14. **NOTE:** Make sure the safety belt webbing is not twisted prior to installation.

    NOTE: Make sure to tighten all nuts and bolts to specification.

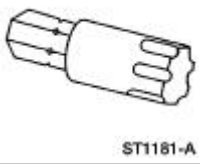
    To install, reverse the removal procedure.

    - Remove the shipping clip after safety belt retractor installation.

15. Check the active restraint system for correct operation.

Safety Belt Shoulder Height Adjuster —Front Row

Special Tool(s)

 ST1181-A	Torx Bit, Safety Belt Bolt 501-010 (T77L-2100-A)

Removal and Installation

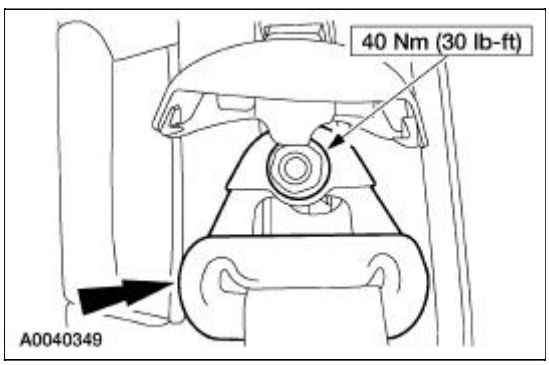
WARNING: All safety belt assemblies including retractors, buckles, front seat belt buckle support assemblies (slide bar), shoulder belt height adjusters (if so equipped) child safety seat tether attachments and attaching hardware should be inspected after any collision. All belt assemblies should be replaced unless a qualified technician finds the assemblies show no damage and operate correctly. Belt assemblies not in use during a collision should also be inspected and replaced if either damage or incorrect operation is noted.

NOTE: The LH side is shown, the RH side is similar.

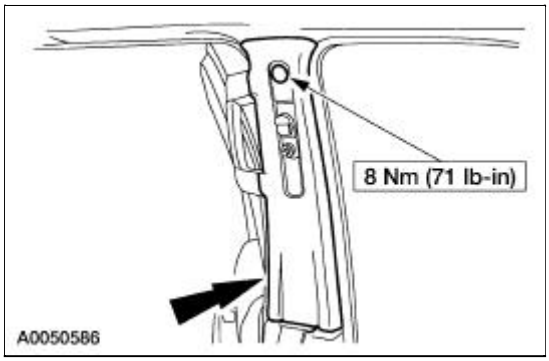
1. **NOTE:** Position the safety belt guide to the lowest position.

   NOTE: Inspect the shoulder safety belt guide cover for damage. If the shoulder safety belt guide cover is damaged or cover does not remain closed, install a new shoulder safety belt guide cover.

   Remove the safety belt guide.
   - Lift up on the cover and remove the nut.

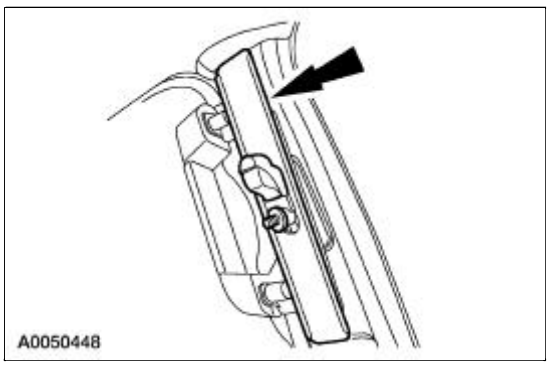


2. Remove the upper B-pillar trim panel.
   - Remove the bolt cover and bolt.
   - Remove the upper B-pillar trim panel by releasing the clips and sliding the upper B-pillar panel downward.

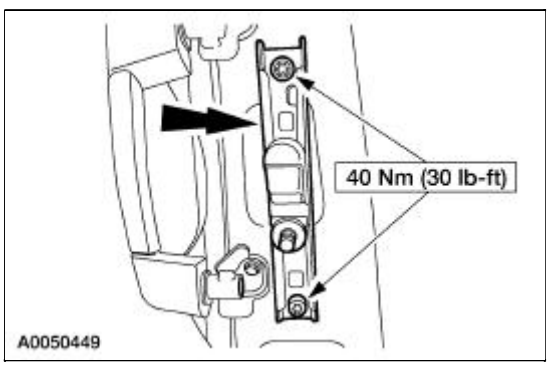


3. Remove the B-pillar trim panel. For additional information, refer to Section 501-05 .

4. Remove the safety belt height adjuster trim cover.



5. Remove the bolts and the safety belt shoulder height adjuster.



6. **NOTE:** Make sure the safety belt webbing is not twisted prior to installation.

   NOTE: Make sure to tighten all nuts and bolts to specification.

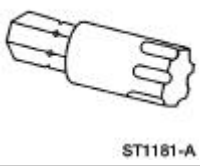
   To install, reverse the removal procedure.

   - When installing the upper B-pillar trim panel, insert the safety belt guide slide into the upper B-pillar trim panel.

7. Check the active restraint system for correct operation.

Safety Belt Shoulder Height Adjuster —Second Row

Special Tool(s)

 ST1181-A	Torx Bit, Safety Belt Bolt 501-010 (T77L-2100-A)

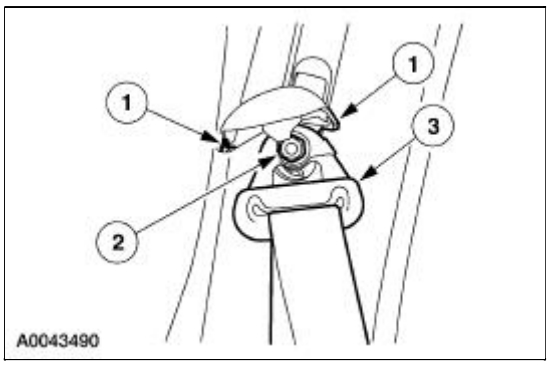
Removal and Installation

WARNING: All safety belt assemblies including retractors, buckles, front seat belt buckle support assemblies (slide bar), shoulder belt height adjusters (if so equipped) child safety seat tether attachments and attaching hardware should be inspected after any collision. All belt assemblies should be replaced unless a qualified technician finds the assemblies show no damage and operate correctly. Belt assemblies not in use during a collision should also be inspected and replaced if either damage or incorrect operation is noted.

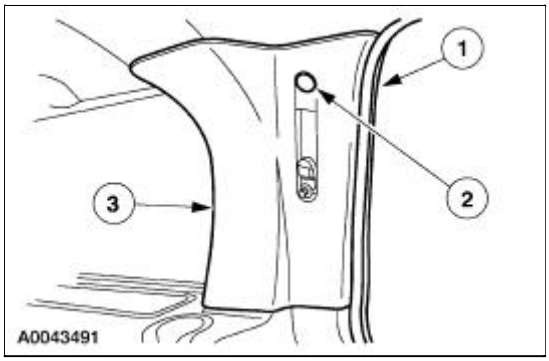
NOTE: The LH side is shown, the RH side is similar.

1. **NOTE:** Inspect the shoulder safety belt guide cover for damage. If the shoulder safety belt guide cover is damaged or if it does not remain closed, install a new shoulder safety belt guide cover.

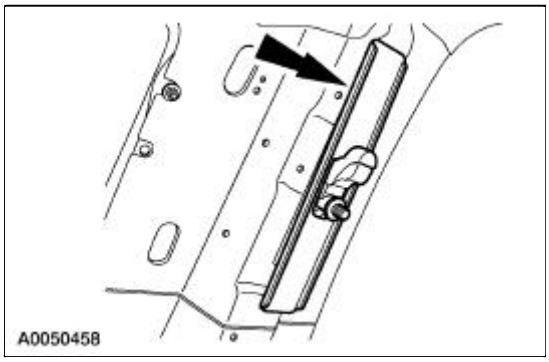
   Remove the second row LH side safety belt guide.
   1. Release the retaining tab at each side and open the safety belt guide cover.
   2. Remove the nut.
   3. Remove the second row LH side safety belt guide.



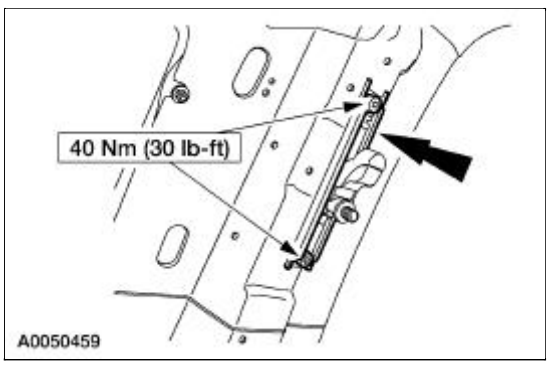
2. Remove the LH C-pillar trim panel.
   1. Separate the weatherstripping along the LH C-pillar trim panel.
   2. Remove the bolt cover and bolt.
   3. Pull out to release the retainers and remove the LH C-pillar trim panel.



3. Remove the safety belt height adjuster trim cover.



4. Remove the bolts and the safety belt shoulder height adjuster.



5. **NOTE:** Make sure the safety belt webbing is not twisted prior to installation.

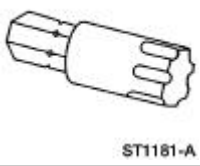
   NOTE: Make sure to tighten all nuts and bolts to specification.

   To install, reverse the removal procedure.

6. Check the active restraint system for correct operation.

Front Safety Belt Buckle —Center

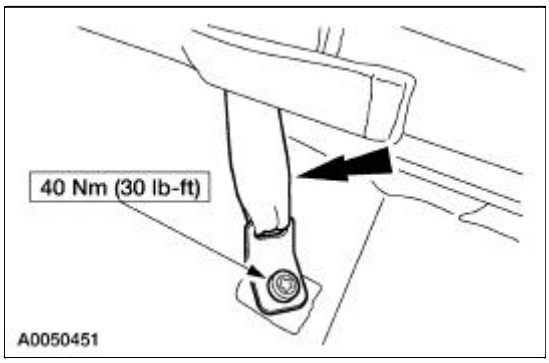
Special Tool(s)

 ST1181-A	Torx Bit, Safety Belt Bolt 501-010 (T77L-2100-A)

Removal and Installation

WARNING: All safety belt assemblies including retractors, buckles, front seat belt buckle support assemblies (slide bar), shoulder belt height adjusters (if so equipped) child safety seat tether attachments and attaching hardware should be inspected after any collision. All belt assemblies should be replaced unless a qualified technician finds the assemblies show no damage and operate correctly. Belt assemblies not in use during a collision should also be inspected and replaced if either damage or incorrect operation is noted.

1. Remove the safety belt buckle bolt and route the safety belt buckle out of the seat.



2. **NOTE:** Make sure the safety belt webbing is not twisted prior to installation.

   NOTE: Make sure to tighten all nuts and bolts to specification.

   To install, reverse the removal procedure.
   - Make sure the safety belt buckle is accessible to the occupant after installation.

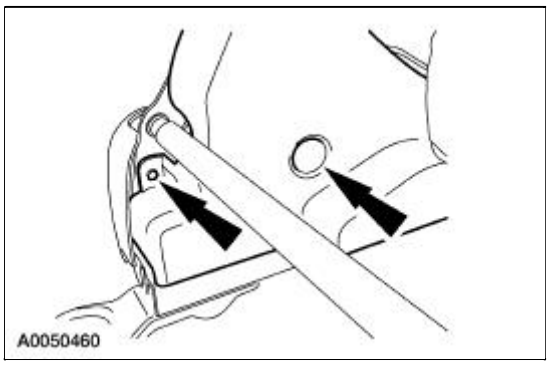
3. Check the active restraint system for correct operation.

Rear Safety Belt Buckle —Second Row, 20 Percent Seat

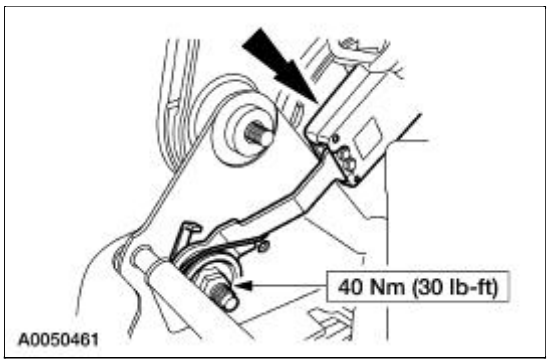
Removal and Installation

WARNING: All safety belt assemblies including retractors, buckles, front seat belt buckle support assemblies (slide bar), shoulder belt height adjusters (if so equipped) child safety seat tether attachments and attaching hardware should be inspected after any collision. All belt assemblies should be replaced unless a qualified technician finds the assemblies show no damage and operate correctly. Belt assemblies not in use during a collision should also be inspected and replaced if either damage or incorrect operation is noted.

1. Remove the second row 20 percent seat. For additional information, refer to Section 501-10 .
2. Remove the screws and the pin-type retainer (not shown), and remove the inboard side shield.
   - It may be necessary to fold the seat to remove the side shield.



3. Remove the nut and the safety belt buckle.

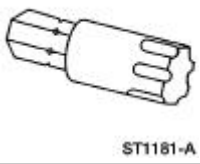


4. **NOTE:** Make sure to tighten all nuts and bolts to specification.

   To install, reverse the removal procedure.
   - When installing the safety belt buckle, make sure to engage the anti-rotation tab to the seat frame.
5. Check the active restraint system for correct operation.

Rear Safety Belt Buckle —Second Row, 40 Percent Seat

Special Tool(s)

 ST1181-A	Torx Bit, Safety Belt Bolt 501-010 (T77L-2100-A)

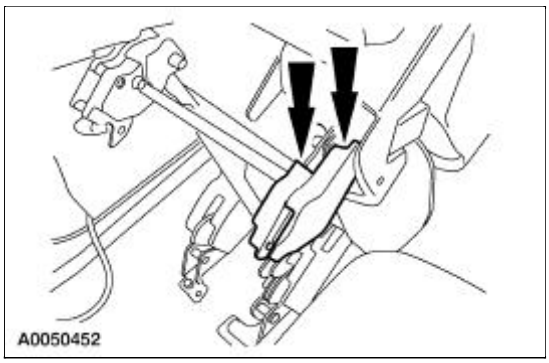
Removal and Installation

WARNING: All safety belt assemblies including retractors, buckles, front seat belt buckle support assemblies (slide bar), shoulder belt height adjusters (if so equipped) child safety seat tether attachments and attaching hardware should be inspected after any collision. All belt assemblies should be replaced unless a qualified technician finds the assemblies show no damage and operate correctly. Belt assemblies not in use during a collision should also be inspected and replaced if either damage or incorrect operation is noted.

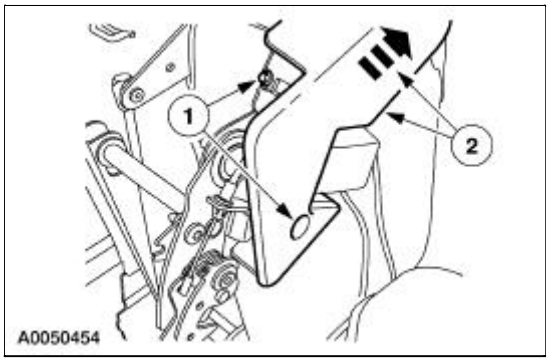
NOTE: The LH side 40 percent seat is shown, the RH side is similar.

1. Pivot the 40 percent seat up.

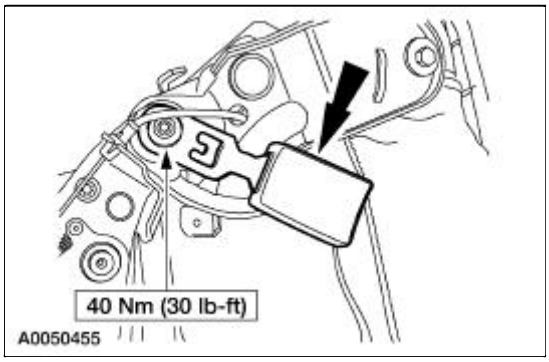
2. Remove the screws and the lower pedestal cover.



3. Remove the seat side shield.
    1. Remove the two screws.
    2. Slide up and remove the side shield.



4. Remove the safety belt buckle bolt and the safety belt buckle.



5. **NOTE:** Make sure to tighten all nuts and bolts to specification.

   To install, reverse the removal procedure.

   - When installing the safety belt buckle, make sure to engage the anti-rotation tab to the seat frame.

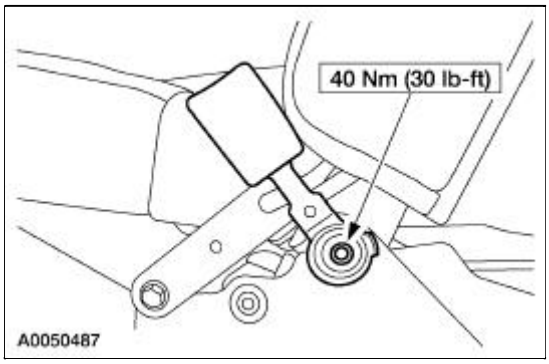
6. Check the active restraint system for correct operation.

Rear Safety Belt Buckle —Third Row, 40 Percent Seat

Removal and Installation

WARNING: All safety belt assemblies including retractors, buckles, front seat belt buckle support assemblies (slide bar), shoulder belt height adjusters (if so equipped) child safety seat tether attachments and attaching hardware should be inspected after any collision. All belt assemblies should be replaced unless a qualified technician finds the assemblies show no damage and operate correctly. Belt assemblies not in use during a collision should also be inspected and replaced if either damage or incorrect operation is noted.

1. Remove the 40 percent third row seat. For additional information, refer to Section 501-10 .
2. Remove the bolt and the safety belt buckle.



3. **NOTE:** Make sure to tighten all nuts and bolts to specification.

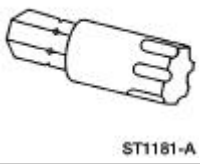
   To install, reverse the removal procedure.

   - When installing the safety belt buckle, make sure to engage the anti-rotation tab to the sheet metal.
   - Make sure the safety belt buckle is accessible to the passenger after installation.

4. Check the active restraint system for correct operation.

Rear Safety Belt Buckle —Third Row, 60 Percent Seat

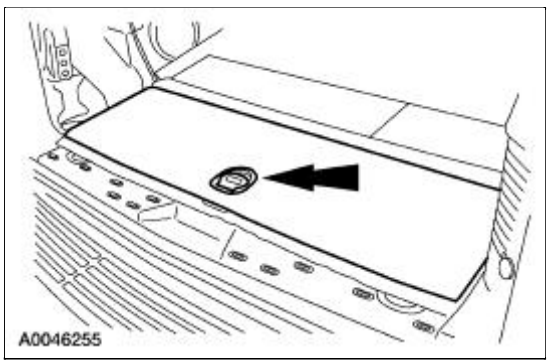
Special Tool(s)

 ST1181-A	Torx Bit, Safety Belt Bolt 501-010 (T77L-2100-A)

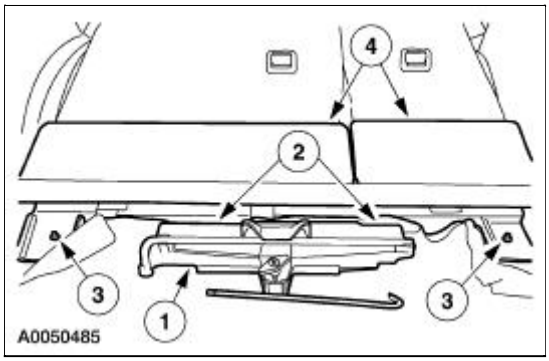
Removal and Installation

WARNING: All safety belt assemblies including retractors, buckles, front seat belt buckle support assemblies (slide bar), shoulder belt height adjusters (if so equipped) child safety seat tether attachments and attaching hardware should be inspected after any collision. All belt assemblies should be replaced unless a qualified technician finds the assemblies show no damage and operate correctly. Belt assemblies not in use during a collision should also be inspected and replaced if either damage or incorrect operation is noted.

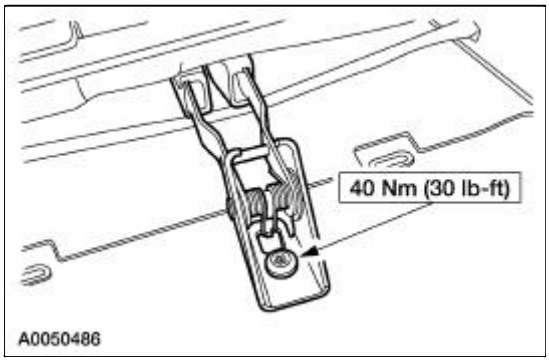
1. Position the third row seats down.
2. Remove the rear load floor panel.



3. Remove the mid-floor panel support.
    1. Remove the jack assembly.
    2. Remove the two pin-type retainers (not shown).
    3. Remove the two bolts.
    4. Position the load floor panels up, lift on the front of the mid-floor panel support to release the three retaining clips (not shown) and remove the support panel.



4. Remove the bolt and the safety belt buckle assembly.



5. **NOTE:** Make sure to tighten all nuts and bolts to specification.

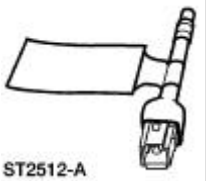
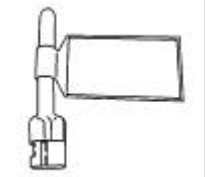
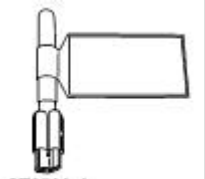
   To install, reverse the removal procedure.

   - When installing the safety belt buckle assembly, make sure to engage the anti-rotation tab to the sheet metal.
   - Make sure the safety belt buckles are accessible to the passengers after installation.

6. Check the active restraint system for correct operation.

Safety Belt Buckle and Pretensioner —40 Percent Seat

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395 (014-R1079)
 ST2512-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F403
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F088 (105-R0012)

Removal

WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

WARNING: After deployment, the air bag surface could contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

WARNING: Never probe the connectors on the air bag module. Doing so could result in air bag deployment which could result in personal injury.

NOTE: The LH forty percent seat is shown, the RH forty percent seat is similar.

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air**

bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

The front impact severity sensor is located at the bottom of the hood latch support bracket.

The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

The second row side impact sensors (if equipped) are located at or near the base of the C-pillars.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

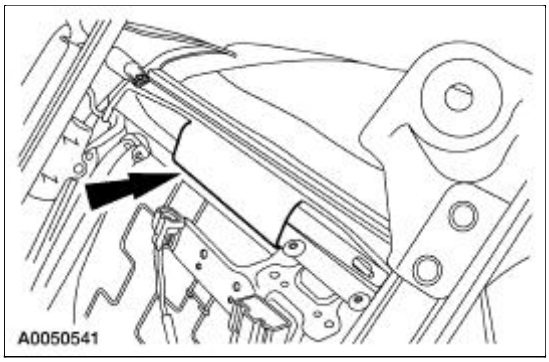
2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation .

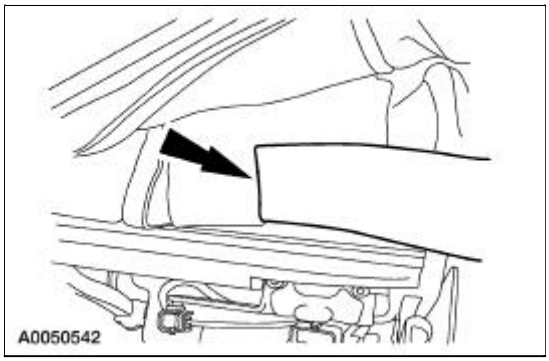
3. **NOTE:** The seat must be positioned to its highest and most forward position to service the safety belt buckle and pretensioner.

   Remove the 40 percent front seat on the side with the affected safety belt buckle and pretensioner. For additional information, refer to Section 501-10 .

4. Release the J-clip.



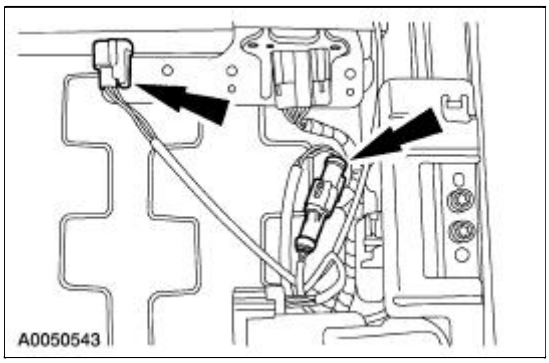
5. Release the hook-and-loop strip and pull the seat cushion trim cover up enough to expose the safety belt buckle and pretensioner.



6. **NOTE:** Make note of the wire harness routing for installation.

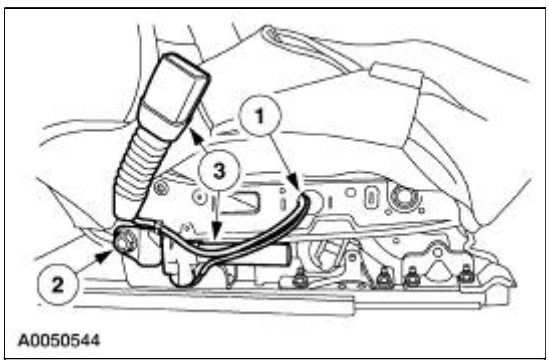
   Remove the safety belt buckle and pretensioner electrical connectors from the seat cushion frame.

   - Disconnect the usage detection switch electrical connector.
   - Separate the safety belt buckle pretensioner electrical connector from the pin-type retainer.



7. **NOTE:** Make note of the wire harness routing for installation.

   Remove the safety belt buckle and pretensioner.
   1. Route out the safety belt buckle and pretensioner usage detection switch and pretensioner electrical connectors.
   2. Remove the nut.
   3. Remove the safety belt buckle and pretensioner.

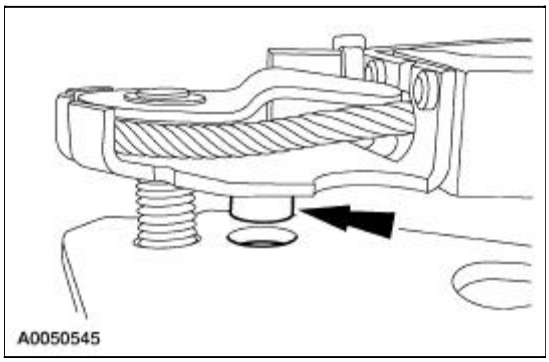


Installation

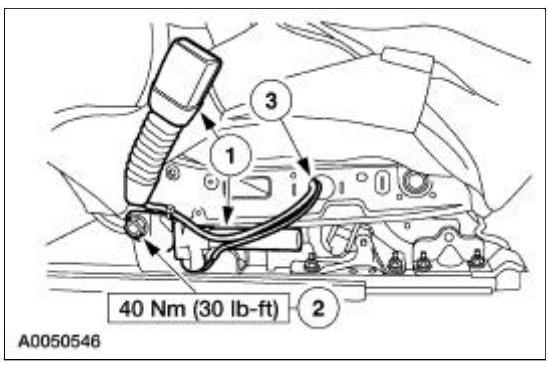
WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions and notes at the beginning of the removal procedure.

1. **NOTE:** Make sure the battery negative cable is still disconnected before proceeding with the installation portion of this procedure.

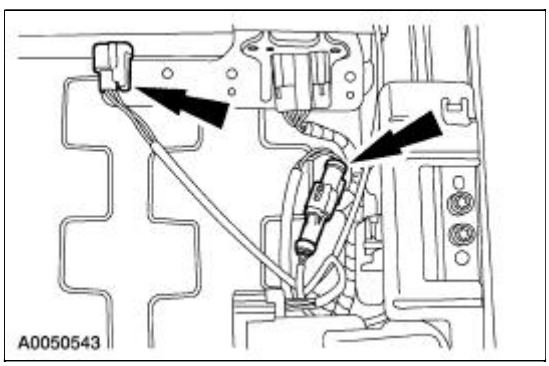
   Align the safety belt buckle and pretensioner anti-rotation tab to the seat bracket.



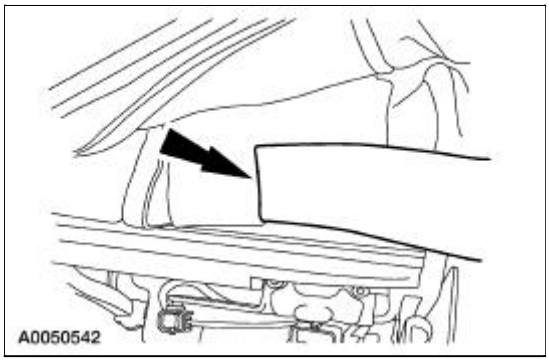
2. Install the safety belt buckle and pretensioner.
   1. With the anti-rotation tab aligned, position the safety belt buckle and pretensioner to the seat.
   2. Install the nut.
   3. Route the safety belt buckle and pretensioner usage detection switch and pretensioner electrical connectors as noted in removal.



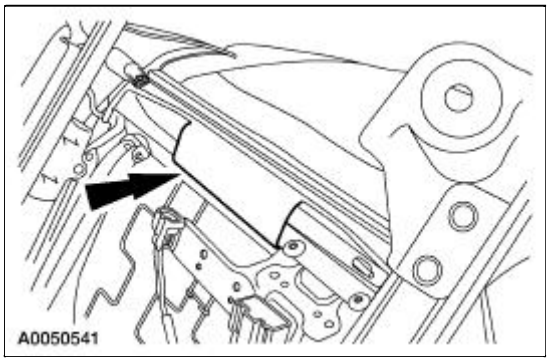
3. Reposition the safety belt buckle and pretensioner electrical connectors to the seat cushion frame.
   - Connect the usage detection switch electrical connector.
   - Reposition the pin-type retainer to the safety belt buckle pretensioner electrical connector and install it under the seat.



4. Reposition the seat cushion trim cover over the safety belt buckle and pretensioner and attach the hook-and-loop strip.



5. Attach the seat backrest J-clip to the seat cushion frame.



6. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the seat removal and installation procedure.**

   Install the 40 percent front seat on the side with the affected safety belt buckle and pretensioner. For additional information, refer to Section 501-10 .

7. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in the General Procedures portion of this section.

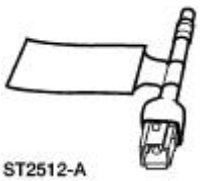
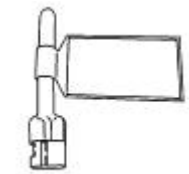
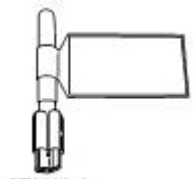
8. **WARNING: Restraint system diagnostic tools are for service only. Tools must be removed prior to operating the vehicle over the road. Failure to remove restraint system diagnostic tools could result in injury and possible violation of vehicle safety standards.**

   With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of Section 501-20B .

9. Check the active restraint system for correct operation. For additional information, refer to Safety Belt System in the Diagnosis and Testing portion of this section.

Safety Belt Buckle and Pretensioner —60 Percent Seat

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395 (014-R1079)
 ST2512-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F403
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F088 (105-R0012)

Removal

WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

WARNING: After deployment, the air bag surface could contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

WARNING: Never probe the connectors on the air bag module. Doing so could result in air bag deployment which could result in personal injury.

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors,**

instrument panel, console, door latches, strikers, seats and hood latches.

The front impact severity sensor is located at the bottom of the hood latch support bracket.

The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

The second row side impact sensors (if equipped) are located at or near the base of the C-pillars.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

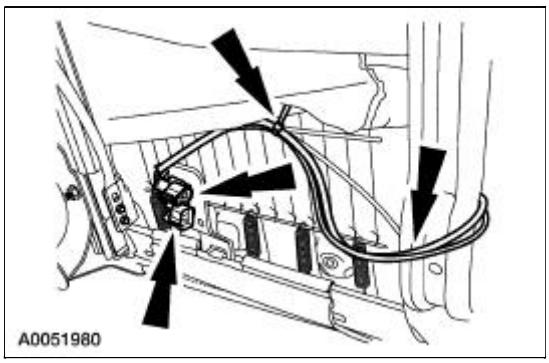
   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation , in the General Procedures portion of this section.

3. **NOTE:** To access the safety belt buckle and pretensioner bolts, the seat must be positioned forward.

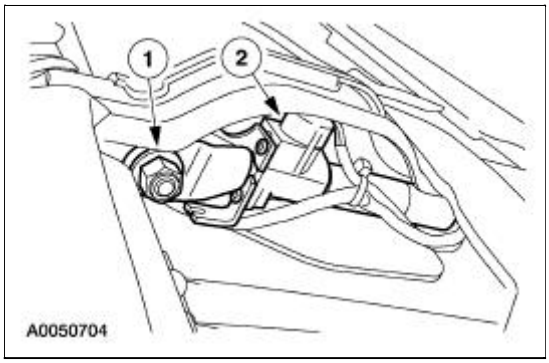
   Remove the 60 percent front seat. For additional information, refer to Section 501-10 .

4. **NOTE:** Make note of the wire harness routing for installation.

   Detach the electrical connectors and route out the wire harnesses.



5. Remove the safety belt buckle and pretensioner.
   1. Remove the nut.
   2. Pull the buckle end back through the seat cushion and remove the safety belt buckle and pretensioner.

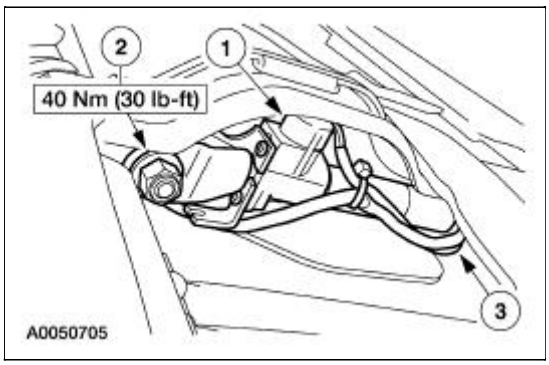


Installation

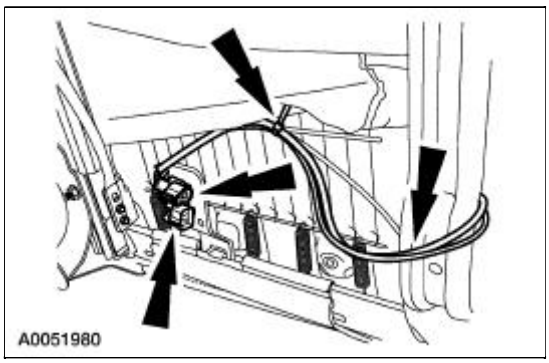
WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions and notes at the beginning of the removal procedure.

1. **NOTE:** Make sure the battery negative cable is still disconnected before proceeding with the installation portion of this procedure.

   Install the safety belt buckle and pretensioner.
   1. Position the safety belt buckle and pretensioner to the seat.
      - Align the safety belt buckle and pretensioner locator tab to the hole in the seat frame.
      - Check that the safety belt buckle end is accessible after positioning.
   2. Install the nut.
   3. Route the safety belt buckle and pretensioner usage detection switch and pretensioner electrical connectors as noted in removal.



2. Attach the electrical connectors and route the wire harnesses as noted in removal.



3. **WARNING: To reduce the risk of serious personal injury, read and follow all**

warnings, cautions, notes, and instructions in the seat removal and installation procedure.

Install the 60 percent front seat. For additional information, refer to Section 501-10 .

4.  **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in the General Procedures portion of this section.

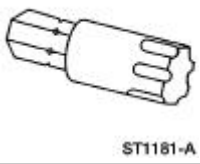
5.  **WARNING: Restraint system diagnostic tools are for service only. Tools must be removed prior to operating the vehicle over the road. Failure to remove restraint system diagnostic tools could result in injury and possible violation of vehicle safety standards.**

   With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of Section 501-20B .

6. Check the active restraint system for correct operation. For additional information, refer to Safety Belt System in the Diagnosis and Testing portion of this section.

Safety Belt —Front Row, Center

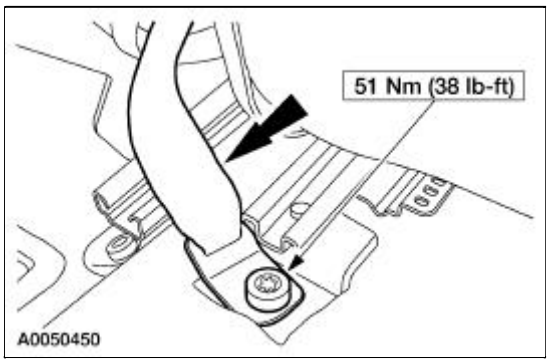
Special Tool(s)

 ST1181-A	Torx Bit, Safety Belt Bolt 501-010 (T77L-2100-A)

Removal and Installation

WARNING: All safety belt assemblies including retractors, buckles, front seat belt buckle support assemblies (slide bar), shoulder belt height adjusters (if so equipped) child safety seat tether attachments and attaching hardware should be inspected after any collision. All belt assemblies should be replaced unless a qualified technician finds the assemblies show no damage and operate correctly. Belt assemblies not in use during a collision should also be inspected and replaced if either damage or incorrect operation is noted.

1. Remove the safety belt bolt and route the safety belt out from the seat.



2. **NOTE:** Make sure the safety belt webbing is not twisted prior to installation.

   NOTE: Make sure to tighten all nuts and bolts to specification.

   To install, reverse the removal procedure.
   1. When installing, make sure the safety belt anchor is on top of the seat bracket.
   2. Make sure the safety belt is accessible to the occupant after installation.

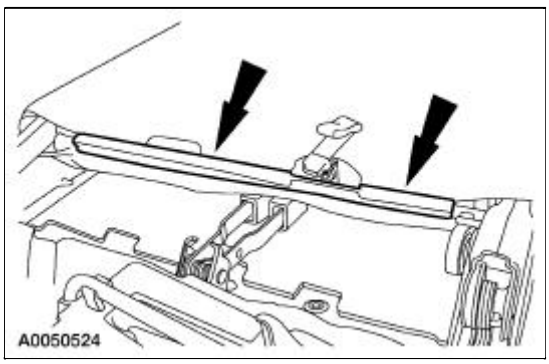
3. Check the active restraint system for correct operation.

Child Safety Seat Tether Anchor

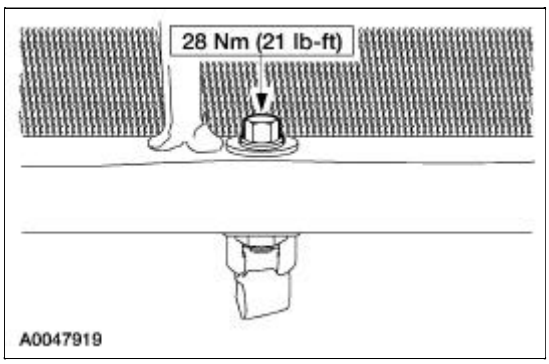
Removal and Installation

WARNING: All safety belt assemblies including retractors, buckles, front seat belt buckle support assemblies (slide bar), shoulder belt height adjusters (if so equipped) child safety seat tether attachments and attaching hardware should be inspected after any collision. All belt assemblies should be replaced unless a qualified technician finds the assemblies show no damage and operate correctly. Belt assemblies not in use during a collision should also be inspected and replaced if either damage or incorrect operation is noted.

1. Position the third row seat backrest down.
2. Release the seat back J-clips.



3. With the seat backrest trim cover and cushion positioned out of the way, remove the bolt and the child safety seat tether anchor.



4. **WARNING: It is important that the bolt/anchor be securely tightened to specification. Otherwise, the child's safety seat may not be correctly secured, and the child could be injured in case of a sudden stop or accident.**

   NOTE: Inspect the seat for damage. If the seat is found to be damaged, install new seat components.

   NOTE: Make sure to tighten the bolts to specification.

   To install, reverse the removal procedure.

5. Check the active restraint system for correct operation.

Torque Specifications

Description	Nm	lb-ft	lb-in
Front impact severity sensor nut	12	9	—
Side impact sensor bolt	12	9	—
Restraints control module top bracket nuts	12	9	—
Restraints control module-to-bracket nuts	12	9	—
Restraints control module bracket-to-floor bolts	12	9	—
Driver air bag module bolts	9	—	80
Passenger air bag module nuts (Navigator)	9	—	80
Passenger air bag module bolts (Expedition)	9	—	80
Safety canopy module bolt, front, upper	8	—	71
Safety canopy module remaining bolts	7	—	62
Clockspring bracket	6	—	53
Safety belt anchor	40	30	—
Weld nut repair screw (10 mm)	21	15	—
Weld nut repair screw (8 mm)	15	11	—
Grounding screw (6 mm)	12	9	—

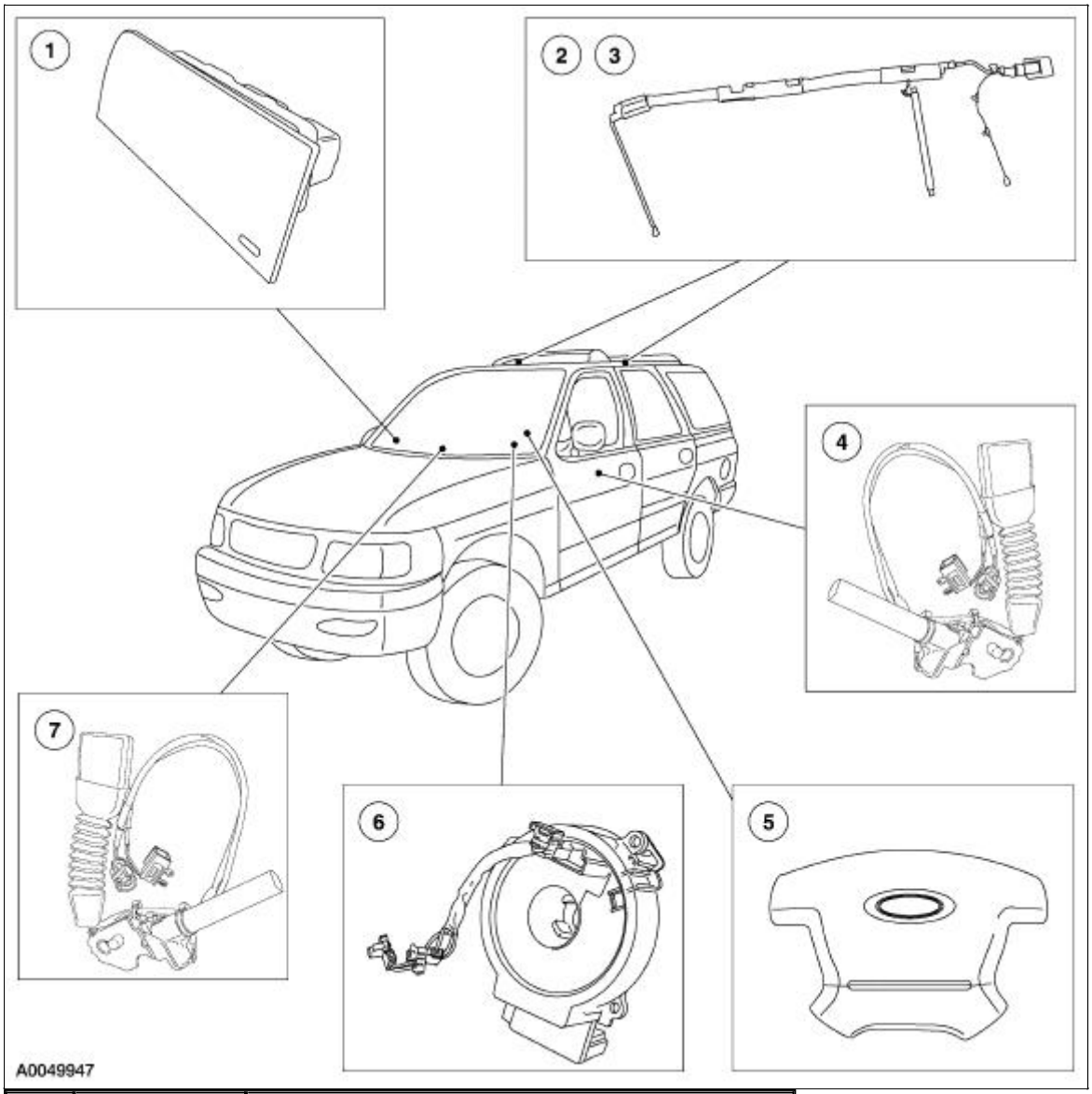
Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS)

The air bag supplemental restraint system (SRS) is designed to provide increased collision protection for front seat and second row outboard occupants in addition to that provided by the three-point safety belt system. Safety belt use is necessary to obtain the best occupant protection and to receive the full advantage of the SRS.

This vehicle line contains dual stage deployment (advanced restraint system) driver and front passenger air bag modules. These vehicles can also be equipped with optional safety canopies that deploy from the A-pillar to the C-pillar upon a side impact or if a rollover condition is detected. If equipped with safety canopies, a unique restraints control module (RCM) is used.

See the following illustration for deployable component location.

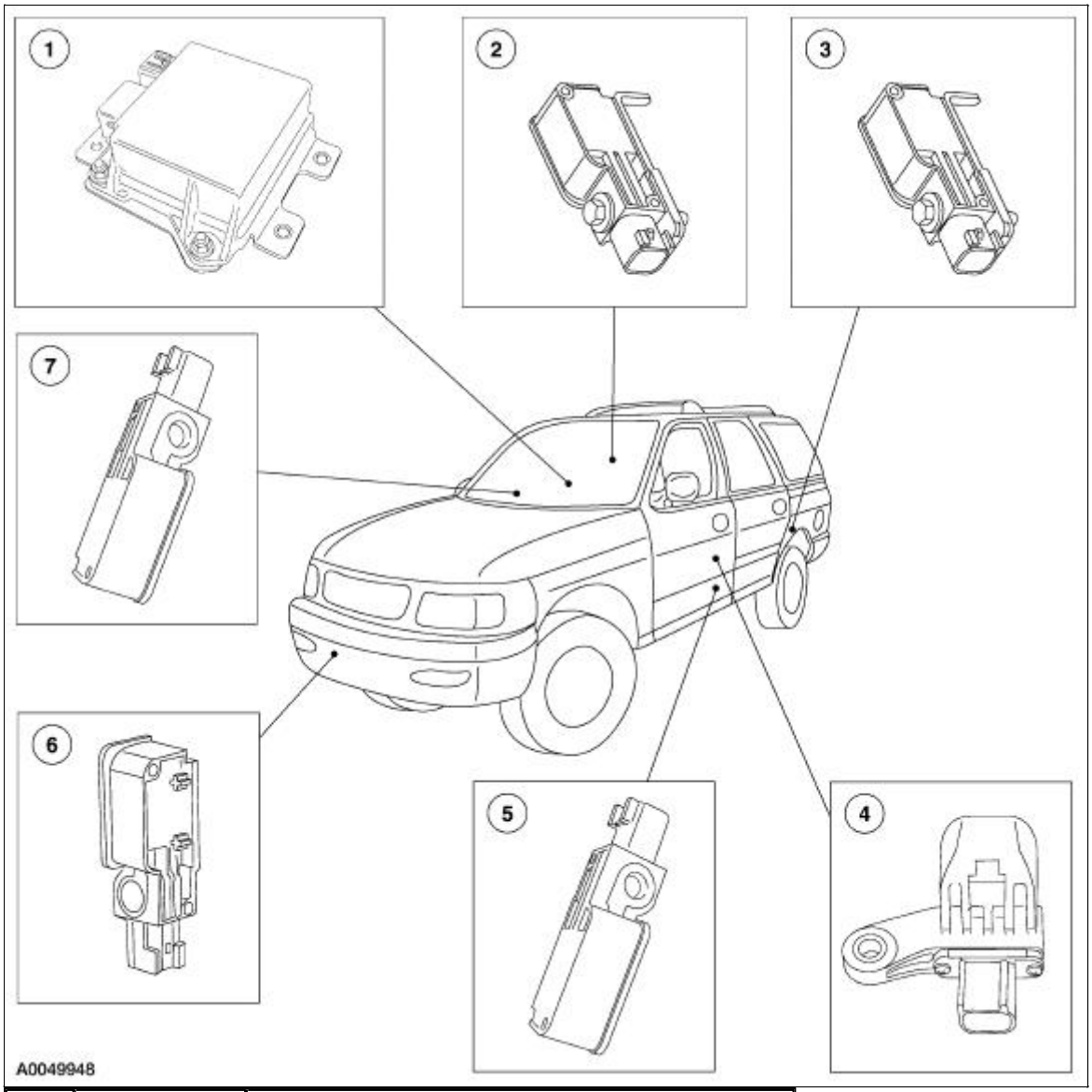
Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) Deployable Components



Item	Part Number	Description
1	611D10	Passenger air bag module
2	042D94	Passenger side safety canopy module
3	042D95	Driver side safety canopy module
4	61203	Driver safety belt buckle and pretensioner
5	043B13	Driver air bag module
6	14A664	Clockspring
7	61202	Passenger safety belt buckle and pretensioner

See the following illustration for sensor component location.

Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) Sensor Components



Item	Part Number	Description
1	14B321	Restraints control module (RCM)
2	14B345	Second row, C-pillar side impact sensor
3	14B345	Second row, C-pillar side impact sensor
4	14B416	Driver seat track position sensor
5	14B345	Front row, driver door, side impact sensor
6	14B006	Front impact severity sensor
7	14B345	Front row, passenger door, side impact sensor

Driver Air Bag Module

The driver air bag module:

- is installed new as an assembly.
- is mounted in the center of the steering wheel.
- cannot be interchanged between Expedition and Navigator vehicles.

Clockspring

The clockspring:

- is mounted on the steering column, behind the steering wheel.
- allows for continuous electrical connections between the driver air bag module and the restraints control module (RCM) when the steering wheel is turned.

Passenger Air Bag Module

The passenger air bag module:

- is installed new as an assembly.
- is mounted in the passenger side of the instrument panel.
- cannot be interchanged between Expedition and Navigator vehicles.

Safety Canopy Module

Some vehicles can be equipped with optional safety canopies for protection during side impacts or rollovers.

Vehicles equipped with safety canopies require a specific headliner. When installing a new headliner on a vehicle equipped with safety canopies, make sure a headliner for safety canopies is being used. The word "AIRBAG" will appear on the headliner where it meets each B-pillar trim panel.

The safety canopy module:

- is installed as an assembly.
- is mounted above the headliner.
- attaches from the A-pillar frame to the C-pillar frame.
- is standard equipment on the Navigator and optional on the Expedition.
- cannot be interchanged from side to side.

Safety Canopy Bridge Resistor

 **CAUTION: Do not deactivate the safety canopy module circuit by removing the bridge resistor from the electrical connector.**

If the safety canopy bridge resistor is removed, an open circuit fault will be generated by the restraints control module (RCM).

If a restraint system diagnostic tool is installed at the safety canopy electrical connector, a low resistance fault will be generated.

The safety canopy bridge resistor:

- is equipped only on Expedition, without optional safety canopy modules.
- must not be removed during deactivation.
- can be accessed with the headliner dropped and is located just behind the RH side second row courtesy light.

Safety Belt Pretensioners

As part of the SRS, the driver and front outboard passenger safety belt buckles are equipped with pretensioners. The safety belt buckle pretensioners remove excess slack from the safety belt webbing. The pretensioners are activated by the restraints control module (RCM) when the module detects a crash event force exceeding a programmed limit.

Safety Belt Buckle Switches

As part of the supplemental restraint system (SRS), the driver and front outboard passenger safety belt buckles are equipped with safety belt buckle switches. The safety belt buckle switches indicate to the restraints control module (RCM) whether the safety belts are connected or disconnected. The RCM uses this information in determining the deployment rate of the dual-stage driver and passenger air bag modules.

Seat Track Position Sensor

The seat track position sensor is mounted to a bracket attached to the inboard side of the seat track. The seat track position sensor informs the restraints control module (RCM) of the driver seat position. The RCM uses this information in determining the deployment rate of the dual-stage driver air bag module.

Restraints Control Module (RCM)

WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.

WARNING: The restraints control module (RCM) orientation is critical for correct system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) has been involved in a collision in which the center tunnel area has been damaged, inspect the mounting and bracket for deformation. If damaged, the RCM must be replaced whether or not the air bags have deployed. In addition, make sure the area of the RCM mounting is restored to its original condition.

NOTE: When installing a new restraints control module (RCM), always make sure the correct RCM is being installed. If an incorrect RCM is installed, erroneous DTCs will result.

The restraints control module (RCM) carries out the following functions:

- deploys the air bag(s) in the event of a deployable crash.
- activates the safety belt buckle pretensioners to remove slack from the safety belt.
- monitors the SRS for faults.
- illuminates the air bag indicator if a fault is detected.
- flashes the air bag indicator to indicate the lamp fault code (LFC) detected.
- communicates through the data link connector (DLC) the current or historical Diagnostic Trouble Codes (DTCs).
- signals the instrument cluster module to activate a chime if the air bag indicator is not available and another SRS fault exists.

The RCM monitors the SRS for possible faults. If a fault is detected while the ignition switch is in the ON position, the RCM will illuminate the air bag indicator located in the instrument cluster.

When the ignition is cycled (turned off and then on), the air bag indicator will prove out by lighting for six seconds and then off for two seconds. After the prove out, the air bag indicator will then flash the two-digit LFC. If an SRS fault exists, the air bag indicator will flash the LFC five times, then it will remain illuminated for the rest of the key cycle. The RCM will also communicate the current and historical DTCs through the DLC, to the scan tool. If the air bag indicator does not function, and the system detects a fault condition, the RCM will signal the instrument cluster module to activate an audible chime. The chime is a series of five sets of five tone bursts. If the chime is heard, the SRS and the air bag indicator require repair.

LFCs are prioritized. If two or more faults occur at the same time, the fault having the highest priority will be displayed. After that fault has been corrected, the next highest priority fault will be displayed.

The RCM includes a backup power supply. This feature provides sufficient backup power to deploy the front air bags and safety belt pretensioners in the event that the ignition circuit is lost or damaged during impact. The backup power supply will deplete its stored energy approximately one minute after the battery ground cable is disconnected.

Electrical System

The electrical system that supports the air bag SRS:

- is powered from the battery through the ignition circuit.
- provides the electrical path from the restraints control module (RCM) to the SRS components.
- provides the electrical path from the RCM to the air bag indicator.
- provides the electrical path from the RCM to the data link connector (DLC).
- provides the electrical path from the RCM to the instrument cluster module.

Sensors

 **WARNING: The restraints control module (RCM) orientation is critical for correct system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) has been involved in a collision in which the center tunnel area has been damaged, inspect the mounting and bracket for deformation. If damaged, the RCM must be replaced whether or not the air bags have deployed. In addition, make sure the area of the RCM mounting is restored to its original condition.**

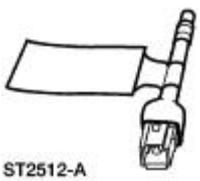
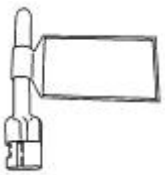
WARNING: Vehicle sensor orientation is critical for correct system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and correctly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

For these vehicles, the SRS uses up to eight sensors. Within the RCM there can be up to three safing sensors which are not separately serviced. The RCM will always have at least one safing sensor for front impact. Two more safing sensors are used if the vehicle is equipped with safety canopy modules. The RCM is mounted to the center tunnel beneath the console or bench seat. All vehicles will have a front impact severity sensor that is located in the front-center of the vehicle, mounted near the bottom of the hood latch support bracket. If the vehicle is equipped with safety canopy modules, there are four additional side impact sensors external to the RCM. One front row side impact sensor is located behind each of the front door interior trim panels. One second row side impact sensor is located at the base of each C-pillar. Mounting orientation is critical for correct operation of all impact and rollover sensors.

Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS)

Refer to Wiring Diagrams Cell 46 for schematic and connector information.

Special Tool(s)

 ST1137-A	FLUKE 73III Automotive Meter 105-R0057 or equivalent
 ST2502-A	Diagnostic Tool, Restraint System (2 req'd) 418-F395 (014-R1079)
 ST2512-A	Diagnostic Tool, Restraint System (1 req'd) 418-F403
 ST2507-A	Diagnostic Tool, Restraint System (2 req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 req'd) 418-F088 (105-R0012)
 ST2332-A	Worldwide Diagnostic System (WDS) 418-FS317 New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

Restraint System Diagnostic Tool Warning

WARNING: Restraint system diagnostic tools are for service only. Tools must be removed prior to operating the vehicle over the road. Failure to remove restraint system diagnostic tools could result in injury and possible violation of vehicle safety standards.

Diagnosing Customer Concerns Without Hard DTCs

If a lamp fault code (LFC) is reported by the customer but is not present when the vehicle comes in for service, follow the Diagnostic Instruction procedures in this section to identify the intermittent DTC.

Once the DTC is known, read the Normal Operation section of the pinpoint test for the DTC involved.

- Follow the deactivation procedure in this section.
- Determine the location of components involved in creating the DTC.
- Carry out a thorough visual inspection of:
  - components.
  - connectors.
  - splices and wiring harnesses.
  - insulation on conductors.

Refer to the Possible Causes section of the pinpoint test for the DTC involved, which lists the common concerns that relate to the DTC. Concerns are listed according to priority.

Diagnosing Customer Concerns with Hard DTCs

All Supplemental Restraint System (SRS) diagnostic procedures will require deactivation and reactivation of the system. Deactivation and reactivation require the disconnection of most SRS components and the installation of restraint system diagnostic tools. This reduces the risk of inadvertent deployment of SRS components while diagnostic procedures are being carried out.

Restraint system diagnostic tools are required for the diagnosis and testing of the SRS. It is not acceptable to short-circuit the air bag module connections with a jumper wire. If a jumper wire is used to short-circuit the air bag module connections, a lamp fault code (LFC) will be displayed.

Deactivation Procedure

WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.

The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

WARNING: Never probe the connectors on a safety canopy module. Doing so can result in safety canopy module deployment.

NOTE: Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road.**

NOTE: After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

1. **WARNING: To avoid accidental deployment and possible personal injury, the RCM backup power supply must be depleted before repairing or replacing any front or side air bag (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

   The second row side impact sensors (if equipped) are located at or near the base of the C-pillars.

   Disconnect the battery ground cable (14301) and wait for one minute. For additional information, refer to Section 414-01 .

2. Remove the driver air bag module. For additional information, refer to Driver Air Bag Module in this section.

3. Attach restraint system diagnostic tools 418-F395 (2 required) to the clockspring side of the driver air bag module electrical connectors.

4. Open the glove compartment to its fullest extent by pushing in on the tabs and releasing the glove compartment.

5. Disconnect the passenger air bag module electrical connector.

6. Attach restraint system diagnostic tool 418-F403 to the harness side of the passenger air bag

module electrical connector.

7. **NOTE:** For vehicles without safety canopies, do not deactivate the safety canopy module circuit by removing the safety canopy bridge resistor from the safety canopy bridge resistor electrical connector.

   If the safety canopy bridge resistor is removed, an open circuit fault will be generated by the RCM.

   If a restraint system diagnostic tool is installed at the safety canopy electrical connector, a low resistance fault will be generated by the RCM.

   The safety canopy bridge resistor is located on the RH side of the vehicle above the headliner.

   Do not disconnect the safety canopy bridge resistor.

8. Vehicles with safety canopies:
   1. Separate the passenger side C-pillar trim panel. For additional information, refer to Section 501-05 .
   2. Disconnect the passenger side safety canopy electrical connector, located on the C-pillar behind the second row safety belt shoulder height adjuster.
   3. Attach a restraint system diagnostic tool 418-F088 (105-R0012) to the vehicle harness side of the passenger side safety canopy electrical connector.

9. From under the passenger front seat, disconnect the safety belt buckle pretensioner electrical connector.

10. Attach restraint system diagnostic tool 418-133 to the passenger front seat safety belt buckle pretensioner electrical connector.

11. Vehicles with safety canopies:
    1. Separate the driver side C-pillar trim panel. For additional information, refer to Section 501-05 .
    2. Disconnect the driver side safety canopy electrical connector, located on the C-pillar behind the second row safety belt shoulder height adjuster.
    3. Attach a restraint system diagnostic tool 418-F088 (105-R0012) to the vehicle harness side of the driver side safety canopy electrical connector.

12. From under the driver front seat, disconnect the safety belt buckle pretensioner electrical connector.

13. Attach restraint system diagnostic tool 418-133 to the driver front seat safety belt buckle pretensioner electrical connector.

14. Reconnect the battery ground cable. For additional information, refer to Section 414-01 .

15. Prove out the system.

Reactivation Procedure

WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the deactivation procedure.

1. Disconnect the battery ground cable and wait one minute. For additional information, refer to Section 414-01 .

2. From under the driver front seat, disconnect the restraint system diagnostic tool and connect the

driver front seat safety belt buckle pretensioner electrical connector.

3. Vehicles with safety canopies:
    1. Remove the restraint system diagnostic tool from the driver side safety canopy electrical connector.
    2. Connect the driver side safety canopy electrical connector.
    3. Install the driver side C-pillar trim panel. For additional information, refer to Section 501-05 .
4. From under the passenger front seat, disconnect the restraint system diagnostic tool and connect the passenger front seat safety belt buckle pretensioner electrical connector.
5. Vehicles with safety canopies:
    1. Remove the restraint system diagnostic tool from the passenger side safety canopy electrical connector.
    2. Connect the passenger side safety canopy electrical connector.
    3. Install the passenger side C-pillar trim panel. For additional information, refer to Section 501-05 .
6. Remove the restraint system diagnostic tool from the passenger air bag module electrical connector.
7. Connect the passenger air bag module electrical connector.
8. Remove the restraint system diagnostic tools from the driver air bag module electrical connectors.
9. Install the driver air bag module. For additional information, refer to Driver Air Bag Module .
10. Reconnect the battery ground cable. For additional information, refer to Section 414-01 .
11. Prove out the system.

Prove Out Procedure

Turn the ignition switch from the OFF to the ON position and visually monitor the air bag indicator with all SRS components connected or restraint system diagnostic tools installed. The air bag indicator will light continuously for approximately six seconds and then turn off. If an SRS fault is present, the air bag indicator will either:

- fail to light.
- remain lit continuously.
- flash.

The flashing might not occur until approximately 30 seconds after the ignition switch has been turned from the OFF to the ON position. This is the time required for the restraints control module (RCM) to complete the testing of the SRS. If the air bag indicator is inoperative and an SRS fault exists, a chime will sound in a pattern of five sets of five beeps. If this occurs, the air bag indicator will need to be repaired before diagnosis can continue.

Glossary

Secondary Air Bag Warning

The secondary air bag warning is an audible fault format that consists of five sets of five tone bursts, with each set of five tone bursts separated by a five second quiet period. One tone burst cycle will

consist of one second ON and one second OFF. This series of five activations is repeated every 30 minutes.

Air Bag/Pretensioner Restraint System Diagnostic Tools

Air bag/pretensioner restraint system diagnostic tools are used to simulate the equivalent resistance of an air bag module or safety belt pretensioner during certain diagnostic procedures.

Disconnect the Component

Disconnect the component means disconnect the component vehicle harness connector. It does not mean remove the component. Do not reconnect a disconnected component unless instructed to do so.

Deactivate the System

Deactivate the system means to carry out a deactivation procedure. For additional information, refer to Deactivation Procedure in this section.

Prove Out the System

Prove out the system means to turn the ignition switch from the OFF to the ON position and visually monitor the air bag indicator with the air bag modules and safety belt pretensioners or restraint system diagnostic tools installed. For additional information, refer to Prove Out Procedure in this section.

Reactivate the System

Reactivate the system means to carry out the reactivation procedure. For additional information, refer to Reactivation Procedure in this section.

Reconnect the System

Reconnect the system means to reconnect all system components. For additional information, refer to Air Bag System Reconnect Checklist in this section.

Install a New Component

Install a new component means to remove the existing component and install a new authorized part obtained from Ford Customer Service Division.

Verify the System

Verify the system means to prove out the system with restraint system diagnostic tools installed in place of the SRS components.

Air Bag Reconnect Checklist

The checklist below should be completed following diagnosis or repair of any air bag system concern:

- All restraint system diagnostic tools removed?
- All in-seat harness connectors connected?
- All air bag modules connected?
- Safety belt pretensioner connectors connected?
- Restraints control module (RCM) connected?

- All sensors (front and side impact sensors) connected?
- Battery connected?

Diagnostic Instructions —Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS)

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-FS317 New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

The symptom chart can be used to help locate supplemental restraint system (SRS) concerns if no diagnostic trouble codes (DTCs) are retrieved and the listed symptoms are observed. Whether or not the listed symptoms are observed, always carry out the following:

1. Retrieve all DTCs stored in the restraints control module (RCM) memory. For additional information, refer to Retrieve/Clear Continuous DTCs in this section.

2. Run the On-Demand Self Test to determine what DTCs are currently being sensed by the RCM. Refer to On-Demand Self Test in this section.

3. If the stored DTCs are different than the current DTCs, always repair the current DTCs first.

4. If memory displays different continuous DTCs than the On-Demand Self Test, carry out in the following order:

- On-Demand Self Test
- Memory (Retrieve/Clear Continuous DTCs)

A DTC can indicate several concerns. The DTCs are to assist in system diagnosis and are not to be considered definitive. Always refer to the pinpoint test corresponding to the DTC to determine where the concern lies and to repair the concern correctly.

The SRS diagnostics can be divided into three sections:

- diagnostic test modes
- PID/data monitor and record
- active command modes

Diagnostic Test Modes

Two menu options are available under the diagnostic test modes:

- Retrieve/Clear Continuous DTCs

- On-Demand Self Test

Retrieve/Clear Continuous DTCs

During vehicle operation, the restraints control module (RCM) will detect and store both intermittent and hard failure DTCs in nonvolatile memory. The DTC strategy employed by the RCM incorporates a time-out scheme for determining when a concern exists in the system. This requires a concern to exist for up to one minute in the system before the RCM will detect it. For the RCM to determine that a concern no longer exists, the concern must be absent for up to one minute. The actual detection time-outs vary with each DTC. The DTCs can be retrieved with a scan tool using the retrieve/clear continuous DTCs option. Any DTCs stored in the RCM will be displayed on the scan tool along with a brief description of the DTC. If no DTCs are present, the scan tool will display a SYSTEM PASSED message. This option can also be used to clear DTCs from the RCM memory, as long as the concern no longer exists. Once 128 key cycles have been recorded since the concern was last detected, the DTC will automatically be removed from memory.

To retrieve or clear DTCs, follow these steps:

5. Connect the scan tool to the data link connector (DLC).
6. Turn the ignition switch to the ON position.
7. Follow the manufacturer's instructions for the scan tool being used.
8. **NOTE:** Before proceeding with the clearing operation, make note of the DTCs displayed. Once cleared, DTCs cannot be retrieved.

   All continuous DTCs will be displayed on the screen.
9. Clear the DTCs. After clearing the DTCs, cycle the key OFF, then ON.
   - Continuous DTCs that have been cleared will **not** re-occur as "Continuous" in the same key cycle. Only new DTCs which were **not** present before clearing can occur as "Continuous" after clearing.

On-Demand Self Test

The On-Demand Self Test option is used to verify that no electrical concerns exist with the air bag SRS. Upon entering the self-test, the restraints control module (RCM) will make an electrical check of each electrical component in the system. If a concern is detected, a DTC is displayed on the scan tool with a brief description of the DTC. Concerns detected during the self-test are not stored in memory, unless the same concern was also detected during normal vehicle operation. The self-test should always be run after any repair to verify that the repair was successful.

To run the On-Demand Self Test, follow these steps:

1. Connect the scan tool to the data link connector (DLC).
2. Turn the ignition switch to the ON position.
3. Follow the manufacturer's instructions for the scan tool being used.
4. The RCM will run the On-Demand Self Test and display on-demand DTCs (reflecting hard system concerns) on the screen.

Bit-Mapped Diagnostic Trouble Codes (DTCs)

Many of the continuous and on-demand DTCs that can be present in the RCM are bit-mapped DTCs that utilize PIDs (flagged faults). Bit-mapped DTCs are conceptually different from the previous style of DTCs. Previously, DTCs identified a specific concern for a given component and pointed to a particular diagnostic path. In the diagnostic path, PIDs are sometimes used to determine the root cause. Bit-mapped DTCs do not identify the specific concern. A bit-mapped DTC identifies the component(s) in which the concern exists. The next level (PIDs or flagged faults) identifies the specific concern.

A scan tool must be used to view the PIDs (flagged faults) of a bit-mapped DTC. Once a scan tool has retrieved a bit-mapped DTC, the scan tool will provide the option to "FLAG" that DTC. When the option to "FLAG" the DTC is available, it must be carried out to identify the specific concern that is present. When the option to "FLAG" the DTC has been carried out, the scan tool will then display the PIDs (flagged faults) for that DTC, including the status or state that exists (on-demand DTC) or existed (continuous DTC).

To view and flag bit-mapped DTCs, follow these steps:

1. Connect the scan tool to the data link connector (DLC).
2. Turn the ignition switch to the ON position.
3. Follow the manufacturer's instructions for the scan tool being used.
4. Carry out an On-Demand Self Test or retrieve continuous DTCs.
5. Select the DTC and the "FLAG" option on the scan tool.
6. The scan tool will display PIDs for the DTC. Record all flagged faults.

PID/Data Monitor and Record

The PID/Data Monitor and Record option allows the scan tool operator to read the state of several parameter IDs (PIDs) to aid in diagnosing the system. PIDs are real time measurements of parameters such as voltages, resistances, etc., calculated by the restraints control module (RCM) and sent to the scan tool for display. Many of the PIDs supported by the RCM are calculated periodically and are, therefore, not true real time readings.

To retrieve PIDs, follow these steps:

1. Connect the scan tool to the data link connector (DLC).
2. Turn the ignition switch to the ON position.
3. Follow the manufacturer's instructions for the scan tool being used.
4. Record all PIDs that are to be retrieved and initiate PID retrieval. PIDs are updated continuously on the display.

Active Commands

Instrument Cluster Module

These commands allow the technician to verify the operation of instrument cluster module components and sub-systems.

Restraints Control Module

These commands allow the technician to verify operation of the supplemental restraint system (SRS) indicator lamps.

Lamp Fault Codes

When the restraints control module (RCM) detects a system fault, it will cause the air bag indicator to flash a coded sequence: a lamp fault code (LFC). The code is two digits. The first digit is flashed with a 0.5 second interval between pulses. There is a 2 second pause before the second digit is flashed, which also has a 0.5 second interval between pulses. There is a 5 second pause between each display of an LFC.

Each LFC is flashed five times after which the air bag indictor will remain lit for the remainder of the key-on cycle. If there are multiple LFCs, each LFC will flash in order of priority.

Diagnostic Trouble Codes (DTCs)

While the lamp fault codes (LFCs) are an indication of a general concern in the passive restraints system, the diagnostic trouble codes (DTCs) are more specific. The DTCs can be retrieved from the restraints control module (RCM) with a scan tool via the data link connector (DLC).

Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Table

DTC [a]	LFC [b]	Description	Action To Take
—	Continuous	The Air Bag Indicator is Illuminated Continuously, RCM Disconnected or Inoperative, Loss of Battery Feed, or Loss of Signal Ground	Go To Pinpoint Test A .
B1231	13	Crash Data Memory Full	Install a new RCM and impact sensors. REFER to Inspection and Repair After a Supplemental Restraint System (SRS) Deployment .
B1317	Continuous	Battery Voltage High	CHECK battery voltage; to be below 16 volts. REFER to Section 414-00 .
B1318	Continuous	Battery Voltage Low	CHECK battery voltage; to be above 9.0 volts. REFER to Section 414-00 .
B1342	12	RCM Is Faulted	Install a new RCM.
B1869	NONE Continuous lamp	Lamp Air Bag Warning Indicator Circuit Open or Short to Ground	Go To Pinpoint Test B .

	Secondary air bag warning sounds if another fault is present		
B1870	NONE Secondary air bag warning sounds if another fault is present	Air Bag Warning Indicator Circuit Short to Battery	Go To Pinpoint Test C .
B1891	53	Air Bag Tone Warning Indicator Circuit Short to Battery	Go To Pinpoint Test D .
B1892	53	Air Bag Tone Warning Indicator Circuit Open or Shorted to Ground	Go To Pinpoint Test E .
B1921	14	Air Bag Diagnostic Monitor Ground Circuit Open	Go To Pinpoint Test F .
B2292	33	Restraint System — Safety Belt Pretensioner Status (Driver Pretensioner Circuit Fault)	Go To Pinpoint Test G .
B2292	34	Restraint System — Safety Belt Pretensioner Status (Passenger Pretensioner Circuit Fault)	Go To Pinpoint Test G .
B2293	19	Restraint System — Air Bag Status (Driver Front Air Bag Circuit Fault)	Go To Pinpoint Test H .
B2293	21	Restraint System — Air Bag Status (Passenger Front Air Bag Circuit Fault)	Go To Pinpoint Test H .
B2294	24	Restraint System — Safety Canopy Module Status (Driver Side Safety Canopy Circuit Fault)	Go To Pinpoint Test I .
B2294	25	Restraint System — Safety Canopy Module Status (Passenger Side Safety Canopy Circuit Fault)	Go To Pinpoint Test I .
B2296	42	Restraint System — Impact Sensor Status (Front Impact Severity Sensor Circuit Fault)	Go To Pinpoint Test J .
B2296	43	Restraint System — Impact Sensor Status (Driver Side Front Row Impact Sensor Circuit Fault)	Go To Pinpoint Test J .
B2296	45	Restraint System — Impact Sensor Status (Driver Side Second Row Impact Sensor Circuit Fault)	Go To Pinpoint Test J .
B2296	44	Restraint System — Impact Sensor Status (Passenger Side Front Row Impact Sensor Circuit Fault)	Go To Pinpoint Test J .
B2296	46	Restraint System — Impact Sensor Status (Passenger Side Second Row Impact Sensor Circuit Fault)	Go To Pinpoint Test J .
B2691	51	Driver Safety Belt Buckle Switch Circuit Fault	Go To Pinpoint Test K .
B2434	51	Driver Safety Belt Buckle Switch Circuit Short To Ground	Go To Pinpoint Test L .
B2435	51	Driver Safety Belt Buckle Switch Circuit Resistance Out Of Range	Go To Pinpoint Test M .

B2692	52	Passenger Safety Belt Buckle Switch Circuit Fault	Go To Pinpoint Test N .
B2438	52	Passenger Safety Belt Buckle Switch Circuit Short To Ground	Go To Pinpoint Test O .
B2439	52	Passenger Safety Belt Buckle Switch Circuit Resistance Out Of Range	Go To Pinpoint Test P .
B2477	Continuous	Module Configuration Error	INSTALL a new RCM
C1414	15	Incorrect Vehicle ID	Go To Pinpoint Test Q .
C1947	49	Seat Track Position Sensor Circuit Short to Ground	Go To Pinpoint Test R .
C1948	49	Seat Track Position Sensor Circuit Resistance Out Of Range	Go To Pinpoint Test S .
C1981	49	Seat Track Position Sensor Circuit Fault	Go To Pinpoint Test T .
—	—	No Communication with the restraints control module.	REFER to Symptom Chart in this section.

[a] DTC: Diagnostic trouble code, retrieved using scan tool.
[b] LFC: Lamp fault code, flashed on air bag indicator.

Inspection and Verification

1. Verify the customer concern by checking the air bag indicator in the instrument cluster. For additional information, refer to Prove Out the System in this section.

2. Visually inspect for obvious signs of mechanical and electrical damage using the following chart.

Visual Inspection Chart

Mechanical	Electrical
● Damaged restraints control module (RCM) bracket ● Damaged front impact severity sensor or bracket ● Damaged side impact sensor or bracket	● Open fuse(s) ● Damaged wiring harness ● Loose or corroded connectors ● Circuitry open/shorted ● Damaged shorting bars

3. If the concern is not visually evident, use the scan tool to retrieve diagnostic trouble codes (DTCs) and carry out the on-demand self test.

4. If the on-demand self test is passed and no DTCs are retrieved, GO to Symptom Chart .

5. If DTCs are retrieved, refer to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Table.

Symptom Chart

Symptom Chart

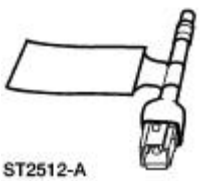
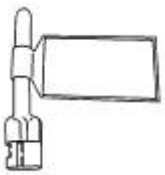
Condition	Possible Sources	Action

• Air bag warning indicator is illuminated continuously	• Fuse to RCM. • Damaged wiring, terminals, or connectors. • A faulty diagnostic connector. • A faulted RCM.	• Go To Pinpoint Test A .
• Air bag indicator flashing	• Air bag/pretensioner supplemental restraint system (SRS) fault.	• REFER to DTC Priority Table.
• Audible tone — DTCs retrieved	• Air bag SRS system fault.	• REFER to DTC Priority Table.
• No communication with the restraints control module (RCM)	• Scan tool. • Data link connector (DLC). • RCM • Circuitry.	• Go To Pinpoint Test U .

Pinpoint Tests —Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS)

Refer to Wiring Diagrams Cell 46 for schematic and connector information.

Special Tool(s)

 ST1137-A	FLUKE 73 III Automotive Meter 105-R0057 or equivalent
 ST2502-A	Diagnostic Tool, Restraint System (2 req'd) 418-F395 (014-R1079)
 ST2512-A	Diagnostic Tool, Restraint System (1 req'd) 418-F403
 ST2507-A	Diagnostic Tool, Restraint System (2 req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 req'd) 418-F088 (105-R0012)
 ST2332-A	Worldwide Diagnostic System (WDS) 418-FS317 New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

Restraint System Diagnostic Tool Warning

WARNING: Restraint system diagnostic tools are for service only. Tools must be removed

prior to operating the vehicle over the road. Failure to remove restraint system diagnostic tools could result in injury and possible violation of vehicle safety standards.

Pinpoint Test A: The Air Bag Warning Indicator Is Illuminated Continuously — RCM Disconnected or Inoperative, Loss of Battery Feed, or Loss of Signal Ground

Normal Operation

NOTE: During normal operation, the air bag indicator will illuminate continuously for 6 seconds after the ignition switch is placed to the ON or START position and after five cycles of a lamp fault code (LFC), if a fault exists. Be sure to cycle the ignition switch and look for a 6 second indicator prove-out without LFCs.

The restraints control module (RCM) will communicate diagnostic trouble codes (DTCs) to the scan tool through the data link connector (DLC). If the scan tool displays NO COMMUNICATION when retrieving continuous DTCs, Go To Pinpoint Test U to troubleshoot the system.

Possible Causes

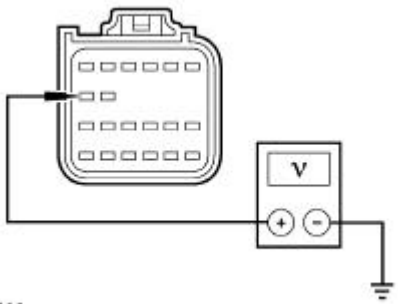
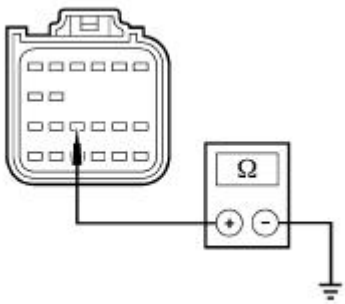
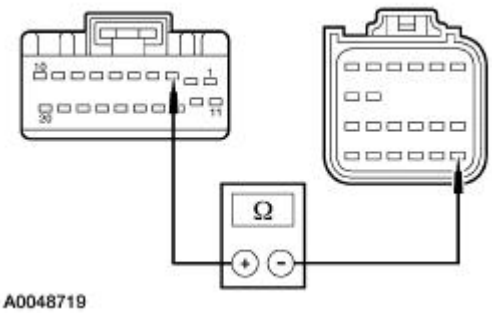
An air bag indicator that is illuminated continuously can be caused by one of the following:

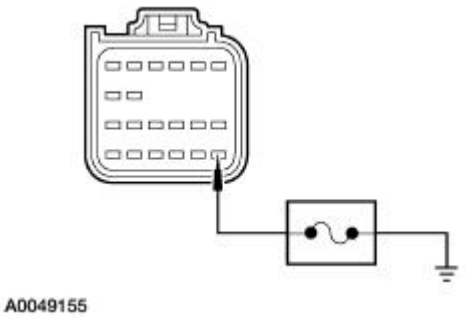
- damaged ignition circuit.
- RCM disconnected from the vehicle harness.
- a loss of RCM signal ground.
- a faulted RCM.
- damaged wiring, terminals, or connectors.
- a loss of RCM battery feed.
- a faulted instrument cluster

PINPOINT TEST A: THE AIR BAG WARNING INDICATOR IS ILLUMINATED CONTINUOUSLY — RCM DISCONNECTED OR INOPERATIVE, LOSS OF BATTERY FEED, OR LOSS OF SIGNAL GROUND

Test Step	Result / Action to Take
NOTE: Vehicles equipped with a 60/40 split bench seat require removal of the RCM to allow the electrical connectors to be disconnected. It will be necessary to reinstall the RCM after connecting the RCM electrical connectors before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. For additional information, refer to Restraints Control Module (RCM) in this section.	
A1 CHECK FOR CONTINUOUS OR ON-DEMAND SELF TEST DTCs ● Enter the following diagnostic mode on the diagnostic tool: Retrieve Continuous DTCs. ● Retrieve and record any continuous DTCs for use later in this pinpoint test. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● **Were any continuous or on-demand self test DTCs retrieved?**	**Yes** If continuous DTCs were retrieved, GO to A2 . If on-demand DTCs were retrieved, GO to the Restraints

	Control Module (RCM) Diagnostic Trouble Code (DTC) Table in this section for pinpoint test direction. **No** GO to A2 .
A2 CHECK THE RCM CONNECTION	
WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury. WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. • Key in OFF position. • Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. • Connect: RCM C310a. • Make sure RCM C310a is connected and fully seated. • **Is RCM C310a fully connected and the connector locking tab engaged?**	**Yes** GO to A3 . **No** CONNECT C310a and ENGAGE the locking tab. GO to A7 .

A3 CHECK CIRCUIT 609 (OG/YE) FOR AN OPEN	
• For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Disconnect: RCM C310a. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Key in ON position. • Measure the voltage between RCM C310a pin 12, circuit 609 (OG/YE), harness side and ground.  A0039638 • **Is the voltage between 9 and 16 volts?**	**Yes** GO to A4 . **No** REPAIR circuit 609 (OG/YE).
A4 CHECK CIRCUIT 649 (BK/OG) FOR AN OPEN	
• Key in OFF position. • Measure the resistance between RCM C310a pin 16, circuit 649 (BK/OG), harness side and ground.  A0039639 • **Is the resistance less than 5 ohms?**	**Yes** GO to A5 . **No** REPAIR circuit 649 (BK/OG). GO to A7 .
A5 CHECK CIRCUIT 608 (BK/YE) FOR AN OPEN	
• Disconnect: Instrument Cluster C220a. • Measure the resistance between instrument cluster module C220a pin 3, circuit 608 (BK/YE), harness side and RCM C310a pin 19, circuit 608 (BK/YE), harness side.  A0048719 • **Is the resistance less than 5 ohms?**	**Yes** GO to A6 . **No** REPAIR circuit 608 (BK/YE).GO to A7 .
A6 CHECK THE INDICATOR LAMP OPERATION (DRIVE LAMP OFF)	
• Connect: Instrument Cluster C220a.	**Yes**

• Key in ON position. • Connect a fused jumper between the RCM C310a pin 19, circuit 608 (BK/YE), harness side and ground.  A0049155 • **Is the indicator lamp off ?**	INSTALL a new RCM. REFER to Restraints Control Module (RCM) in this section. GO to A7 . **No** REPAIR or INSTALL a new instrument cluster module. REFER to Section 413-01 . GO to A7 .
A7 CHECK FOR ADDITIONAL DTCs	
• Refer to the continuous DTCs recorded during Step A1. • **Were any continuous DTCs retrieved during Step A1?**	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Table in this section for pinpoint test direction. **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. CLEAR all DTCs.

Pinpoint Test B: DTC B1869 — Lamp Air Bag Warning Indicator Circuit Open or Short to Ground

Normal Operation

If the restraints control module (RCM) detects an open or short to ground on the air bag warning indicator circuit, it will store diagnostic trouble code (DTC) B1869 in memory.

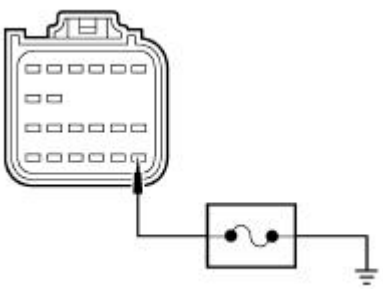
Possible Causes

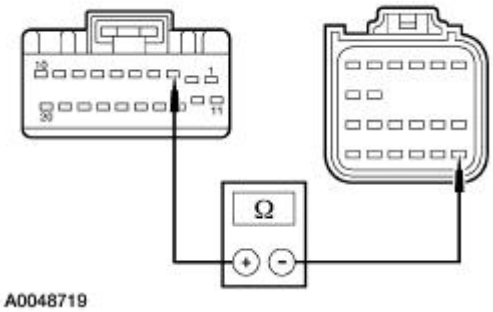
An air bag indicator circuit failure can be caused by:

- damaged wiring, terminals, or connectors.
- a faulted RCM.
- a faulty indicator bulb.
- an instrument cluster module internal concern.

PINPOINT TEST B: DTC B1869 — LAMP AIR BAG WARNING INDICATOR CIRCUIT OPEN OR SHORT TO GROUND

Test Step	Result / Action to Take
NOTE: Vehicles equipped with a 60/40 split bench seat require removal of the RCM to allow the electrical connectors to be disconnected. It will be necessary to reinstall the RCM after connecting the RCM electrical connectors before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. For additional information, refer to Restraints Control Module (RCM) in this section.	
B1 CHECK FOR A HARD OR INTERMITTENT DTC • Enter the following diagnostic mode on the diagnostic tool: Retrieve Continuous DTCs. • Retrieve and record any continuous DTCs for use later in this pinpoint test. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • **Was DTC B1869 retrieved during the on-demand self test?**	**Yes** If the air bag indicator lamp **does** illuminate,GO to B2 . If the air bag indicator **does not** illuminate,GO to B4 . **No** This is an intermittent fault. The fault condition is not present at this time. GO to B5 .
B2 CHECK THE INDICATOR LAMP OPERATION (DRIVE LAMP OFF) **WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.** **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal**	**Yes** INSTALL a new RCM. REFER to Restraints Control Module (RCM) in this section. GO to B6 . **No** GO to B3 .

injury. **WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.** **WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury.** **WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. • Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. • For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Disconnect: RCM C310a. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Key in ON position. • Connect a fused jumper between the RCM C310a pin 19, circuit 608 (BK/YE), harness side and ground.  A0049155 • **Is the indicator lamp off?**	
B3 CHECK CIRCUIT 608 (BK/YE) FOR AN OPEN	
• Key in OFF position. • Disconnect: Instrument Cluster Module C220a. • Measure the resistance between instrument cluster module C220a pin 3, circuit 608 (BK/YE), harness side and RCM C310a pin 19, circuit 608 (BK/YE), harness side.	**Yes** REPAIR or INSTALL a new instrument cluster module. REFER to Section 413-01 . GO to B6 . **No**

 A0048719 • **Is the resistance less than 5 ohms?**	REPAIR circuit 608 (BK/YE).GO to B6 .
B4 CHECK THE INDICATOR LAMP OPERATION (DRIVE LAMP ON)	
• Key in OFF position. • For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Disconnect: RCM C310a. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Key in ON position. • **Is the indicator lamp on?**	**Yes** INSTALL a new RCM. REFER to Restraints Control Module (RCM) in this section. GO to B6 . **No** REPAIR circuit 608 (BK/YE). GO to B6 .
B5 CHECK FOR AN INTERMITTENT FAULT	
WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury. WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools	**Yes** GO to B2 . **No** CHECK for causes of intermittent open or short to ground on circuit 608 (BK/YE). ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to B6 .

must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. ● Key in OFF position. ● Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● **Was DTC B1869 retrieved during the on-demand self test?**	
B6 CHECK FOR ADDITIONAL DTCs	
● Refer to the continuous DTCs recorded during Step B1. ● **Were any continuous DTCs retrieved during Step B1?**	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction. **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. CLEAR all DTCs.

Pinpoint Test C: DTC B1870 — Air Bag Warning Indicator Circuit Short to Battery

Normal Operation

If the restraints control module detects an open or short to battery on the air bag warning indicator circuit, it will store diagnostic trouble code (DTC) B1870 in memory. If any other DTCs are detected with this DTC active, the secondary air bag warning will be activated.

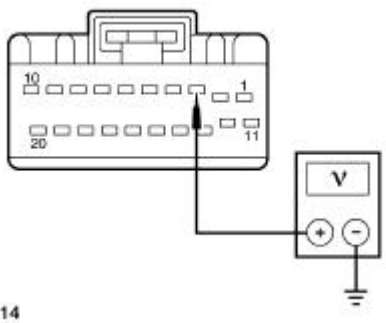
Possible Causes

An air bag indicator circuit short to battery can be caused by:

- damaged wiring, terminals, or connectors.
- a faulted RCM.

PINPOINT TEST C: DTC B1870 — AIR BAG INDICATOR CIRCUIT SHORT TO BATTERY

Test Step	Result / Action to Take
NOTE: Vehicles equipped with a 60/40 split bench seat require removal of the RCM to allow the electrical connectors to be disconnected. It will be necessary to reinstall the RCM after connecting the RCM electrical connectors before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. For additional information, refer to Restraints Control Module (RCM) in this section.	
C1 CHECK FOR A HARD OR INTERMITTENT DTC • Enter the following diagnostic mode on the diagnostic tool: Retrieve Continuous DTCs. • Retrieve and record any continuous DTCs for use later in this pinpoint test. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • **Was DTC B1870 retrieved during the on-demand self test?**	**Yes** GO to C2. **No** This is an intermittent fault. The fault condition is not present at this time. GO to C4.
C2 CHECK CIRCUIT 608 (BK/YE) FOR A SHORT TO BATTERY **WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.** **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury. WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on a safey canopy module. Doing so can**	**Yes** GO to C3. **No** REPAIR circuit 608 (BK/YE). GO to C5.

result in safety canopy deployment. NOTE: Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. **NOTE:** Any DTCs for air bag indicator faults associated with the instrument cluster module will be logged by the RCM. ● Key in OFF position. ● Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. ● For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . ● Disconnect: Instrument Cluster Module C220a. ● Disconnect: RCM C310a. ● For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . ● Key in ON position. ● Measure the voltage between C220a pin 3, circuit 608 (BK/YE), harness side and ground.  A0049214 ● **Is the voltage less than 0.2 volt?**	
C3 CHECK THE RCM	
● Key in OFF position. ● For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . ● Connect: RCM C310a. ● For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● **NOTE:** DTC B1869 should be retrieved when carrying out the on-demand self test due to an open on circuit 608 (BK/YE), DTC B1870 should not be retrieved at this time. ● **Was DTC B1870 retrieved during the on-demand self test?**	**Yes** INSTALL a new RCM. REFER to Restraints Control Module (RCM) in this section. GO to C5 . **No** REPAIR or INSTALL a new instrument cluster module. REFER to Section 413-01 . GO to C5 .

C4 CHECK FOR AN INTERMITTENT FAULT	
WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury. WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. • Key in OFF position. • Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • **Was DTC B1870 retrieved during the on-demand self test?**	**Yes** GO to C2 . **No** CHECK for causes of intermittent short to battery on circuit 608 (BK/YE). ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. ACTIVATE other systems in the same wire bundle. REPAIR any intermittent concerns found. GO to C5 .
C5 CHECK FOR ADDITIONAL DTCs	
• Refer to the continuous DTCs recorded during Step C1. • **Were any continuous DTCs retrieved during Step C1?**	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code

	(DTC) Table in this section for pinpoint test direction. **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. CLEAR all DTCs.

Pinpoint Test D: DTC B1891 — Air Bag Tone Warning Indicator Circuit Short to Battery

Normal Operation

The restraints control module (RCM) monitors its connection to the instrument cluster module at C310a pin 22. This connection is used to signal a chime if the air bag indicator is inoperative and another SRS fault exists. If the RCM detects a short to battery on the connection to the instrument cluster module, it will store diagnostic trouble code (DTC) B1891 in memory.

Possible Causes

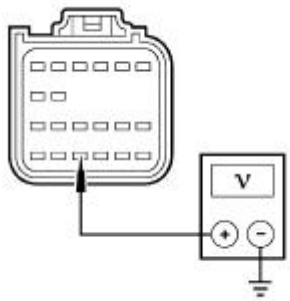
An air bag tone warning circuit short to battery or ignition can be caused by:

- damaged wiring, terminals, or connectors.
- a damaged or inoperative instrument cluster module.
- a faulted RCM.

PINPOINT TEST D: DTC B1891 — AIR BAG TONE WARNING INDICATOR CIRCUIT SHORT TO BATTERY

Test Step	Result / Action to Take
NOTE: Vehicles equipped with a 60/40 split bench seat require removal of the RCM to allow the electrical connectors to be disconnected. It will be necessary to reinstall the RCM after connecting the RCM electrical connectors before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. For additional information, refer to Restraints Control Module (RCM) in this section.	
D1 CHECK FOR A HARD OR INTERMITTENT DTC ● Enter the following diagnostic mode on the diagnostic tool: Retrieve Continuous DTCs. ● Retrieve and record any continuous DTCs for use later in this pinpoint test. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand	**Yes** This is a hard fault. The fault condition is still present. This

Self Test. ● **Was DTC B1891 retrieved during the on-demand self test?**	fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to D2 . **No** This is an intermittent fault. The fault condition is not present at this time. GO to D4 .
D2 CHECK THE AIR BAG TONE WARNING INDICATOR CIRCUIT FOR A SHORT TO BATTERY	
WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury. WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. ● Key in OFF position. ● Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner	**Yes** GO to D3 . **No** REPAIR circuit 1083 (LB/BK).GO to D5 .

Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. • For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Disconnect: RCM C310a. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Disconnect: Instrument Cluster Module C220a. • Key in ON position. • Measure the voltage between RCM C310a pin 22, circuit 1083 (LB/BK), harness side and ground.  A0049254 • **Is the voltage less than 0.2 volt?**	
D3 CHECK THE AIR BAG TONE WARNING INDICATOR CIRCUIT	
• Key in OFF position. • For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Connect: RCM C310a. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • **NOTE:** DTC B1892 should be retrieved when carrying out the on-demand self test due to an open circuit 1083 (LB/BK), DTC B1891 should not be retrieved at this time. • **Was DTC B1891 retrieved during the on-demand self test?**	**Yes** INSTALL a new RCM. REFER to Restraints Control Module (RCM) in this section. GO to D5 . **No** INSTALL a new instrument cluster module. REFER to Section 413-01 . GO to D5 .
D4 CHECK FOR AN INTERMITTENT FAULT	
WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury. WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can**	**Yes** GO to D2 . **No** CHECK for causes of intermittent short to voltage on circuit 1083 (LB/BK). ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently.

result in personal injury.  **WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury.**  **WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. ● Key in OFF position. ● Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● **Was DTC B1891 retrieved during the on-demand self test?**	REPAIR any intermittent concerns found. GO to D5 .
D5 CHECK FOR ADDITIONAL DTCs	
● Refer to the continuous DTCs recorded during Step D1. ● **Were any continuous DTCs retrieved during Step D1?**	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Table in this section for pinpoint test direction. **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.

	CLEAR all DTCs.

Pinpoint Test E: LFC 53/DTC B1892 — Air Bag Tone Warning Indicator Circuit Short to Ground or Open

Normal Operation

The restraints control module (RCM) monitors its connection to the instrument cluster module at C310a pin 22. This connection is used to signal a chime if the air bag indicator is inoperative and another SRS fault exists. If the RCM detects a short to ground or open on the connection to the cluster, it will store diagnostic trouble code (DTC) B1892 in memory and flash lamp fault code (LFC) 53 (or a higher priority code if one exists) on the air bag indicator.

Possible Causes

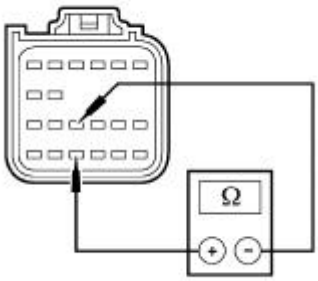
An air bag tone warning indicator circuit short to ground or open can be caused by:

- damaged wiring, terminals, or connectors.
- a damaged or inoperative instrument cluster module.
- a faulted RCM.

PINPOINT TEST E: LFC 53/DTC B1892 — AIR BAG TONE WARNING INDICATOR CIRCUIT SHORT TO GROUND OR OPEN

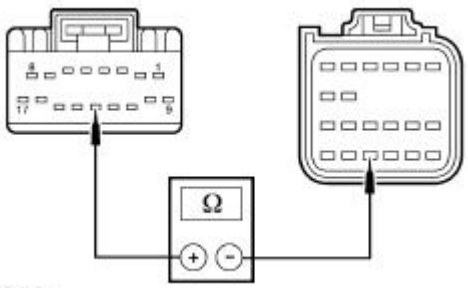
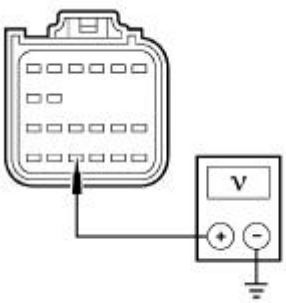
Test Step	Result / Action to Take
NOTE: Vehicles equipped with a 60/40 split bench seat require removal of the RCM to allow the electrical connectors to be disconnected. It will be necessary to reinstall the RCM after connecting the RCM electrical connectors before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. For additional information, refer to Restraints Control Module (RCM) in this section.	
E1 CHECK FOR A HARD OR INTERMITTENT DTC • Enter the following diagnostic mode on the diagnostic tool: Retrieve Continuous DTCs. • Retrieve and record any continuous DTCs for use later in this pinpoint test. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • **Was DTC B1892 retrieved during the on-demand self test?**	**Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to E2 . **No** This is an intermittent fault. The fault condition is not present at this time. GO to E5 .

E2 CHECK THE AIR BAG TONE WARNING INDICATOR CIRCUIT FOR A GROUND SHORT	
WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury. WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. • Key in OFF position. • Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. • For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Disconnect: RCM C310a. • Disconnect: Instrument Cluster Module C220a. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Measure the resistance between RCM C310a pin 22, circuit 1083 (LB/BK), harness side and RCM C310a pin 16, circuit 649 (BK/OG), harness side.	**Yes** GO to E3 . **No** REPAIR circuit 1083 (LB/BK). GO to E6 .



A0049256

- **Is the resistance greater than 1,000,000 ohms?**

E3 CHECK THE AIR BAG TONE WARNING INDICATOR CIRCUIT FOR AN OPEN	
• Key in OFF position. • Measure the resistance between RCM C310a pin 22, circuit 1083 (LB/BK), harness side and instrument cluster module C220b pin 13, circuit 1083 (LB/BK), harness side.  A0049257 • **Is the resistance less than 5 ohms?**	**Yes** GO to E4 . **No** REPAIR circuit 1083 (LB/BK). GO to E6 .
E4 CHECK THE AIR BAG TONE WARNING INDICATOR	
• Connect: Instrument Cluster Module C220b. • Key in ON position. • Measure the voltage at RCM C310a pin 22, circuit 1083 (LB/BK).  A0049254 • **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new RCM. REFER to Restraints Control Module (RCM) in this section. GO to E6 . **No** INSTALL a new instrument cluster module. REFER to Section 413-01 . GO to E6 .
E5 CHECK FOR AN INTERMITTENT FAULT	
WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in**	**Yes** GO to E2 . **No** CHECK for causes of intermittent short to ground or open on circuit 1083 (LB/BK).

possible personal injury. **WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.** **WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.** **WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury.** **WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. ● Key in OFF position. ● Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● **Was DTC B1892 retrieved during the on-demand self test?**	ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to E6 .
E6 CHECK FOR ADDITIONAL DTCs	
● Refer to the continuous DTCs recorded during Step E1. ● **Were any continuous DTCs retrieved during Step E1?**	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Table in this section for pinpoint test direction. **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER

	to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. CLEAR all DTCs.

Pinpoint Test F: LFC 14/DTC B1921 — Air Bag Diagnostic Monitor Ground Circuit Open

Normal Operation

WARNING: The tightening torque of the restraints control module (RCM) retaining bolts is critical for correct air bag supplemental restraint system (SRS) operation. Refer to Restraints Control Module (RCM) in this section for correct torque values.

NOTE: A resistance difference as low as 10 ohms may set the LFC.

The restraints control module (RCM) monitors the resistance between the ground connections at the mounting bracket and the reference ground at C310a pin 16, circuit 649 (BK/OG). If the RCM detects a difference in resistance, it will store diagnostic trouble code (DTC) B1921 in memory and flash lamp fault code (LFC) 14 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

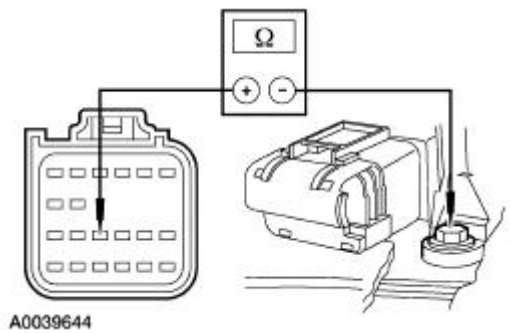
A resistance difference between the RCM bracket ground and harness ground can be caused by:

- RCM or RCM bracket not securely mounted.
- damaged wiring, terminals, or connectors.
- a faulted RCM.

PINPOINT TEST F: LFC 14/DTC B1921 — AIR BAG DIAGNOSTIC MONITOR CIRCUIT OPEN

Test Step	Result / Action to Take
NOTE: Vehicles equipped with a 60/40 split bench seat require removal of the RCM to allow the electrical connectors to be disconnected. It will be necessary to reinstall the RCM after connecting the RCM electrical connectors before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. For additional information, refer to Restraints Control Module (RCM) in this section.	
F1 CHECK FOR A HARD OR INTERMITTENT DTC ● Enter the following diagnostic mode on the diagnostic tool: Retrieve Continuous DTCs. ● Retrieve and record any continuous DTCs for use later in this pinpoint test. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● **Was DTC B1921 retrieved during the on-demand self test?**	**Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no

	longer retrieved during the on-demand self test. GO to F2 . **No** This is an intermittent fault. The fault condition is not present at this time. GO to F5 .
F2 INSPECT THE RCM MOUNTING, MOUNTING BRACKET AND MOUNTING SURFACE	
WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury. WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. • Key in OFF position. • Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. • Inspect the RCM retainers and RCM bracket mounting bolts and make sure they are fully seated and tightened correctly.	**Yes** CLEAN and TIGHTEN the bolts. REPAIR the mounting surface as necessary. REINSTALL the RCM and mounting bracket to the mounting surface. GO to F6 . **No** GO to F3 .

• Remove the RCM. Refer to Restraints Control Module (RCM) in this section. • Visually inspect the RCM, mounting bracket and mounting surface for damage, corrosion or dirt. • **Was a significant amount of corrosion or dirt found, or was the RCM mounting bracket attached to the mounting surface incorrectly or were the RCM bolts not fully seated and tightened correctly?**	
F3 INSTALL THE RCM AND CARRY OUT THE ON-DEMAND SELF TEST	
• Clean the RCM mounting surfaces and bolts. • Install the RCM. Refer to Restraints Control Module (RCM) in this section. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • **Was DTC B1921 retrieved during the on-demand self test?**	**Yes** GO to F4 . **No** Fault corrected. GO to F6 .
F4 CHECK GROUND CIRCUIT 649 (BK/OG) FOR HIGH RESISTANCE	
• Key in OFF position. • Measure the resistance between RCM C310a pin 16, circuit 649 (BK/OG), harness side and the RCM case ground.  A0039644 • **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new RCM. REFER to Restraints Control Module (RCM) in this section. GO to F6 . **No** REPAIR circuit 649 (BK/OG). GO to F6 .
F5 CHECK FOR AN INTERMITTENT FAULT	
WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury. WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the**	**Yes** GO to F2 . **No** CHECK for causes of intermittent high resistance on circuit 649 (BK/OG) or the chassis ground. ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to F6 .

electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE: Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. ● Key in OFF position. ● Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● **Was DTC B1921 retrieved during the on-demand self test?**	
F6 CHECK FOR ADDITIONAL DTCs	
● Refer to the continuous DTCs recorded during Step F1. ● **Were any continuous DTCs retrieved during Step F1?**	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Table in this section for pinpoint test direction. **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. CLEAR all DTCs.

Pinpoint Test G: LFC 33 and 34/DTC B2292 — Restraint System Safety Belt Pretensioner Status

Normal Operation

The restraints control module (RCM) checks all of the safety belt pretensioners for faults. If the RCM detects one of the following faults on any of the safety belt pretensioner circuits, it will store diagnostic trouble code (DTC) B2292 in memory and flash, depending on the fault indicator, either lamp fault

code (LFC) 33 or 34 depending on the fault (or higher priority code if one exists) on the air bag indicator.

Fault Conditions

The RCM monitors for the following fault conditions:

- low resistance.
- circuit open.
- circuit short to voltage.
- circuit short to ground.

Possible Causes

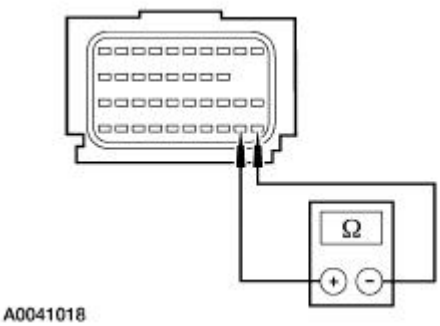
A safety belt pretensioner status fault can be caused by:

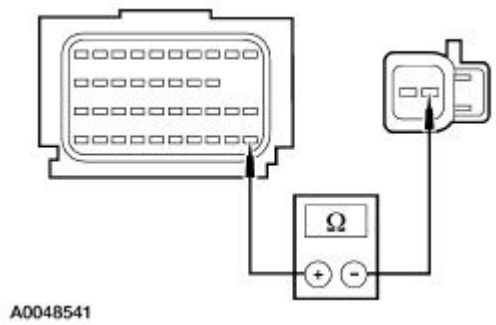
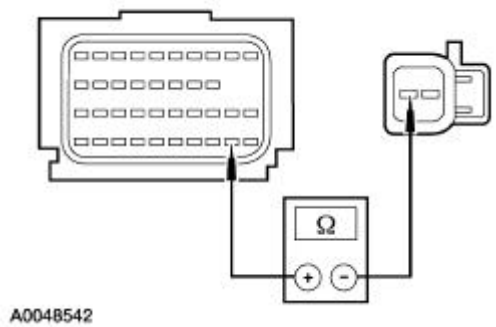
- damaged wiring, terminals, or connectors.
- a faulted pretensioner.
- a faulted RCM.

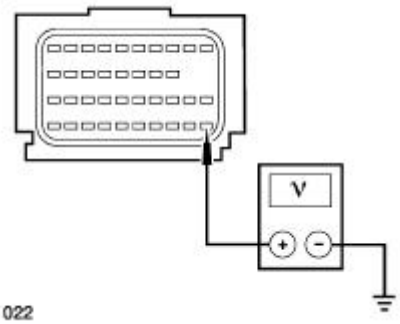
PINPOINT TEST G: LFC 33 AND 34/DTC B2292 — RESTRAINT SYSTEM SAFETY BELT PRETENSIONER STATUS

Test Step	Result / Action to Take
NOTE: Vehicles equipped with a 60/40 split bench seat require removal of the RCM to allow the electrical connectors to be disconnected. It will be necessary to reinstall the RCM after connecting the RCM electrical connectors before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. For additional information, refer to Restraints Control Module (RCM) in this section.	
G1 CHECK FOR A HARD OR INTERMITTENT DTC • Enter the following diagnostic mode on the diagnostic tool: Retrieve/Flag Continuous DTCs. • Retrieve, flag and record any continuous DTCs for use later in this pinpoint test. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • Enter the following diagnostic mode on the diagnostic tool: Flag DTC B2292. • Retrieve and record any flagged faults for use later in this pinpoint test. • **Was DTC B2292 retrieved during the on-demand self test?**	**Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to G2 . **No** This is an intermittent fault. The fault condition is not present at this time. GO to

	G18 .
G2 CHECK THE PRETENSIONER	
WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury. WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. • Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • **Was DTC B2292 retrieved during the on-demand self test?**	**Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. Using the flagged faults recorded in the Step G1, GO to the appropriate pinpoint test step. If a flagged fault of **"?"** was recorded, multiple faults exist and the entire pinpoint test must be carried out before installing a new RCM. For driver safety belt pretensioner (DF_PRT) with a low resistance (LOWRES) fault, GO to G3 . For DF_PRT with an open circuit (O_CIR) fault, GO to G4 . For DF_PRT with a short to battery (STB) fault, GO to G6 . For DF_PRT with a short to ground (STG) fault, GO to G8 .

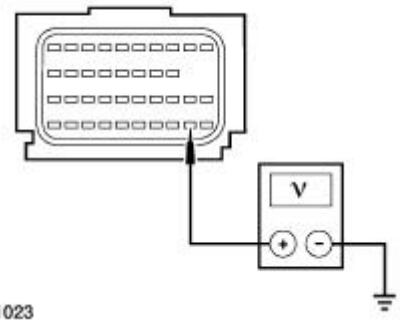
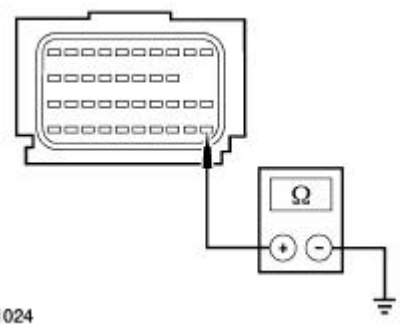
	For passenger safety belt pretensioner (PF_PRT) with a low resistance (LOWRES) fault, GO to G10. For PF_PRT with an open circuit (O_CIR) fault, GO to G11. For PF_PRT with a short to battery (STB) fault, GO to G13. For PF_PRT with a short to ground (STG) fault, GO to G15. **No** INSTALL a new driver or passenger safety belt pretensioner. REFER to Section 501-20A. GO to G19.
G3 CHECK THE DRIVER SAFETY BELT PRETENSIONER CIRCUIT 1079 (LG/RD) AND CIRCUIT 1080 (LG/BK) FOR LOW RESISTANCE ● Key in OFF position. ● For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01. ● Disconnect: Driver Safety Belt Pretensioner Restraint System Diagnostic Tool. ● Disconnect: RCM C310b. ● For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01. ● Measure the resistance between RCM C310b pin 32, circuit 1080 (LG/BK), and pin 31, circuit 1079 (LG/RD), harness side.  A0041018	**Yes** GO to G17. **No** REPAIR circuit 1079 (LG/RD) and circuit 1080 (LG/BK). GO to G19.

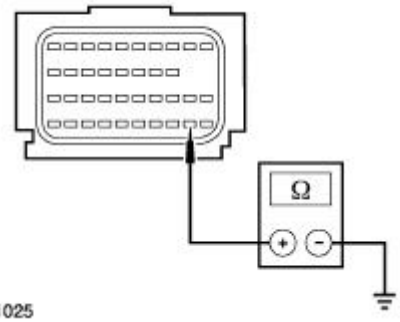
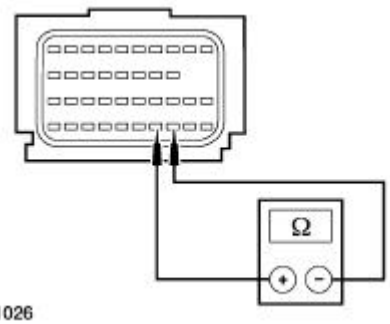
• **Is the resistance greater than 1,000,000 ohms?**	
G4 CHECK CIRCUIT 1079 (LG/RD) FOR AN OPEN	
• Key in OFF position. • For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Disconnect: Driver Safety Belt Pretensioner Restraint System Diagnostic Tool. • Disconnect: RCM C310b. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Measure the resistance between RCM C310b pin 31, circuit 1079 (LG/RD), harness side and driver safety belt buckle pretensioner C3201 pin 1, circuit 1079 (LG/RD), harness side.  A0048541 • **Is the resistance less than 0.5 ohm?**	**Yes** GO to G5 . **No** REPAIR circuit 1079 (LG/RD). GO to G19 .
G5 CHECK CIRCUIT 1080 (LG/BK) FOR AN OPEN	
• Measure the resistance between RCM C310b pin 32, circuit 1080 (LG/BK), harness side and driver safety belt buckle pretensioner C3201 pin 2, circuit 1080 (LG/BK), harness side.  A0048542 • **Is the resistance less than 0.5 ohm?**	**Yes** GO to G17 . **No** REPAIR circuit 1080 (LG/BK). GO to G19 .
G6 CHECK CIRCUIT 1079 (LG/RD) FOR A SHORT TO VOLTAGE	
• Key in OFF position. • For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Disconnect: Driver Safety Belt Pretensioner Restraint System Diagnostic Tool. • Disconnect: RCM C310b. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Key in ON position. • Measure the voltage between RCM C310b pin 31, circuit 1079 (LG/RD), harness side and ground.	**Yes** GO to G7 . **No** REPAIR circuit 1079 (LG/RD). GO to G19 .

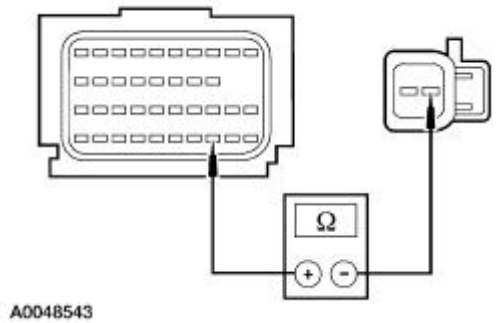


A0041022

- **Is the voltage less than 0.2 volt?**

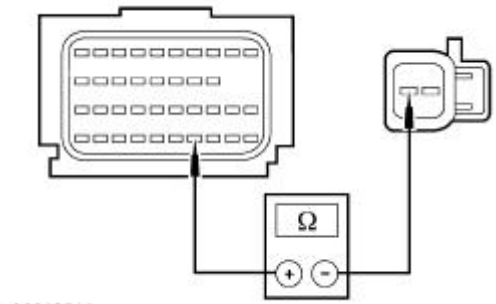
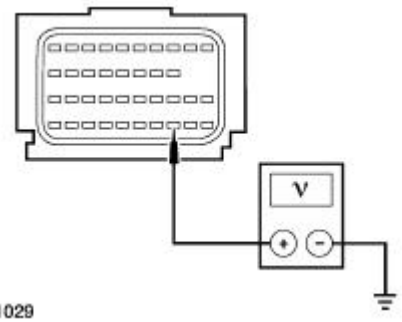
G7 CHECK CIRCUIT 1080 (LG/BK) FOR A SHORT TO VOLTAGE	
• Measure the voltage between RCM C310b pin 32, circuit 1080 (LG/BK), harness side and ground.  A0041023 • **Is the voltage less than 0.2 volt?**	**Yes** GO to G17 . **No** REPAIR circuit 1080 (LG/BK). GO to G19 .
G8 CHECK CIRCUIT 1079 (LG/RD) FOR A SHORT TO GROUND	
• Key in OFF position. • For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Disconnect: Driver Safety Belt Pretensioner Restraint System Diagnostic Tool. • Disconnect: RCM C310b. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Measure the resistance between RCM C310b pin 31, circuit 1079 (LG/RD), harness side and ground.  A0041024 • **Is the resistance greater than 1,000,000 ohms?**	**Yes** GO to G9 . **No** REPAIR circuit 1079 (LG/RD). GO to G19 .
G9 CHECK CIRCUIT 1080 (LG/BK) FOR A SHORT TO GROUND	
• Measure the resistance between RCM C310b pin 32, circuit 1080 (LG/BK), harness side and ground.	**Yes** GO to G17 . **No** REPAIR circuit

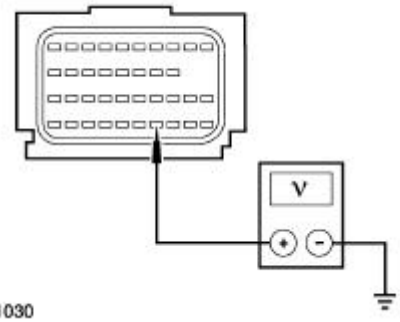
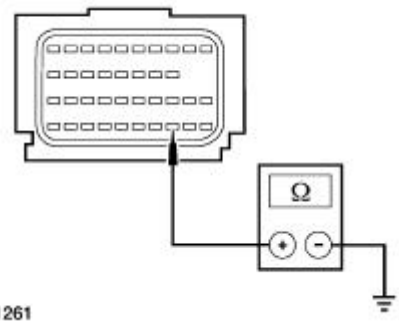
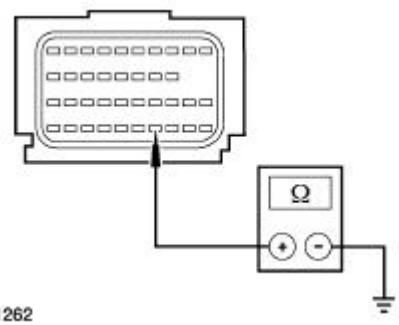
 A0041025 ● **Is the resistance greater than 1,000,000 ohms?**	1080 (LG/BK). GO to G19 .
G10 CHECK THE PASSENGER SAFETY BELT PRETENSIONER CIRCUIT 1081 (YE/RD) AND CIRCUIT 1082 (YE/BK) FOR LOW RESISTANCE	
● Key in OFF position. ● For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . ● Disconnect: Passenger Safety Belt Pretensioner Restraint System Diagnostic Tool. ● Disconnect: RCM C310b. ● For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . ● Measure the resistance between RCM C310b pin 34, circuit 1082 (YE/BK), and pin 33, circuit 1081 (YE/RD), harness side.  A0041026 ● **Is the resistance greater than 1,000,000 ohms?**	**Yes** GO to G17 . **No** REPAIR circuit 1082 (YE/BK) and circuit 1081 (YE/RD).GO to G19 .
G11 CHECK CIRCUIT 1081 (YE/RD) FOR AN OPEN	
● Key in OFF position. ● For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . ● Disconnect: Passenger Safety Belt Pretensioner Restraint System Diagnostic Tool. ● Disconnect: RCM C310b. ● For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . ● Measure the resistance between RCM C310b pin 33, circuit 1081 (YE/RD), harness side and passenger safety belt buckle pretensioner C3202 pin 1, circuit 1081 (YE/RD), harness side.	**Yes** GO to G12 . **No** REPAIR circuit 1081 (YE/RD). GO to G19 .



A0048543

- **Is the resistance less than 0.5 ohm?**

G12 CHECK CIRCUIT 1082 (YE/BK) FOR AN OPEN	
• Measure the resistance between RCM C310b pin 34, circuit 1082 (YE/BK), harness side and passenger safety belt buckle pretensioner C3202 pin 2, circuit 1082 (YE/BK), harness side.  A0048544 • **Is the resistance less than 0.5 ohm?**	**Yes** GO to G17 . **No** REPAIR circuit 1082 (YE/BK). GO to G19 .
G13 CHECK CIRCUIT 1081 (YE/RD) FOR A SHORT TO VOLTAGE	
• Key in OFF position. • For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Disconnect: Passenger Safety Belt Pretensioner Restraint System Diagnostic Tool. • Disconnect: RCM C310b. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Key in ON position. • Measure the voltage between RCM C310b pin 33, circuit 1081 (YE/RD), harness side and ground.  A0041029 • **Is the voltage less than 0.2 volt?**	**Yes** GO to G14 . **No** REPAIR circuit 1081 (YE/RD). GO to G19 .
G14 CHECK CIRCUIT 1082 (YE/BK) FOR A SHORT TO VOLTAGE	
• Measure the voltage between RCM C310b pin 34, circuit 1082 (YE/BK), harness side and ground.	**Yes** GO to G17 .

 A0041030 ● **Is the voltage less than 0.2 volt?**	**No** REPAIR circuit 1082 (YE/BK). GO to G19 .
G15 CHECK CIRCUIT 1081 (YE/RD) FOR A SHORT TO GROUND	
● Key in OFF position. ● For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . ● Disconnect: Passenger Safety Belt Pretensioner Restraint System Diagnostic Tool. ● Disconnect: RCM C310b. ● For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . ● Measure the resistance between RCM C310b pin 33, circuit 1081 (YE/RD), harness side and ground.  A0041261 ● **Is the resistance greater than 1,000,000 ohms?**	**Yes** GO to G16 . **No** REPAIR circuit 1081 (YE/RD). GO to G19 .
G16 CHECK CIRCUIT 1082 (YE/BK) FOR A SHORT TO GROUND	
● Measure the resistance between RCM C310b pin 34, circuit 1082 (YE/BK), harness side and ground.  A0041262 ● **Is the resistance greater than 1,000,000 ohms?**	**Yes** GO to G17 . **No** REPAIR circuit 1082 (YE/BK). GO to G19 .
G17 CONFIRM THE RCM FAULT	
NOTE: Make sure all restraint system diagnostic tools, sensor electrical connectors and the RCM electrical connector are connected before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. ● Key in OFF position.	**Yes** If a **"?"** was flagged by the scan tool, CARRY OUT

• For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Connect: Restraint System Diagnostic Tools. • Connect: RCM C310b. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • Enter the following diagnostic mode on the diagnostic tool: Flag DTC B2292. • Retrieve and record any flagged faults. • **Was DTC B2292 retrieved during the on-demand self test?**	the entire pinpoint test before installing a new RCM. INSTALL a new RCM. REFER to Restraints Control Module (RCM) in this section. GO to G19 . **No** Fault corrected. GO to G19 .
G18 CHECK FOR AN INTERMITTENT FAULT **WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.** **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.** **WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. • Key in OFF position. • Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing	**Yes** Check for causes of the intermittent fault at or near the affected safety belt pretensioner electrical connector. REPAIR any intermittent concern found. If an intermittent concern **was** found and repaired, GO to G19 If an intermittent concern **was not** found and repaired, USE the flagged faults recorded and GO to the appropriate pinpoint test step. If a flagged fault of **"?"** was recorded, multiple faults exist and the entire pinpoint test must be carried out before installing a new RCM. For driver safety belt pretensioner

portion of this section. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● Enter the following diagnostic mode on the diagnostic tool: Flag DTC B2292. ● If DTC B2292 is retrieved during the on-demand self test, retrieve and record any flagged faults ● **Was DTC B2292 retrieved during the on-demand self test?**	(DF_PRT) with a low resistance (LOWRES) fault, GO to G3 . For DF_PRT with an open circuit (O_CIR) fault, GO to G4 . For DF_PRT with a short to battery (STB) fault, GO to G6 . For DF_PRT with a short to ground (STG) fault, GO to G8 . For passenger safety belt pretensioner (PF_PRT) with a low resistance (LOWRES) fault, GO to G10 . For PF_PRT with an open circuit (O_CIR) fault, GO to G11 . For PF_PRT with a short to battery (STB) fault, GO to G13 . For PF_PRT with a short to ground (STG) fault, GO to G15 . **No** CHECK for causes of the intermittent fault. ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently.

	REPAIR any intermittent concerns found. GO to G19 .
G19 CHECK FOR ADDITIONAL DTCs	
• Refer to the continuous DTCs recorded during Step G1. • **Were any continuous DTCs retrieved during Step G1?**	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Table in this section for pinpoint test direction. **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. CLEAR all DTCs.

Pinpoint Test H: LFC 19 and 21 /DTC B2293 — Restraint System - Airbag Status

Normal Operation

The restraints control module (RCM) checks all of the front air bag circuits for faults. If the RCM detects one of the following faults on any of the front air bag circuits, it will store diagnostic trouble code (DTC) B2293 in memory, and depending on the fault, flash either lamp fault code (LFC) 19 or 21 depending on the fault (or higher priority code if one exists) on the air bag indicator.

Fault Conditions

The RCM monitors for the following fault conditions:

- low resistance.
- circuit open.
- circuit short to voltage.
- circuit short to ground.

Possible Causes

A driver air bag status fault can be caused by:

- damaged wiring, terminals, or connectors.
- driver air bag sub-harness.
- a faulty clockspring.
- a faulty driver air bag module.
- a faulted RCM.

A passenger air bag status fault can be caused by:

- damaged wiring, terminals, or connectors.
- a faulty passenger air bag module.
- a faulted RCM.

PINPOINT TEST H: LFC 19 AND 21/DTC B2293 — RESTRAINT SYSTEM - AIR BAG STATUS

Test Step	Result / Action to Take
NOTE: Vehicles equipped with a 60/40 split bench seat require removal of the RCM to allow the electrical connectors to be disconnected. It will be necessary to reinstall the RCM after connecting the RCM electrical connectors before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. For additional information, refer to Restraints Control Module (RCM) in this section.	
H1 CHECK FOR A HARD OR INTERMITTENT DTC	
• Enter the following diagnostic mode on the diagnostic tool: Retrieve/Flag Continuous DTCs. • Retrieve, flag and record any continuous DTCs for use later in this pinpoint test. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • Enter the following diagnostic mode on the diagnostic tool: Flag DTC B2293. • Retrieve and record any flagged faults for use later in this pinpoint test. • **Was DTC B2293 retrieved during the on-demand self test?**	**Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test.GO to H2 . **No** This is an intermittent fault. The fault condition is not present at this time. GO to H38 .
H2 CHECK THE DRIVER AND PASSENGER AIR BAG MODULES	
WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint	**Yes** This is a hard fault. The fault

system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.

The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE: Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

- Key in OFF position.
- Deactivate the system. REFER to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section.
- Key in ON position.
- Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test.
- **Was DTC B2293 retrieved during the on-demand self test?**

condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test.

Using the flagged faults recorded in the Step H1, GO to the appropriate pinpoint test step.

If a flagged fault of **"?"** was recorded, multiple faults exist and the entire pinpoint test must be carried out before installing a new RCM.

For driver air bag module squib 1 (D_ABAG) with a short to ground (STG) fault, GO to H3 .

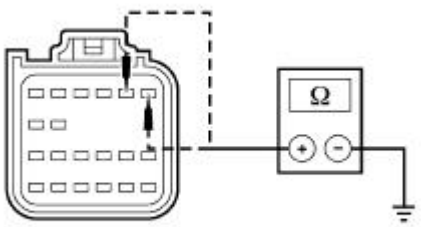
For driver air bag module squib 1 (D_ABAG) with a short to battery (STB) fault, GO to H5 .

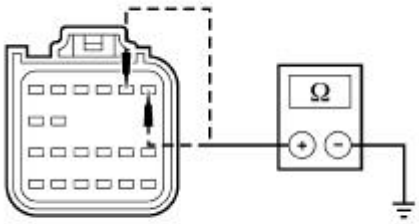
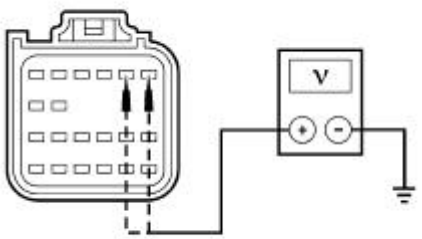
For driver air bag module squib 1 (D_ABAG) with an open circuit (O_CIR) fault, GO to H7 .

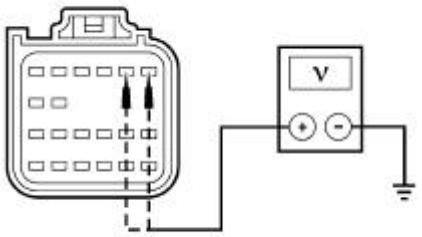
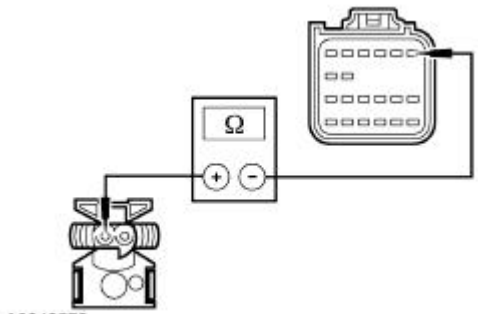
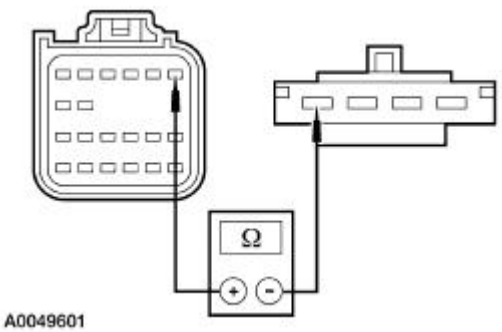
For driver air bag module squib 1 (D_ABAG) with a low resistance (LOWRES) fault, GO to

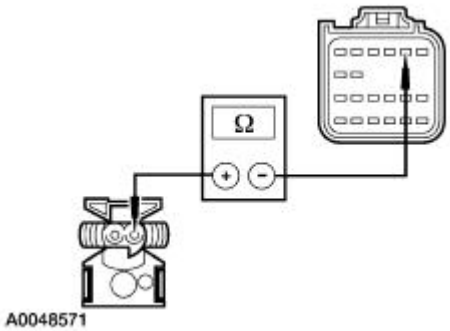
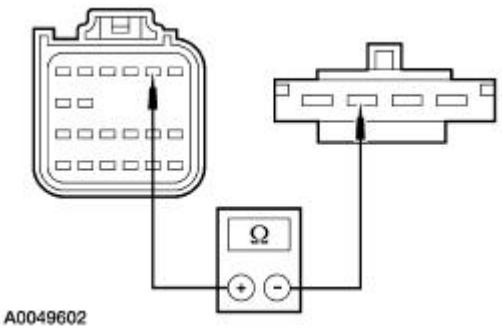
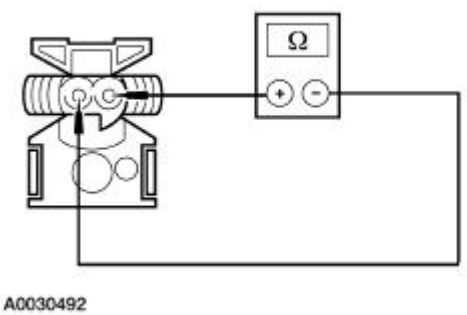
	H11 . For passenger air bag module squib 1 (P_ABAG) with a short to ground (STG) fault, GO to H14 . For passenger air bag module squib 1 (P_ABAG) with a short to battery (STB) fault, GO to H15 . For passenger air bag module squib 1 (P_ABAG) with an open circuit (O_CIR) fault, GO to H16 . For passenger air bag module squib 1 (P_ABAG) with a low resistance (LOWRES) fault, GO to H18 . For driver air bag module squib 2 (D_ABAG2) with a short to ground (STG) fault, GO to H20 . For driver air bag module squib 2 (D_ABAG2) with a short to battery (STB) fault, GO to H22 . For driver air bag module squib 2 (D_ABAG2) with an open circuit (O_CIR) fault, GO to H24 .

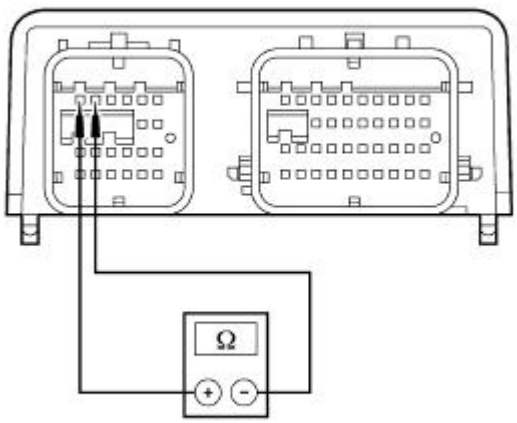
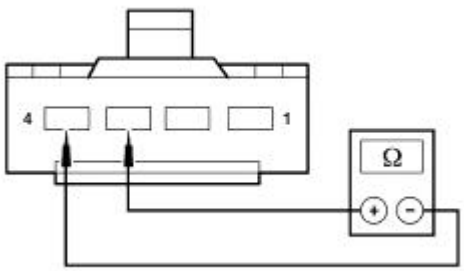
	For driver air bag module squib 2 (D_ABAG2) with a low resistance (LOWRES) fault, GO to H28 . For passenger air bag module squib 2 (P_ABAG2) with a short to ground (STG) fault, GO to H31 . For passenger air bag module squib 2 (P_ABAG2) with a short to battery (STB) fault, GO to H32 . For passenger air bag module squib 2 (P_ABAG2) with an open circuit (O_CIR) fault, GO to H33 . For passenger air bag module squib 2 (P_ABAG2) with a low resistance (LOWRES) fault, GO to H35 . **No** If a flagged fault of **"?"** was recorded in Step H1, multiple faults exist and the entire pinpoint test must be carried out before installing a new driver or passenger air bag module. If a fault was flagged against driver air bag module in Step

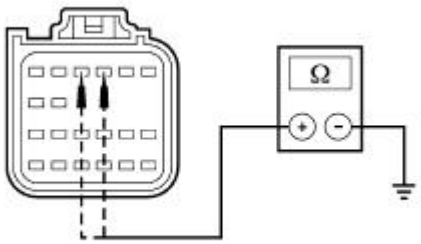
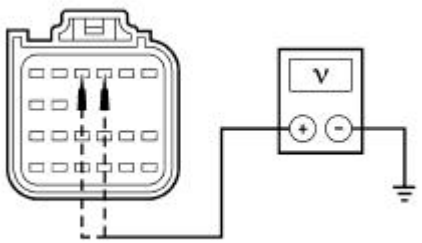
	H1, INSTALL a new driver air bag module. REFER to Driver Air Bag Module in this section. GO to H39. If a fault was flagged against passenger air bag module in Step H1, INSTALL a new passenger air bag module. REFER to Passenger Air Bag Module in this section. GO to H39.
H3 CHECK CIRCUIT 614 (GY/OG) AND CIRCUIT 615 (GY/WH) FOR A SHORT TO GROUND BETWEEN THE RCM AND THE DRIVER AIR BAG MODULE ● Key in OFF position. ● For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01. ● Disconnect: RCM C310a. ● Disconnect: Driver Air Bag Module Squib 1 Restraint System Diagnostic Tool. ● For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01. ● Measure the resistance between RCM C310a pin 1, circuit 614 (GY/OG), harness side and ground; and between RCM C310a pin 2, circuit 615 (GY/WH), harness side and ground.  A0041212 ● **Are the resistances greater than 1,000,000 ohms?**	**Yes** GO to H37. **No** GO to H4.
H4 CHECK CIRCUIT 614 (GY/OG) AND CIRCUIT 615 (GY/WH) FOR A SHORT TO GROUND BETWEEN THE RCM AND THE CLOCKSPRING ● Disconnect: Clockspring C218a. ● Measure the resistance between RCM C310a pin 1, circuit 614 (GY/OG), harness side and ground; and between RCM C310a pin 2, circuit 615 (GY/WH), harness side and ground.	**Yes** INSTALL a new clockspring. REFER to Clockspring in this section. GO to H39. **No**

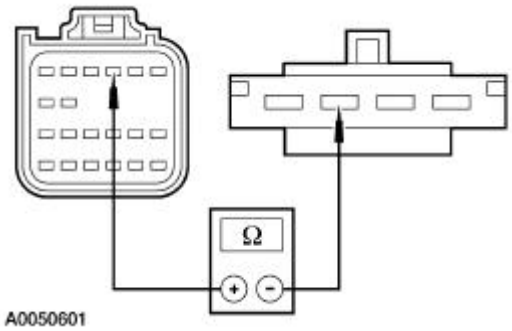
 A0041212 ● **Are the resistances greater than 1,000,000 ohms?**	Due to the shorting bar feature in the electrical connector, the fault can exist in either circuit. Do not remove or defeat the shorting bar. REPAIR circuit 614 (GY/OG) or circuit 615 (GY/WH). GO to H39 .
H5 CHECK CIRCUIT 614 (GY/OG) AND CIRCUIT 615 (GY/WH) FOR A SHORT TO VOLTAGE BETWEEN THE RCM AND THE DRIVER AIR BAG MODULE	
● Key in OFF position. ● For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . ● Disconnect: Driver Air Bag Module Squib 1 Restraint System Diagnostic Tool. ● Disconnect: RCM C310a. ● For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . ● Key in ON position. ● Measure the voltage between RCM C310a pin 1, circuit 614 (GY/OG), harness side and ground; and between RCM C310a pin 2, circuit 615 (GY/WH), harness side and ground.  A0041263 ● **Are the voltages less than 0.2 volt?**	**Yes** GO to H37 . **No** GO to H6 .
H6 CHECK CIRCUIT 614 (GY/OG) AND CIRCUIT 615 (GY/WH) FOR A SHORT TO VOLTAGE BETWEEN THE RCM AND THE CLOCKSPRING	
● Key in OFF position. ● Disconnect: Clockspring C218a. ● Key in ON position. ● Measure the voltage between RCM C310a pin 1, circuit 614 (GY/OG), harness side and ground; and between RCM C310a pin 2, circuit 615 (GY/WH), harness side and ground.	**Yes** INSTALL a new clockspring. REFER to Clockspring in this section. GO to H39 . **No** Due to the shorting bar feature in the electrical connector, the fault can exist in

 A0041263 ● **Are the voltages less than 0.2 volt?**	either circuit. Do not remove or defeat the shorting bar. REPAIR circuit 614 (GY/OG) or 615 (GY/WH). GO to H39 .
H7 CHECK CIRCUIT 614 (GY/OG) AND CIRCUIT 615 (GY/WH) FOR AN OPEN BETWEEN THE RCM AND THE DRIVER AIR BAG MODULE	
● Key in OFF position. ● For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . ● Disconnect: Driver Air Bag Module Squib 1 Restraint System Diagnostic Tool. ● Disconnect: RCM C310a. ● For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . ● Measure the resistance between RCM C310a pin 1, circuit 614 (GY/OG), harness side and driver air bag module squib 1, circuit 614 (GY/OG), harness side.  A0048570 ● **Is the resistance less than 0.5 ohm?**	**Yes** GO to H9 . **No** GO to H8 .
H8 CHECK CIRCUIT 614 (GY/OG) FOR AN OPEN BETWEEN THE RCM AND THE CLOCKSPRING	
● Disconnect: Clockspring C218a. ● Measure the resistance between RCM C310a pin 1, circuit 614 (GY/OG), harness side and clockspring C218a pin 4, circuit 614 (GY/OG), harness side.  A0049601 ● **Is the resistance less than 0.5 ohm?**	**Yes** INSTALL a new clockspring. REFER to Clockspring in this section. GO to H39 . **No** REPAIR circuit 614 (GY/OG). GO to H39 .
H9 CHECK CIRCUIT 615 (GY/WH) FOR AN OPEN BETWEEN THE RCM AND THE DRIVER AIR BAG MODULE	

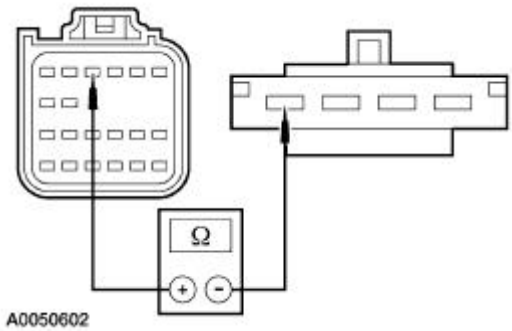
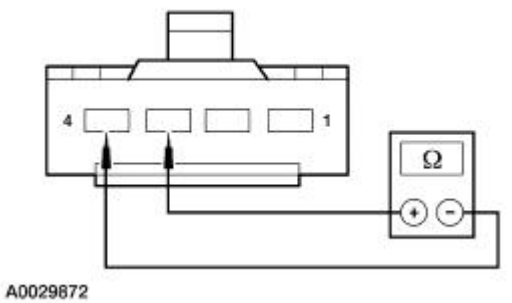
• Measure the resistance between RCM C310a pin 2, circuit 615 (GY/WH), harness side and driver air bag module squib 1, circuit 615 (GY/WH), harness side.  • **Is the resistance less than 0.5 ohm?**	**Yes** GO to H37 . **No** GO to H10 .
H10 CHECK CIRCUIT 615 (GY/WH) FOR AN OPEN BETWEEN THE RCM AND THE CLOCKSPRING	
• Disconnect: Clockspring C218a. • Measure the resistance between RCM C310a pin 2, circuit 615 (GY/WH), harness side and clockspring C218a pin 3, circuit 615 (GY/WH), harness side.  • **Is the resistance less than 0.5 ohm?**	**Yes** INSTALL a new clockspring. REFER to Clockspring in this section. GO to H39 . **No** REPAIR circuit 615 (GY/WH). GO to H39 .
H11 CHECK CIRCUIT 614 (GY/OG) AND CIRCUIT 615 (GY/WH) FOR LOW RESISTANCE BETWEEN THE DRIVER AIR BAG MODULE AND THE RCM	
• Key in OFF position. • Disconnect: Driver Air Bag Module Squib 1 Restraint System Diagnostic Tool. • Measure the resistance between driver air bag module squib 1, circuit 614 (GY/OG) and circuit 615 (GY/WH), harness side.  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to H37 . **No** GO to H12 .
H12 MEASURE RESISTANCE BETWEEN RCM CIRCUIT 614 (GY/OG) AND CIRCUIT 615 (GY/WH)	
• For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .	**Yes** GO to H13 .

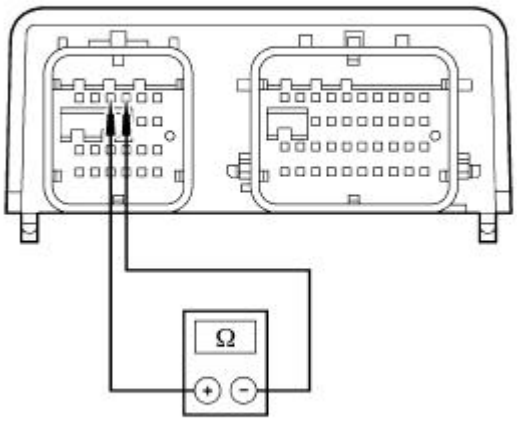
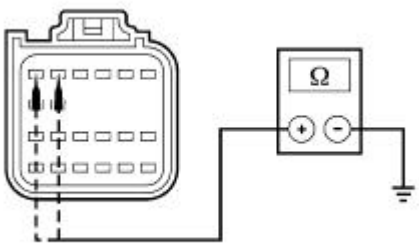
• Disconnect: RCM C310a. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Measure the resistance between RCM C310a pin 1, circuit 614 (GY/OG), and pin 2, circuit 615 (GY/WH), component side.  A0041266 • **Is the resistance greater than 10,000 ohms?**	**No** GO to H37 .
H13 CHECK CIRCUIT 614 (GY/OG) AND CIRCUIT 615 (GY/WH) FOR LOW RESISTANCE BETWEEN THE CLOCKSPRING AND THE RCM	
• Connect: RCM C310a. • Disconnect: Clockspring C218a. • Measure the resistance between clockspring C218a pin 4, circuit 614 (GY/OG) and pin 3, circuit 615 (GY/WH), harness side.  A0029872 • **Is the resistance greater than 10,000 ohms?**	**Yes** INSTALL a new clockspring. REFER to Clockspring in this section. GO to H39 . **No** REPAIR circuit 614 (GY/OG) and circuit 615 (GY/WH). GO to H39 .
H14 CHECK CIRCUIT 607 (LB/OG) AND CIRCUIT 616 (PK/BK) FOR A SHORT TO GROUND BETWEEN THE RCM AND THE PASSENGER AIR BAG MODULE	
• Key in OFF position. • For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Disconnect: Passenger Air Bag Module Restraint System Diagnostic Tool. • Disconnect: RCM C310a. • For vehicles equipped with a 60/40 split bench seat, connect the battery	**Yes** GO to H37 . **No** Due to the shorting bar feature in the electrical

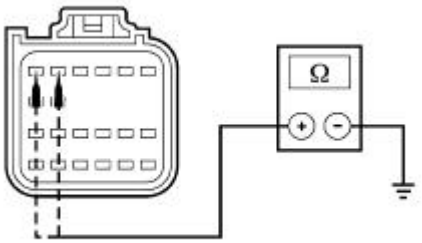
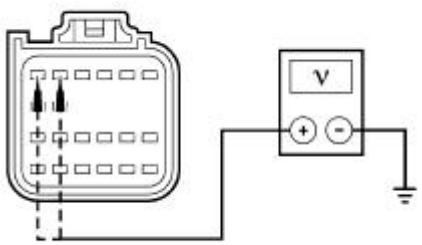
ground cable. For additional information, refer to Section 414-01 . ● Measure the resistance between RCM C310a pin 3, circuit 607 (LB/OG), harness side and ground; and between RCM C310a pin 4, circuit 616 (PK/BK), harness side and ground.  A0041267 ● **Are the resistances greater than 1,000,000 ohms?**	connector, the fault can exist in either circuit. Do not remove or defeat the shorting bar. REPAIR circuit 607 (LB/OG) or 616 (PK/BK). GO to H39 .
H15 CHECK CIRCUIT 607 (LB/OG) AND CIRCUIT 616 (PK/BK) FOR A SHORT TO VOLTAGE BETWEEN THE RCM AND THE PASSENGER AIR BAG MODULE	
● Key in OFF position. ● For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . ● Disconnect: Passenger Air Bag Module Restraint System Diagnostic Tool. ● Disconnect: RCM C310a. ● For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . ● Key in ON position. ● Measure the voltage between RCM C310a pin 3, circuit 607 (LB/OG), harness side and ground; and between RCM C310a pin 4, circuit 616 (PK/BK), harness side and ground.  A0041268 ● **Are the voltages less than 0.2 volt?**	**Yes** GO to H37 . **No** Due to the shorting bar feature in the electrical connector, the fault can exist in either circuit. Do not remove or defeat the shorting bar. REPAIR circuit 607 (LB/OG) or circuit 616 (PK/BK). GO to H39 .
H16 CHECK CIRCUIT 607 (LB/OG) FOR AN OPEN BETWEEN THE RCM AND THE PASSENGER AIR BAG MODULE	
● Key in OFF position. ● For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . ● Disconnect: Passenger Air Bag Module Restraint System Diagnostic Tool. ● Disconnect: RCM C310a. ● For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . ● Measure the resistance between RCM C310a pin 3, circuit 607 (LB/OG), harness side and passenger air bag module C256 pin 3, circuit 607 (LB/OG), harness side.	**Yes** GO to H17 . **No** REPAIR circuit 607 (LB/OG). GO to H39 .

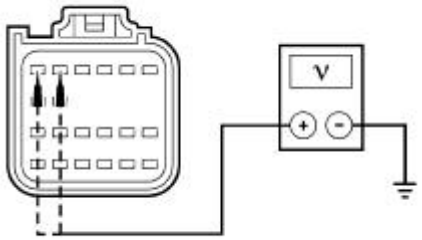
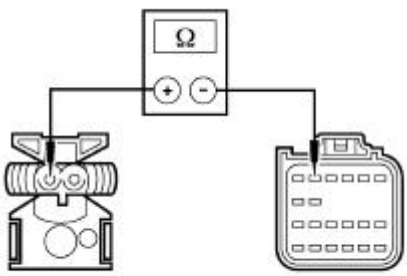


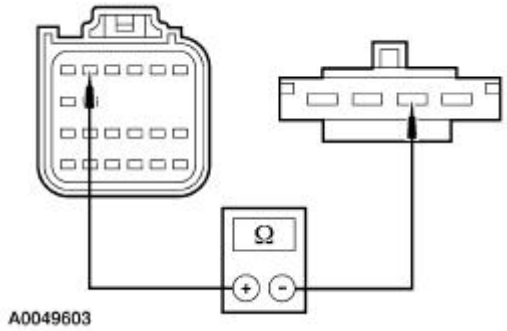
- **Is the resistance less than 0.5 ohm?**

H17 CHECK CIRCUIT 616 (PK/BK) FOR AN OPEN BETWEEN THE RCM AND THE PASSENGER AIR BAG MODULE	
• Measure the resistance between RCM C310a pin 4, circuit 616 (PK/BK), harness side and passenger air bag module C256 pin 4, circuit 616 (PK/BK), harness side.  • **Is the resistance less than 0.5 ohm?**	**Yes** GO to H37 . **No** REPAIR circuit 616 (PK/BK). GO to H39 .
H18 CHECK CIRCUIT 607 (LB/OG) AND CIRCUIT 616 (PK/BK) FOR LOW RESISTANCE BETWEEN THE PASSENGER AIR BAG MODULE AND THE RCM	
• Key in OFF position. • Disconnect: Passenger Air Bag Module Restraint System Diagnostic Tool. • Measure the resistance between passenger air bag module C256 pin 3, circuit 607 (LB/OG), and pin 4, circuit 616 (PK/BK), harness side.  • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to H37 . **No** GO to H19 .
H19 MEASURE THE RESISTANCE BETWEEN RCM CIRCUITS 607 (LB/OG) AND CIRCUIT 616 (PK/BK)	
• For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Disconnect: RCM C310a. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 .	**Yes** REPAIR circuit 607 (LB/OG) and circuit 616 (PK/BK). GO to H22 .

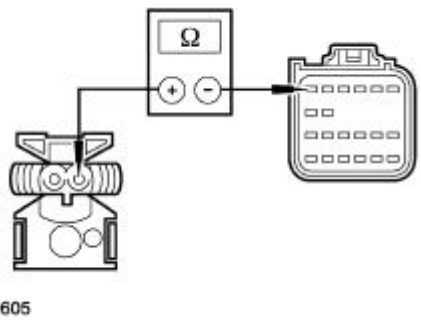
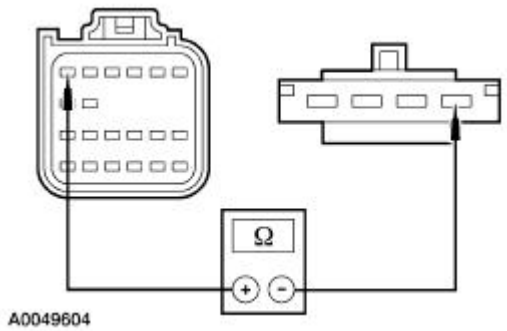
• Measure the resistance between RCM C310a pin 3, circuit 607 (LB/OG), and pin 4, circuit 616 (PK/BK), component side.  A0041271 • **Is the resistance greater than 10,000 ohms?**	**No** GO to H37 .
H20 CHECK CIRCUIT 1516 (YE/WH) AND CIRCUIT 1517 (RD/OG) FOR A SHORT TO GROUND BETWEEN THE RCM AND THE DRIVER AIR BAG MODULE	
• Key in OFF position. • For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Disconnect: RCM C310a. • Disconnect: Driver Air Bag Module Squib 2 Restraint System Diagnostic Tool. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Measure the resistance between the RCM C310a pin 5, circuit 1516 (YE/WH), harness side and ground; and between the RCM C310a pin 6, circuit 1517 (RD/OG), harness side and ground.  A0041272 • **Are the resistances greater than 1,000,000 ohms?**	**Yes** GO to H37 . **No** GO to H21 .
H21 CHECK CIRCUIT 1516 (YE/WH) AND CIRCUIT 1517 (RD/OG) FOR A SHORT TO GROUND BETWEEN THE RCM AND THE CLOCKSPRING	
• Disconnect: Clockspring C218a. • Measure the resistance between the RCM C310a pin 5, circuit 1516 (YE/WH), harness side and ground; and between the RCM C310a pin	**Yes** INSTALL a new clockspring.

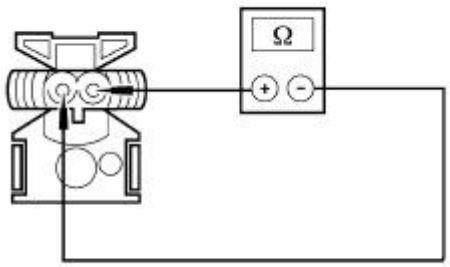
6, circuit 1517 (RD/OG), harness side and ground.  A0041272 ● **Are the resistances greater than 1,000,000 ohms?**	REFER to Clockspring in this section. GO to H39 . **No** Due to the shorting bar feature in the electrical connector, the fault can exist in either circuit. Do not remove or defeat the shorting bar. REPAIR circuit 1516 (YE/WH) or 1517 (RD/OG). GO to H39 .
H22 CHECK CIRCUIT 1516 (YE/WH) AND CIRCUIT 1517 (RD/OG) FOR A SHORT TO VOLTAGE BETWEEN THE RCM AND THE DRIVER AIR BAG MODULE	
● Key in OFF position. ● For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . ● Disconnect: Driver Air Bag Module Squib 2 Restraint System Diagnostic Tool. ● Disconnect: RCM C310a. ● For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . ● Key in ON position. ● Measure the voltage between the RCM C310a pin 5, circuit 1516 (YE/WH), harness side and ground; and between the RCM C310a pin 6, circuit 1517 (RD/OG), harness side and ground.  A0041273 ● **Are the voltages less than 0.2 volt?**	**Yes** GO to H37 . **No** GO to H23 .
H23 CHECK CIRCUIT 1516 (YE/WH) AND CIRCUIT 1517 (RD/OG) FOR A SHORT TO VOLTAGE BETWEEN THE RCM AND THE CLOCKSPRING	
● Key in OFF position. ● Disconnect: Clockspring C218a. ● Key in ON position. ● Measure the voltage between the RCM C310a pin 5, circuit 1516 (YE/WH), harness side and ground; and between the RCM C310a pin 6, circuit 1517 (RD/OG), harness side and ground.	**Yes** INSTALL a new clockspring. REFER to Clockspring in this section. GO to H39 .

 A0041273 ● **Are the voltages less than 0.2 volt?**	**No** Due to the shorting bar feature in the electrical connector, the fault can exist in either circuit. Do not remove or defeat the shorting bar. REPAIR circuit 1516 (YE/WH) or 1517 (RD/OG). GO to H39 .
H24 CHECK CIRCUIT 1516 (YE/WH) FOR AN OPEN BETWEEN THE RCM AND THE DRIVER AIR BAG MODULE	
● Key in OFF position. ● For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . ● Disconnect: Driver Air Bag Module Squib 2 Restraint System Diagnostic Tool. ● Disconnect: RCM C310a. ● For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . ● Measure the resistance between the RCM C310a pin 5, circuit 1516 (YE/WH), harness side and the driver air bag module squib 2, circuit 1516 (YE/WH), harness side.  A0049606 ● **Is the resistance less than 0.5 ohm?**	**Yes** GO to H26 . **No** GO to H25 .
H25 CHECK CIRCUIT 1516 (YE/WH) FOR AN OPEN BETWEEN THE RCM AND THE CLOCKSPRING	
● Disconnect: Clockspring C218a. ● Measure the resistance between the RCM C310a pin 5, circuit 1516 (YE/WH), harness side and the clockspring C218a pin 2, circuit 1516 (YE/WH), harness side.	**Yes** INSTALL a new clockspring. REFER to Clockspring . GO to H39 . **No** REPAIR circuit 1516 (YE/WH). GO to H39 .



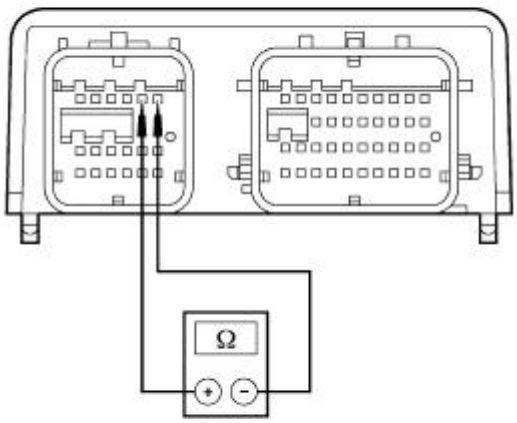
- **Is the resistance less than 0.5 ohm?**

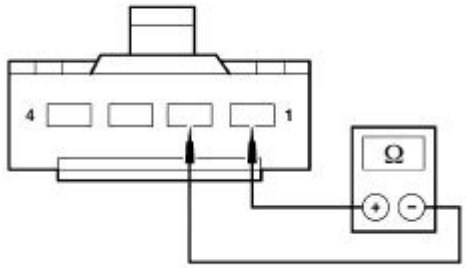
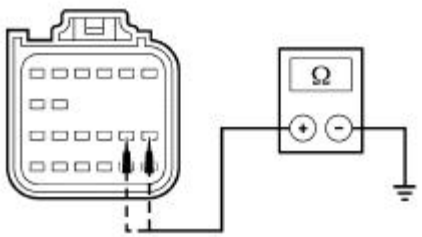
H26 CHECK CIRCUIT 1517 (RD/OG) FOR AN OPEN BETWEEN THE RCM AND THE DRIVER AIR BAG MODULE	
• Measure the resistance between the RCM C310a pin 6, circuit 1517 (RD/OG), harness side and the driver air bag module squib 2, circuit 1517 (RD/OG), harness side.  • **Is the resistance less than 0.5 ohm?**	**Yes** GO to H37 . **No** GO to H27 .
H27 CHECK CIRCUIT 1517 (RD/OG) FOR AN OPEN BETWEEN THE RCM AND THE CLOCKSPRING	
• Disconnect: Clockspring C218a. • Measure the resistance between the RCM C310a pin 6, circuit 1517 (RD/OG), harness side and the clockspring C218a pin 1, circuit 1517 (RD/OG), harness side.  • **Is the resistance less than 0.5 ohm?**	**Yes** INSTALL a new clockspring. REFER to Clockspring in this section. GO to H39 . **No** REPAIR circuit 1517 (RD/OG). GO to H39 .
H28 CHECK FOR LOW RESISTANCE ON CIRCUITS 1516 (YE/WH) AND 1517 (RD/OG) BETWEEN THE RCM AND THE DRIVER AIR BAG MODULE	
• Key in OFF position. • Disconnect: Driver Air Bag Module Squib 2 Restraint System Diagnostic Tool. • Measure the resistance between the driver air bag module squib 2, circuit 1516 (YE/WH), harness side and circuit 1517 (RD/OG), harness side.	**Yes** GO to H37 . **No** GO to H29 .

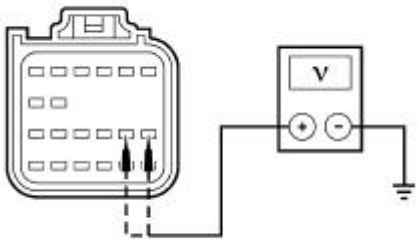


A0030495

- **Is the resistance greater than 10,000 ohms?**

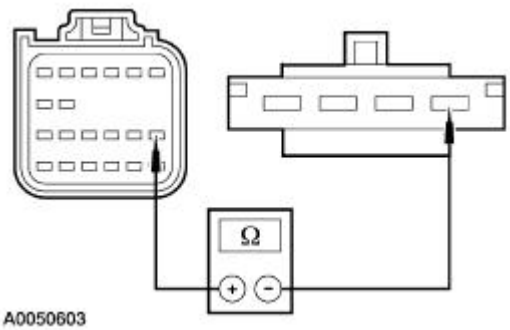
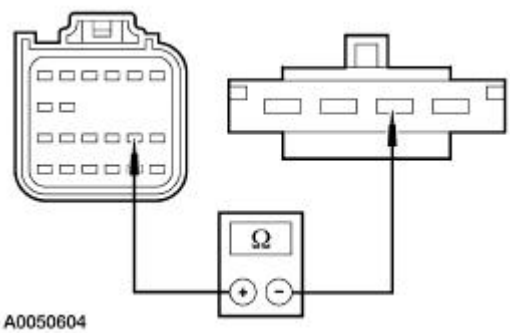
H29 MEASURE THE RESISTANCE BETWEEN THE RCM CIRCUIT 1516 (YE/WH) AND CIRCUIT 1517 (RD/OG)	
• For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Disconnect: RCM C310a. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Measure the resistance between the RCM C310a pin 5, circuit 1516 (YE/WH), component side and pin 6, circuit 1517 (RD/OG), component side.  A0041276 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to H30 . **No** GO to H37 .
H30 CHECK FOR LOW RESISTANCE ON CIRCUIT 1516 (YE/WH) AND CIRCUIT 1517 (RD/OG) BETWEEN THE DRIVER AIR BAG MODULE AND THE CLOCKSPRING	
• Connect: RCM C310a. • Disconnect: Clockspring C218a. • Measure the resistance between the clockspring C218a pin 2, circuit 1516 (YE/WH), harness side and pin 1, circuit 1517 (RD/OG), harness side.	**Yes** INSTALL a new clockspring. REFER to Clockspring in this section. GO to H39 .

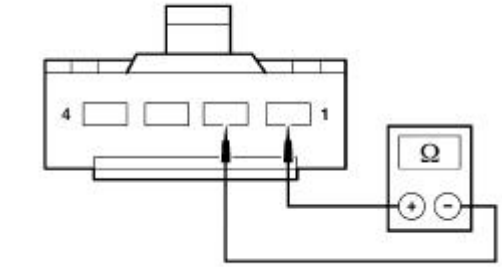
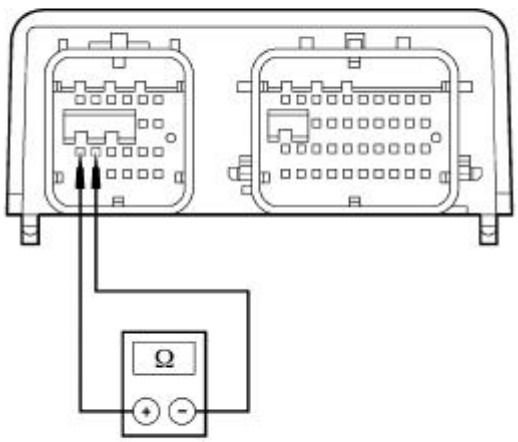
 A0029882 ● **Is the resistance greater than 10,000 ohms?**	**No** REPAIR circuit 1516 (YE/WH) and circuit 1517 (RD/OG). GO to H39 .
H31 CHECK CIRCUIT 1518 (RD/WH) AND CIRCUIT 1519 (LG/RD) FOR A SHORT TO GROUND BETWEEN THE RCM AND THE PASSENGER AIR BAG MODULE	
● Key in OFF position. ● For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . ● Disconnect: Passenger Air Bag Module Restraint System Diagnostic Tool. ● Disconnect: RCM C310a. ● For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . ● Measure the resistance between the RCM C310a pin 13, circuit 1518 (RD/WH), harness side and ground; and between the RCM C310a pin 14, circuit 1519 (LG/RD), harness side and ground.  A0041277 ● **Are the resistances greater than 1,000,000 ohms?**	**Yes** GO to H37 . **No** Due to the shorting bar feature in the electrical connector, the fault can exist in either circuit. REPAIR circuit 1518 (RD/WH) or circuit 1519 (LG/RD). GO to H39 .
H32 CHECK CIRCUIT 1518 (RD/WH) AND CIRCUIT 1519 (LG/RD) FOR A SHORT TO VOLTAGE BETWEEN THE RCM AND THE PASSENGER AIR BAG MODULE	
● Key in OFF position. ● For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . ● Disconnect: Passenger Air Bag Module Restraint System Diagnostic Tool. ● Disconnect: RCM C310a. ● For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . ● Key in ON position. ● Measure the voltage between the RCM C310a pin 13, circuit 1518 (RD/WH), harness side and ground; and between the RCM C310a pin 14, circuit 1519 (LG/RD), harness side and ground.	**Yes** GO to H37 . **No** Due to the shorting bar feature in the electrical connector, the fault can exist in either circuit. REPAIR circuit 1518 (RD/WH) or circuit 1519 (LG/RD). GO to H39 .



A0041278

- **Are the voltages less than 0.2 volt?**

H33 CHECK CIRCUIT 1518 (RD/WH) FOR AN OPEN BETWEEN THE RCM AND THE PASSENGER AIR BAG MODULE	
• Key in OFF position. • For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Disconnect: Passenger Air Bag Module Restraint System Diagnostic Tool. • Disconnect: RCM C310a. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Measure the resistance between the RCM C310a pin 13, circuit 1518 (RD/WH), harness side and the passenger air bag module C256 pin 1, circuit 1518 (RD/WH), harness side.  A0050603 • **Is the resistance less than 0.5 ohm?**	**Yes** GO to H34 . **No** REPAIR circuit 1518 (RD/WH). GO to H39 .
H34 CHECK CIRCUIT 1519 (LG/RD) FOR AN OPEN BETWEEN THE RCM AND THE PASSENGER AIR BAG MODULE	
• Measure the resistance between the RCM C310a pin 14, circuit 1519 (LG/RD), harness side and the passenger air bag module C256 pin 2, circuit 1519 (LG/RD), harness side.  A0050604 • **Is the resistance less than 0.5 ohm?**	**Yes** GO to H37 . **No** REPAIR circuit 1519 (LG/RD). GO to H39 .
H35 CHECK FOR LOW RESISTANCE ON CIRCUIT 1518 (RD/WH) AND CIRCUIT 1519 (LG/RD) BETWEEN THE RCM AND THE PASSENGER AIR BAG MODULE	

• Key in OFF position. • Disconnect: Passenger Air Bag Module Restraint System Diagnostic Tool. • Measure the resistance between the passenger air bag module C256 pin 1, circuit 1518 (RD/WH), harness side and pin 2, circuit 1519 (LG/RD), harness side.  A0029882 • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to H37 . **No** GO to H36 .
H36 MEASURE THE RESISTANCE BETWEEN THE RCM CIRCUIT 1518 (RD/WH) AND CIRCUIT 1519 (LG/RD)	
• For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Disconnect: RCM C310a. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Measure the resistance between the RCM C310a pin 13, circuit 1518 (RD/WH), component side and pin 14, circuit 1519 (LG/RD), component side.  A0041281 • **Is the resistance greater than 10,000 ohms?**	**Yes** REPAIR circuit 1518 (RD/WH) and circuit 1519 (LG/RD). GO to H39 . **No** GO to H37 .
H37 CONFIRM THE RCM FAULT	
NOTE: Make sure all restraint system diagnostic tools, sensor electrical connectors and the RCM electrical connector are connected before carrying out the on-demand self-test. If not, erroneous DTCs will be recorded	**Yes** If a **"?"** was flagged by the scan tool,

• Key in OFF position. • Connect: Restraint System Diagnostic Tools. • Connect: RCM C310a. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • Retrieve and record any flagged faults. • **Was DTC B2293 retrieved during the on-demand self test?**	CARRY OUT the entire pinpoint test before installing a new RCM. INSTALL a new RCM. REFER to Restraints Control Module (RCM) in this section. GO to H39 . **No** Fault corrected. GO to H39 .
H38 CHECK FOR AN INTERMITTENT FAULT **WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.** **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.** **WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. • Key in OFF position. • Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner	**Yes** CHECK for causes of the intermittent fault at or near the affected air bag module connector. REPAIR any intermittent concerns found. If an intermittent concern **was** found and repaired, GO to H39 . If an intermittent concern **was not** found and repaired, USE the flagged faults recorded and GO to the appropriate pinpoint test step. If a flagged fault of **"?"** was recorded multiple faults exist and the entire pinpoint test must be carried out before installing a new RCM. For driver air bag module squib 1

Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● Enter the following diagnostic mode on the diagnostic tool: Flag DTC B2293. ● If the DTC B2293 is retrieved during the on-demand self test, retrieve and record any flagged faults. ● **Was the DTC B2293 retrieved during the on-demand self test?**	(D_ABAG) with a short to ground (STG) fault, GO to H3 . For driver air bag module squib 1 (D_ABAG) with a short to battery (STB) fault, GO to H5 . For driver air bag module squib 1 (D_ABAG) with an open circuit (O_CIR) fault, GO to H7 . For driver air bag module squib 1 (D_ABAG) with a low resistance (LOWRES) fault, GO to H11 . For passenger air bag module squib 1 (P_ABAG) with a short to ground (STG) fault, GO to H14 . For passenger air bag module squib 1 (P_ABAG) with a short to battery (STB) fault, GO to H15 . For passenger air bag module squib 1 (P_ABAG) with an open circuit (O_CIR) fault, GO to H16 . For passenger air bag module squib 1 (P_ABAG) with a low resistance

		(LOWRES) fault, GO to H18 . For driver air bag module squib 2 (D_ABAG2) with a short to ground (STG) fault, GO to H20 . For driver air bag module squib 2 (D_ABAG2) with a short to battery (STB) fault, GO to H22 . For driver air bag module squib 2 (D_ABAG2) with an open circuit (O_CIR) fault, GO to H24 . For driver air bag module squib 2 (D_ABAG2) with a low resistance (LOWRES) fault, GO to H28 . For passenger air bag module squib 2 (P_ABAG2) with a short to ground (STG) fault, GO to H31 . For passenger air bag module squib 2 (P_ABAG2) with a short to battery (STB) fault, GO to H32 . For passenger air bag module squib 2 (P_ABAG2) with an open circuit (O_CIR) fault,

	GO to H33 . For passenger air bag module squib 2 (P_ABAG2) with a low resistance (LOWRES) fault, GO to H35 . **No** CHECK for causes of the intermittent fault. ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to H39 .
H39 CHECK FOR ADDITIONAL DTCs	
• Refer to the continuous DTCs recorded during Step H1. • **Were any continuous DTCs retrieved during Step H1?**	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Table in this section for pinpoint test direction. **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) . CLEAR all DTCs.

Normal Operation

The restraints control module (RCM) checks all safety canopy module circuits for faults. If the RCM detects one of the following faults on any of the safety canopy module circuits, it will store diagnostic trouble code (DTC) B2294 in memory and flash, depending on the fault, either lamp fault code (LFC) 24 or 25 depending on the fault (or higher priority code if one exists) on the air bag indicator.

Fault Conditions

The RCM monitors for the following fault conditions:

- low resistance.
- circuit open.
- circuit short to voltage.
- circuit short to ground.

Possible Causes

A safety canopy module status fault can be caused by:

- damaged wiring, terminals, or connectors.
- a faulty safety canopy module.
- a faulted RCM.

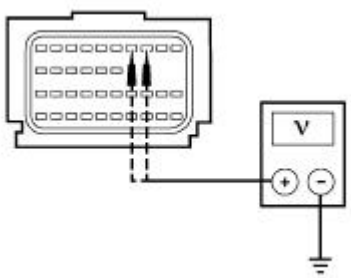
PINPOINT TEST I: LFC 24 AND 25/DTC B2294 — RESTRAINT SYSTEM SAFETY CANOPY MODULE STATUS

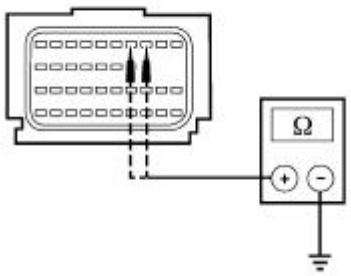
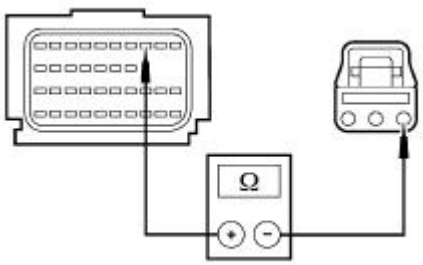
Test Step	Result / Action to Take
NOTE: Vehicles equipped with a 60/40 split bench seat require removal of the RCM to allow the electrical connectors to be disconnected. It will be necessary to reinstall the RCM after connecting the RCM electrical connectors before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. For additional information, refer to Restraints Control Module (RCM) in this section.	
I1 CHECK FOR A HARD OR INTERMITTENT DTC	
• Enter the following diagnostic mode on the diagnostic tool: Retrieve Continuous DTCs. • Retrieve, flag and record any continuous DTCs for use later in this pinpoint test. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • Enter the following diagnostic mode on the diagnostic tool: Flag B2294. • Retrieve and record any flagged faults for use later in this pinpoint test. • **Was DTC B2294 retrieved during the on-demand self test?**	**Yes** **For vehicles with safety canopy modules:** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self

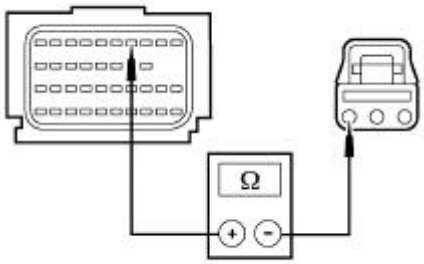
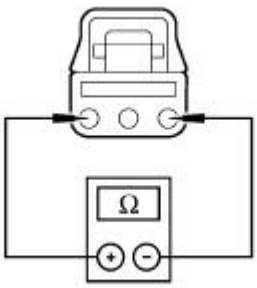
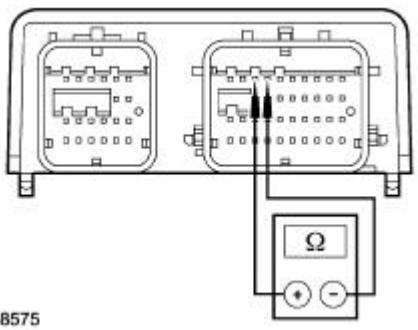
	test.GO to I3 . **For vehicles without safety canopy modules:** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test.GO to I2 . **No** This is an intermittent fault. The fault condition is not present at this time. GO to I17 .
I2 CHECK THE SAFETY CANOPY MODULE BRIDGE RESISTOR	
WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.** **WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint**	**Yes** Using the flagged faults recorded Step I1, GO to the appropriate pinpoint test step. If a flagged fault of **"?"** was recorded in Step I1, multiple faults exist and the entire pinpoint test must be carried out before installing a new RCM. For passenger safety canopy module (PFCURTN) with a short to battery (STB) fault, GO to I10 . For passenger safety canopy module (PFCURTN)

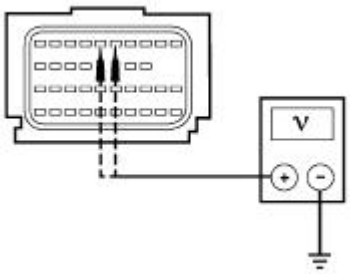
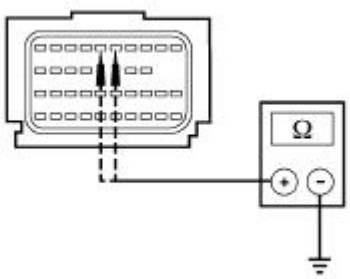
system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE: After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. ● Key in OFF position. ● Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. ● Disconnect: RH Side Safety Canopy Bridge Resistor. ● Install a known good safety canopy bridge resistor. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● Enter the following diagnostic mode on the diagnostic tool: Flag DTC B2294. ● **Was DTC B2294 retrieved during the on-demand self test?**	with a short to ground (STG) fault, GO to I11 . For passenger safety canopy module (PFCURTN) with an open circuit (O_CIR) fault, GO to I12 . For passenger safety canopy module (PFCURTN) with a low resistance (LOWRES) fault, GO to I14 . **No** Fault Corrected. GO to I18 .
I3 CHECK THE DRIVER AND PASSENGER SAFETY CANOPY MODULES	
WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.** **WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint**	**Yes** Using the flagged faults recorded in Step I1, GO to the appropriate pinpoint test step. If a flagged fault of **"?"** was recorded in Step I1, multiple faults exist and the entire pinpoint test must be carried out before installing a new RCM. For driver safety canopy module (DFCURTN) with a short to battery (STB) fault, GO to I4 . For driver safety canopy module (DFCURTN) with a short to ground (STG) fault, GO to I5 .

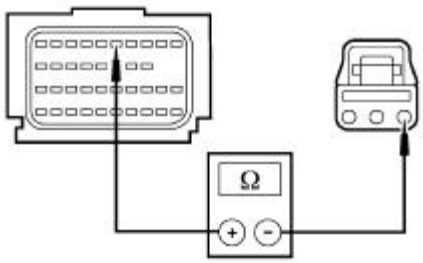
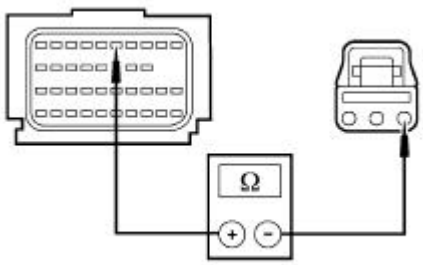
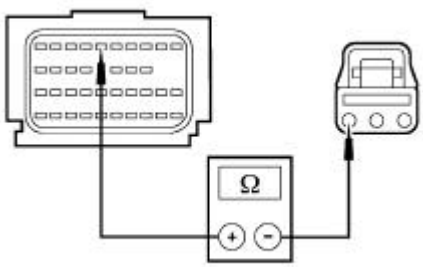
system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE: After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. • Key in OFF position. • Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • **Was DTC B2294 retrieved during the on-demand self test?**	For driver safety canopy module (DFCURTN) with an open circuit (O_CIR) fault, GO to I6 . For driver safety canopy module (DFCURTN) with a low resistance (LOWRES) fault, GO to I8 . For passenger safety canopy module (PFCURTN) with a short to battery (STB) fault, GO to I10 . For passenger safety canopy module (PFCURTN) with a short to ground (STG) fault, GO to I11 . For passenger safety canopy module (PFCURTN) with an open circuit (O_CIR) fault, GO to I12 . For passenger safety canopy module (PFCURTN) with a low resistance (LOWRES) fault, GO to I14 . **No** If a flagged fault of **"?"** was recorded in Step I1, multiple faults exist and the entire pinpoint test must be carried out before

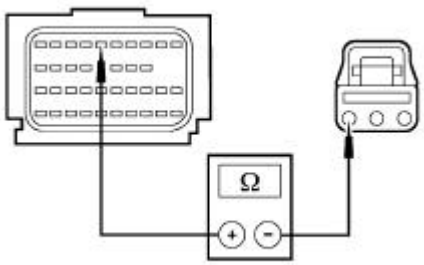
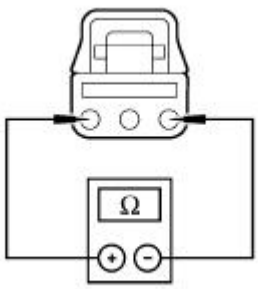
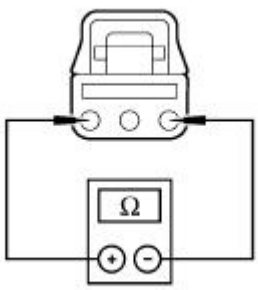
	installing a new safety canopy module. If a fault was flagged against the driver safety canopy module in Step I1, INSTALL a new driver safety canopy module. REFER to Safety Canopy Module in this section. GO to I18 . If a fault was flagged against the passenger safety canopy module in Step I1, INSTALL a new passenger safety canopy module. REFER to Safety Canopy Module in this section. GO to I18 .
I4 CHECK CIRCUIT 1257 (WH/LB) AND CIRCUIT 1258 (BN/LB) FOR A SHORT TO BATTERY BETWEEN THE RCM AND THE DRIVER SAFETY CANOPY MODULE	
• Key in OFF position. • For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Disconnect: Driver Side Safety Canopy Restraint System Diagnostic Tool. • Disconnect: RCM C310b. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Key in ON position. • Measure the voltage between RCM C310b pin 3, circuit 1257 (WH/LB), harness side and ground; and between RCM C310b pin 4, circuit 1258 (BN/LB), harness side and ground.  A0048593 • **Are the voltages less than 0.2 volt?**	**Yes** GO to I16 . **No** Due to the shorting bar feature in the electrical connector, the fault can exist in either circuit. REPAIR circuit 1257 (WH/LB) or circuit 1258 (BN/LB). GO to I18 .
I5 CHECK CIRCUIT 1257 (WH/LB) AND CIRCUIT 1258 (BN/LB) FOR A SHORT TO GROUND BETWEEN THE RCM AND THE DRIVER SAFETY	

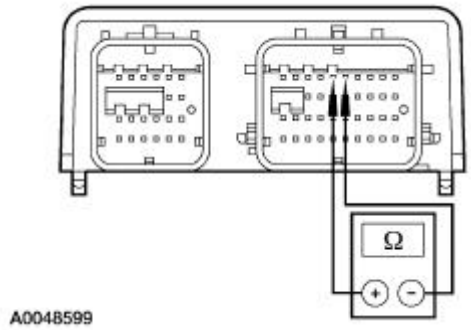
CANOPY MODULE	
• Key in OFF position. • For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Disconnect: Driver Safety Canopy Restraint System Diagnostic Tool. • Disconnect: RCM C310b. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Measure the resistance between RCM C310b pin 3, circuit 1257 (WH/LB), harness side and ground; and between RCM C310b pin 4 circuit 1258 (BN/LB), harness side and ground.  A0048594 • **Is the resistance greater than 1,000,000 ohms?**	**Yes** GO to I16 . **No** Due to the shorting bar feature in the electrical connector, the fault can exist in either circuit. REPAIR circuit 1257 (WH/LB) or circuit 1258 (BN/LB). GO to I18 .
I6 CHECK CIRCUIT 1257 (WH/LB) FOR AN OPEN BETWEEN THE RCM AND THE DRIVER SAFETY CANOPY MODULE	
• Key in OFF position. • For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Disconnect: Driver Safety Canopy Restraint System Diagnostic Tool. • Disconnect: RCM C310b. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Measure the resistance between RCM C310b pin 3, circuit 1257 (WH/LB), harness side and driver safety canopy module C9006 pin 1, circuit 1257 (WH/LB), harness side.  A0048600 • **Is the resistance less than 0.5 ohm?**	**Yes** GO to I7 . **No** REPAIR circuit 1257 (WH/LB). GO to I18 .
I7 CHECK CIRCUIT 1258 (BN/LB) FOR AN OPEN BETWEEN THE RCM AND THE DRIVER SAFETY CANOPY MODULE	
• Measure the resistance between RCM C310b pin 4, circuit 1258 (BN/LB), harness side and driver safety canopy module C9006 pin 3, circuit 1258 (BN/LB), harness side.	**Yes** GO to I16 . **No** REPAIR circuit 1258 (BN/LB). GO to I18 .

 A0048574 ● **Is the resistance less than 0.5 ohm?**	
I8 CHECK FOR LOW RESISTANCE ON CIRCUIT 1257 (WH/LB) AND CIRCUIT 1258 (BN/LB) BETWEEN THE DRIVER SAFETY CANOPY MODULE AND THE RCM	
● Key in OFF position. ● Disconnect: Driver Safety Canopy Restraint System Diagnostic Tool. ● Measure the resistance between driver side safety canopy module C9006, circuit 1257 (WH/LB) and circuit 1258 (BN/LB), harness side.  DR1050-A ● **Is the resistance greater than 10, 000 ohms?**	**Yes** GO to I16 . **No** GO to I9 .
I9 MEASURE RESISTANCE BETWEEN RCM CIRCUIT 1257 (WH/LB) AND CIRCUIT 1258 (BN/LB)	
● For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . ● Disconnect: RCM C310b. ● For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . ● Measure the resistance between RCM C310b pin 3, circuit 1257 (WH/LB), and pin 4, circuit 1258 (BN/LB), component side.  A0048575 ● **Is the resistance greater than 10,000 ohms?**	**Yes** REPAIR circuit 1257 (WH/LB) and circuit 1258 (BN/LB). GO to I18 . **No** GO to I16 .
I10 CHECK CIRCUIT 1259 (YE/WH) AND CIRCUIT 1260 (BN/YE) FOR A SHORT TO BATTERY BETWEEN THE RCM AND THE PASSENGER SAFETY CANOPY MODULE	
● Key in OFF position.	**Yes**

• For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Disconnect: Passenger Safety Canopy Restraint System Diagnostic Tool. • Vehicles with safety canopies. • Disconnect: RH Side Safety Canopy Bridge Resistor C9003. • Vehicles without safety canopies. • Disconnect: RCM C310b. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Key in ON position. • Measure the voltage between RCM C310b pin 5, circuit 1259 (YE/WH), harness side and ground; and between RCM C310b pin 6, circuit 1260 (BN/YE), harness side and ground.  A0048595 • **Are the voltages less than 0.2 volt?**	GO to I16 . **No** Due to the shorting bar feature in the electrical connector, the fault can exist in either circuit. REPAIR circuit 1259 (YE/WH) or circuit 1260 (BN/YE). GO to I18 .
I11 CHECK CIRCUIT 1259 (YE/WH) AND CIRCUIT 1260 (BN/YE) FOR A SHORT TO GROUND BETWEEN THE RCM AND THE PASSENGER SAFETY CANOPY MODULE	
• Key in OFF position. • For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Disconnect: Passenger Safety Canopy Module Restraint System Diagnostic Tool. • Vehicles with safety canopies. • Disconnect: RH Side Safety Canopy Bridge Resistor C9003. • Vehicles without safety canopies. • Disconnect: RCM C310b. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Measure the resistance between RCM C310b pin 5, circuit 1259 (YE/WH), harness side and ground; and between RCM C310b pin 6, circuit 1260 (BN/YE), harness side and ground.  A0048596 • **Is the resistance greater than 1,000,000 ohms?**	**Yes** GO to I16 . **No** Due to the shorting bar feature in the electrical connector, the fault can exist in either circuit. REPAIR circuit 1259 (YE/WH) or circuit 1260 (BN/YE). GO to I18 .
I12 CHECK CIRCUIT 1259 (YE/WH) FOR AN OPEN BETWEEN THE RCM AND THE PASSENGER SAFETY CANOPY MODULE	

• Key in OFF position. • For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Disconnect: Passenger Safety Canopy Module Restraint System Diagnostic Tool. • Vehicles with safety canopies. • Disconnect: RH Side Safety Canopy Module Bridge Resistor C9003. • Vehicles without safety canopies. • Disconnect: RCM C310b. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • **For vehicles with safety canopies** , measure the resistance between RCM C310b pin 5, circuit 1259 (YE/WH), harness side and passenger safety canopy module C9007 pin 1, circuit 1259 (YE/WH), harness side.  A0048597 • **For vehicles without safety canopies** , measure the resistance between RCM C310b pin 5, circuit 1259 (YE/WH), harness side and RH side safety canopy bridge resistor C9003 pin 1, circuit 1259 (YE/WH), harness side.  A0048597 • **Is the resistance less than 0.5 ohm?**	**Yes** GO to I13 . **No** REPAIR circuit 1259 (YE/WH). GO to I18 .
I13 CHECK CIRCUIT 1260 (BN/YE) FOR OPEN BETWEEN THE RCM AND THE PASSENGER SAFETY CANOPY MODULE	
• **For vehicles with safety canopies** , measure the resistance between RCM C310b pin 6, circuit 1260 (BN/YE), harness side and passenger safety canopy module C9007 pin 3, circuit 1260 (BN/YE), harness side.  A0048598	**Yes** GO to I14 . **No** REPAIR circuit 1260 (BN/YE). GO to I18 .

• **For vehicles without safety canopies** , measure the resistance between RCM C310b pin 6, circuit 1260 (BN/YE), harness side and RH side safety canopy bridge resistor C9003 pin 3, circuit 1260 (BN/YE), harness side.  A0048598 • **Is the resistance less than 0.5 ohm?**	
I14 CHECK FOR LOW RESISTANCE ON CIRCUIT 1259 (YE/WH) AND CIRCUIT 1260 (BN/YE) BETWEEN THE PASSENGER SAFETY CANOPY MODULE AND THE RCM	
• Key in OFF position. • Disconnect: Passenger Safety Canopy Module Restraint System Diagnostic Tool. • Vehicles with safety canopies. • Disconnect: RH Side Safety Canopy Module Bridge Resistor. • Vehicles without safety canopies. • **For vehicles with safety canopies** , measure the resistance between passenger safety canopy module C9007, circuit 1259 (YE/WH), and circuit 1260 (BN/YE), harness side.  DR1050-A • **For vehicles without safety canopies** , measure the resistance between RH safety canopy bridge resistor C9003, circuit 1259 (YE/WH), and circuit 1260 (BN/YE), harness side.  DR1050-A • **Is the resistance greater than 10,000 ohms?**	**Yes** GO to I16 . **No** GO to I15 .
I15 MEASURE RESISTANCE BETWEEN RCM CIRCUIT 1259 (YE/WH) AND CIRCUIT 1260 (BN/YE)	
• For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional	**Yes** REPAIR circuit

information, refer to Section 414-01 . • Disconnect: RCM C310b. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Measure the resistance between RCM C310b pin 5, circuit 1259 (YE/WH), and pin 6, circuit 1260 (BN/YE), component side.  • **Is the resistance greater than 10,000 ohms?**	1259 (YE/WH) and circuit 1260 (BN/YE).GO to I18 . **No** GO to I16 .
I16 CONFIRM THE RCM FAULT	
NOTE: Make sure all restraint system diagnostic tools, sensor electrical connectors and the RCM electrical connector are connected before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. • Key in OFF position. • For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Connect: Restraint System Diagnostic Tools. • Vehicles with safety canopies. • Connect: RH Side Safety Canopy Bridge Resistor C9003. • Vehicles without safety canopies. • Connect: RCM C310b. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • Retrieve and record any flagged faults. • **Was DTC B2294 retrieved during the on-demand self test?**	**Yes** If a **"?"** was flagged by the scan tool, CARRY OUT the entire pinpoint test before installing a new RCM. INSTALL a new RCM. REFER to Restraints Control Module (RCM) in this section. GO to I18 . **No** Fault corrected. GO to I18 .
I17 CHECK FOR AN INTERMITTENT FAULT	
WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.** **WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can**	**Yes** CHECK for causes of the intermittent fault at or near the affected safety canopy module connector. REPAIR any intermittent concerns found. If an intermittent concern **was** found and repaired, GO to I18 .

result in personal injury.  **WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury.**  **WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

- Key in OFF position.
- Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section.
- Key in ON position.
- Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test.
- Enter the following diagnostic mode on the diagnostic tool: Flag DTC B2294.
- If the DTC B2294 is retrieved during the on-demand self test, retrieve and record any flagged faults.
- **Was DTC B2294 retrieved during on-demand self test?**

If an intermittent concern **was not** found and repaired, USE the flagged faults recorded and GO to the appropriate pinpoint test step.

If a flagged fault of **"?"** was recorded in Step I1, multiple faults exist and the entire pinpoint test must be carried out before installing a new RCM.

For driver safety canopy module (DFCURTN) with a short to battery (STB) fault, GO to I4 .

For driver safety canopy module (DFCURTN) with a short to ground (STG) fault, GO to I5 .

For driver safety canopy module (DFCURTN) with an open circuit (O_CIR) fault, GO to I6 .

For driver safety canopy module (DFCURTN) with a low resistance (LOWRES) fault, GO to I8 .

For passenger safety canopy module (PFCURTN) with a short to battery (STB) fault, GO to I10 .

For passenger safety canopy

	module (PFCURTN) with a short to ground (STG) fault, GO to I11 . For passenger safety canopy module (PFCURTN) with an open circuit (O_CIR) fault, GO to I12 . For passenger safety canopy module (PFCURTN) with a low resistance (LOWRES) fault, GO to I14 . **No** CHECK for causes of the intermittent fault. ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to I18 .
I18 CHECK FOR ADDITIONAL DTCs	
• Refer to the continuous DTCs recorded during Step I1. • **Were any continuous DTCs retrieved during Step I1?**	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Table in this section for pinpoint test direction. **No** RECONNECT the system.

	REACTIVATE the system. PROVE OUT the system. REFER to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. CLEAR all DTCs.

Pinpoint Test J: LFC 42, 43, 44, 45 and 46/DTC B2296 — Restraint System - Impact Sensor Status

Normal Operation

The restraints control module (RCM) checks all of the impact sensor circuits for faults. If the RCM detects one of the following faults on any of the impact sensor circuits, it will store diagnostic trouble code (DTC) B2296 in memory and flash either lamp fault code (LFC) 42, 43, 44, 45 or 46 depending on the fault (or higher priority code if one exists) on the air bag indicator.

Fault Conditions

The RCM monitors for the following fault conditions:

- low resistance.
- circuit open.
- circuit short to voltage.
- circuit short to ground.

Possible Causes

A impact sensor status fault can be caused by:

- damaged wiring, terminals, or connectors.
- a faulty impact sensor.
- incorrect sensor mounting.
- a faulted RCM.

PINPOINT TEST J: LFC 42, 43, 44, 45 AND 46/DTC B2296 — RESTRAINT SYSTEM IMPACT SENSOR STATUS

Test Step	Result / Action to Take
NOTE: Vehicles equipped with a 60/40 split bench seat require removal of the RCM to allow the electrical connectors to be disconnected. It will be necessary to reinstall the RCM after connecting the RCM electrical connectors before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. For additional information, refer to Restraints Control Module	

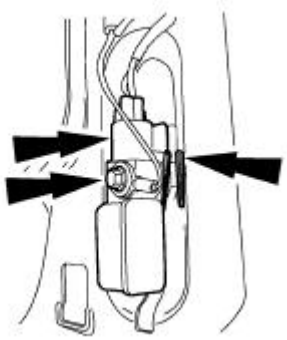
(RCM) in this section.

J1 CHECK FOR A HARD OR INTERMITTENT DTC	
• Enter the following diagnostic mode on the diagnostic tool: Retrieve/Flag Continuous DTCs. • Retrieve, flag and record any continuous DTCs for use later in this pinpoint test. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • Enter the following diagnostic mode on the diagnostic tool: Flag DTC B2296. • Retrieve and record any flagged faults for use later in this pinpoint test. • **Was DTC B2296 retrieved during the on-demand self test?**	**Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. If a flagged fault of **"?"** was recorded, multiple faults exist and the entire pinpoint test must be carried out before installing a new RCM. For first row driver side impact (F_D_SEN) sensor with a mounting/communications (COMM) fault, GO to J2 . For first row driver side impact sensor (F_D_ SEN) with an internal fault (INT) fault, INSTALL a new first row driver side impact sensor. REFER to Side Impact Sensor—Front Row in this section. GO to J54 . For first row passenger side impact sensor (F_P_ SEN) with a mounting/communications (COMM) fault, GO to J12 . For first row passenger side impact sensor (F_P_ SEN) with an internal fault (INT) fault, INSTALL a new first row passenger side impact sensor. REFER to Side Impact Sensor—Front Row in this section. GO to J54 . For second row driver side impact sensor(D_2_SEN) with a mounting/communication (COMM) fault, GO to J22 . For second row driver side impact sensor (D_2_ SEN) with an internal (INT) fault, INSTALL a new second row driver side impact sensor. REFER to Side Impact Sensor—Second Row in this section. GO to J54 .

	For second row passenger side impact sensor (P_2_ SEN) with a mounting /communications (COMM) fault, GO to J32 . For second row passenger side impact sensor (P_2_SEN) with an internal (INT) fault, INSTALL a new second row passenger side impact sensor. REFER to Side Impact Sensor—Second Row in this section. GO to J54 . For front impact severity sensor (FNT_SEN) with a mounting/communications (COMM) fault, GO to J42 . For front impact severity sensor (FNT_SEN) with an internal fault (INT) fault, INSTALL a new front impact severity sensor. REFER to Front Impact Severity Sensor in this section. GO to J54 . **No** This is an intermittent fault. The fault condition is not present at this time. GO to J53 .
J2 INSPECT THE FIRST ROW DRIVER SIDE IMPACT SENSOR MOUNTING, AND MOUNTING SURFACE	
WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury.** **WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.** **WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped**	**Yes** CLEAN and TIGHTEN the bolt. REPAIR the mounting surface as necessary. REINSTALL the first row driver side impact sensor. GO to J54 . **No** GO to J3 .

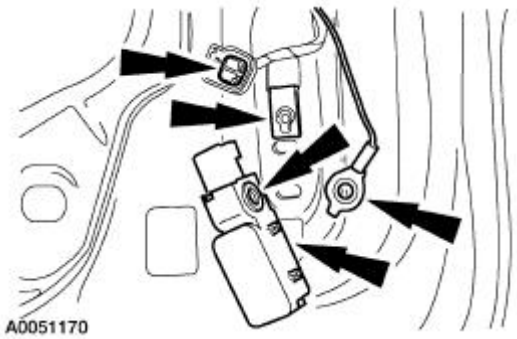
vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. **WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

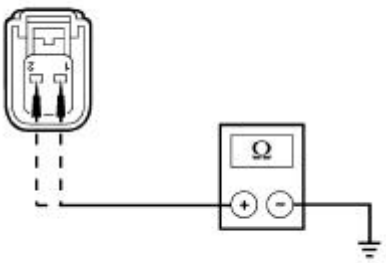
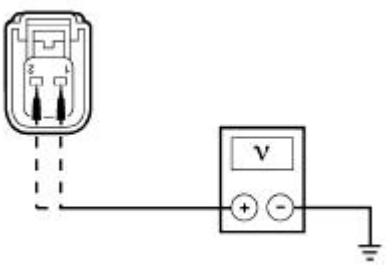
- Key in OFF position.
- Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section.
- Access the first row driver side impact sensor located behind the front door trim panel. For additional information, refer to Side Impact Sensor—Front Row in this section.
- Inspect the first row driver side impact sensor for:
    - loose electrical connector and ground wire.
    - damaged J-clip.
    - loose sensor mounting bolt.

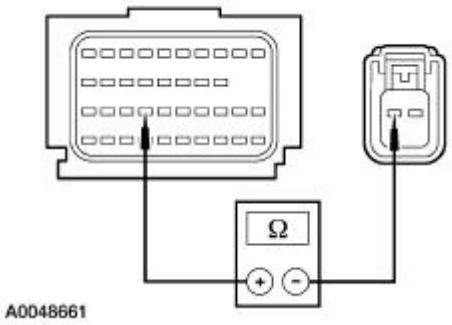
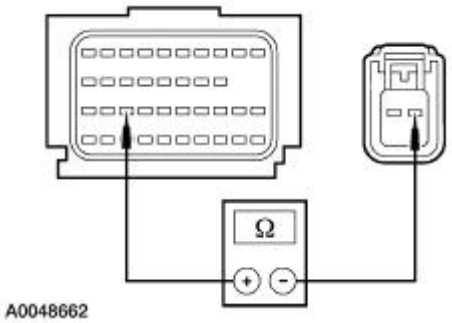
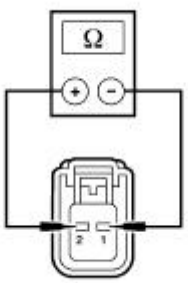


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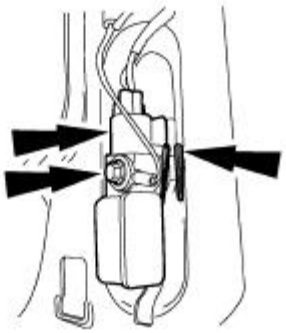
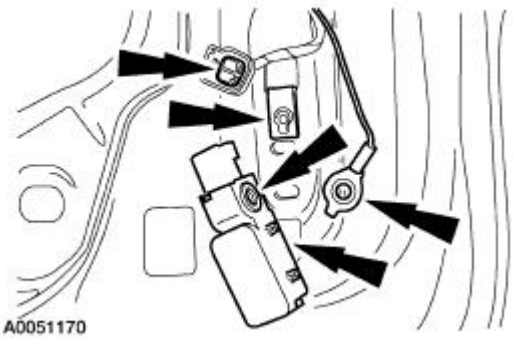
- **CAUTION: The ground wire must be placed between the bolt head and the sensor. Never position the ground wire between the J-clip retaining nut and the sensor.**
- **CAUTION: Always replace the J-clip retaining nut whenever installing a side impact sensor.**
- Remove the first row driver side impact sensor.
- Visually inspect the first row driver side impact sensor, alignment tabs, electrical connectors, J-clip and mounting surface for damage, corrosion or dirt.

 A0051170 ● **Was a significant amount of corrosion or dirt found, or was the first row driver side impact sensor attached to the mounting surface incorrectly or was the impact sensor bolt not fully seated and tightened correctly?**	
J3 INSTALL THE FIRST ROW DRIVER SIDE IMPACT SENSOR AND CARRY OUT THE ON-DEMAND SELF TEST	**Yes** GO to J4 . **No** Fault corrected. GO to J54 .
CAUTION: The ground wire must be placed between the bolt head and the sensor. Never position the ground wire between the J-clip retaining nut and the sensor. CAUTION: Always replace the J-clip retaining nut whenever installing a side impact sensor. ● Clean and repair the mounting surface as necessary. ● Clean the first row driver side impact sensor mounting bolt. ● Install the first row driver side impact sensor. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Flag DTC B2296. ● Retrieve and record any flagged faults for use later in this pinpoint test. ● **Was DTC B2296 retrieved during the on-demand self test?**	
J4 CHECK THE FIRST ROW DRIVER SIDE IMPACT SENSOR GROUND CIRCUIT 1262 (BN/LG) FOR HIGH RESISTANCE	**Yes** GO to J6 . **No** GO to J5 .
● Key in OFF position. ● Disconnect: First Row Driver Side Impact Sensor C539. ● Measure the resistance between first row driver side impact sensor C539 pin 1, circuit 1262 (BN/LG), harness side and the first row driver side impact sensor case ground. ● **Is the resistance less than 100 ohms?**	
J5 CLEAN THE FIRST ROW DRIVER SIDE IMPACT SENSOR MOUNTING SURFACE AND CARRY OUT THE ON-DEMAND SELF TEST	**Yes** GO to J6 . **No** Fault corrected. GO to J54 .
CAUTION: The ground wire must be placed between the bolt head and the sensor. Never position the ground wire between the J-clip retaining nut and the sensor. CAUTION: Always replace the J-clip retaining nut whenever installing a side impact sensor. ● Remove the first row driver side impact sensor. ● Clean and repair the mounting surface as necessary. ● Clean the first row driver side impact sensor mounting bolt. ● Install the first row driver side impact sensor. ● Enter the following diagnostic mode on the diagnostic tool: Flag DTC B2296. ● Retrieve and record any flagged faults for use later in this	

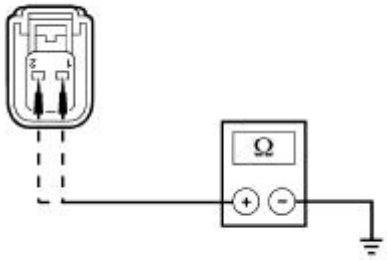
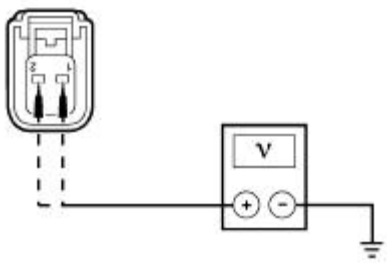
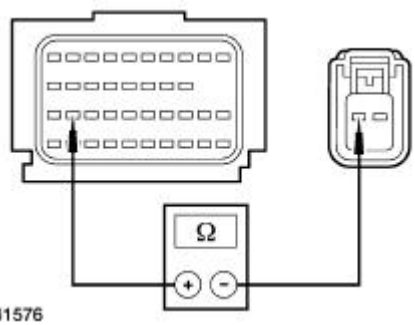
pinpoint test. ● **Was DTC B2296 retrieved during the on-demand self test?**	
J6 CHECK CIRCUIT 1261 (WH/LG) AND CIRCUIT 1262 (BN/LG) FOR A SHORT TO GROUND BETWEEN THE FIRST ROW DRIVER SIDE IMPACT SENSOR AND THE RCM	
● Key in OFF position. ● For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . ● Disconnect: RCM C310a. ● Disconnect: RCM C310b. ● For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . ● Measure the resistance between first row driver side impact sensor C539 pin 1, circuit 1262 (BN/LG), harness side and ground; and between pin 2, circuit 1261 (WH/LG), harness side and ground.  A0029893 ● **Are the resistances greater than 1,000,000 ohms?**	**Yes** GO to J7 . **No** REPAIR circuit 1261 (WH/LG) or circuit 1262 (BN/LG). GO to J54 .
J7 CHECK CIRCUIT 1261 (WH/LG) AND CIRCUIT 1262 (BN/LG) FOR A SHORT TO VOLTAGE BETWEEN THE FIRST ROW DRIVER SIDE IMPACT SENSOR AND THE RCM	
● Key in ON position. ● Measure the voltage between first row driver side impact sensor C539 pin 1, circuit 1262 (BN/LG), harness side and ground; and between pin 2, circuit 1261 (WH/LG), harness side and ground.  A0029894 ● **Are the voltages less than 0.2 volt?**	**Yes** GO to J8 . **No** REPAIR circuit 1261 (WH/LG) or circuit 1262 (BN/LG). GO to J54 .
J8 CHECK CIRCUIT 1261 (WH/LG) FOR AN OPEN BETWEEN THE RCM AND THE FIRST ROW DRIVER SIDE IMPACT SENSOR	
● Key in OFF position. ● Measure the resistance between RCM C310b pin 27, circuit 1261 (WH/LG), harness side and first row driver side impact sensor C539 pin 2, circuit 1261 (WH/LG), harness side.	**Yes** GO to J9 . **No**

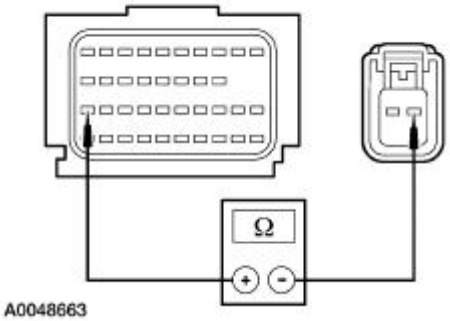
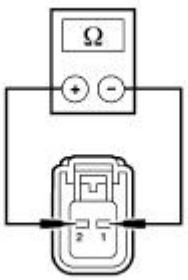
 A0048661 ● **Is the resistance less than 0.5 ohm?**	REPAIR circuit 1261 (WH/LG). GO to J54 .
J9 CHECK CIRCUIT 1262 (BN/LG) FOR AN OPEN BETWEEN THE RCM AND FIRST ROW DRIVER SIDE IMPACT SENSOR	
● Measure the resistance between RCM C310b pin 28, circuit 1262 (BN/LG), harness side and first row driver side impact sensor C539 pin 1, circuit 1262 (BN/LG), harness side.  A0048662 ● **Is the resistance less than 0.5 ohm?**	**Yes** GO to J10 . **No** REPAIR circuit 1262 (BN/LG). GO to J54 .
J10 CHECK CIRCUIT 1261 (WH/LG) FOR A SHORT TO CIRCUIT 1262 (BN/LG) BETWEEN THE RCM AND THE FIRST ROW DRIVER SIDE IMPACT SENSOR	
● Measure the resistance between first row driver side impact sensor C539 pin 2, circuit 1261 (WH/LG), harness side and pin 1, circuit 1262 (BN/LG), harness side.  A0049598 ● **Is the resistance greater than 1,000,000 ohms?**	**Yes** GO to J11 . **No** REPAIR circuit 1261 (WH/LG) and circuit 1262 (BN/LG). GO to J54 .
J11 CHECK THE FIRST ROW DRIVER SIDE IMPACT SENSOR	
● For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . ● Connect: RCM C310a. ● Connect: RCM C310b. ● Install a known good first row driver side impact sensor. ● For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 .	**Yes** INSTALL the original first row driver side impact sensor. GO to J52 . **No** Fault corrected. GO to J54 .

• Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • Enter the following diagnostic mode on the diagnostic tool: Flag DTC B2296. • Retrieve and record any flagged faults for use later in this pinpoint test. • **Were any faults flagged against the first row driver side impact sensor?**	
J12 INSPECT THE FIRST ROW PASSENGER SIDE IMPACT SENSOR MOUNTING, AND MOUNTING SURFACE **WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.** **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury.** **WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.** **WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. • Key in OFF position. • Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section.	**Yes** CLEAN and TIGHTEN the bolt. REPAIR the mounting surface and electrical connections as necessary. REINSTALL the first row passenger side impact sensor. GO to J54 . **No** GO to J13 .

• Access the first row passenger side impact sensor located behind the front door trim panel. For additional information, refer to Side Impact Sensor—Front Row in this section. • Inspect the first row passenger side impact sensor for: • loose electrical connector and ground wire. • damaged J-clip. • loose sensor mounting bolt.  A0051169 • **CAUTION: The ground wire must be placed between the bolt head and the sensor. Never position the ground wire between the J-clip retaining nut and the sensor.** • **CAUTION: Always replace the J-clip retaining nut whenever installing a side impact sensor.** • Remove the first row passenger side impact sensor. • Visually inspect the first row passenger side impact sensor, alignment tabs, electrical connectors, J-clip and mounting surface for damage, corrosion or dirt.  A0051170 • **Was a significant amount of corrosion or dirt found, or was the passenger side impact sensor attached to the mounting surface incorrectly or was the sensor bolt not fully seated and tightened correctly?**	
J13 INSTALL THE FIRST ROW PASSENGER SIDE IMPACT SENSOR AND CARRY OUT THE ON-DEMAND SELF TEST	
CAUTION: The ground wire must be placed between the bolt head and the sensor. Never position the ground wire between the J-clip retaining nut and the sensor. CAUTION: Always replace the J-clip retaining nut whenever installing a side impact sensor. • Clean and repair the mounting surface as necessary. • Clean the first row passenger side impact sensor mounting bolt. • Install the first row passenger side impact sensor. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool:	**Yes** GO to J14 . **No** Fault corrected. GO to J54 .

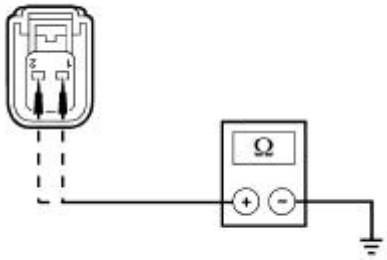
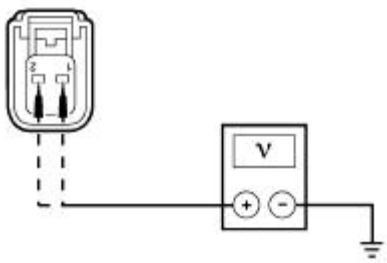
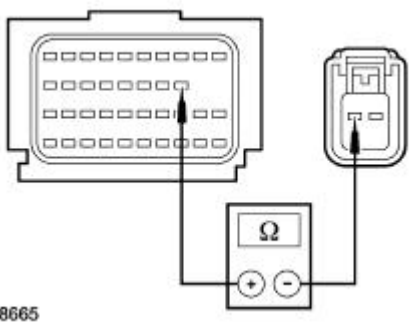
On-Demand Self Test. ● Enter the following diagnostic mode on the diagnostic tool: Flag DTC B2296. ● Retrieve and record any flagged faults for use later in this pinpoint test. ● **Was DTC B2296 retrieved during the on-demand self test?**	
J14 CHECK THE FIRST ROW PASSENGER SIDE IMPACT SENSOR GROUND CIRCUIT 1264 (BN) FOR HIGH RESISTANCE	
● Key in OFF position. ● Disconnect: First Row Passenger Side Impact Sensor C631. ● Measure the resistance between first row passenger side impact sensor C631 pin 1, circuit 1264 (BN), harness side and first row passenger side impact sensor case ground. ● **Is the resistance less than 100 ohms?**	**Yes** GO to J16 . **No** GO to J15 .
J15 CLEAN FIRST ROW PASSENGER SIDE IMPACT SENSOR MOUNTING SURFACE AND CARRY OUT ON-DEMAND SELF TEST	
CAUTION: The ground wire must be placed between the bolt head and the sensor. Never position the ground wire between the J-clip retaining nut and the sensor. CAUTION: Always replace the J-clip retaining nut whenever installing a side impact sensor. ● Remove the first row passenger side impact sensor. ● Clean and repair the mounting surface as necessary. ● Clean the first row passenger side impact sensor mounting bolts. ● Install the first row passenger side impact sensor. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● Enter the following diagnostic mode on the diagnostic tool: Flag DTC B2296. ● Retrieve and record any flagged faults for use later in this pinpoint test. ● **Was DTC B2296 retrieved during the on-demand self test?**	**Yes** GO to J16 . **No** Fault corrected. GO to J54 .
J16 CHECK CIRCUIT 1263 (WH) AND CIRCUIT 1264 (BN) FOR A SHORT TO GROUND BETWEEN THE FIRST ROW PASSENGER SIDE IMPACT SENSOR AND THE RCM	
● Key in OFF position. ● For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . ● Disconnect: RCM C310a. ● Disconnect: RCM C310b. ● For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . ● Measure the resistance between first row passenger side impact sensor C631 pin 2, circuit 1263 (WH), harness side and ground; and between pin 1, circuit 1264 (BN), harness side and ground.	**Yes** GO to J17 . **No** REPAIR circuit 1263 (WH) or circuit 1264 (BN).GO to J54 .

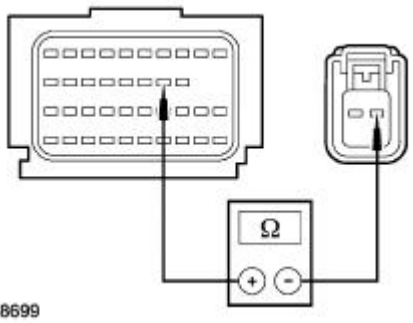
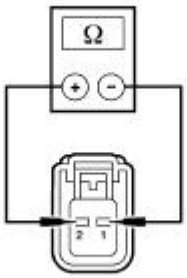
 A0029893 ● **Are the resistances greater than 1,000,000 ohms?**	
J17 CHECK CIRCUIT 1263 (WH) AND CIRCUIT 1264 (BN) FOR A SHORT TO BATTERY BETWEEN THE FIRST ROW PASSENGER SIDE IMPACT SENSOR AND THE RCM	
● Key in ON position. ● Measure the voltage between first row passenger side impact sensor C631 pin 2, circuit 1263 (WH), harness side and ground; and between pin 1, circuit 1264 (BN), harness side and ground.  A0029894 ● **Are the voltages less than 0.2 volt?**	**Yes** GO to J18 . **No** REPAIR circuit 1263 (WH) or circuit 1264 (BN). GO to J54 .
J18 CHECK CIRCUIT 1263 (WH) FOR AN OPEN BETWEEN THE RCM AND THE FIRST ROW PASSENGER SIDE IMPACT SENSOR	
● Key in OFF position. ● Measure the resistance between RCM C310b pin 29, circuit 1263 (WH), harness side and first row passenger side impact sensor C631 pin 2, circuit 1263 (WH), harness side.  A0041576 ● **Is the resistance less than 0.5 ohm?**	**Yes** GO to J19 . **No** REPAIR circuit 1263 (WH). GO to J54 .
J19 CHECK CIRCUIT 1264 (BN) FOR AN OPEN BETWEEN THE RCM AND THE FIRST ROW PASSENGER SIDE IMPACT SENSOR	
● Measure the resistance between RCM C310b pin 30, circuit 1264 (BN), harness side and first row passenger side impact sensor C631 pin 1, circuit 1264 (BN), harness side.	**Yes** GO to J20 .

 A0048663 ● **Is the resistance less than 0.5 ohm?**	**No** REPAIR circuit 1264 (BN). GO to J54 .
J20 CHECK CIRCUIT 1263 (WH) FOR A SHORT TO CIRCUIT 1264 (BN) BETWEEN THE RCM AND THE FIRST ROW PASSENGER SIDE IMPACT SENSOR	
● Measure the resistance between first row passenger side impact sensor C631 pin 2, circuit 1263 (WH), harness side pin 1, circuit 1264 (BN), harness side.  A0049598 ● **Is the resistance greater than 1,000,000 ohms?**	**Yes** GO to J21 . **No** REPAIR short between circuit 1263 (WH) and circuit 1264 (BN). GO to J54 .
J21 CHECK THE FIRST ROW PASSENGER SIDE IMPACT SENSOR	
● For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . ● Connect: RCM C310a. ● Connect: RCM C310b. ● Install a known good first row passenger side impact sensor. ● For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● Enter the following diagnostic mode on the diagnostic tool: Flag DTC B2296. ● Retrieve and record any flagged faults for use later in this pinpoint test. ● **Were any faults flagged against the first row passenger side impact sensor?**	**Yes** INSTALL the original first row passenger side impact sensor. GO to J52 . **No** Fault corrected. GO to J54 .
J22 INSPECT THE SECOND ROW DRIVER SIDE IMPACT SENSOR MOUNTING, AND MOUNTING SURFACE	
WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.	**Yes** CLEAN and TIGHTEN the bolt. REPAIR the mounting surface as necessary. REINSTALL the second row driver side impact sensor. GO to J54 .

The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. **WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.** **WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. • Key in OFF position. • Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. • Access the second row side impact sensor. For additional information, refer to Side Impact Sensor—Second Row in his section. • Inspect the second row driver side impact sensor for: • a loose electrical connector. • a loose sensor mounting bolt. • a loose sensor mounting bracket. • Remove the second row driver side impact sensor. • Visually inspect the second row driver side impact sensor, electrical connector, mounting bracket and mounting surface for damage, corrosion or dirt. • **Was a significant amount of corrosion or dirt found, or was the second row driver side impact sensor mounting bracket attached to the mounting surface incorrectly or was the second row driver side impact sensor bolt not fully seated and tightened correctly?**	**No** GO to J23 .
J23 INSTALL THE SECOND ROW DRIVER SIDE IMPACT	

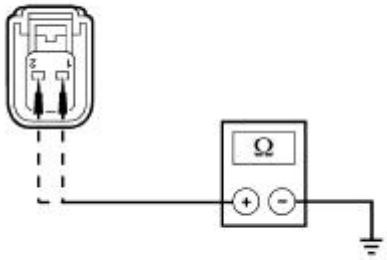
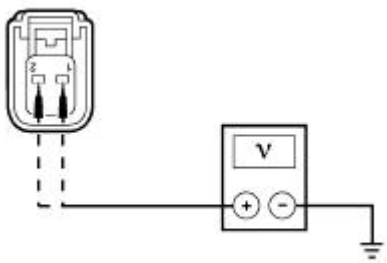
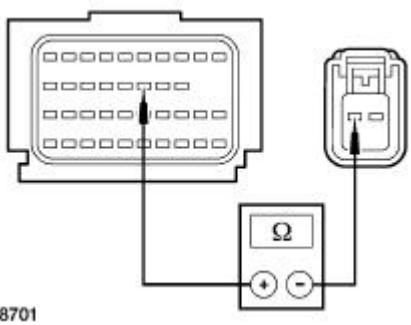
SENSOR AND CARRY OUT THE ON-DEMAND SELF TEST	
• Clean and repair the mounting surface as necessary. • Clean the second row driver side impact sensor mounting bolt. • Install the second row driver side impact sensor. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: Flag DTC B2296. • Retrieve and record any flagged faults for use later in this pinpoint test. • **Was DTC B2296 retrieved during the on-demand self test?**	**Yes** GO to J24 . **No** Fault corrected. GO to J54 .
J24 CHECK THE SECOND ROW DRIVER SIDE IMPACT SENSOR GROUND CIRCUIT 1642 (DG/WH) FOR HIGH RESISTANCE	
• Key in OFF position. • Disconnect: Second Row Driver Side Impact Sensor C9004. • Measure the resistance between second row driver side impact sensor C9004 pin 1, circuit 1642 (DG/WH), harness side and the second row driver side impact sensor case ground. • **Is the resistance less than 100 ohms?**	**Yes** GO to J26 . **No** GO to J25 .
J25 CLEAN THE SECOND ROW DRIVER SIDE IMPACT SENSOR MOUNTING SURFACE AND CARRY OUT THE ON-DEMAND SELF TEST	
• Remove the second row driver side impact sensor. • Clean and repair the mounting surface as necessary. • Clean the second row driver side impact sensor mounting bolt. • Install the second row driver side impact sensor. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • Enter the following diagnostic mode on the diagnostic tool: Flag DTC B2296. • Retrieve and record any flagged faults for use later in this pinpoint test. • **Was DTC B2296 retrieved during the on-demand self test?**	**Yes** GO to J26 . **No** Fault corrected. GO to J54 .
J26 CHECK CIRCUIT 1641 (PK) AND CIRCUIT 1642 (DG/WH) FOR A SHORT TO GROUND BETWEEN THE SECOND ROW DRIVER SIDE IMPACT SENSOR AND THE RCM	
• Key in OFF position. • For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Disconnect: RCM C310a. • Disconnect: RCM C310b. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Measure the resistance between second row driver side impact sensor C9004 pin 1, circuit 1642 (DG/WH), harness side and ground; and between pin 2, circuit 1641 (PK), harness side and ground.	**Yes** GO to J27 . **No** REPAIR circuit 1641 (PK) or circuit 1642 (DG/WH). GO to J54 .

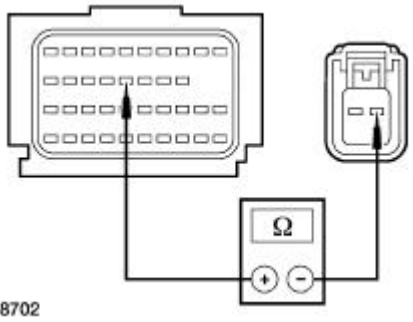
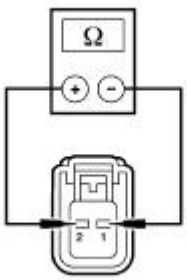
 A0029893 ● **Are the resistances greater than 1,000,000 ohms?**	
J27 CHECK CIRCUIT 1641 (PK) AND CIRCUIT 1642 (DG/WH) FOR A SHORT TO BATTERY BETWEEN THE SECOND ROW DRIVER SIDE IMPACT SENSOR AND THE RCM	
● Key in ON position. ● Measure the voltage between second row driver side impact sensor C9004 pin 2, circuit 1641 (PK), harness side and ground; and between pin 1, circuit 1642 (DG/WH), harness side and ground.  A0029894 ● **Are the voltages less than 0.2 volt?**	**Yes** GO to J28 . **No** REPAIR circuit 1641 (PK) or circuit 1642 (DG/WH). GO to J54 .
J28 CHECK CIRCUIT 1641 (PK) FOR AN OPEN BETWEEN THE RCM AND THE SECOND ROW DRIVER SIDE IMPACT SENSOR	
● Key in OFF position. ● Measure the resistance between RCM C310b pin 13, circuit 1641 (PK), harness side and second row driver side impact sensor C9004 pin 2, circuit 1641 (PK), harness side.  A0048665 ● **Is the resistance less than 0.5 ohm?**	**Yes** GO to J29 . **No** REPAIR circuit 1641 (PK). GO to J54 .
J29 CHECK CIRCUIT 1642 (DG/WH) FOR AN OPEN BETWEEN THE RCM AND THE SECOND ROW DRIVER SIDE IMPACT SENSOR	
● Measure the resistance between RCM C310b pin 14, circuit 1642 (DG/WH), harness side and second row driver side impact sensor C9004 pin 1, circuit 1642 (DG/WH), harness	**Yes** GO to J30 .

side.  ● **Is the resistance less than 0.5 ohm?**	**No** REPAIR circuit 1642 (DG/WH). GO to J54 .
J30 CHECK CIRCUIT 1641 (PK) FOR A SHORT TO CIRCUIT 1642 (DG/WH) BETWEEN THE RCM AND SECOND ROW DRIVER SIDE IMPACT SENSOR	
● Measure the resistance between second row driver side impact sensor C9004 pin 2, circuit 1641 (PK), harness side and pin 1, circuit 1642 (DG/WH), harness side.  ● **Is the resistance greater than 1,000,000 ohms?**	**Yes** GO to J31 . **No** REPAIR circuit 1641 (PK) or circuit 1642 (DG/WH). GO to J54 .
J31 CHECK THE SECOND ROW DRIVER SIDE IMPACT SENSOR	
● For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . ● Connect: RCM C310a. ● Connect: RCM C310b. ● Install a known good second row driver side impact sensor. ● For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● Enter the following diagnostic mode on the diagnostic tool: Flag DTC B2296. ● Retrieve and record any flagged faults for use later in this pinpoint test. ● **Were any faults flagged against the second row driver side impact sensor?**	**Yes** INSTALL the original second row driver side impact sensor. GO to J52 . **No** Fault corrected. GO to J54 .
J32 INSPECT THE SECOND ROW PASSENGER SIDE IMPACT SENSOR MOUNTING, MOUNTING BRACKET AND MOUNTING SURFACE	
WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner	**Yes** CLEAN, TIGHTEN the bolt or REPAIR the mounting surface as necessary. REINSTALL the second

Supplemental Restraint System (SRS) in this section. **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury.** **WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.** **WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. ● Key in OFF position. ● Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. ● Inspect the second row passenger side impact sensor mounting and make sure that the retaining bolt is fully seated and tightened correctly. ● Remove the second row passenger side impact sensor. ● Visually inspect the second row passenger side impact sensor, mounting bracket and mounting surface for damage, corrosion or dirt. ● **Was a significant amount of corrosion or dirt found, or was the second row passenger side impact sensor mounting bracket attached to the mounting surface incorrectly or were the impact sensor bolts not fully seated and tightened correctly?**	row passenger side impact sensor. GO to J54 . **No** GO to J33 .
J33 INSTALL THE SECOND ROW PASSENGER SIDE IMPACT SENSOR AND CARRY OUT THE ON-DEMAND SELF TEST	
● Clean and repair the mounting surface as necessary.	**Yes**

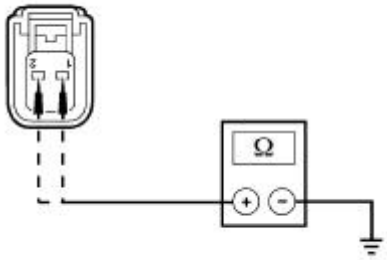
• Clean the second row passenger side impact sensor mounting bolt. • Install the second row passenger side impact sensor. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • Enter the following diagnostic mode on the diagnostic tool: Flag DTC B2296. • Retrieve and record any flagged faults for use later in this pinpoint test. • **Was DTC B2296 retrieved during the on-demand self test?**	GO to J34 . **No** Fault corrected. GO to J54 .
J34 CHECK THE SECOND ROW PASSENGER SIDE IMPACT SENSOR GROUND CIRCUIT 1644 (LB/WH) FOR HIGH RESISTANCE	
• Key in OFF position. • Disconnect: Second Row Passenger Side Impact Sensor C9005. • Measure the resistance between second row passenger side impact sensor C9005 pin 1, circuit 1644 (LB/WH), harness side and the second row passenger side impact sensor case ground. • **Is the resistance less than 100 ohms?**	**Yes** GO to J36 . **No** GO to J35 .
J35 CLEAN THE SECOND ROW PASSENGER SIDE IMPACT SENSOR MOUNTING SURFACE AND CARRY OUT THE ON-DEMAND SELF TEST	
• Remove the second row passenger side impact sensor. • Clean and repair the mounting surface as necessary. • Clean the second row passenger side impact sensor mounting bolt. • Install the second row passenger side impact sensor. • Enter the following diagnostic mode on the diagnostic tool: Flag DTC B2296. • Retrieve and record any flagged faults for use later in this pinpoint test. • **Was DTC B2296 retrieved during the on-demand self test?**	**Yes** GO to J36 . **No** Fault corrected. GO to J54 .
J36 CHECK CIRCUIT 1643 (WH/RD) AND CIRCUIT 1644 (LB/WH) FOR A SHORT TO GROUND BETWEEN THE SECOND ROW PASSENGER SIDE IMPACT SENSOR AND THE RCM	
• Key in OFF position. • For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Disconnect: RCM C310a. • Disconnect: RCM C310b. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Measure the resistance between second row passenger side impact sensor C9005 pin 2, circuit 1643 (WH/RD), harness side and ground; and between pin 1, circuit 1644 (LB/WH), harness side and ground.	**Yes** GO to J37 . **No** REPAIR circuit 1643 (WH/RD) or circuit 1644 (LB/WH).GO to J54 .

 A0029893 ● **Are the resistances greater than 1,000,000 ohms?**	
J37 CHECK CIRCUIT 1643 (WH/RD) AND CIRCUIT 1644 (LB/WH) FOR A SHORT TO VOLTAGE BETWEEN THE SECOND ROW PASSENGER SIDE IMPACT SENSOR AND THE RCM	
● Key in ON position. ● Measure the voltage between second row passenger side impact sensor C9005 pin 2, circuit 1643 (WH/RD), harness side and ground; and between pin 1, circuit 1644 (LB/WH), harness side and ground.  A0029894 ● **Are the voltages less than 0.2 volt?**	**Yes** GO to J38 . **No** REPAIR circuit 1643 (WH/RD) or circuit 1644 (LB/WH). GO to J54 .
J38 CHECK CIRCUIT 1643 (WH/RD) FOR AN OPEN BETWEEN THE RCM AND THE SECOND ROW PASSENGER SIDE IMPACT SENSOR	
● Key in OFF position. ● Measure the resistance between RCM C310b pin 15, circuit 1643 (WH/RD), harness side and second row passenger side impact sensor C9005 pin 2, circuit 1643 (WH/RD), harness side.  A0048701 ● **Is the resistance less than 0.5 ohm?**	**Yes** GO to J39 . **No** REPAIR circuit 1643 (WH/RD). GO to J54 .
J39 CHECK CIRCUIT 1644 (LB/WH) FOR AN OPEN BETWEEN THE RCM AND THE SECOND ROW PASSENGER SIDE IMPACT SENSOR	
● Measure the resistance between RCM C310b pin 16, circuit	**Yes**

1644 (LB/WH), harness side and second row passenger side impact sensor C9005 pin 1, circuit 1644 (LB/WH), harness side.  • **Is the resistance less than 0.5 ohm?**	GO to J40 . **No** REPAIR circuit 1644 (LB/WH). GO to J54 .
J40 CHECK CIRCUIT 1643 (WH/RD) FOR A SHORT TO CIRCUIT 1644 (LB/WH) BETWEEN THE RCM AND THE SECOND ROW PASSENGER SIDE IMPACT SENSOR	
• Measure the resistance between second row passenger side impact sensor C9005 pin 2, circuit 1643 (WH/RD), harness side and pin 1, circuit 1644 (LB/WH), harness side.  • **Is the resistance greater than 1,000,000 ohms?**	**Yes** GO to J41 . **No** REPAIR circuit 1643 (WH/RD) and circuit 1644 (LB/WH). GO to J54 .
J41 CHECK THE SECOND ROW PASSENGER SIDE IMPACT SENSOR	
• For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Connect: RCM C310a. • Connect: RCM C310b. • Install a known good second row passenger side impact sensor. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • Enter the following diagnostic mode on the diagnostic tool: Flag DTC B2296. • Retrieve and record any flagged faults for use later in this pinpoint test. • **Were any faults flagged against the second row passenger side impact sensor?**	**Yes** INSTALL the original second row passenger side impact sensor. GO to J52 . **No** Fault corrected. GO to J54 .
J42 INSPECT THE FRONT IMPACT SEVERITY SENSOR MOUNTING, MOUNTING BRACKET AND MOUNTING SURFACE	
WARNING: If the supplemental restraint system	**Yes** CLEAN, TIGHTEN bolt or

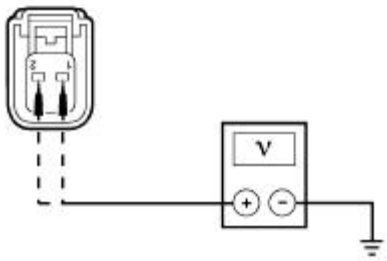
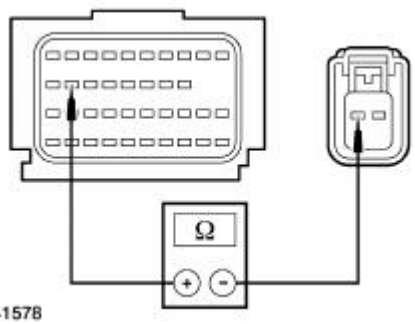
(SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury.** **WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.** **WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. ● Key in OFF position. ● Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. ● Key in OFF position. ● Inspect the front impact severity sensor mounting and make sure that the retaining bolt is fully seated and tightened correctly. ● Remove the front impact severity sensor. Refer to Front Impact Severity Sensor in this section. ● Visually inspect the front impact severity sensor, mounting bracket and mounting surface for damage, corrosion or dirt. ● **Was a significant amount of corrosion or dirt found, or was the front impact severity sensor mounting bracket attached to the mounting surface incorrectly or were the front impact severity sensor bolts not fully seated and tightened correctly?**	REPAIR the mounting surface as necessary. REINSTALL the front impact severity sensor. GO to J54 . **No** GO to J43 .

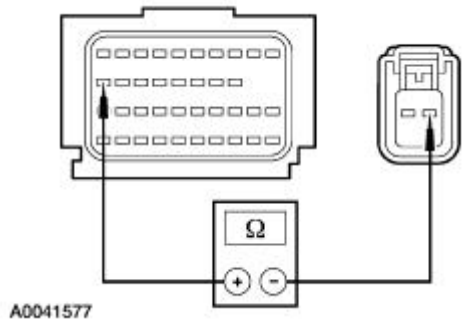
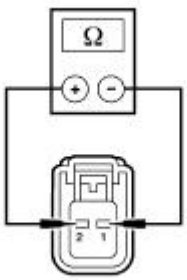
J43 INSTALL THE FRONT IMPACT SEVERITY SENSOR AND CARRY OUT THE ON-DEMAND SELF TEST	
• Clean and repair the mounting surface as necessary. • Clean the front impact severity sensor mounting bolt. • Install the front impact severity sensor. Refer to Front Impact Severity Sensor . • Key in OFF position. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • Enter the following diagnostic mode on the diagnostic tool: Flag DTC B2296. • Retrieve and record any flagged faults for use later in this pinpoint test. • **Was DTC B2296 retrieved during the on-demand self test?**	**Yes** GO to J44 . **No** Fault corrected. GO to J54 .
J44 CHECK THE FRONT IMPACT SEVERITY SENSOR GROUND CIRCUIT 618 (VT/LG) FOR HIGH RESISTANCE	
• Key in OFF position. • Disconnect: Front Impact Severity Sensor C177. • Measure the resistance between front impact severity sensor C177 pin 1, circuit 618 (VT/LG), harness side and front impact severity sensor case ground. • **Is the resistance less than 100 ohms?**	**Yes** GO to J46 . **No** GO to J45 .
J45 CLEAN THE FRONT IMPACT SEVERITY SENSOR MOUNTING SURFACE AND CARRY OUT THE ON-DEMAND SELF-TEST	
• Remove the front impact severity sensor. Refer to Front Impact Severity Sensor . • Clean and repair the mounting surface as necessary. • Clean the front impact severity sensor mounting bolt. • Install the front impact severity sensor. Refer to Front Impact Severity Sensor . • Key in OFF position. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • Enter the following diagnostic mode on the diagnostic tool: Flag DTC B2296. • Retrieve and record any flagged faults for use later in this pinpoint test. • **Was DTC B2296 retrieved during the on-demand self test?**	**Yes** GO to J46 . **No** Fault corrected. GO to J54 .
J46 CHECK CIRCUIT 617 (PK/OG) AND CIRCUIT 618 (VT/LG) FOR A SHORT TO GROUND BETWEEN THE RCM AND THE FRONT IMPACT SEVERITY SENSOR	
• Key in OFF position. • For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Disconnect: RCM C310a. • Disconnect: RCM C310b. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Measure the resistance between front impact severity sensor C177 pin 2, circuit 617 (PK/OG), harness side and ground; and between front impact severity sensor C177 pin 1, circuit 618 (VT/LG), harness side and ground.	**Yes** GO to J47 . **No** REPAIR circuit 617 (PK/OG) or circuit 618 (VT/LG).GO to J54 .



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- **Are the resistances greater than 1,000,000 ohms?**

J47 CHECK CIRCUIT 617 (PK/OG) AND CIRCUIT 618 (VT/LG) FOR A SHORT TO VOLTAGE BETWEEN THE RCM AND THE FRONT IMPACT SEVERITY SENSOR	
• Key in ON position. • Measure the voltage resistance between front impact severity sensor C177 pin 2, circuit 617 (PK/OG), harness side and ground; and between front impact severity sensor C177 pin 1, circuit 618 (VT/LG), harness side and ground.  A0029894 • **Are the voltages less than 0.2 volt?**	**Yes** GO to J48 . **No** REPAIR circuit 617 (PK/OG) or circuit 618 (VT/LG). GO to J54 .
J48 CHECK CIRCUIT 617 (PK/OG) FOR AN OPEN BETWEEN THE RCM AND THE FRONT IMPACT SEVERITY SENSOR	
• Key in OFF position. • Measure the resistance between RCM C310b pin 19, circuit 617 (PK/OG), harness side and front impact severity sensor C177 pin 2, circuit 617 (PK/OG), harness side.  A0041578 • **Is the resistance less than 0.5 ohm?**	**Yes** GO to J49 . **No** REPAIR circuit 617 (PK/OG). GO to J54 .
J49 CHECK CIRCUIT 618 (VT/LG) FOR AN OPEN BETWEEN THE RCM AND THE FRONT IMPACT SEVERITY SENSOR	
• Measure the resistance between RCM C310b pin 20, circuit 618 (VT/LG), harness side and front impact severity sensor C177 pin 1, circuit 618 (VT/LG), harness side.	**Yes** GO to J50 . **No** REPAIR circuit 618

 ● **Is the resistance less than 0.5 ohm?**	(VT/LG). GO to J54 .
J50 CHECK CIRCUIT 617 (PK/OG) FOR A SHORT TO CIRCUIT 618 (VT/LG) BETWEEN THE RCM AND THE FRONT IMPACT SEVERITY SENSOR	
● Measure the resistance between C177 pin 2, circuit 617 (PK/OG), harness side and the front impact severity sensor C177 pin 1, circuit 618 (VT/LG), harness side.  ● **Is the resistance greater than 1,000,000 ohms?**	**Yes** GO to J51 . **No** REPAIR circuits 617 (PK/OG) and circuit 618 (VT/LG). GO to J54 .
J51 CHECK THE FRONT IMPACT SEVERITY SENSOR	
● For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . ● Connect: RCM C310a. ● Connect: RCM C310b. ● Install a known good front impact severity sensor. ● For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● Enter the following diagnostic mode on the diagnostic tool: Flag DTC B2296. ● Retrieve and record any flagged faults for use later in this pinpoint test. ● **Were any faults flagged against the front impact severity sensor?**	**Yes** INSTALL the original front impact severity sensor. GO to J52 . **No** Fault corrected. GO to J54 .
J52 CONFIRM THE RCM FAULT	
NOTE: Make sure all restraint system diagnostic tools, sensor electrical connectors, and the RCM electrical connector are connected before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. ● Key in OFF position. ● For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .	**Yes** If a **"?"** was flagged by the scan tool, CARRY OUT the entire pinpoint test before installing a new RCM. INSTALL a new RCM. GO to J54 .

• Connect: Impact Sensors. • Connect: RCM C310a. • Connect: RCM C310b. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • Enter the following diagnostic mode on the diagnostic tool: Flag DTC B2296. • Retrieve and record any flagged faults. • **Was DTC B2296 retrieved during the on-demand self test?**	**No** Fault corrected. GO to J54 .
J53 CHECK FOR AN INTERMITTENT FAULT	
WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury.** **WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.** **WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of	**Yes** This is a hard fault. The fault condition is still present. The fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. If a flagged fault of **"?"** was recorded, multiple faults exist and the entire pinpoint test must be carried out before installing a new RCM. For first row driver side impact (F_D_SEN) sensor with a mounting/communications (COMM) fault, GO to J2 . For first row driver side impact sensor (F_D_ SEN) with an internal fault (INT) fault, INSTALL a new first row driver side impact sensor. REFER to Side Impact Sensor—Front Row in this section. GO to J54 . For first row passenger side impact sensor (F_P_ SEN) with a mounting/communications (COMM) fault, GO to J12 . For first row passenger side impact sensor (F_P_ SEN) with an internal fault (INT) fault, INSTALL a new first row passenger side impact sensor. REFER to Side Impact Sensor—Front Row in this section. GO to J54 . For second row driver side

faults before releasing the vehicle to the customer. ● Key in OFF position. ● Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● Enter the following diagnostic mode on the diagnostic tool: Flag DTC B2296. ● If DTC B2296 is retrieved during the on-demand self test, retrieve and record any flagged faults. ● **Was DTC B2296 retrieved during the on-demand self test?**	impact sensor (D_2_SEN) with a mounting/communication (COMM) fault, GO to J22 . For second row driver side impact sensor (D_2_ SEN) with an internal (INT) fault, INSTALL a new second row driver side impact sensor. REFER to Side Impact Sensor—Second Row in this section. GO to J54 . For second row passenger side impact sensor (P_2_ SEN) with a mounting /communications (COMM) fault, GO to J32 . For second row passenger side impact sensor (P_2_SEN) with an internal (INT) fault, INSTALL a new second row passenger side impact sensor. REFER to Side Impact Sensor—Second Row in this section. GO to J54 . For front impact severity sensor (FNT_SEN) with a mounting/communications (COMM) fault, GO to J42 . For front impact severity sensor (FNT_SEN) with an internal fault (INT) fault, INSTALL a new front impact severity sensor. REFER to Front Impact Severity Sensor in this section. GO to J54 . **No** CHECK for causes of the intermittent fault. ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found.
J54 CHECK FOR ADDITIONAL DTCs	
● Refer to the continuous DTCs recorded during Step J1. ● **Were any continuous DTCs retrieved during Step J1?**	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Table in this section for pinpoint test direction.

	No RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. CLEAR all DTCs.

Pinpoint Test K: LFC 51/DTC B2691 — Driver Safety Belt Buckle Switch Circuit Fault

Normal Operation

The restraints control module (RCM) checks the safety belt buckle switch circuits for faults. If the RCM detects an open circuit or short to voltage fault, it will store diagnostic trouble code (DTC) B2691 in memory and flash lamp fault code (LFC) 51 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

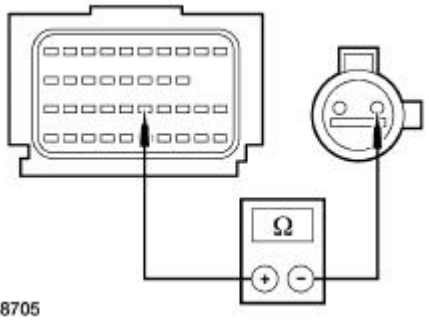
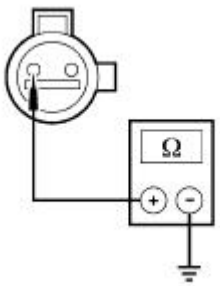
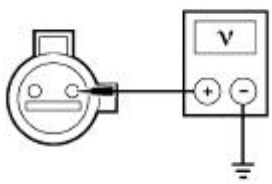
A driver safety belt buckle switch open circuit or short to voltage fault can be caused by:

- damaged wiring, terminals, or connectors.
- a faulty driver safety belt buckle switch.
- a faulted RCM.

PINPOINT TEST K: LFC 51/DTC B2691 — DRIVER SAFETY BELT BUCKLE SWITCH CIRCUIT FAULT

Test Step	Result / Action to Take
NOTE: Vehicles equipped with a 60/40 split bench seat require removal of the RCM to allow the electrical connectors to be disconnected. It will be necessary to reinstall the RCM after connecting the RCM electrical connectors before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. For additional information, refer to Restraints Control Module (RCM) in this section.	
K1 CHECK FOR A HARD OR INTERMITTENT DTC	
• Enter the following diagnostic mode on the diagnostic tool: Retrieve Continuous DTCs. • Retrieve and record any continuous DTCs for use later in this pinpoint test. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • **Was the DTC B2691 retrieved during the on-demand self test?**	**Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to K2 . **No**

	This is an intermittent fault. The fault condition is not present at this time. GO to K7 .
K2 CHECK CIRCUIT 85 (BN/LB) FOR AN OPEN BETWEEN THE RCM AND THE DRIVER SAFETY BELT BUCKLE SWITCH	
WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.** **WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing a SRS **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. • Key in OFF position. • Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. • Key in OFF position. • For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Disconnect: RCM C310b. • Disconnect: Driver Safety Belt Buckle Switch C3065. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 .	**Yes** GO to K3 . **No** REPAIR circuit 85 (BN/LB). GO to K8 .

• Measure the resistance between RCM C310b pin 25, circuit 85 (BN/LB), harness side and driver safety belt buckle switch C3065 pin 2, circuit 85 (BN/LB), harness side.  A0048705 • **Is the resistance less than 0.5 ohm?**	
K3 CHECK CIRCUIT 649 (BK/OG) FOR AN OPEN	
• Measure the resistance between driver safety belt buckle switch C3065 pin 1, circuit 649 (BK/OG), harness side and ground.  A0048711 • **Is the resistance less than 0.5 ohm?**	**Yes** GO to K4 . **No** REPAIR circuit 649 (BK/OG). GO to K8 .
K4 CHECK CIRCUIT 85 (BN/LB) FOR A SHORT TO VOLTAGE	
• Key in ON position. • Measure the voltage between driver safety belt buckle switch C3065 pin 2, circuit 85 (BN/LB), harness side and ground.  A0048712 • **Is the voltage less than 0.2 volt?**	**Yes** GO to K5 . **No** REPAIR circuit 85 (BN/LB). GO to K8 .
K5 CHECK THE DRIVER SAFETY BELT BUCKLE SWITCH	
• Key in OFF position. • For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Connect: RCM C310b. • Install a known good driver safety belt buckle assembly. REFER to Section 501-20A . • Connect: Driver Safety Belt Buckle Switch C3065. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 .	**Yes** GO to K6 . **No** Fault corrected. GO to K8 .

• Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • **Was DTC B2691 retrieved during the on-demand self test?**	
K6 CONFIRM THE RCM FAULT	
NOTE: Make sure all restraint system diagnostic tools, sensor electrical connectors, and the RCM electrical connector are connected before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. • Key in OFF position. • Reinstall the original driver safety belt buckle assembly. REFER to Section 501-20A . • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • **Was DTC B2691 retrieved during the on-demand self test?**	**Yes** INSTALL a new RCM. REFER to Restraints Control Module (RCM) in this section. GO to K8 . **No** Fault corrected. GO to K8 .
K7 CHECK FOR AN INTERMITTENT FAULT	
WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.** **WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing a SRS **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. • Key in OFF position. • Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner	**Yes** GO to K2 . **No** CHECK for causes of the intermittent fault. ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to K8 .

Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● **Was DTC B2691 retrieved during the on-demand self test?**	
K8 CHECK FOR ADDITIONAL DTCs	
● Refer to the continuous DTCs recorded during Step K1. ● **Were any continuous DTCs retrieved during Step K1?**	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Table in this section for pinpoint test direction. **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) . CLEAR all DTCs.

Pinpoint Test L: LFC 51/DTC B2434 — Driver Safety Belt Buckle Switch Circuit Short to Ground

Normal Operation

The restraints control module (RCM) checks the driver safety belt buckle switch circuits for faults. If the RCM detects a short to ground fault, it will store diagnostic trouble code (DTC) B2434 in memory and flash lamp fault code (LFC) 51 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

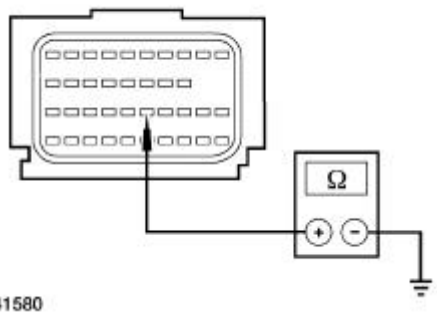
A driver safety belt buckle switch circuit fault can be caused by:

- damaged wiring, terminals, or connectors.
- a faulty driver safety belt buckle switch.
- a faulted RCM.

PINPOINT TEST L: LFC 51/DTC B2434 — DRIVER SAFETY BELT

BUCKLE SWITCH CIRCUIT SHORT TO GROUND

Test Step	Result / Action to Take
NOTE: Vehicles equipped with a 60/40 split bench seat require removal of the RCM to allow the electrical connectors to be disconnected. It will be necessary to reinstall the RCM after connecting the RCM electrical connectors before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. For additional information, refer to Restraints Control Module (RCM) in this section.	
L1 CHECK FOR A HARD OR INTERMITTENT DTC ● Enter the following diagnostic mode on the diagnostic tool: Retrieve Continuous DTCs. ● Retrieve and record any continuous DTCs for use later in this pinpoint test. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● **Was DTC B2434 retrieved during the on-demand self test?**	**Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to L2. **No** This is an intermittent fault. The fault condition is not present at this time. GO to L5.
L2 CHECK CIRCUIT 85 (BN/LB) FOR A SHORT TO GROUND BETWEEN THE RCM AND THE DRIVER SAFETY BELT BUCKLE SWITCH **WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.** **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.** **WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and**	**Yes** GO to L3. **No** REPAIR circuit 85 (BN/LB). GO to L6.

could result in personal injury. **WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing a SRS **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. ● Key in OFF position. ● Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. ● For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . ● Disconnect: Driver Safety Belt Buckle Switch C3065. ● Disconnect: RCM C310b. ● For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . ● Measure the resistance between the RCM C310b pin 25, circuit 85 (BN/LB), harness side and ground.  A0041580 ● **Is the resistance greater than 1,000,000 ohms?**	
L3 CHECK THE DRIVER SAFETY BELT BUCKLE SWITCH	
● For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . ● Connect: RCM C310b. ● Install a known good driver safety belt buckle assembly. REFER to Section 501-20A . ● Connect: Driver Safety Belt Buckle Switch C3065. ● For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● **Was DTC B2434 retrieved during the on-demand self test?**	**Yes** GO to L4 . **No** Fault corrected.GO to L6 .
L4 CONFIRM THE RCM FAULT	
NOTE: Make sure all restraint system diagnostic tools, sensor electrical connectors, and the RCM electrical connector are connected before carrying out the on-demand self test. If not, erroneous DTCs will be recorded.	**Yes** INSTALL a new RCM. REFER to Restraints

• Key in OFF position. • Reinstall the original driver safety belt buckle assembly. REFER to Section 501-20A . • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • **Was DTC B2434 retrieved during the on-demand self test?**	Control Module (RCM) in this section. GO to L6 . **No** Fault corrected. GO to L6 .
L5 CHECK FOR AN INTERMITTENT FAULT	
WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury. WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing a SRS **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. • Key in OFF position. • Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • **Was DTC B2434 retrieved during the on-demand self test?**	**Yes** GO to L2 . **No** CHECK for causes of the intermittent fault. ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to L2 .
L6 CHECK FOR ADDITIONAL DTCs	
• Refer to the continuous DTCs recorded during Step L1. • **Were any continuous DTCs retrieved during Step L1?**	**Yes** Do not clear any

	DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Table in this section for pinpoint test direction. **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) . CLEAR all DTCs.

Pinpoint Test M: LFC 51/DTC B2435 — Driver Safety Belt Buckle Switch Resistance Out of Range

Normal Operation

The restraints control module (RCM) checks the driver safety belt buckle switch circuits for faults. If the RCM detects a current out of range fault, it will store diagnostic trouble code (DTC) B2435 in memory and flash lamp fault code (LFC) 51 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

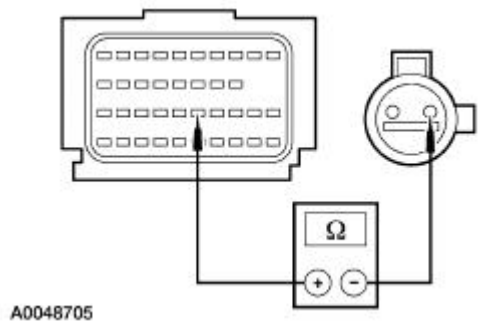
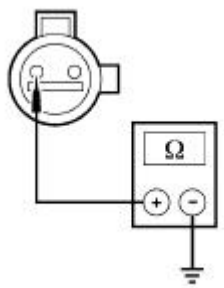
A driver safety belt buckle switch current out of range fault can be caused by:

- damaged wiring, terminals, or connectors.
- a faulty driver safety belt buckle and pretensioner assembly.
- a faulted RCM.

PINPOINT TEST M: LFC 51/DTC B2435 — DRIVER SAFETY BELT BUCKLE SWITCH RESISTANCE OUT OF RANGE

Test Step	Result / Action to Take
NOTE: Vehicles equipped with a 60/40 split bench seat require removal of the RCM to allow the electrical connectors to be disconnected. It will be necessary to reinstall the RCM after	

connecting the RCM electrical connectors before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. For additional information, refer to Restraints Control Module (RCM) in this section.	
M1 CHECK FOR A HARD OR INTERMITTENT DTC • Enter the following diagnostic mode on the diagnostic tool: Retrieve Continuous DTCs. • Retrieve and record any continuous DTCs for use later in this pinpoint test. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • **Was DTC B2435 retrieved during the on-demand self test?**	**Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to M2 . **No** This is an intermittent fault. The fault condition is not present at this time. GO to M6 .
M2 CHECK CIRCUIT 85 (BN/LB) FOR AN OPEN BETWEEN THE RCM AND THE DRIVER SAFETY BELT BUCKLE SWITCH **WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.** **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.** **WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint**	**Yes** GO to M3 . **No** REPAIR circuit 85 (BN/LB). GO to M7 .

system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE: After diagnosing or repairing a SRS **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. ● Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. ● Key in OFF position. ● For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . ● Disconnect: RCM C310b. ● Disconnect: Driver Safety Belt Buckle Switch C3065. ● For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . ● Measure the resistance between RCM C310b pin 25, circuit 85 (BN/LB), harness side and driver safety belt buckle switch C3065 pin 2, circuit 85 (BN/LB), harness side.  A0048705 ● **Is the resistance less than 0.5 ohm?**	
M3 CHECK CIRCUIT 649 (BK/OG) FOR AN OPEN	
● Measure the resistance between driver safety belt buckle switch C3065 pin 1, circuit 649 (BK/OG), harness side and ground.  A0048711 ● **Is the resistance less than 0.5 ohm?**	**Yes** GO to M4 . **No** REPAIR circuit 649 (BK/OG). GO to M7 .
M4 CHECK THE SAFETY BELT BUCKLE SWITCH	
● For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . ● Connect: RCM C310b. ● Install a known good driver safety belt buckle assembly. REFER to Section 501-20A . ● Connect: Driver Safety Belt Buckle Switch C3065. ● For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 .	**Yes** GO to M5 . **No** Fault corrected. GO to M7 .

• Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • **Was DTC B2435 retrieved during the on-demand self test?**	
M5 CONFIRM THE RCM FAULT	
NOTE: Make sure all restraint system diagnostic tools, sensor electrical connectors, and the RCM electrical connector are connected before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. • Key in OFF position. • Reinstall the original driver safety belt buckle assembly. REFER to Section 501-20A . • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • **Was DTC B2435 retrieved during the on-demand self test?**	**Yes** INSTALL a new RCM. REFER to Restraints Control Module (RCM) in this section. GO to M7 . **No** Fault corrected. GO to M7 .
M6 CHECK FOR AN INTERMITTENT FAULT	
WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.** **WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing a SRS **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. • Key in OFF position. • Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner	**Yes** GO to M2 . **No** CHECK for causes of the intermittent fault. ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to M7 .

Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● **Was DTC B2435 retrieved during the on-demand self test?**	
M7 CHECK FOR ADDITIONAL DTCs	
● Refer to the continuous DTCs recorded during Step M1. ● **Were any continuous DTCs retrieved during Step M1?**	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Table in this section for pinpoint test direction. **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. CLEAR all DTCs.

Pinpoint Test N: LFC 52/DTC B2692 — Passenger Safety Belt Buckle Switch Circuit Fault

Normal Operation

The restraints control module (RCM) checks the passenger safety belt buckle switch circuits for faults. If the RCM detects an open circuit or short to voltage fault, it will store diagnostic trouble code (DTC) B2692 in memory and flash lamp fault code (LFC) 52 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

A passenger safety belt buckle switch open circuit or short to voltage fault can be caused by:

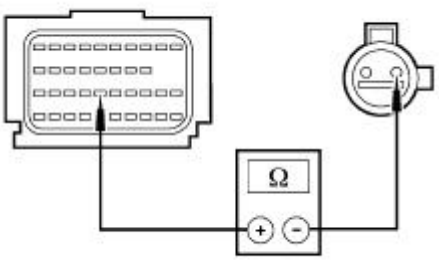
- damaged wiring, terminals, or connectors.
- a faulty passenger safety belt buckle switch.
- a faulted RCM.

PINPOINT TEST N: LFC 52/DTC B2692 — PASSENGER SAFETY BELT BUCKLE SWITCH CIRCUIT FAULT

Test Step	Result / Action to Take
NOTE: Vehicles equipped with a 60/40 split bench seat require removal of the RCM to allow the electrical connectors to be disconnected. It will be necessary to reinstall the RCM after connecting the RCM electrical connectors before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. For additional information, refer to Restraints Control Module (RCM) in this section.	
N1 CHECK FOR A HARD OR INTERMITTENT DTC ● Enter the following diagnostic mode on the diagnostic tool: Retrieve Continuous DTCs. ● Retrieve and record any continuous DTCs for use later in this pinpoint test. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● **Was DTC B2692 retrieved during the on-demand self test?**	**Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to N2. **No** This is an intermittent fault. The fault condition is not present at this time. GO to N7.
N2 CHECK CIRCUIT 1514 (RD/BK) FOR AN OPEN BETWEEN THE RCM AND THE PASSENGER SAFETY BELT BUCKLE SWITCH **WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.** **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.** **WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and**	**Yes** GO to N3. **No** REPAIR circuit 1514 (RD/BK). GO to N8.

could result in personal injury. **WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing a SRS **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

- Key in OFF position.
- Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section.
- For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .
- Disconnect: RCM C310b.
- Disconnect: Passenger Safety Belt Buckle Switch C3066.
- For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 .
- Measure the resistance between RCM C310b pin 26, circuit 1514 (RD/BK), harness side and passenger safety belt buckle switch C3066 pin 1, circuit 1514 (RD/BK), harness side.

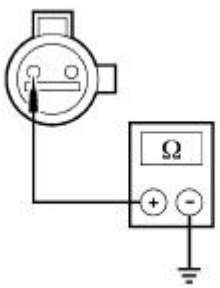


A0048715

- **Is the resistance less than 0.5 ohm?**

N3 CHECK CIRCUIT 649 (BK/OG) FOR AN OPEN

- Measure the resistance between passenger safety belt buckle switch C3066 pin 1, circuit 649 (BK/OG), harness side and ground.



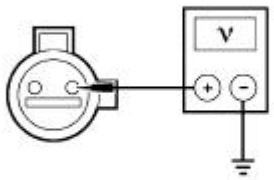
A0048711

- **Is the resistance less than 0.5 ohm?**

Yes
GO to N4 .

No
REPAIR circuit 649 (BK/OG).
GO to N8 .

N4 CHECK CIRCUIT 1514 (RD/BK) FOR A SHORT TO VOLTAGE

• Key in ON position. • Measure the voltage between passenger safety belt buckle switch C3066 pin 2, circuit 1514 (RD/BK), harness side and ground.  A0048712 • **Is the voltage less than 0.2 volt?**	**Yes** GO to N5 . **No** REPAIR circuit 1514 (RD/BK). GO to N8 .
N5 CHECK THE SAFETY BELT BUCKLE SWITCH	
• Key in OFF position. • Connect: RCM C310b. • For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Install a known good passenger safety belt buckle assembly. REFER to Section 501-20A . • Connect: Passenger Safety Belt Buckle Switch C3066. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • **Was DTC B2692 retrieved during the on-demand self test?**	**Yes** GO to N6 . **No** Fault corrected. GO to N8 .
N6 CONFIRM THE RCM FAULT	
NOTE: Make sure all restraint system diagnostic tools, sensor electrical connectors, and the RCM electrical connector are connected before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. • Key in OFF position. • Reinstall the original passenger safety belt buckle assembly. REFER to Section 501-20A . • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • **Was DTC B2692 retrieved during the on-demand self test?**	**Yes** INSTALL a new RCM. REFER to Restraints Control Module (RCM) in this section. GO to N8 . **No** Fault corrected. GO to N8 .
N7 CHECK FOR AN INTERMITTENT FAULT	
WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.**	**Yes** GO to N2 . **No** CHECK for causes of the intermittent fault. ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE: Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing a SRS **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. ● Key in OFF position. ● Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● **Was DTC B2692 retrieved during the on-demand self test?**	intermittent concerns found. GO to N8 .
N8 CHECK FOR ADDITIONAL DTCs	
● Refer to the continuous DTCs recorded during Step N1. ● **Were any continuous DTCs retrieved during Step N1?**	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Table in this section for pinpoint test direction. **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag and Safety Belt Pretensioner

	Supplemental Restraint System (SRS) . CLEAR all DTCs.

Pinpoint Test O: LFC 52/DTC B2438 — Passenger Safety Belt Buckle Switch Circuit Short to Ground

Normal Operation

The restraints control module (RCM) checks the passenger safety belt buckle switch circuits for faults. If the RCM detects a short to ground fault, it will store diagnostic trouble code (DTC) B2438 in memory and flash lamp fault code (LFC) 52 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

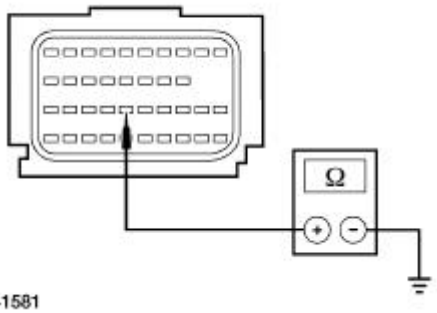
A passenger safety belt buckle switch circuit fault can be caused by:

- damaged wiring, terminals, or connectors.
- a faulty passenger safety belt buckle switch.
- a faulted RCM.

PINPOINT TEST O: LFC 52/DTC B2438 — PASSENGER SAFETY BELT BUCKLE SWITCH CIRCUIT SHORT TO GROUND

Test Step	Result / Action to Take
NOTE: Vehicles equipped with a 60/40 split bench seat require removal of the RCM to allow the electrical connectors to be disconnected. It will be necessary to reinstall the RCM after connecting the RCM electrical connectors before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. For additional information, refer to Restraints Control Module (RCM) in this section.	
O1 CHECK FOR A HARD OR INTERMITTENT DTC • Enter the following diagnostic mode on the diagnostic tool: Retrieve Continuous DTCs. • Retrieve and record any continuous DTCs for use later in this pinpoint test. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • **Was DTC B2438 retrieved during the on-demand self test?**	**Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to O2 . **No** This is an intermittent fault. The fault condition is not present at this

	time. GO to O5 .
O2 CHECK CIRCUIT 1514 (RD/BK) FOR A SHORT TO GROUND BETWEEN THE RCM AND THE PASSENGER SAFETY BELT BUCKLE SWITCH	
WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury. WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing a SRS **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. • Key in OFF position. • Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. • For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Disconnect: Passenger Safety Belt Buckle Switch C3066. • Disconnect: RCM C310b. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Measure the resistance between the RCM C310b pin 26, circuit 1514 (RD/BK), harness side and ground.	**Yes** GO to O3 . **No** REPAIR circuit 1514 (RD/BK). GO to O6 .



- **Is the resistance greater than 1,000,000 ohms?**

O3 CHECK THE PASSENGER SAFETY BELT BUCKLE SWITCH - For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . - Connect: RCM C310b. - Install a known good passenger safety belt buckle assembly. REFER to Section 501-20A . - Connect: Passenger Safety Belt Buckle Switch C3066. - For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . - Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. - **Was DTC B2438 retrieved during the on-demand self test?**	**Yes** GO to O4 . **No** Fault corrected. GO to O6 .
O4 CONFIRM THE RCM FAULT **NOTE:** Make sure all restraint system diagnostic tools, sensor electrical connectors, and the RCM electrical connector are connected before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. - Key in OFF position. - Reinstall the original passenger safety belt buckle assembly. REFER to Section 501-20A . - Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. - **Was DTC B2438 retrieved during the on-demand self test?**	**Yes** INSTALL a new RCM. REFER to Restraints Control Module (RCM) in this section. GO to O6 . **No** Fault corrected. GO to O6 .
O5 CHECK FOR AN INTERMITTENT FAULT **WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.** **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.** **WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt**	**Yes** GO to O2 . **No** CHECK for causes of the intermittent fault. ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to O6 .

pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury.  **WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing a SRS **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. ● Key in OFF position. ● Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● **Was DTC B2438 retrieved during the on-demand self test?**	
O6 CHECK FOR ADDITIONAL DTCs	
● Refer to the continuous DTCs recorded during Step O1. ● **Were any continuous DTCs retrieved during Step O1?**	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Table in this section for pinpoint test direction. **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) . CLEAR all DTCs.

Pinpoint Test P: LFC 52/DTC B2439 — Passenger Safety Belt Buckle Switch Resistance Out of Range

Normal Operation

The restraints control module (RCM) checks the passenger safety belt buckle switch circuits for faults. If the RCM detects a current out of range fault, it will store diagnostic trouble code (DTC) B2439 in memory and flash lamp fault code (LFC) 52 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

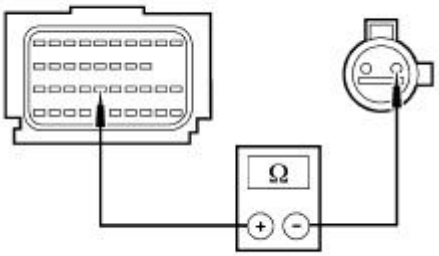
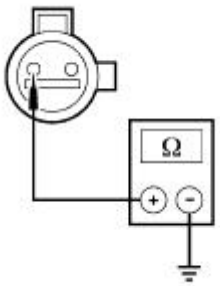
A passenger safety belt buckle switch current out of range fault can be caused by:

- damaged wiring, terminals, or connectors.
- a faulty passenger safety belt buckle switch.
- a faulted RCM.

PINPOINT TEST P: LFC 52/DTC B2439 — PASSENGER SAFETY BELT BUCKLE SWITCH RESISTANCE OUT OF RANGE

Test Step	Result / Action to Take
NOTE: Vehicles equipped with a 60/40 split bench seat require removal of the RCM to allow the electrical connectors to be disconnected. It will be necessary to reinstall the RCM after connecting the RCM electrical connectors before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. For additional information, refer to Restraints Control Module (RCM) in this section.	
P1 CHECK FOR A HARD OR INTERMITTENT DTC • Enter the following diagnostic mode on the diagnostic tool: Retrieve Continuous DTCs. • Retrieve and record any continuous DTCs for use later in this pinpoint test. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • **Was DTC B2439 retrieved during the on-demand self test?**	**Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to P2. **No** This is an intermittent fault. The fault condition is not present at this time. GO to P6.
P2 CHECK CIRCUIT 1514 (RD/BK) FOR AN OPEN BETWEEN THE RCM AND THE PASSENGER SAFETY BELT BUCKLE SWITCH **WARNING: If the supplemental restraint system (SRS) is**	**Yes** GO to P3.

being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.** **WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing a SRS **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. • Key in OFF position. • Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. • For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Disconnect: RCM C310b. • Disconnect: Passenger Safety Belt Buckle Switch C3066. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Measure the resistance between RCM C310b pin 26, circuit 1514 (RD/BK), harness side and passenger safety belt buckle switch C3066 pin 2, circuit 1514 (RD/BK), harness side.	**No** REPAIR circuit 1514 (RD/BK). GO to P7 .

 A0048715 ● **Is the resistance less than 0.5 ohm?**	
P3 CHECK CIRCUIT 649 (BK/OG) FOR AN OPEN	
● Measure the resistance between passenger safety belt buckle switch C3066 pin 1, circuit 649 (BK/OG), harness side and ground.  A0048711 ● **Is the resistance less than 0.5 ohm?**	**Yes** GO to P4 . **No** REPAIR circuit 649 (BK/OG). GO to P7 .
P4 CHECK THE SAFETY BELT BUCKLE SWITCH	
● For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . ● Connect: RCM C310b. ● Install a known good passenger safety belt buckle assembly. REFER to Section 501-20A . ● Connect: Passenger Safety Belt Buckle Switch C3066. ● For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● **Was DTC B2439 retrieved during the on-demand test?**	**Yes** GO to P5 . **No** Fault corrected. GO to P7 .
P5 CONFIRM THE RCM FAULT	
NOTE: Make sure all restraint system diagnostic tools, sensor electrical connectors, and the RCM electrical connector are connected before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. ● Key in OFF position. ● Reinstall the original passenger safety belt buckle assembly. REFER to Section 501-20A . ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● **Was DTC B2439 retrieved during the on-demand self test?**	**Yes** INSTALL a new RCM. REFER to Restraints Control Module (RCM) in this section. GO to P7 . **No** Fault corrected. GO to P7 .
P6 CHECK FOR AN INTERMITTENT FAULT	
WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint	**Yes** GO to P2 .

system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.** **WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing a SRS **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. • Key in OFF position. • Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • **Was DTC B2439 retrieved during the on-demand self test?**	**No** CHECK for causes of the intermittent fault. ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to P7 .
P7 CHECK FOR ADDITIONAL DTCs	
• Refer to the continuous DTCs recorded during Step P1. • **Were any continuous DTCs retrieved during Step P1?**	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Table in this section for pinpoint test direction.

	No RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. CLEAR all DTCs.

Pinpoint Test Q: LFC 15/DTC C1414 — Incorrect Vehicle ID

Normal Operation

The restraint control module (RCM) monitors the electrical condition at C310a pins 20 and 21 to detect the vehicle identification code. The RCM compares the pin state with a preprogrammed code. If the RCM detects an unexpected condition at either of these pins, it will store diagnostic trouble code (DTC) C1414 in memory and flash lamp fault code (LFC) 15 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

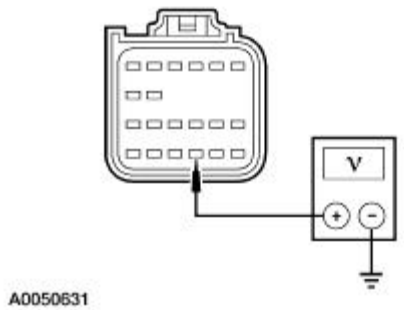
An incorrect vehicle identification code can be caused by:

- incorrect RCM for vehicle.
- wiring concern at RCM C310a pins 20 or 21.
- a faulted RCM.

PINPOINT TEST Q: LFC 15/DTC C1414 — INCORRECT VEHICLE ID

Test Step	Result / Action to Take
NOTE: Vehicles equipped with a 60/40 split bench seat require removal of the RCM to allow the electrical connectors to be disconnected. It will be necessary to reinstall the RCM after connecting the RCM electrical connectors before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. For additional information, refer to Restraints Control Module (RCM) in this section.	
Q1 CHECK FOR A HARD OR INTERMITTENT DTC	
• Enter the following diagnostic mode on the diagnostic tool: Retrieve Continuous DTCs. • Retrieve and record any continuous DTCs for use later in this pinpoint test. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • **Was DTC C1414 retrieved during the on-demand self test?**	**Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is

	corrected and the DTC is no longer retrieved during the on-demand self test.GO to Q2 . **No** This is an intermittent fault. The fault condition is not present at this time. GO to Q6 .
Q2 CHECK THE VEHICLE IDENTIFICATION PIN NO. 20	
WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.** **WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. **NOTE:** For this application, RCM C310a pin 20 must have no connection. • Key in OFF position. • Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section.	**Yes** DETERMINE the cause of incorrect harness configuration. REPAIR as necessary.GO to Q7 . **No** GO to Q3 .

• For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Disconnect: RCM C310a. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Inspect C310a harness side. Make sure there is no wire attached to pin cavity 20. • **Is a wire attached at C310a pin cavity 20?**	
Q3 CHECK FOR VOLTAGE AT THE VEHICLE IDENTIFICATION PIN 21 CIRCUIT 609 (OG/YE)	
NOTE: For this application, RCM C310a pin 21 must have ignition voltage. • Key in ON position. • Measure the voltage between RCM C310a pin 21, circuit 609 (OG/YE), harness side and ground,  • **Is the voltage greater than 10 volts?**	**Yes** GO to Q4 . **No** REPAIR circuit 609 (OG/YE).GO to Q7 .
Q4 CHECK RCM PART NUMBER	
• Check the part number on the RCM against the part number listed in the master parts catalog. • **Did the part number on the RCM match the part number listed in the master parts catalog?**	**Yes** GO to Q5 . **No** INSTALL a new RCM with the correct part number. REFER to Restraints Control Module (RCM) in this section. GO to Q7 .
Q5 CONFIRM THE RCM FAULT	
NOTE: Make sure all restraint system diagnostic tools, sensor electrical connectors, and the RCM electrical connector are connected before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. • Key in OFF position. • For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Connect: RCM C310a. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • **Was the DTC C1414 retrieved during the on-demand self test?**	**Yes** INSTALL a new RCM. GO to Q7 . **No** Fault corrected. GO to Q7 .
Q6 CHECK FOR INTERMITTENT FAULTS	

• Refer to the continuous DTCs recorded during Step Q1. • **Was the continuous DTC retrieved during Step Q1 an intermittent fault?**	**Yes** GO to Q2 . **No** CHECK for causes of the intermittent fault. ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found.GO to Q7 .
Q7 CHECK FOR ADDITIONAL DTCs	
• Refer to the continuous DTCs recorded during Step Q1. • **Were any continuous DTCs retrieved during Step Q1?**	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Table in this section for pinpoint test direction. **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. CLEAR all DTCs.

Pinpoint Test R: LFC 49/DTC C1947 — Seat Track Position Sensor Circuit Short to Ground

Normal Operation

The restraints control module (RCM) monitors the driver seat track position sensor circuits. If the RCM detects a short to ground, it will store diagnostic trouble code (DTC) C1947 in memory and flash lamp

fault code (LFC) 49 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

A driver seat track position sensor short to ground fault can be caused by:

- damaged wiring, terminals, or connectors.
- a faulty driver seat track position sensor.
- a faulted RCM.

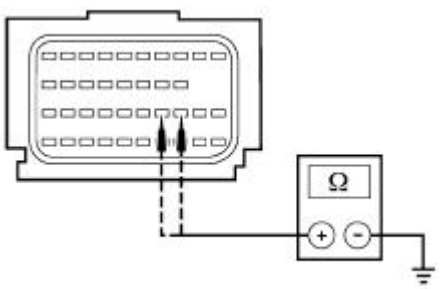
PINPOINT TEST R: LFC 49/DTC C1947 — SEAT TRACK POSITION SENSOR CIRCUIT SHORT TO GROUND

Test Step	Result / Action to Take
NOTE: Vehicles equipped with a 60/40 split bench seat require removal of the RCM to allow the electrical connectors to be disconnected. It will be necessary to reinstall the RCM after connecting the RCM electrical connectors before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. For additional information, refer to Restraints Control Module (RCM) in this section.	
R1 CHECK FOR A HARD OR INTERMITTENT DTC • Enter the following diagnostic mode on the diagnostic tool: Retrieve Continuous DTCs. • Retrieve and record any continuous DTCs for use later in this pinpoint test. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • **Was DTC C1947 retrieved during the on-demand self test?**	**Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and DTC is no longer retrieved during the on-demand self test. GO to R2. **No** This is an intermittent fault. The fault condition is not present at this time. GO to R5.
R2 CHECK CIRCUIT 1520 (LG) AND CIRCUIT 1558 (TN/BK) FOR A SHORT TO GROUND BETWEEN THE RCM AND THE DRIVER SEAT **WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.** **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal**	**Yes** GO to R3. **No** REPAIR circuit 1520 (LG) or circuit 1558 (TN/BK). GO to R6.

injury. **WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.**

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. **WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury.** **WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

- Key in OFF position.
- Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section.
- Key in OFF position.
- For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .
- Disconnect: RCM C310b.
- Disconnect: Seat Track Position Sensor C356.
- For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 .
- Measure the resistance between RCM C310b pin 23, circuit 1520 (LG), harness side and ground; and between pin 24, circuit 1558 (TN/BK), harness side and ground.



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- **Are the resistances greater than 1,000,000 ohms?**

R3 CHECK THE SEAT TRACK POSITION SENSOR	
• For vehicles equipped with a 60/40 split bench seat, disconnect the	**Yes**

battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Connect: RCM C310b. • Install a known good seat track position sensor. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • **Was DTC C1947 retrieved during the on-demand self test?**	GO to R4 . **No** Fault corrected. GO to R6 .
R4 CONFIRM THE RCM FAULT	
NOTE: Make sure all restraint system diagnostic tools, sensor electrical connectors, and the RCM electrical connector are connected before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. • Key in OFF position. • Reinstall the original seat track position sensor. • Connect: Seat Track Position Sensor C356. • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self-Test. • **Was DTC C1947 retrieved during the on-demand self test?**	**Yes** INSTALL a new RCM. REFER to Restraints Control Module (RCM) in this section. GO to R6 . **No** Fault corrected. GO to R6 .
R5 CHECK FOR AN INTERMITTENT FAULT	
WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.** **WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or	**Yes** GO to R2 . **No** CHECK for causes of the intermittent fault. ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to R6 .

repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. ● Key in OFF position. ● Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● **Was DTC C1947 retrieved during the on-demand self test?**	
R6 CHECK FOR ADDITIONAL DTCs	
● Refer to the continuous DTCs recorded during Step R1. ● **Were any continuous DTCs retrieved during Step R1?**	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Table in this section for pinpoint test direction. **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. CLEAR all DTCs.

Pinpoint Test S: LFC 49/DTC C1948 — Seat Track Position Sensor Circuit Resistance Out of Range

NOTE: Due to the seat track position sensor being a hall-effect type sensor, this pinpoint test will be diagnosing a current out of range fault instead of the current DTC definition for a resistance out of range fault.

Normal Operation

The restraints control module (RCM) monitors the driver seat track position sensor circuits. If the RCM detects a current out of range condition, it will store diagnostic trouble code (DTC) C1948 in memory and flash lamp fault code (LFC) 49 (or higher priority code if one exists) on the air bag indicator.

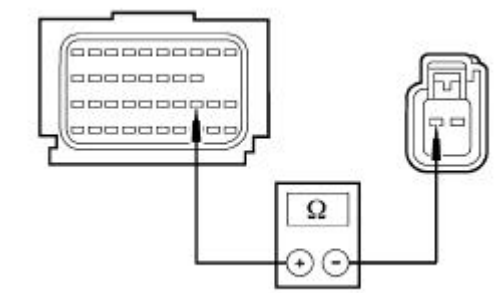
Possible Causes

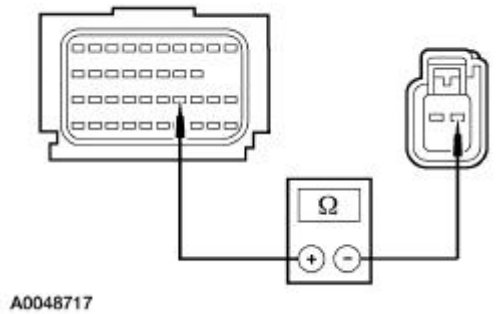
A driver safety belt buckle and pretensioner switch current out of range fault can be caused by:

- damaged wiring, terminals, or connectors.
- a faulty driver seat track position sensor.
- a faulted RCM.

PINPOINT TEST S: LFC 49/DTC C1948 — SEAT TRACK POSITION SENSOR CIRCUIT RESISTANCE OUT OF RANGE

Test Step	Result / Action to Take
NOTE: Vehicles equipped with a 60/40 split bench seat require removal of the RCM to allow the electrical connectors to be disconnected. It will be necessary to reinstall the RCM after connecting the RCM electrical connectors before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. For additional information, refer to Restraints Control Module (RCM) in this section.	
S1 CHECK FOR A HARD OR INTERMITTENT DTC • Enter the following diagnostic mode on the diagnostic tool: Retrieve Continuous DTCs. • Retrieve and record any continuous DTCs for use later in this pinpoint test. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • **Was DTC C1948 retrieved during the on-demand self test?**	**Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and DTC is no longer retrieved during the on-demand self test. GO to S2. **No** This is an intermittent fault. The fault condition is not present at this time. GO to S6.
S2 CHECK CIRCUIT 1520 (LG) FOR AN OPEN **WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.** **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.**	**Yes** GO to S3. **No** REPAIR circuit 1520 (LG). GO to S7.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE: Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. ● Key in OFF position. ● Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. ● Key in OFF position. ● For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . ● Disconnect: RCM C310b. ● Disconnect: Seat Track Position Sensor C356. ● For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . ● Measure the resistance between RCM C310b pin 23, circuit 1520 (LG), harness side and driver seat track position sensor C356 pin 2, circuit 1520 (LG), harness side.  A0048716 ● **Is the resistance less than 0.5 ohm?**	
S3 CHECK CIRCUIT 1558 (TN/BK) FOR AN OPEN	
● Measure the resistance between RCM C310b pin 24, circuit 1558 (TN/BK), harness side and driver seat track position sensor C356 pin 1, circuit 1558 (TN/BK), harness side.	**Yes** GO to S4 . **No** REPAIR circuit 1558 (TN/BK). GO to S7 .



- **Is the resistance less than 0.5 ohm?**

S4 CHECK THE SEAT TRACK POSITION SENSOR - For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . - Connect: RCM C310b. - Install a known good seat track position sensor. - Connect: Seat Track Position Sensor C356. - For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . - Key in ON position. - Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. - **Was DTC C1948 retrieved during the on-demand self test?**	**Yes** GO to S5 . **No** Fault corrected. GO to S7 .
S5 CONFIRM THE RCM FAULT **NOTE:** Make sure all restraint system diagnostic tools, sensor electrical connectors, and the RCM electrical connector are connected before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. - Key in OFF position. - Reinstall the original seat track position sensor. - Connect: Seat Track Position Sensor C356. - Key in ON position. - Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. - **Was DTC C1948 retrieved during the on-demand self test?**	**Yes** INSTALL a new RCM. REFER to Restraints Control Module (RCM) in this section. GO to S7 . **No** Fault corrected. GO to S7 .
S6 CHECK FOR AN INTERMITTENT FAULT **WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.** **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.** **WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt**	**Yes** GO to S2 . **No** CHECK for causes of the intermittent fault. ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to S7 .

pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury.  **WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. ● Key in OFF position. ● Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● **Was DTC C1948 retrieved during the on-demand self test?**	
S7 CHECK FOR ADDITIONAL DTCs	
● Refer to the continuous DTCs recorded during Step S1. ● **Were any continuous DTCs retrieved during Step S1?**	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Table in this section for pinpoint test direction. **No** RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) . CLEAR all DTCs.

Pinpoint Test T: LFC 49/DTC C1981 — Seat Track Position Sensor Circuit Fault

Normal Operation

The restraints control module (RCM) monitors the driver seat track position sensor circuits. If the RCM detects an open or short to battery, it will store diagnostic trouble code (DTC) C1982 in memory and flash lamp fault code (LFC) 49 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

A driver seat track position sensor open circuit or short to battery fault can be caused by:

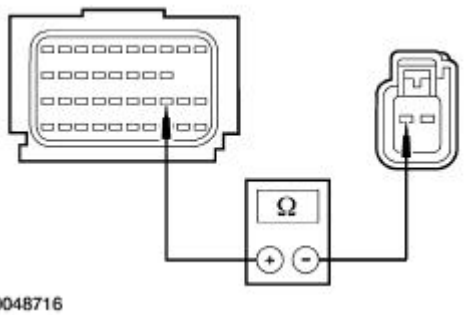
- damaged wiring, terminals, or connectors.
- a faulted RCM.

PINPOINT TEST T: LFC 49/DTC C1982 — SEAT TRACK POSITION SENSOR CIRCUIT FAULT

Test Step	Result / Action to Take
NOTE: Vehicles equipped with a 60/40 split bench seat require removal of the RCM to allow the electrical connectors to be disconnected. It will be necessary to reinstall the RCM after connecting the RCM electrical connectors before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. For additional information, refer to Restraints Control Module (RCM) in this section.	
T1 CHECK FOR A HARD OR INTERMITTENT DTC • Enter the following diagnostic mode on the diagnostic tool: Retrieve Continuous DTCs. • Retrieve and record any continuous DTCs for use later in this pinpoint test. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • **Was DTC C1982 retrieved during the on-demand self test?**	**Yes** This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and DTC is no longer retrieved during the on-demand self test. GO to T2. **No** This is an intermittent fault. The fault condition is not present at this time. GO to T6.
T2 CHECK CIRCUIT 1520 (LG) FOR AN OPEN **WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.**	**Yes** GO to T3. **No** REPAIR circuit 1520 (LG). GO to T7.

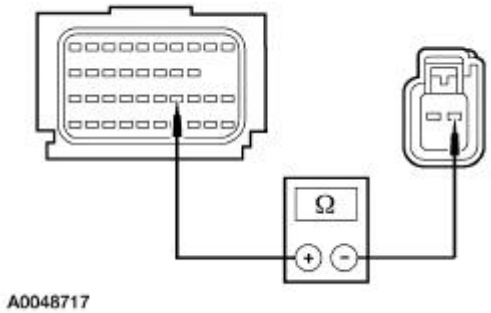
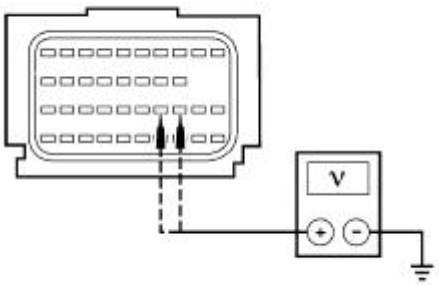
The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. **WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.** **WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.** **WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury.** **WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

- Key in OFF position.
- Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section.
- Key in OFF position.
- For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .
- Disconnect: RCM C310b.
- Disconnect: Seat Track Position Sensor C356.
- For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 .
- Measure the resistance between RCM C310b pin 23, circuit 1520 (LG), harness side and driver seat track position sensor C356 pin 2, circuit 1520 (LG), harness side.



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- **Is the resistance less than 0.5 ohm?**

• Measure the resistance between RCM C310b pin 24, circuit 1558 (TN/BK), harness side and driver seat track position sensor C356 pin 1, circuit 1558 (TN/BK), harness side.  A0048717 • **Is the resistance less than 0.5 ohm?**	**Yes** GO to T4 . **No** REPAIR circuit 1558 (TN/BK). GO to T7 .
T4 CHECK CIRCUITS 1520 (LG) AND CIRCUIT 1558 (TN/BK) FOR A SHORT TO BATTERY	
• Key in ON position. • Measure the voltage between RCM C310b pin 23, circuit 1520 (LG), harness side and ground; and between pin 24, circuit 1558 (TN/BK), harness side and ground.  A0048718 • **Are the voltages less than 0.2 volt?**	**Yes** GO to T5 . **No** REPAIR circuit 1520 (LG) or circuit 1558 (TN/BK). GO to T7 .
T5 CONFIRM THE RCM FAULT	
NOTE: Make sure all restraint system diagnostic tools, sensor electrical connectors, and the RCM electrical connector are connected before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. • Key in OFF position. • For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Connect: RCM C310b. • Connect: Seat Track Position Sensor C356. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Key in ON position. • Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. • **Was DTC C1982 retrieved during the on-demand self test?**	**Yes** INSTALL a new RCM. REFER to Driver Air Bag Module in this section. GO to T7 . **No** Fault corrected. GO to T7 .
T6 CHECK FOR AN INTERMITTENT FAULT	
WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.	**Yes** GO to T2 . **No** CHECK for causes of the

The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury. WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE: Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. ● Key in OFF position. ● Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion in this section. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● **Was DTC C1982 retrieved during the on-demand self test?**	intermittent fault. ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to T7 .
T7 CHECK FOR ADDITIONAL DTCs	
● Refer to the continuous DTCs recorded during Step T1. ● **Were any continuous DTCs retrieved during Step T1?**	**Yes** Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Table in this section for pinpoint test direction. **No** RECONNECT

	the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. CLEAR all DTCs.

Pinpoint Test U: No Communication With The Restraints Control Module (RCM)

Normal Operation

The scan tool communicates with the restraints control module (RCM) monitors through the data link connector (DLC) C251 pin 7, 70 (LB/WH).

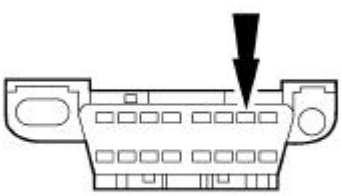
Possible Causes

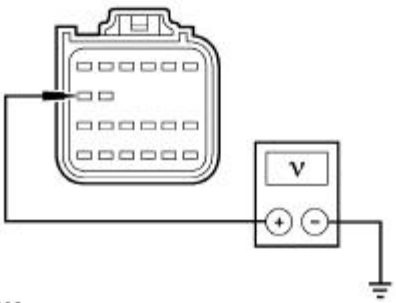
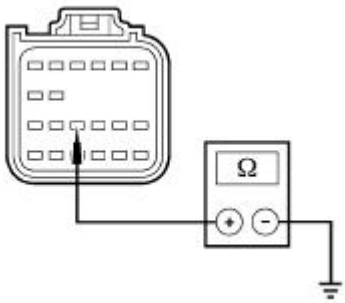
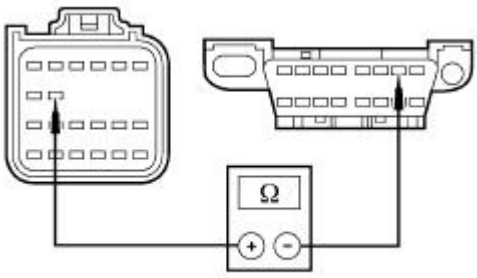
A no communication fault with the RCM can be caused by:

- damaged wiring, terminals, or connectors.
- a faulty data link connector (DLC).
- a faulted RCM.

PINPOINT TEST U: NO COMMUNICATION WITH THE RESTRAINTS CONTROL MODULE (RCM)

Test Step	Result / Action to Take
NOTE: Vehicles equipped with a 60/40 split bench seat require removal of the RCM to allow the electrical connectors to be disconnected. It will be necessary to reinstall the RCM after connecting the RCM electrical connectors before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. For additional information, refer to Restraints Control Module (RCM) in this section.	
U1 CHECK THE RCM C310a PIN 11 FOR DAMAGE	
WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. **The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. WARNING: Do not handle, move or**	**Yes** GO to U2 . **No** REPAIR RCM C310a or RCM C310a pin 11 as necessary. RETEST the communication to the RCM. REACTIVATE

change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury. WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury. WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury. WARNING: Never probe the electrical connector on a safety canopy module. Doing so can result in safety canopy deployment. NOTE: Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer. • Key in OFF position. • Deactivate the system. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. • For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . • Disconnect: RCM C310a. • For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . • Inspect the RCM C310a, harness side and RCM C310a, component side, pin 11 for damage. • **Are RCM C310a and RCM C310a pin 11 OK?**	the system. REFER to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.
U2 CHECK THE DLC C251 PIN 7 FOR DAMAGE • Inspect the DLC C251 and DLC C251 pin 7 for damage.  A0030459 • **Are DLC C251 and DLC C251 pin 7 OK?**	**Yes** GO to U3 . **No** REPAIR DLC C251 or DLC C251 pin 7 as necessary. RETEST the communication to the RCM. REACTIVATE the system. REFER to Air Bag and Safety Belt Pretensioner

	Supplemental Restraint System (SRS) in this section.
U3 CHECK THE IGNITION CIRCUIT 609 (OG/YE) FOR AN OPEN ● Key in ON position. ● Measure the voltage between RCM C310a pin 12, circuit 609 (OG/YE), harness side and ground.  A0039638 ● **Is the voltage greater than 10 volts?**	**Yes** GO to U4 . **No** REPAIR circuit 609 (OG/YE). RETEST the communication to the RCM. REACTIVATE the system. REFER to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.
U4 CHECK THE GROUND CIRCUIT 649 (BK/OG) FOR AN OPEN ● Key in OFF position. ● Measure the resistance between RCM C310a pin 16, circuit 649 (BK/OG), harness side and a sheet metal ground near the RCM.  A0039639 ● **Is the resistance less than 5 ohms?**	**Yes** GO to U5 . **No** REPAIR circuit 649 (BK/OG). RETEST the communication to the RCM. REACTIVATE the system. REFER to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.
U5 CHECK CIRCUIT 70 (LB/WH) FOR AN OPEN ● Measure the resistance between RCM C310a pin 11, circuit 70 (LB/WH), harness side and the DLC C251 pin 7, circuit 70 (LB/WH), harness side.  A0041599 ● **Is the resistance less than 5 ohms?**	**Yes** GO to U6 . **No** REPAIR circuit 70 (LB/WH). RETEST the communication to the RCM. REACTIVATE the system. REFER to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this

	section.
U6 CONFIRM THE RCM FAULT	
NOTE: Make sure the safety belt pretensioner restraint system diagnostic tools, sensor electrical connectors, and the RCM electrical connector are connected before carrying out the on-demand self test. If not, erroneous DTCs will be recorded. ● For vehicles equipped with a 60/40 split bench seat, disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 . ● Connect: RCM C310a. ● For vehicles equipped with a 60/40 split bench seat, connect the battery ground cable. For additional information, refer to Section 414-01 . ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● **Did the scan tool communicate with the RCM?**	**Yes** Fault corrected. REACTIVATE the system. REFER to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section. **No** INSTALL a new RCM. RETEST the communication to the RCM. REACTIVATE the system. REFER to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.

Inspection and Repair After a Supplemental Restraint System (SRS) Deployment

WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.

The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury.

NOTE: Diagnostics or repairs are not to be carried out on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road.**

NOTE: After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

1. When any deployable device (driver air bag, passenger air bag, seat side air bag, safety belt pretensioner, etc.) or combination of devices are deployed and/or the RCM has the DTC B1231 (Crash Data Memory Full) in memory, the repair of the vehicle's supplemental restraint system (SRS) is to include the removal of all deployed devices and the installation of new deployable devices, the removal and installation of new impact sensors, and the removal and installation of a new RCM.

2. When any damage to the impact sensor mounting points or mounting hardware has occurred, repair or install new mounting points and mounting hardware as needed.

3. When the driver air bag module has deployed a new clockspring must be installed.

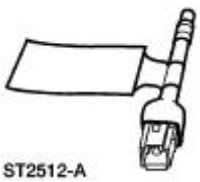
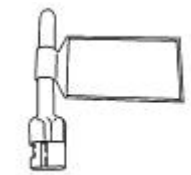
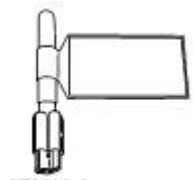
4. Inspect the entire vehicle for damage, including the following components:
   - steering column.
   - instrument panel knee bolsters and mounting points.
   - instrument panel braces and brackets.
   - instrument panel and mounting points.
   - seats and seat mounting points.
   - safety belts, safety belt buckles, and safety belt retractors. For additional information, refer to Section 501-20A .
   - supplemental restraint system (SRS) wiring, wiring harnesses, and connectors.

5. After carrying out the review and inspection of the entire vehicle for damage, repair or install

new components as needed.

Supplemental Restraint System (SRS) Deactivation and Reactivation

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (2 req'd) 418-F395 (014-R1079)
 ST2512-A	Diagnostic Tool, Restraint System (1 req'd) 418-F403
 ST2507-A	Diagnostic Tool, Restraint System (2 req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 req'd) 418-F088 (105-R0012)

Deactivation

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Do not set a live air bag module down with the trim cover face down. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an airbag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

WARNING: Never probe the connectors on the safety canopy module. Doing so can result in safety canopy module deployment.

WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

WARNING: Restraint system diagnostic tools are for service only. Tools must be removed prior to operating the vehicle over the road. Failure to remove restraint system diagnostic tools could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side air bag and/or a safety belt pretensioner (if equipped) system is being serviced, **the air bag system must be deactivated.**

NOTE: Restraint system diagnostic tools **MUST** be installed under the seats in the seat side air bag (if equipped) and safety belt pretensioner (if equipped) to floor connectors.

NOTE: Diagnostics or repairs are not to be carried out on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road.**

NOTE: After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

All vehicles

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

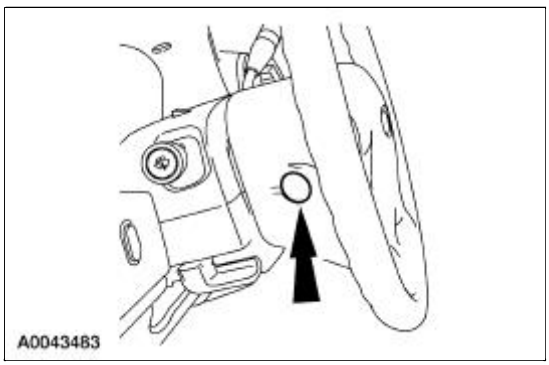
   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

The second row side impact sensors (if equipped) are located at or near the base of the C-pillars.

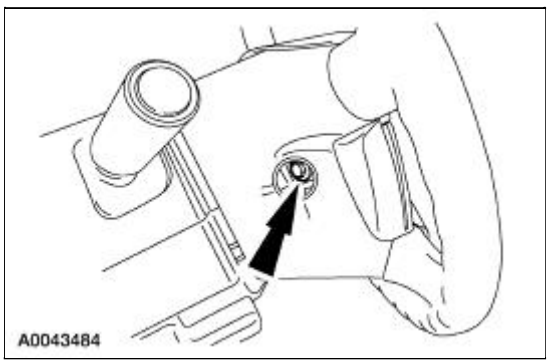
To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

2. Remove the two steering wheel back cover plugs (one shown).

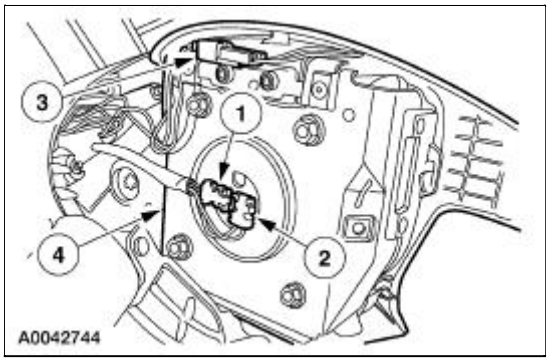


3. Remove the two driver air bag module bolts (one shown).



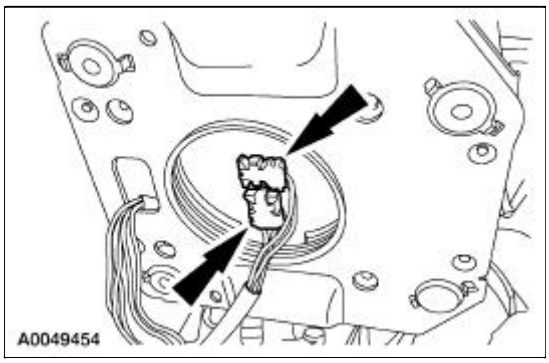
Expedition vehicles

4. Remove the driver air bag module.
    1. Release the two retaining tabs. Disconnect the driver air bag module electrical connector.
        - Label the driver air bag module squib number on the driver air bag module electrical connector before disconnecting.
    2. Release the two retaining tabs. Disconnect the driver air bag module electrical connector.
        - Label the driver air bag module squib number on the driver air bag module electrical connector before disconnecting.
    3. Disconnect the horn switch electrical connector.
    4. Remove the driver air bag module.

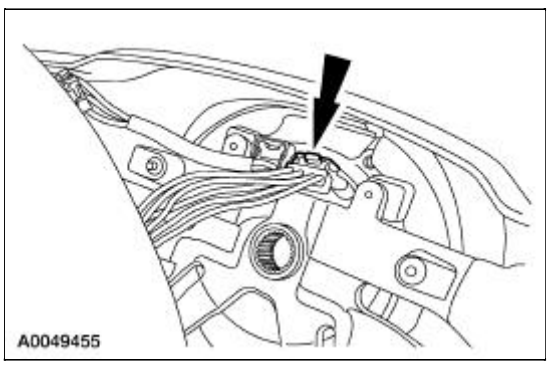


Navigator vehicles

5. Disconnect the driver air bag module
    - Release the two tabs on each driver air bag module electrical connector and disconnect them.
        - Label each driver air bag module electrical connector before disconnecting.

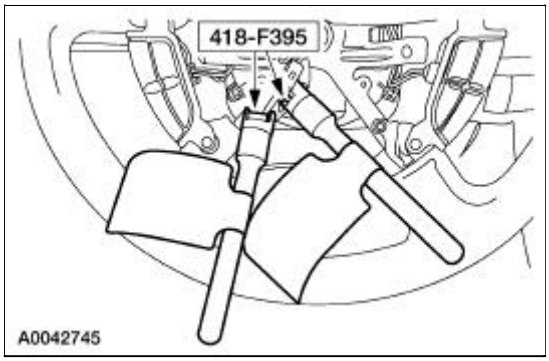


6. Release the tab and disconnect the driver air bag module accessories electrical connector at the top of the clockspring and remove the driver air bag module.

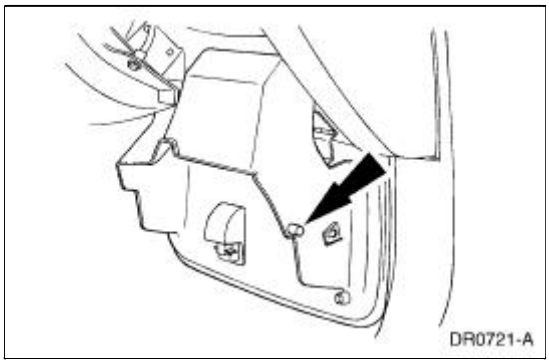


All vehicles

7. Attach the restraint system diagnostic tools to the clockspring electrical connectors at the top of the steering column.

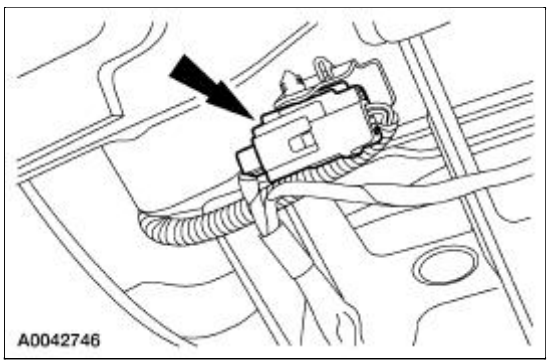


8. While pushing in on the two glove compartment door tabs, position the glove compartment downward.

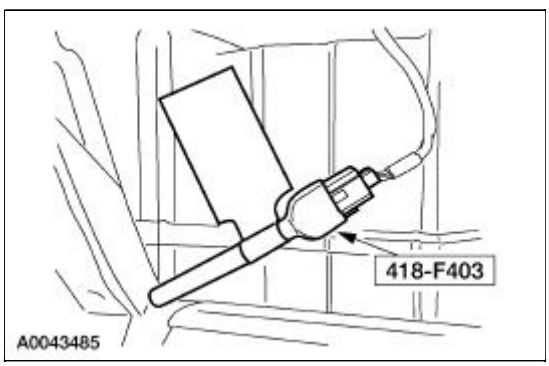


9. **NOTE:** The Expedition is shown, the Navigator is similar.

   Through the glove compartment opening, release the tab and disconnect the passenger air bag module electrical connector.



10. Attach the restraint system diagnostic tool to the vehicle harness side of the passenger air bag module electrical connector.



Vehicles without safety canopies

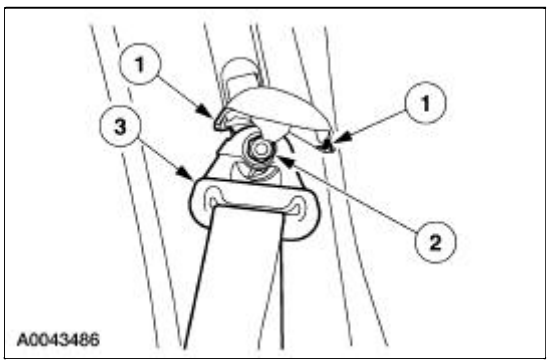
11. **CAUTION: Do not deactivate the safety canopy module circuit by removing the safety canopy bridge resistor from the safety canopy electrical connector.**

    If the safety canopy bridge resistor is removed, an open circuit fault will be generated by the restraints control module (RCM).
    If a restraint system diagnostic tool is installed at the safety canopy electrical connector, a low resistance fault will be generated by the RCM.

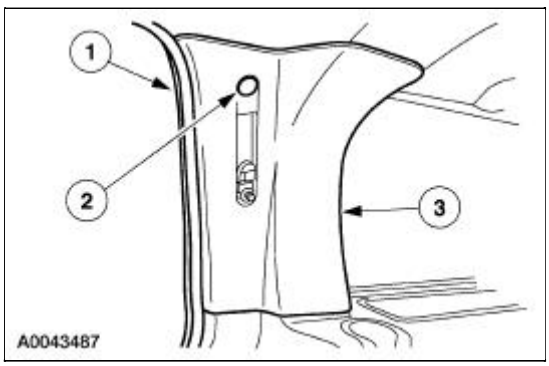
Vehicles with safety canopies

12. **NOTE:** Inspect the shoulder safety belt guide cover for damage. If the shoulder safety belt guide cover is damaged or if it does not remain closed, install a new shoulder safety belt guide cover.

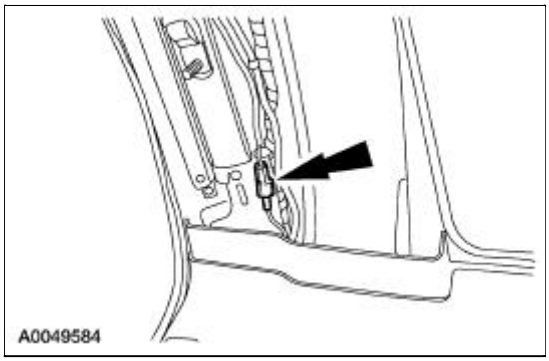
    Remove the second row passenger side safety belt guide.
    1. Release the retaining tab at each side and open the safety belt guide cover.
    2. Remove the nut.
    3. Remove the second row passenger side safety belt guide.



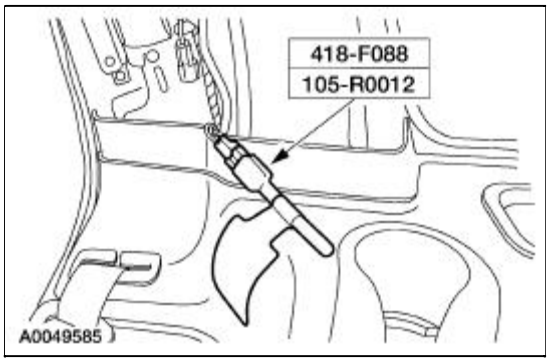
13. Remove the passenger side C-pillar trim panel.
    1. Separate the weather-stripping along the passenger side C-pillar trim panel.
    2. Remove the bolt cover and bolt.
    3. Pull out to release the retainers and remove the passenger side C-pillar trim panel.



14. Disconnect the passenger side safety canopy electrical connector.

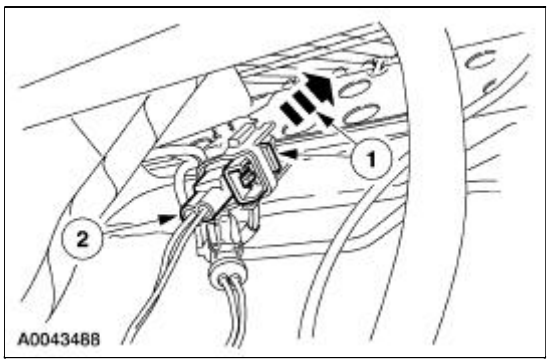


15. Attach the restraint system diagnostic tool to the vehicle harness side of the passenger side safety canopy electrical connector.

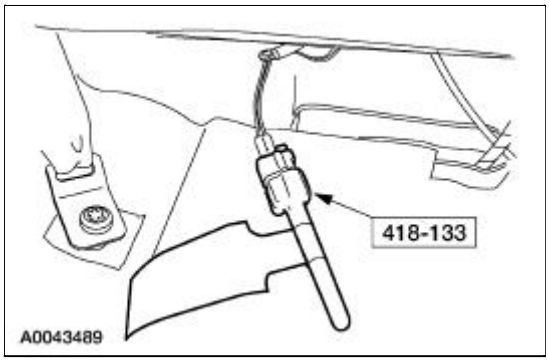


All vehicles

16. Disconnect the passenger seat safety belt buckle pretensioner electrical connector.
    1. Slide and disengage the passenger seat safety belt buckle pretensioner electrical connector locking clip.
    2. Push in to release the tab and disconnect the passenger seat safety belt buckle pretensioner electrical connector.



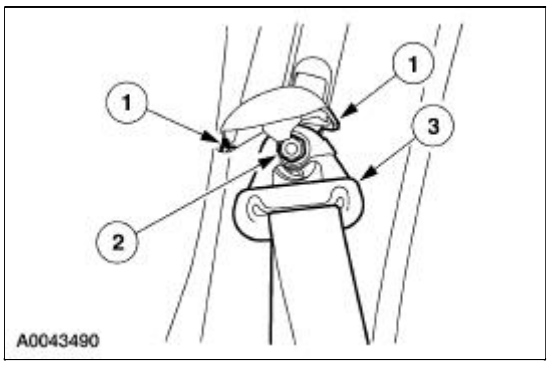
17. Attach the restraint system diagnostic tool to the passenger seat safety belt buckle pretensioner floor electrical connector.



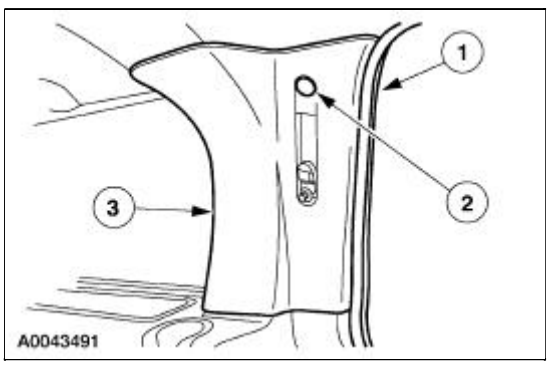
Vehicles with safety canopies

18. **NOTE:** Inspect the shoulder safety belt guide cover for damage. If the shoulder safety belt guide cover is damaged or if it does not remain closed, install a new shoulder safety belt guide cover.

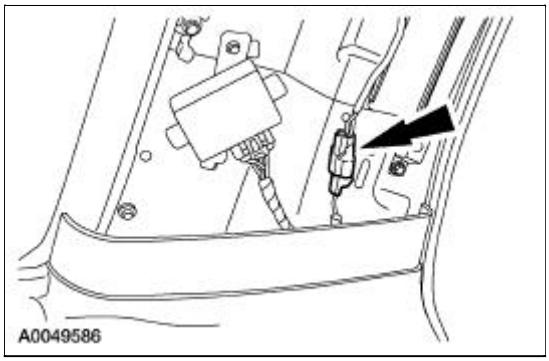
    Remove the second row driver side safety belt guide.
    1. Release the retaining tab at each side and open the safety belt guide cover.
    2. Remove the nut.
    3. Remove the second row driver side safety belt guide.



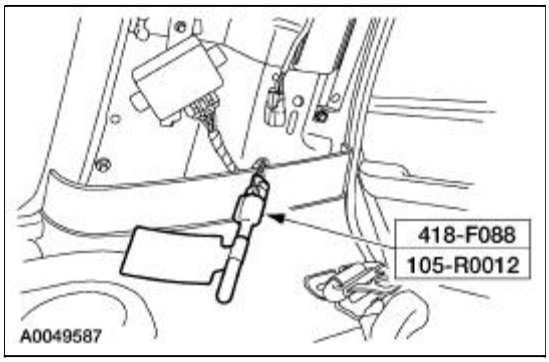
19. Remove the driver side C-pillar trim panel.
    1. Separate the weather-stripping along the driver side C-pillar trim panel.
    2. Remove the bolt cover and bolt.
    3. Pull out to release the retainers and remove the driver side C-pillar trim panel.



20. Disconnect the driver side safety canopy electrical connector.

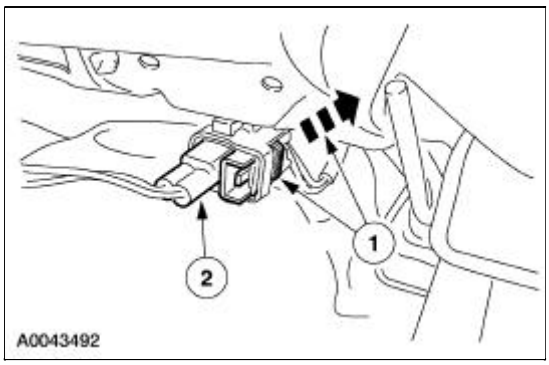


21. Attach the restraint system diagnostic tool to the vehicle harness side of the driver side safety canopy electrical connector.

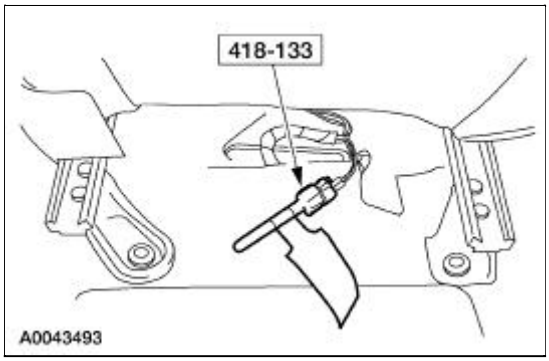


All vehicles

22. Disconnect the driver seat safety belt buckle pretensioner electrical connector.
    1. Slide and disengage the driver seat safety belt buckle pretensioner electrical connector locking clip.
    2. Push in to release the tab and disconnect the driver seat safety belt buckle pretensioner electrical connector.



23. Attach the restraint system diagnostic tool to the driver seat safety belt buckle pretensioner floor electrical connector.



24. Connect the battery ground cable. For additional information, refer to Section 414-01 .

25. With the restraint system diagnostic tools installed at all deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of Section 501-20B .

26. Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

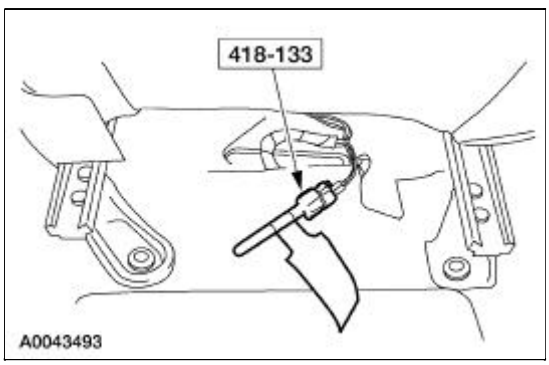
Reactivation

WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the deactivation procedure.

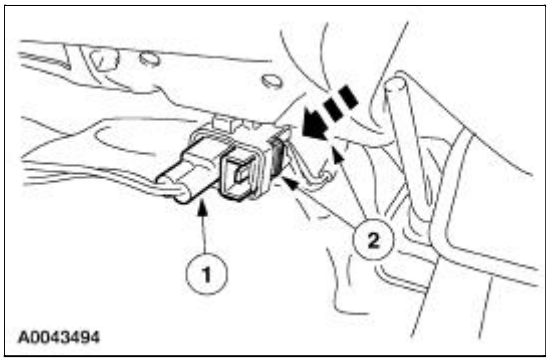
All vehicles

1. **NOTE:** Make sure the battery negative cable is still disconnected before proceeding with the reactivation portion of this procedure.

   Remove the restraint system diagnostic tool from the driver seat safety belt buckle pretensioner floor electrical connector.

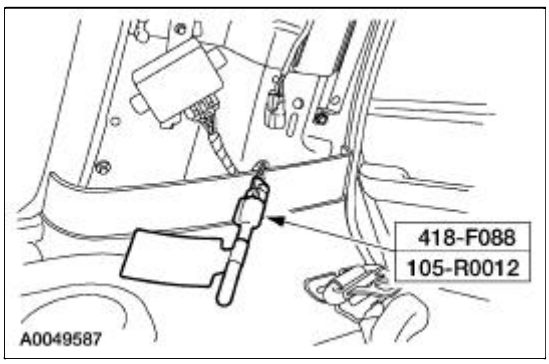


2. Connect the driver seat safety belt buckle pretensioner electrical connector.
   1. Connect the driver seat safety belt buckle pretensioner electrical connector.
   2. Slide and engage the driver seat safety belt buckle pretensioner electrical connector locking clip.

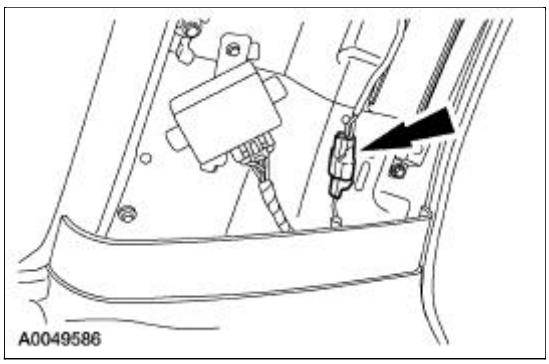


Vehicles with safety canopies

3. Remove the restraint system diagnostic tool from the vehicle harness side of the driver side safety canopy electrical connector.

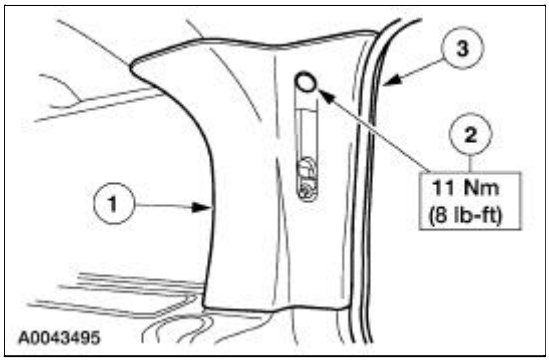


4. Connect the driver side safety canopy electrical connector.



5. **WARNING: Anytime the safety canopy module has deployed, the headliner, and all A, B, and C pillar upper trim panels and attaching hardware must be replaced along with any other damaged components and hardware. Failure to do so may result in personal injury in the event of a safety canopy module deployment.**

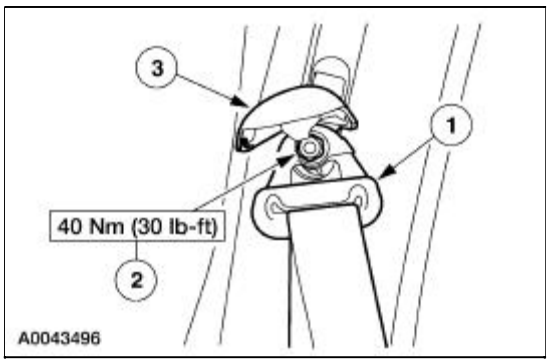
   Install the driver side C-pillar trim panel.
   1. Position the driver side C-pillar trim panel and push in, engaging the retainers.
   2. Install the bolt and bolt cover.
   3. Install the weather-stripping along the driver side C-pillar trim panel.



6. **NOTE:** Inspect the shoulder safety belt guide cover for damage. If the shoulder safety belt guide cover is damaged or if it does not remain closed, install a new shoulder safety belt guide cover.

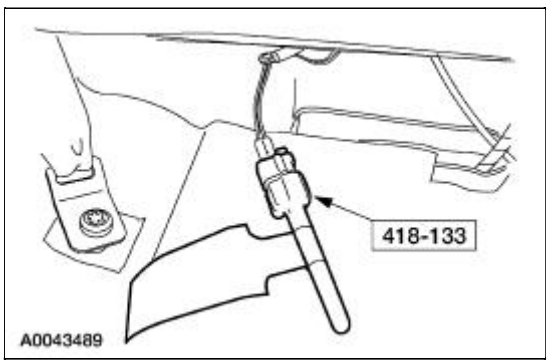
   NOTE: Make sure the safety belt is not twisted prior to installation.

   Install the second row driver side safety belt guide.
   1. Position the second row driver side safety belt guide.
   2. Install the nut.
   3. Close the safety belt guide cover.

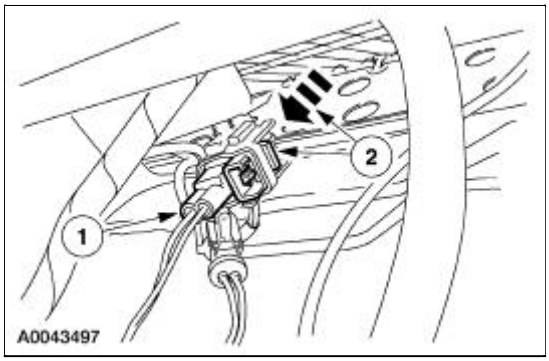


All vehicles

7. Remove the restraint system diagnostic tool from the passenger seat safety belt buckle pretensioner floor electrical connector.

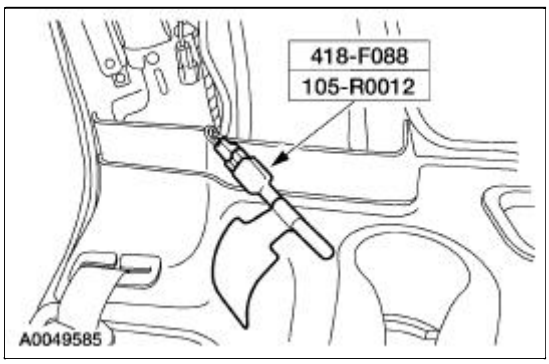


8. Connect the passenger seat safety belt buckle pretensioner electrical connector.
   1. Connect the passenger seat safety belt buckle pretensioner electrical connector.
   2. Slide and engage the passenger seat safety belt buckle pretensioner electrical connector locking clip.

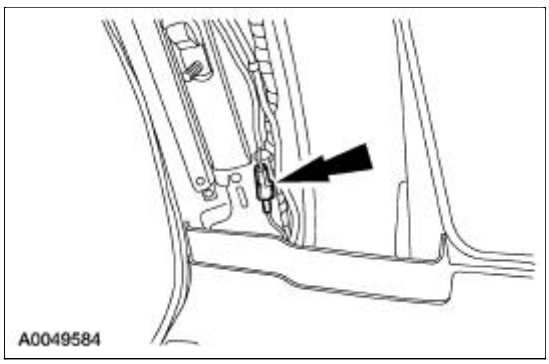


Vehicles with safety canopies

9. Remove the restraint system diagnostic tool from the vehicle harness side of the passenger side safety canopy electrical connector.

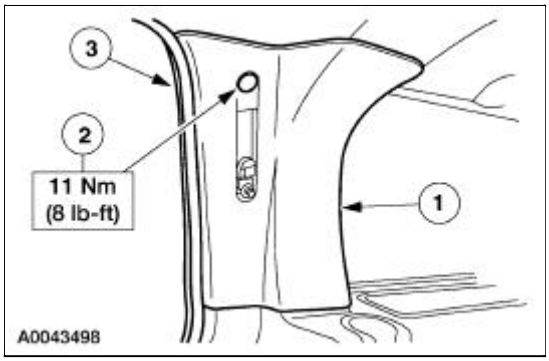


10. Connect the passenger side safety canopy electrical connector.



11. **WARNING: Anytime the safety canopy module has deployed, the headliner, and all A, B, and C pillar upper trim panels and attaching hardware must be replaced along with any other damaged components and hardware. Failure to do so may result in personal injury in the event of a safety canopy module deployment.**

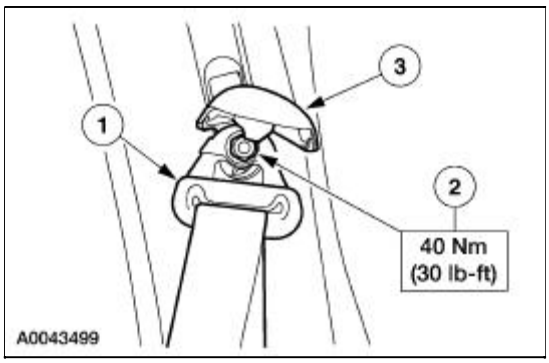
    Install the passenger C-pillar trim panel.
    1. Position the passenger side C-pillar trim panel and push in, engaging the retainers.
    2. Install the bolt and bolt cover.
    3. Install the weather-stripping along the passenger side C-pillar trim panel.



12. **NOTE:** Inspect the shoulder safety belt guide cover for damage. If the shoulder safety belt guide cover is damaged or if it does not remain closed, install a new shoulder safety belt guide cover.

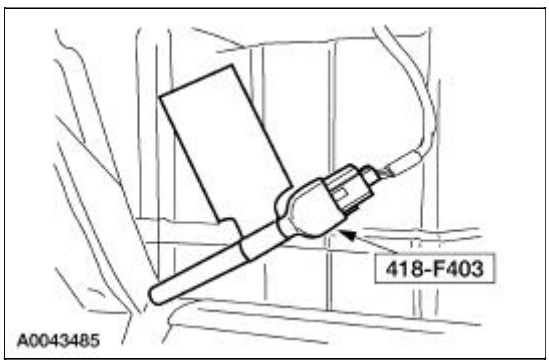
    NOTE: Make sure the safety belt is not twisted prior to installation.

    Install the second row passenger side safety belt guide.
    1. Position the second row passenger side safety belt guide.
    2. Install the nut.
    3. Close the safety belt guide cover.



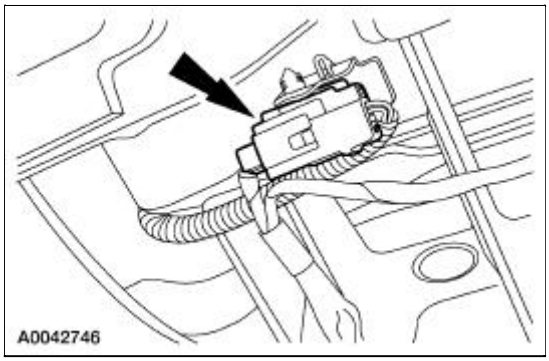
All vehicles

13. Remove the restraint system diagnostic tool from the vehicle harness side of the passenger air bag module electrical connector.



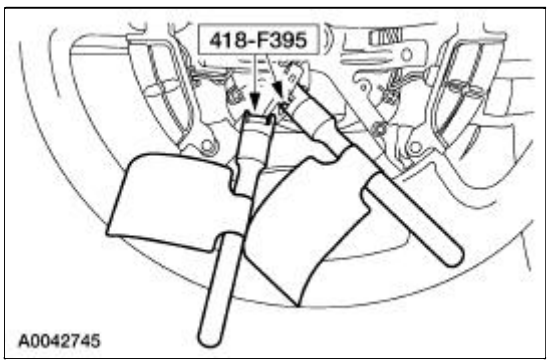
14. **NOTE:** The Expedition is shown, the Navigator is similar.

    Connect the passenger air bag module electrical connector.



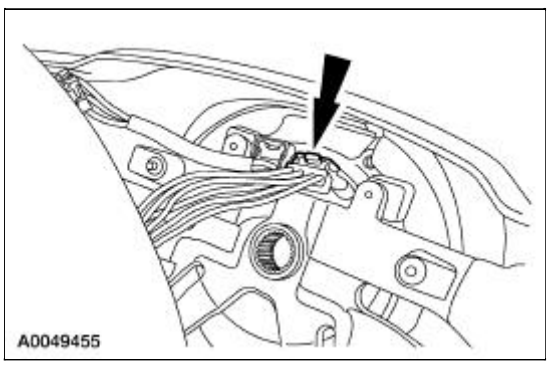
15. Close the glove compartment.

16. Remove the restraint system diagnostic tools from the clockspring electrical connector at the top of the steering column.



Navigator vehicles

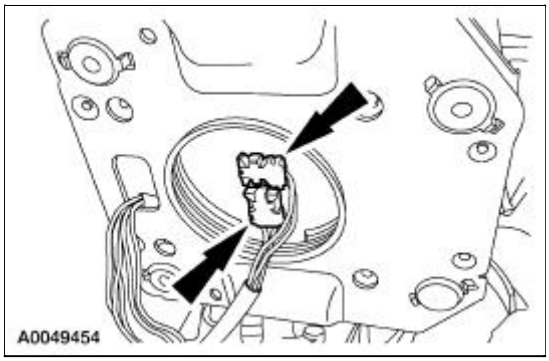
17. Connect the driver air bag module accessories electrical connector to the connector end at the top of the clockspring.



18. **CAUTION: The clockspring electrical connectors are unique and cannot be reversed when connected to the driver air bag module. Match the electrical connector key to the keyway in the driver air bag module. Do not force the electrical connectors into the driver air bag module.**

    Connect the driver air bag module electrical connectors as noted during removal.

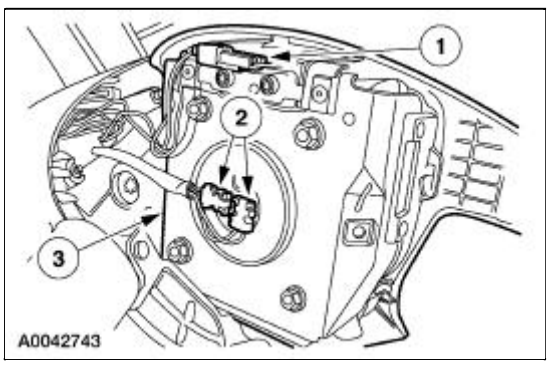
    - Position the driver air bag module to the steering wheel.



Expedition vehicles

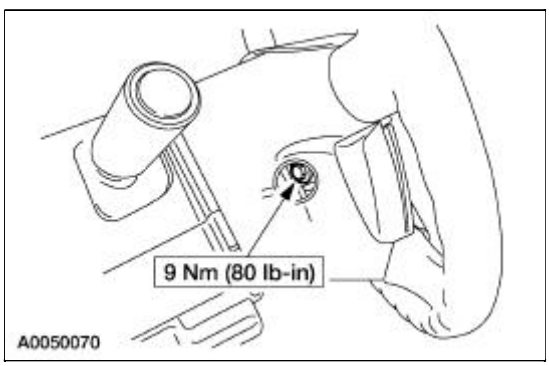
19. Position the driver air bag module to the steering wheel.
    1. Connect the horn switch electrical connector.
    2. **CAUTION: The clockspring electrical connectors are unique and cannot be reversed when connected to the driver air bag module. Match the electrical connector key to the keyway in the driver air bag module. Do not force the electrical connectors into the driver air bag module.**

       Connect the driver air bag module electrical connectors as noted during removal.
    3. Position the driver air bag module to the steering wheel.

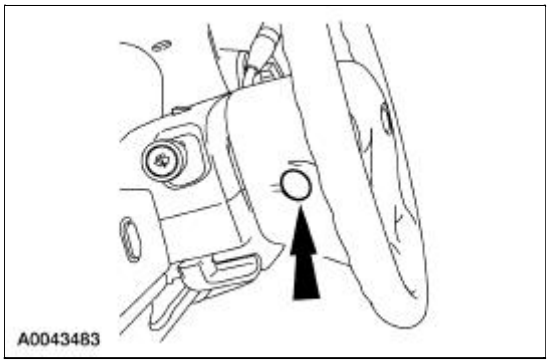


All vehicles

20. Install the two driver air bag module bolts (one shown).



21. Install the two steering wheel back cover plugs (one shown).



22. Connect the battery ground cable. For additional information, refer to Section 414-01 .

23. **WARNING: Restraint system diagnostic tools are for service only. Tools must be removed prior to operating the vehicle over the road. Failure to remove restraint system diagnostic tools could result in injury and possible violation of vehicle safety standards.**

    With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of Section 501-20B .

Vehicles with safety canopies

24. Check the active restraint system for correct operation. For additional information, refer to Section 501-20A .

Air Bag Disposal —Deployed

1.  **WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.**

   Dispose of the deployed air bag modules and safety belt pretensioners in the same manner as any other part to be scrapped.

Air Bag Disposal —Undeployed Inoperative

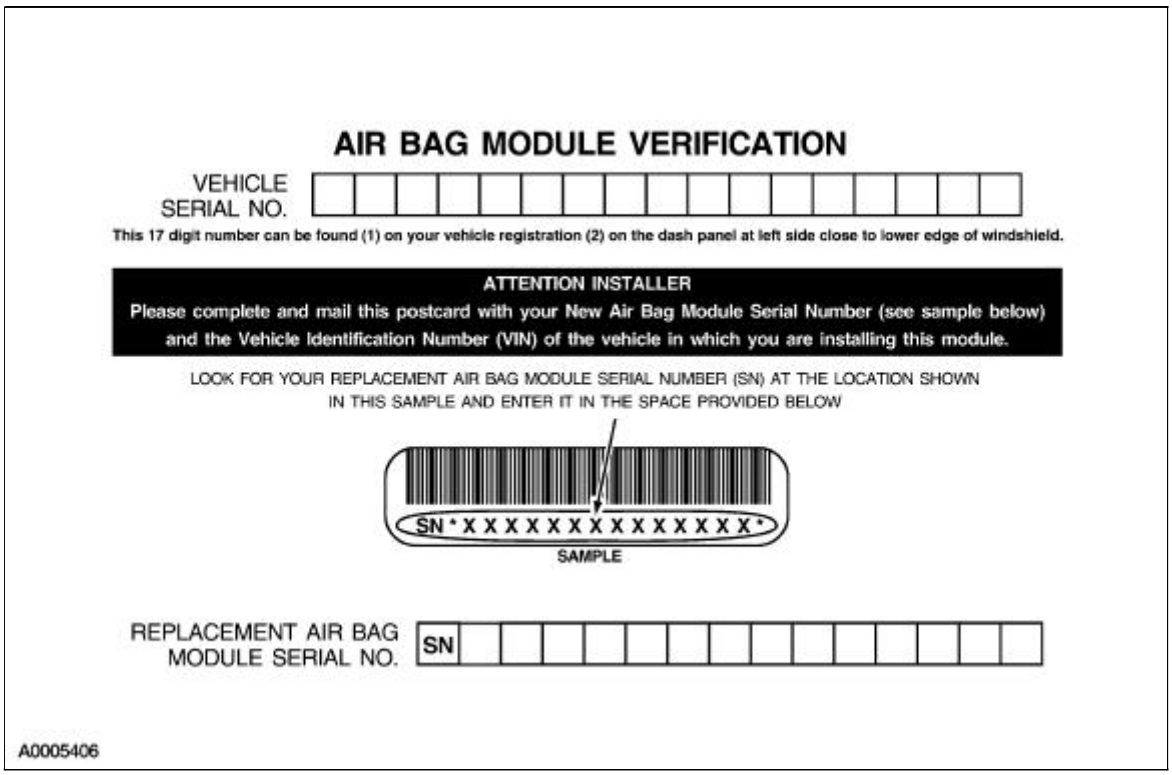
WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

WARNING: Carry a live air bag module with the air bag and trim cover or deployment door pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

NOTE: All inoperative air bag modules and safety belt pretensioners have been placed on the Mandatory Return List. All discolored or damaged air bag modules must be treated the same as any inoperative live air bag being returned.

1. Remove the inoperative component from the vehicle. For additional information, refer to the appropriate air bag procedure in this section.



2. **NOTE:** When installing a new air bag module, a prepaid return postcard is provided with the replacement air bag module. The serial number for the new part and the vehicle identification number (VIN) must be recorded and sent to Ford Motor Company.

   If installing a new air bag module, record the necessary information and return the inoperative air bag module to Ford Motor Company.

Air Bag Disposal —Driver, Undeployed, Scrapped Vehicle

Remote Deployment

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

WARNING: Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Do not set a live air bag module down with the trim cover face down. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Remote deployment is to be carried out outdoors with all personnel at least 6.1 meters (20 feet) away to ensure personal safety. Due to the loud report which occurs when the air bag is deployed, hearing protection is required.

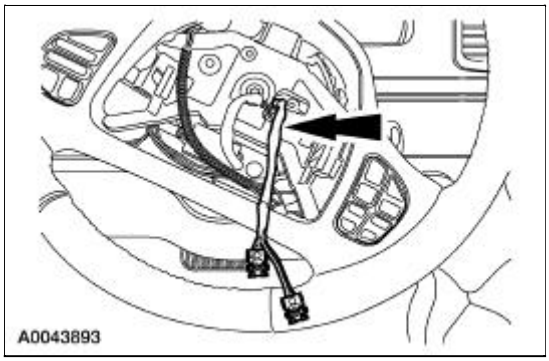
WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

NOTE: A typical driver air bag disposal is shown that is similar for all vehicles.

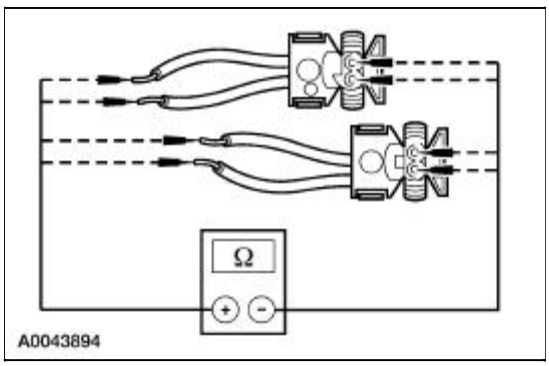
1. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the driver air bag module removal and installation procedure.**

   Remove the driver air bag module from the vehicle. For additional information, refer to Driver Air Bag Module in this section.

2. Cut the clockspring wire harness. Remove the sheathing over the wires.

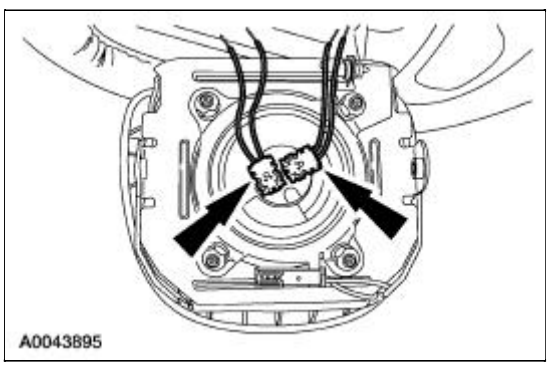


3. Strip the insulation from all four wires. Carry out an ohms check from the stripped end of each wire to the connector end. If any of the four wires reads more than 0.5 ohm use another connector.

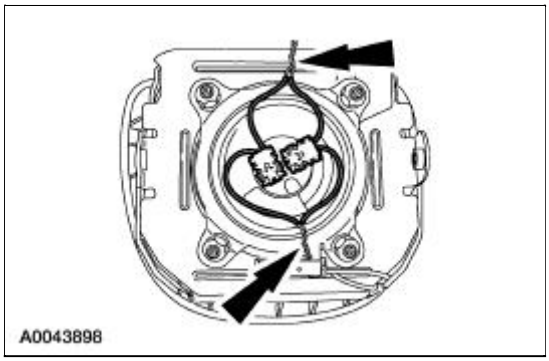


4. **CAUTION: The clockspring electrical connectors are unique and cannot be reversed when connected to the driver air bag module. Match the electrical connector key to the keyway in the driver air bag module. Do not force the electrical connectors into the driver air bag module.**

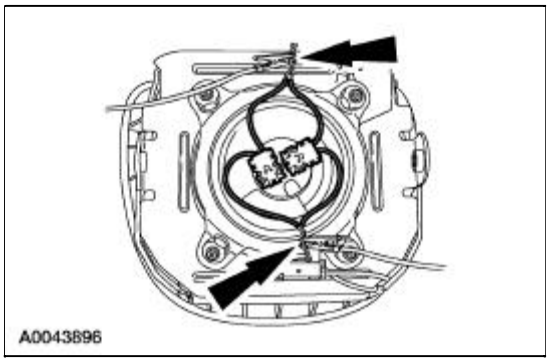
   Match the driver air bag module electrical connector key to the keyway in the driver air bag module. Connect the two driver air bag module electrical connectors to the driver air bag module.



5. Twist together one wire from each pair.



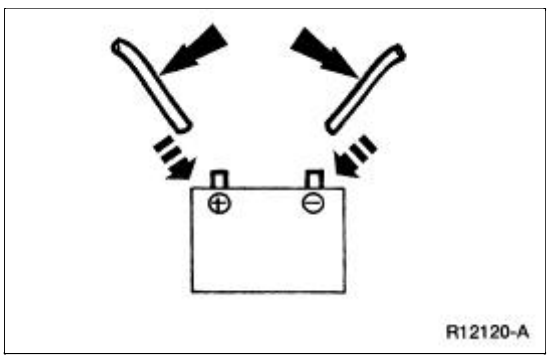
6. Obtain two wires (20 gauge minimum) at least 6.1 meters (20 feet) long and attach one end of each wire to each twisted splice.



7. Place the air bag module on a flat surface in an open outdoor area with the trim cover and air bag facing up.

8. Remain at least 6.1 meters (20 feet) away from the air bag module.

9. Deploy the air bag module by touching the other ends of the two wires to the terminals of a 12-volt battery.



10. To allow for cooling, wait at least ten minutes before approaching the deployed air bag.

11. Dispose of the deployed air bag module in the same manner as any other part to be scrapped.

Air Bag Disposal —Passenger, Undeployed, Scrapped Vehicle

Remote Deployment

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module or safety belt retractor/pretensioner assembly. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

WARNING: Carry a live air bag module with the air bag and trim cover or deployment door pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Remote deployment is to be carried out outdoors with all personnel at least 6.1 meters (20 feet) away to ensure personal safety. Due to the loud report which occurs when the air bag is deployed, hearing protection is required.

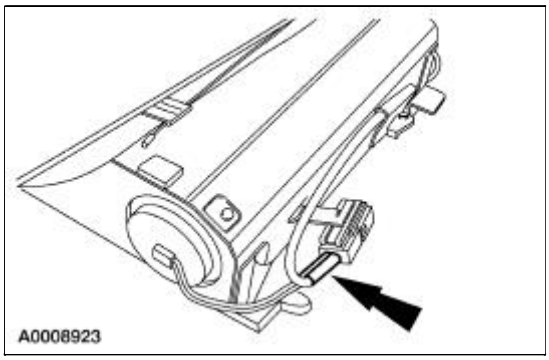
WARNING: Do not place the driver or passenger air bag module with the trim cover or deployment door facing down, as the forces of the deploying air bag could cause it to ricochet and cause personal injury.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

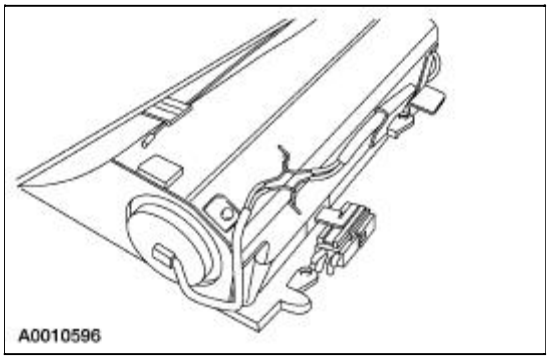
NOTE: A typical passenger air bag disposal is shown that is similar for all vehicles.

1. Remove the passenger air bag from the vehicle. For additional information, refer to Passenger Air Bag Module in this section.

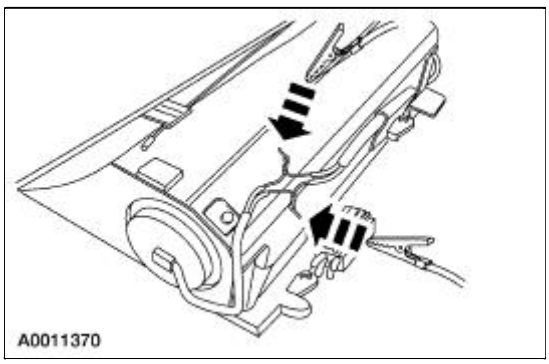
2. Cut and strip all four wires at the air bag electrical connector.



3. Twist together one wire from each pair.



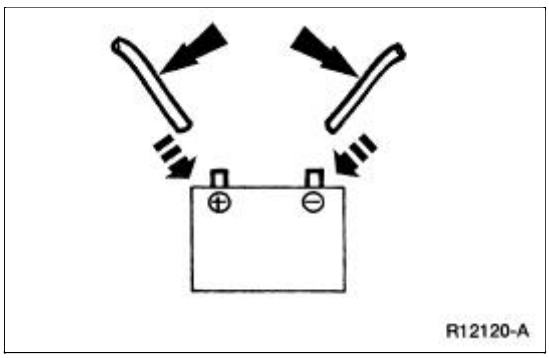
4. Obtain two wires (20 gauge minimum) at least 6.1 meters (20 feet) long and attach one end of each wire to each twisted splice.



5. Place the air bag module on a flat surface in an open outdoor area with the trim cover facing upward.

6. Remain at least 6.1 meters (20 feet) away from the air bag module.

7. Deploy the air bag module by touching the other ends of the two wires to the terminals of a 12-volt battery.



8. To allow for cooling, wait at least ten minutes before approaching the deployed air bag.

9. Dispose of the deployed air bag module in the same manner as any other part to be scrapped.

Air Bag Disposal —Safety Canopy, Undeployed, Scrapped Vehicle

Remote Deployment

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Remote deployment is to be performed outdoors with all personnel at least 6.1 meters (20 feet) away to ensure personal safety. Due to the loud report which occurs when the air bag is deployed, hearing protection is required.

NOTE: A typical safety canopy disposal is shown that is similar for all vehicles.

NOTE: The safety canopy module deployment for a scrapped vehicle will occur in its installed position in the vehicle.

NOTE: The left hand side is shown, the right hand side is similar.

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

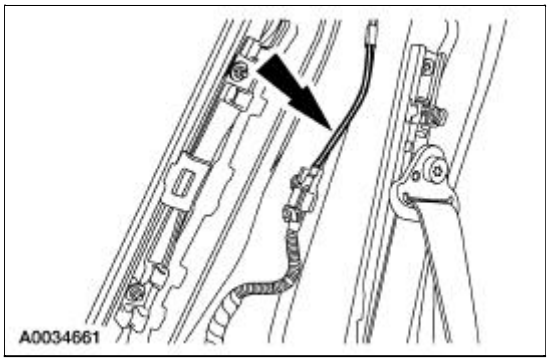
   The second row side impact sensors (if equipped) are located at or near the base of the C-pillars.

   To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

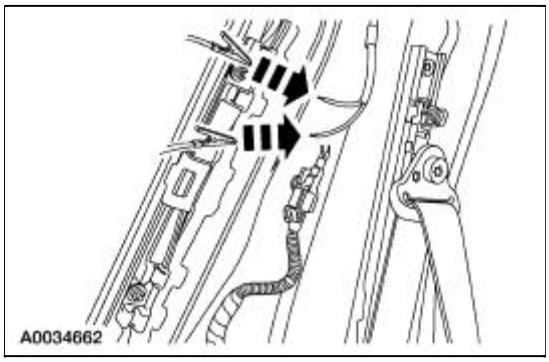
   Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

2. Remove the C-pillar trim panel from the same side as the safety canopy to be disposed. For additional information, refer to Section 501-05 .

3. Cut and strip the wires near the electrical connector.

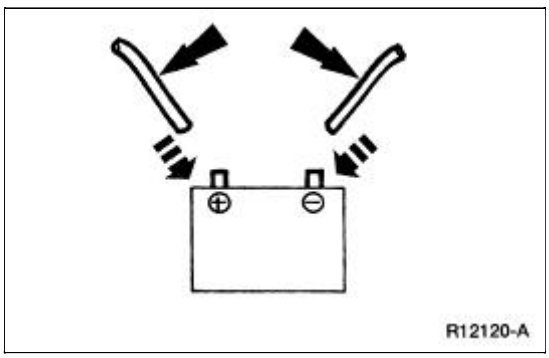


4. Obtain two wires (20 gauge minimum) at least 9.1 meters (30 feet) long and attach one end of each wire to the stripped wires on the safety canopy module.



5. Remain at least 6.1 meters (20 feet) away from the vehicle.

6. Deploy the safety canopy module by touching the other ends of the two wires to the terminals of a 12-volt battery.



7. To allow for cooling, wait at least ten minutes before approaching the deployed safety canopy module.

8. Dispose of the deployed safety canopy module in the same manner as any other part to be scrapped.

Safety Belt Pretensioner Disposal —Deployed

1. **WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury.**

   Dispose of the deployed safety belt pretensioner in the same manner as any other part to be scrapped.

Safety Belt Pretensioner Disposal —Undeployed, Inoperative

WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

WARNING: Carry a live safety belt retractor pretensioner or safety belt buckle pretensioner so as to keep fingers and clothing away from moveable parts. This will reduce the risk of injury in the event of an accidental deployment.

NOTE: All inoperative safety belt buckle pretensioners and safety belt retractor pretensioners have been placed on the Mandatory Return List. All damaged safety belt buckle pretensioners and safety belt retractor pretensioners must be treated the same as any inoperative live safety belt buckle pretensioner or safety belt retractor pretensioner being returned.

1. Remove the inoperative safety belt buckle pretensioner or safety belt retractor pretensioner from the vehicle. For additional information, refer to Section 501-20A .

2. Package and return the inoperative safety belt buckle pretensioner or safety belt retractor pretensioner to Ford Motor Company.

Safety Belt Pretensioner Disposal —Undeployed, Scrapped Vehicle

Remote Deployment

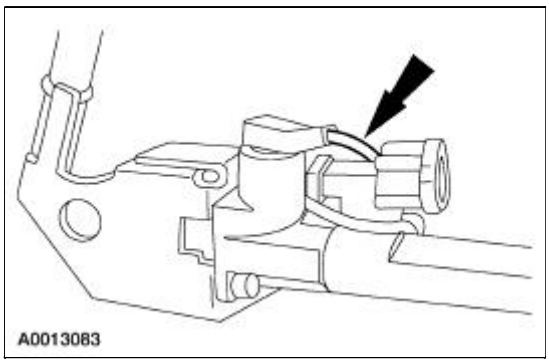
WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

WARNING: Remote deployment is to be performed outdoors with all personnel at least 6.1 meters (20 feet) away to ensure personal safety. Due to the loud report which occurs when the safety belt pretensioner is deployed, hearing protection is required.

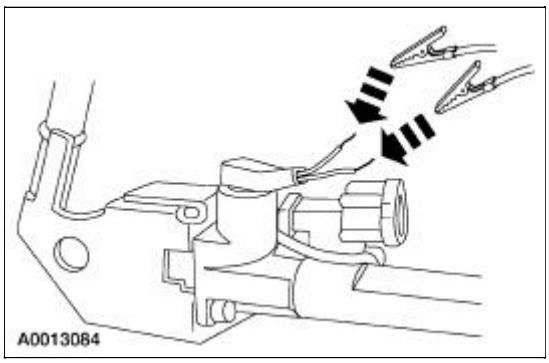
WARNING: Do not position the safety belt buckle pretensioner or safety belt retractor pretensioner so that moveable parts contact the support surface, as the forces of the deploying pretensioner can cause it to ricochet and cause personal injury.

1. Remove the safety belt buckle pretensioner assembly from the vehicle. For additional information, refer to Section 501-20A .

2. Cut and strip the wires near the electrical connector.



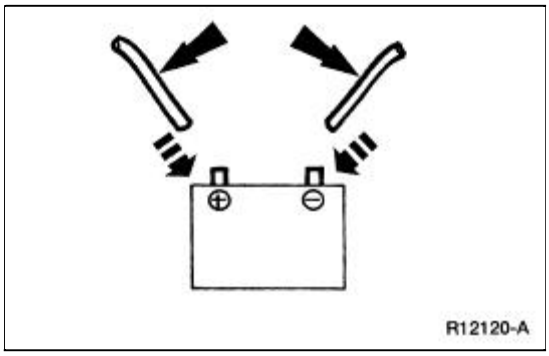
3. Obtain two wires (20 gauge minimum) at least 6.1 meters (20 feet) long and attach one end of each wire to the safety belt buckle pretensioner wires.



4. Position the safety belt buckle pretensioner assembly on a flat surface in an open outdoor area so that moveable parts do not contact the support surface.

5. Remain at least 6.1 meters (20 feet) away from the safety belt buckle pretensioner assembly.

6. Deploy the safety belt buckle pretensioner by touching the other ends of the two wires to the terminals of a 12–volt battery.



7. To allow for cooling, wait at least ten minutes before approaching the deployed safety belt buckle pretensioner.

8. Dispose of the deployed safety belt buckle pretensioner in the same manner as any other part to be scrapped.

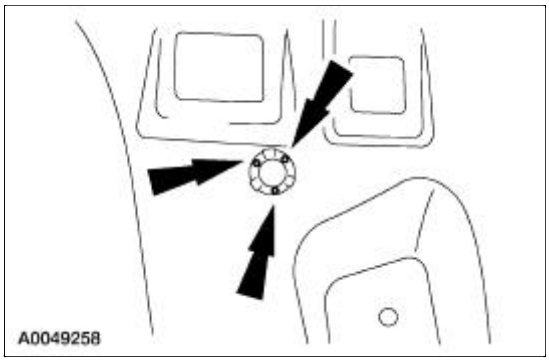
Weld Nut Repair —Missing Weld Nut

CAUTION: Installing a J-nut in place of a weld nut is not a recommended repair.

NOTE: C-pillar repair shown, others similar.

1. Remove the component from where the weld nut is to be repaired. Refer to the appropriate removal and installation procedure in this section.

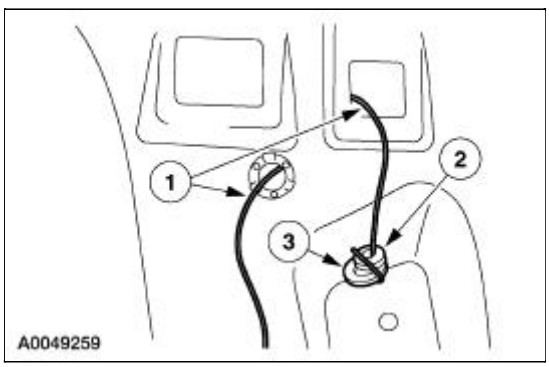
2. Drill three equally spaced 5/64 in (1.75 mm) holes in close proximity to where the weld nut face will be plug welded back to the sheet metal.



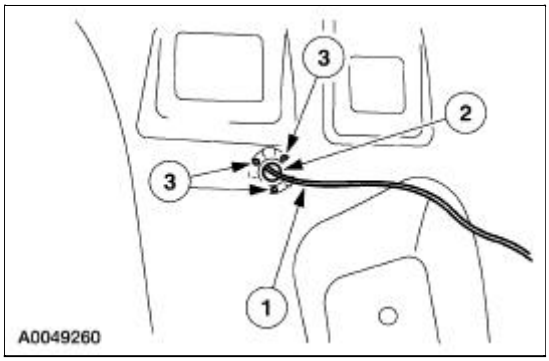
3. Obtain the appropriate 6 mm (0.24 in) or 8 mm (0.32 in) weld nut.

4. Obtain the appropriate 6 mm (0.24 in) by 1.0 or 8 mm (0.32 in) by 1.25 grounding screw (self-tapping).

5. Set up for the positioning of the weld nut.
    1. Route a sufficient length of wire through the weld nut clearance hole and back out an adjacent access hole.
    2. Position a weld nut, shoulder end up, onto the wire.
    3. Position a flat washer onto the wire and secure it so it cannot be pulled off.



6. Plug weld the weld nut into position.
    1. Pull the welding wire back through the clearance hole, allowing the weld nut and flat washer to follow the welding wire through and stop against the sheet metal.
    2. Make sure the weld nut shoulder is aligned through the clearance hole in the sheet metal.
    3. With the weld nut firmly held in position, plug weld the weld nut at the three holes drilled previously.



7. Metal finish as required.
8. Verify the nut is securely in place.
9. Install the component with the previously obtained screw.
10. Tighten the attaching screws to specification. For additional information, refer to Specifications in this section.

Weld Nut Repair —Stripped Weld Nut

1. Remove the component from where the weld nut is to be repaired. Refer to the appropriate removal and installation procedure in this section.

2. Inspect the weld nut and surrounding area for repair.
   - If there is not enough clearance for a larger bolt stud to go through or a larger bolt head to turn, then a threaded insert will have to be installed. Follow the instructions with the thread insert repair kit.

3. If a 6 mm weld nut is stripped, drill out the hole using a letter "H" or 0.26 in (6.5 mm) drill bit. Then tap, using an 8 mm by 1.25 bit.
   - Do not oversize a 6 mm weld nut by more than 8 mm.

4. If an 8 mm weld nut is stripped, drill the hole using a letter "R" or 0.3990 in (9.75 mm) drill bit. Then tap, using a 10 mm by 1.50 bit.
   - Do not oversize an 8 mm weld nut by more than 10 mm.

5. Obtain the appropriate oversized screw.

6. Install the attaching screw(s) to the component.

7. Tighten the attaching screws to specification. For additional information, refer to Specifications in this section.

Rivet Nut Replacement

CAUTION: If the safety canopy module has deployed, the tether cord rivet nut must be inspected and replaced if damaged before installing a new safety canopy.

NOTE: A typical rivet nut replacement is shown that is similar for all vehicles.

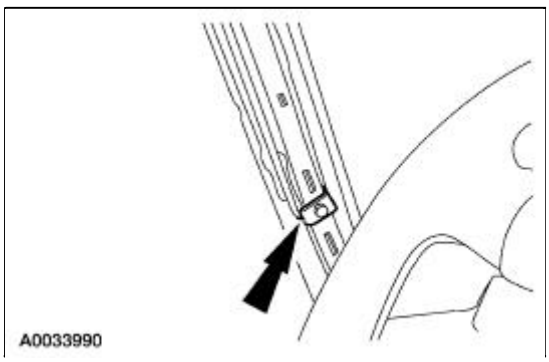
NOTE: The left-hand drive driver side is shown, all others are similar.

1. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in the General Procedures portion of this section.

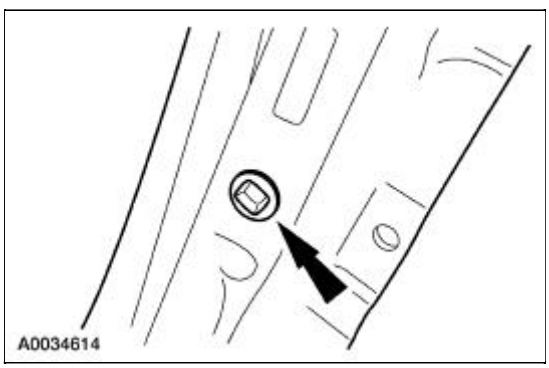
2. Remove the A-pillar trim panel. For additional information, refer to Section 501-05 .

3. Remove the bolt and bracket for the tether cord from the A-pillar.



4. Position and secure the side air curtain tether cord and bracket assembly out of the way.

5. Using the appropriate service tool, sand the rivet nut shoulder until the shoulder surface is removed.



6. Punch the remaining portion of the rivet nut through the rivet nut hole.

7. **NOTE:** Use only Ford Motor Company factory-authorized replacement parts for rivet nut repair procedure.

   Obtain the correct square shank rivet nut for the vehicle application from the Ford Master Parts Catalog, and insert it into the rivet nut hole.

8. Using a suitable rivet nut installing tool, install the rivet nut. For additional information, refer to the tool manufacturer's operating instructions.

9. Position the A-pillar tether cord. Install the bolt. See the appropriate component removal and installation procedure or Specifications for the correct torque specification.

10. **NOTE:** The tether cord must be positioned correctly in place before installing the A-pillar trim panel.

    Install the A-pillar trim panel. For additional information, refer to Section 501-05 .

11. **WARNING: To reduce the risk of serious injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

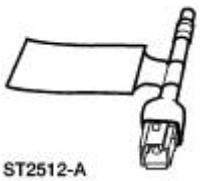
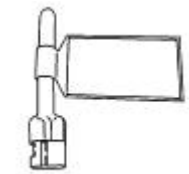
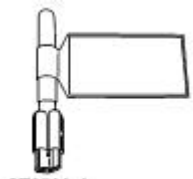
    Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in the General Procedure portion of this section.

12. **WARNING: The restraint system diagnostic tools are for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

    With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section.

Side Impact Sensor —Front Row

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (2 req'd) 418-F395 (014-R1079)
 ST2512-A	Diagnostic Tool, Restraint System (1 req'd) 418-F403
 ST2507-A	Diagnostic Tool, Restraint System (2 req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 req'd) 418-F088 (105-R0012)

Removal

WARNING: Vehicle sensor orientation is critical for correct system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and correctly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

NOTE: The driver side is shown, the passenger side is similar.

NOTE: Repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

The second row side impact sensors (if equipped) are located at or near the base of the C-pillars.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

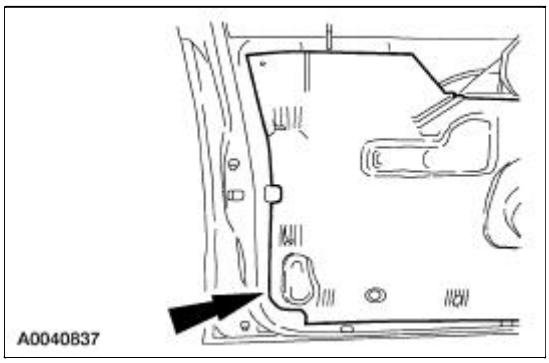
Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

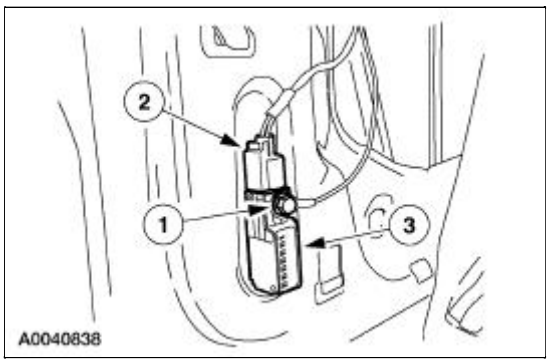
   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in the General Procedures portion of this section.

3. Remove the front interior door trim panel on the side with the affected side impact sensor. For additional information, refer to Section 501-05 .

4. Separate the weathershield enough to access the side impact sensor.



5. Remove the side impact sensor.
   1. Remove the bolt.
   2. Disconnect the electrical connector.
   3. Remove the side impact sensor.



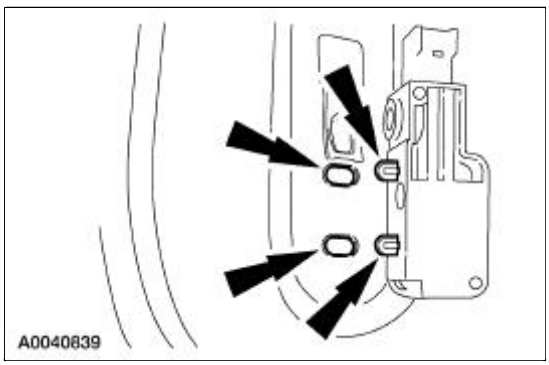
Installation

WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions and notes at the beginning of the removal procedure.

1. **CAUTION: Always replace the J-clip retaining nut whenever installing a side impact sensor.**

   NOTE: Make sure the battery negative cable is still disconnected before continuing with the installation portion of this procedure.

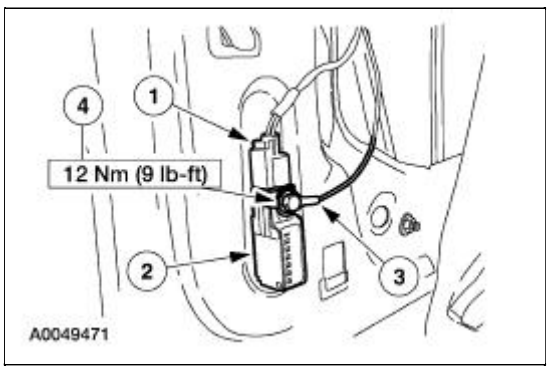
   Align the locator tabs to the openings in the door.



2. **CAUTION: The ground wire must be placed between the bolt head and the sensor. Never position the ground wire between the J-clip retaining nut and the sensor.**

   CAUTION: Always replace the J-clip retaining nut whenever installing a side impact sensor.

   Install the side impact sensor.
   1. Connect the electrical connector.
   2. With the locator tabs aligned to the openings in the door, position the side impact sensor to the door.
   3. Position the ground wire between the bolt head and the sensor.
   4. Install the bolt.



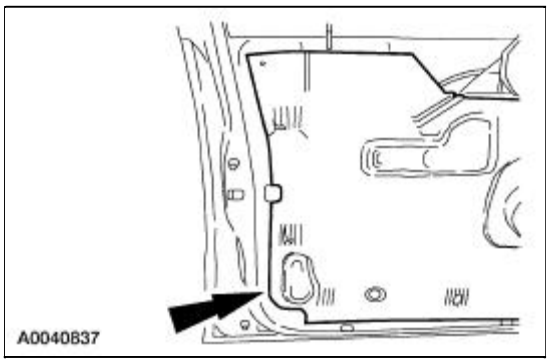
3. Connect the battery ground cable. For additional information, refer to Section 414-01 .

4. With the restraint system diagnostic tools installed at all deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section.

5. Disconnect the battery ground cable and wait at least one minute. For additional information,

refer to Section 414-01 .

6. Position back the weathershield.



7. Install the front interior door trim panel on the side with the affected side impact sensor. For additional information, refer to Section 501-05 .

8. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in the General Procedures portion of this section.

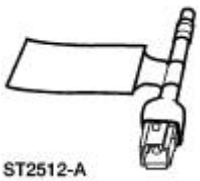
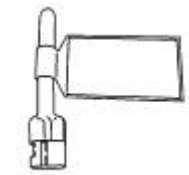
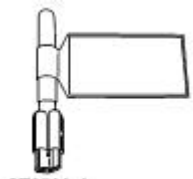
9. Connect the battery ground cable. For additional information, refer to Section 414-01 .

10. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

    With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section.

Side Impact Sensor —Second Row

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (2 req'd) 418-F395 (014-R1079)
 ST2512-A	Diagnostic Tool, Restraint System (1 req'd) 418-F403
 ST2507-A	Diagnostic Tool, Restraint System (2 req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 req'd) 418-F088 (105-R0012)

Removal

WARNING: Vehicle sensor orientation is critical for correct system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and correctly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

NOTE: The driver side is shown, the passenger side is similar.

NOTE: Repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

The second row side impact sensors (if equipped) are located at or near the base of the C-pillars.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

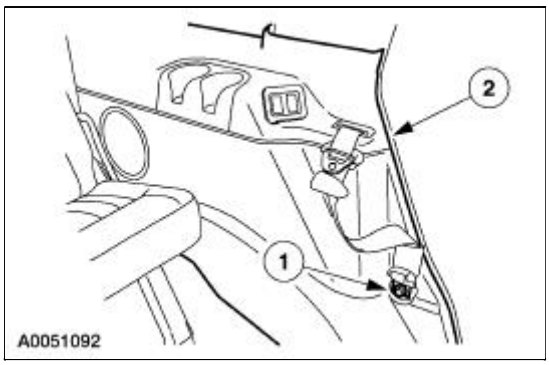
Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

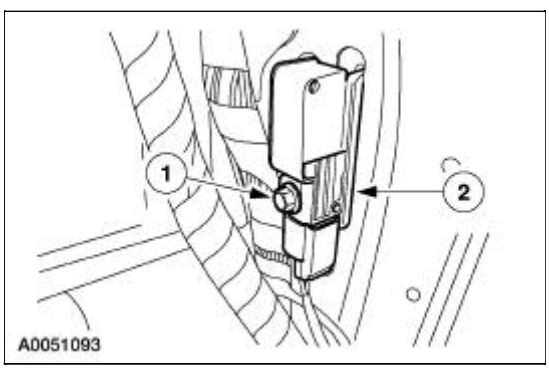
   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation , in the General Procedures portion of this section.

3. Remove the rear door scuff plate.

4. Separate the rear quarter trim panel.
   1. Remove the safety belt anchor.
   2. Pull out at the front of the rear quarter trim panel, releasing the retaining clips, allowing access to the side impact sensor.



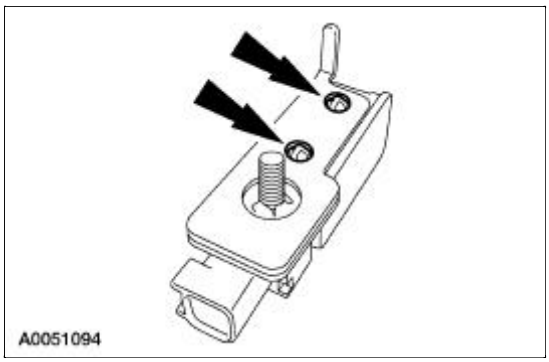
5. Remove the side impact sensor.
   1. Remove the bolt.
   2. Disconnect and remove the side impact sensor.



Installation

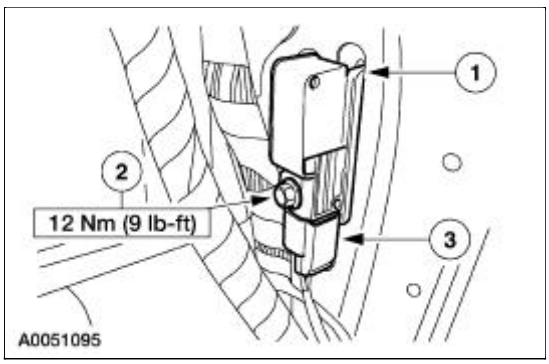
WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions and notes at the beginning of the removal procedure.

1. Make sure the second row side impact sensor tabs are aligned to the bracket.



2. **NOTE:** Make sure the battery negative cable is still disconnected before proceeding with the installation procedure.

   Install the second row side impact sensor with bracket.
   1. Align and insert the second row side impact sensor bracket locator pin to the opening in the quarter panel sheet metal.
   2. Install the bolt.
   3. Connect the electrical connector.



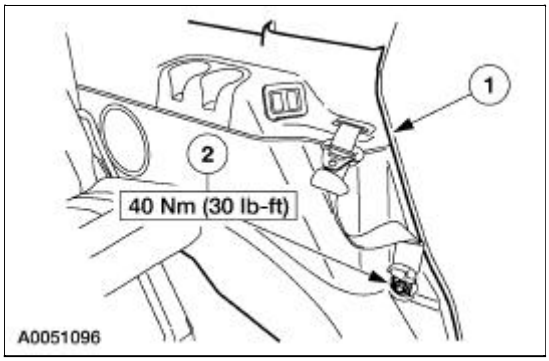
3. Connect the battery ground cable. For additional information, refer to Section 414-01 .

4. With the restraint system diagnostic tools installed at all deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) , in the Diagnosis and Testing portion of this section.

5. Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

6. **NOTE:** Make sure the safety belt webbing is not twisted prior to installation.

   Install the rear quarter trim panel.
   1. Align the rear quarter trim panel and push in, seating the retaining clips.
   2. Install the safety belt anchor.



7. Install the rear door scuff plate.

8. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation , in the General Procedures portion of this section.

9. Connect the battery ground cable. For additional information, refer to Section 414-01 .

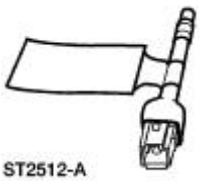
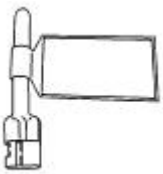
10. **WARNING: Restraint system diagnostic tools are for service only. Tools must be removed prior to operating the vehicle over the road. Failure to remove restraint system diagnostic tools could result in injury and possible violation of vehicle safety standards.**

    With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) , in the Diagnosis and Testing portion of this section.

11. Check the active restraint system for correct operation. For additional information, refer to Section 501-20A .

Front Impact Severity Sensor

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (2 req'd) 418-F395 (014-R1079)
 ST2512-A	Diagnostic Tool, Restraint System (1 req'd) 418-F403
 ST2507-A	Diagnostic Tool, Restraint System (2 req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 req'd) 418-F088 (105-R0012)

Removal

WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

NOTE: Repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

   The first row side impact sensors (if equipped) are located in the first row doors, behind

the door trim panel.

The second row side impact sensors (if equipped) are located at or near the base of the C-pillars.

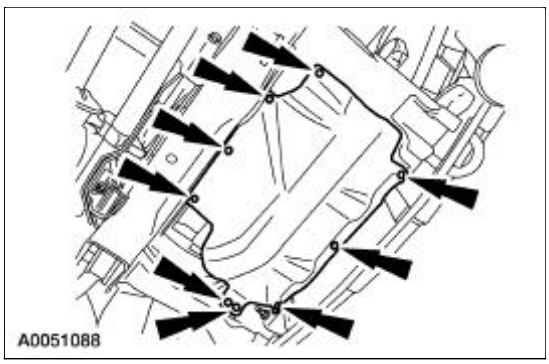
To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

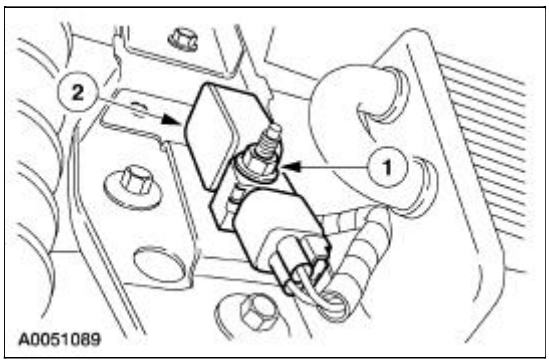
   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation , in the General Procedures portion of this section.

3. Remove the pin-type retainers and the front lower splash shield.



4. **NOTE:** The front impact severity sensor is mounted on the bottom of the hood latch support bracket.

   Remove the front impact severity sensor.
   1. Remove the nut.
   2. Disconnect and remove the front impact severity sensor.



Installation

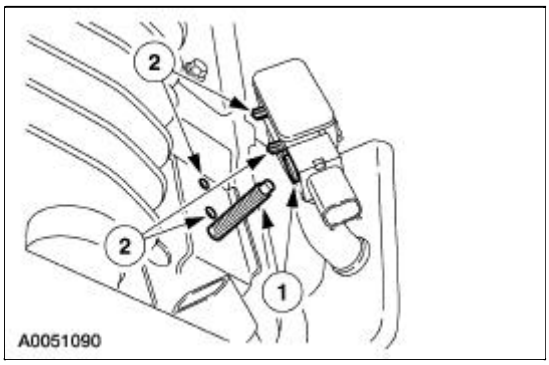
WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions and notes at the beginning of the removal procedure.

1. **CAUTION: If the hood latch support bracket or weld stud are damaged in any way that would affect the way the front impact severity sensor mounts to its original manufactured position, a new hood latch support bracket must be installed.**

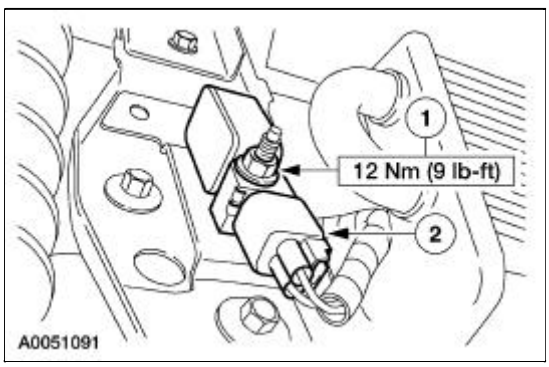
   NOTE: Make sure the battery negative cable is still disconnected before continuing with the installation portion of this procedure.

   NOTE: Make sure the hood latch support bracket and front impact severity sensor mating surfaces are clean and debris free.

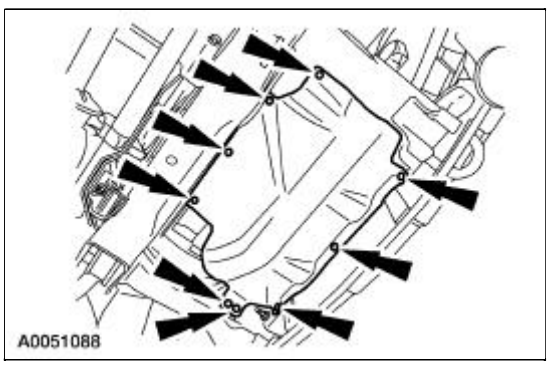
   Position the front impact severity sensor.
   1. Position the front impact severity sensor onto the hood latch support bracket stud.
   2. While sliding the front impact severity sensor onto the stud, align the locator tabs to the hood latch support bracket alignment holes.



2. Install the front impact severity sensor.
   1. With the front impact severity sensor sitting flat up against the hood latch support bracket, install the nut.
   2. Connect the front impact severity sensor.



3. Position the front lower splash shield and install the pin-type retainers.



4. Connect the battery ground cable. For additional information, refer to Section 414-01 .

5. With the restraint system diagnostic tools installed at all deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) , in the Diagnosis and Testing portion of this section.

6. Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

7. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation , in the General Procedures portion of this section.

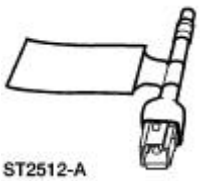
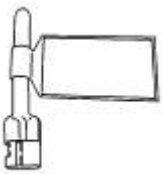
8. Connect the battery ground cable. For additional information, refer to Section 414-01 .

9. **WARNING: Restraint system diagnostic tools are for service only. Tools must be removed prior to operating the vehicle over the road. Failure to remove restraint system diagnostic tools could result in injury and possible violation of vehicle safety standards.**

   With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) , in the Diagnosis and Testing portion of this section.

Restraints Control Module (RCM)

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (2 req'd) 418-F395 (014-R1079)
 ST2512-A	Diagnostic Tool, Restraint System (1 req'd) 418-F403
 ST2507-A	Diagnostic Tool, Restraint System (2 req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 req'd) 418-F088 (105-R0012)

Removal

WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.

WARNING: The restraints control module (RCM) orientation is critical for proper air bag supplemental restraint system (SRS) operation. If a vehicle equipped with an SRS system has been involved in a collision in which the center tunnel area has been damaged, inspect the mounting and bracket for deformation. If damaged, the RCM must be replaced whether or not the air bags have deployed. In addition, make sure the area of the RCM mounting is restored to its original condition.

WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

CAUTION: Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage can result.

NOTE: When installing a new restraints control module (RCM), always make sure the correct RCM is being installed. If an incorrect RCM is installed, erroneous DTCs will result.

NOTE: Repair is made by installing a new part only. If the new part does not correct the condition, install the original part and carry out the diagnostic procedure again.

All vehicles

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

   The second row side impact sensors (if equipped) are located at or near the base of the C-pillars.

   To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

   Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in the General Procedures portion of this section.

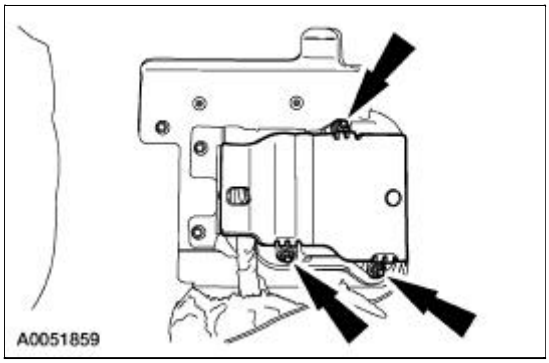
Vehicles with a center console

3. Remove the center console. For additional information, refer to Section 501-12 .

Vehicles with 60/40 front bench seat

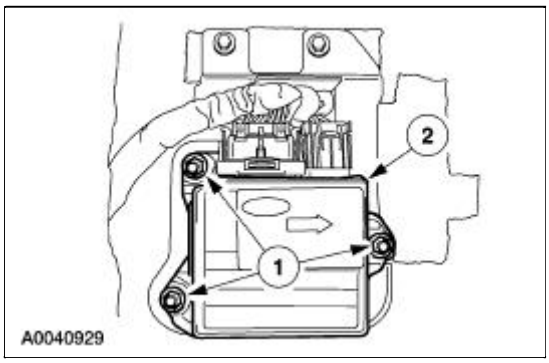
4. Remove the 60 percent portion of the front bench seat. For additional information, refer to Section 501-10 .

5. Remove the nuts and the restraints control module (RCM) top bracket.



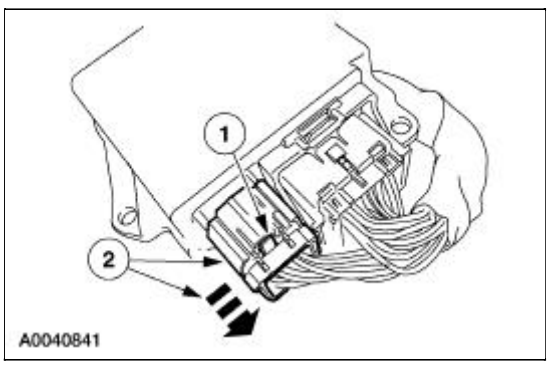
6. **WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.**

   Separate the RCM from the bracket.
   1. Remove the nuts.
   2. Separate the RCM from the bracket.

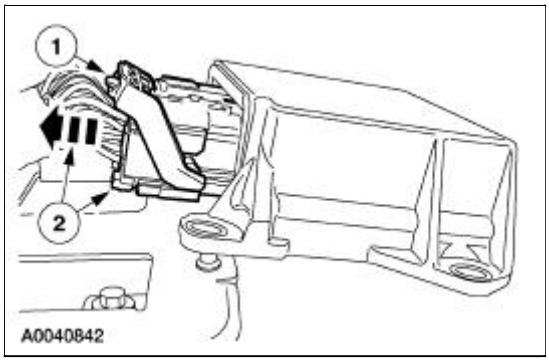


All vehicles

7. Disconnect the small restraints control module (RCM) electrical connector.
   1. Push down to release the retaining tab.
   2. While releasing the retaining tab, pull out and disconnect the small RCM electrical connector.



8. Disconnect the large RCM electrical connector.
   1. Pinch the thumb tab and pivot the connector position assurance lever away from the RCM, disengaging the lever.
   2. Pull out and disconnect the large RCM electrical connector.

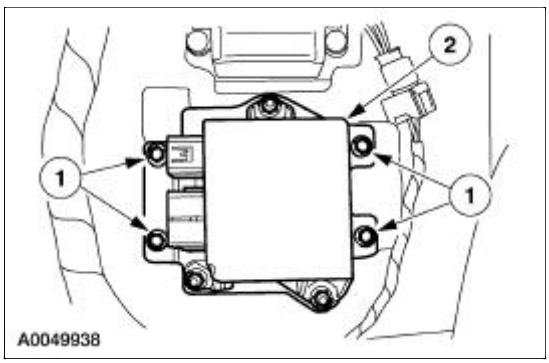


Vehicles with 60/40 front bench seat

9. Remove the RCM.

Vehicles with a center console

10. Remove the RCM.
    1. Remove the RCM bracket bolts.
    2. Remove the RCM with bracket.



Installation

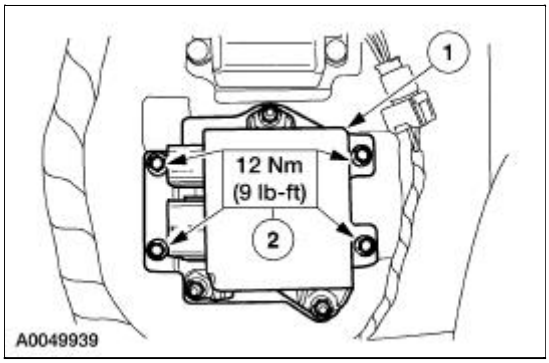
WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions and notes at the beginning of the removal procedure.

Vehicles with a center console

1. **WARNING: The tightening torque of the air bag restraints control module (RCM) bracket retaining bolts is critical for correct system operation.**

   NOTE: Make sure the battery negative cable is still disconnected before continuing with the installation portion of this procedure.

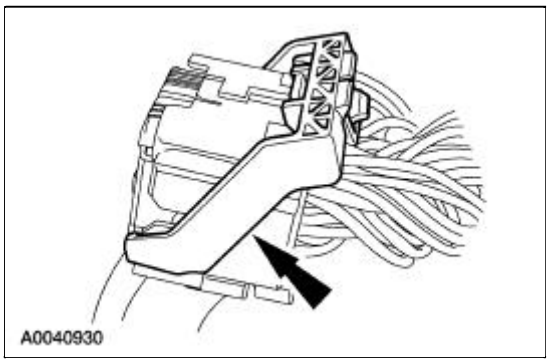
   Install the RCM.
   1. Position the RCM with bracket.
   2. Install the bolts.



All vehicles

2. **NOTE:** Make sure the battery negative cable is still disconnected before continuing with the installation portion of this procedure.

   Make sure the connector position assurance lever is in the full release position before attempting to connect the connector.



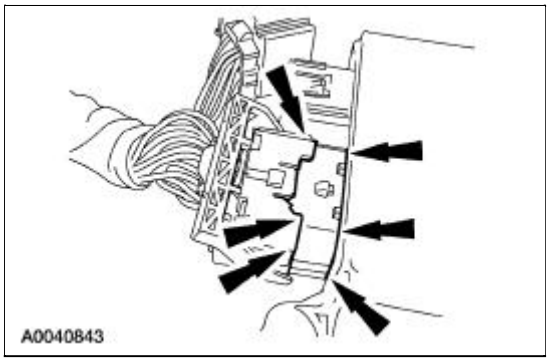
3. **WARNING: Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow these instructions may result in the inadvertent deployment of the safety canopy and risk of personal injury.**

   CAUTION: Putting the large RCM electrical connector into the RCM on an angle can cause bad electrical connections and damage components.

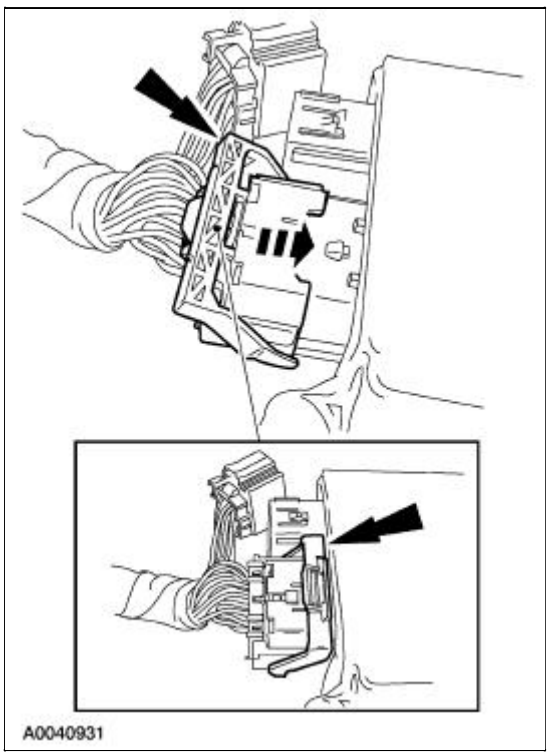
   Position the large RCM electrical connector into the RCM.

   - **CAUTION: Do not push the connector on to where the lever pivots and seats itself. Light pressure is needed to get the connector into position on the RCM before using the lever to fully seat the connector.**

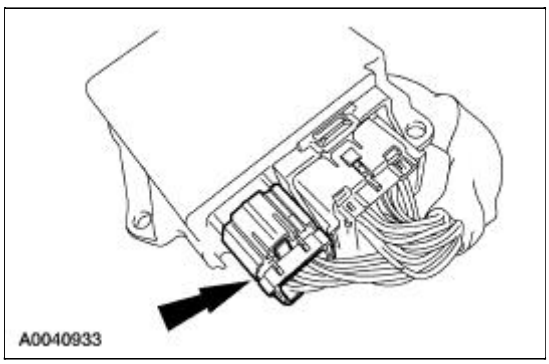
     With the large RCM electrical connector uniformly aligned to the RCM, lightly push in until a subtle audible click is heard and slight resistance is felt.



4. Connect the RCM electrical connector.
    - Pivot the connector position assurance lever toward the RCM, drawing the connector in to the RCM.
        - Make sure the thumb tab is engaged to the retainer on the RCM and locked in place.



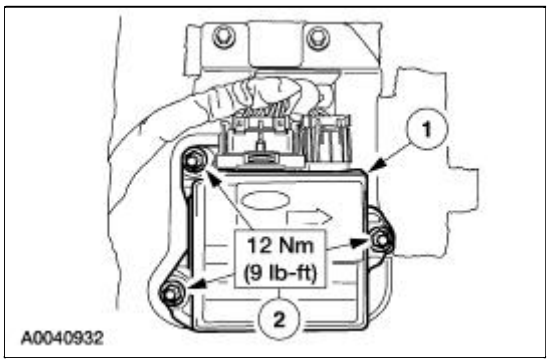
5. Connect the small RCM electrical connector.



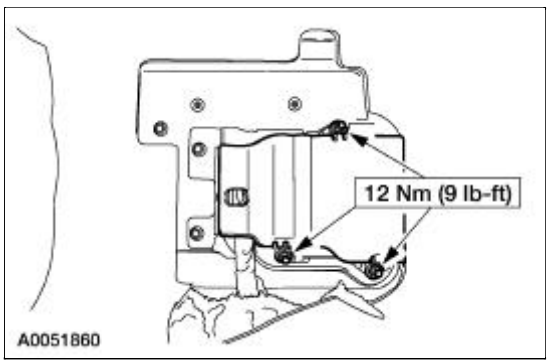
Vehicles with 60/40 front bench seat

6. **WARNING: The tightening torque of the air bag restraints control module (RCM) to bracket retaining nuts is critical for correct system operation.**

   Install the RCM.
   1. Position the RCM to the bracket.
      - While positioning the RCM onto the bracket, make sure the wire harness is positioned between the RCM and the bracket shield.
   2. Install the nuts.



7. Position the RCM top bracket and install the nuts.



All vehicles

8. Connect the battery ground cable. For additional information, refer to Section 414-01 .

9. With the restraint system diagnostic tools installed at all deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) , in the Diagnosis and Testing portion of this section.

10. Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

Vehicles with a center console

11. Install the center console. For additional information, refer to Section 501-12 .

Vehicles with 60/40 front bench seat

12. Install the 60 percent portion of the front bench seat. For additional information, refer to Section 501-10 .

All vehicles

13. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

    Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation , in the General Procedures portion of this section.

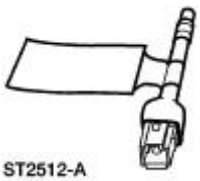
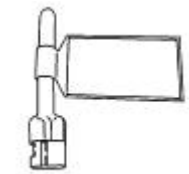
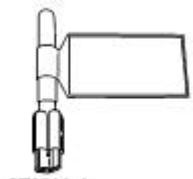
14. Connect the battery ground cable. For additional information, refer to Section 414-01 .

15. **WARNING: Restraint system diagnostic tools are for service only. Tools must be removed prior to operating the vehicle over the road. Failure to remove restraint system diagnostic tools could result in injury and possible violation of vehicle safety standards.**

    With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) , in the Diagnosis and Testing portion of this section.

Driver Air Bag Module

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (2 req'd) 418-F395 (014-R1079)
 ST2512-A	Diagnostic Tool, Restraint System (1 req'd) 418-F403
 ST2507-A	Diagnostic Tool, Restraint System (2 req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 req'd) 418-F088 (105-R0012)

Removal

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Do not set a live air bag module down with the trim cover face down. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

WARNING: The safety belt buckle pretensioner and safety belt retractor pretensioner are pyrotechnic devices. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

WARNING: Never probe the connectors on the safety canopy module. Doing so can result in safety canopy module deployment.

WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

WARNING: Restraint system diagnostic tools are for service only. Tools must be removed prior to operating the vehicle over the road. Failure to remove restraint system diagnostic tools could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side air bag and/or a safety belt pretensioner (if equipped) system is being serviced, **the air bag system must be deactivated.**

NOTE: Restraint system diagnostic tools **MUST** be installed under the seats in the seat side air bag (if equipped) and safety belt pretensioner (if equipped) to floor connectors.

NOTE: Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road.**

NOTE: After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

NOTE: Repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

All vehicles

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

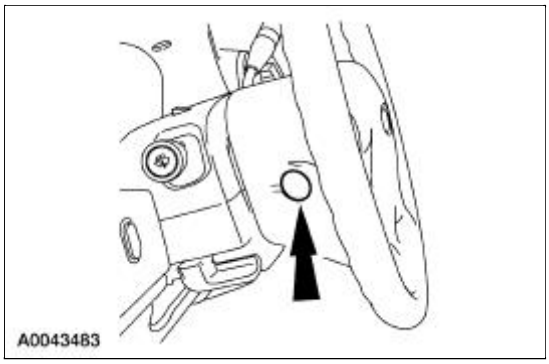
   The second row side impact sensors (if equipped) are located at or near the base of the

C-pillars.

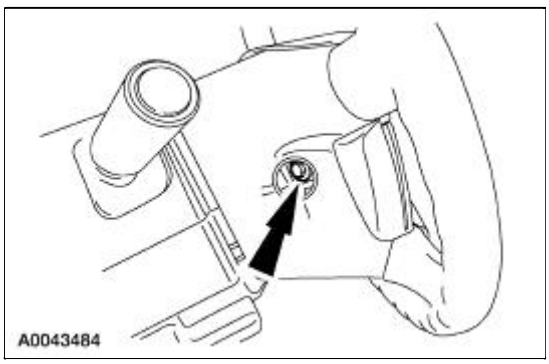
To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

2. Remove the two steering wheel back cover plugs (one shown).

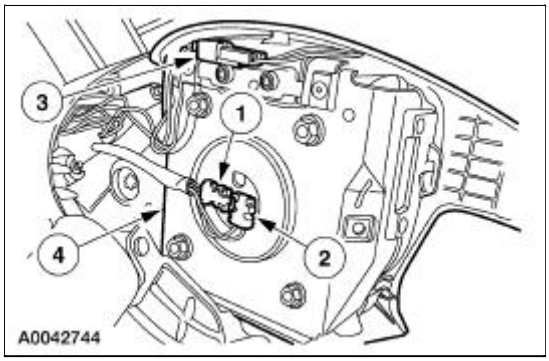


3. Remove the two driver air bag module bolts (one shown).



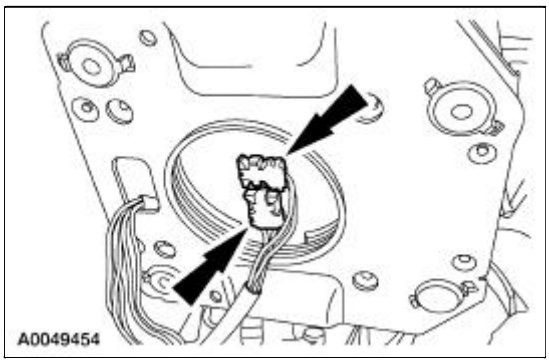
Expedition vehicles

4. Remove the driver air bag module.
    1. Release the two retaining tabs. Disconnect the driver air bag module electrical connector.
        - Label the driver air bag module squib number on the driver air bag module electrical connector before disconnecting.
    2. Release the two retaining tabs. Disconnect the driver air bag module electrical connector.
        - Label the driver air bag module squib number on the driver air bag module electrical connector before disconnecting.
    3. Disconnect the horn switch electrical connector.
    4. Remove the driver air bag module.

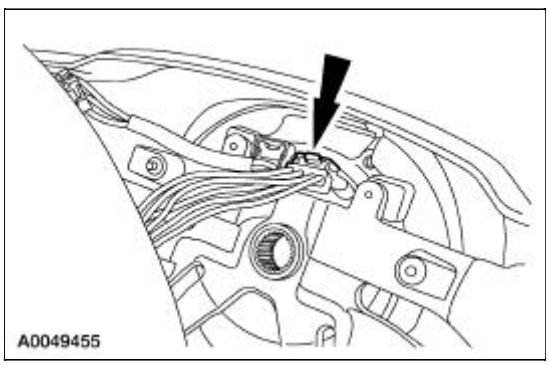


Navigator vehicles

5. Disconnect the driver air bag module
    - Release the two tabs on each driver air bag module electrical connector and disconnect them.
        - Label each driver air bag module electrical connector before disconnecting.

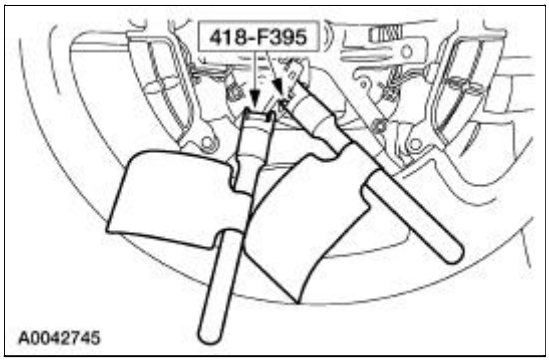


6. Release the tab and disconnect the driver air bag module accessories electrical connector at the top of the clockspring and remove the driver air bag module.

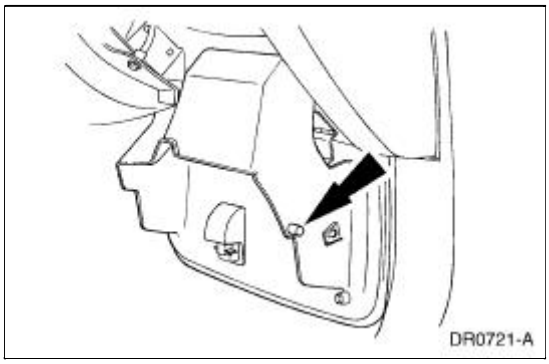


All vehicles

7. Attach the restraint system diagnostic tools to the clockspring electrical connectors at the top of the steering column.

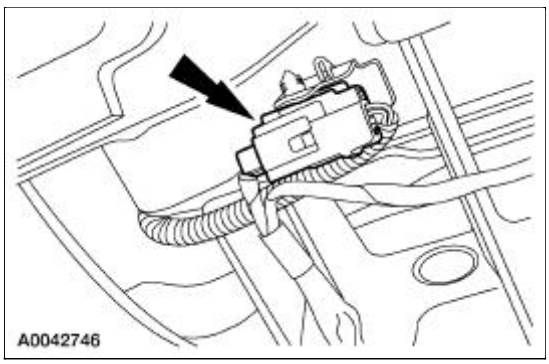


8. While pushing in on the two glove compartment door tabs, position the glove compartment downward.

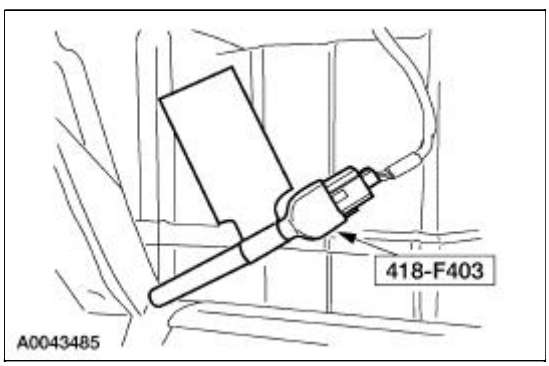


9. **NOTE:** Expedition is shown, Navigator is similar.

   Through the glove compartment opening, release the tab and disconnect the passenger air bag module electrical connector.



10. Attach the restraint system diagnostic tool to the vehicle harness side of the passenger air bag module electrical connector.



Vehicles without safety canopies

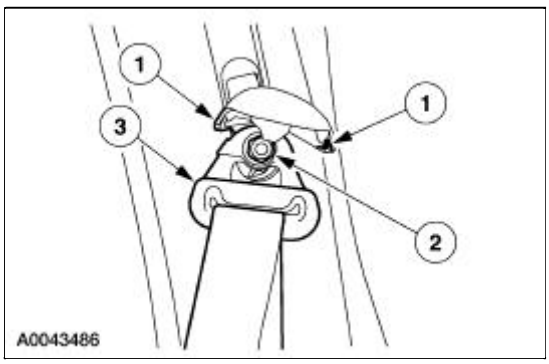
11. **CAUTION: Do not deactivate the safety canopy module circuit by removing the safety canopy bridge resistor from the safety canopy electrical connector.**

    If the safety canopy bridge resistor is removed, an open circuit fault will be generated by the restraints control module (RCM).
    If a restraint system diagnostic tool is installed at the safety canopy electrical connector, a low resistance fault will be generated by the RCM.

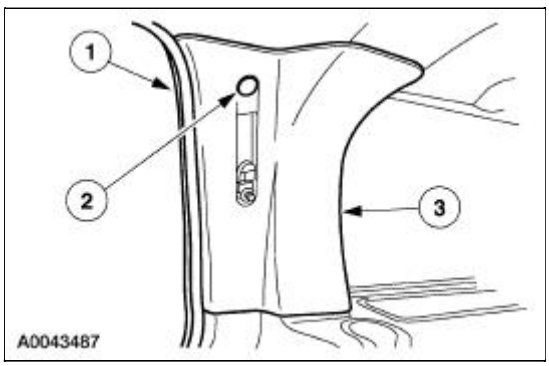
Vehicles with safety canopies

12. **NOTE:** Inspect the shoulder safety belt guide cover for damage. If the shoulder safety belt guide cover is damaged or if it does not remain closed, install a new shoulder safety belt guide cover.

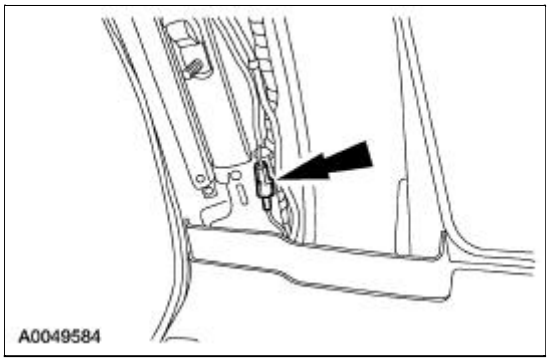
    Remove the second row passenger side safety belt guide.
    1. Release the retaining tab at each side and open the safety belt guide cover.
    2. Remove the nut.
    3. Remove the second row passenger side safety belt guide.



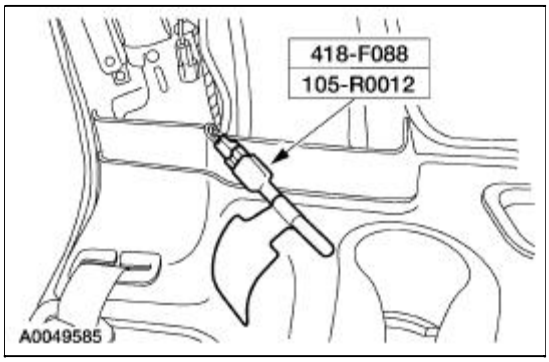
13. Remove the passenger side C-pillar trim panel.
    1. Separate the weather-stripping along the passenger side C-pillar trim panel.
    2. Remove the bolt cover and bolt.
    3. Pull out to release the retainers and remove the passenger side C-pillar trim panel.



14. Disconnect the passenger side safety canopy electrical connector.

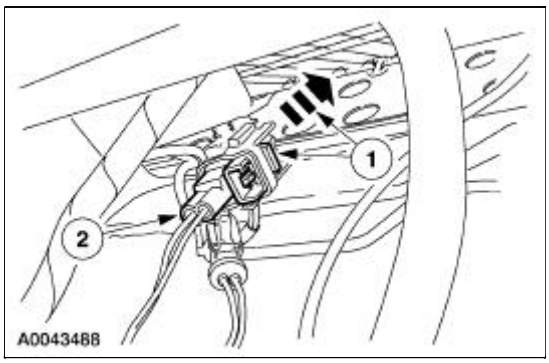


15. Attach the restraint system diagnostic tool to the vehicle harness side of the passenger side safety canopy electrical connector.

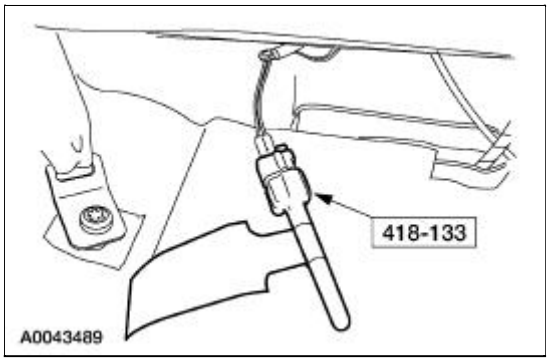


All vehicles

16. Disconnect the passenger seat safety belt buckle pretensioner electrical connector.
    1. Slide and disengage the passenger seat safety belt buckle pretensioner electrical connector locking clip.
    2. Push in to release the tab and disconnect the passenger seat safety belt buckle pretensioner electrical connector.



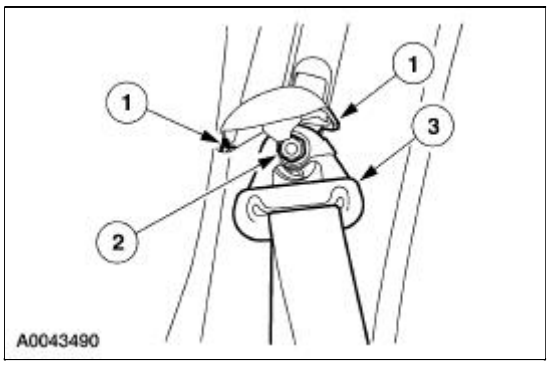
17. Attach the restraint system diagnostic tool to the passenger seat safety belt buckle pretensioner floor electrical connector.



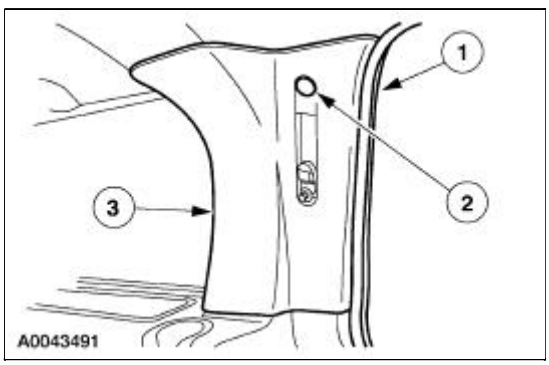
Vehicles with safety canopies

18. **NOTE:** Inspect the shoulder safety belt guide cover for damage. If the shoulder safety belt guide cover is damaged or if it does not remain closed, install a new shoulder safety belt guide cover.

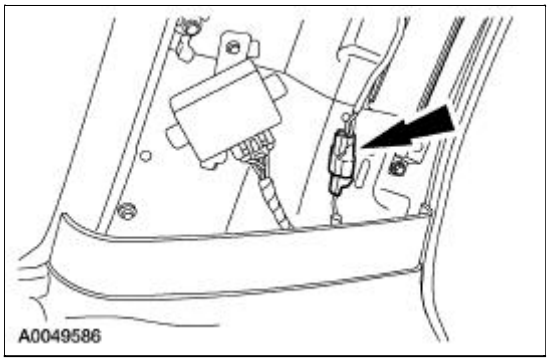
    Remove the second row driver side safety belt guide.
    1. Release the retaining tab at each side and open the safety belt guide cover.
    2. Remove the nut.
    3. Remove the second row driver side safety belt guide.



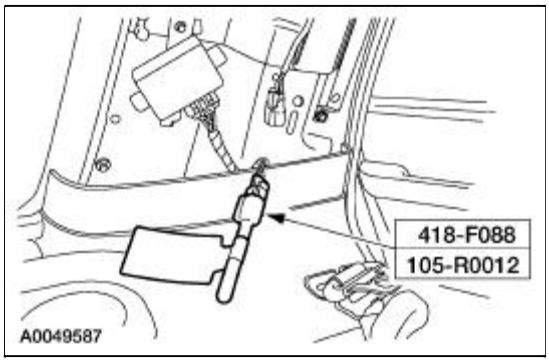
19. Remove the driver side C-pillar trim panel.
    1. Separate the weather-stripping along the driver side C-pillar trim panel.
    2. Remove the bolt cover and bolt.
    3. Pull out to release the retainers and remove the driver side C-pillar trim panel.



20. Disconnect the driver side safety canopy electrical connector.

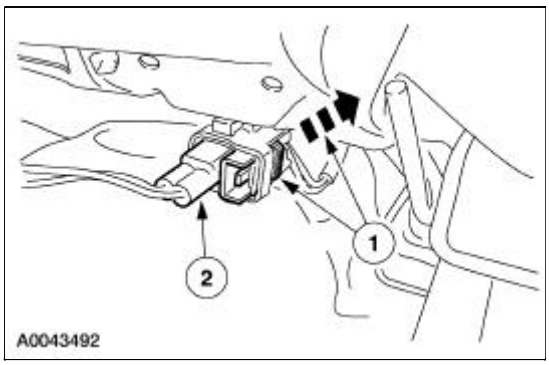


21. Attach the restraint system diagnostic tool to the vehicle harness side of the driver side safety canopy electrical connector.

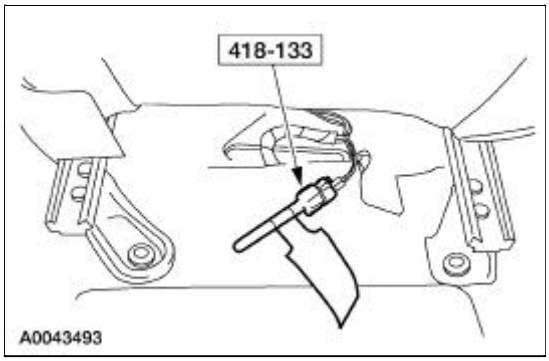


All vehicles

22. Disconnect the driver seat safety belt buckle pretensioner electrical connector.
    1. Slide and disengage the driver seat safety belt buckle pretensioner electrical connector locking clip.
    2. Push in to release the tab and disconnect the driver seat safety belt buckle pretensioner electrical connector.



23. Attach the restraint system diagnostic tool to the driver seat safety belt buckle pretensioner floor electrical connector.



24. Connect the battery ground cable. For additional information, refer to Section 414-01 .

25. With the restraint system diagnostic tools installed at all deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section.

26. Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

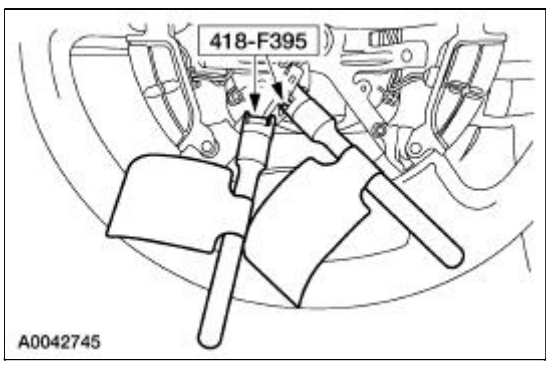
Installation

WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions and notes at the beginning of the removal procedure.

All vehicles

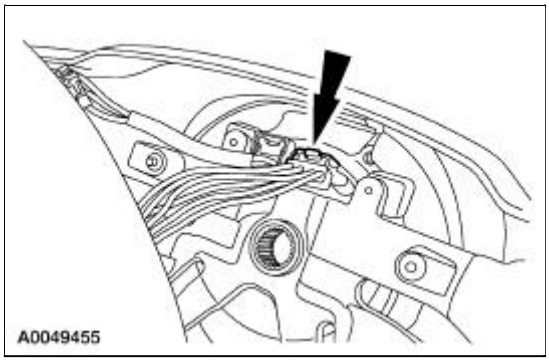
1. **NOTE:** Make sure the battery negative cable is still disconnected before continuing with the installation procedure.

   Remove the restraint system diagnostic tools from the clockspring electrical connector at the top of the steering column.



Navigator vehicles

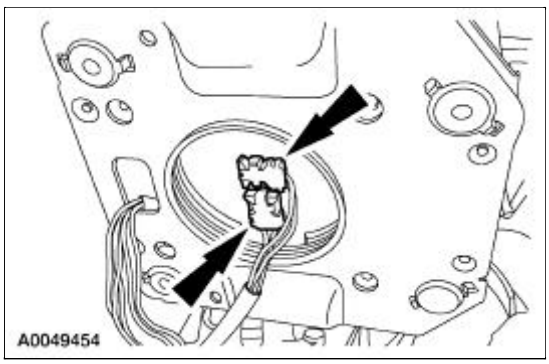
2. Connect the driver air bag module accessories electrical connector to the connector end at the top of the clockspring.



3. **CAUTION: The clockspring electrical connectors are unique and cannot be reversed when connected to the driver air bag module. Match the electrical connector key to the keyway in the driver air bag module. Do not force the electrical connectors into the driver air bag module.**

   Connect the driver air bag module electrical connectors as noted during removal.

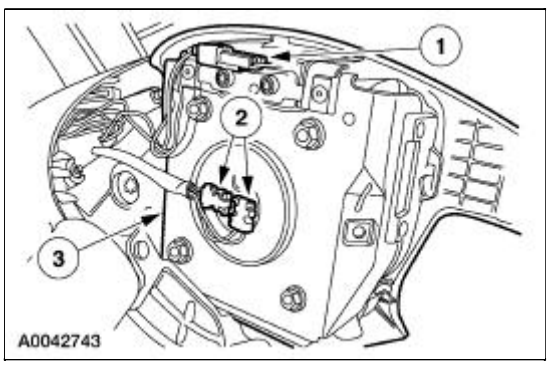
   - Position the driver air bag module to the steering wheel.



Expedition vehicles

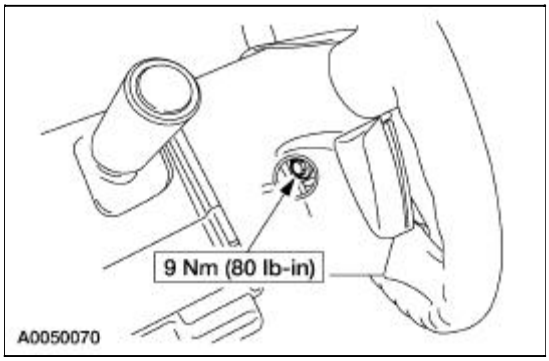
4. Position the driver air bag module to the steering wheel.
   1. Connect the horn switch electrical connector.
   2. **CAUTION: The clockspring electrical connectors are unique and cannot be reversed when connected to the driver air bag module. Match the electrical connector key to the keyway in the driver air bag module. Do not force the electrical connectors into the driver air bag module.**

      Connect the driver air bag module electrical connectors as noted during removal.
   3. Position the driver air bag module to the steering wheel.

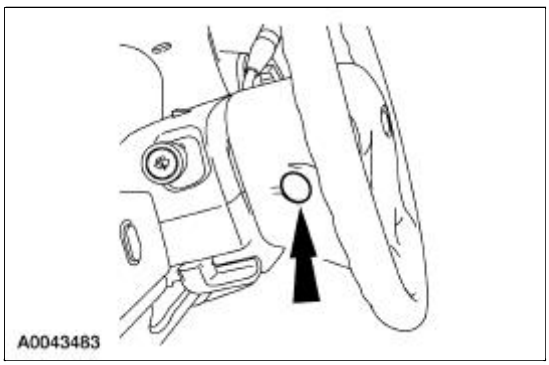


All vehicles

5. Install the two driver air bag module bolts (one shown).



6. Install the two steering wheel back cover plugs (one shown).



7. Connect the battery ground cable. For additional information, refer to Section 414-01 .

8. With the restraint system diagnostic tools still installed at the remaining deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section.

9. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

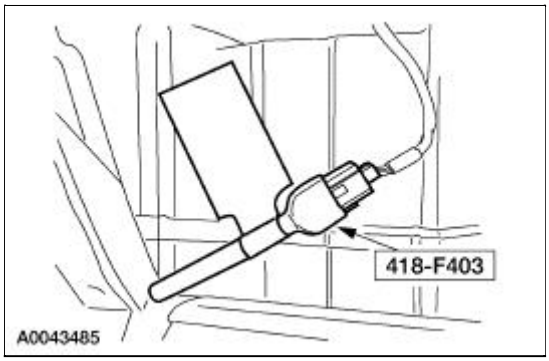
   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

   The second row side impact sensors (if equipped) are located at or near the base of the C-pillars.

   To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

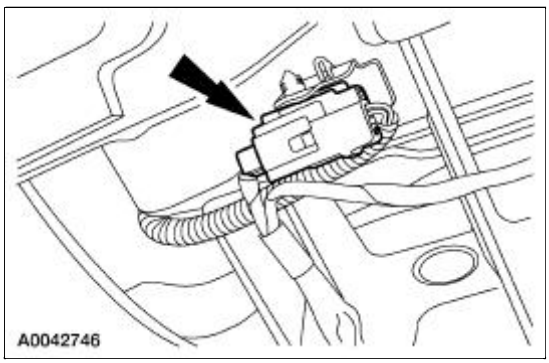
   Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

10. Remove the restraint system diagnostic tool from the vehicle harness side of the passenger air bag module electrical connector.



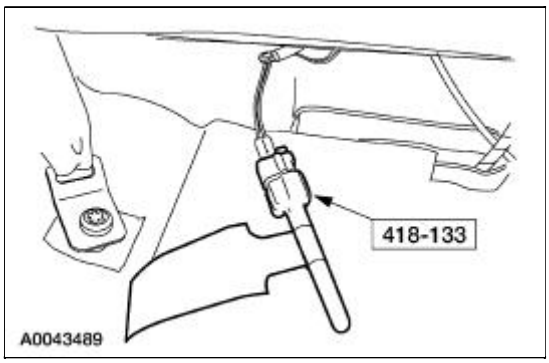
11. **NOTE:** Expedition is shown, Navigator is similar.

    Connect the passenger air bag module electrical connector.

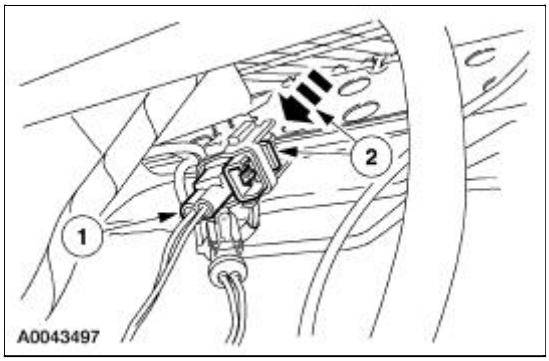


12. Close the glove compartment.

13. Remove the restraint system diagnostic tool from the passenger seat safety belt buckle pretensioner floor electrical connector.

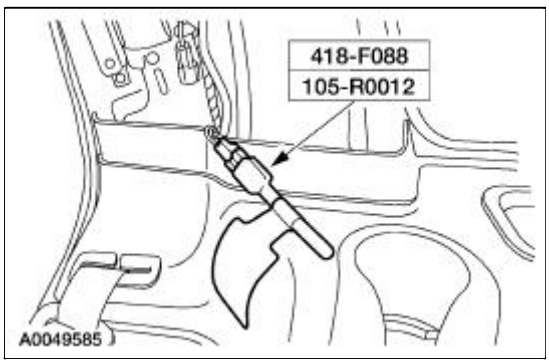


14. Connect the passenger seat safety belt buckle pretensioner electrical connector.
    1. Connect the passenger seat safety belt buckle pretensioner electrical connector.
    2. Slide and engage the passenger seat safety belt buckle pretensioner electrical connector locking clip.

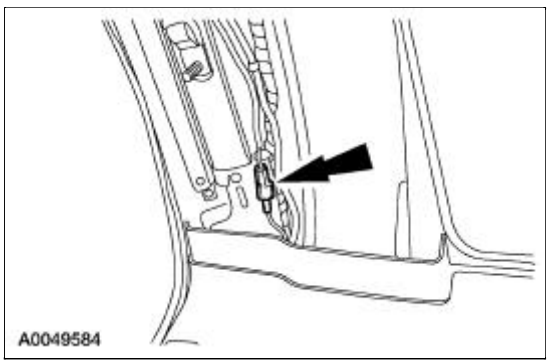


Vehicles with safety canopies

15. Remove the restraint system diagnostic tool from the vehicle harness side of the passenger side safety canopy electrical connector.

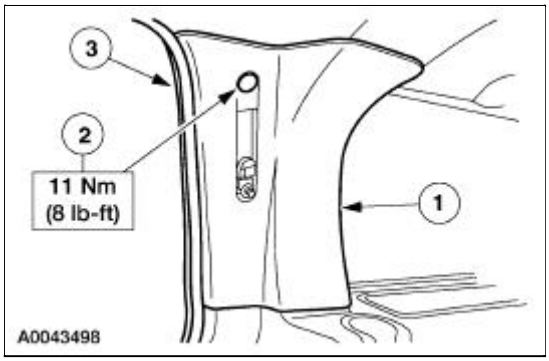


16. Connect the passenger side safety canopy electrical connector.



17. **WARNING: Anytime the safety canopy module has deployed, the headliner, and all A, B, and C pillar upper trim panels and attaching hardware must be replaced along with any other damaged components and hardware. Failure to do so may result in personal injury in the event of a safety canopy module deployment.**

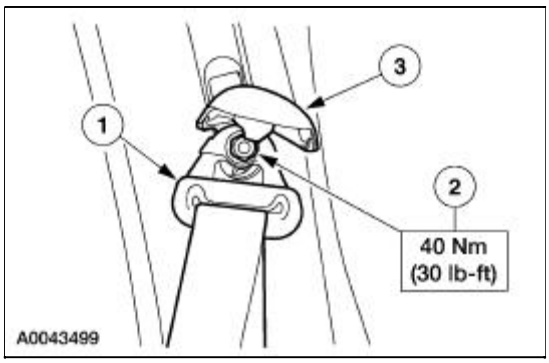
    Install the passenger C-pillar trim panel.
    1. Position the passenger side C-pillar trim panel and push in, engaging the retainers.
    2. Install the bolt and bolt cover.
    3. Install the weather-stripping along the passenger side C-pillar trim panel.



18. **NOTE:** Inspect the shoulder safety belt guide cover for damage. If the shoulder safety belt guide cover is damaged or if it does not remain closed, install a new shoulder safety belt guide cover.

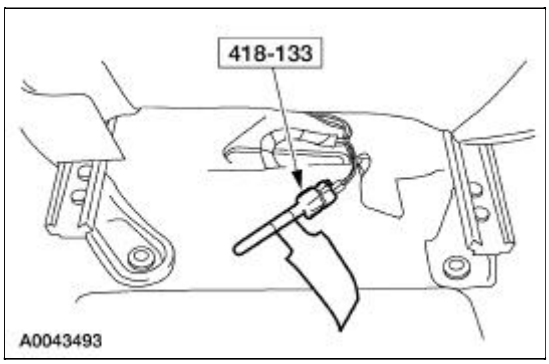
    NOTE: Make sure the safety belt is not twisted prior to installation.

    Install the second row passenger side safety belt guide.
    1. Position the second row passenger side safety belt guide.
    2. Install the nut.
    3. Close the safety belt guide cover.

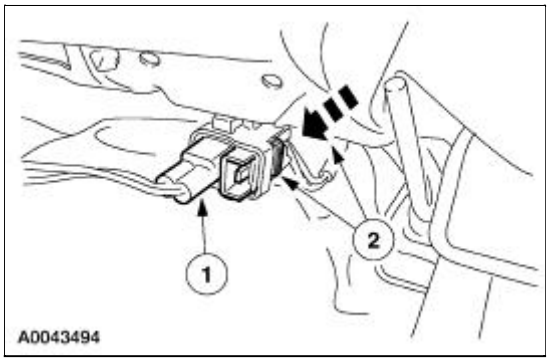


All vehicles

19. Remove the restraint system diagnostic tool from the driver seat safety belt buckle pretensioner floor electrical connector.

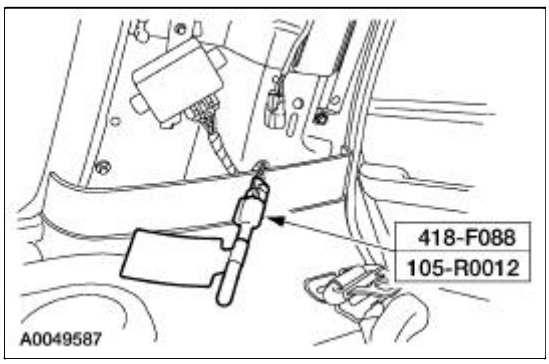


20. Connect the driver seat safety belt buckle pretensioner electrical connector.
    1. Connect the driver seat safety belt buckle pretensioner electrical connector.
    2. Slide and engage the driver seat safety belt buckle pretensioner electrical connector locking clip.

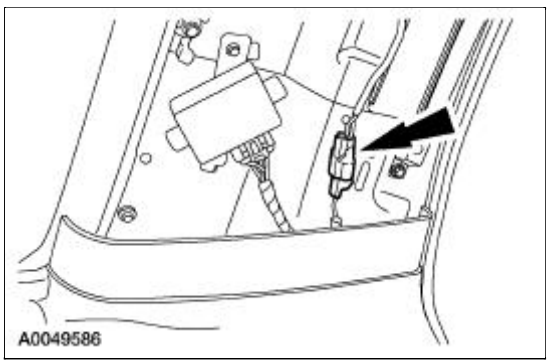


Vehicles with safety canopies

21. Remove the restraint system diagnostic tool from the vehicle harness side of the driver side safety canopy electrical connector.

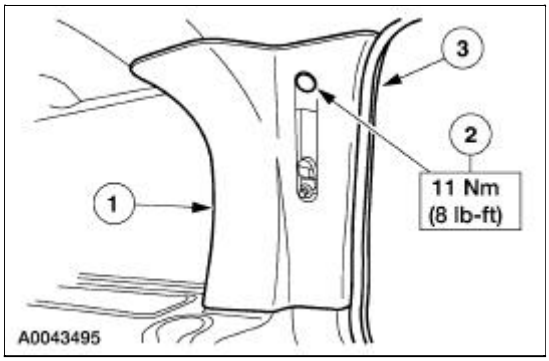


22. Connect the driver side safety canopy electrical connector.



23. **WARNING: Anytime the safety canopy module has deployed, the headliner, and all A, B, and C pillar upper trim panels and attaching hardware must be replaced along with any other damaged components and hardware. Failure to do so may result in personal injury in the event of a safety canopy module deployment.**

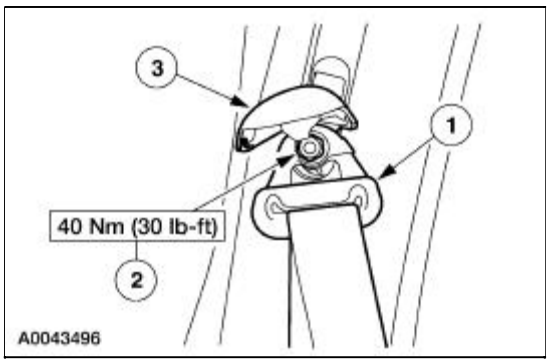
    Install the driver side C-pillar trim panel.
    1. Position the driver side C-pillar trim panel and push in, engaging the retainers.
    2. Install the bolt and bolt cover.
    3. Install the weather-stripping along the driver side C-pillar trim panel.



24. **NOTE:** Inspect the shoulder safety belt guide cover for damage. If the shoulder safety belt guide cover is damaged or if it does not remain closed, install a new shoulder safety belt guide cover.

    NOTE: Make sure the safety belt is not twisted prior to installation.

    Install the second row driver side safety belt guide.
    1. Position the second row driver side safety belt guide.
    2. Install the nut.
    3. Close the safety belt guide cover.



All vehicles

25. Connect the battery ground cable. For additional information, refer to Section 414-01 .

26. **WARNING: Restraint system diagnostic tools are for service only. Tools must be removed prior to operating the vehicle over the road. Failure to remove restraint system diagnostic tools could result in injury and possible violation of vehicle safety standards.**

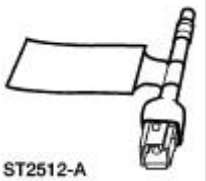
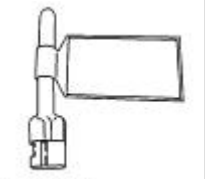
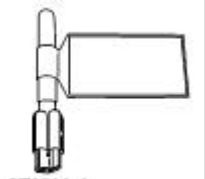
    With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) , in the Diagnosis and Testing portion of this section.

Vehicles with safety canopies

27. Check the active restraint system for correct operation. For additional information, refer to Section 501-20A .

Passenger Air Bag Module

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (2 req'd) 418-F395 (014-R1079)
 ST2512-A	Diagnostic Tool, Restraint System (1 req'd) 418-F403
 ST2507-A	Diagnostic Tool, Restraint System (2 req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 req'd) 418-F088 (105-R0012)

Removal

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Carry a live air bag module with the air bag and deployment door pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Do not set a live air bag module down with the deployment door face down. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

WARNING: Air bag modules with discolored or damaged trim covers must be replaced, not repainted.

NOTE: Repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

All vehicles

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

   The second row side impact sensors (if equipped) are located at or near the base of the C-pillars.

   To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

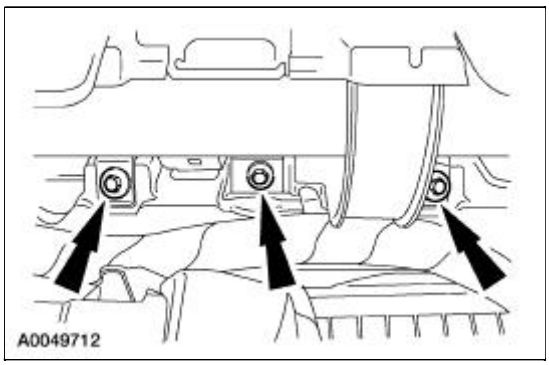
   Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation , in the General Procedures portion of this section.

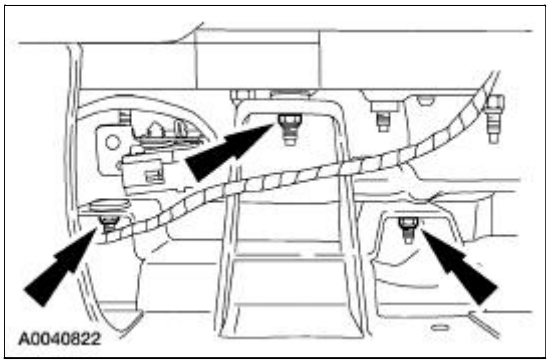
Expedition vehicles

3. Through the glove box opening, remove the passenger air bag module bolts.



Navigator vehicles

4. Through the glove box opening, remove the passenger air bag module nuts.

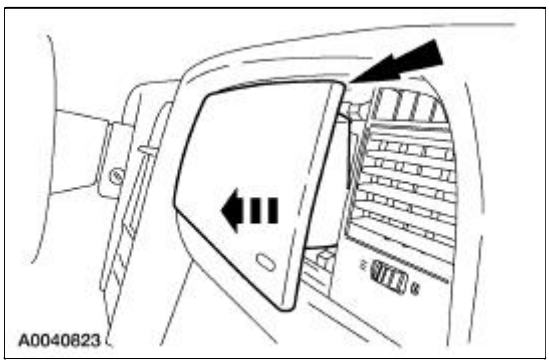


All vehicles

5. **CAUTION: Do not handle the passenger air bag module by grabbing the edges of the deployment door.**

   NOTE: The Expedition is shown, the Navigator is similar.

   Reaching one hand into the glove box opening, push out on the passenger air bag module and remove the passenger air bag module from the instrument panel.



Installation

WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions and notes at the beginning of the removal procedure.

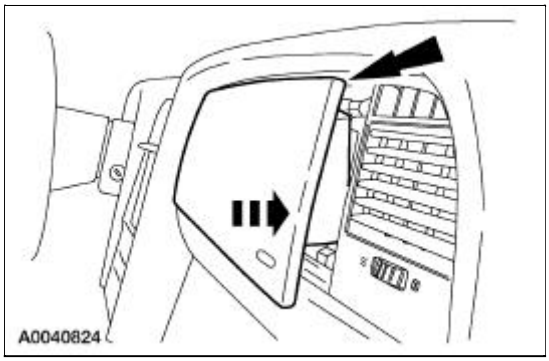
All vehicles

1. **CAUTION: Do not handle the passenger air bag module by grabbing the edges of the deployment door.**

   NOTE: Make sure the battery negative cable is still disconnected before proceeding with the installation portion of this procedure.

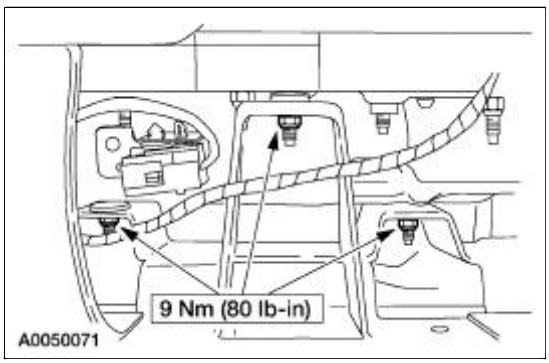
   NOTE: The Expedition is shown, the Navigator is similar.

   Position the passenger air bag module into the instrument panel.



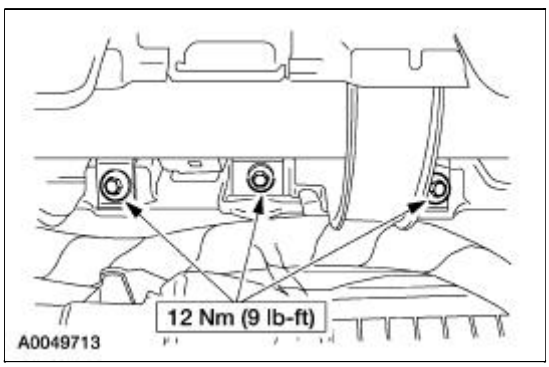
Navigator vehicles

2. Install the passenger air bag module nuts.



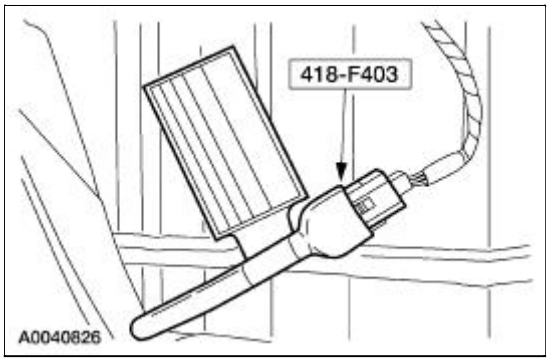
Expedition vehicles

3. Install the passenger air bag module bolts.



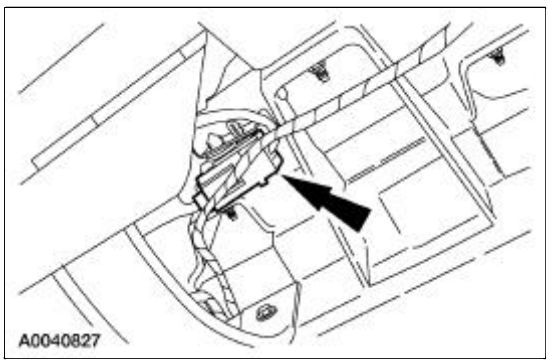
All vehicles

4. Remove the restraint system diagnostic tool from the vehicle harness.



5. **NOTE:** Expedition is shown, Navigator is similar.

   Connect the passenger air bag module electrical connector.



6. Close the glove box.

7. Connect the battery ground cable. For additional information, refer to Section 414-01 .

8. With the restraint system diagnostic tools still installed at the remaining deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) , in the Diagnosis and Testing portion of this section.

9. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

   The second row side impact sensors (if equipped) are located at or near the base of the C-pillars.

   To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

   Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

10. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

    Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in the General Procedures portion of this section.

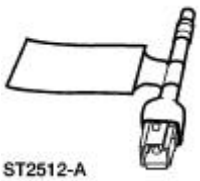
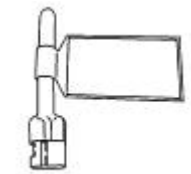
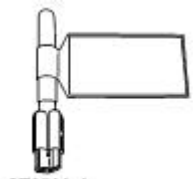
11. Connect the battery ground cable. For additional information, refer to Section 414-01 .

12. **WARNING: Restraint system diagnostic tools are for service only. Tools must be removed prior to operating the vehicle over the road. Failure to remove restraint system diagnostic tools could result in injury and possible violation of vehicle safety standards.**

    With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section.

Safety Canopy Module

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (2 req'd) 418-F395 (014-R1079)
 ST2512-A	Diagnostic Tool, Restraint System (1 req'd) 418-F403
 ST2507-A	Diagnostic Tool, Restraint System (2 req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 req'd) 418-F088 (105-R0012)

Removal

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: To reduce the risk of personal injury from an accidental deployment, always carry or place a live safety canopy module with the safety canopy and tear seam pointed away from your body. Failure to do so can result in personal injury in the event of a safety canopy module deployment.

WARNING: After deployment, the surface of the safety canopy can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

WARNING: Never probe the connector on the safety canopy module. Doing so can result in safety canopy deployment which can result in personal injury.

WARNING: Anytime the safety canopy has deployed, the headliner, and all A, B, and C pillar upper trim panels and attaching hardware must be replaced along with any other damaged components and hardware. Failure to do so can result in personal injury in the event of a safety canopy deployment.

WARNING: Vehicles equipped with safety canopy modules require a specific headliner. When installing a new headliner on a vehicle equipped with safety canopy modules, make sure a headliner for safety canopy modules is being used. The word "AIRBAG" will appear on the headliner where it meets each B-pillar trim panel. Failure to do so can result in personal injury in the event of a safety canopy module deployment.

WARNING: Before installing the safety canopy module, inspect the roofline for any damage. If necessary, the sheet metal must be reworked to its original condition and structural integrity. All damaged fasteners must be replaced and any foreign objects removed. Failure to do so may result in personal injury in the event of a safety canopy deployment.

WARNING: Inspect the safety canopy before installation. If the safety canopy is damaged or the cover has separated or safety canopy material has been exposed, a new safety canopy module must be installed. Do not attempt to repair the safety canopy module. Failure to follow these instructions can result in personal injury in the event of a safety canopy module deployment.

WARNING: To reduce the risk of injury, do not obstruct or place objects in the deployment path of the safety canopy module. Failure to follow these instructions can result in personal injury in the event of a safety canopy module deployment.

WARNING: Never put any type of fastener or tie strap around any part of the safety canopy module or interior trim panel. This will prevent the safety canopy module from deploying correctly. Failure to do so can result in personal injury in the event of a safety canopy module deployment.

NOTE: Repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

NOTE: The passenger side safety canopy module is shown, the driver side is similar.

All vehicles

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

   The second row side impact sensors (if equipped) are located at or near the base of the C-pillars.

   To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if

equipped).

Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation , in the General Procedures portion of this section.

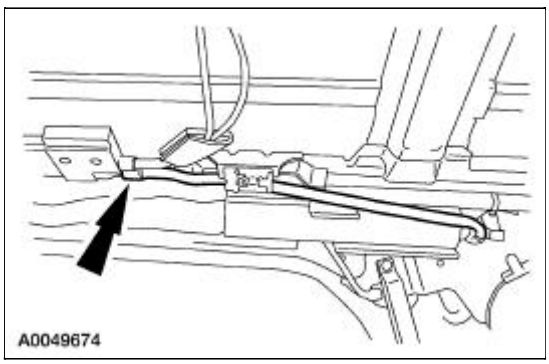
3. **WARNING: Anytime the safety canopy has deployed, the headliner, and all A, B, and C pillar upper trim panels and attaching hardware must be replaced along with any other damaged components and hardware. Failure to do so may result in personal injury in the event of a safety canopy deployment.**

   WARNING: Vehicles equipped with safety canopy modules require a specific headliner. When installing a new headliner on a vehicle equipped with safety canopy modules, make sure a headliner for safety canopy modules is being used. The word "AIRBAG" will appear on the headliner where it meets each B-pillar trim panel. Failure to do so can result in personal injury in the event of a safety canopy module deployment.

   Remove the headliner. For additional information, refer to Section 501-05 .

Vehicles with a moonroof

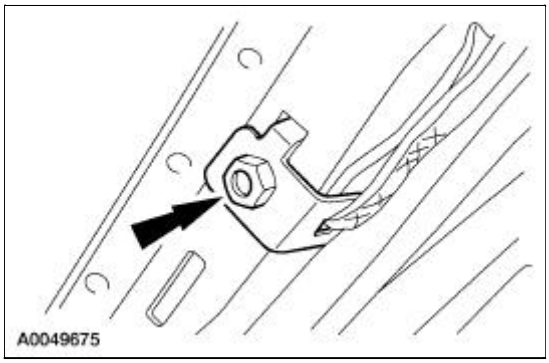
4. Separate the moonroof drain tube and position to the side.



All vehicles

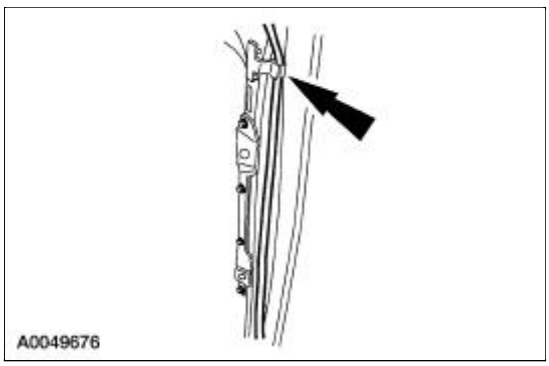
5. **CAUTION: Inspect the rivet nut and A-pillar sheet metal for damage. Install a new rivet nut if necessary. For additional information, refer to Rivet Nut Replacement .**

   Remove the tether cord bolt and bracket from the A-pillar.

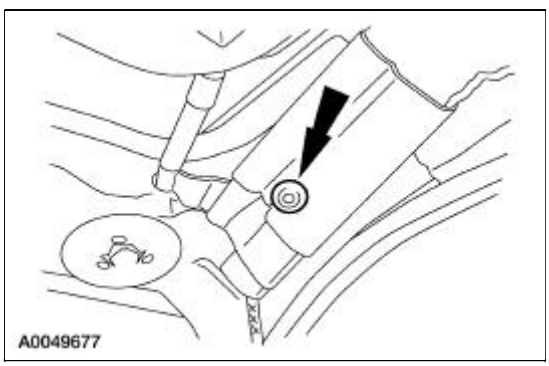


6. **NOTE:** If not installing a new safety canopy module, the pin-type retainer can remain installed.

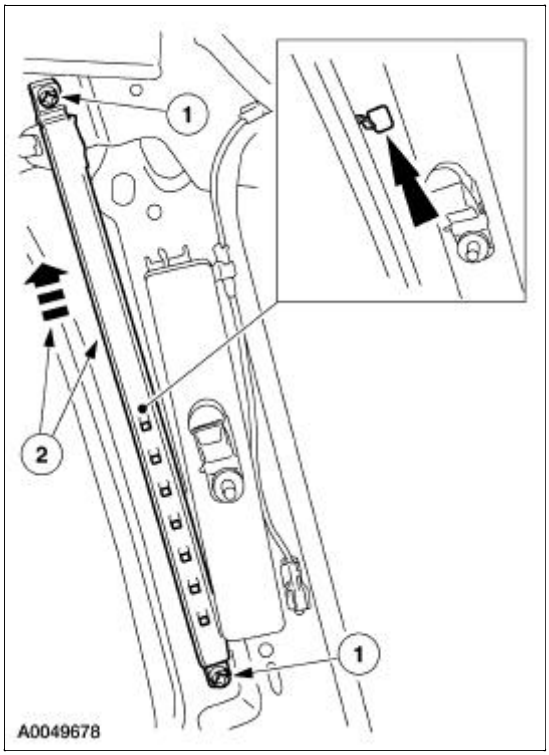
   Remove the tether cord and pin-type retainer from the A-pillar.



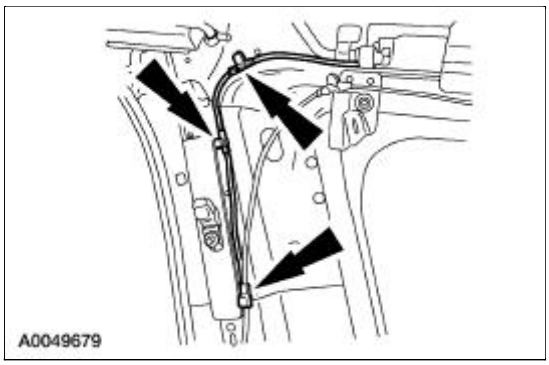
7. Remove the screw at the roofline near the A-pillar.



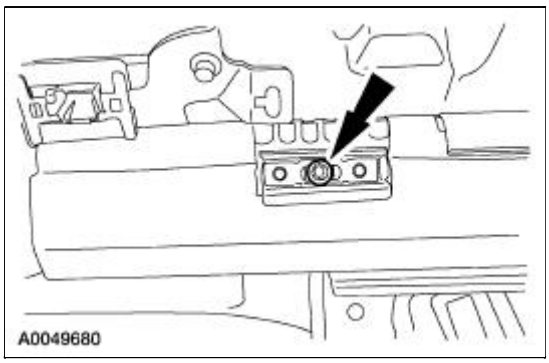
8. Separate the rear tether bracket assembly from the C-pillar.
   1. Remove the bolts.
   2. Slide up and rotate the hook out, separating the tether bracket assembly from the C-pillar.



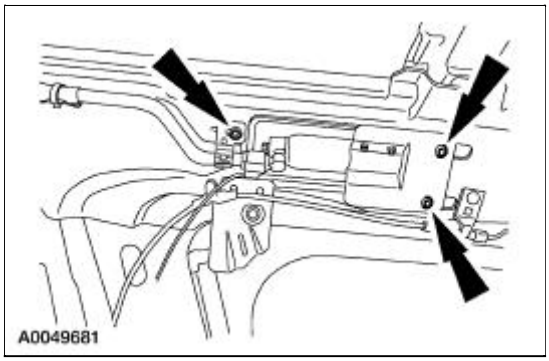
9. Remove the safety canopy wire harness and electrical connector pin-type retainers at the C-pillar.



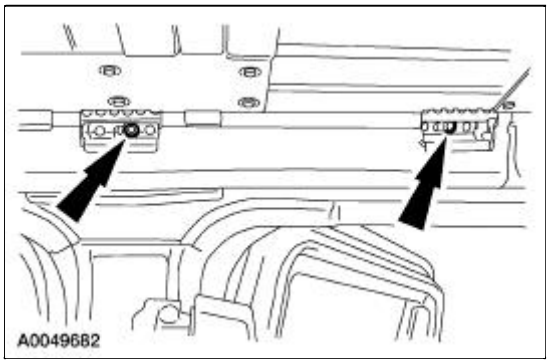
10. Remove the screw at the rear ramp.



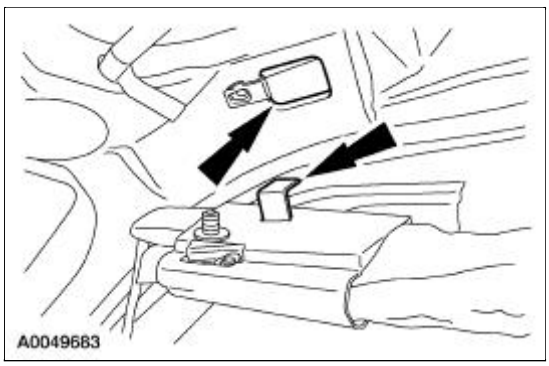
11. Remove the screws at the canister.



12. Remove the two screws at the front ramp.



13. Slide the front of the safety canopy up and rotate the hook out of the roofline sheet metal and remove the safety canopy.



Installation

WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions and notes at the beginning of the removal procedure.

All vehicles

1. **WARNING: Before installing the safety canopy module, inspect the roofline for any damage. If necessary, the sheet metal must be reworked to its original condition and structural integrity. All damaged fasteners must be replaced and any foreign objects removed. Failure to do so may result in personal injury in the event of a safety canopy module deployment.**

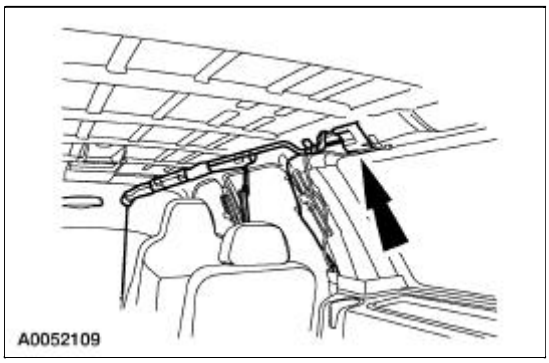
   WARNING: Before installing the safety canopy module, if the module is damaged or the cover has separated or the safety canopy material has been exposed, install a new

safety canopy module. Do not attempt to repair the safety canopy. Failure to follow these instructions could result in personal injury in the event of a safety canopy deployment.

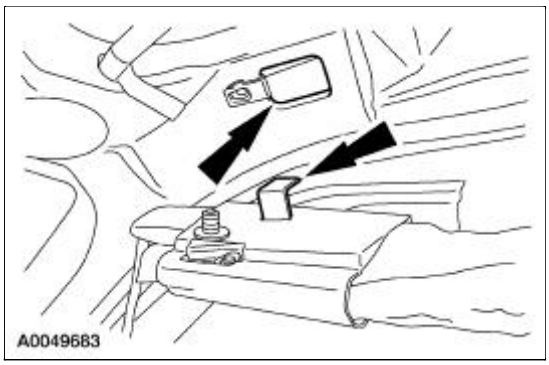
WARNING: Never put any type of fastener or tie strap around any part of the safety canopy module or interior trim panel. This will prevent the safety canopy module from deploying correctly. Failure to do so can result in personal injury in the event of a safety canopy module deployment.

NOTE: Make sure the battery negative cable is still disconnected before proceeding with the installation portion of this procedure.

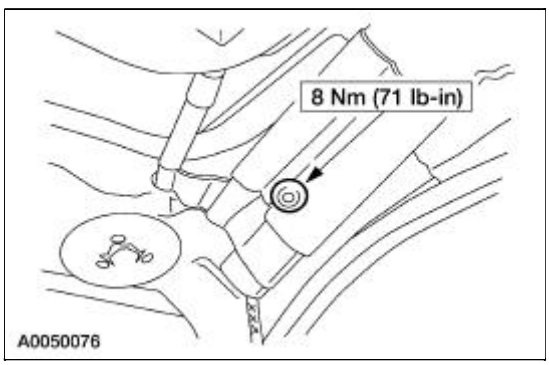
With the safety canopy module positioned in the vehicle as shown, angle the rear of the safety canopy module to the sheet metal, so that the deployment canister can be inserted into the sheet metal opening.



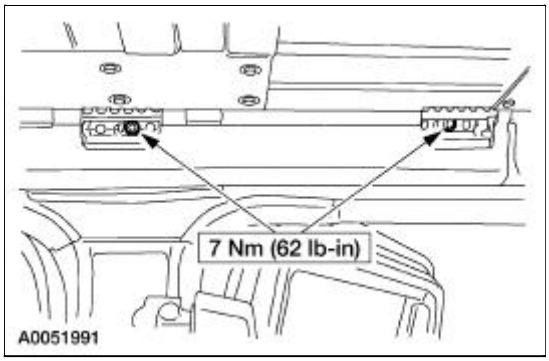
2. Position the safety canopy and engage the front hook to the roofline sheet metal.



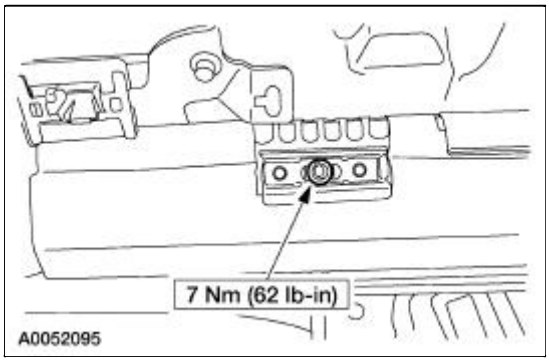
3. Install the screw at the roofline near the A-pillar.



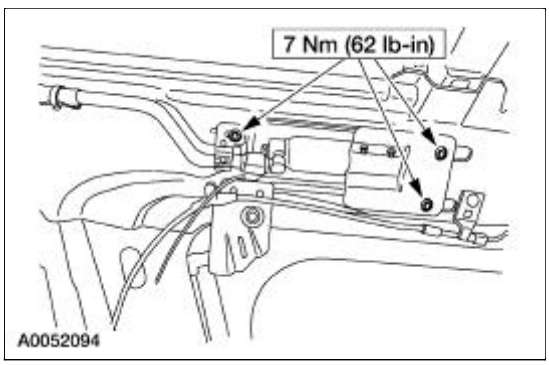
4. Install the two screws at the front ramp.



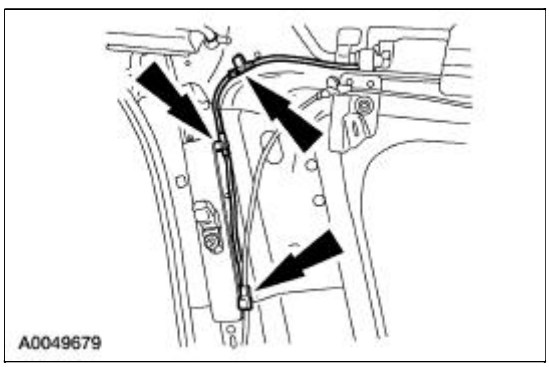
5. Install the screw at the rear ramp.



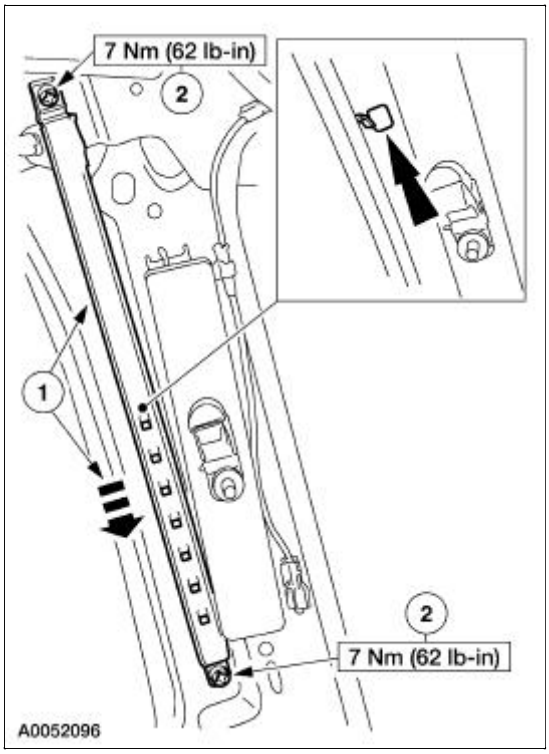
6. Install the screws at the canister.



7. Route and install the safety canopy wire harness and electrical connector pin-type retainers at the C-pillar.

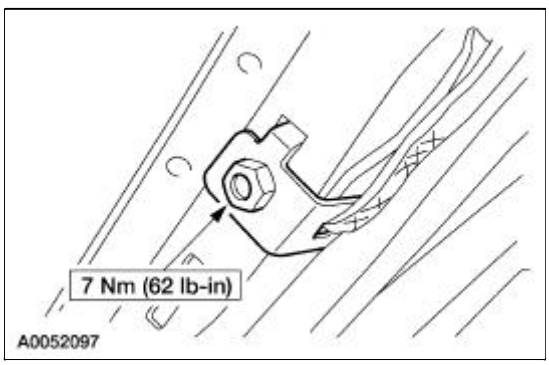


8. Install the rear tether bracket assembly to the C-pillar.
    1. Rotate and slide down the tether bracket assembly hook, engaging it to the C-pillar sheet metal.
    2. Install the bolts.

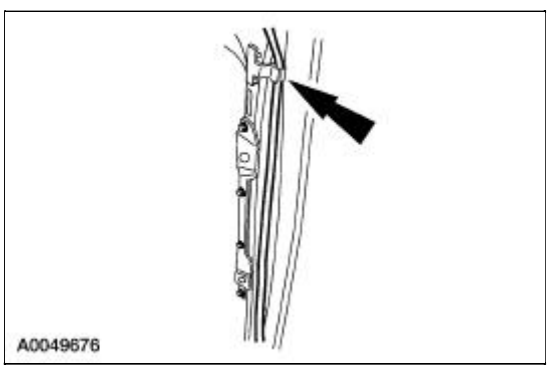


9. **CAUTION: Inspect the rivet nut and A-pillar sheet metal for damage. Install a new rivet nut if necessary. For additional information, refer to Rivet Nut Replacement .**

   Position the bracket and install the bolt for the tether cord to the A-pillar.

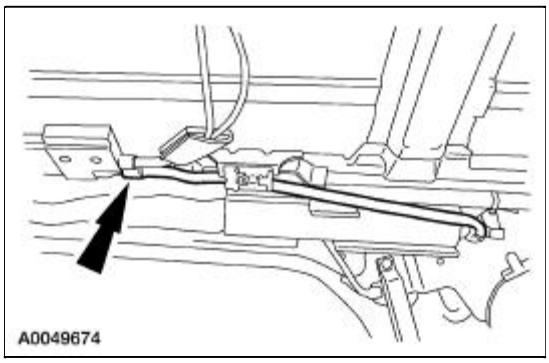


10. Make sure the tether is securely engaged into the pin-type retainer and install the pin-type retainer to the A-pillar.
    - If a new safety canopy module was not installed, route the tether and securely engage it into the pin-type retainer at the A-pillar.



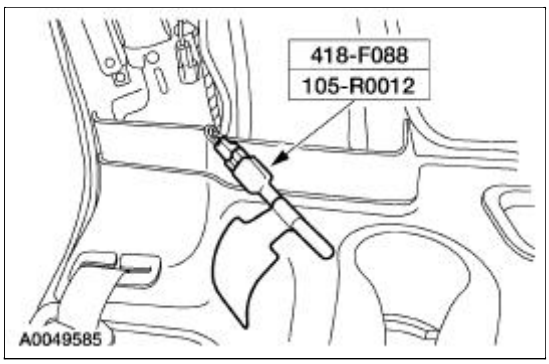
Vehicles with a moonroof

11. Route and connect the moonroof drain tube.

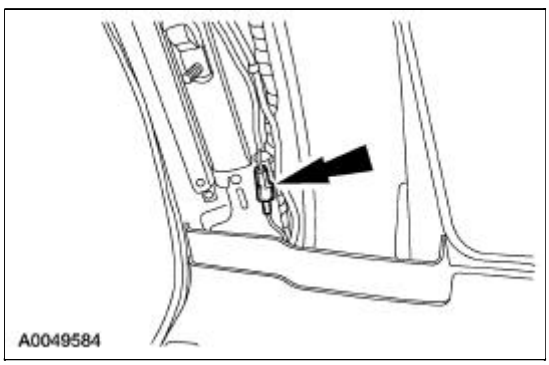


All vehicles

12. Remove the restraint system diagnostic tool from the vehicle harness side of the safety canopy electrical connector.



13. Connect the safety canopy electrical connector.



14. Connect the battery ground cable. For additional information, refer to Section 414-01 .

15. With the restraint system diagnostic tools still installed at the remaining deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) , in the Diagnosis and Testing portion of this section.

16. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors,**

instrument panel, console, door latches, strikers, seats and hood latches.

The front impact severity sensor is located at the bottom of the hood latch support bracket.

The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

The second row side impact sensors (if equipped) are located at or near the base of the C-pillars.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

17. **WARNING: Anytime the safety canopy has deployed, the headliner, and all A, B, and C pillar upper trim panels and attaching hardware must be replaced along with any other damaged components and hardware. Failure to do so may result in personal injury in the event of a safety canopy deployment.**

    WARNING: Vehicles equipped with safety canopy modules require a specific headliner. When installing a new headliner on a vehicle equipped with safety canopy modules, make sure a headliner for safety canopy modules is being used. The word "AIRBAG" will appear on the headliner where it meets each B-pillar trim panel. Failure to do so can result in personal injury in the event of a safety canopy module deployment.

    Install the headliner. For additional information, refer to Section 501-05 .

18. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

    Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation , in the General Procedures portion of this section.

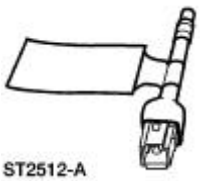
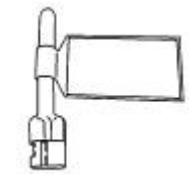
19. Connect the battery ground cable. For additional information, refer to Section 414-01 .

20. **WARNING: Restraint system diagnostic tools are for service only. Tools must be removed prior to operating the vehicle over the road. Failure to remove restraint system diagnostic tools could result in injury and possible violation of vehicle safety standards.**

    With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) , in the Diagnosis and Testing portion of this section.

Safety Canopy Bridge Resistor

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (2 req'd) 418-F395 (014-R1079)
 ST2512-A	Diagnostic Tool, Restraint System (1 req'd) 418-F403
 ST2507-A	Diagnostic Tool, Restraint System (2 req'd) 418-133 (014-R1076)

Removal

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

NOTE: There is only one safety canopy bridge resistor. The bridge resistor can be accessed with the headliner dropped and is located just behind the RH side second row courtesy light.

NOTE: Repair is made by installing a new part only. If the new part does not correct the condition, install the original part and carry out the diagnostic procedure again.

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

   The second row side impact sensors (if equipped) are located at or near the base of the C-pillars.

   To deplete the backup power supply energy, disconnect the battery ground cable and

wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

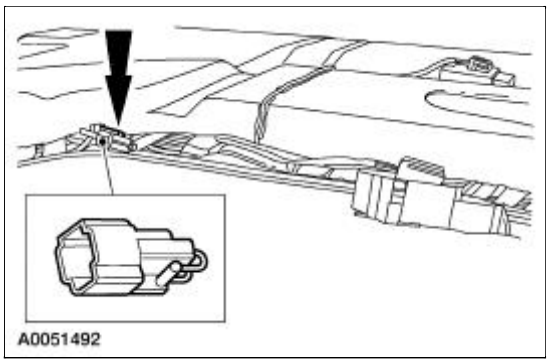
Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation , in the General Procedures portion of this section.

3. Lower but do not remove the headliner. For additional information, refer to Section 501-12 .

4. Remove the safety canopy bridge resistor.
   - Release the safety canopy bridge resistor from the adhesive.
   - Disconnect and remove the safety canopy bridge resistor.

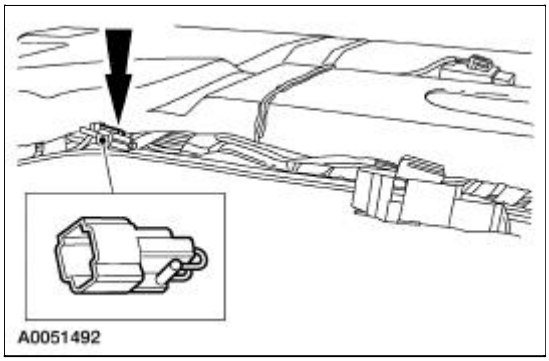


Installation

WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions and notes at the beginning of the removal procedure.

1. **NOTE:** Make sure the battery negative cable is still disconnected before continuing with the installation procedure.

   Install the safety canopy bridge resistor.
   - Connect the electrical connector.
   - Position the safety canopy bridge resistor.
     - Apply an appropriate adhesive to hold the safety canopy bridge resistor in place.



2. Install the headliner. For additional information, refer to Section 501-12 .

3. Connect the battery ground cable. For additional information, refer to Section 414-01 .

4. With the restraint system diagnostic tools still installed at the remaining deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) , in the Diagnosis and Testing portion of this section.

5. Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

6. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation , in the General Procedures portion of this section.

7. Connect the battery ground cable. For additional information, refer to Section 414-01 .

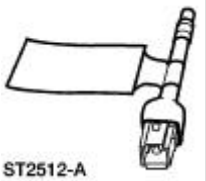
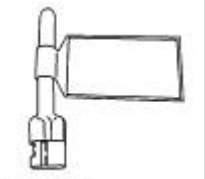
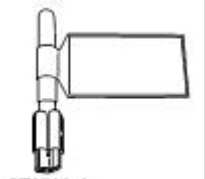
8. **WARNING: Restraint system diagnostic tools are for service only. Tools must be removed prior to operating the vehicle over the road. Failure to remove restraint system diagnostic tools could result in injury and possible violation of vehicle safety standards.**

   With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) , in the Diagnosis and Testing portion of this section.

9. Check the active restraint system for correct operation. For additional information, refer to Section 501-20A .

Clockspring

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (2 req'd) 418-F395 (014-R1079)
 ST2512-A	Diagnostic Tool, Restraint System (2 req'd) 418-F403
 ST2507-A	Diagnostic Tool, Restraint System (2 req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 req'd) 418-F088 (105-R0012)

Removal

WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: Do not set a live air bag module down with the trim cover face down. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

WARNING: Air bag modules with discolored or damaged trim covers must be replaced, not repainted.

NOTE: Repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The front impact severity sensor is located at the bottom of the hood latch support bracket.

   The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

   The second row side impact sensors (if equipped) are located at or near the base of the C-pillars.

   To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

   Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

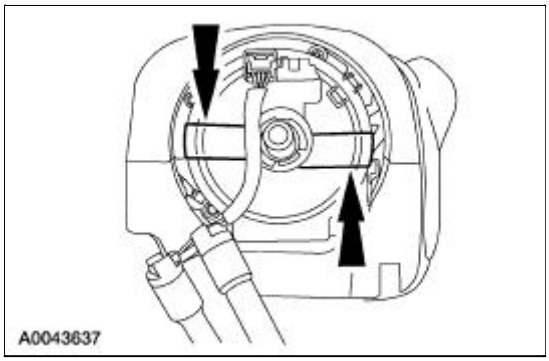
   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation , in the General Procedures portion of this section.

3. Make sure the road wheels are in the straight-ahead position.

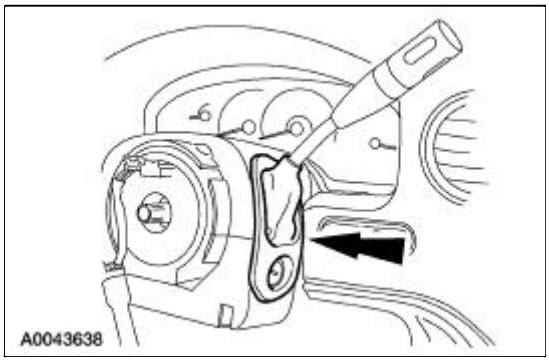
4. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the steering wheel removal and installation procedure.**

   Remove the steering wheel. For additional information, refer to Section 211-04 .

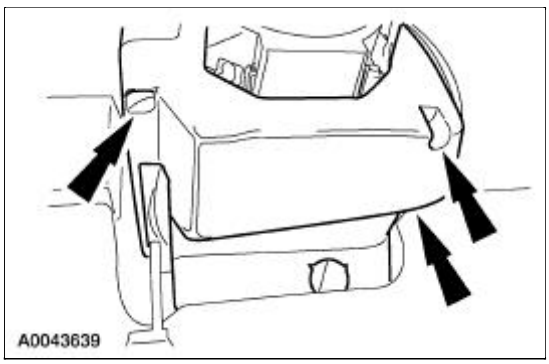
5. Apply two strips of masking tape across the clockspring to prevent accidental rotation when the clockspring is removed.



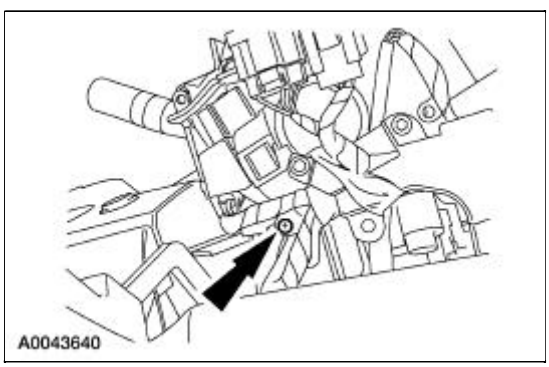
6. Release the tabs and slide the gear selector cover away from the steering column shrouds.



7. From under the steering column, remove the three screws and the lower steering column shroud.

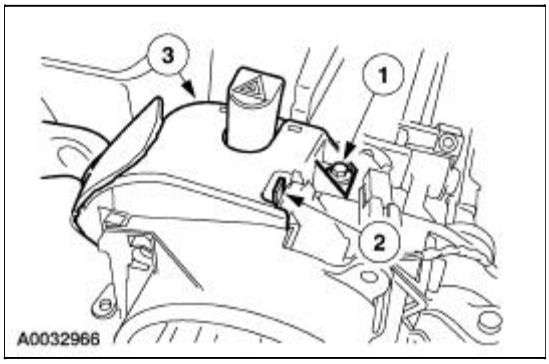


8. From under the steering column remove the screw and then remove the upper steering column shroud.

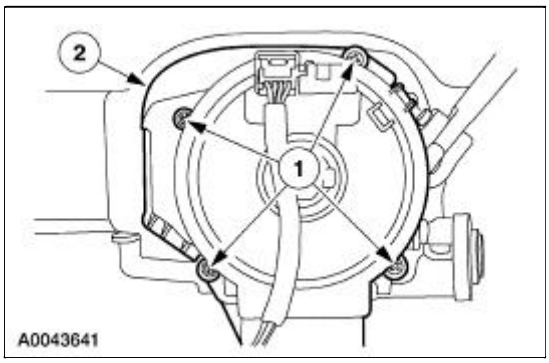


9. Separate the multi-function switch from the clockspring.
    1. Remove the screw.
    2. Release the tab.

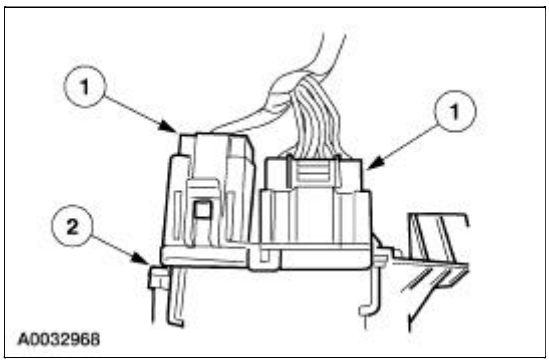
3. While releasing the retaining tab, slide the multi-function switch up and out of the way.



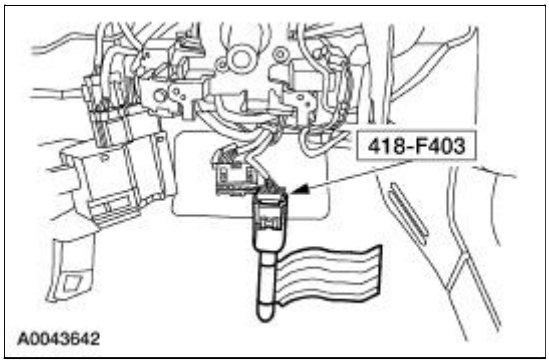
10. Separate the clockspring from the steering column.
    1. Remove the screws.
    2. Slide the clockspring off the steering column shaft.



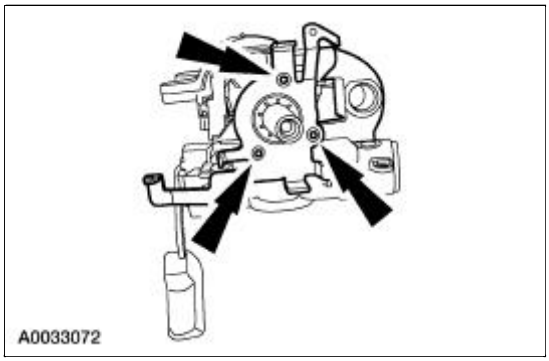
11. Remove the clockspring.
    1. Disconnect the clockspring electrical connectors.
    2. Remove the clockspring.



12. Attach the restraint system diagnostic tool to the vehicle harness side of the clockspring electrical connector.



13. Inspect the clockspring bracket for damage and remove as necessary.



14. Connect the battery ground cable. For additional information, refer to Section 414-01 .

15. With the restraint system diagnostic tools installed at all deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) , in the Diagnosis and Testing portion of this section.

16. Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

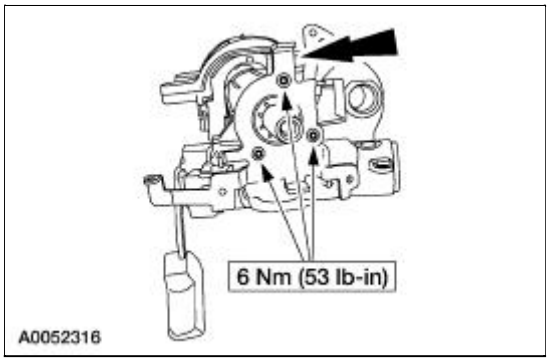
17. Remove the restraint system diagnostic tools from the clockspring electrical connectors if not reusing the same clockspring .

Installation

WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions and notes at the beginning of the removal procedure.

Vehicles to receive a new clockspring bracket

1. Install the clockspring bracket and screws.



Vehicles receiving a new clockspring

2. **NOTE:** A new clockspring is supplied in a centralized position and held there with a key.

   Remove the key from the clockspring, holding the rotor in its centralized position.
   - Do not allow the clockspring rotor to turn.

Vehicles needing clockspring recentering

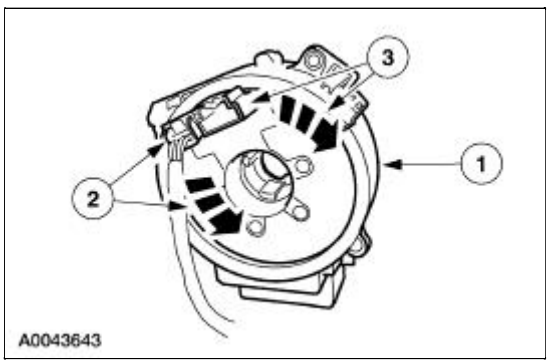
3. **WARNING: Incorrect centralization may result in premature component failure. If in doubt when centralizing the clockspring, repeat the centralizing procedure. Failure to follow this instruction may result in personal injury.**

   CAUTION: Make sure the road wheels are in the straight-ahead position.

   NOTE: If a clockspring has rotated out of center, follow through with this step.

   Centralize the clockspring.
   1. Hold the clockspring outer housing stationary.
   2. **CAUTION: Overturning will destroy the clockspring. The internal ribbon wire acts as the stop and can be broken from its internal connection.**

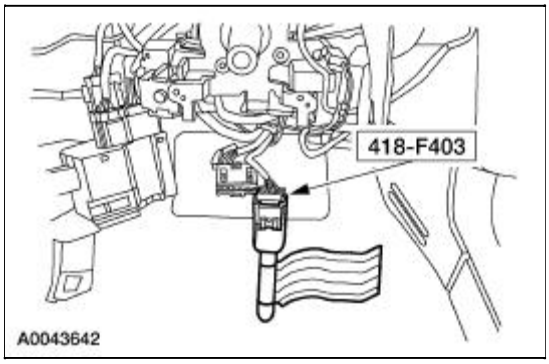
      While turning the rotor counterclockwise, carefully feel for the ribbon wire to run out of length. Stop turning when a slight resistance is felt.
   3. Turn the clockspring clockwise approximately 2.75 turns. This is the center point of the clockspring.
      - Do not allow the rotor to turn from this position.



All vehicles

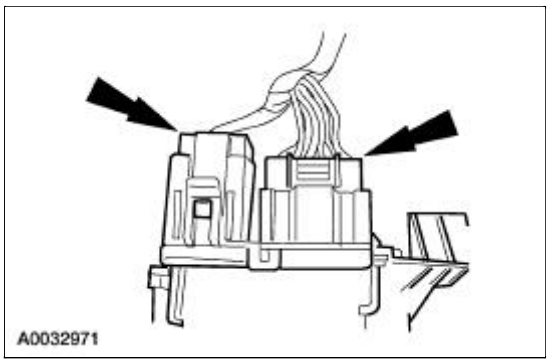
4. Remove the restraint system diagnostic tool from the vehicle harness side of the clockspring

electrical connector.



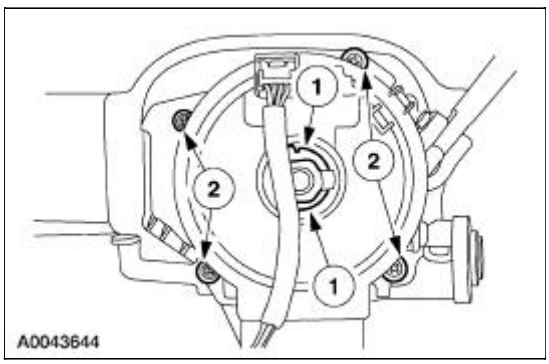
5. **NOTE:** Make sure the battery negative cable is disconnected before continuing with the installation procedure.

   Connect the clockspring electrical connectors.



6. **NOTE:** Slight turning of the clockspring rotor is allowable for alignment purposes to the steering column.

   Install the clockspring onto the steering column.
   1. With the flats of the clockspring aligned to the flats of the steering column, slide the clockspring onto the steering column.
   2. Install the screws.



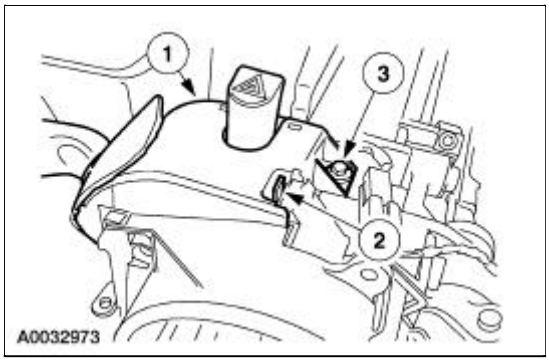
Vehicle repairs using the same clockspring

7. Remove the tape applied during clockspring removal.

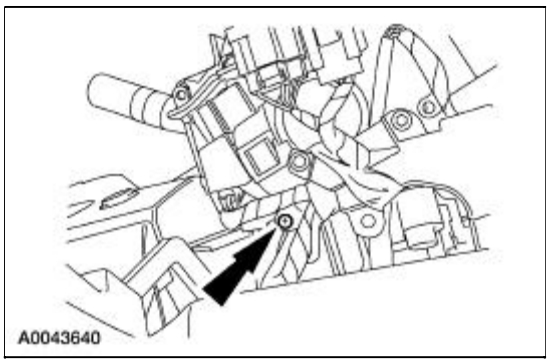
All vehicles

8. Install the multi-function switch.

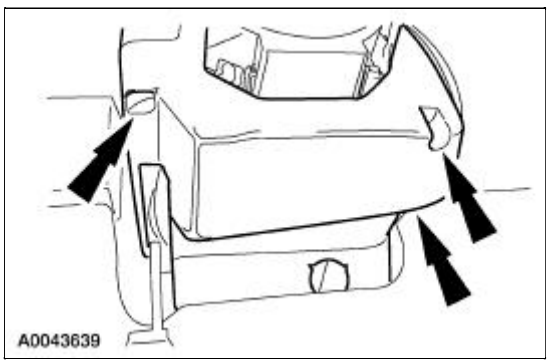
1. Align the multi-function switch and slide it down into position.
2. Check that the retaining tab is engaged.
3. Install the screw.



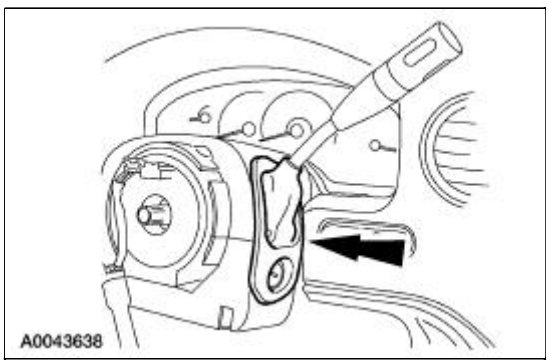
9. Position the upper steering column shroud, and from under the steering column, install the screw.



10. Position the lower steering column shroud and install the three screws.



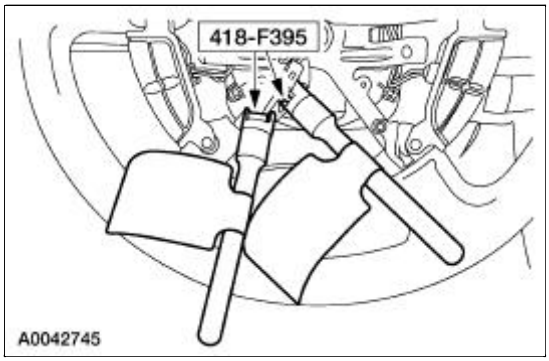
11. Reposition the gear selector cover to the steering column shrouds and engage the tabs.



12. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the steering wheel removal and installation procedure.**

    Install the steering wheel. Do not install the driver air bag module at this time. For additional information, refer to Section 211-04 .

13. Attach the restraint system diagnostic tools to the clockspring electrical connectors at the top of the steering column.

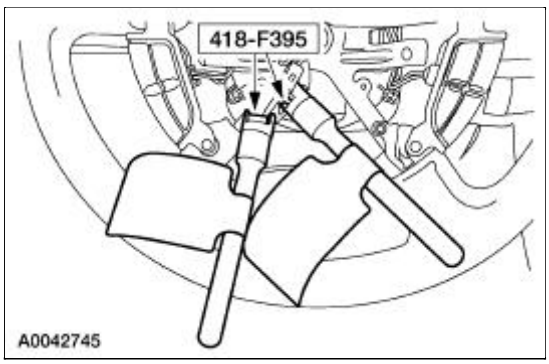


14. Connect the battery ground cable. For additional information, refer to Section 414-01 .

15. With the restraint system diagnostic tools installed at all deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) , in the Diagnosis and Testing portion of this section.

16. Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

17. Remove the restraint system diagnostic tools from the clockspring electrical connectors at the top of the steering column.

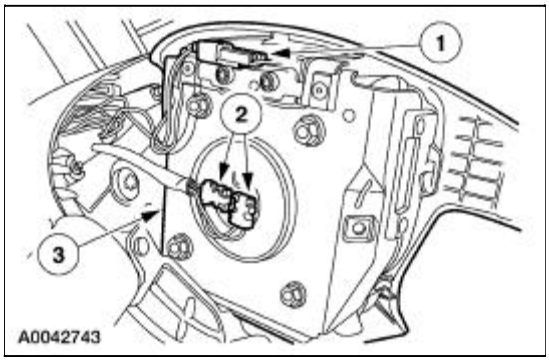


Expedition vehicles

18. Position the driver air bag module to the steering wheel.
    1. Connect the horn switch electrical connector.
    2. **CAUTION: The clockspring electrical connectors are unique and cannot be reversed when connected to the driver air bag module. Match the electrical connector key to the keyway in the driver air bag module. Do not force the electrical connectors into the driver air bag module.**

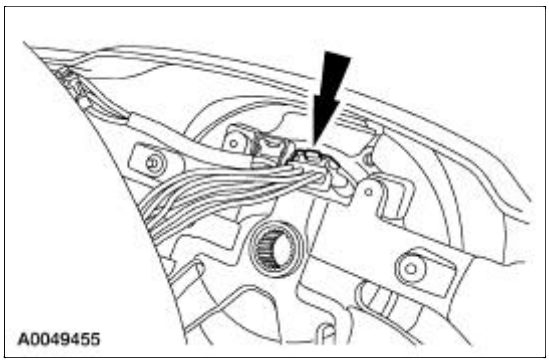
       Connect the driver air bag module electrical connectors as noted during the deactivation procedure.

3. Position the driver air bag module to the steering wheel.



Navigator vehicles

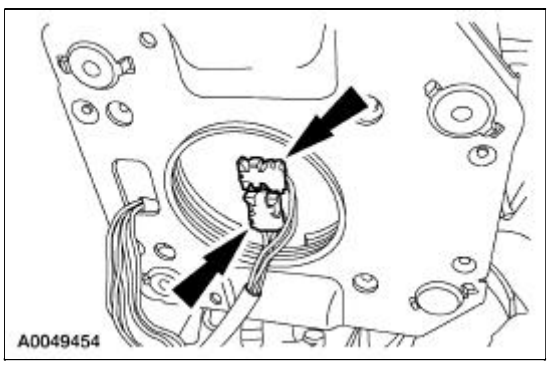
19. Connect the driver air bag module accessories electrical connector to the connector end at the top of the clockspring.



20. **CAUTION: The clockspring electrical connectors are unique and cannot be reversed when connected to the driver air bag module. Match the electrical connector key to the keyway in the driver air bag module. Do not force the electrical connectors into the driver air bag module.**

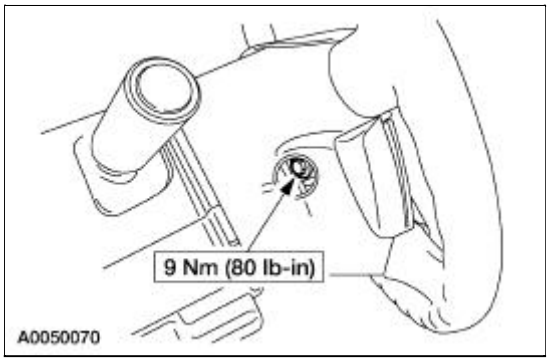
    Connect the driver air bag module electrical connectors as noted during removal.

    - Position the driver air bag module to the steering wheel.

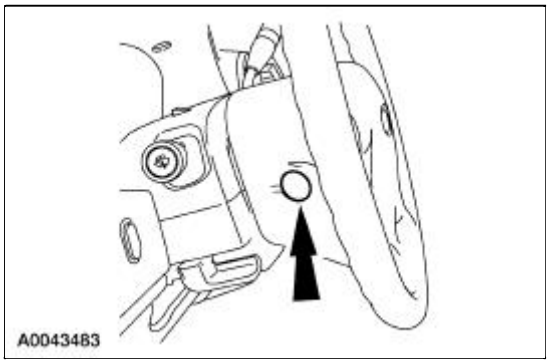


All vehicles

21. Install the two driver air bag module bolts (one shown).



22. Install the two steering wheel back cover plugs (one shown).



23. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

    Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation , in the General Procedures portion of this section.

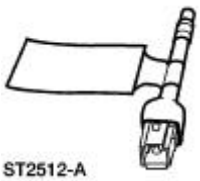
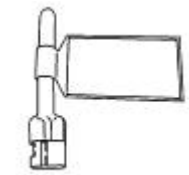
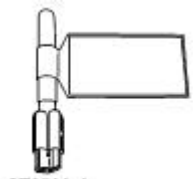
24. Connect the battery ground cable. For additional information, refer to Section 414-01 .

25. **WARNING: Restraint system diagnostic tools are for service only. Tools must be removed prior to operating the vehicle over the road. Failure to remove restraint system diagnostic tools could result in injury and possible violation of vehicle safety standards.**

    With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) , in the Diagnosis and Testing portion of this section.

Seat Position Sensor

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (2 req'd) 418-F395 (014-R1079)
 ST2512-A	Diagnostic Tool, Restraint System (1 req'd) 418-F403
 ST2507-A	Diagnostic Tool, Restraint System (2 req'd) 418-133 (014-R1076)
 ST2506-A	Diagnostic Tool, Restraint System (2 req'd) 418-F088 (105-R0012)

Removal

WARNING: Always wear safety glasses when repairing a supplemental restraint system (SRS) vehicle and when handling an airbag module. This will reduce the risk of injury in the event of an accidental deployment.

WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

1. **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

The front impact severity sensor is located at the bottom of the hood latch support bracket.

The first row side impact sensors (if equipped) are located in the first row doors, behind the door trim panel.

The second row side impact sensors (if equipped) are located at or near the base of the C-pillars.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the supplemental restraint system deactivation/reactivation procedure.**

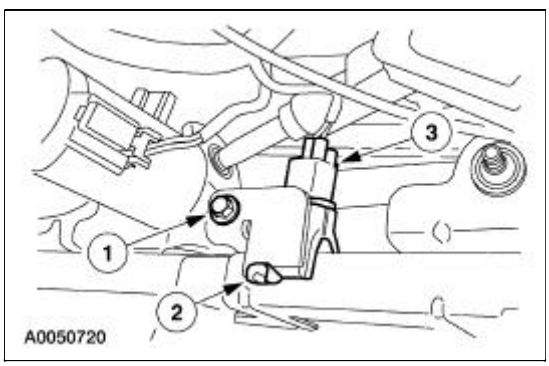
   Deactivate the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) , in the Diagnosis and Testing portion of this section.

3. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the seat removal and installation procedure.**

   NOTE: Before removing the seat, position it to access the seat position sensor.

   Remove the 40 percent driver front seat. For additional information, refer to Section 501-10 in the Removal and Installation portion of that section.

4. Remove the seat position sensor.
   1. Remove the bolt.
   2. Release the tab and separate the seat position sensor from the seat.
   3. Disconnect and remove the seat position sensor.

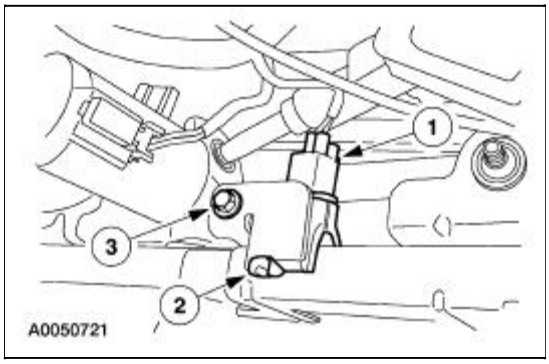


Installation

WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions and notes at the beginning of the removal procedure.

1. Install the seat position sensor.
   1. Connect the seat position sensor.
   2. Position the seat position sensor to the seat, engaging the tab to the seat bracket.

3. Install the bolt.



2. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the seat removal and installation procedure.**

   Install the 40 percent driver front seat. For additional information, refer to Section 501-10 , in the Removal and Installation portion of that section.

3. **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the supplemental restraint system deactivation/reactivation procedure.**

   Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation , in the General Procedures portion of this section.

4. **WARNING: Restraint system diagnostic tools are for service only. Tools must be removed prior to operating the vehicle over the road. Failure to remove restraint system diagnostic tools could result in injury and possible violation of vehicle safety standards.**

   With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section.

5. Check the active restraint system for correct operation. For additional information, refer to Section 501-20A .

Torque Specifications

Description	Nm	lb-ft
Body mount bolts	80	59
Radiator body mount bolts	80	59
Body mount bolts to frame	55	41
Number 4 body mount nut	55	41
Transmission mount nuts	103	76
Transmission crossmember bolts	90	66
Spare tire winch bolts	25	18
Frame mounted heat shield bolts	15	11

Frame and Body Mounting

The frame (5005) is made up of two steel boxed side rails and crossmembers, which are welded to the two side rails. The transmission crossmember is bolted to the side rails. The side welded rails and crossmembers are not replaced separately.

The service kits available for the frame are:

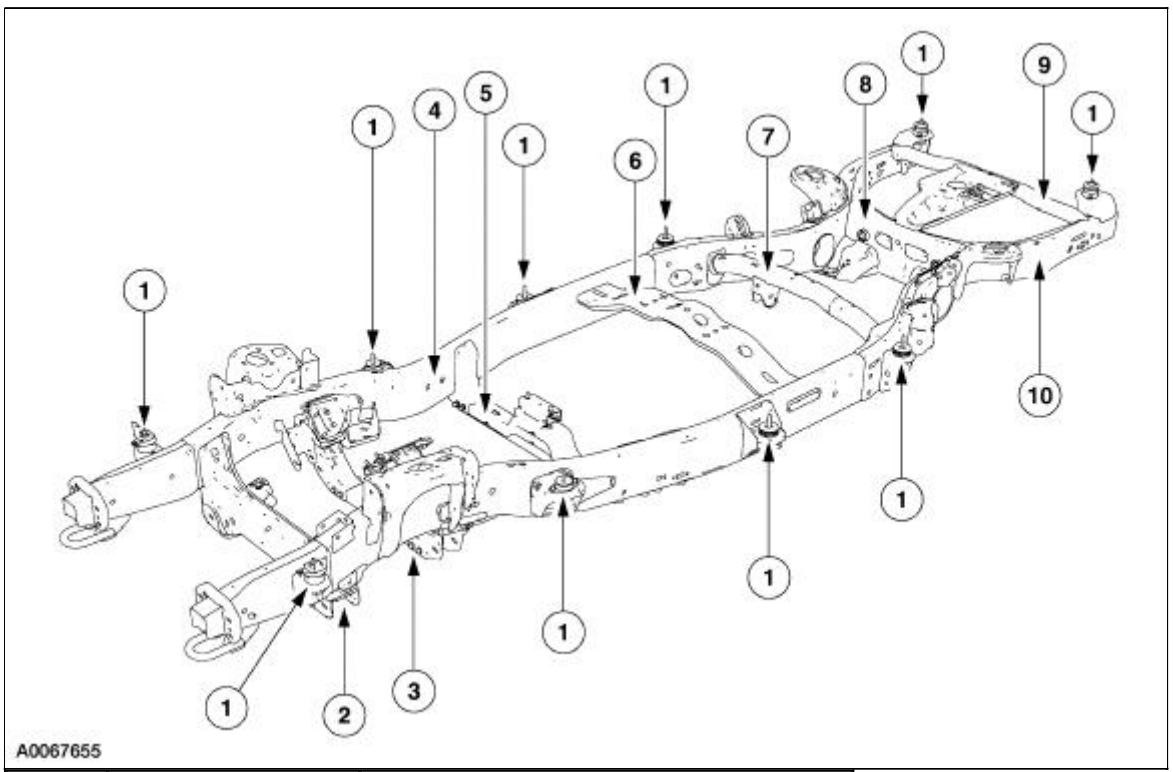
- RH front horn replacement kit (5D058).
- LH front horn replacement kit (5D059).
- Front bumper bracket replacement kit (17N775).
- 1B crossmember replacement kit (5C075).
- Transmission crossmember replacement kit (5059).

Refer to the instructions included in the kits for installation instructions.

Frame Mounted Heat Shields

All frame mounted heat shields are torqued to 15Nm (11 lb-ft).

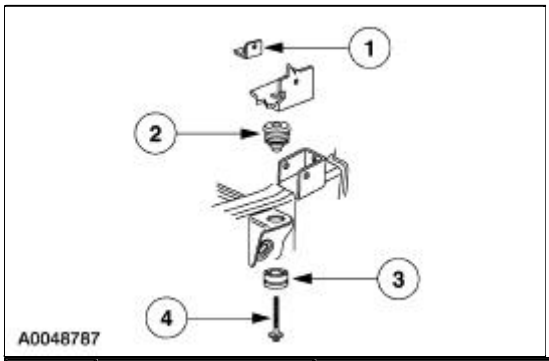
Frame Components



Item	Part Number	Description
1	—	Body to frame mounts
2	—	Front crossmember No. 1

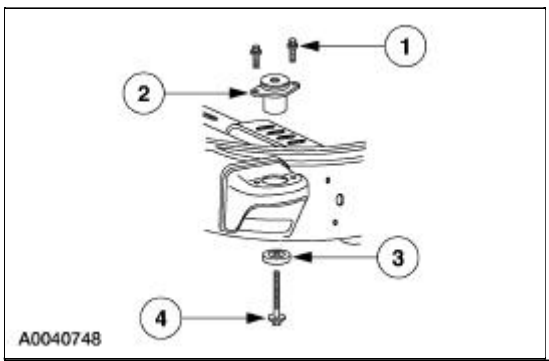
3	—	1B crossmember
4	—	RH frame rail
5	—	Transmission crossmember
6	—	Crossmember No. 3
7	—	Crossmember No. 4
8	—	Crossmember No. 5
9	—	Crossmember No. 6
10	—	LH frame rail

Radiator Support Mount



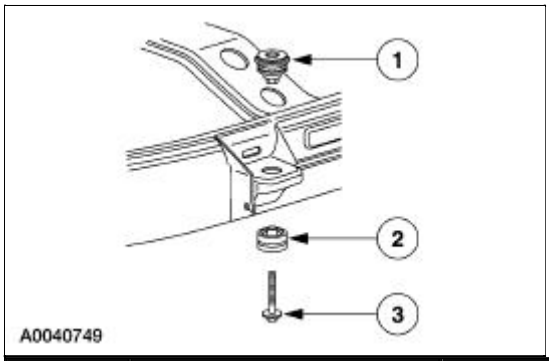
Item	Part Number	Description
1	8052 (RH)	Bracket assembly
	8053 (LH)	Bracket assembly
2	7800192	Upper radiator support body mount
3	7800193	Lower radiator support body mount
4	78001B39	Radiator support body mount bolt

No. 1 Body Mount



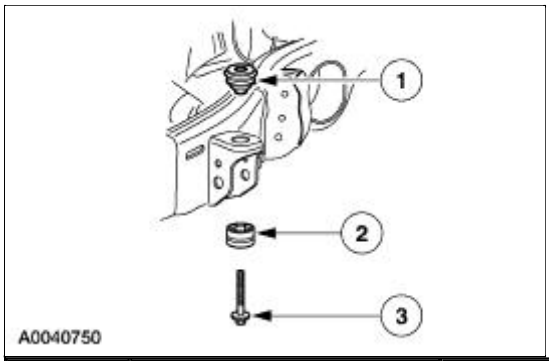
Item	Part Number	Description
1	W506433	Bolts
2	7800192	Body mount
3	W708210	Washer
4	W708330	Body mount bolt

No. 2 Body Mount



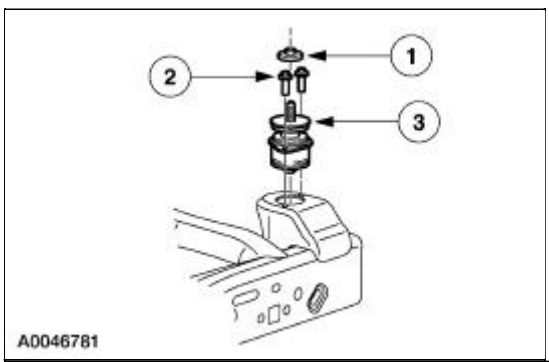
Item	Part Number	Description
1	7800192	Upper body mount
2	7800193	Lower body mount
3	W708330	Body mount bolt

No. 3 Body Mount



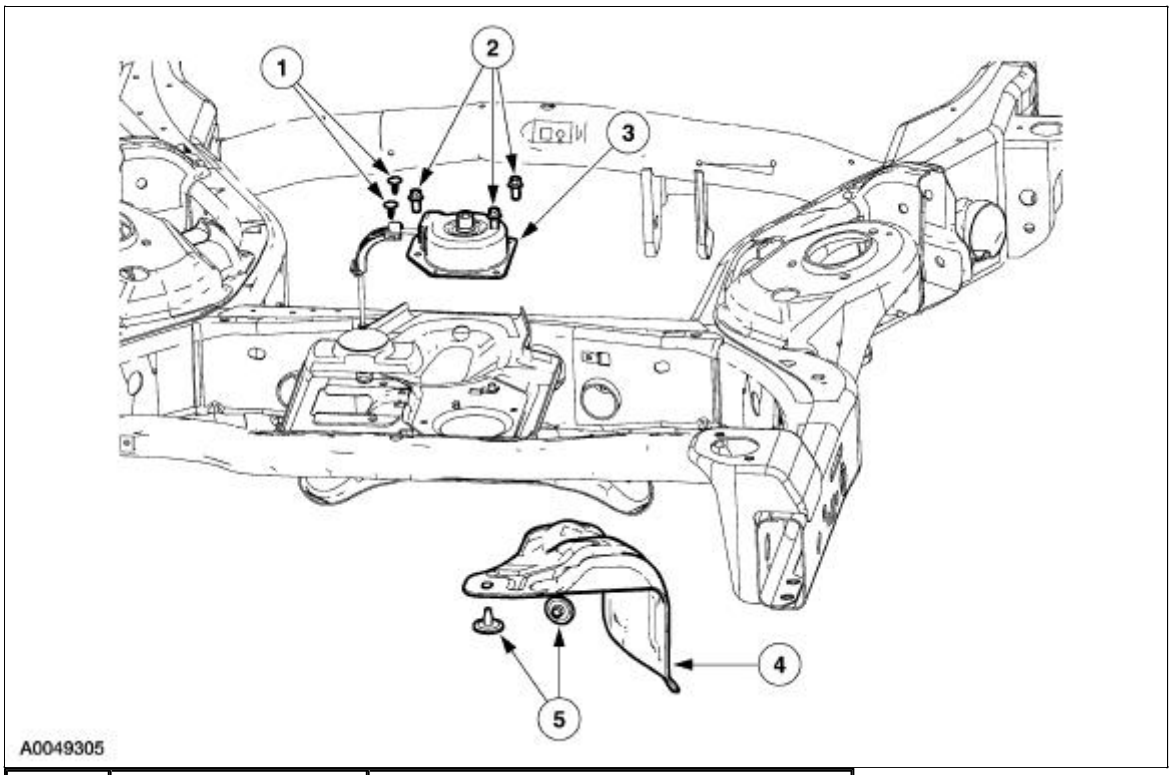
Item	Part Number	Description
1	7800192	Upper body mount
2	7800193	Lower body mount
3	W708330	Body mount bolt

No. 4 Body Mount



Item	Part Number	Description
1	W708109	Body mount nut and washer
2	W506433	Body mount bolts
3	7800192	Body mount

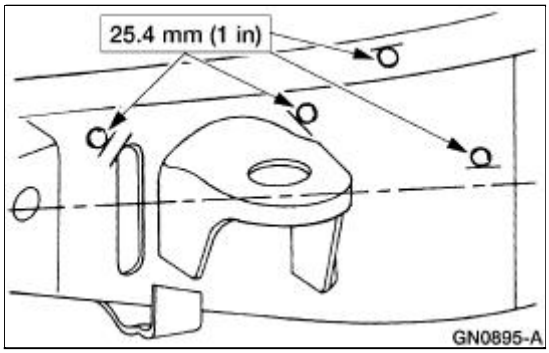
Spare Tire Winch



Item	Part Number	Description
1	W705589	Pin-type retainers
2	W505263	Spare tire winch bolts
3	1A131	Spare tire winch assembly
4	1A484	Spare tire heat shield
5	W707959	Spare tire heat shield bolts

Frame Maintenance —Drilling Precautions

1. If a hole must be drilled in the frame, make sure the hole meets the following requirements:
   - The hole is at least the specified distance from the edge of the nearest hole.
   - The edge of the drilled hole is at least the specified distance from the edge of the flange.
   - The drilled hole is at least the specified distance from any other existing bracket or component of the frame.



Frame Maintenance —Welding Precautions

1. If welding must be done on a frame, make sure the following requirements are met:
    - If the frame is attached to the vehicle, the battery ground cable (14301) must be disconnected before using any electrical welding equipment. For additional information, refer to 414-01.
    - Do not use gas welding equipment; arc welding is the only approved method.
    - Use a temperature-indicating crayon to make sure that the temperature does not exceed 750°C (1,400°F).
    - Install new spot-welded components by spot welding where possible. If spot welding is not possible, use puddle welding.

Frame Maintenance —Frame Straightening

1. **WARNING: Straightening of front frame rail convolute is prohibited. Failure to follow these instructions may result in personal injury.**

   When straightening the frame, make sure the following requirements are met:

   - **CAUTION: Reposition and/or shield any fuel lines, brake lines, or wiring harness or component in the heated area.**

     If heat is needed to straighten a frame member, keep the temperature below 650° C (1,200° F) (a dull red glow). A temperature sensitive thermal melt crayon should be used to monitor heat buildup.
   - Heat should be kept to a minimum area so that the hardness of the metal will not be affected.
   - Straightening should only be attempted on frames that fail to meet specifications of the diagonal checking method or where damage is apparent.
   - Straightening should be limited to parts which are not severely bent.
   - Reposition and/or shield any fuel lines, brake lines, or wiring harnesses or components in heated area.

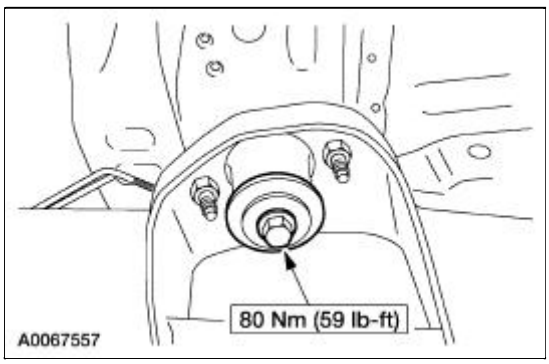
Body Support —Number 1

Removal and Installation

WARNING: If equipped with air suspension, the electrical power to the air suspension system must be shut down prior to hoisting, jacking or towing an air suspension equipped vehicle. This can be accomplished by turning off the air suspension switch located at the left rear interior of the vehicle. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.

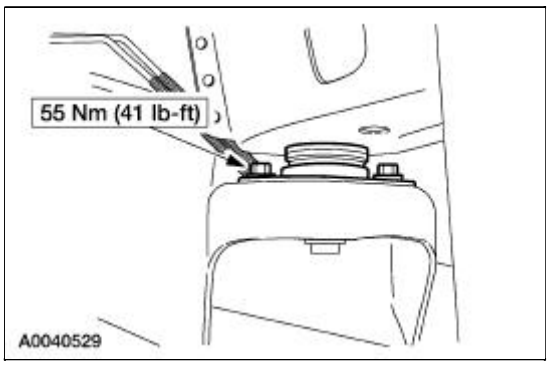
NOTE: Left side shown, right side similar.

1. Remove the body mount bolt.



2. Loosen the remaining body mount bolts.

3. Raise the vehicle body enough to remove the body mount bolts and body mount.



4. **NOTE:** No lubricants of any kind are to be used during body mount installation.

   NOTE: Do not reuse body mount fasteners. New fasteners must be installed for each fastener that has been removed or loosened.

   To install, reverse the removal procedure.

Body Support —Number 2 and Number 3

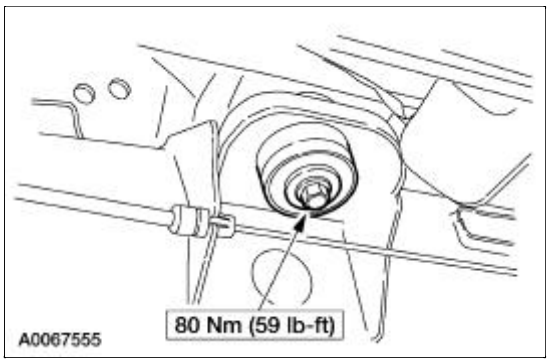
Removal and Installation

WARNING: If equipped with air suspension, the electrical power to the air suspension system must be shut down prior to hoisting, jacking or towing an air suspension equipped vehicle. This can be accomplished by turning off the air suspension switch located at the left rear interior of the vehicle. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.

NOTE: Body mount number two, left side shown, all others similar.

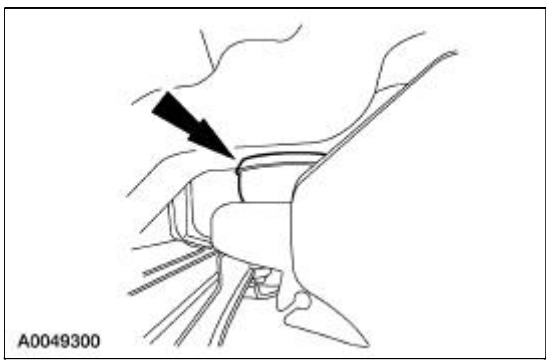
Upper and lower body mount

1. Remove the body mount bolt and lower body mount.



Upper body mount

2. Loosen the remaining body mount bolts.
3. Raise the vehicle body enough to remove the upper body mount.



Upper and lower body mount

4. **NOTE:** No lubricants of any kind are to be used during body mount installation.

   NOTE: Do not reuse body mount fasteners. New fasteners must be installed for each fastener that has been removed or loosened.

To install, reverse the removal procedure.

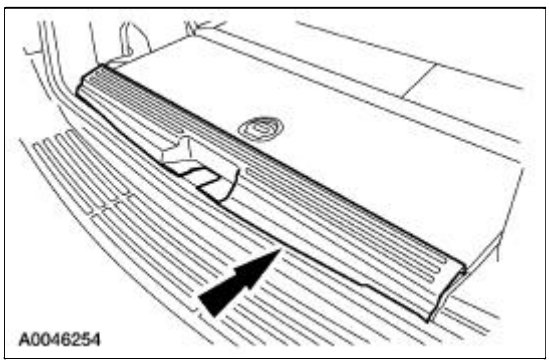
Body Support —Number 4

Removal and Installation

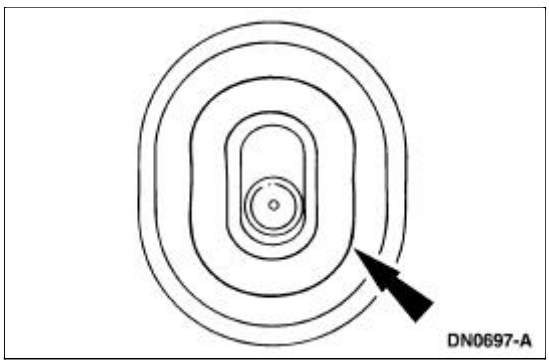
WARNING: If equipped with air suspension, the electrical power to the air suspension system must be shut down prior to hoisting, jacking or towing an air suspension equipped vehicle. This can be accomplished by turning off the air suspension switch located at the left rear interior of the vehicle. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.

NOTE: Left side shown, right side similar.

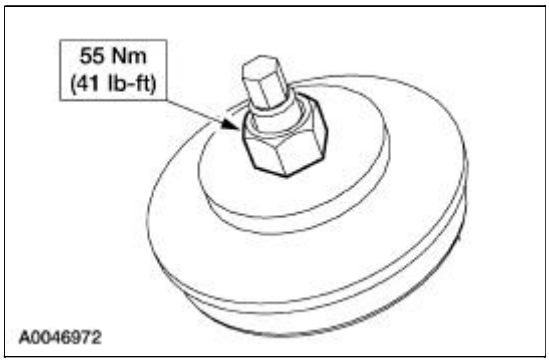
1. Remove the liftgate scuff plate.



2. Remove the body mount bolt cover.

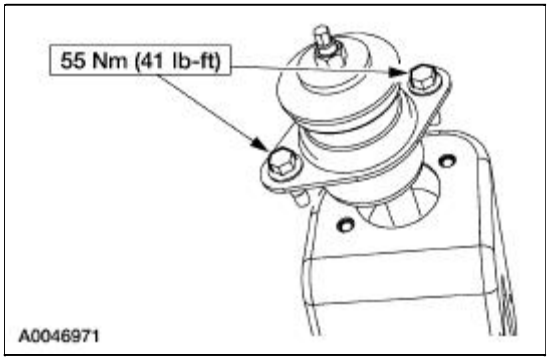


3. Remove the body mount nut.



4. Loosen the remaining body mount bolts.

5. Raise the vehicle body enough to remove the body mount bolts.



6. **NOTE:** No lubricants of any kind are to be used during body mount installation.

   NOTE: Do not reuse body mount fasteners. New fasteners must be installed for each fastener that has been removed or loosened.

   To install, reverse the removal procedure.

Body Support —Radiator Support

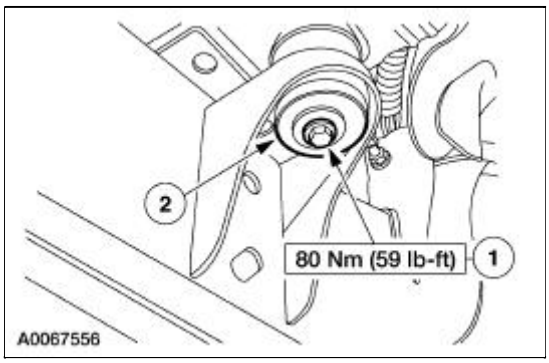
Removal and Installation

WARNING: If equipped with air suspension, the electrical power to the air suspension system must be shut down prior to hoisting, jacking or towing an air suspension equipped vehicle. This can be accomplished by turning off the air suspension switch located at the left rear interior of the vehicle. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.

NOTE: Left side shown, right side similar.

Upper and lower body mount

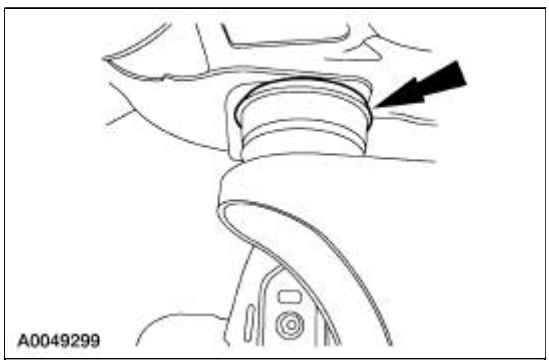
1. Remove the lower radiator body mount.
    1. Remove the lower radiator body mount bolt.
    2. Remove the lower radiator body mount.



Upper body mount

2. Loosen the remaining body mount bolts.

3. Raise the vehicle body enough to remove the upper body mount.



Upper and lower body mount

4. **NOTE:** No lubricants of any kind are to be used during body mount installation.

   NOTE: Do not reuse body mount fasteners. New fasteners must be installed for each fastener

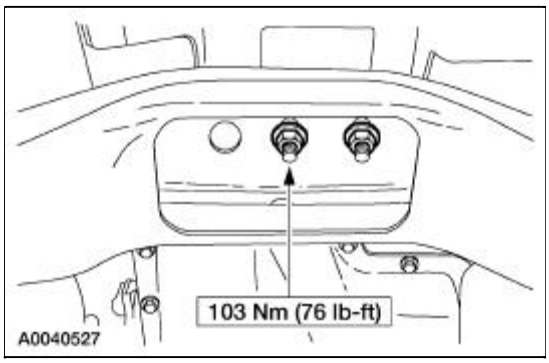
that has been removed or loosened.

To install, reverse the removal procedure.

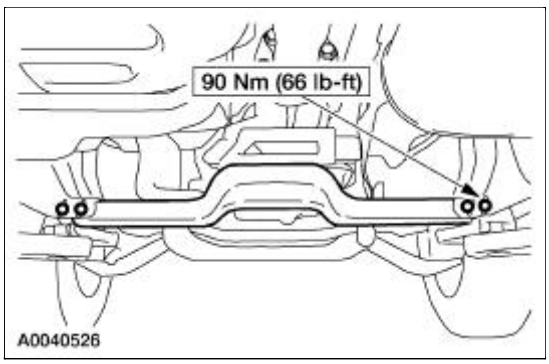
Crossmember —Transmission

Removal and Installation

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Remove the transmission mount nuts.



3. Support the transmission.
4. Remove the transmission crossmember bolts and transmission crossmember.



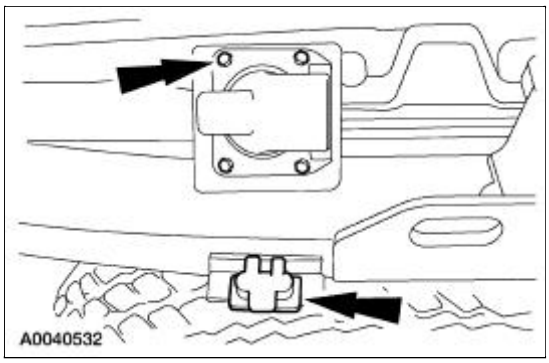
5. To install, reverse the removal procedure.

Trailer Hitch

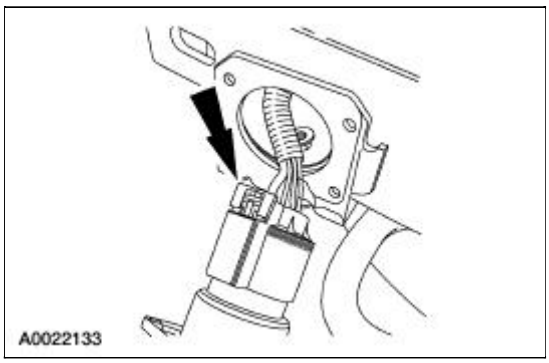
Removal and Installation

WARNING: Do not permanently remove the trailer hitch. Always reinstall the hitch before delivery of the vehicle to the customer. Failure to follow this warning could increase the risk of injury in a rear end collision.

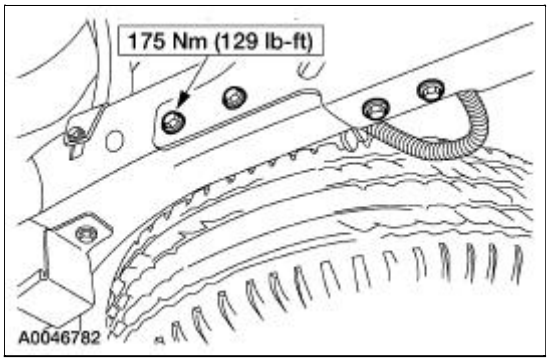
1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Remove the trailer hitch rear bumper cover trim panel.
3. Remove the trailer lighting plug cover and disconnect the electrical connector.



4. Remove the trailer lighting plug.
    1. Position the plug away from the trailer hitch.
    2. Disconnect the electrical connector.
    3. Remove the trailer lighting plug.



5. Remove the trailer hitch.
    - Remove the eight bolts.



6. **NOTE:** Do not reuse body support mounting fasteners. New fasteners must be installed for each fastener that has been removed or loosened.

   To install, reverse the removal procedure.

GENERAL INFORMATION

INTRODUCTION

In the past, when cars were simpler, diagrams were simpler. All components were connected by wires, and diagrams seldom exceeded 4 pages in length. Today, some wiring diagrams require more than 16 pages. It would be impractical to expect a service technician to trace a wire from page 1 across every page to page 16.

Components shown with a dashed line instead of a solid line indicate not all circuits are shown in this particular diagram (circuits shown in system diagrams are typically applicable to that system only). The remaining circuits connected to that component will be shown in the appropriate system that they apply to.

Today, the wiring diagram necessary to support a given repair procedure is included within that article or a link is provided to the appropriate SYSTEM WIRING DIAGRAM article. For example, the wiring diagram for a Ford EEC-IV system may be included in ENGINE PERFORMANCE and WIRING DIAGRAMS articles for Ford Motor Co. The wiring diagram for a cruise control system may be included in ACCESSORIES & EQUIPMENT section for the specific vehicle manufacturer, and the wiring diagram for an anti-lock brake system may be included in BRAKES and WIRING DIAGRAMS for the specific manufacturer.

WIRING DIAGRAMS contains all wiring diagrams not included in STARTING & CHARGING SYSTEMS and ACCESSORIES & EQUIPMENT. This includes: Data Link Connectors, Ground Distribution, Power Distribution, Engine Performance, Electric Cooling Fans, Anti-Lock Brakes, Electronic Suspension and Electronic Steering wiring diagrams. The Data Link Connectors wiring diagrams show the circuits by which the various on-board computers exchange information, and the diagnostic connectors used for diagnosis and their location. The Ground Distribution wiring diagrams show all vehicle ground points, their location, and the components common to those ground points. The Power Distribution wiring diagrams show the power feed circuits and the components common to those power feeds.

Wiring diagrams used to support the information in ACCESSORIES & EQUIPMENT are drawn in a "top-down" format. The diagrams are drawn with the power source at the top of the diagram and the ground point at the bottom of the diagram. Component locations are identified on the wiring diagrams. Any wires that do not connect directly to a component are identified on the diagram to indicate where they go.

WIRING DIAGRAM COLOR ABBREVIATIONS

COLOR ABBREVIATIONS

Color	Normal	Optional

Black	BLK	BK
Blue	BLU	BU
Brown	BRN	BN
Clear	CLR	CR
Dark Blue	DK BLU	DK BU
Dark Green	DK GRN	DK GN
Green	GRN	GN
Gray	GRY	GY
Light Blue	LT BLU	LT BU
Light Green	LT GRN	LT GN
Orange	ORG	OG
Pink	PNK	PK
Purple	PPL	PL
Red	RED	RD
Tan	TAN	TN
Violet	VIO	VI
White	WHT	WT
Yellow	YEL	YL

WIRING DIAGRAM SYMBOLS

NOTE: Standard wiring symbols are used on all wiring diagrams. The list below will help clarify any symbols that are not easily understood at a glance. Most components are labeled "Motor", "Switch" or "Relay" in addition to being drawn with the standard symbol.

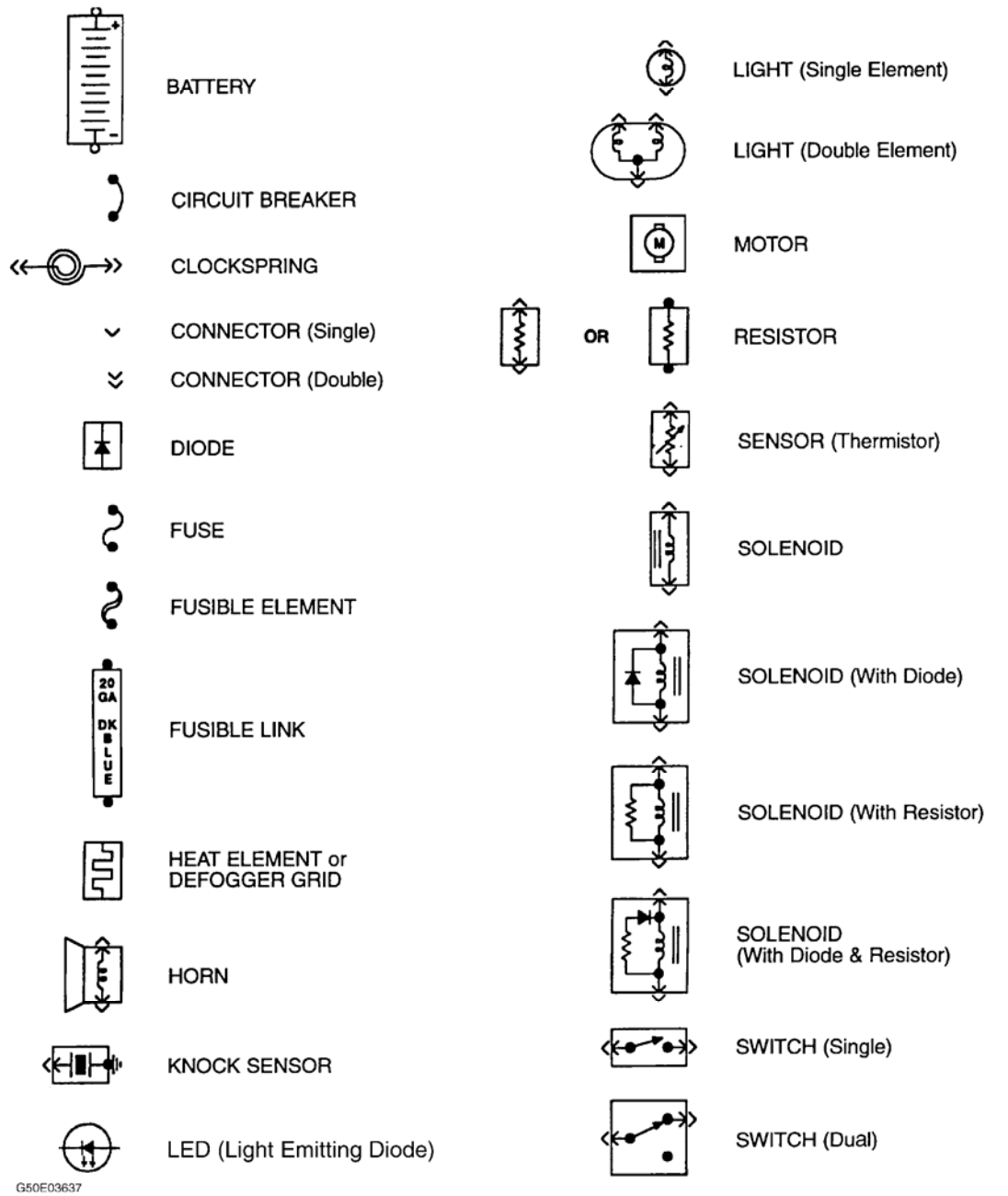
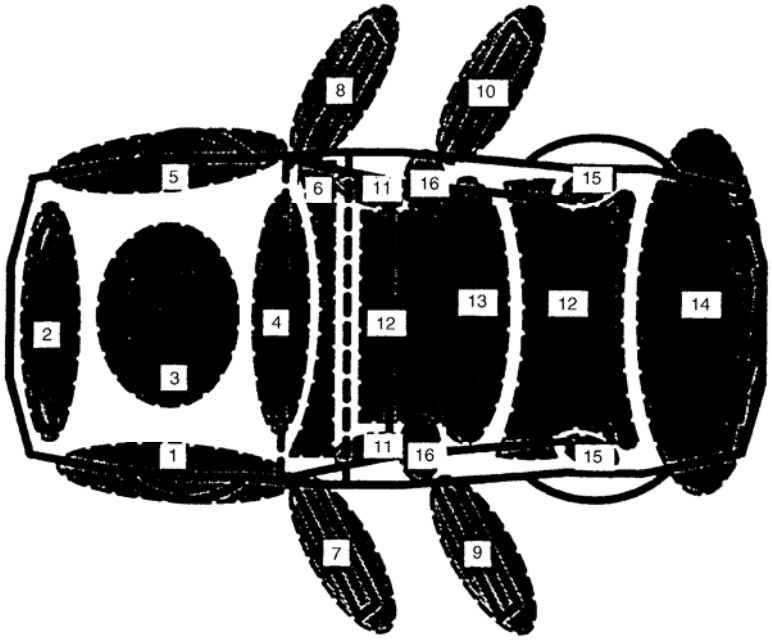


Fig. 1: Identifying Standard Wiring Diagram Symbols

WIRING DIAGRAM GROUND NUMBER LOCATIONS

NOTE: **The following illustration depicts standardized ground numbers and locations to be used in conjunction with wiring diagrams applying to 2001 and prior model years only. See Fig. 2 . Wiring diagrams applying to newer model years depict manufacturer-specified ground numbers and locations. Do not utilize the illustration with 2002 and newer**

model year wiring diagrams.



1) Left Fender
G100 ..... Front Of Fender
G102 ..... On Shock Tower
G104 ..... Rear Of Fender

2) Front of Vehicle
G106 ..... Behind Left Headlight
G107 ..... Behind Right Headlight
G108 ..... Left Radiator Support
G109 ..... Right Radiator Support

3) Engine
G110 ..... Left Front Of Engine
G111 ..... Left Front Behind Battery
G112 ..... Left Side Of Engine
G114 ..... Left Rear Of Engine
G115 ..... Rear Of Engine
G117 ..... Right Rear Of Engine
G119 ..... Right Front Of Engine
G120 ..... Right Side Of Engine
G125 ..... Front Of Engine
G127 ..... Left Underside Of Hood
G128 ..... Right Underside Of Hood
G129 ..... Top Center Of Transaxle

4) Safety Wall
G116 ..... Left Side Of Safety Wall
G121 ..... Center Of Safety Wall
G123 ..... Right Side Of Safety Wall

5) Right Fender
G101 ..... Front Of Fender
G103 ..... On Shock Tower
G105 ..... Rear Of Fender

6) Instrument Panel
G200 ..... Left Kick Panel
G201 ..... Right Side Of I/P
G202 ..... Left Side Of I/P
G203 ..... Right Kick Panel
G204 ... Left Rear Of Steering Support
G205 .. Right Rear Of Steering Support
G206 ..... Center Of I/P
G207 ..... Top Of Steering Column

7) Left Front Door
G500 ..... Left Front Door

8) Right Front Door
G600 ..... Right Front Door

9) Left Rear Door
G700 ..... Left Rear Door

10) Right Rear Door
G800 ..... Right Rear Door

11) "A" Pillars
G900 ..... Left "A" Pillar
G901 ..... Right "A" Pillar

12) Passenger Compartment
G300 ..... Below Left Front Seat
G301 ..... Below Right Front Seat
G302 ..... Below Center Console
G303 ..... Below Right Rear Seat
G304 ..... Below Left Rear Seat
G306 ..... Below Center Of Rear Seat
G307 ..... Below Right Rear Window
G309 ..... Left Front Door Sill
G310 ..... Behind Right Rear Seat
G311 ..... Center Of Rear Shelf
G312 ..... Behind Left Rear Seat

13) Roof
G902 ..... Left Front Of Roof
G903 ..... Right Front Of Roof
G906 ..... Left Rear Of Roof
G907 ..... Right Rear Of Roof
G908 ..... Center Front Of Roof
G909 ..... Center Rear Of Roof

14) Rear Of Vehicle
G400 ..... Left Front Side Of Trunk
G401 ..... Right Front Side Of Trunk
G402 ..... Left Rear Wheelwell
G403 ..... Right Rear Wheelwell
G404 ..... Left Rear Side Of Trunk
G405 ..... Right Rear Side Of Trunk
G406 ..... Center Rear Of Trunk Lid
G407 ..... Center Rear Of Trunk
G408 ..... Center Front Of Trunk
G409 ..... Rear Of Cargo Bed

15) "C" Pillars
G904 ..... Left "C" Pillar
G905 ..... Right "C" Pillar

16) "B" Pillars
G305 ..... Right "B" Pillar
G308 ..... Left "B" Pillar

G00027307

Fig. 2: Ground Numbers & Locations (2001 & Prior Model Years)

WIRING DIAGRAM COMPONENT LOCATIONS

When trying to locate a component in a wiring diagram and you don't know the specific system where it is located, use this handy component locator to find the system wiring diagram in which the component is located. Then, go to that system and locate the component within the wiring diagram.

For example, if you don't know the specific system in which the ignition switch is located, look up ignition switch in the wiring diagram component location tables and go to the appropriate wiring diagram(s) which contain either full or partial views of the ignition switch. The full view of the ignition switch is located in Power Distribution.

The first listing for the component will be the full or most complete view of the component. Additional listings will be partial views of the component. Not all components are used on all models.

All components will have a partial view in Ground Distribution and Power Distribution. Data Link Connectors show connecting circuits between modules. Alternate names for components may be listed in wiring diagram component locations tables.

WIRING DIAGRAM COMPONENT LOCATIONS

Component	Wiring Diagram
ABS Electronic Control Unit	Anti-Lock Brakes; Data Link Connectors
ABS Hydraulic Unit	Anti-Lock Brakes
Acceleration Sensor	Anti-Lock Brakes
Accessory Delay Relay	Power Windows
A/C Compressor Clutch Relay	Engine Performance
A/C Sensor	Engine Performance
A/C Pressure Switch	Engine Performance
Adaptive Lamp Control Module	Exterior Lights
Air Bag(s)	Air Bag Restraint System
Air Bag Module	Air Bag Restraint System
Air Bag Sensor(s)	Air Bag Restraint System
Air Injection Pump Relay	Engine Performance
Air Temperature Sensor	Overhead Console
Alternator (Generator)	Generators & Regulators
Anti-Theft Control Module	Anti-Theft System; Starters
Autolamp Control Relay	Headlight Systems; Daytime Running Lights
Automatic Shutdown (ASD) Relay	Engine Performance; Generators & Regulators
Autostick Switch	Engine Performance
Auxiliary Battery Relay	Generators & Regulators
Back-Up Lights	Back-Up Lights; Exterior Lights
Barometric (BARO) Pressure Sensor	Engine Performance
Battery	Power Distribution
Battery Temperature Sensor	Engine Performance
Body Control Module	Body Control Computer; Anti-Theft System; Daytime Running Lights; Engine Performance; Headlight Systems; Warning Systems
Boost Control Solenoid	Engine Performance
Boost Sensor	Engine Performance
Brake Fluid Level Switch	Analog Instrument Panels
Brake On/Off (BOO) Switch	Cruise Control Systems; Engine Performance; Shift Interlock Systems
Buzzer Module	Warning Systems

Camshaft Position (CMP) Sensor	Engine Performance
Central Control Module	Anti-Theft System
Clockspring	Air Bag Restraint System; Cruise Control Systems; Steering Column Switches
Clutch Pedal Position Switch	Starters
Clutch Start Switch	Starters
Combination Meter	Analog Instrument Panels
Constant Control Relay Module (CCRM)	Engine Performance; Electric Cooling Fans
Convenience Center	Power Distribution; Illumination/Interior Lights
Convertible Top Motor	Power Convertible Top
Convertible Top Switch	Power Convertible Top
Crankshaft Position (CKP) Sensor	Engine Performance
Cruise Control Module	Cruise Control Systems
Cruise Control Switch	Cruise Control Systems
Condenser Fan Relay(s)	Electric Cooling Fans
Data Link Connector (DLC)	Engine Performance
Daytime Running Lights Module	Daytime Running Lights; Exterior Lights
Defogger Relay	Rear Window Defogger
Diagnostic Energy Reserve Module (DERM)	Air Bag Restraint System
Discriminating Sensor (Air Bag)	Air Bag Restraint System
Distributor	Engine Performance
Door Lock Actuators	Power Door Locks; Remote Keyless Entry
Door Lock Relay(s)	Power Door Locks
Electrochromic Mirror	Power Mirrors
Electronic Level Control (ELC) Height Sensor	Electronic Suspension
Electronic Level Control (ELC) Module	Electronic Suspension
Engine Coolant Temperature (ECT) Sending Unit	Analog Instrument Panels
Engine Coolant Temperature (ECT) Sensor	Engine Performance
Engine Control Module	Engine Performance; Generators & Regulators; Starters
ETACS ECU	Warning Systems; Power Windows; Remote Keyless Entry
Evaporative (EVAP) Emissions Canister	Engine Performance
EVAP Canister Purge Solenoid	Engine Performance
EVAP Canister Vent Solenoid	Engine Performance
Exhaust Gas Recirculation (EGR) Valve	Engine Performance
Fuel Tank Vacuum Sensor	Engine Performance
Fog Lights	Headlight Systems; Daytime Running Lights
Fog Light Relay	Headlight Systems; Daytime Running Lights
Fuel Door Release Solenoid	Power Fuel Door Release
Fuel Gauge Sending Unit	Analog Instrument Panels
Fuel Injectors	Engine Performance
Fuel Pump	Engine Performance
Fuel Pump Relay	Engine Performance; Power Distribution

Fuse/Relay Block	Power Distribution
Fusible Links	Power Distribution; Generators & Regulators; Starters
Generator	Generators & Regulators; Engine Performance; Power Distribution
Generic Electronic Module (GEM)	Body Control Modules; Electronic Suspension
Glow Plug Relay	Engine Performance
Glow Plugs	Engine Performance
Grounds	Ground Distribution
Headlight Door Module	Headlight Doors
Headlight Relay	Headlight Systems; Daytime Running Lights
Headlights	Headlight Systems; Daytime Running Lights
Heated Oxygen Sensor(s) (HO2S)	Engine Performance
Heated Windshield Control Module	Heated Windshields
Height Sensor	Electronic Suspension
Horns	Steering Column Switches
Horn Relay	Steering Column Switches
Idle Air Control (IAC) Motor/Valve	Engine Performance
Ignition Coil(s)	Engine Performance
Ignition Key Lock Cylinder	Anti-Theft System
Ignition Module	Engine Performance
Ignition Switch	Power Distribution; Engine Performance; Generators & Regulators; Starters
Illuminated Entry Module	Illumination/Interior Lights
Illumination Lights	Illumination/Interior Lights
Impact Sensor	Air Bag Restraint System
Inertia Fuel Shutoff Switch	Engine Performance
Inhibit Relay	Starters
Instrument Cluster	Analog Instrument Panels
Intake Air Temperature (IAT) Sensor	Engine Performance
Interior Lights	Illumination/Interior Lights
Interlock Switch	Starters
Junction Block	Power Distribution
Keyless Entry Receiver	Remote Keyless Entry
Key Reminder Switch	Starters
Knock Sensor	Engine Performance
Lamp Control Module	Exterior Lights
License Plate Lamp	Exterior Lights
Lighting Control Module	Lighting Control Modules; Anti-Theft System; Daytime Running Lights; Headlight Systems
Lower Relay	Power Convertible Top
Malfunction Indicator Light (MIL)	Engine Performance; Instrument Panels
Manifold Absolute Pressure (MAP) Sensor	Engine Performance
Mass Airflow (MAF) Sensor	Engine Performance

Mega Fuse	Generators & Regulators
Memory Seat/Mirror Module	Memory Systems
Mirror Defogger	Rear Window Defogger
Moon Roof Motor	Power Moon Roof
Moon Roof Relay	Power Moon Roof
Multi-Function Control Module	Warning Systems
Neutral Safety Switch	Starters
Oil Level Switch	Engine Performance
Oil Pressure Switch/Sending Unit	Analog Instrument Panels; Engine Performance
Overhead Console	Overhead Console
Oxygen Sensor(s) (O2S)	Engine Performance
Parking Brake Switch	Analog Instrument Panels
Park Lights	Exterior Lights
Park/Neutral Position Switch	Starters; Engine Performance; Anti-Theft System; Body Control Module
Perimeter Lighting Control Relay	Exterior Lights
Power Amplifier	Power Antennas
Power Antenna Module	Power Antennas
Power Antenna Motor	Power Antennas
Power Distribution Center	Power Distribution; Generators & Regulators; Starters
Power Door Lock Motors	Power Door Locks
Power Mirror Motors	Power Mirrors; Memory Systems
Power Sliding Door Controller	Power Sliding Side Door
Power Seat Motors	Power Seats; Memory Systems
Power Steering Pressure Switch	Engine Performance
Power Top Motor	Power Convertible Top
Power Top Relay(s)	Power Convertible Top
Powertrain Control Module	Engine Performance; Analog Instrument Panels; Cruise Control Systems; Data Link Connectors; Generators & Regulators; Starters
Power Window Motors	Power Windows
Power Window Relay(s)	Power Windows
Radiator Fan Motor(s)	Electric Cooling Fans
Radiator Fan Relay(s)	Engine Performance; Electric Cooling Fans;
Rainsense Module	Wiper/Washer Systems
Raise Relay	Power Convertible Top
Remote Anti-Theft Personality (RAP) Module	Anti-Theft System; Starters; Warning Systems
Seat Belt Pretensioners	Air Bag Restraint System
Seat Belt Retractor Solenoid	Passive Restraints
Seat Belt Switch	Air Bag Restraint System; Passive Restraints
Shift Interlock Solenoid	Shift Interlock Systems
Shift Lock Actuator	Shift Interlock Systems
Side Marker Lights	Exterior Lights

SIR Coil Assembly (Clockspring)	Air Bag Restraint System
Slip Ring (Clockspring)	Air Bag Restraint System; Steering Column Switches
SRS Control Module	Air Bag Restraint System
Starter Motor	Starters
Starter Interrupt Relay	Starters
Starter Solenoid	Starters
Starter Relay	Starters
Steering Wheel Position Sensor	Anti-Lock Brakes
Stoplights	Exterior Lights
Stoplight Switch	Engine Performance; Cruise Control Systems; Anti-Lock Brakes
Sun Roof ECU	Power Sun Roof
Sun Roof Motor	Power Sun Roof
Sun Roof Position Sensor	Power Sun Roof
Taillights	Exterior Lights
Throttle Position (TP) Sensor	Engine Performance
Torque Converter Clutch Solenoid/Switch	Engine Performance
Traction Control Switch	Anti-Lock Brakes
Trailer Tow Connector	Exterior Lights
Trailer Tow Relay	Exterior Lights
Transmission/Transaxle	Engine Performance
Transmission Control Module (TCM)	Engine Performance; Starters
Transmission Range Sensor	Starters; Back-Up Lights; Engine Performance
Transmission Range Switch	Back-Up Lights; Engine Performance; Anti-Theft System
Turn Signal Flasher	Exterior Lights
Turn Signal Lights	Exterior Lights
Twilight Sentinel Switch	Headlight Systems; Daytime Running Lights
Vapor Canister Leak Detection Pump	Engine Performance
Vehicle Control Module (VCM)	Engine Performance
Vehicle Dynamic Module	Electronic Suspension
Vehicle Speed Control Servo	Cruise Control Systems
Vehicle Speed Sensor	Data Link Connectors; Analog Instrument Panels; Cruise Control Systems; Electronic Suspension
Voltage Regulator	Generators & Regulators
Water-In-Fuel Sensor	Engine Performance; Analog Instrument Panels
Wheel Speed Sensors	Anti-Lock Brakes
Window Timer Module	Power Convertible Top
Windshield Intermittent Wiper Relay	Wiper/Washer Systems
Windshield Washer Motor	Wiper/Washer Systems
Wiper Motor	Wiper/Washer Systems

AIR CONDITIONING

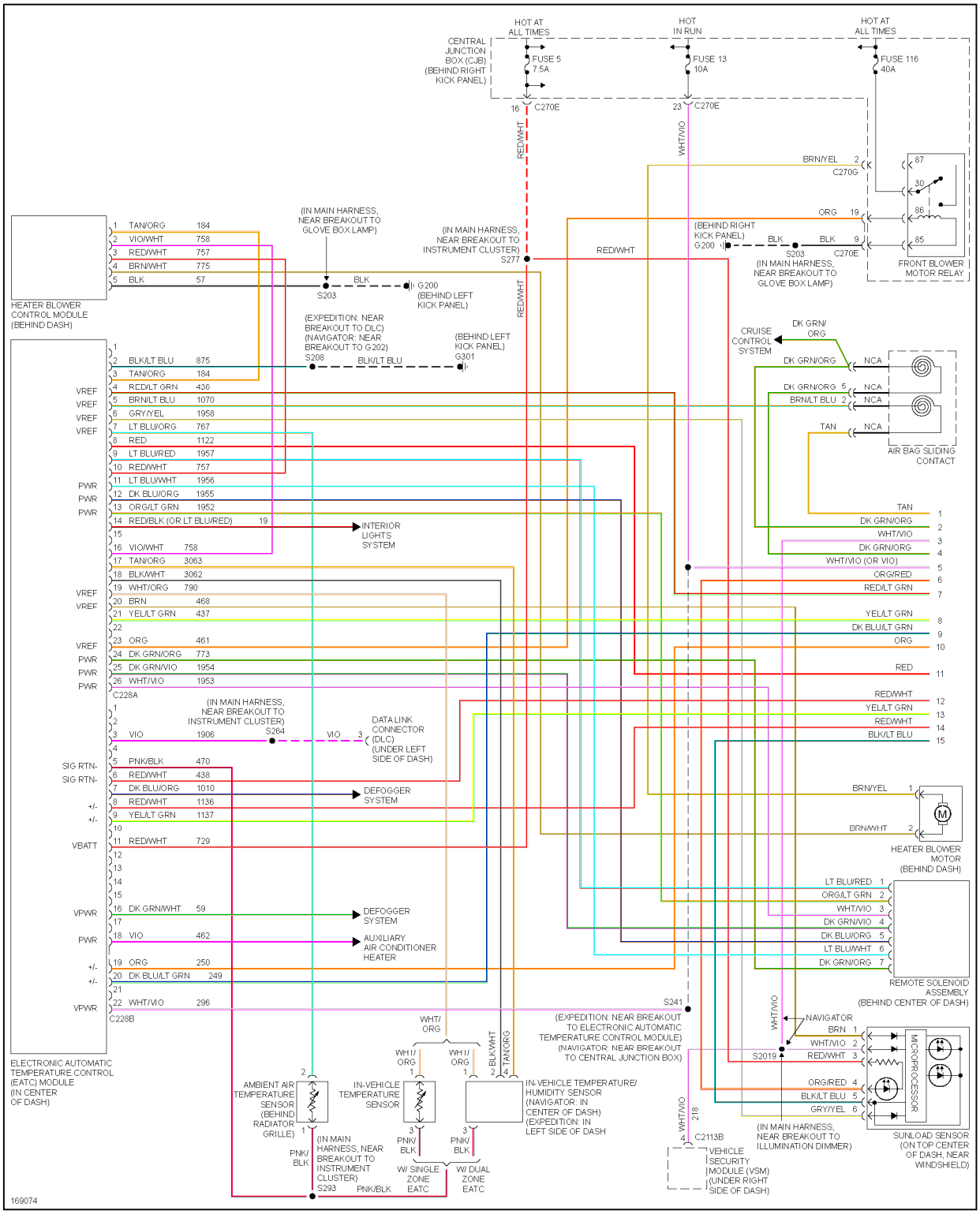


Fig. 1: Automatic A/C Circuit (1 of 2)

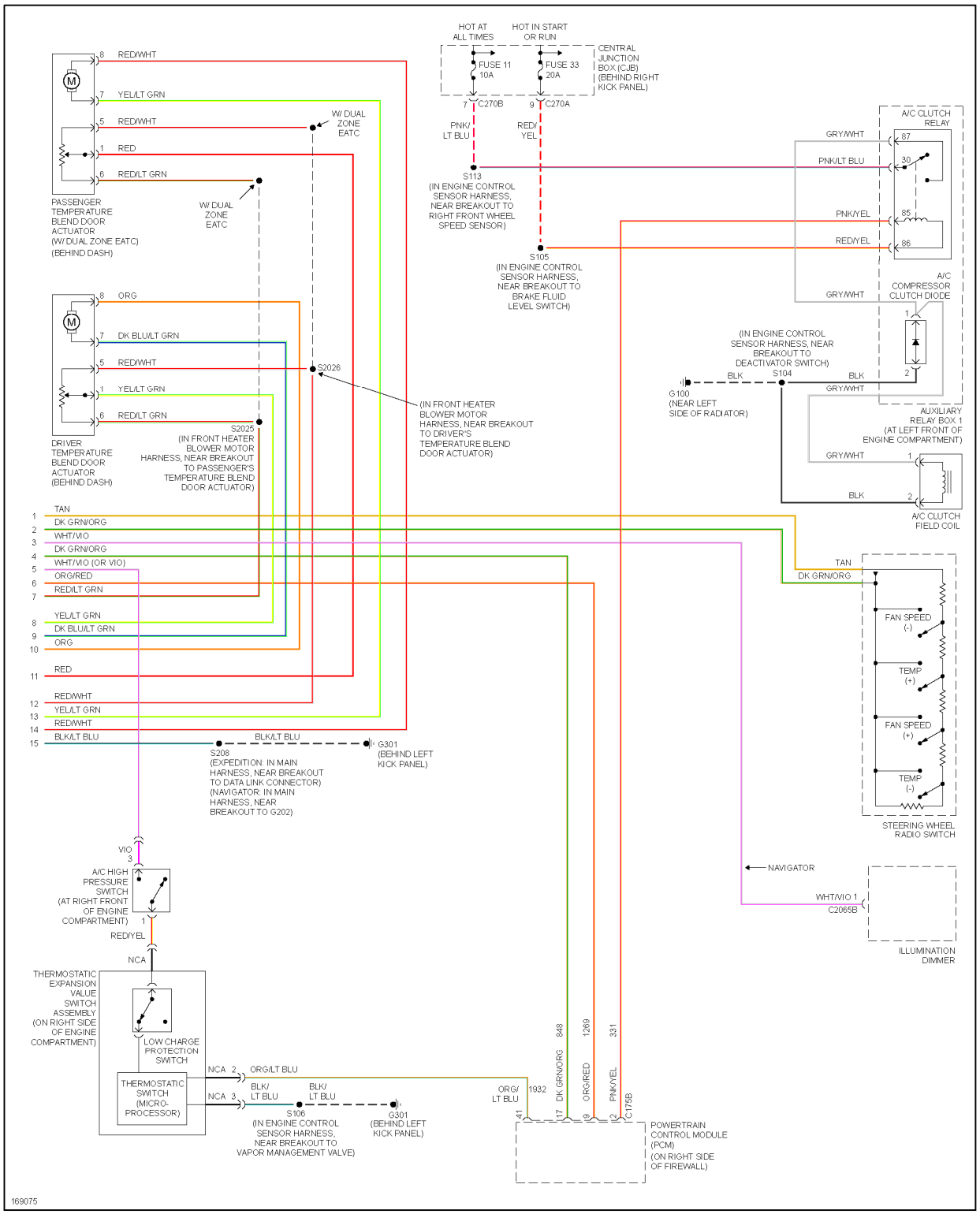


Fig. 2: Automatic A/C Circuit (2 of 2)

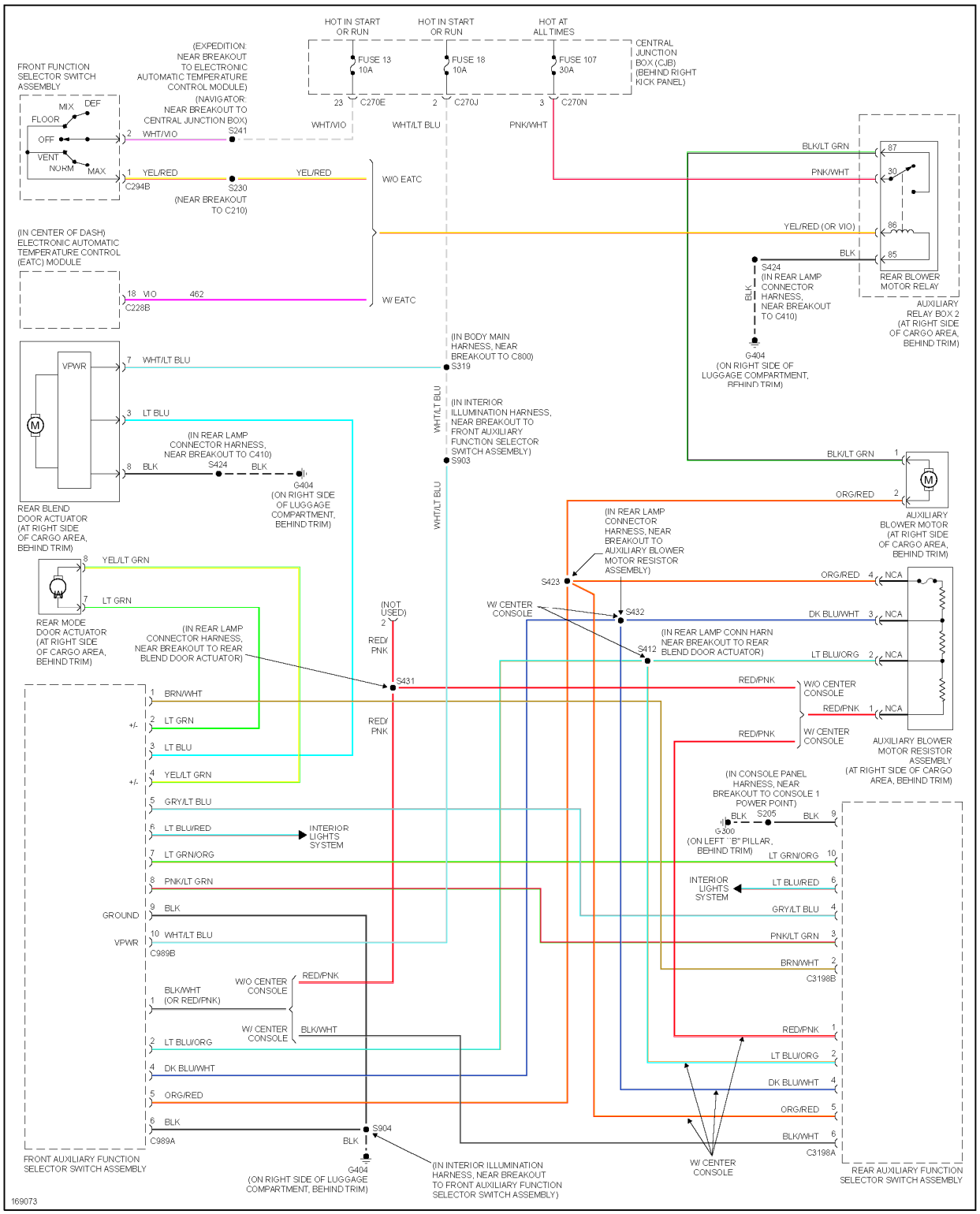


Fig. 3: Auxiliary Heater-A/C Circuit

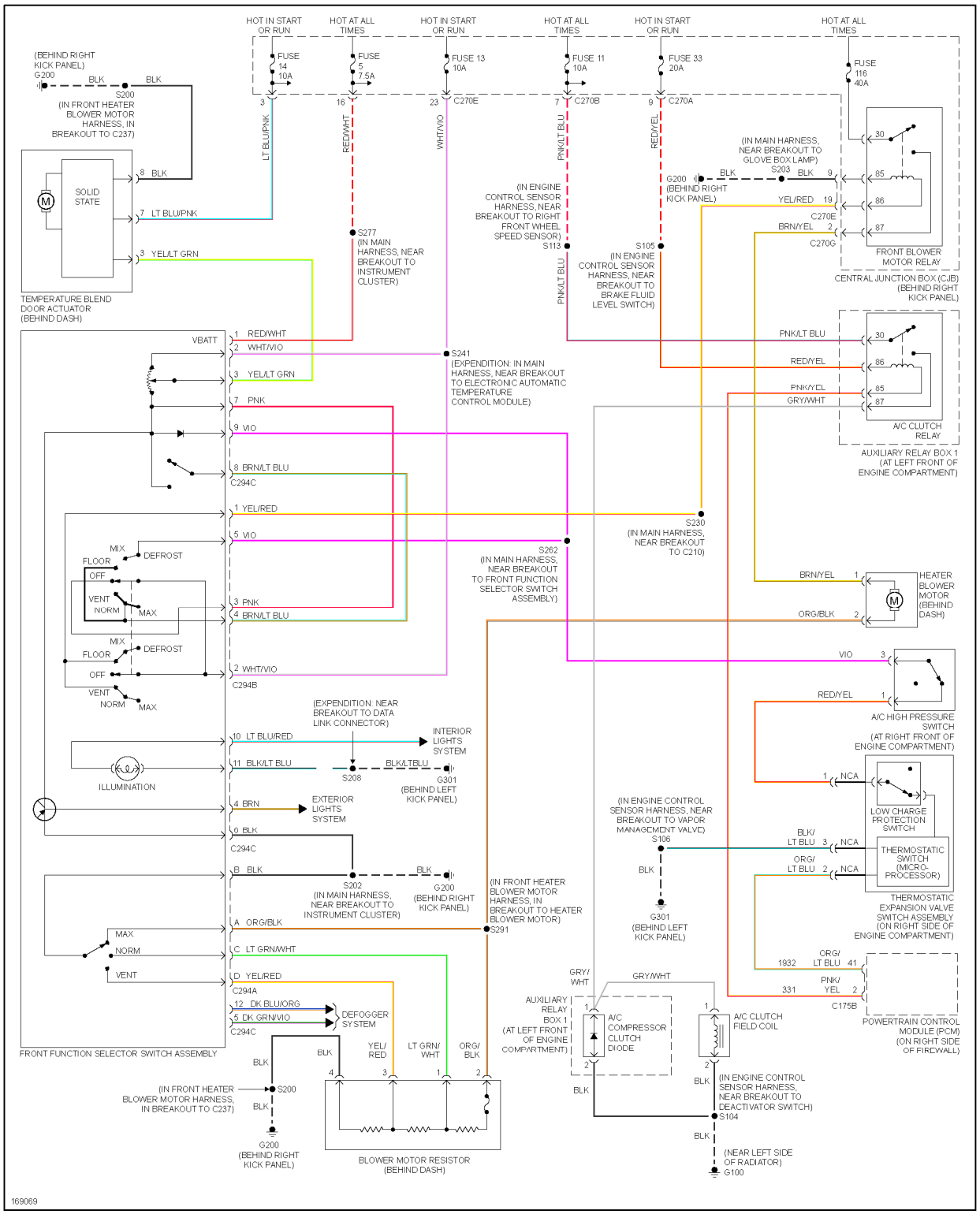


Fig. 4: Manual A/C Circuit

SYSTEM WIRING DIAGRAMS

Ford - Expedition

ANTI-LOCK BRAKES

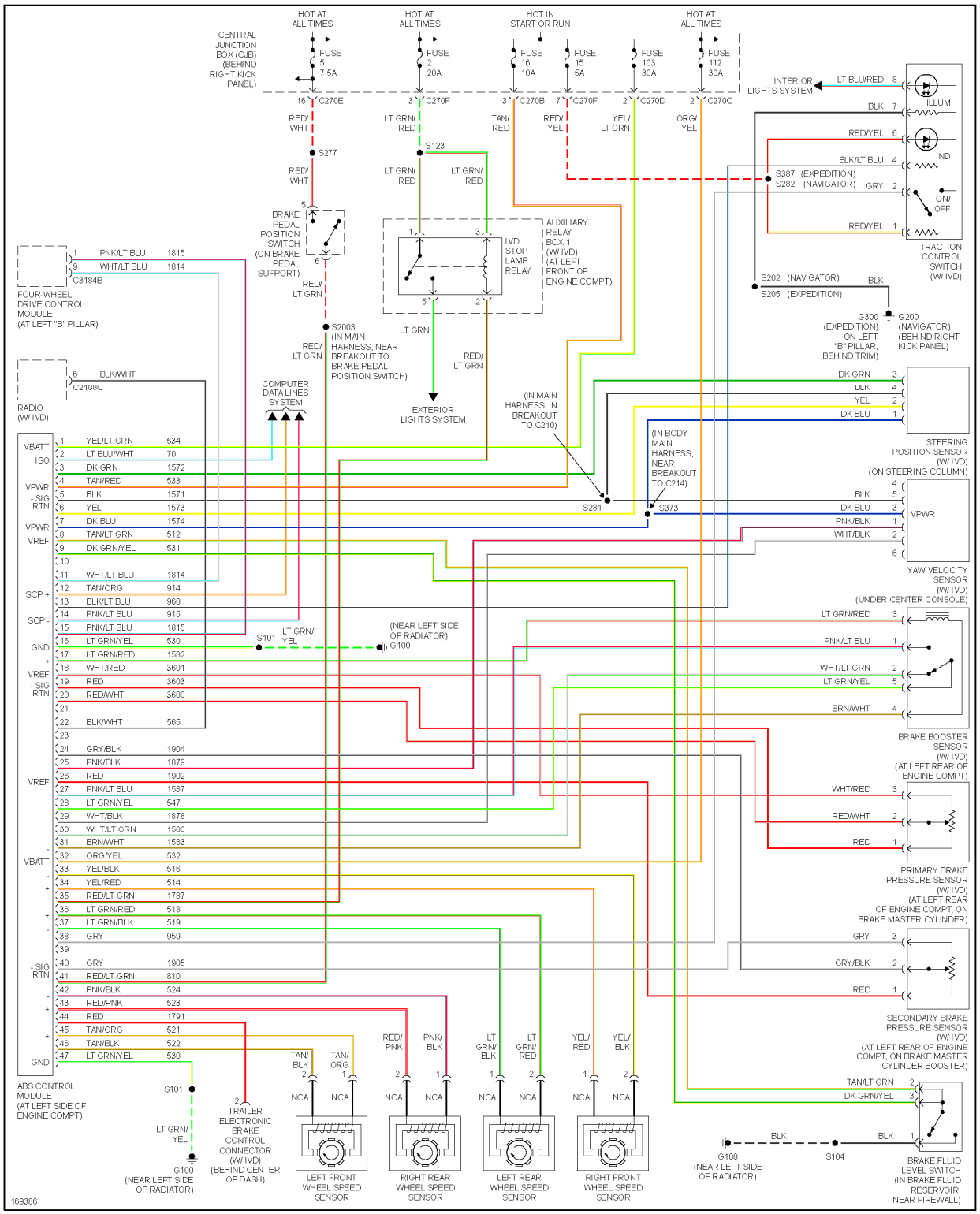


Fig. 5: Anti-lock Brakes Circuit

ANTI-THEFT

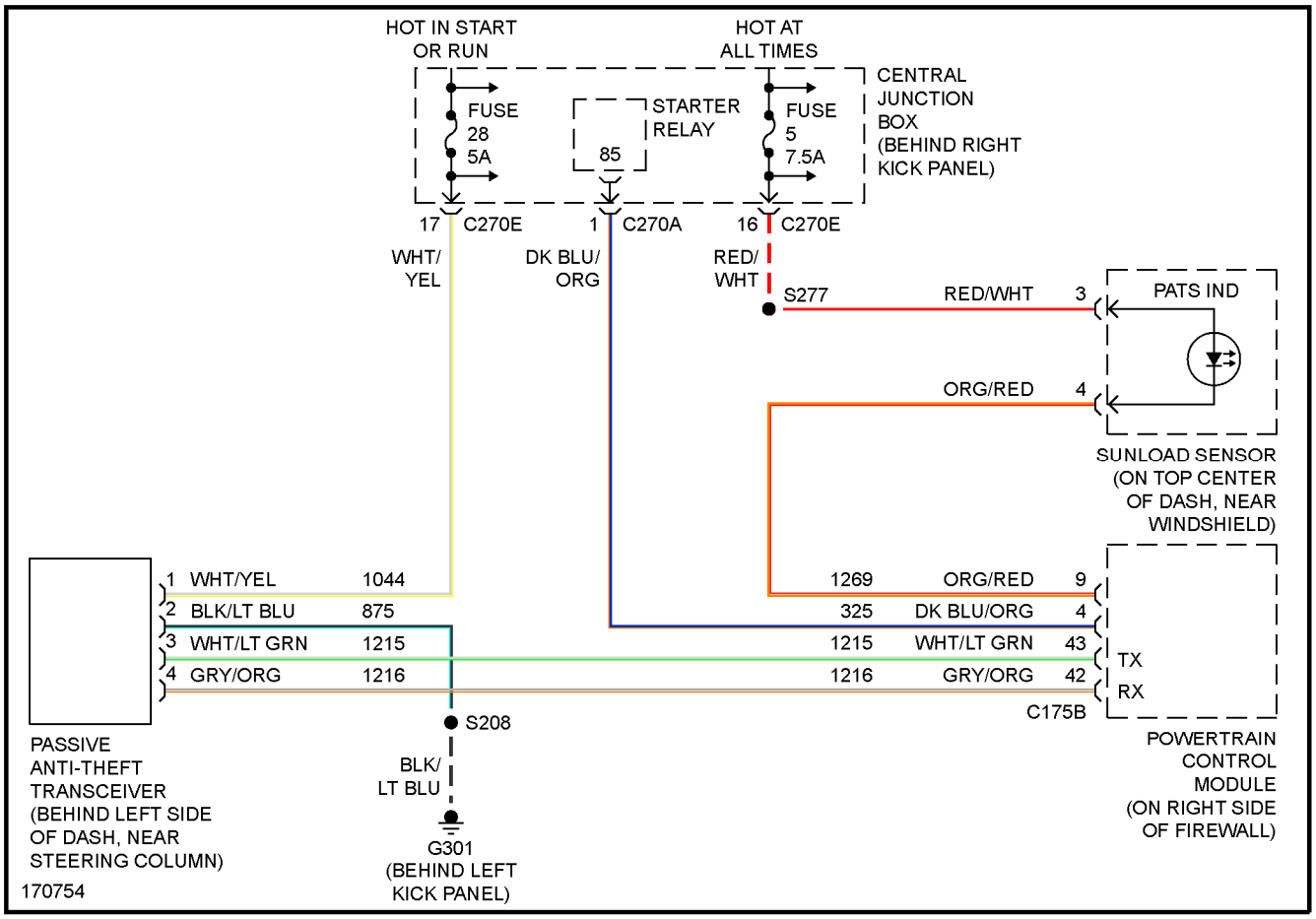


Fig. 6: Passive Anti-theft Circuit

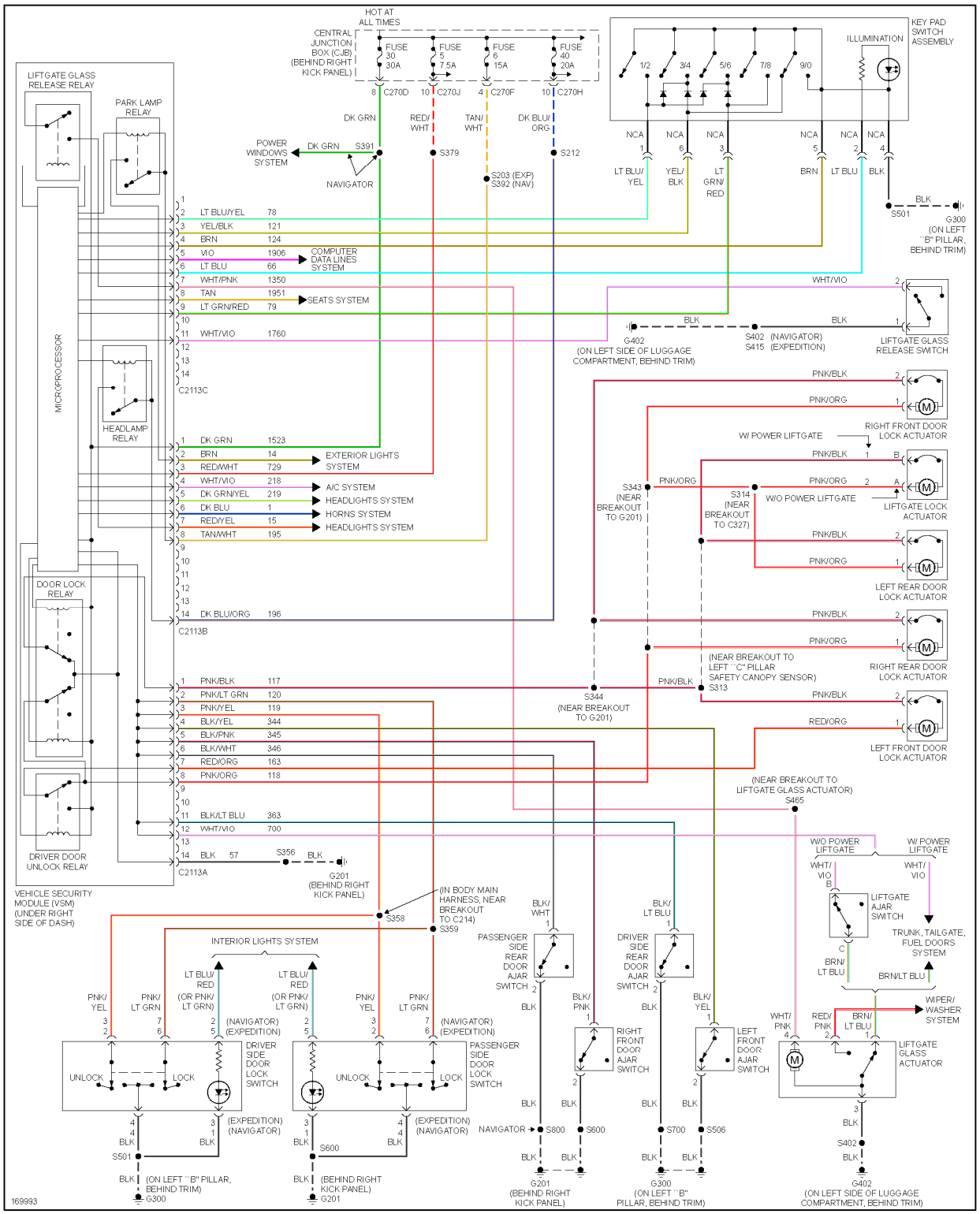


Fig. 7: Power Door Locks Circuit

COMPUTER DATA LINES

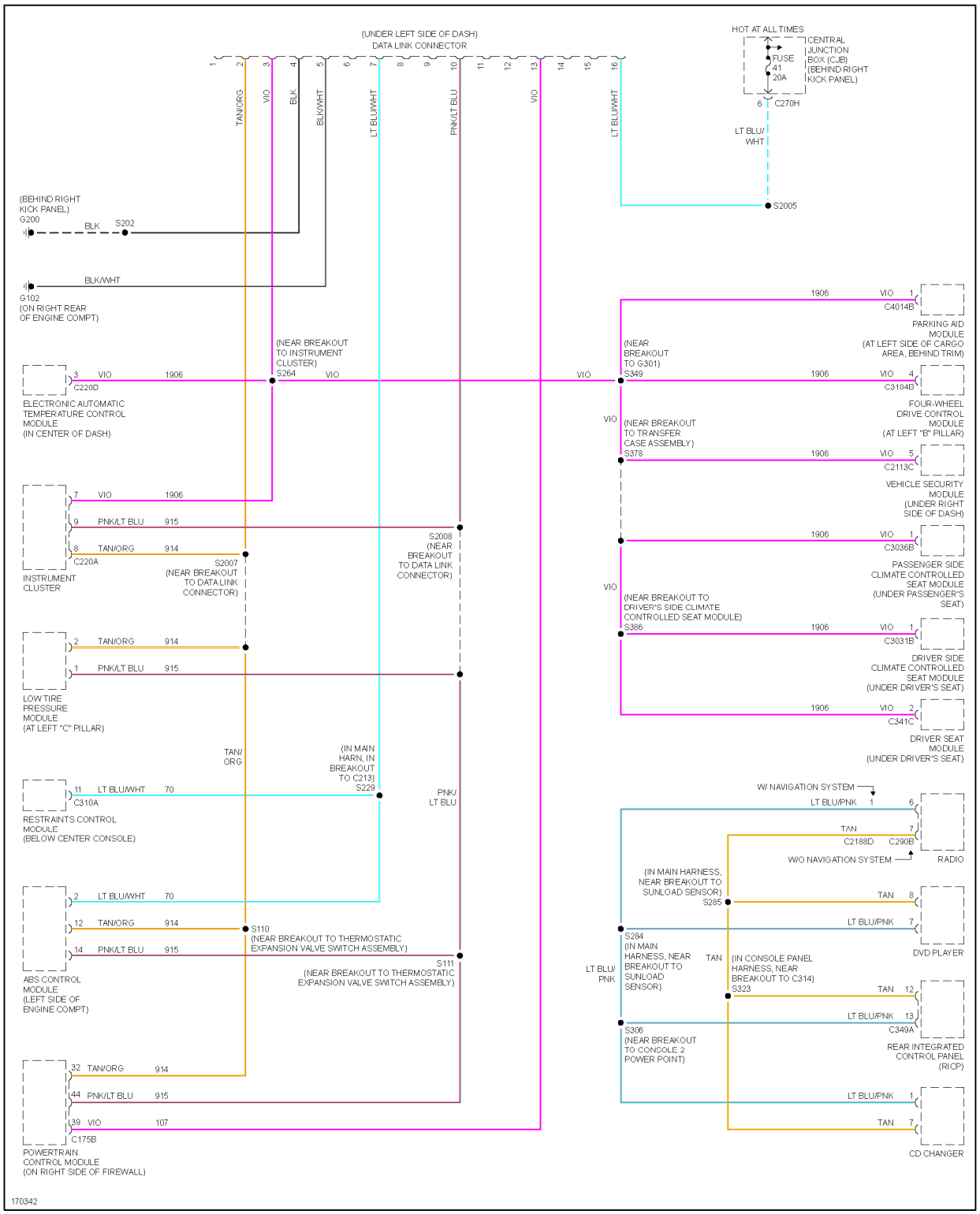


Fig. 8: Computer Data Lines Circuit

COOLING FAN

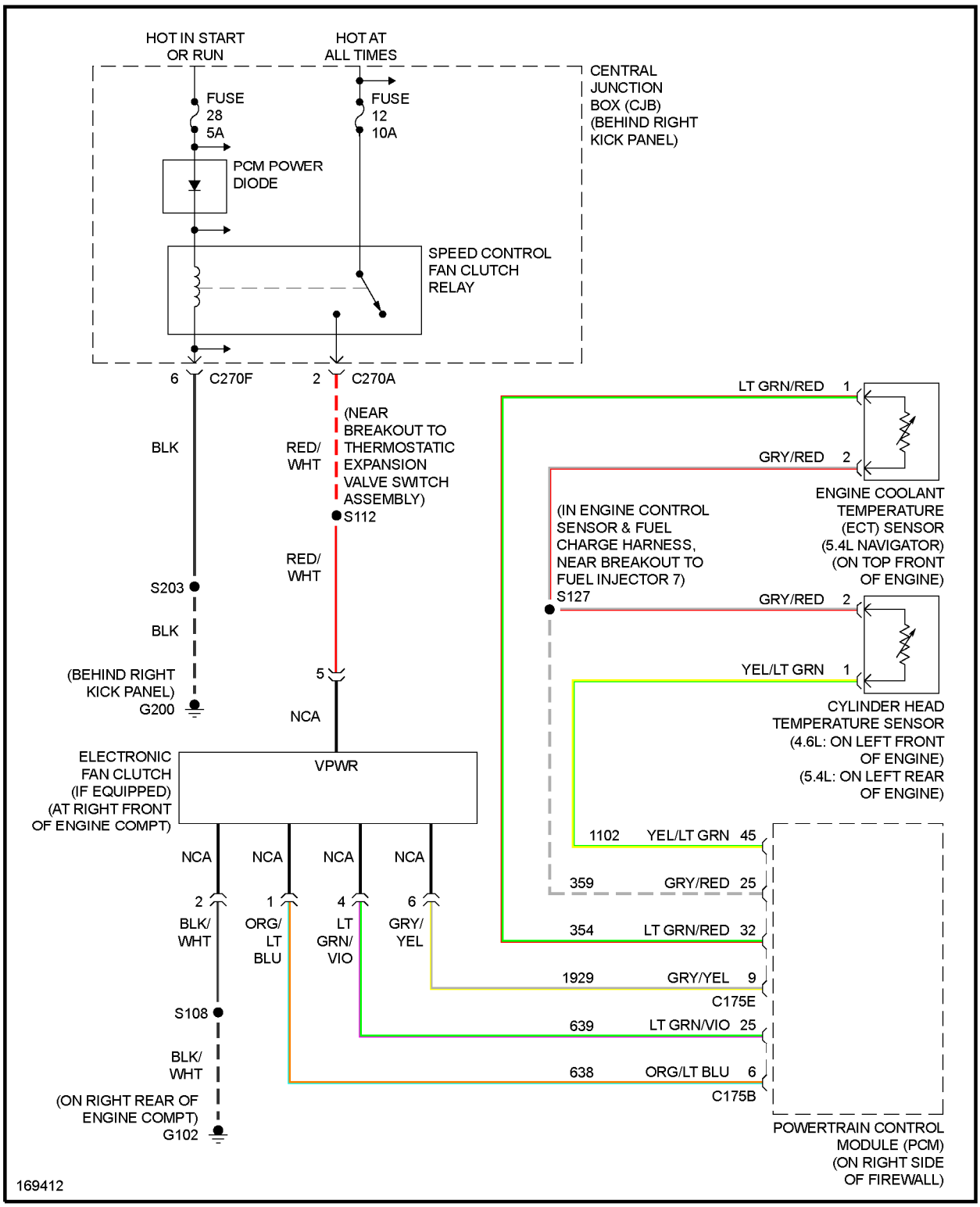


Fig. 9: Cooling Fan Circuit

CRUISE CONTROL

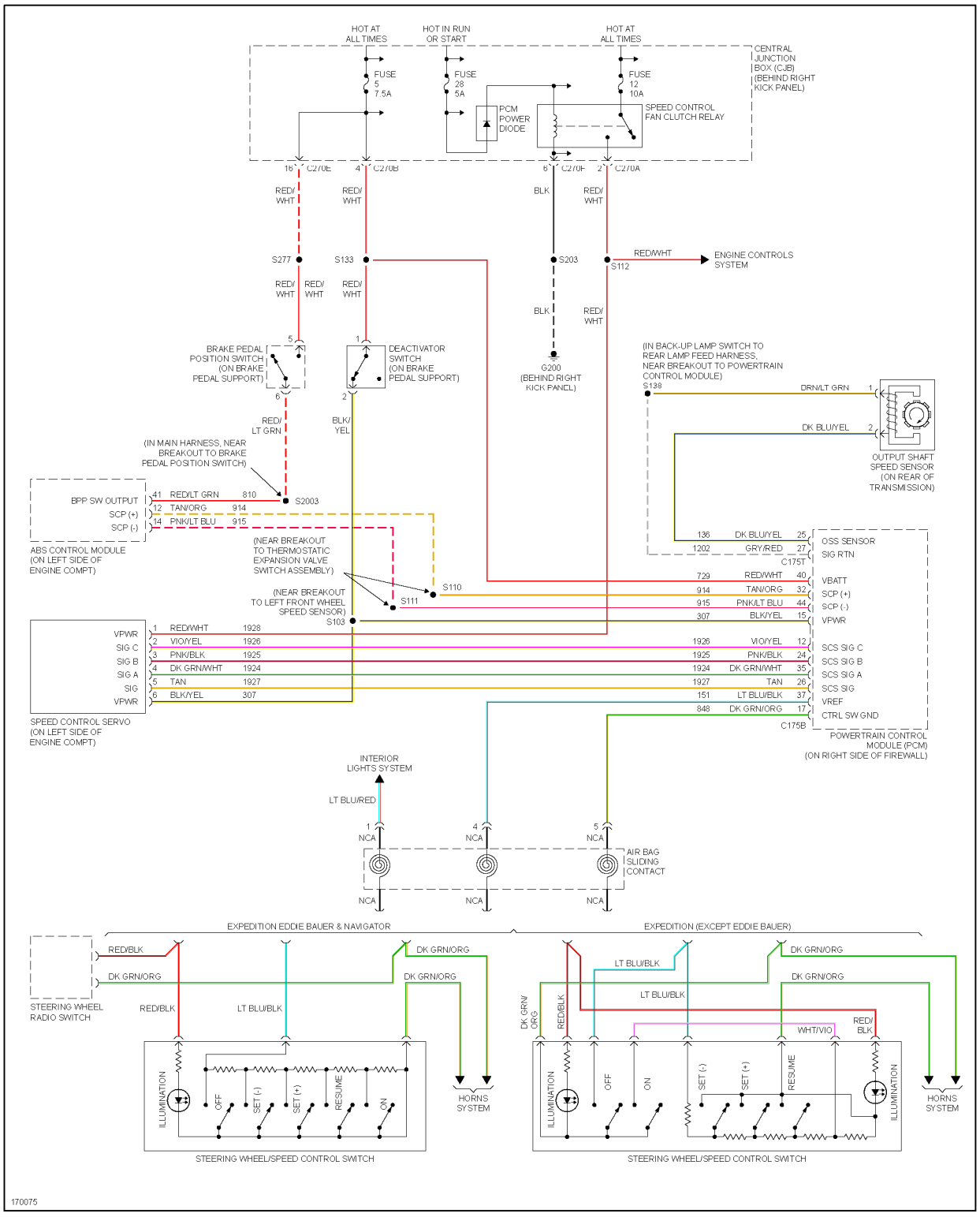


Fig. 10: Cruise Control Circuit

DEFOGGERS

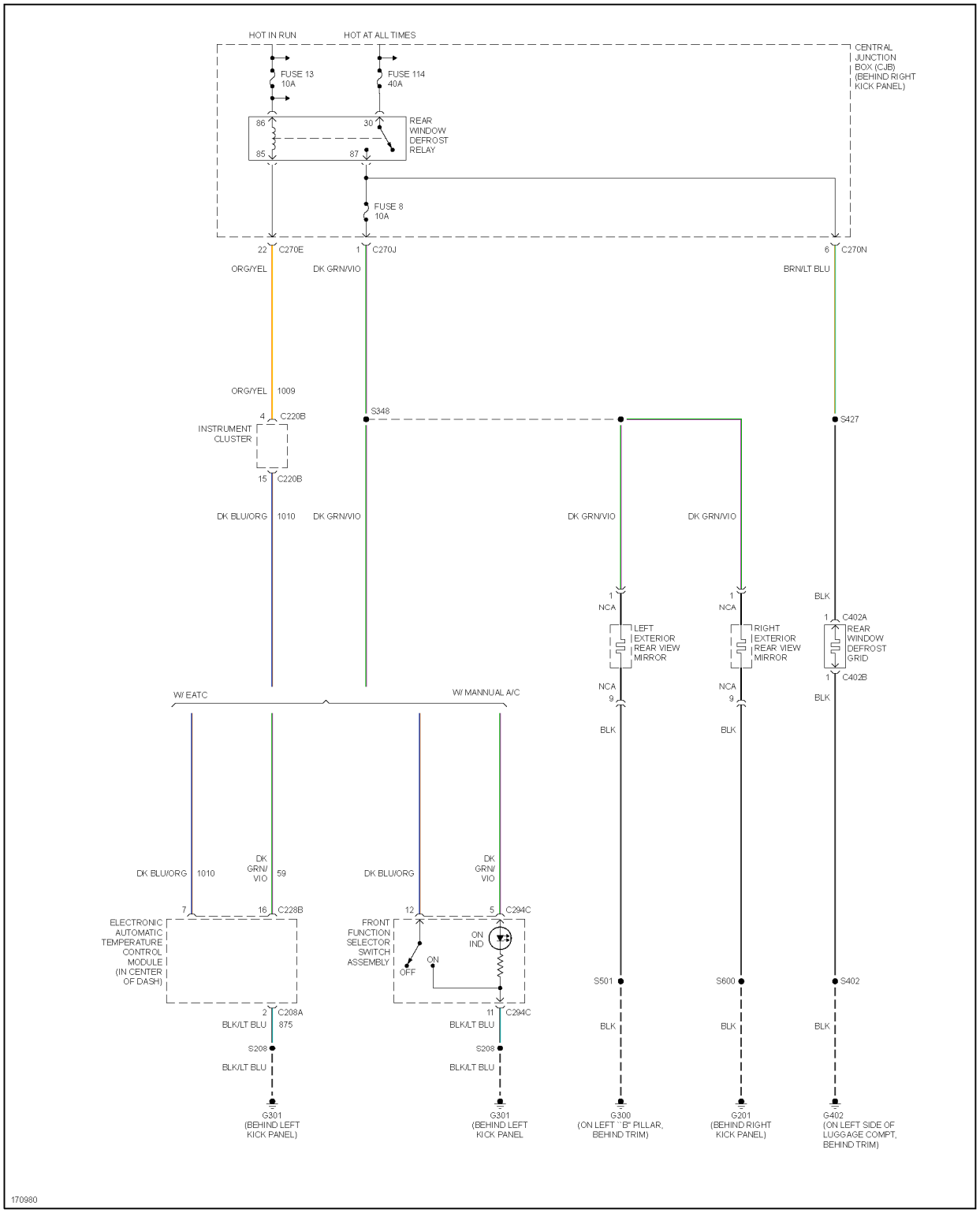


Fig. 11: Defoggers Circuit

ELECTRONIC POWER STEERING

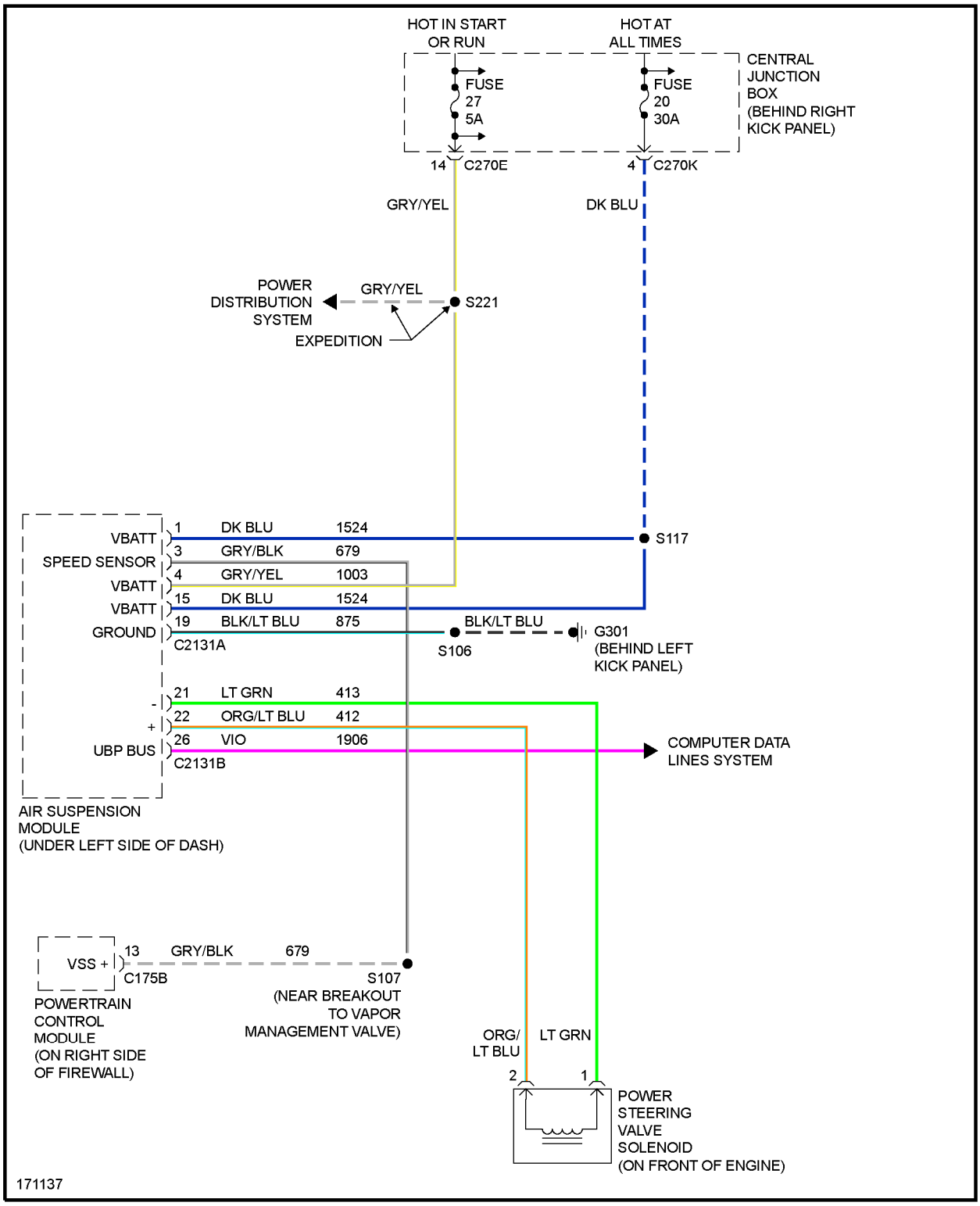


Fig. 12: Electronic Power Steering Circuit

ELECTRONIC SUSPENSION

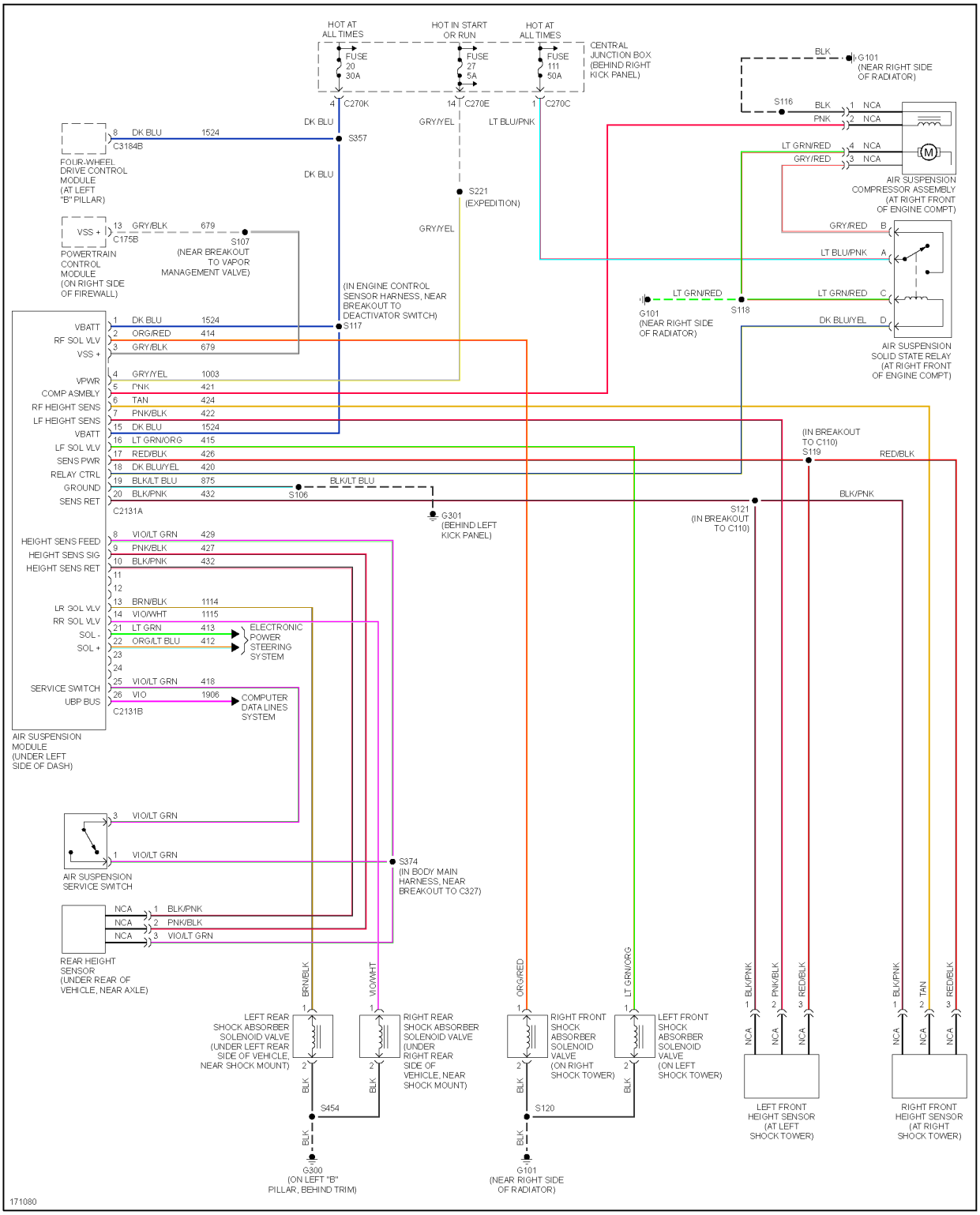


Fig. 13: Electronic Suspension Circuit

ENGINE PERFORMANCE

4.6L

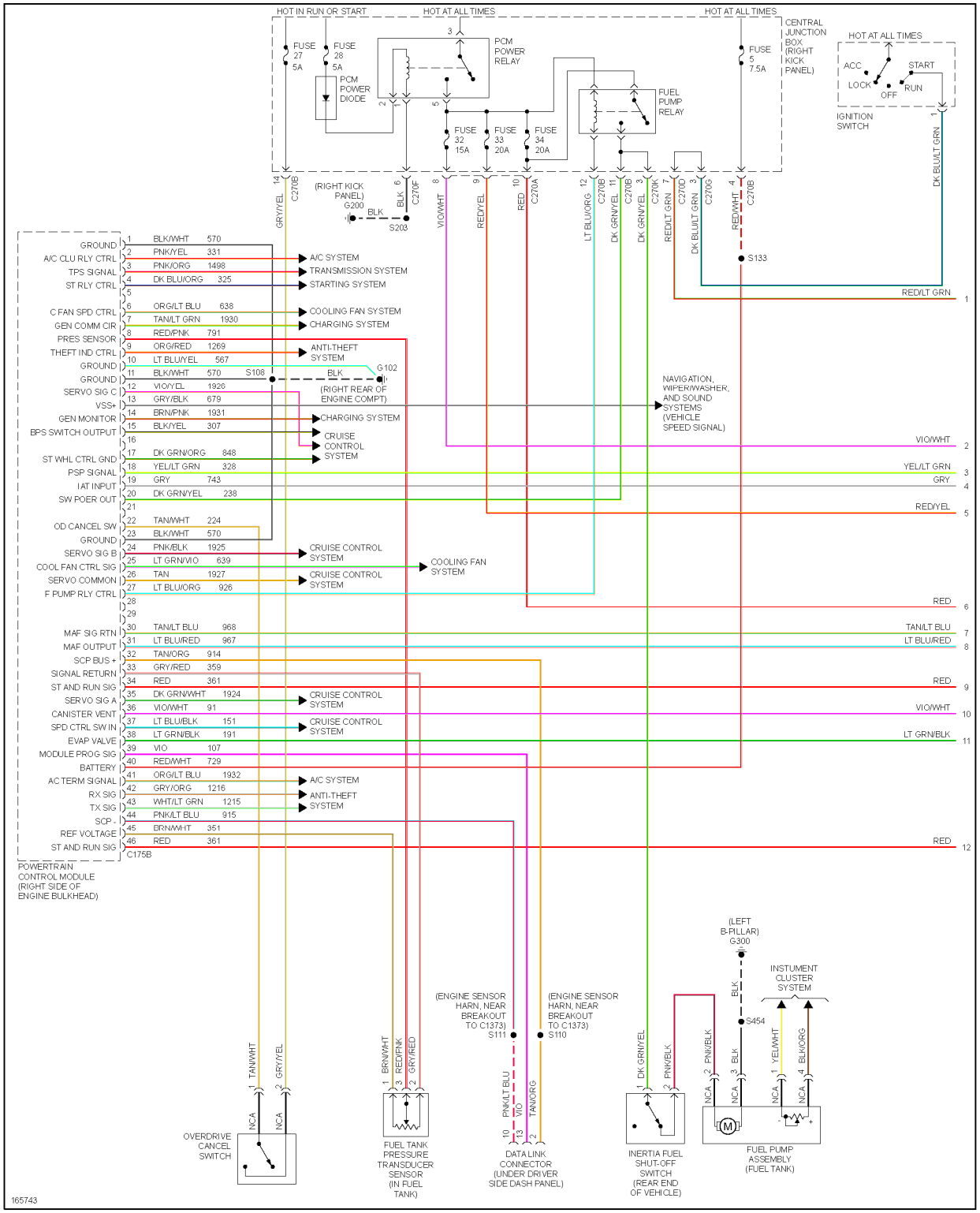


Fig. 14: 4.6L, Engine Performance Circuit (1 of 4)

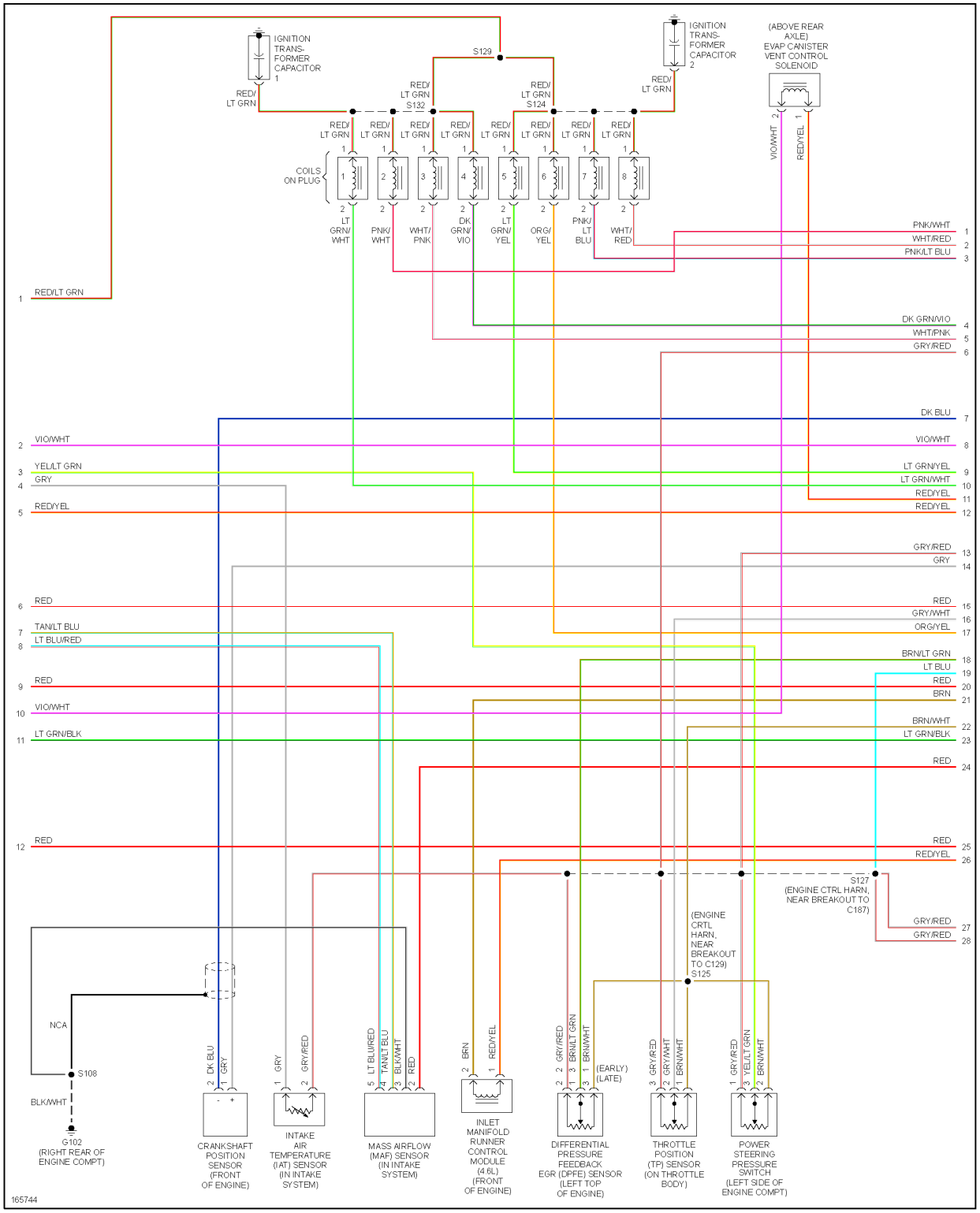


Fig. 15: 4.6L, Engine Performance Circuit (2 of 4)

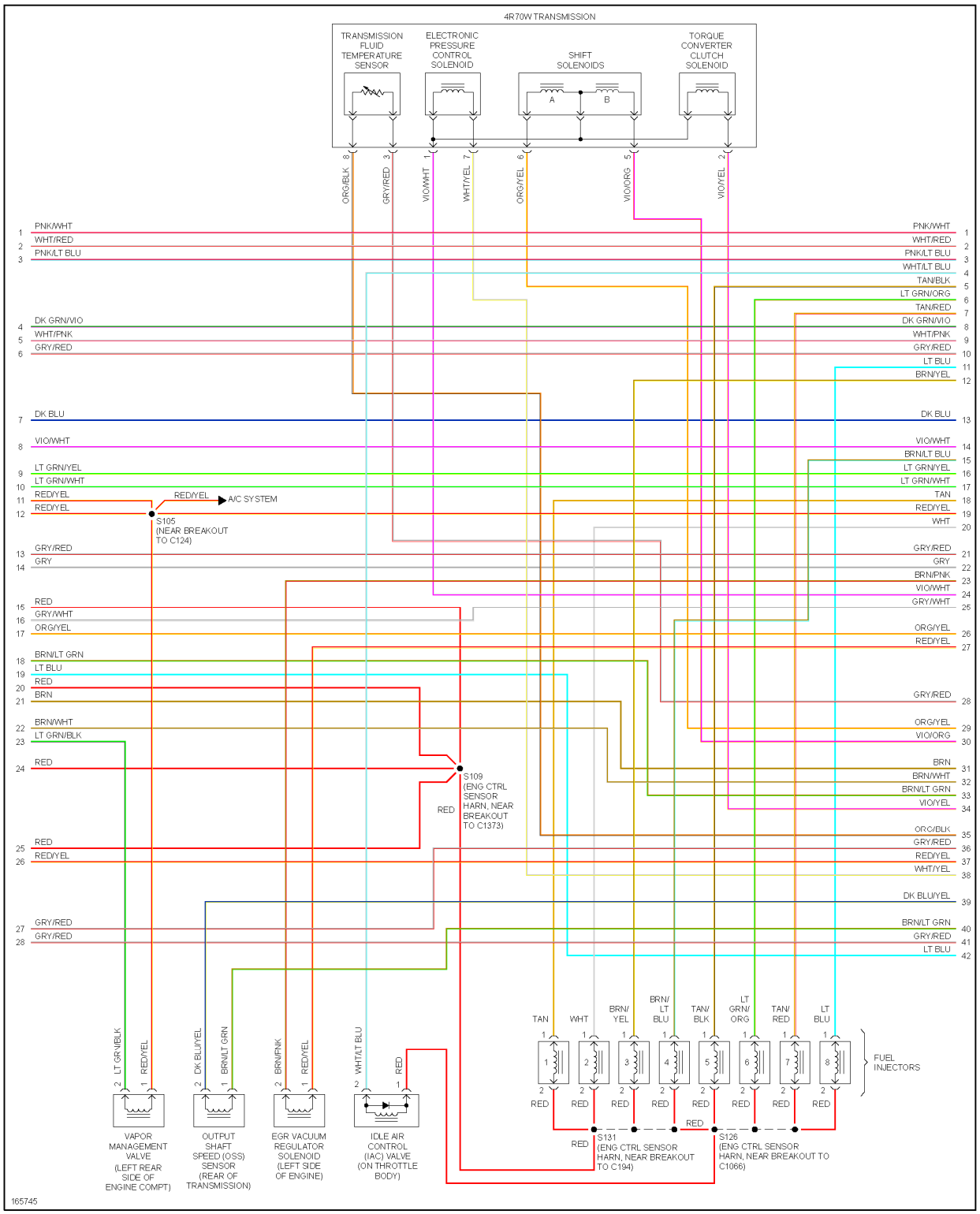


Fig. 16: 4.6L, Engine Performance Circuit (3 of 4)

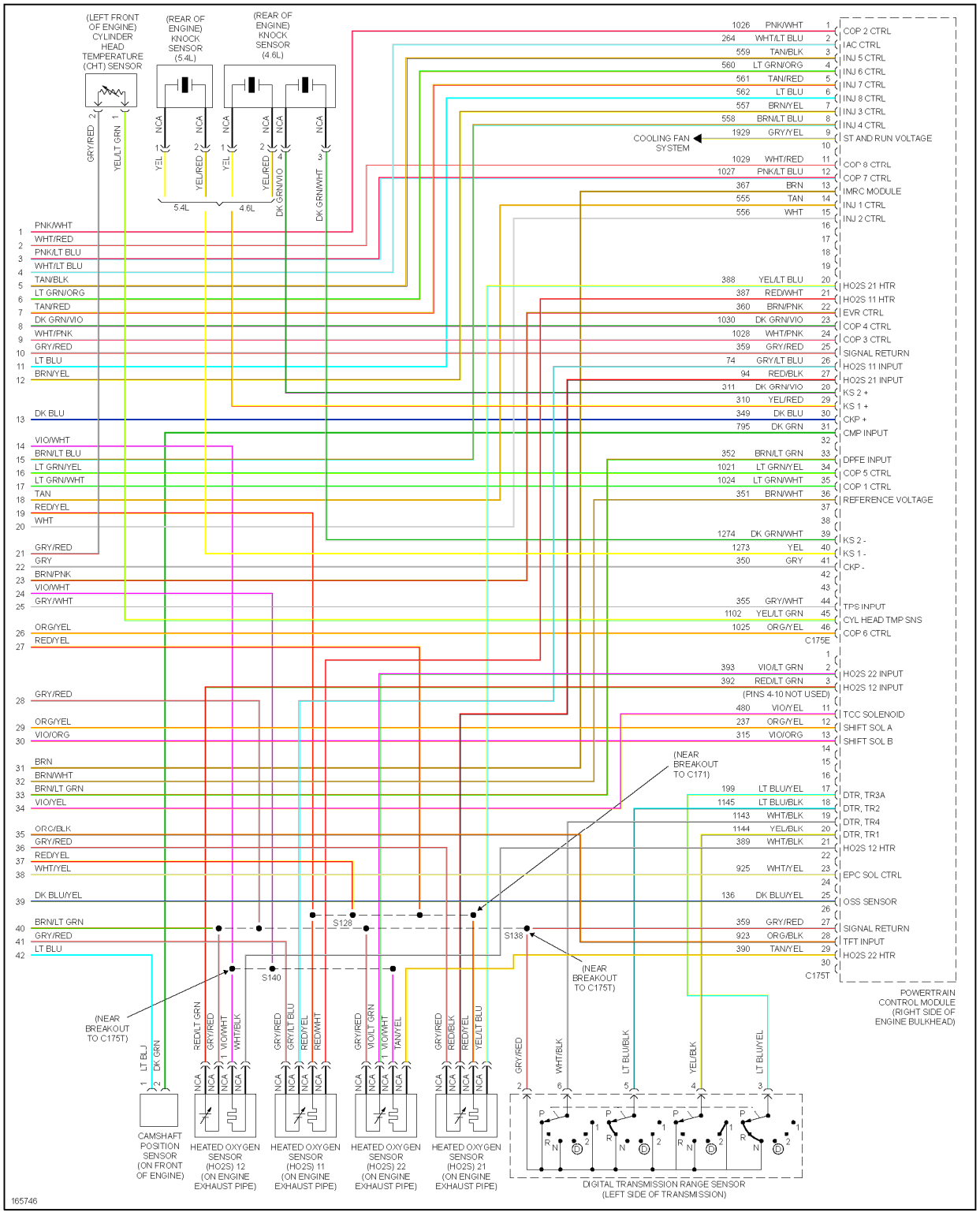


Fig. 17: 4.6L, Engine Performance Circuit (4 of 4)

5.4L

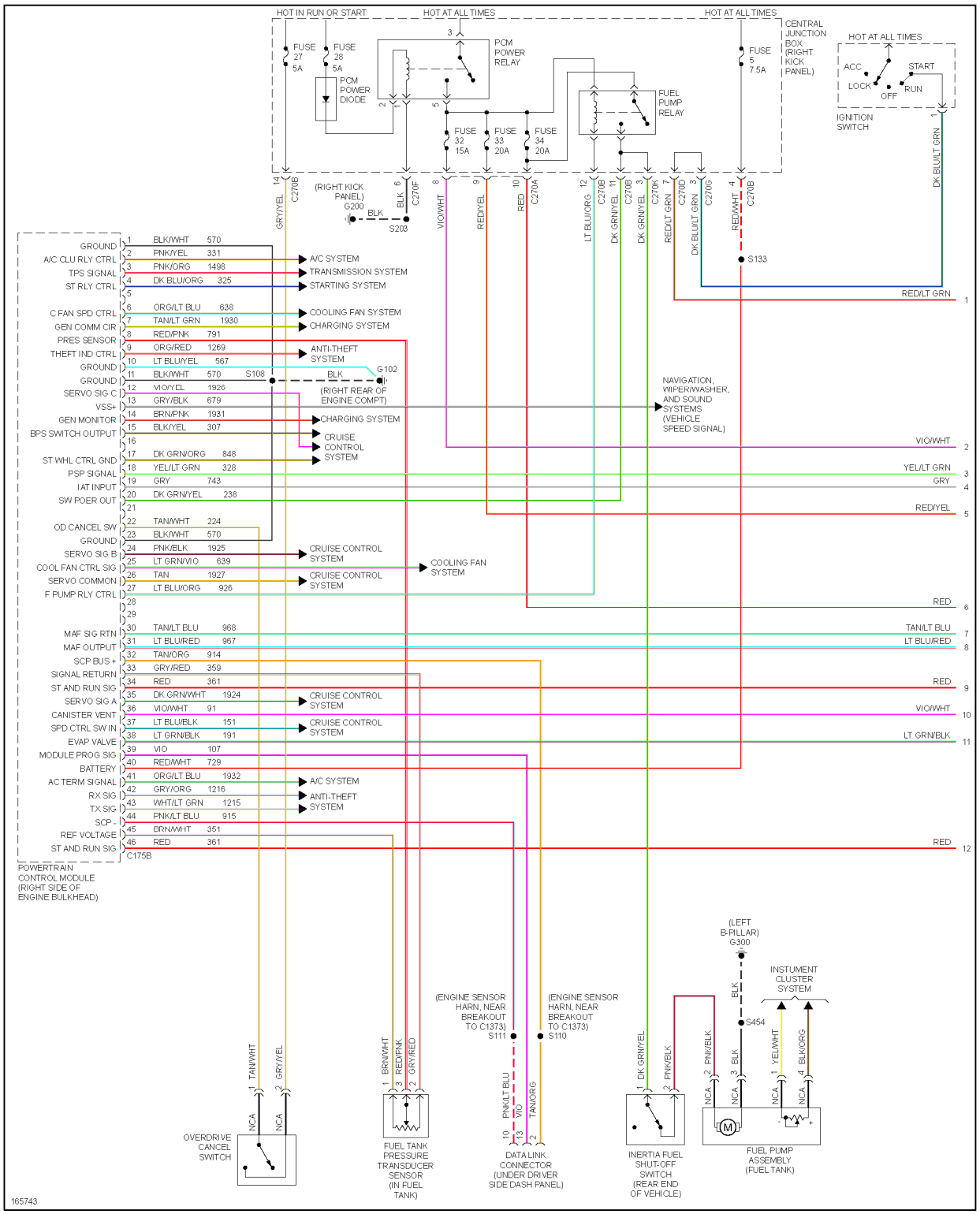


Fig. 18: 5.4L, Engine Performance Circuit (1 of 4)

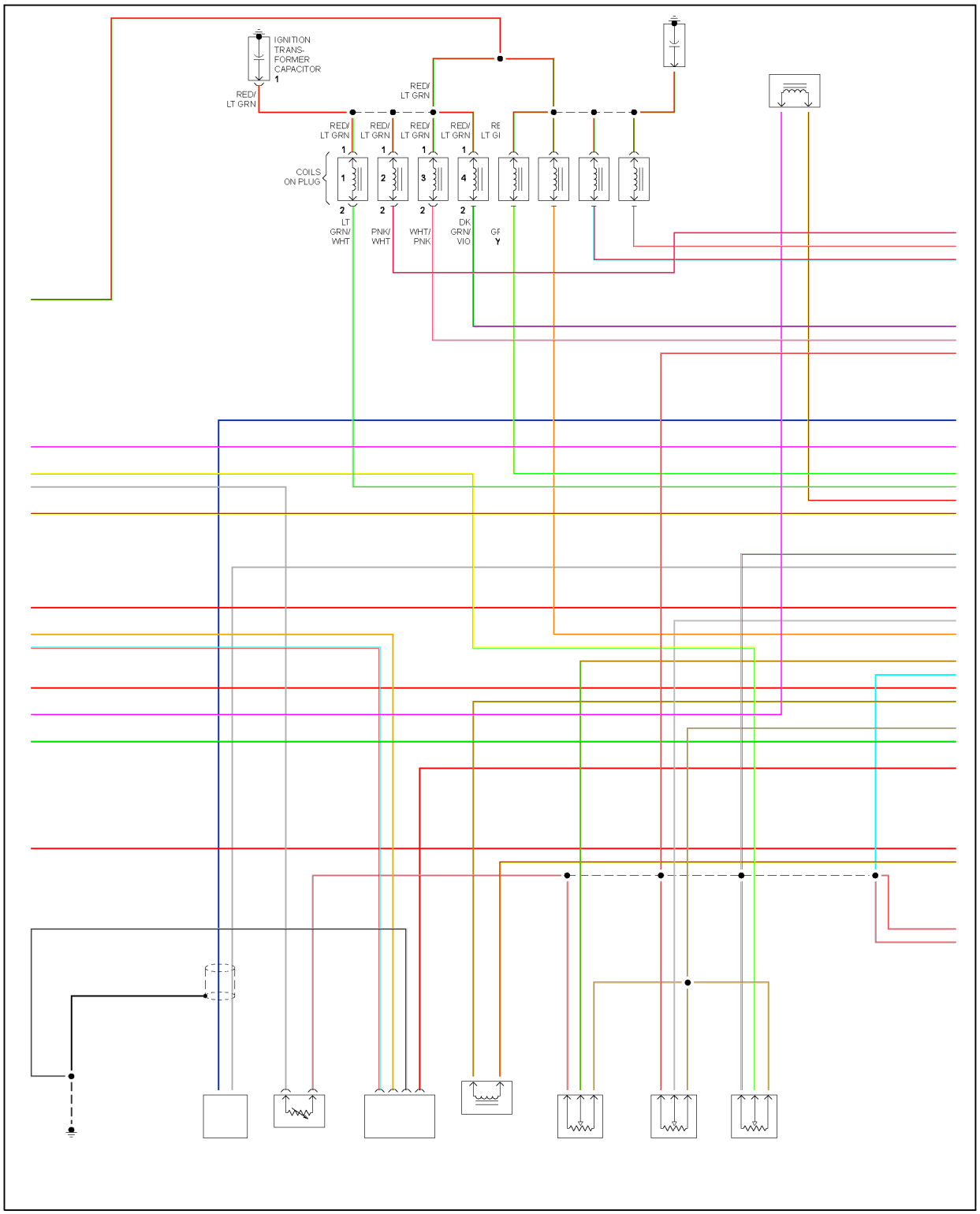


Fig. 19: 5.4L, Engine Performance Circuit (2 of 4)

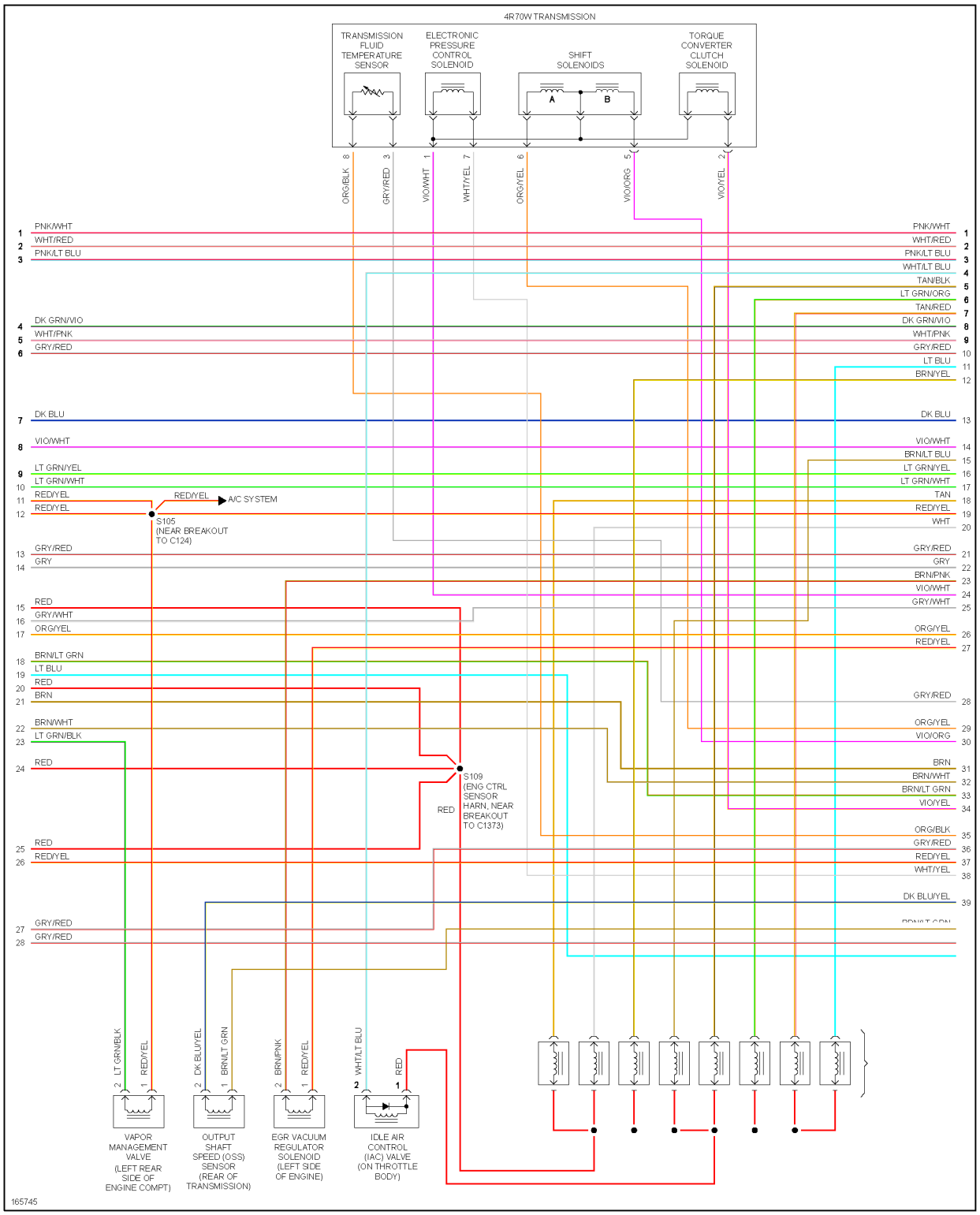


Fig. 20: 5.4L, Engine Performance Circuit (3 of 4)

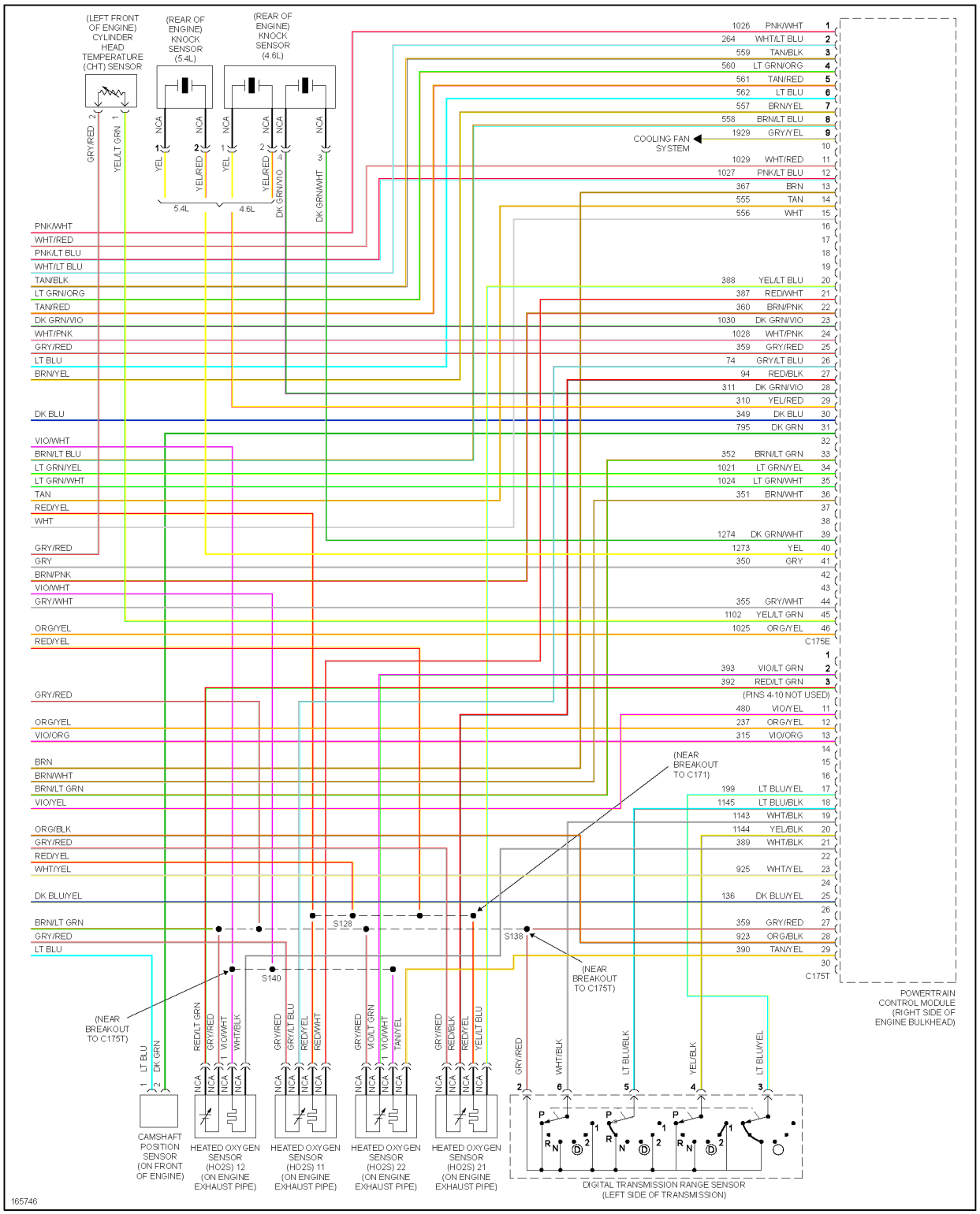


Fig. 21: 5.4L, Engine Performance Circuit (4 of 4)

EXTERIOR LIGHTS

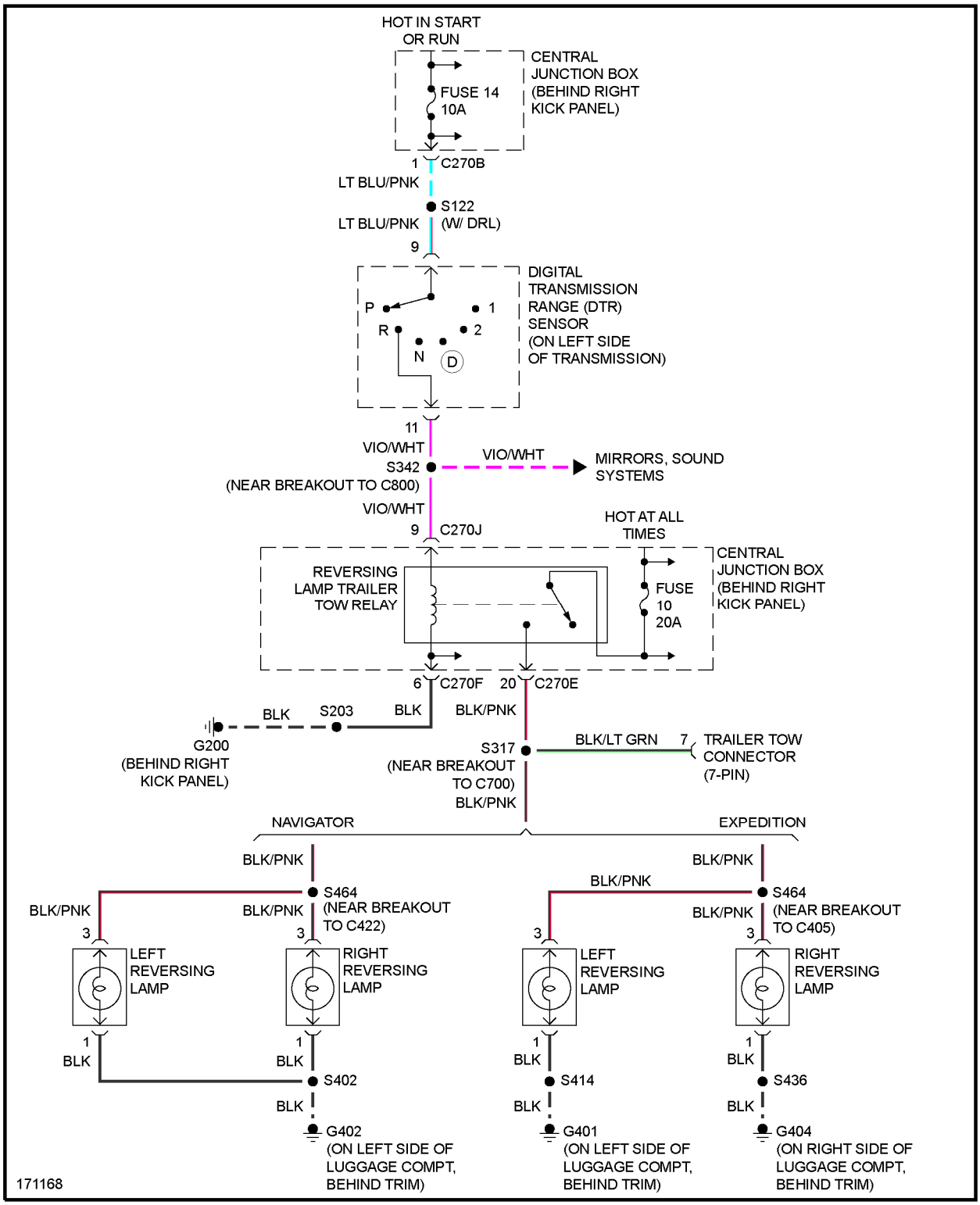


Fig. 22: Back-up Lamps Circuit

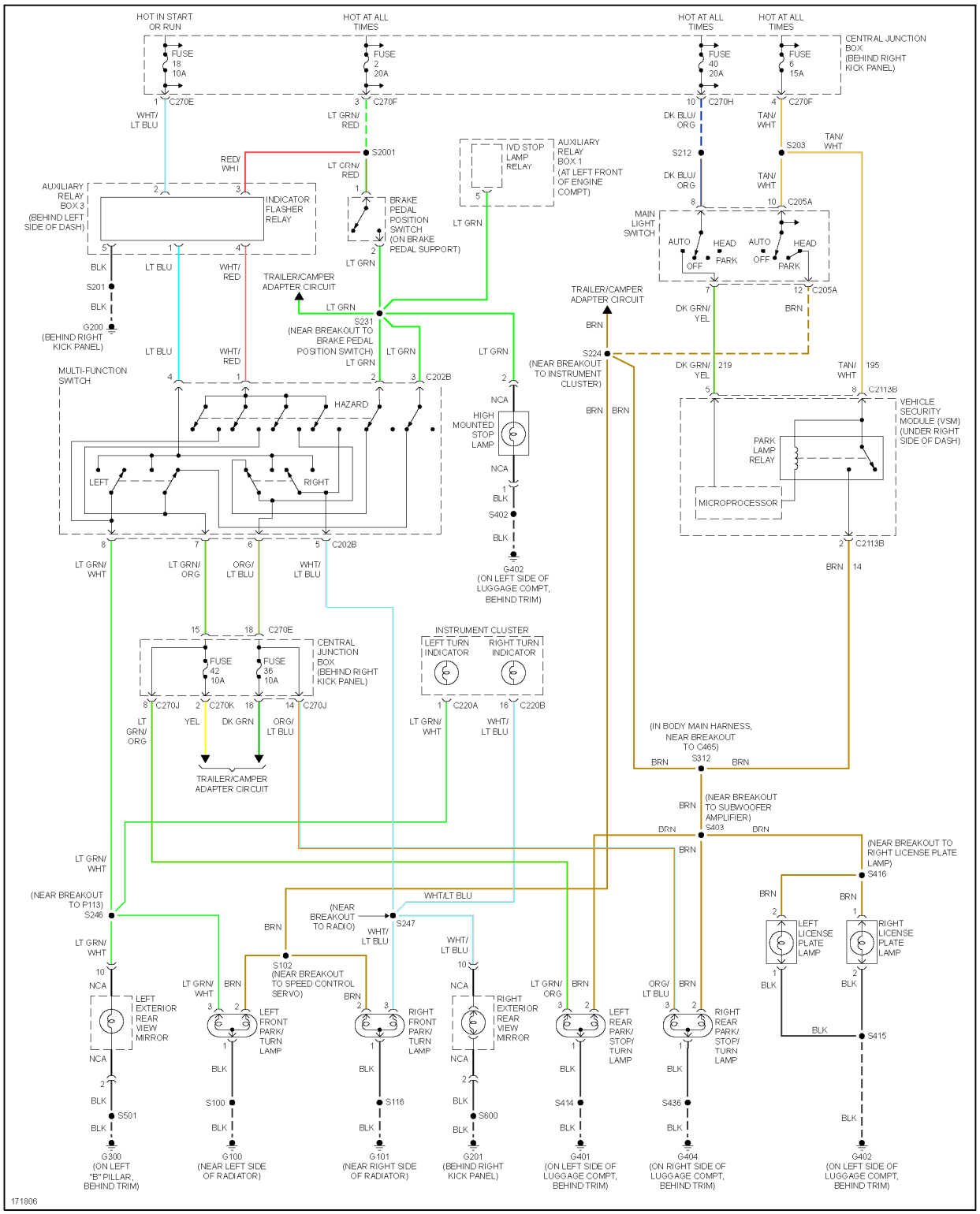


Fig. 23: Exterior Lamps Circuit

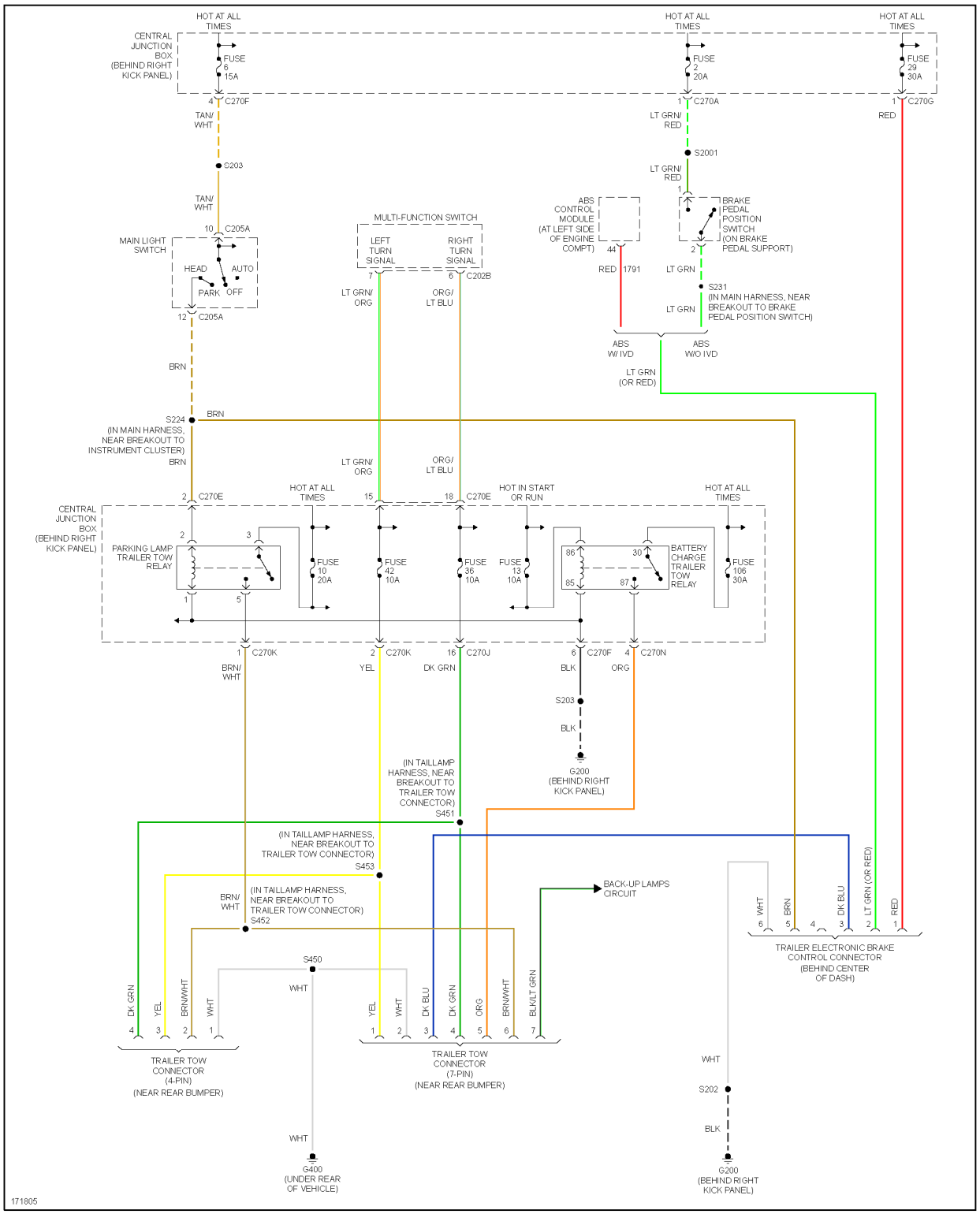


Fig. 24: Trailer/Camper Adapter Circuit

GROUND DISTRIBUTION

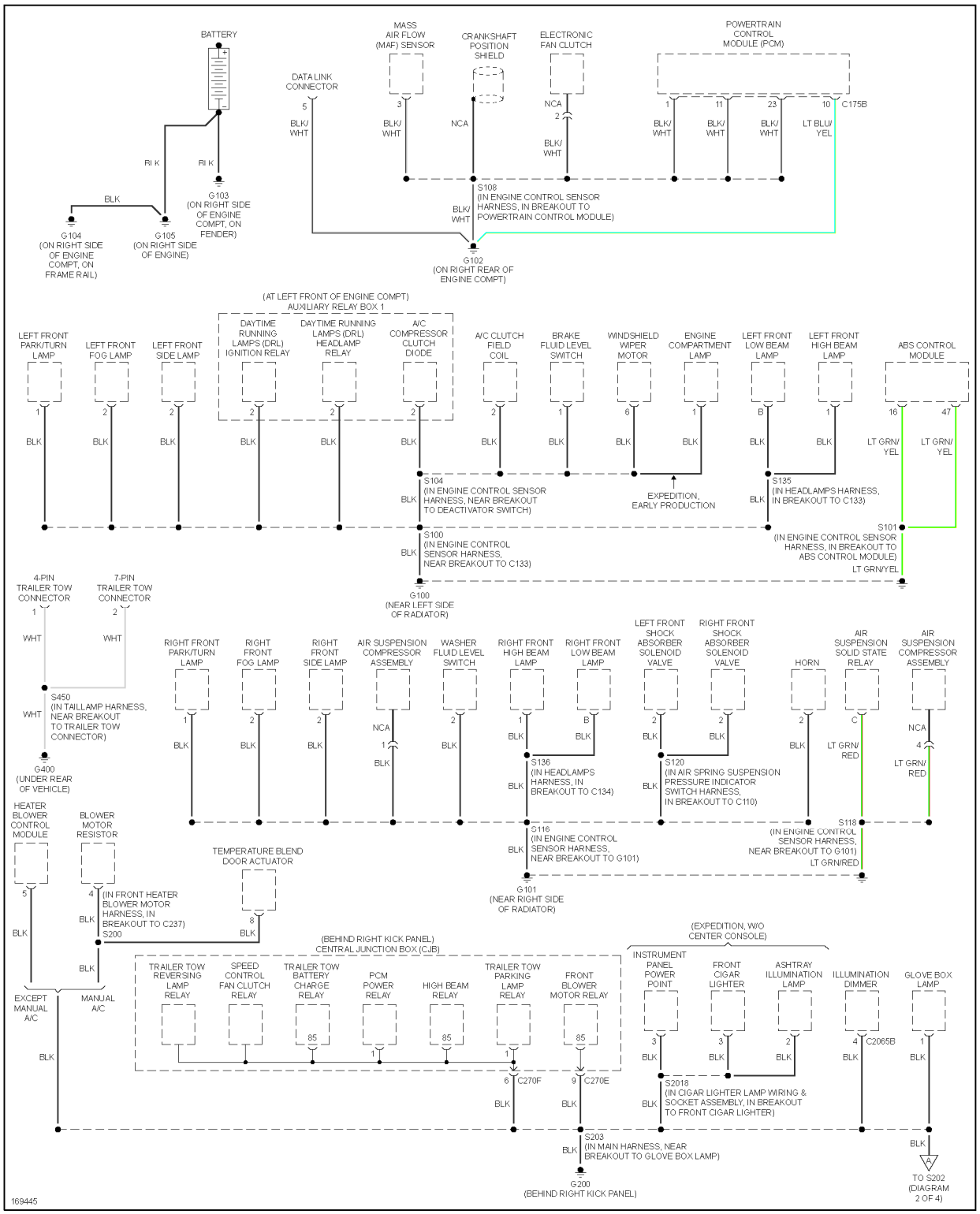


Fig. 25: Ground Distribution Circuit (1 of 4)

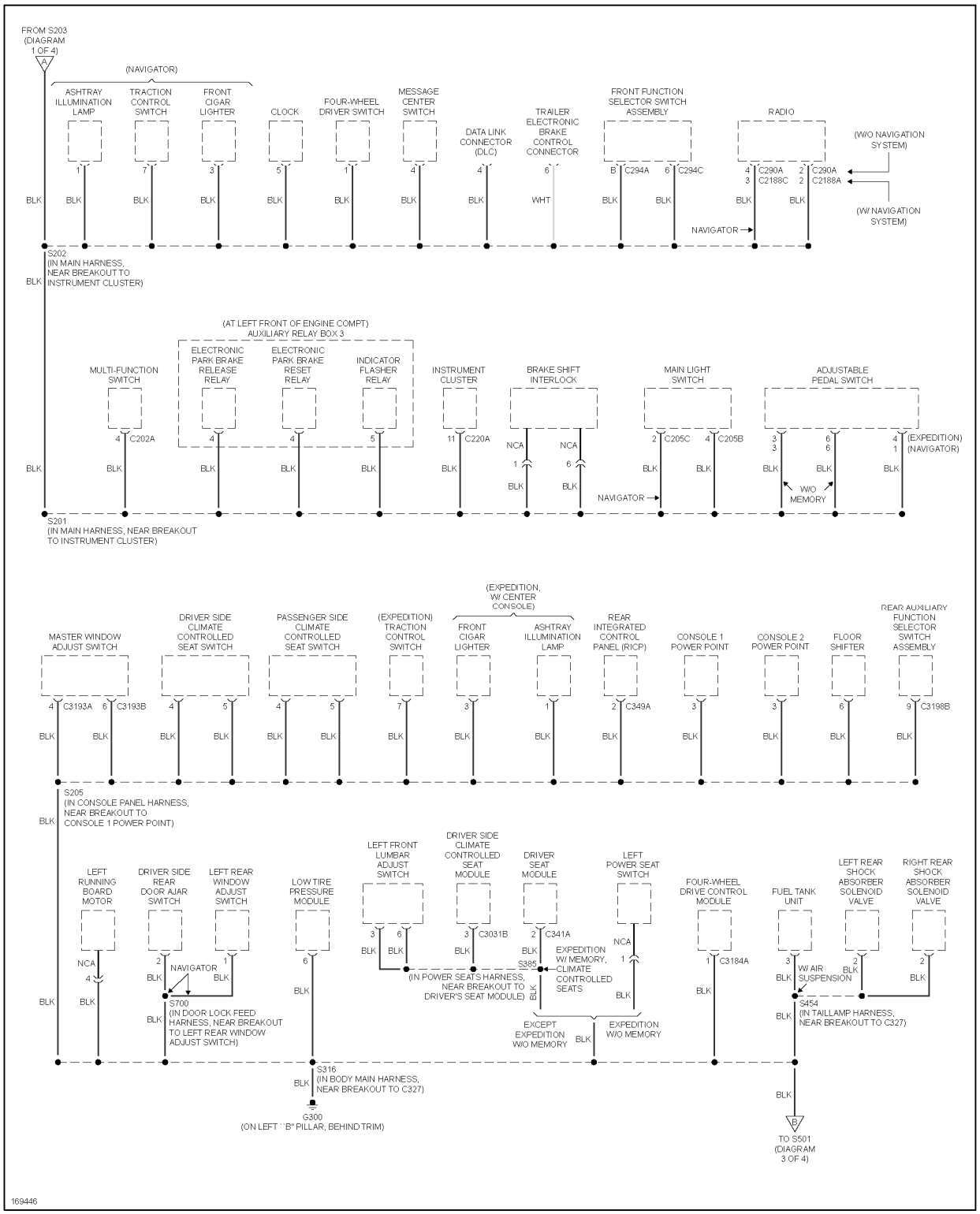


Fig. 26: Ground Distribution Circuit (2 of 4)

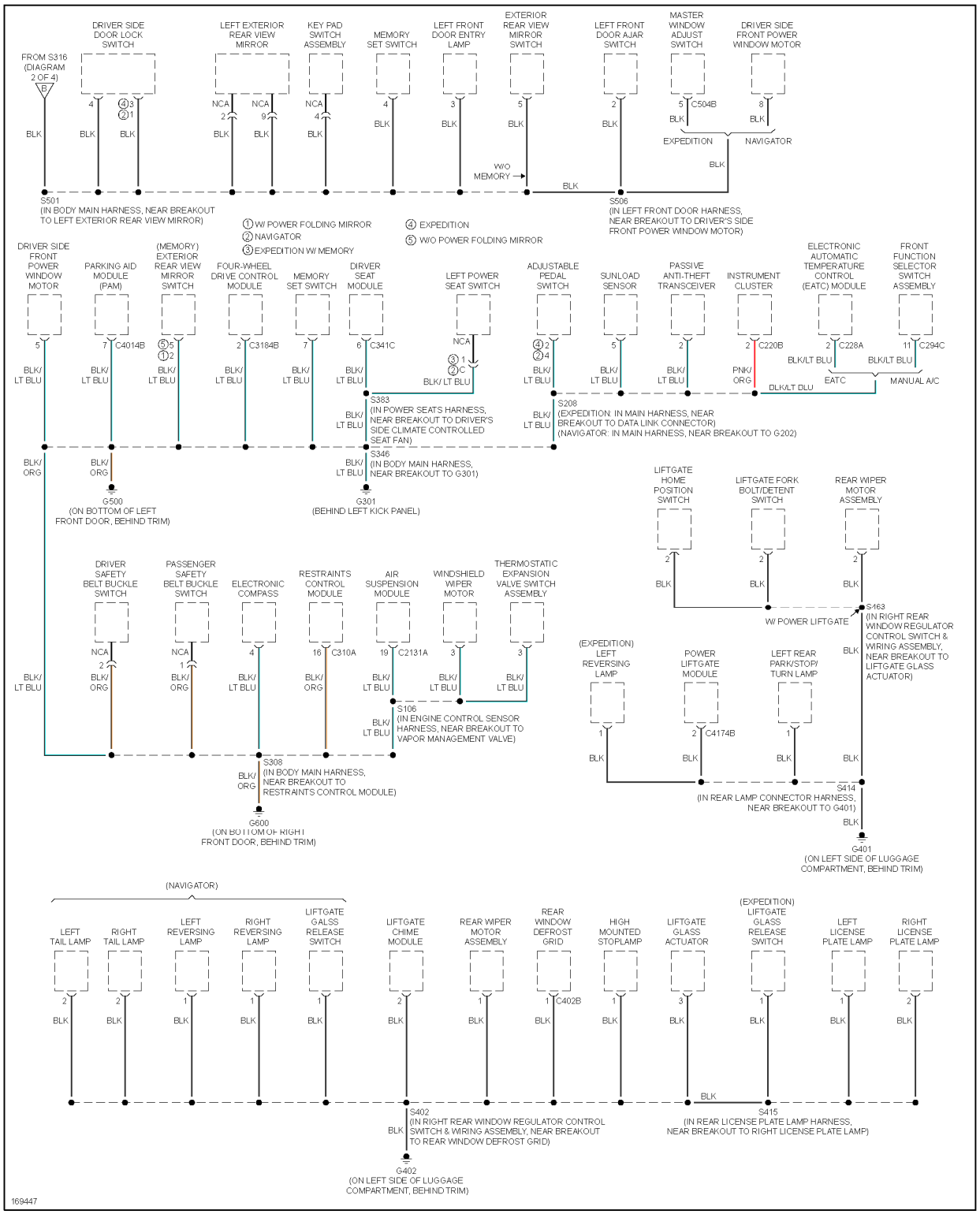


Fig. 27: Ground Distribution Circuit (3 of 4)

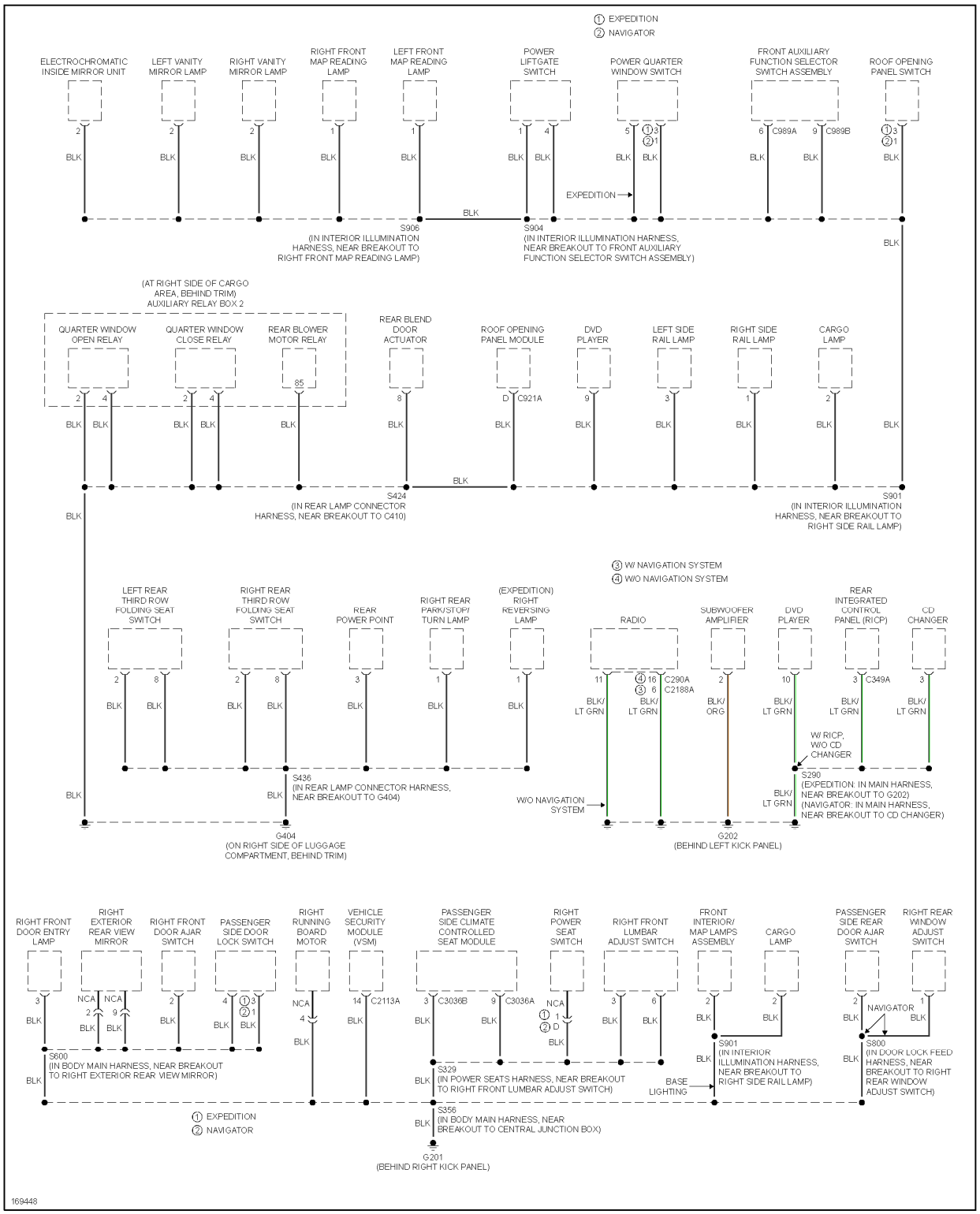


Fig. 28: Ground Distribution Circuit (4 of 4)

HEADLIGHTS

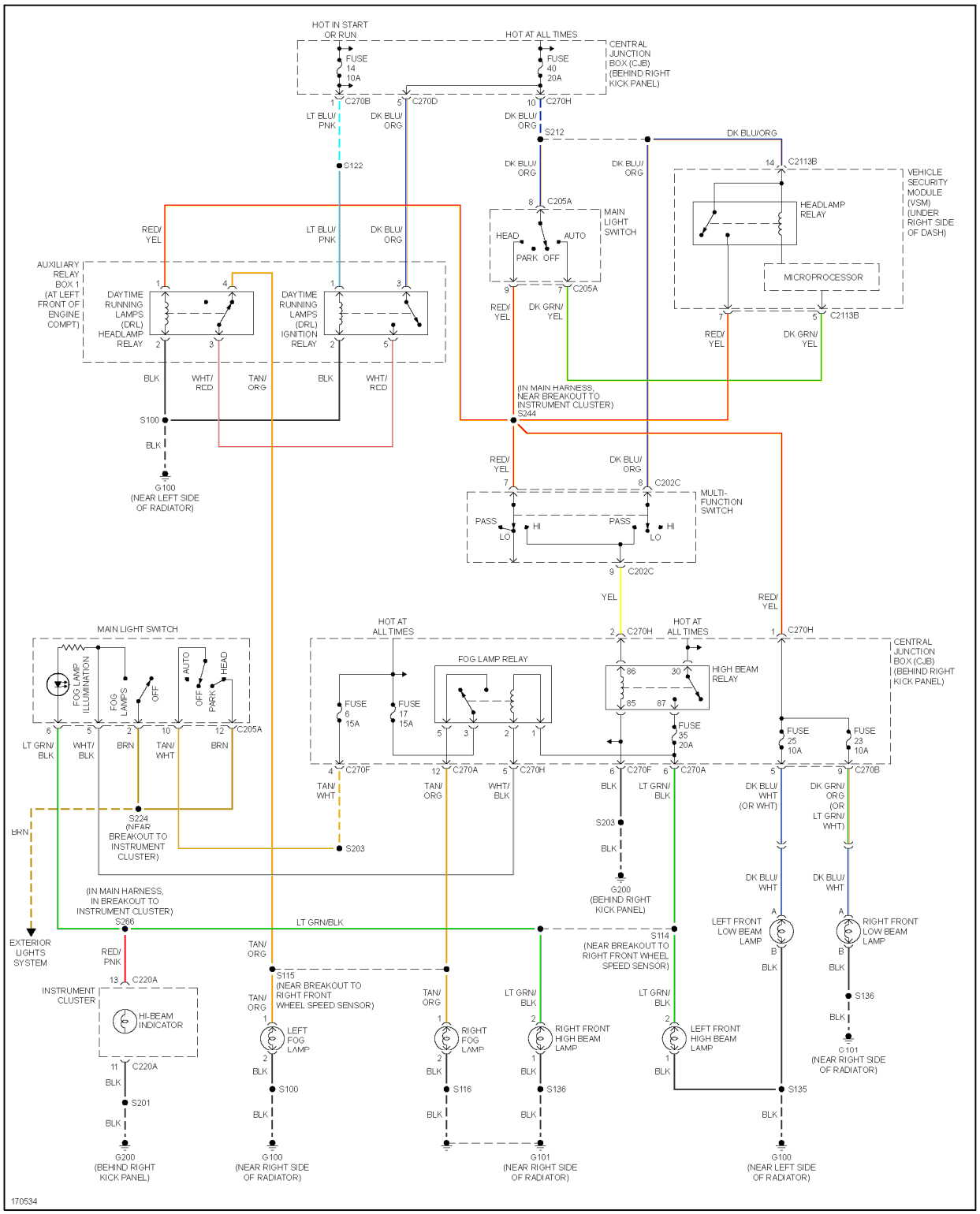


Fig. 29: Headlights Circuit, W/ DRL

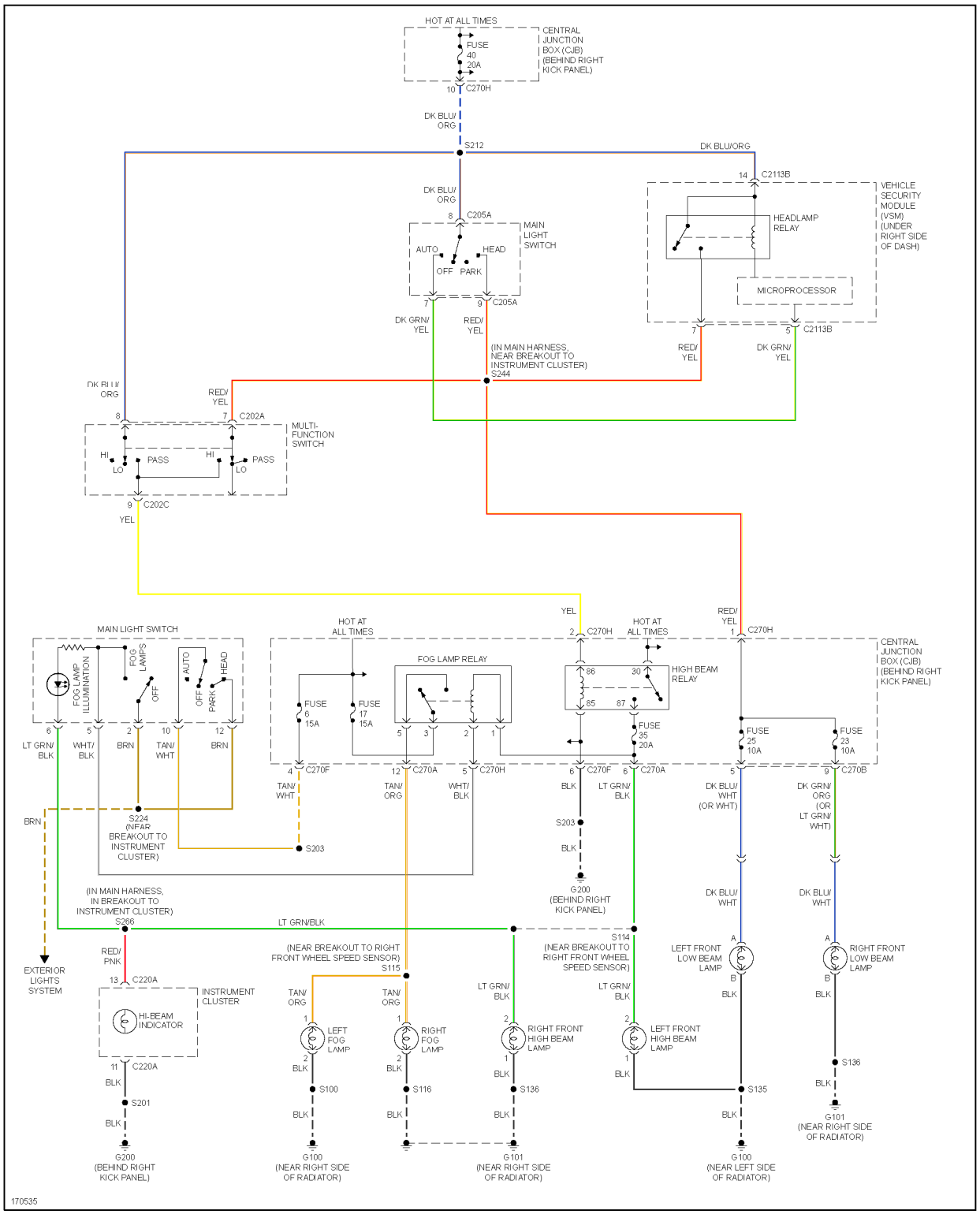


Fig. 30: Headlights Circuit, W/O DRL

HORN

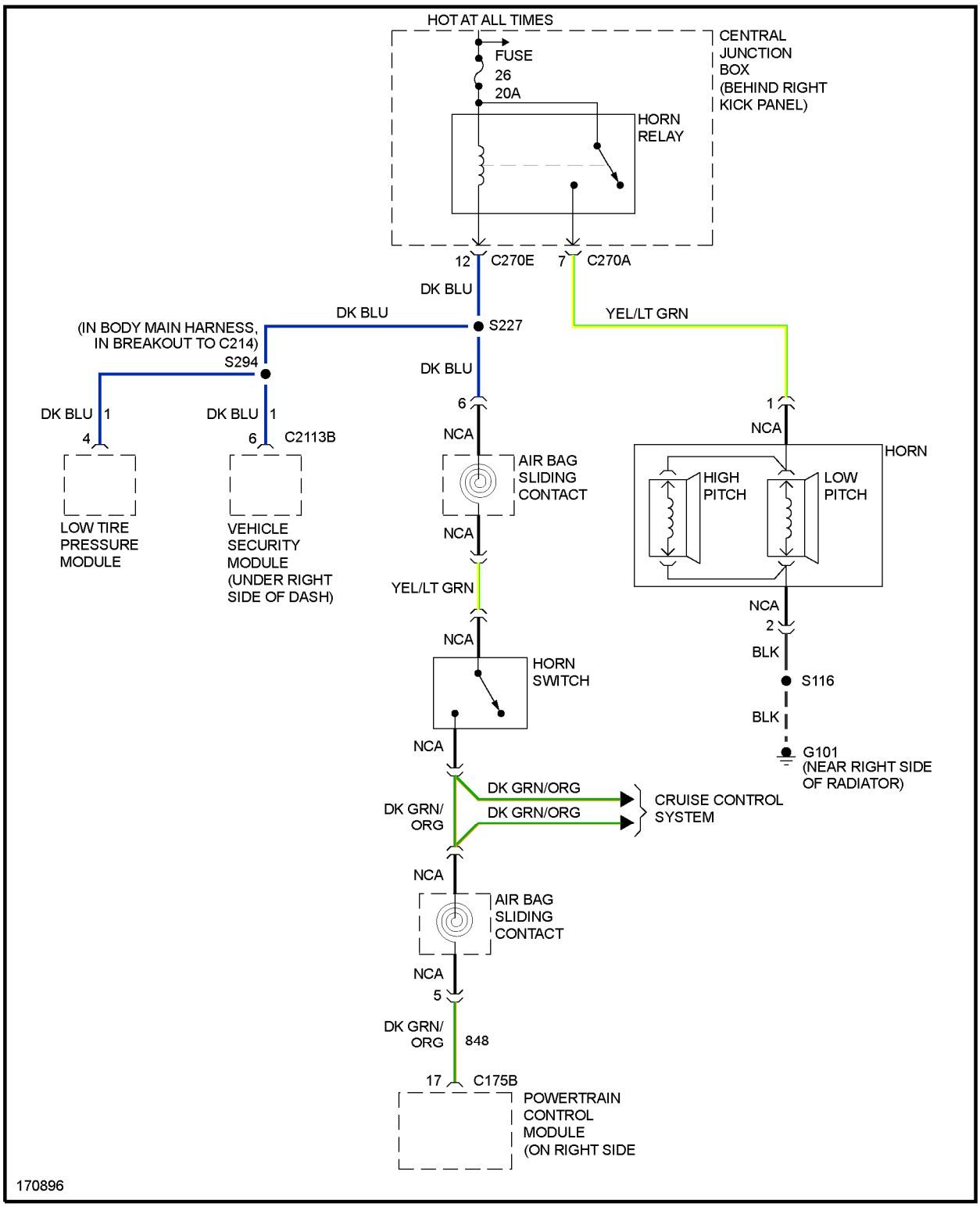


Fig. 31: Horn Circuit

INSTRUMENT CLUSTER

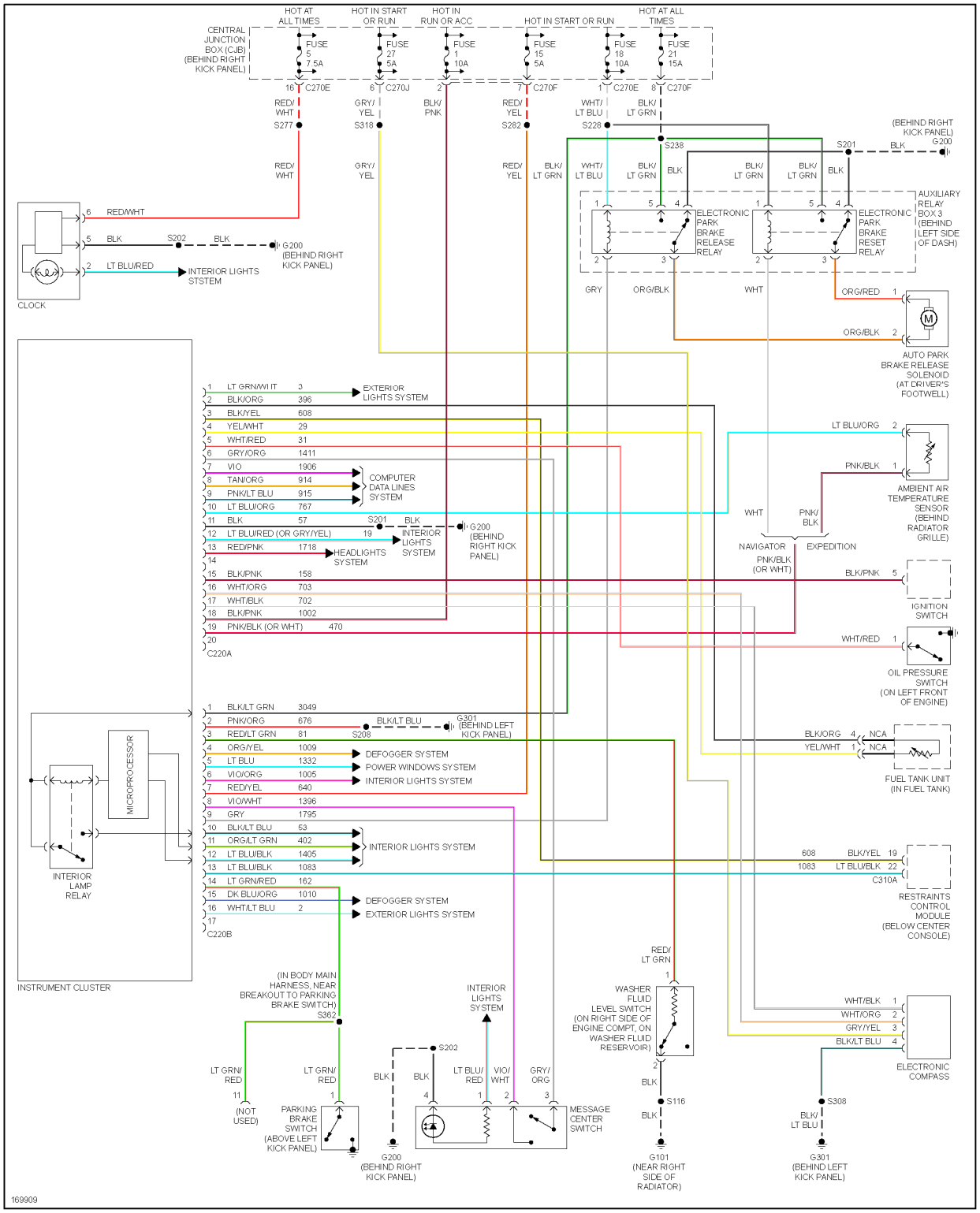


Fig. 32: Instrument Cluster Circuit

INTERIOR LIGHTS

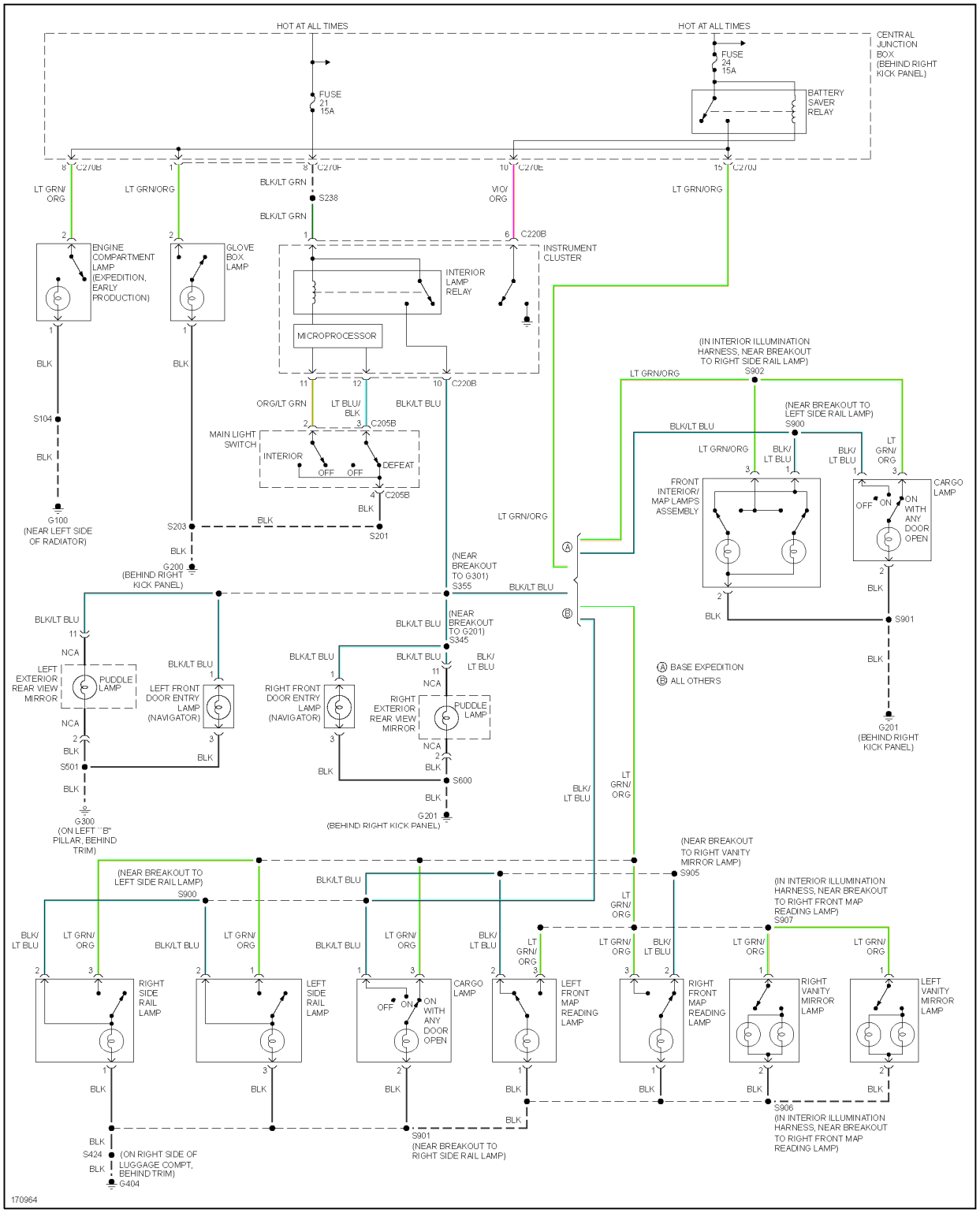


Fig. 33: Courtesy Lamps Circuit

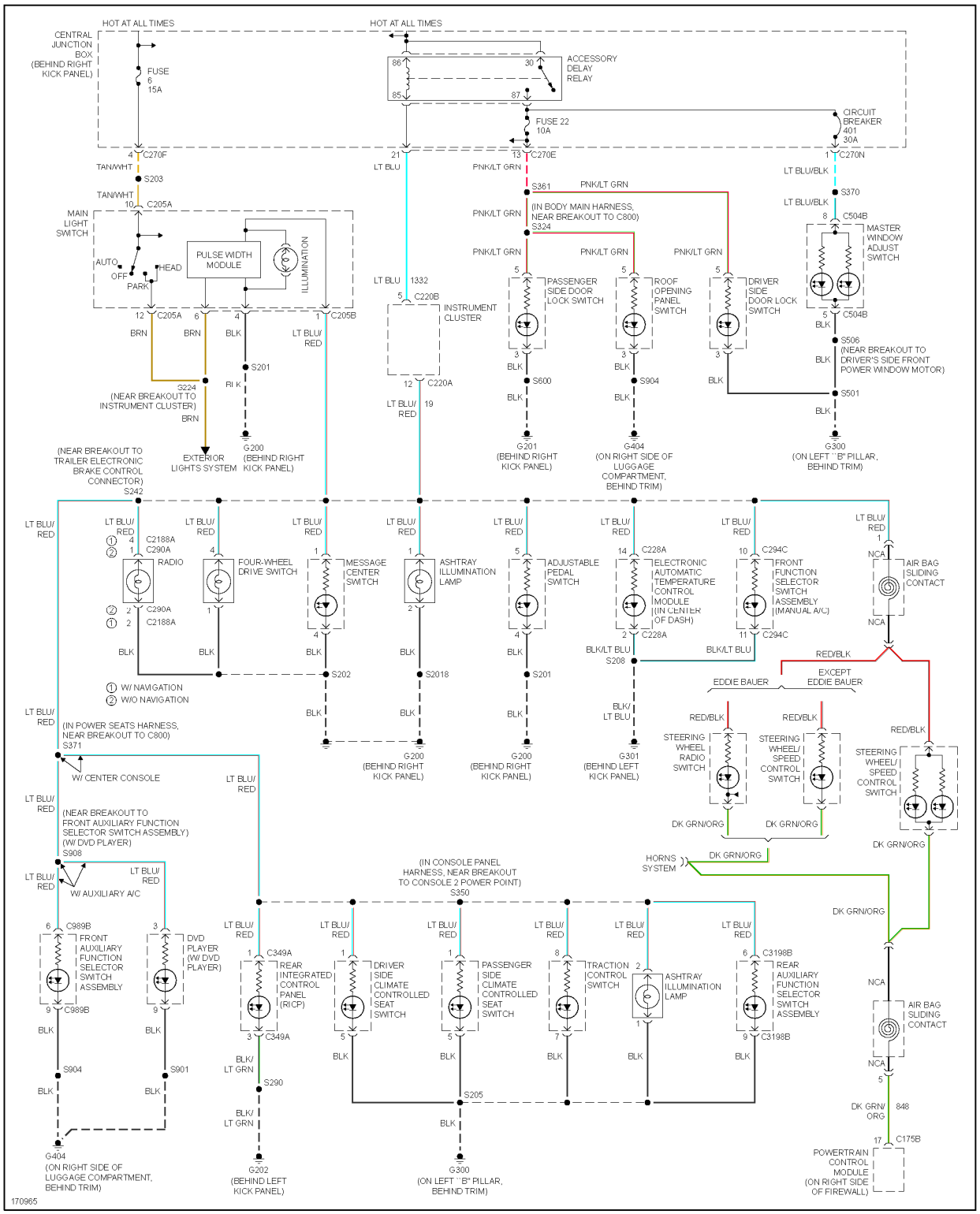


Fig. 34: Instrument Illumination Circuit

MEMORY SYSTEMS

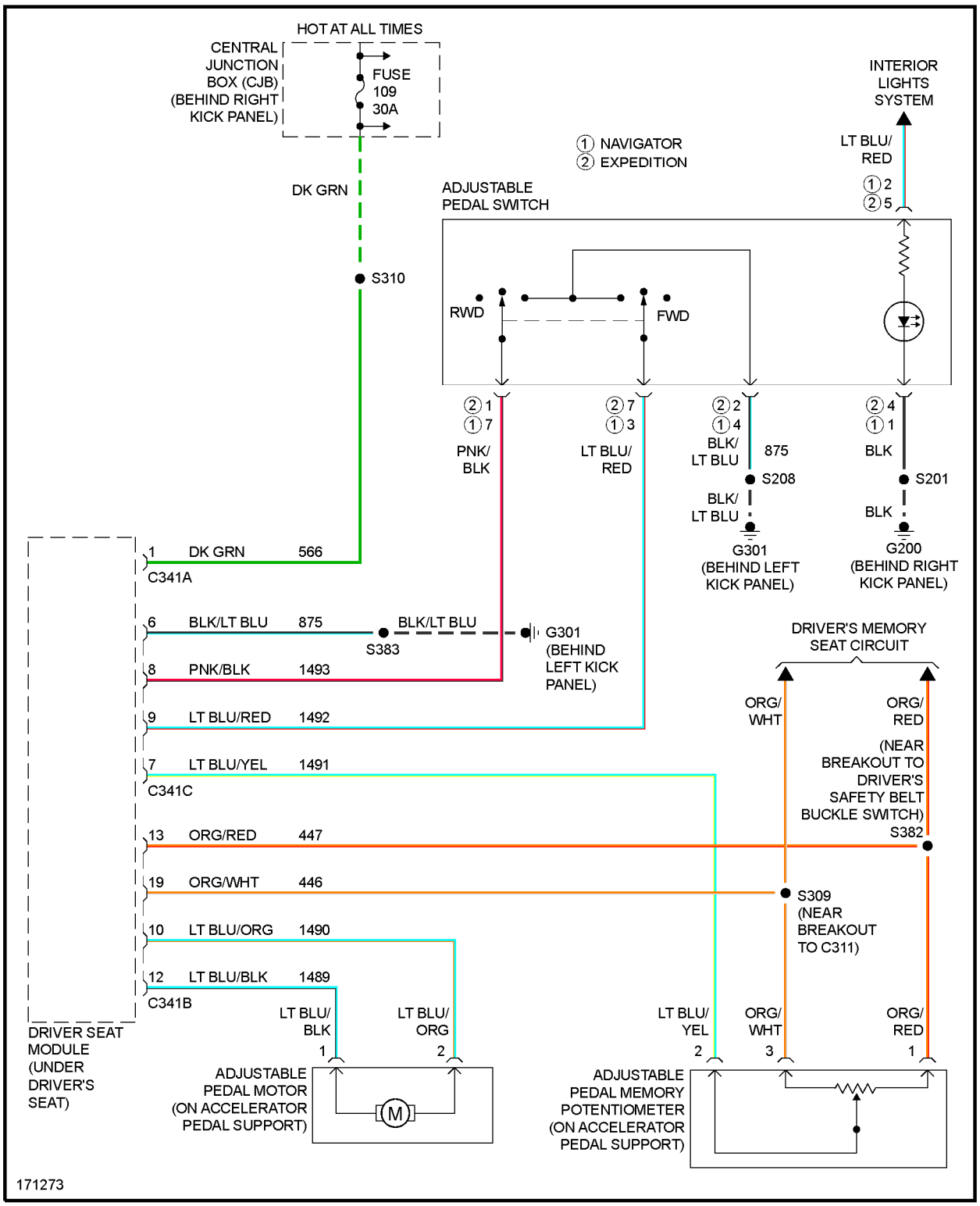


Fig. 35: Adjustable Pedal Circuit

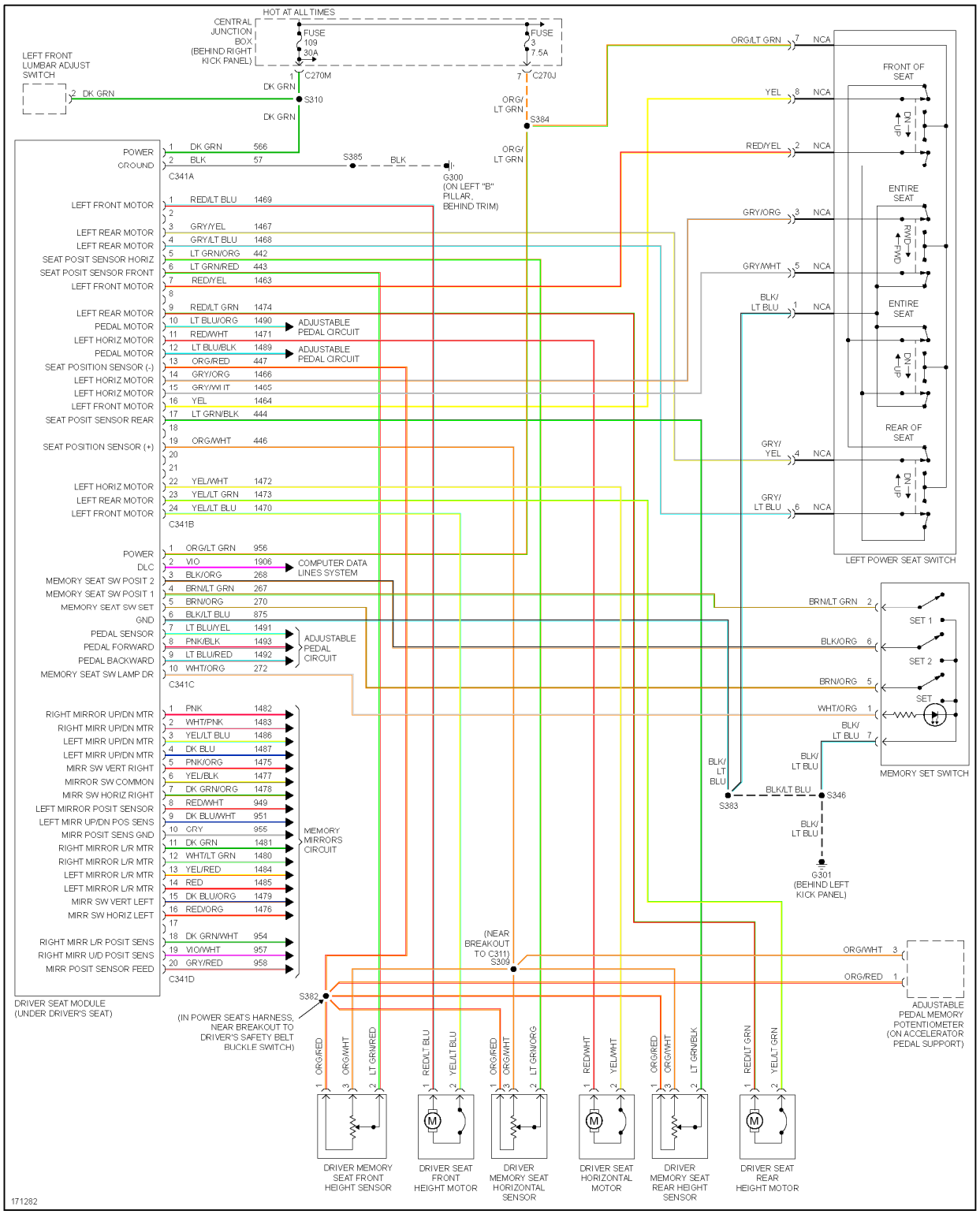


Fig. 36: Driver"s Memory Seat Circuit

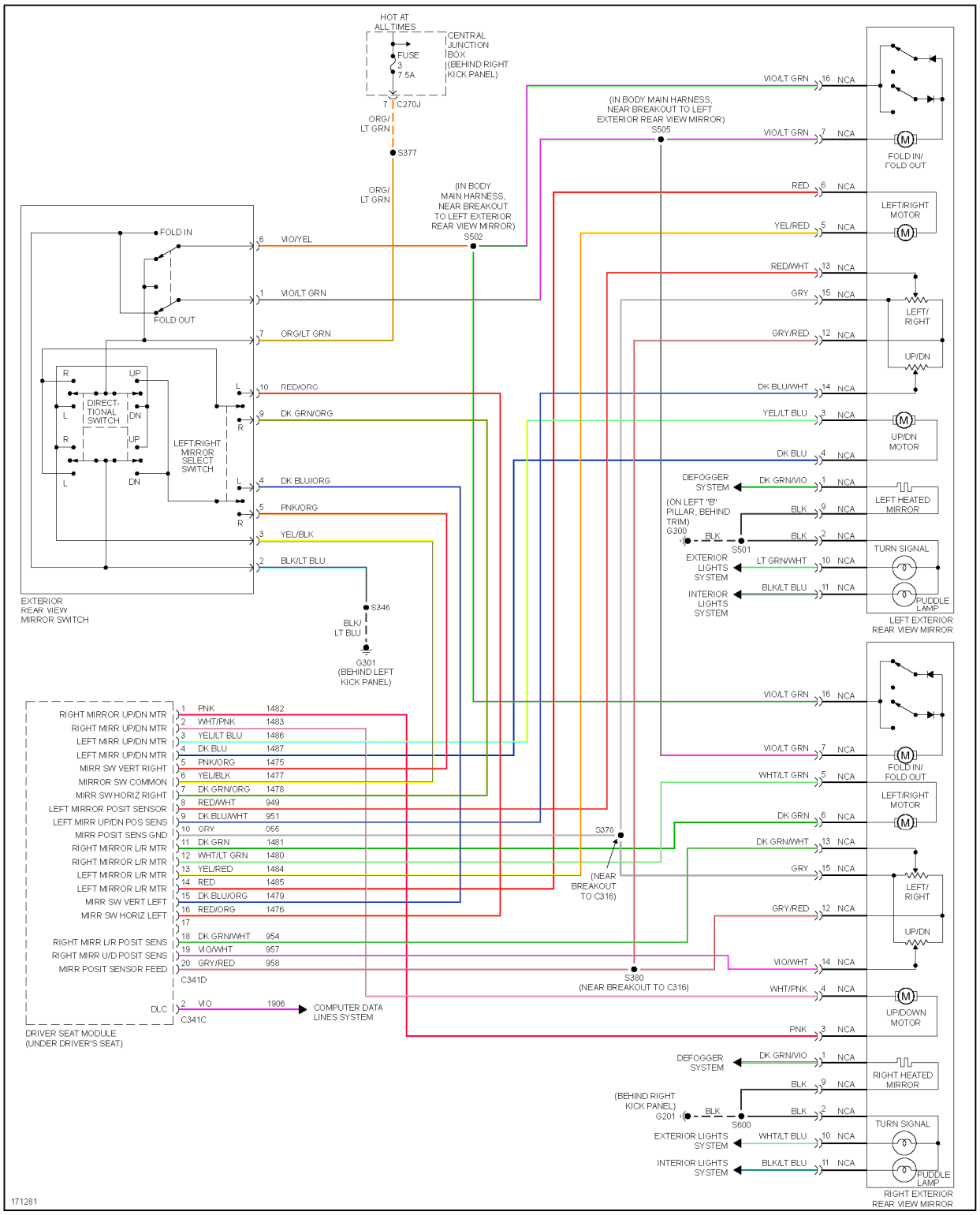


Fig. 37: Memory Mirrors Circuit, W/ Power Folding Mirrors

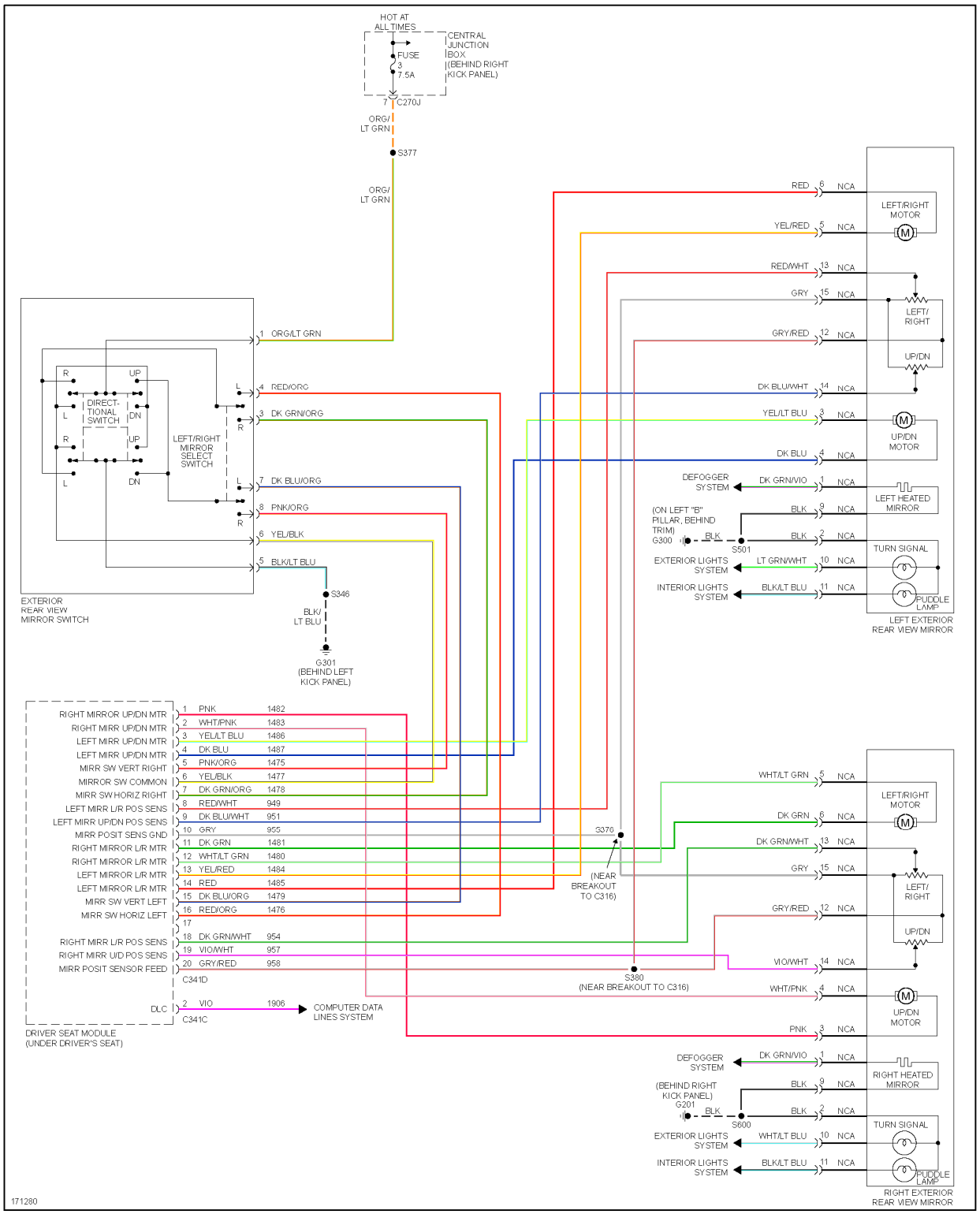


Fig. 38: Memory Mirrors Circuit, W/O Power Folding Mirrors

NAVIGATION

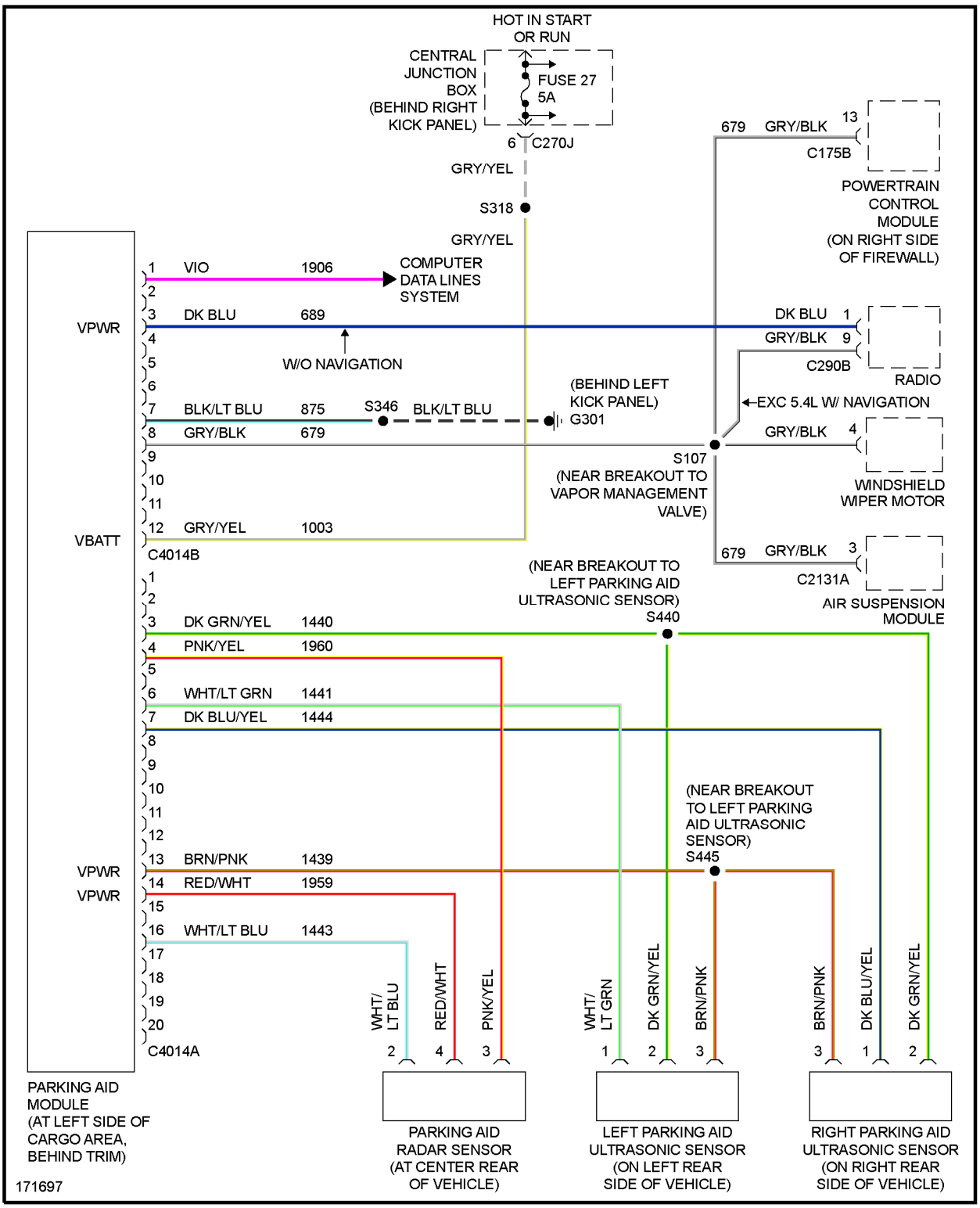


Fig. 39: Parking Assistant Circuit

POWER DISTRIBUTION

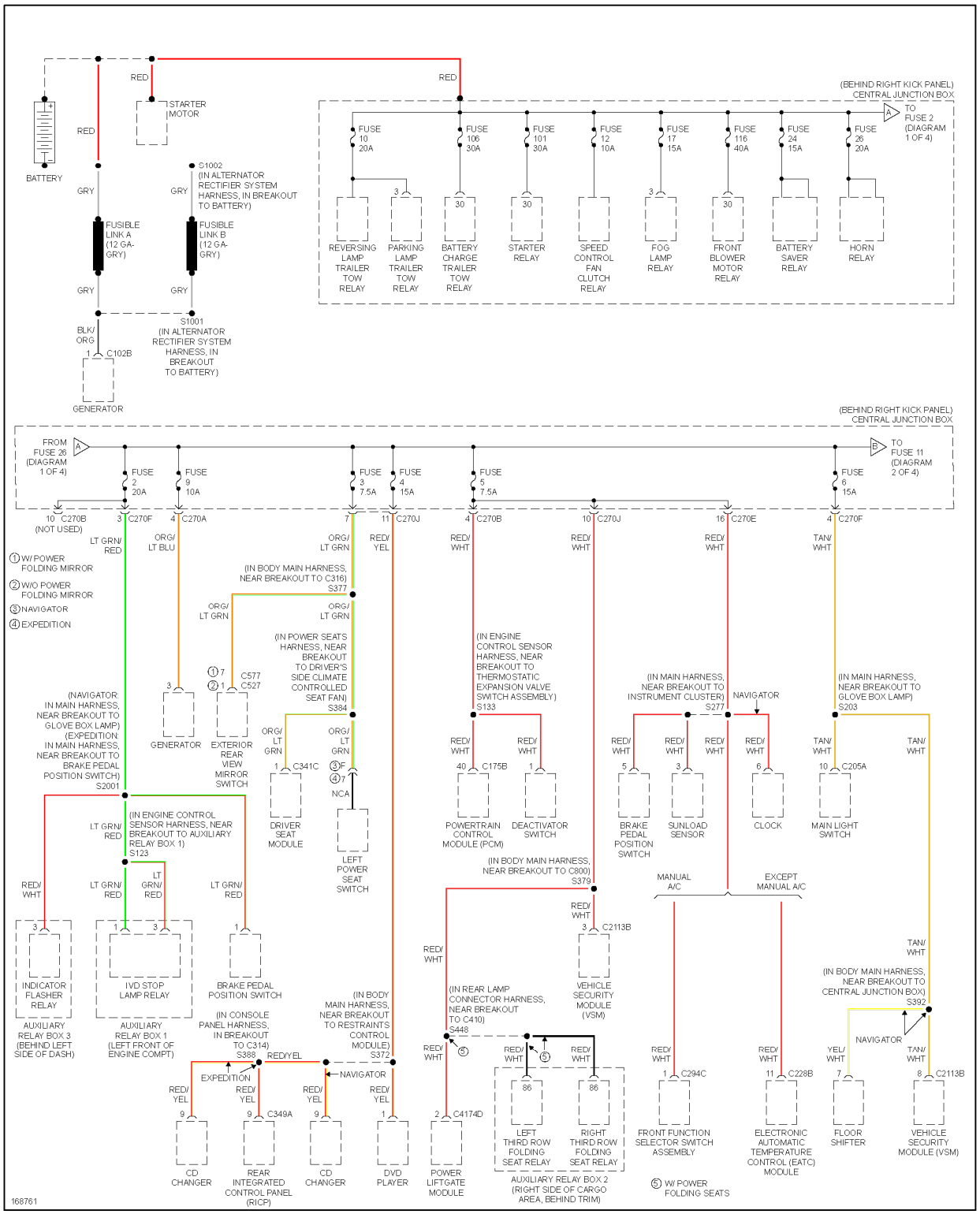


Fig. 40: Power Distribution Circuit (1 of 4)

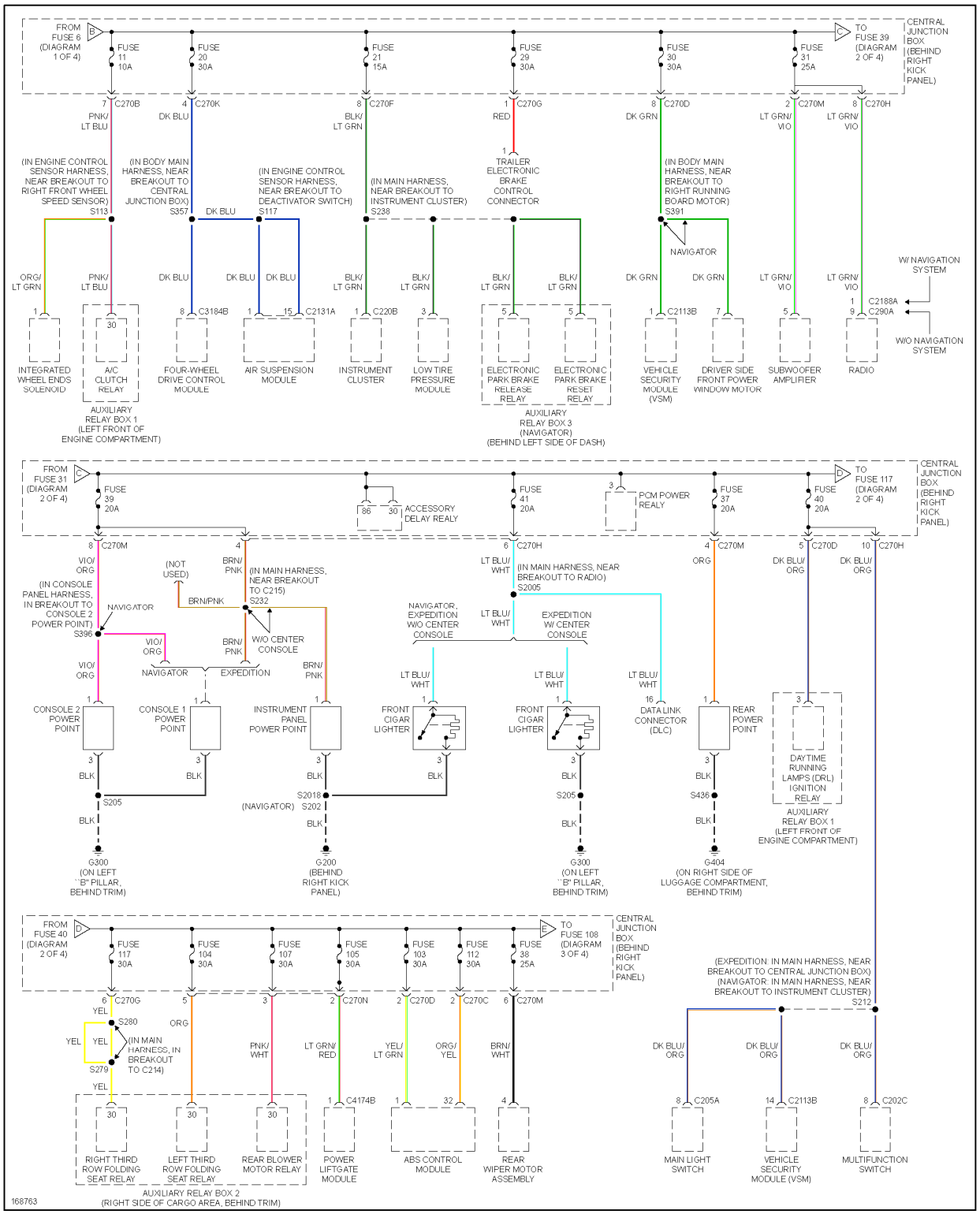


Fig. 41: Power Distribution Circuit (2 of 4)

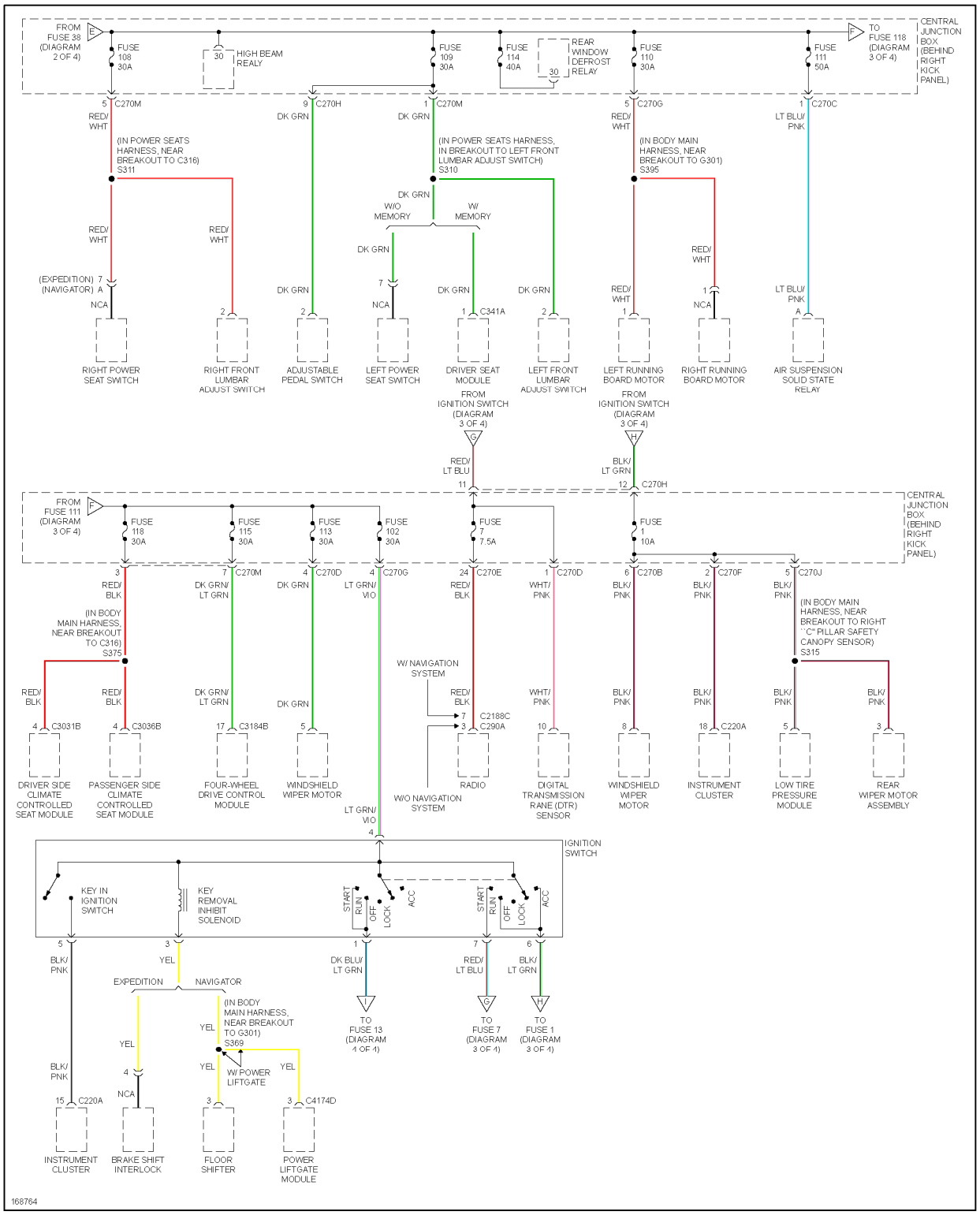


Fig. 42: Power Distribution Circuit (3 of 4)

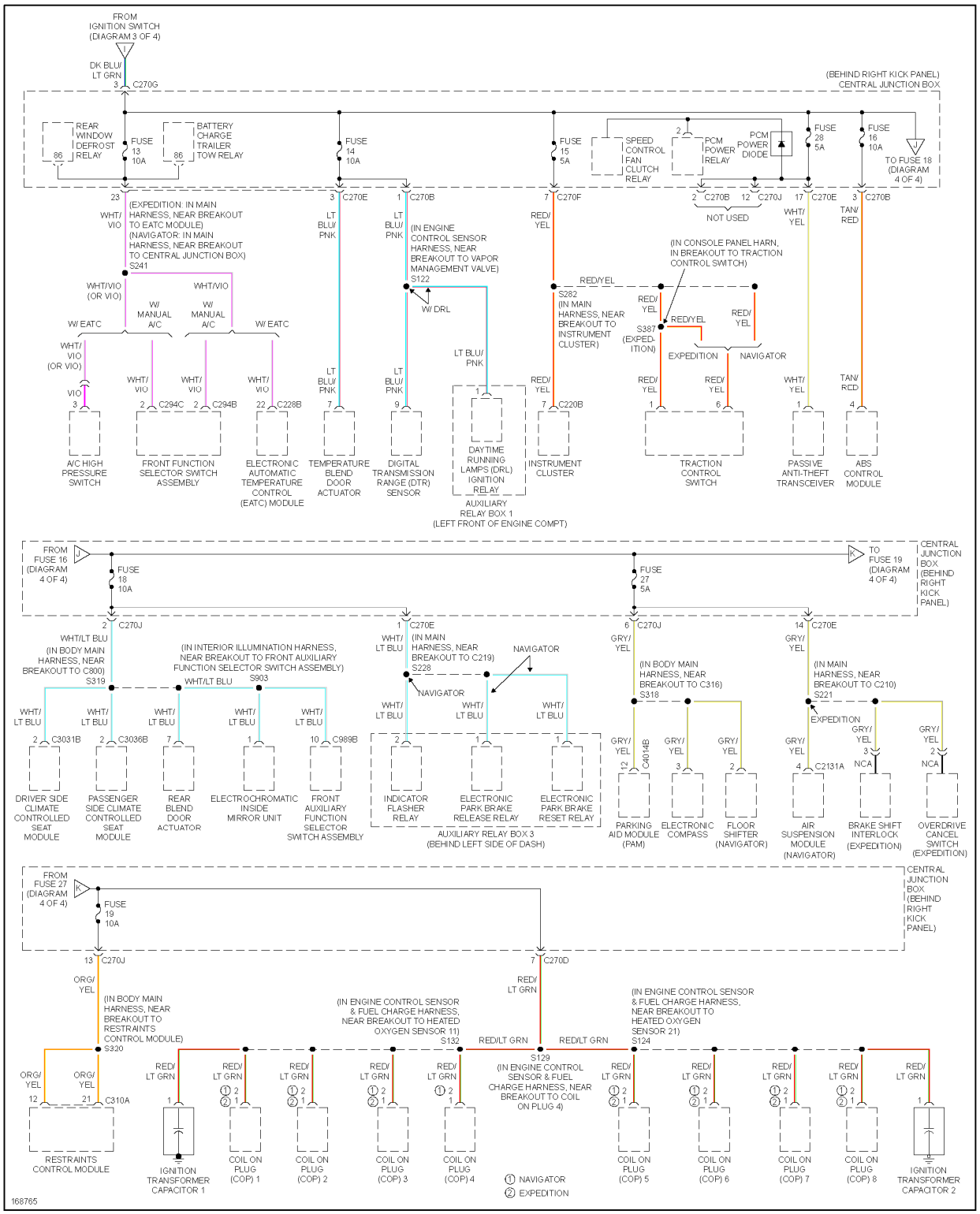


Fig. 43: Power Distribution Circuit (4 of 4)

POWER MIRRORS

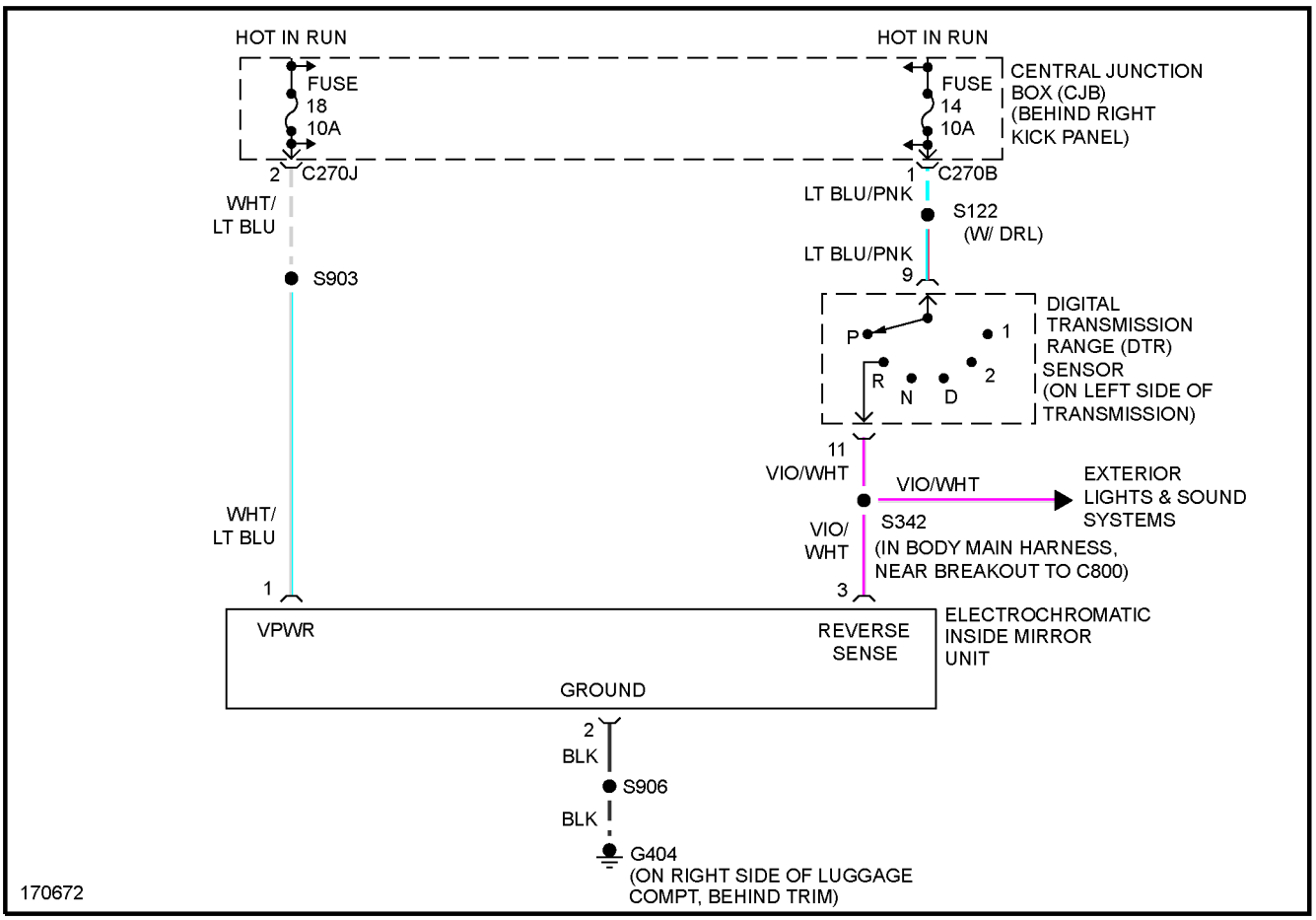


Fig. 44: Electronic Day/Night Mirror Circuit

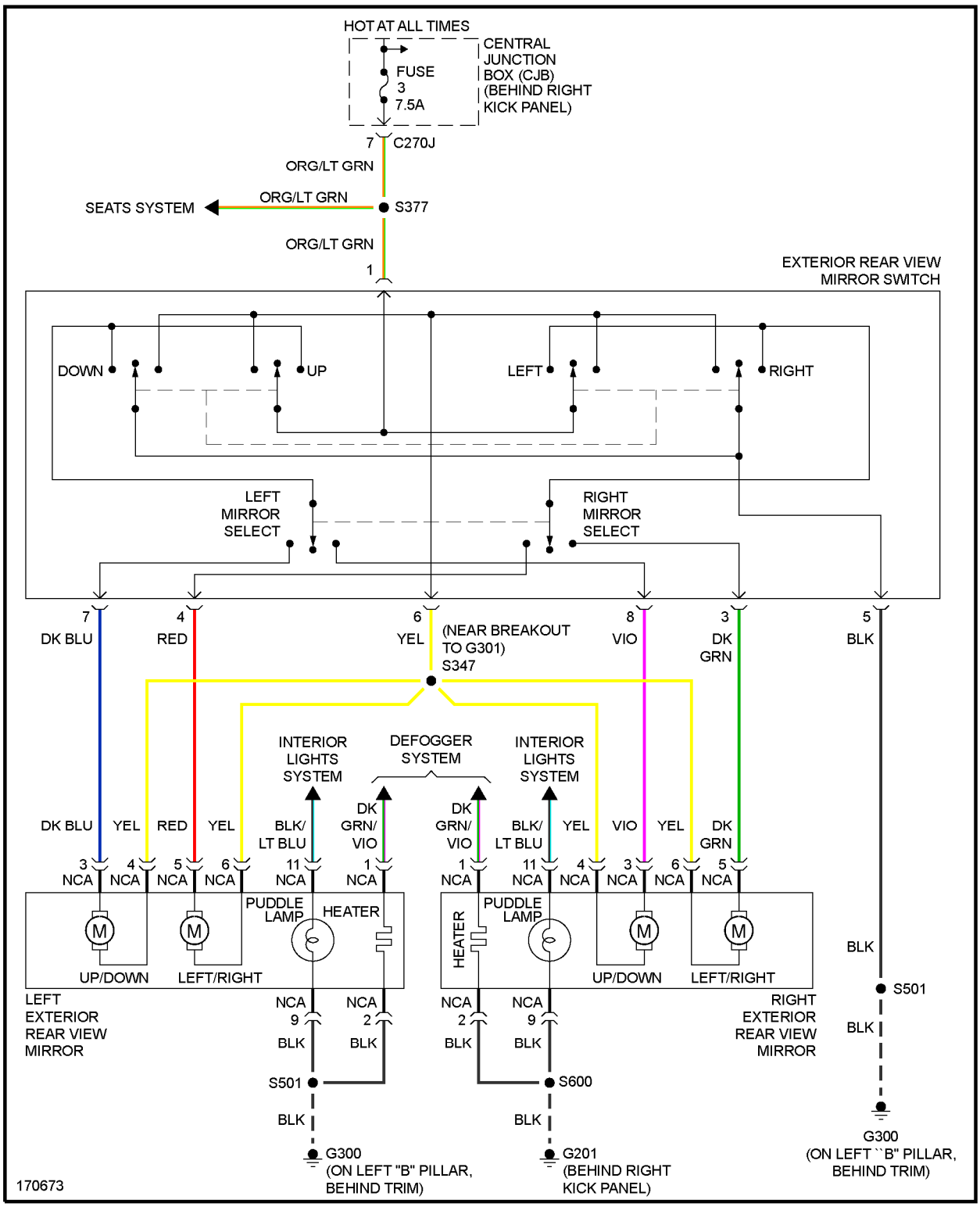


Fig. 45: Power Mirrors Circuit

POWER SEATS

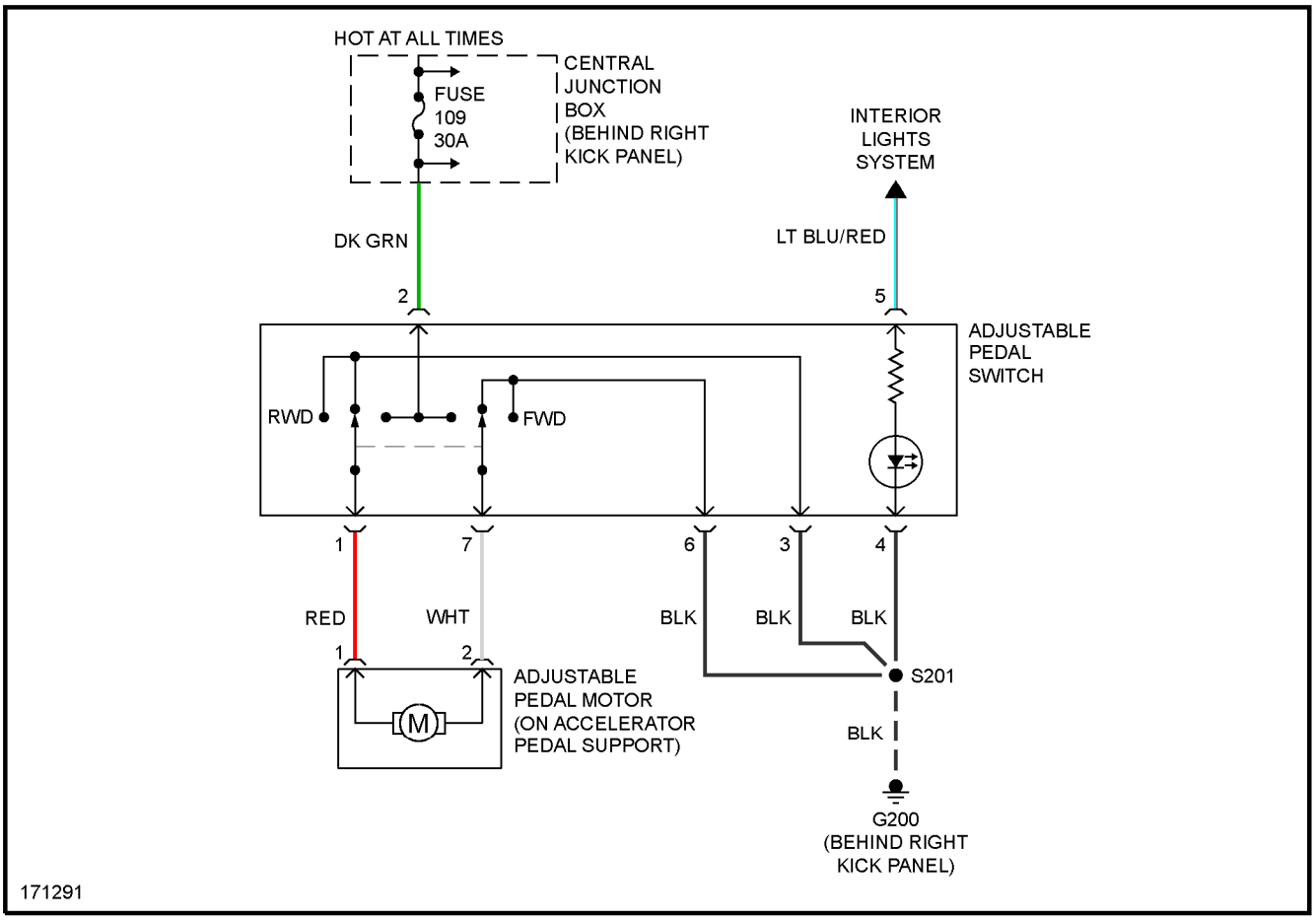


Fig. 46: Adjustable Pedal Circuit

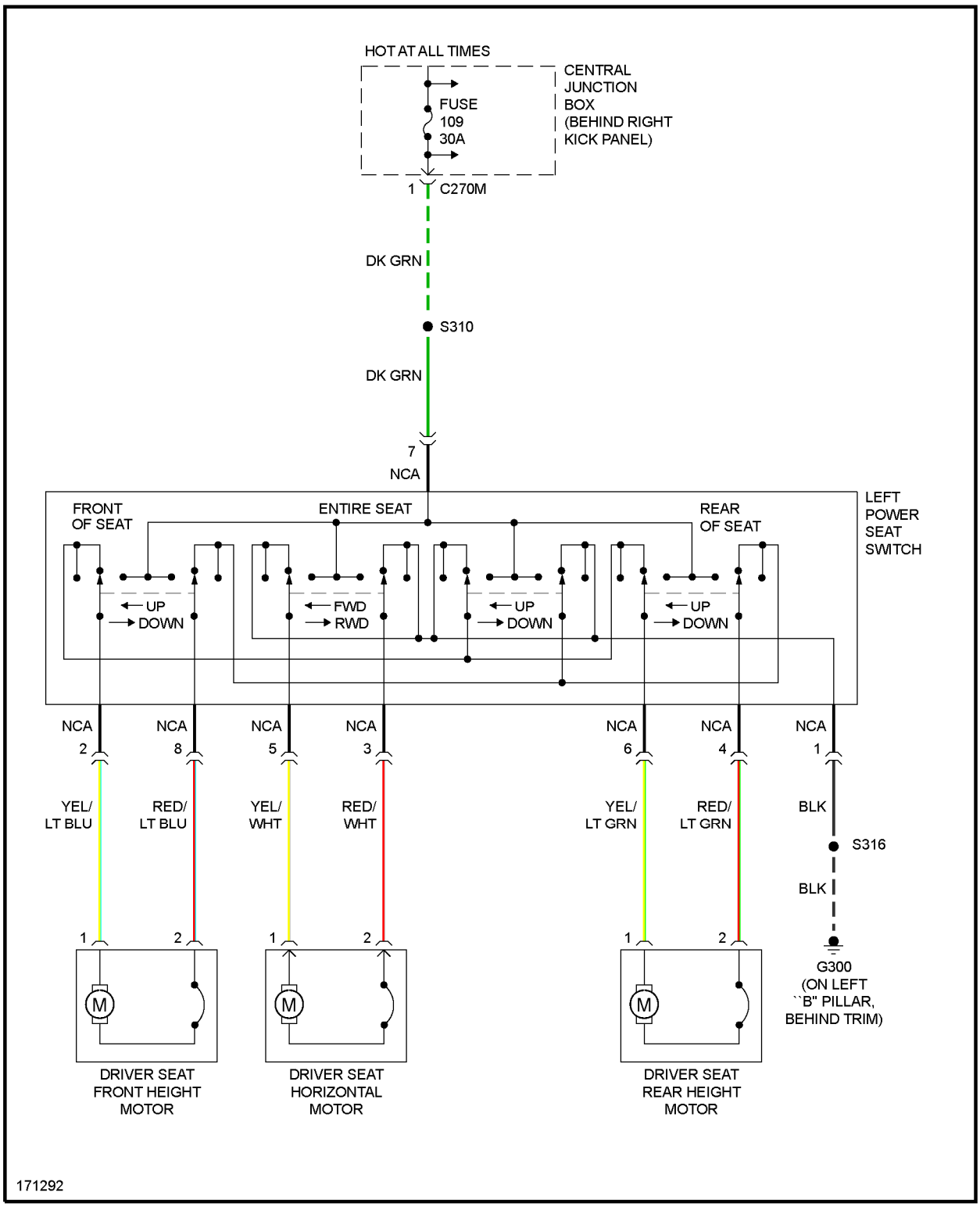


Fig. 47: Driver Power Seat Circuit

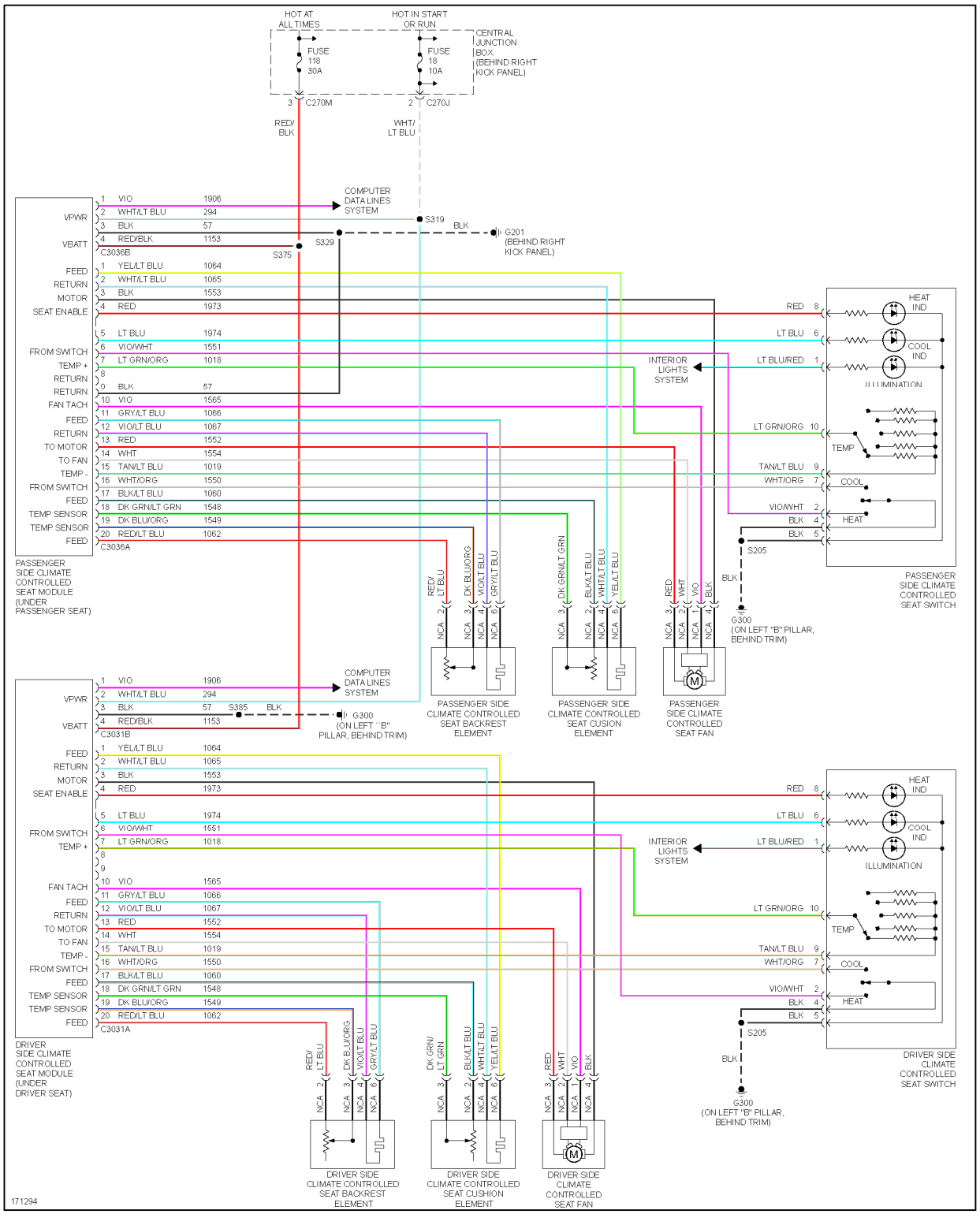


Fig. 48: Heated Seats Circuit

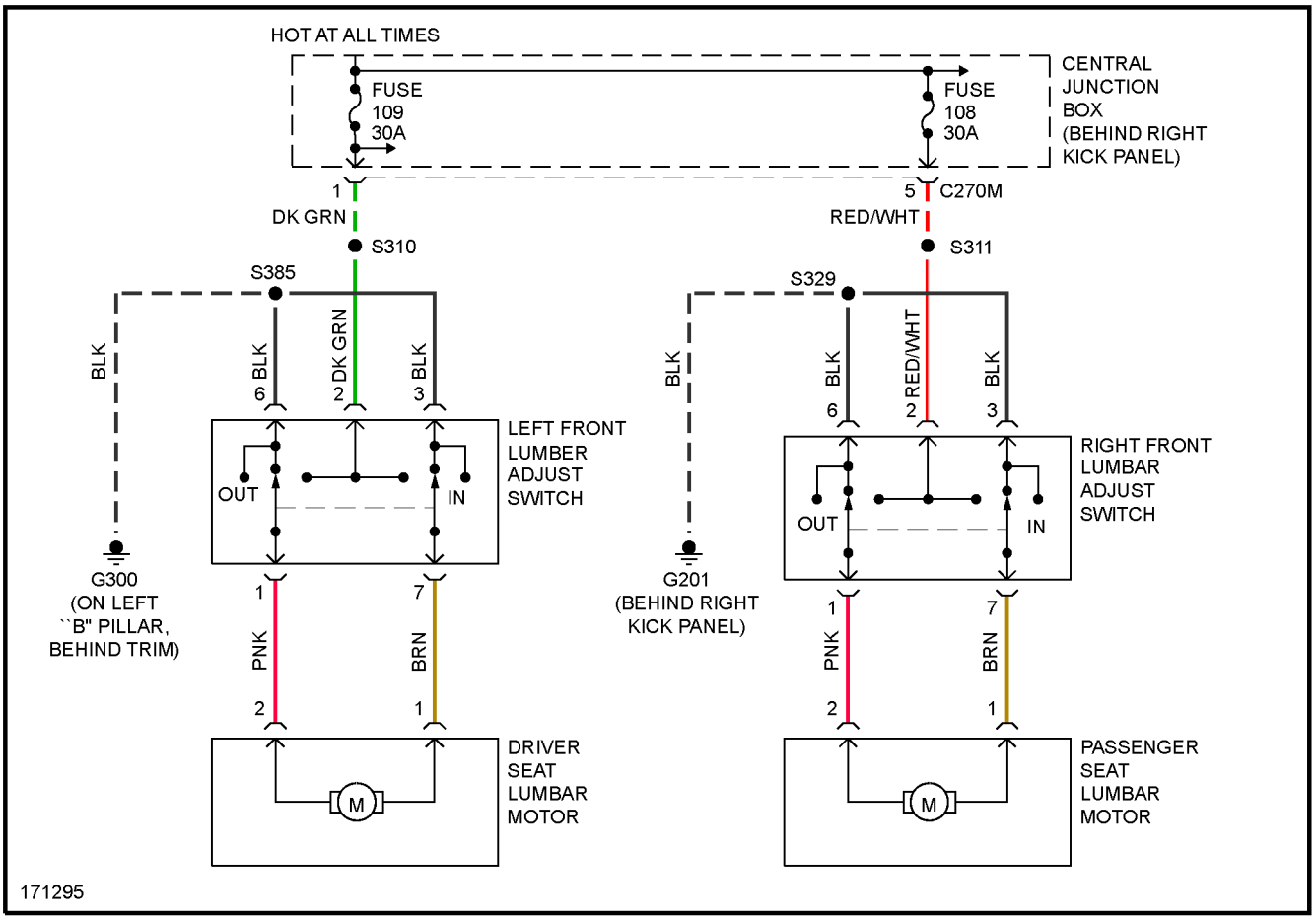


Fig. 49: Lumbar Circuit

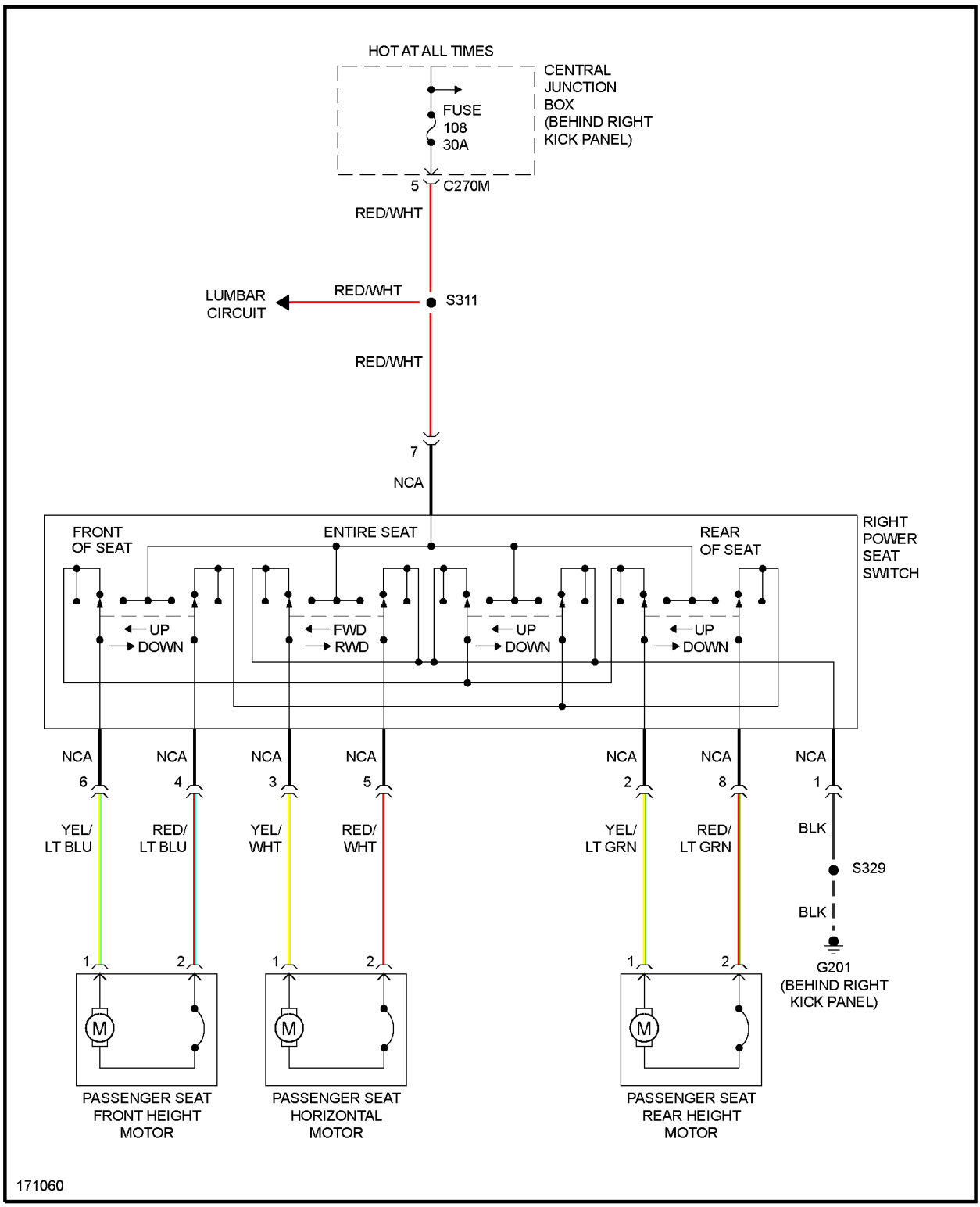


Fig. 50: Passenger Power Seat Circuit

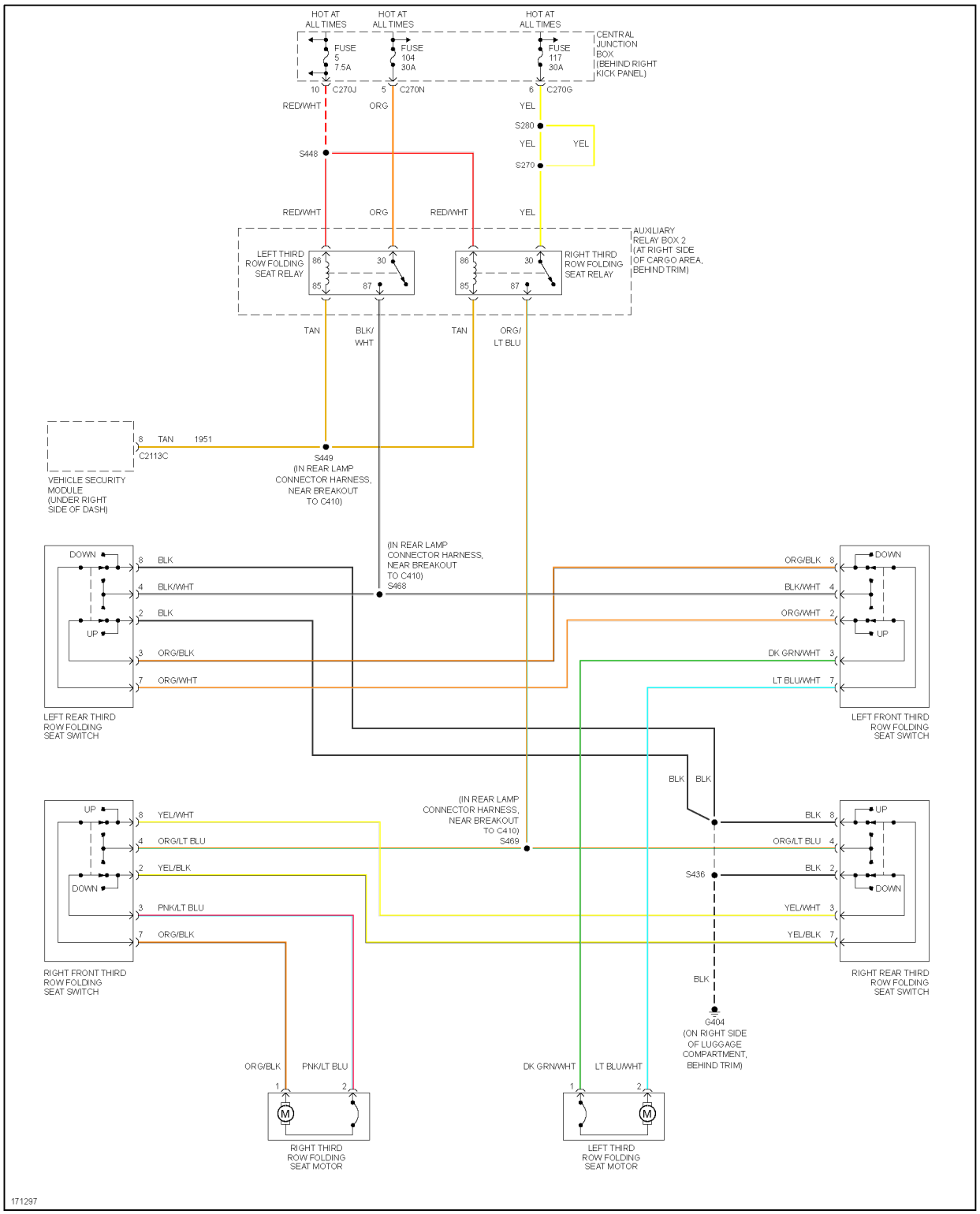


Fig. 51: Third Row Folding Seat Circuit

POWER TOP/SUNROOF

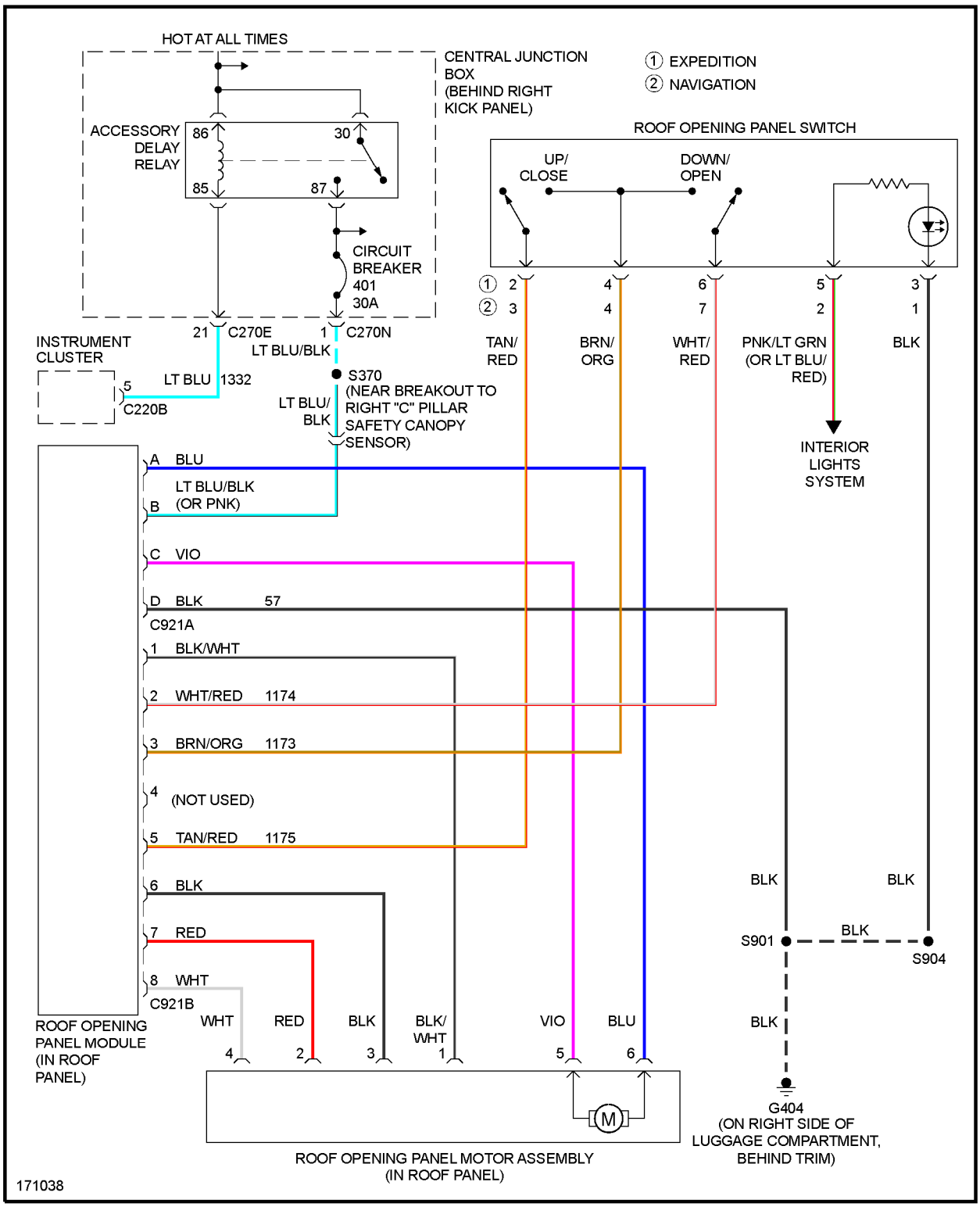


Fig. 52: Power Top/Sunroof Circuit

POWER WINDOWS

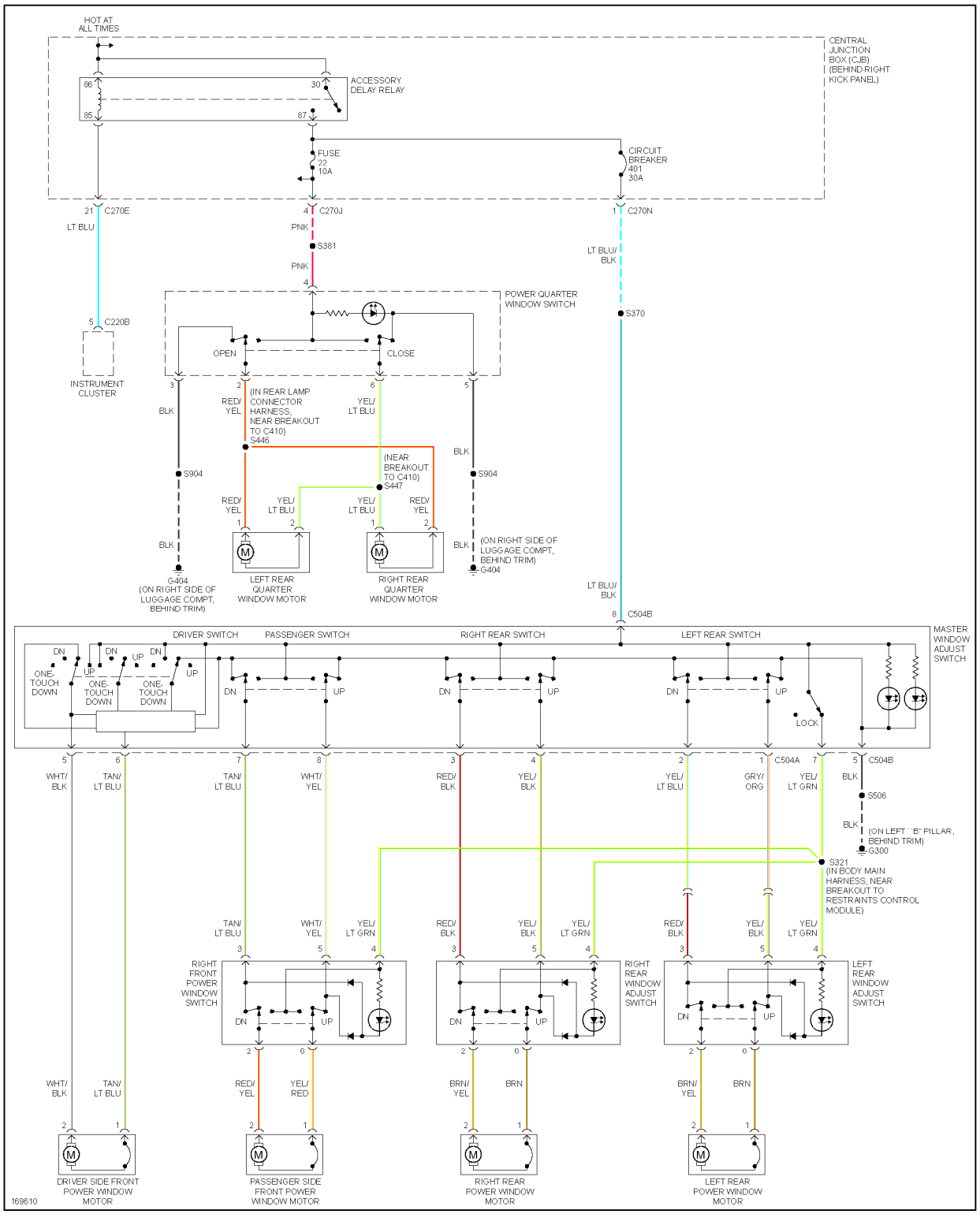


Fig. 53: Power Windows Circuit

RADIO

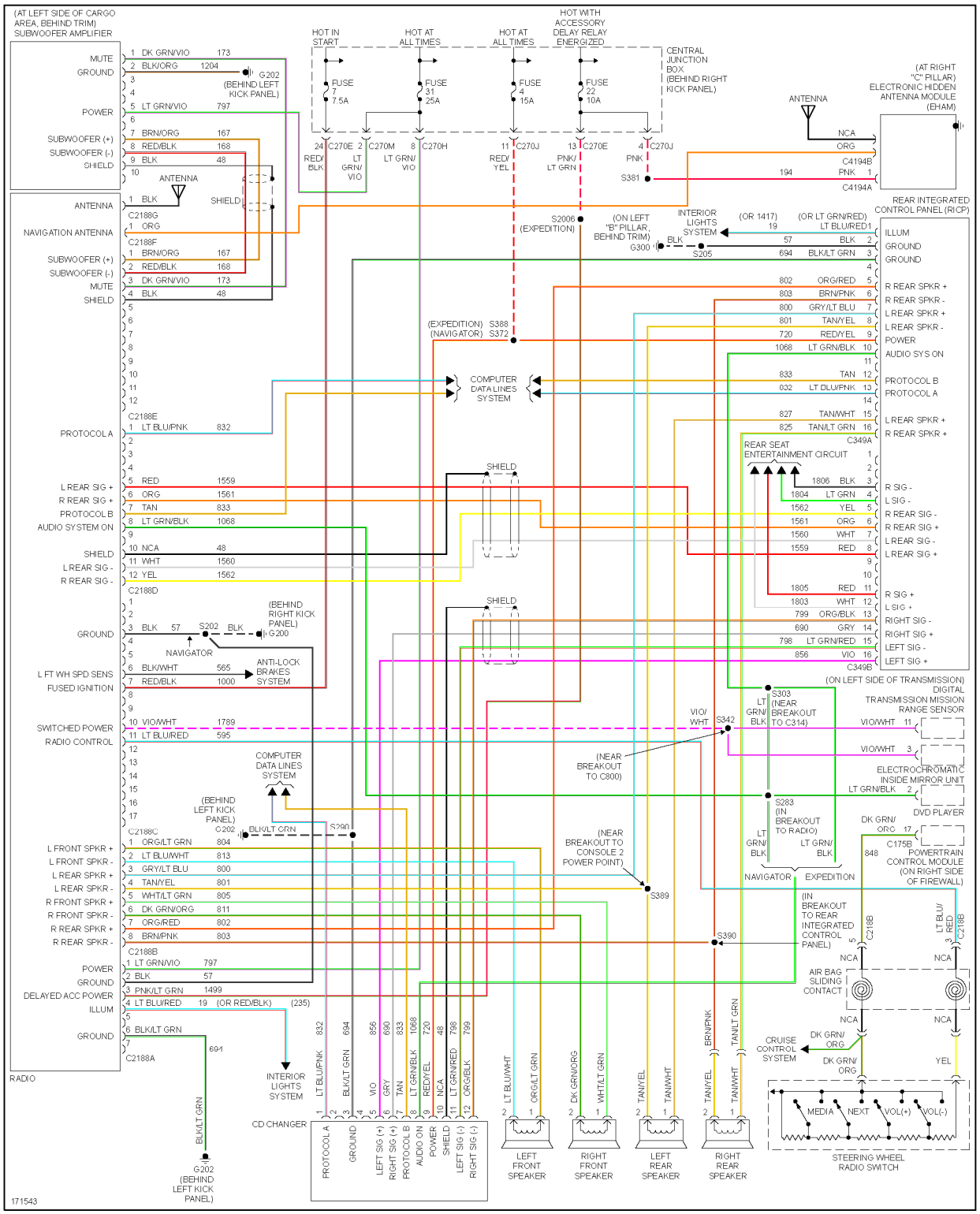


Fig. 54: Navigation Circuit, W/ Navigation

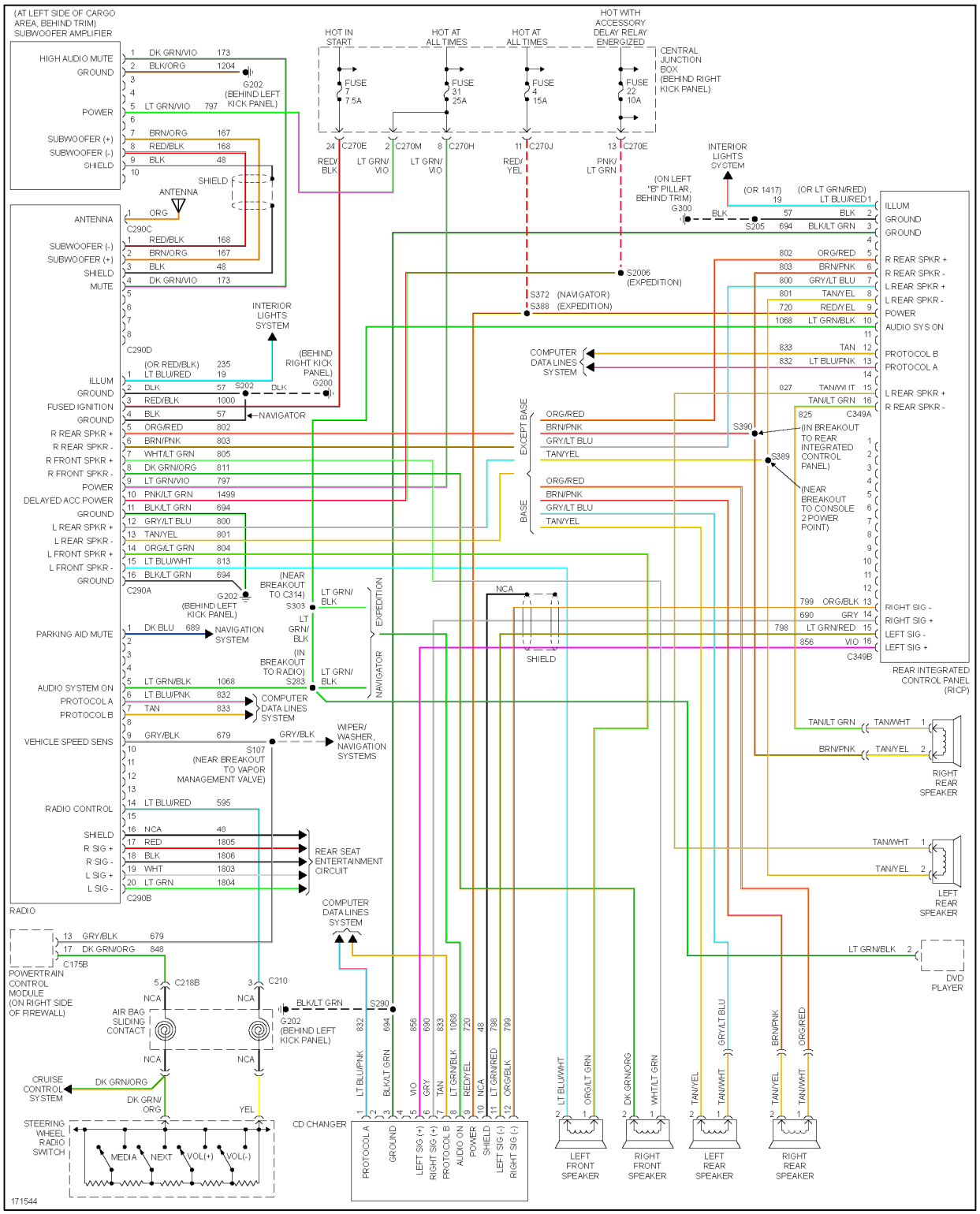


Fig. 55: Radio Circuit, W/O Navigation

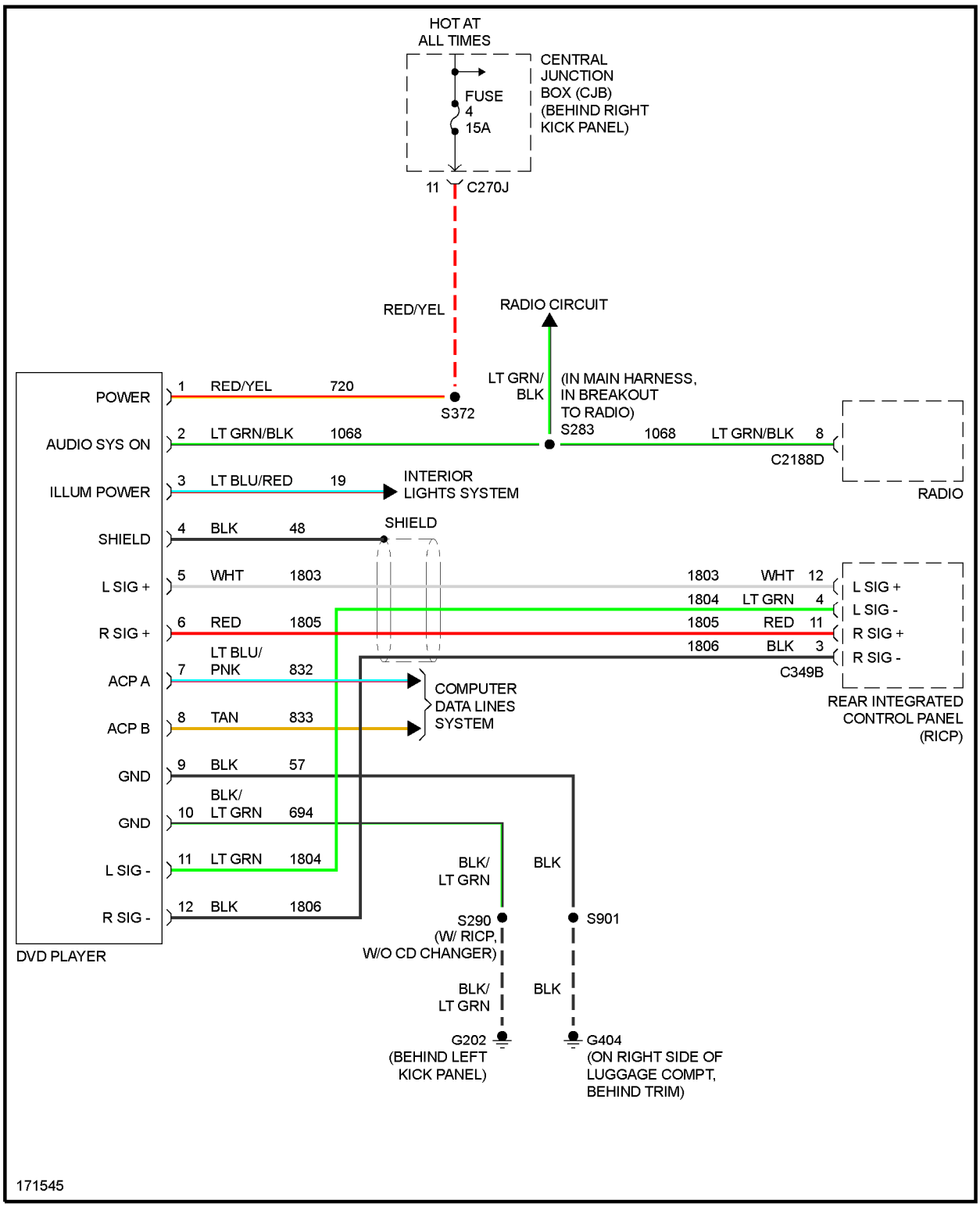


Fig. 56: Rear Seat Entertainment Circuit, W/ Navigation

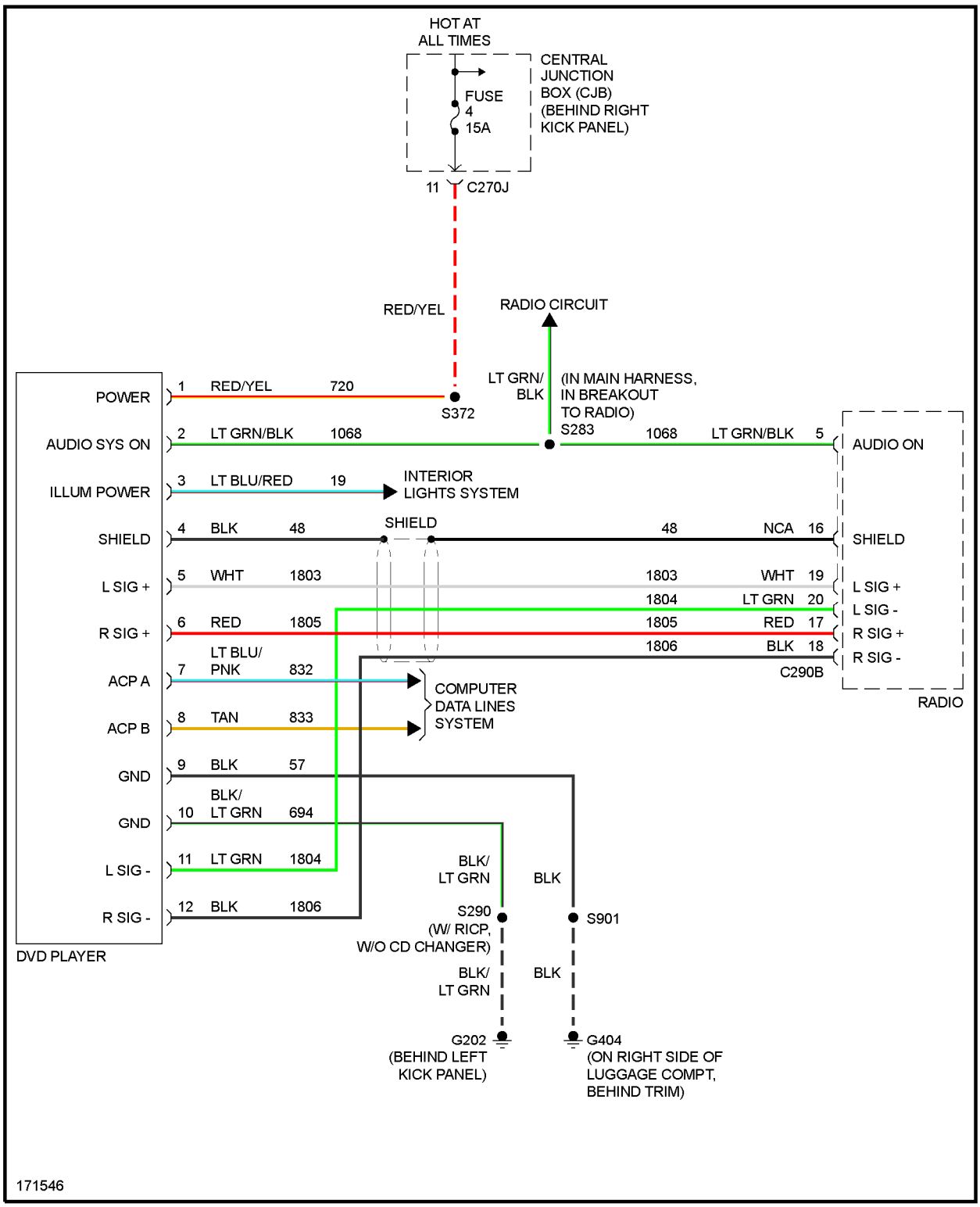


Fig. 57: Rear Seat Entertainment Circuit, W/O Navigation

SHIFT INTERLOCK

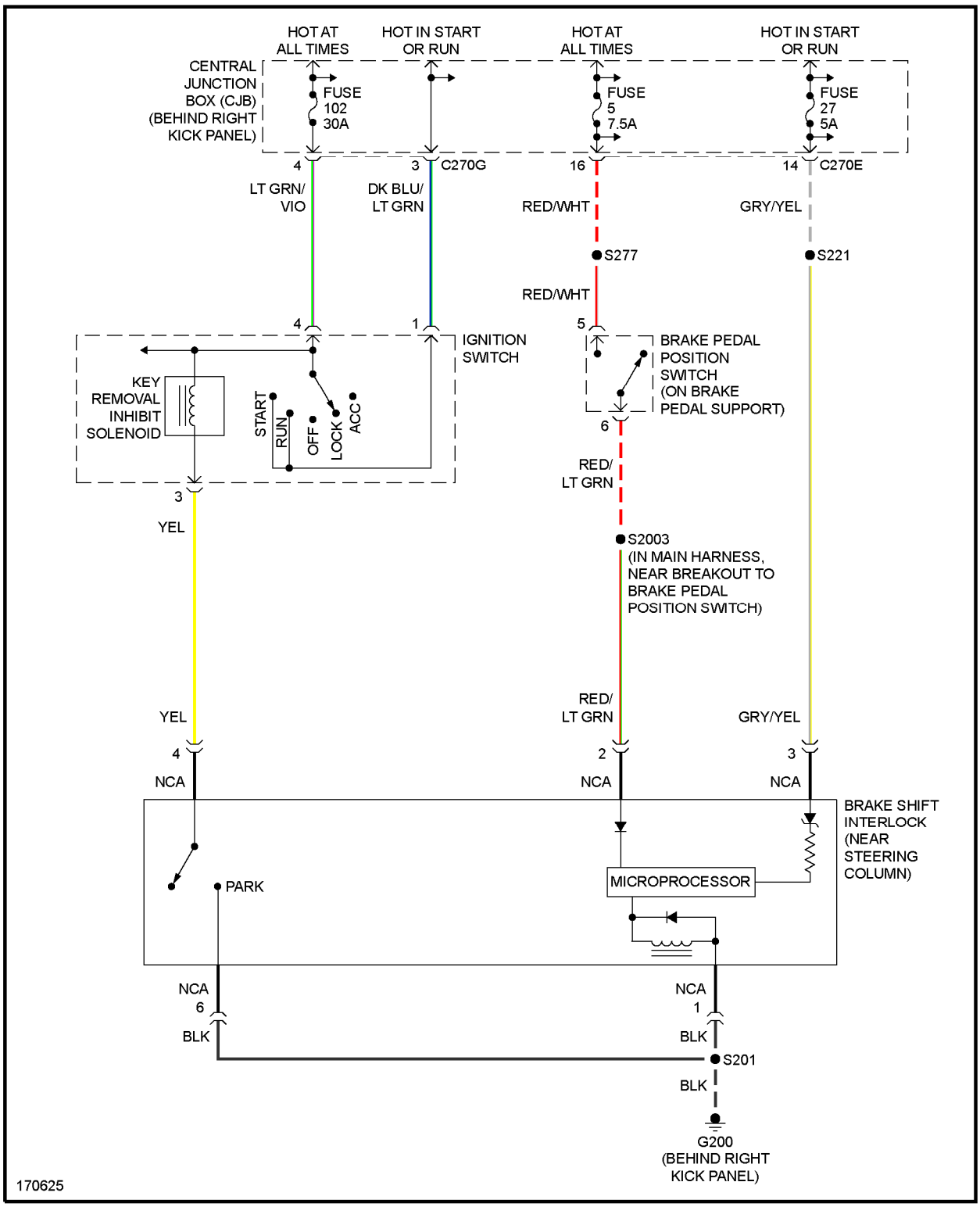


Fig. 58: Shift Interlock Circuit

STARTING/CHARGING

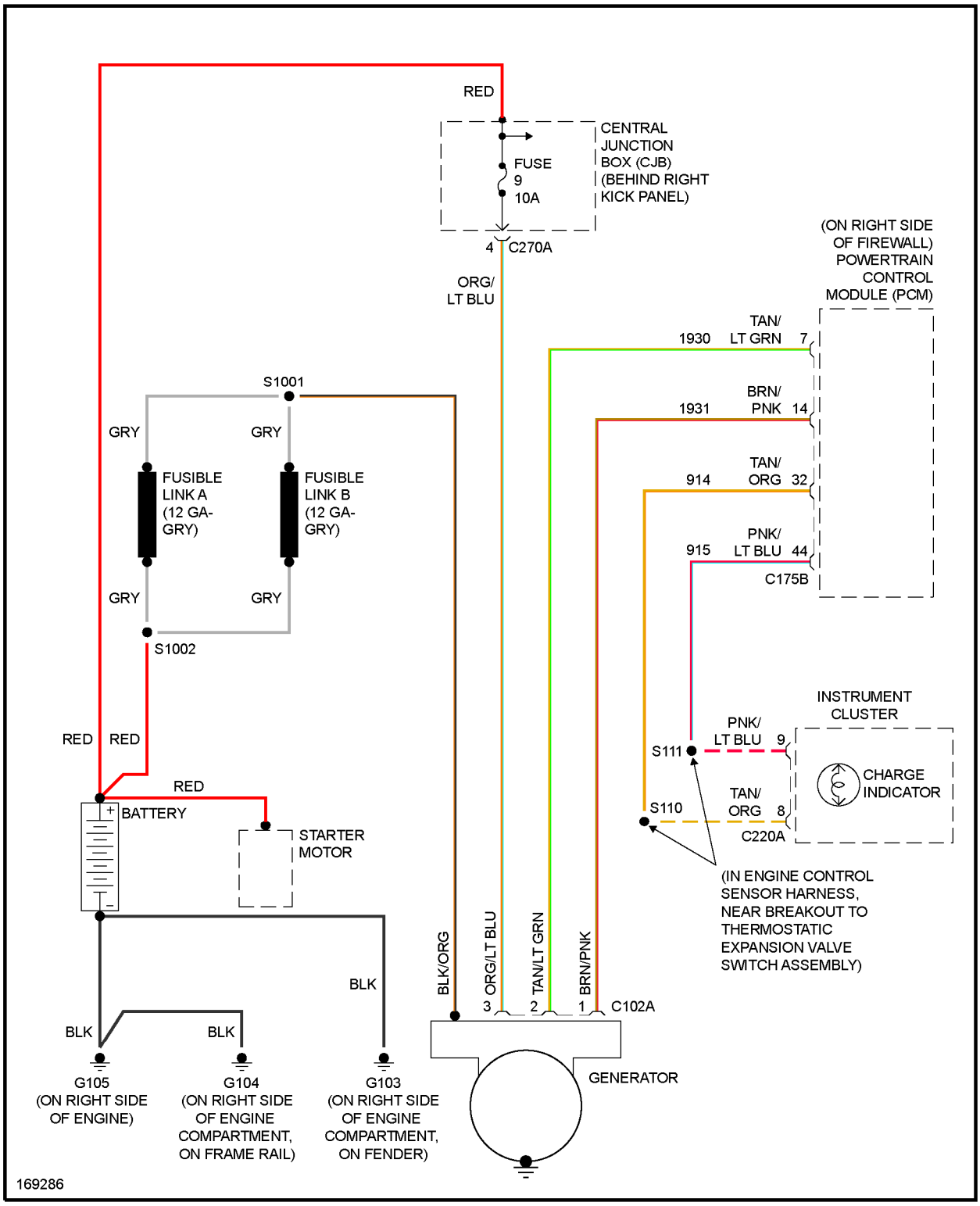


Fig. 59: Charging Circuit

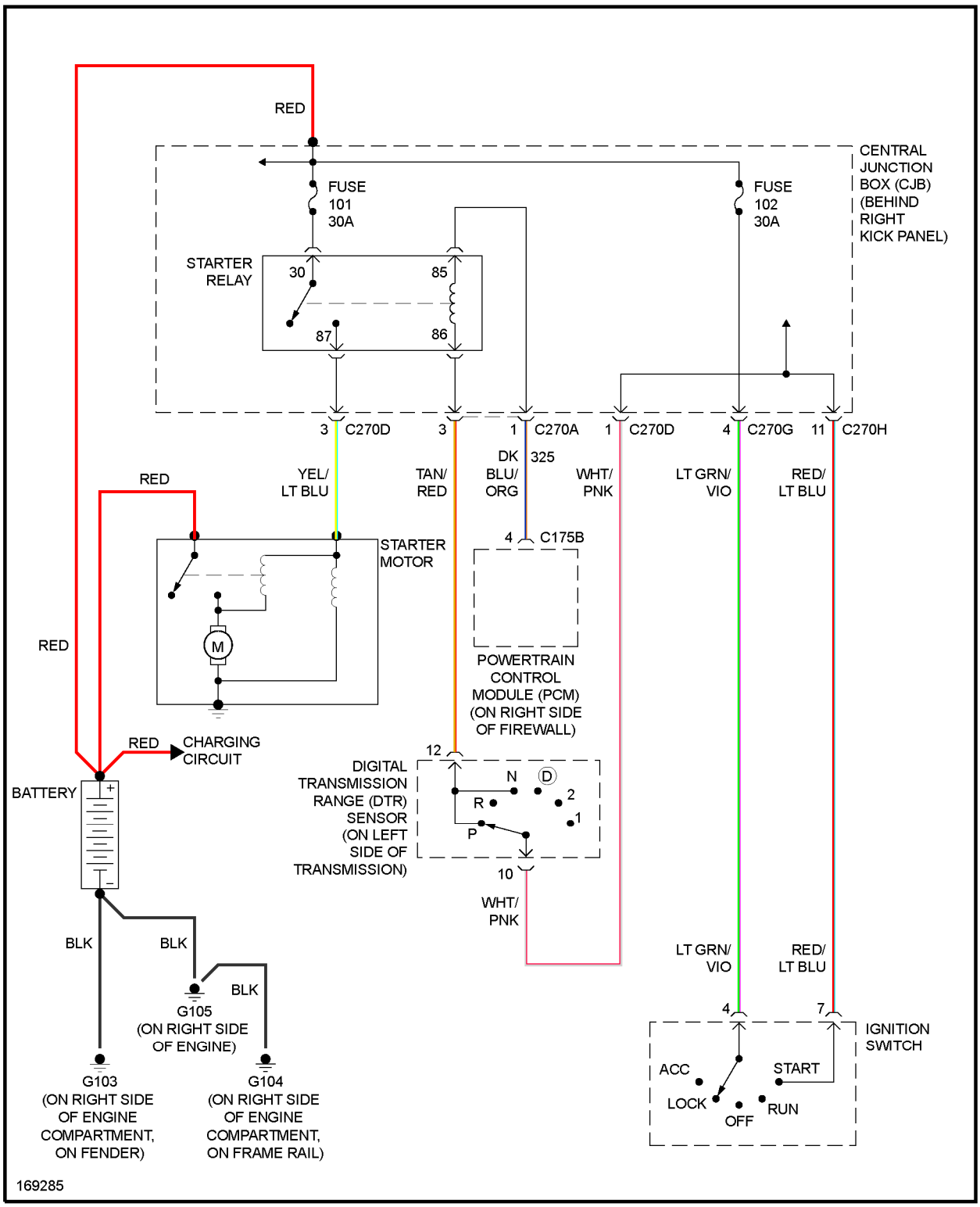


Fig. 60: Starting Circuit

SUPPLEMENTAL RESTRAINTS

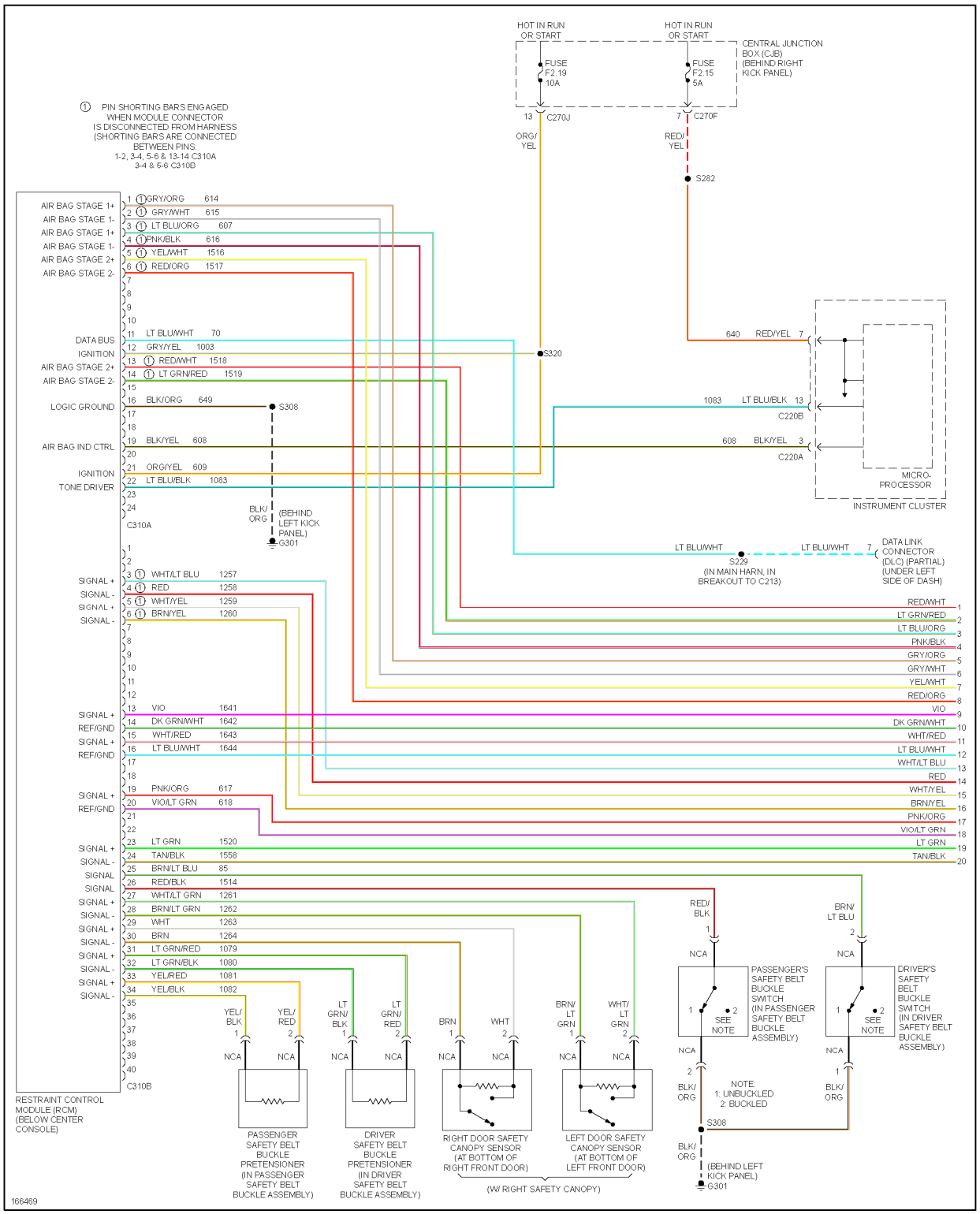


Fig. 61: Supplemental Restraints Circuit (1 of 2)

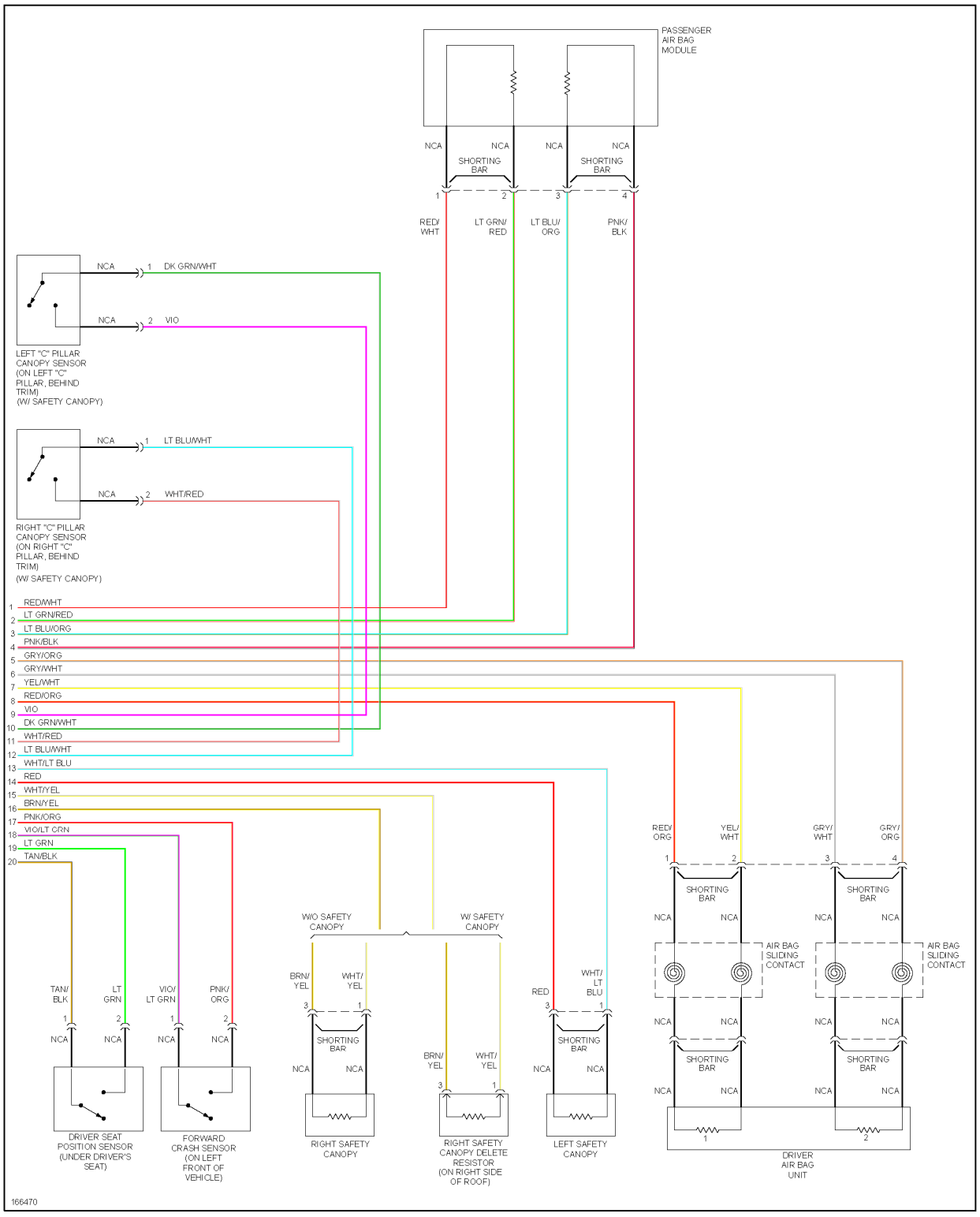


Fig. 62: Supplemental Restraints Circuit (2 of 2)

TRANSMISSION

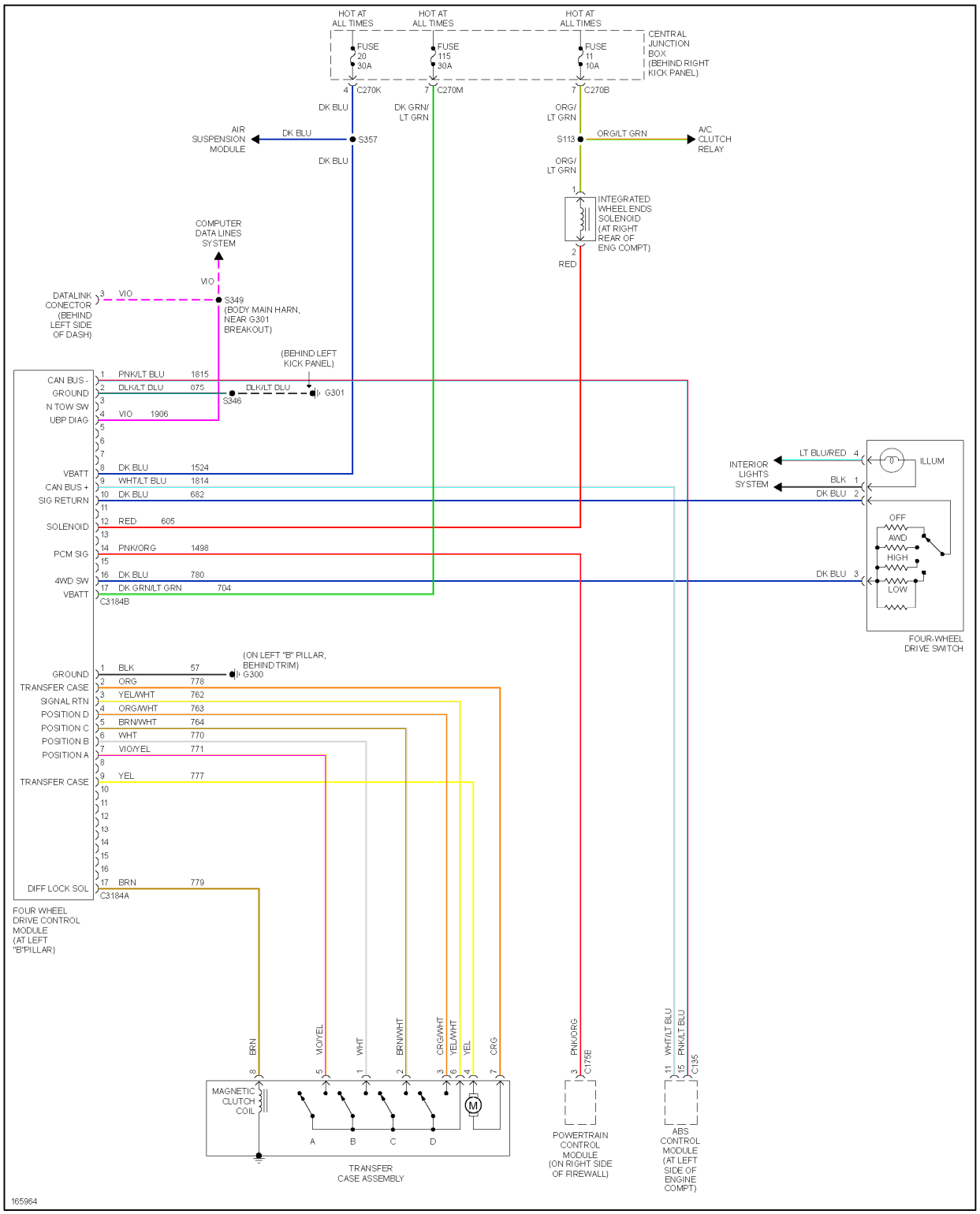


Fig. 63: 4WD Circuit

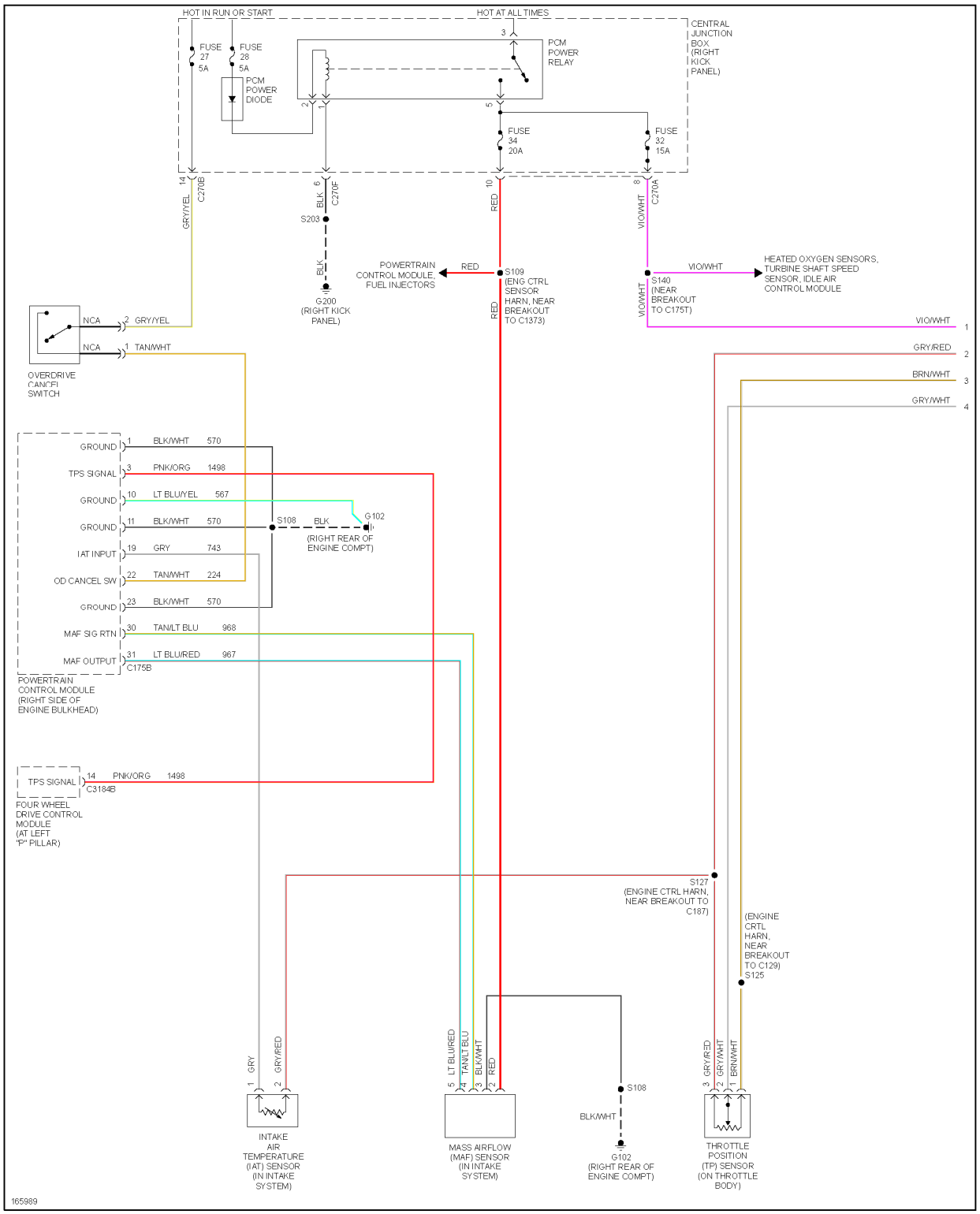


Fig. 64: A/T Circuit (1 of 2)

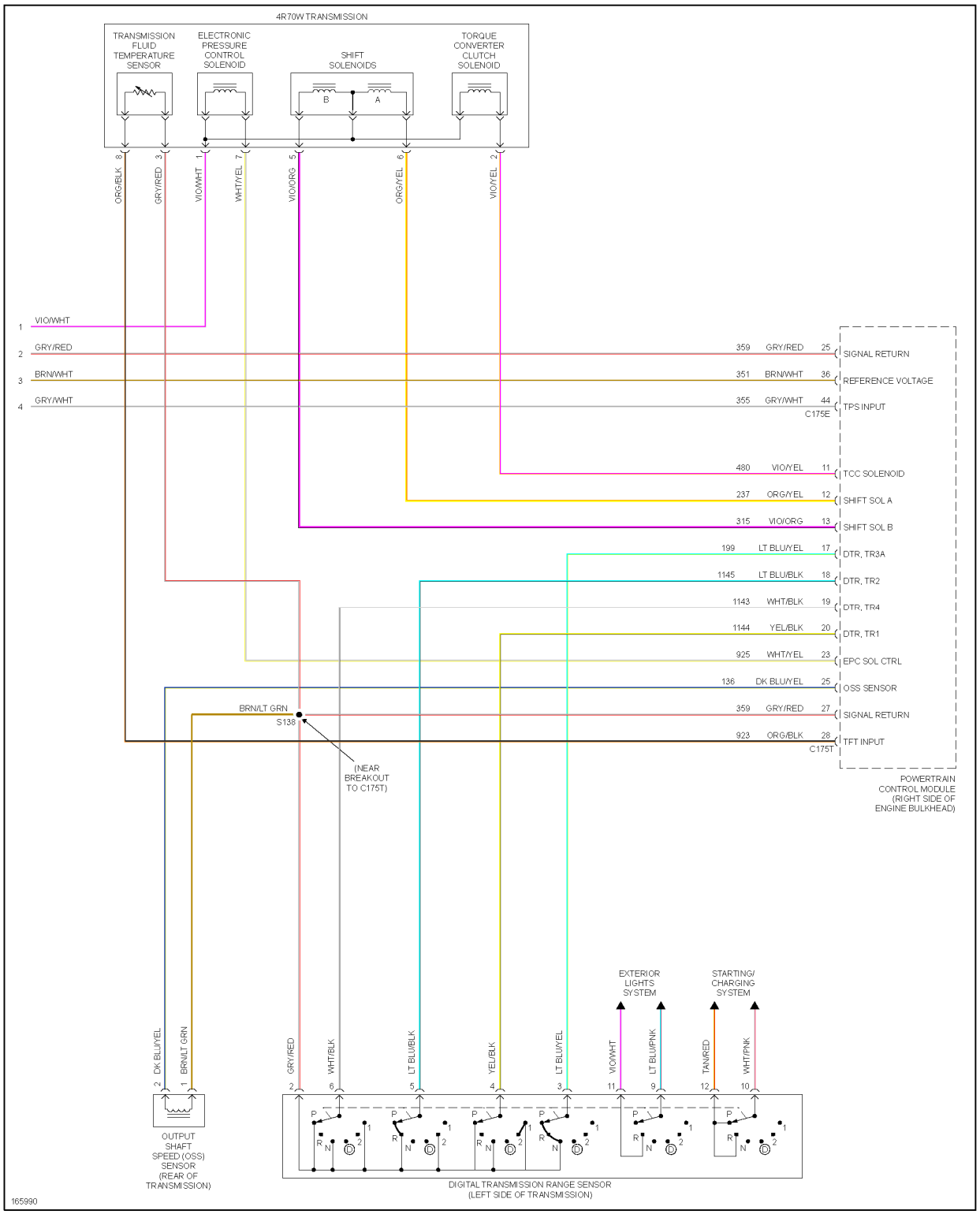


Fig. 65: A/T Circuit (2 of 2)

TRUNK, TAILGATE, FUEL DOOR

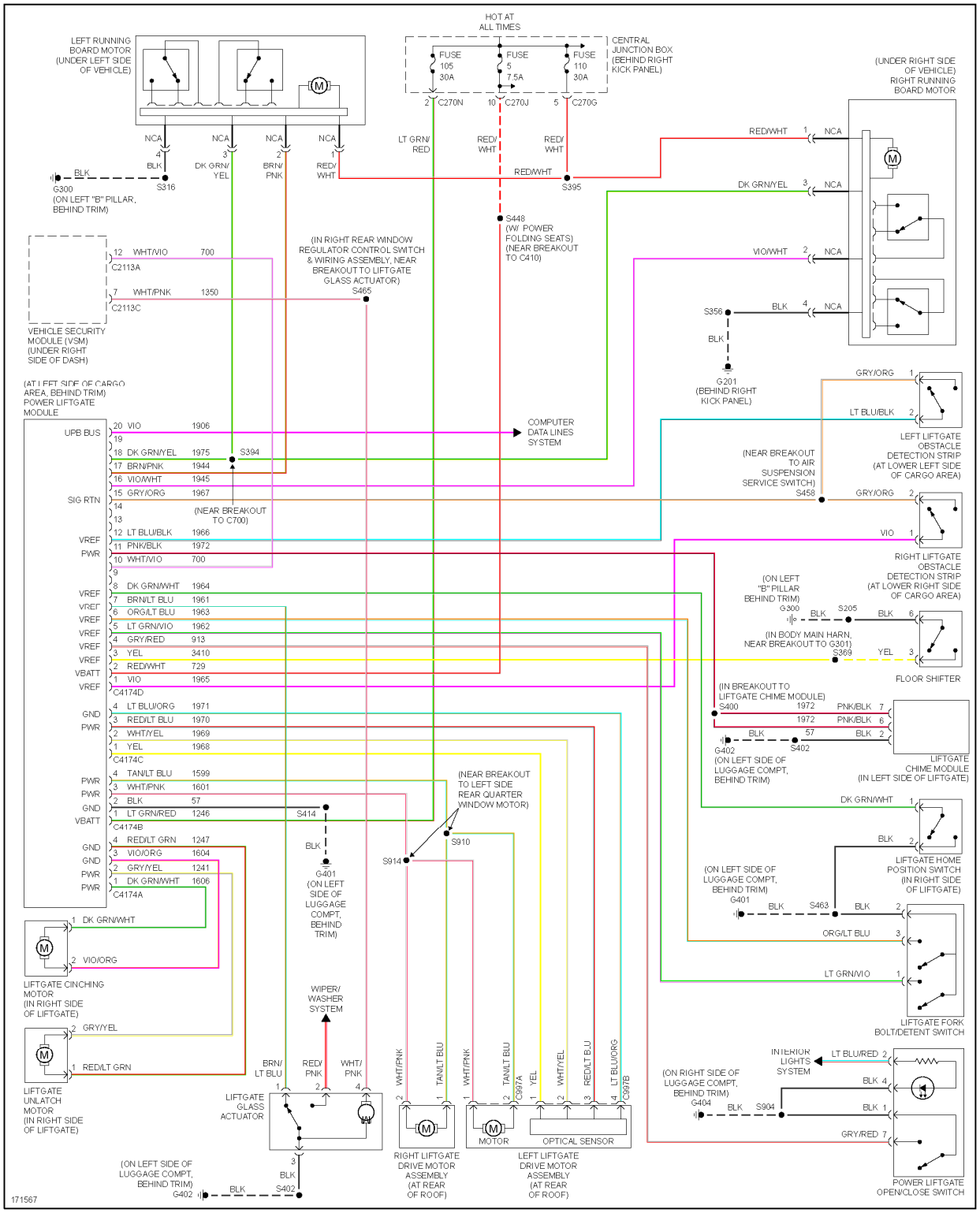


Fig. 66: Trunk, Tailgate, Fuel Door Circuit

WARNING SYSTEMS

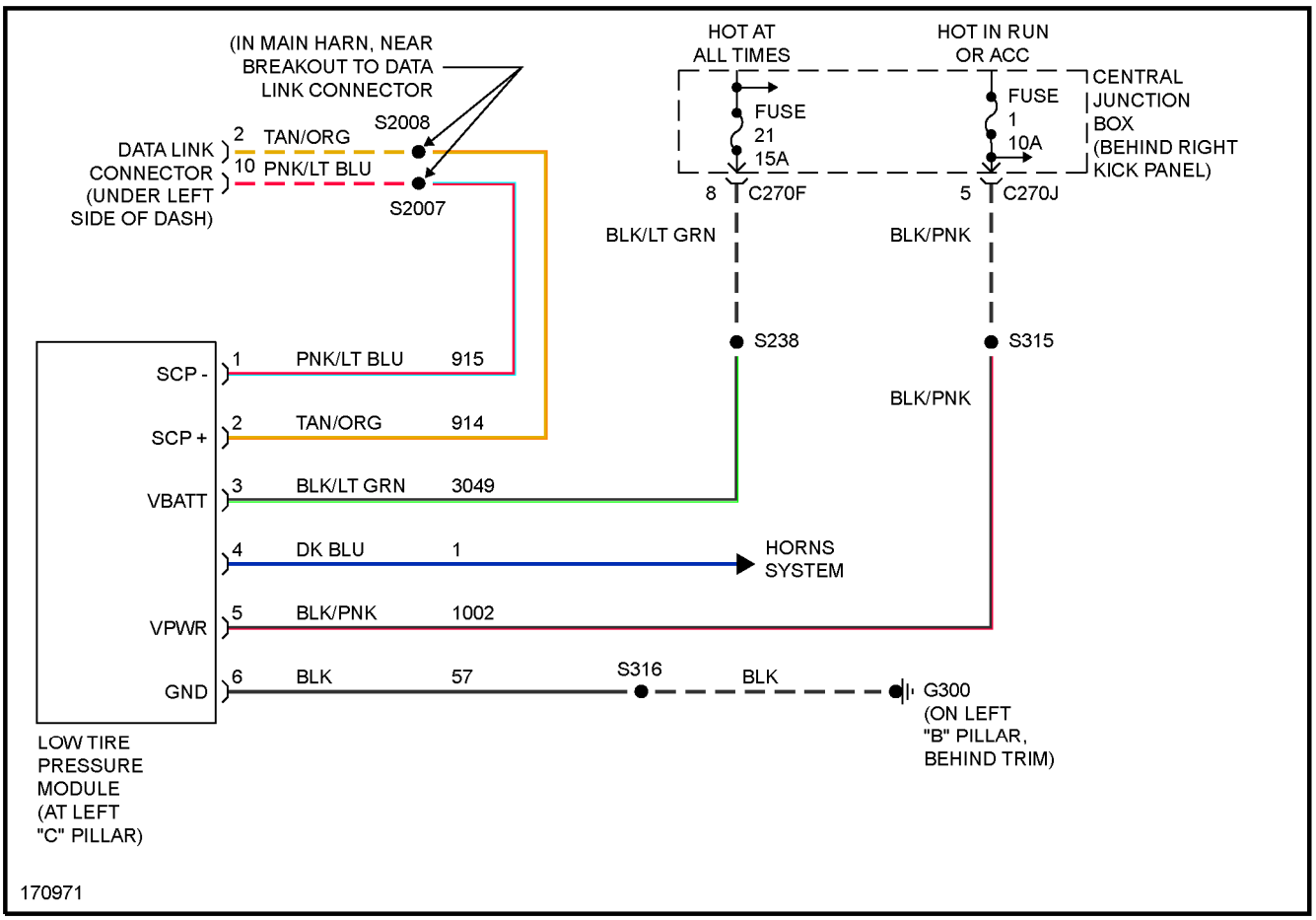


Fig. 67: Tire Pressure Monitoring Circuit

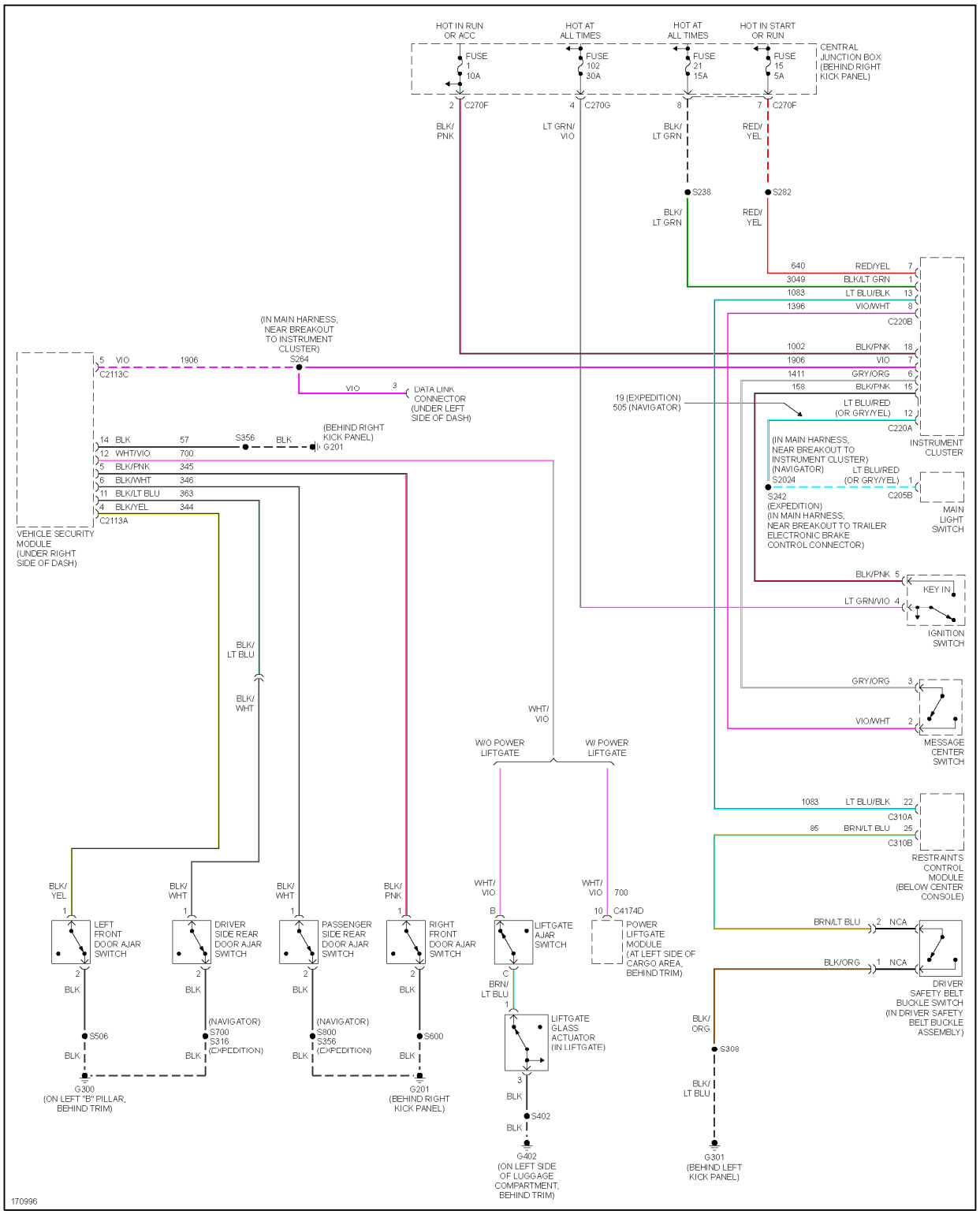


Fig. 68: Warning Systems Circuit

WIPER/WASHER

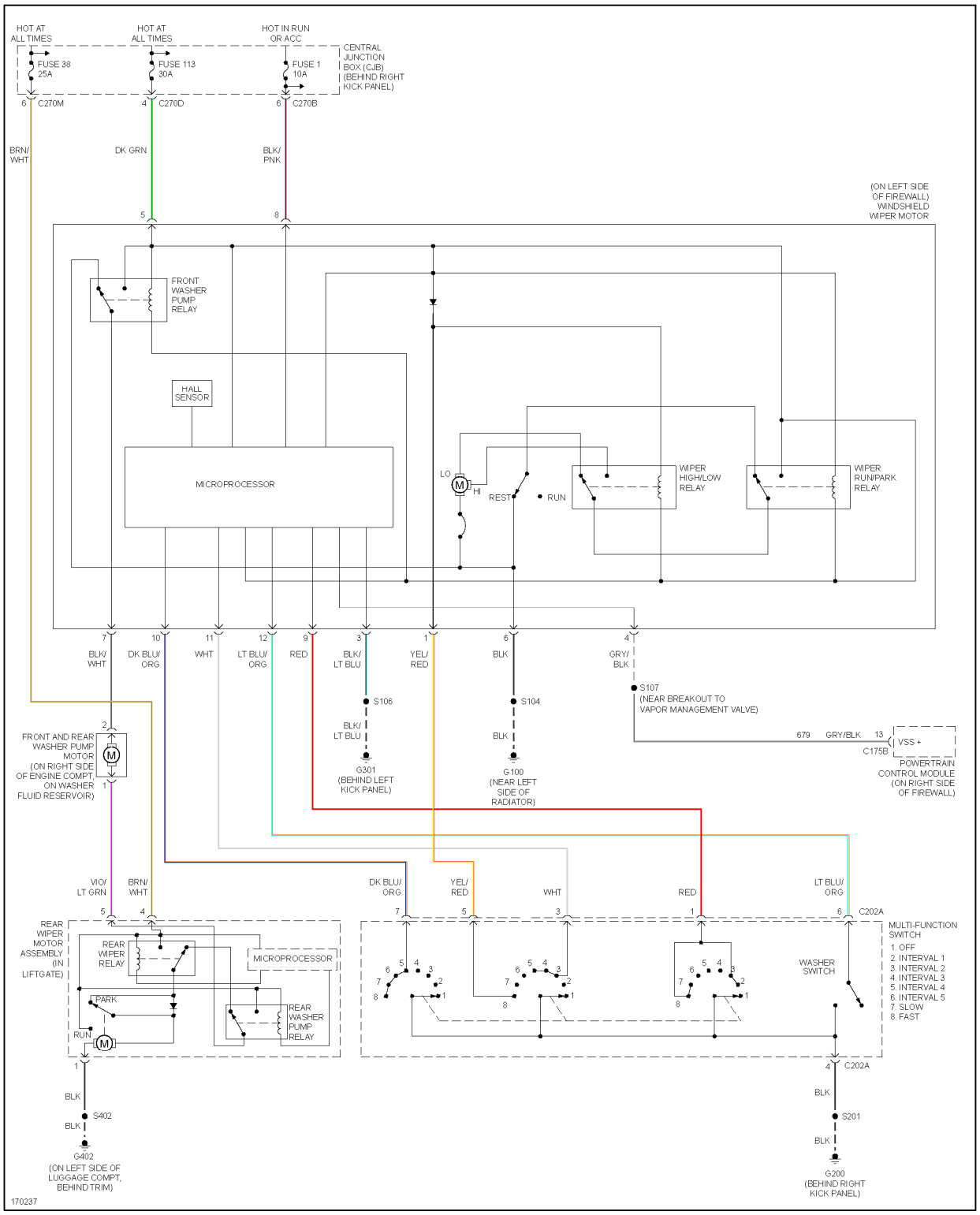


Fig. 69: Front Washer/Wiper Circuit

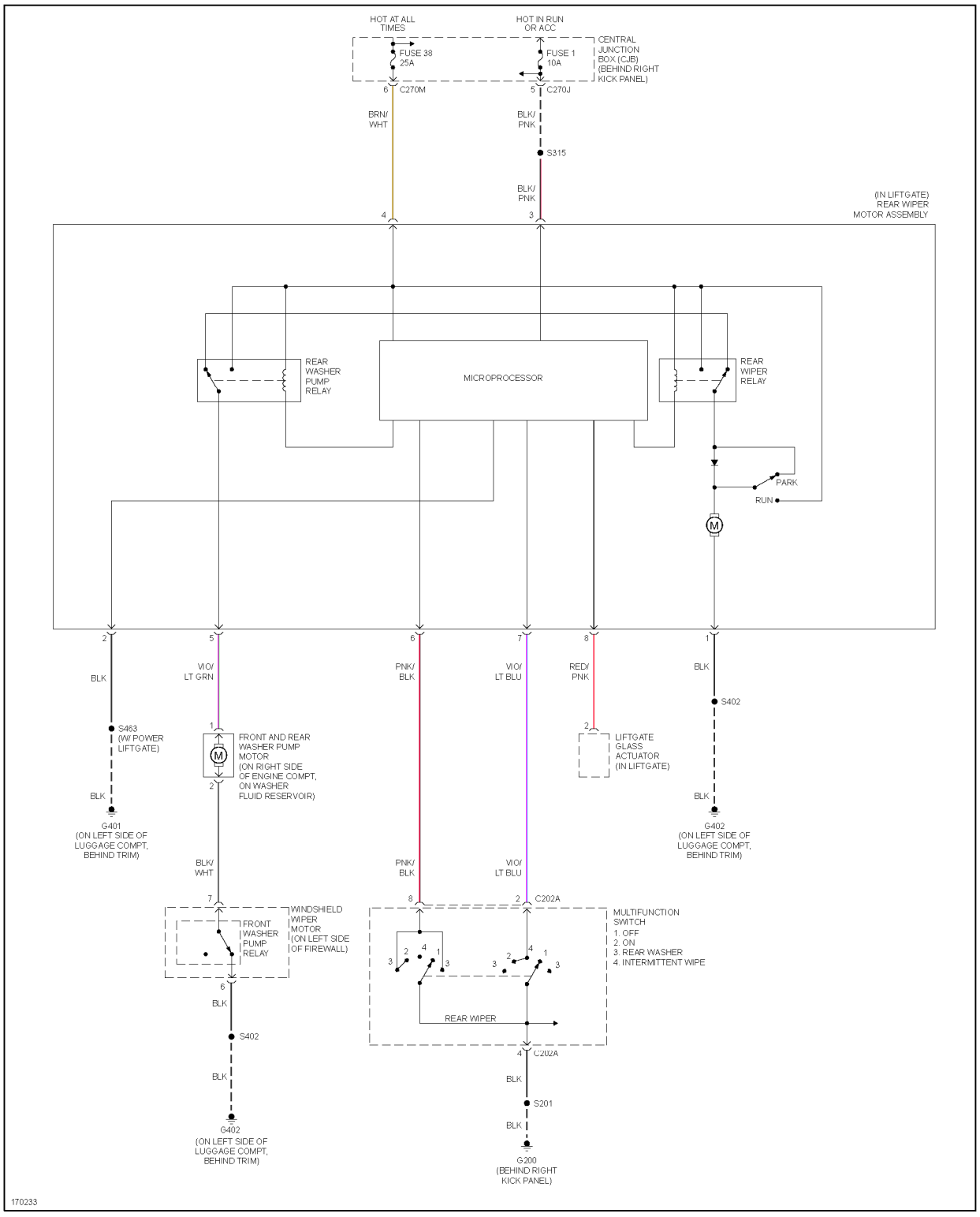


Fig. 70: Rear Washer/Wiper Circuit

2003 ELECTRICAL

Fuses & Circuit Breakers - Expedition & Navigator

IDENTIFICATION

CAUTION: When battery is disconnected, vehicle computer and memory systems may lose memory data. Driveability problems may exist until computer systems have completed a relearn cycle. See COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION before disconnecting battery.

CENTRAL JUNCTION BOX

NOTE: Central junction box is located behind right kick panel. See Fig. 1.

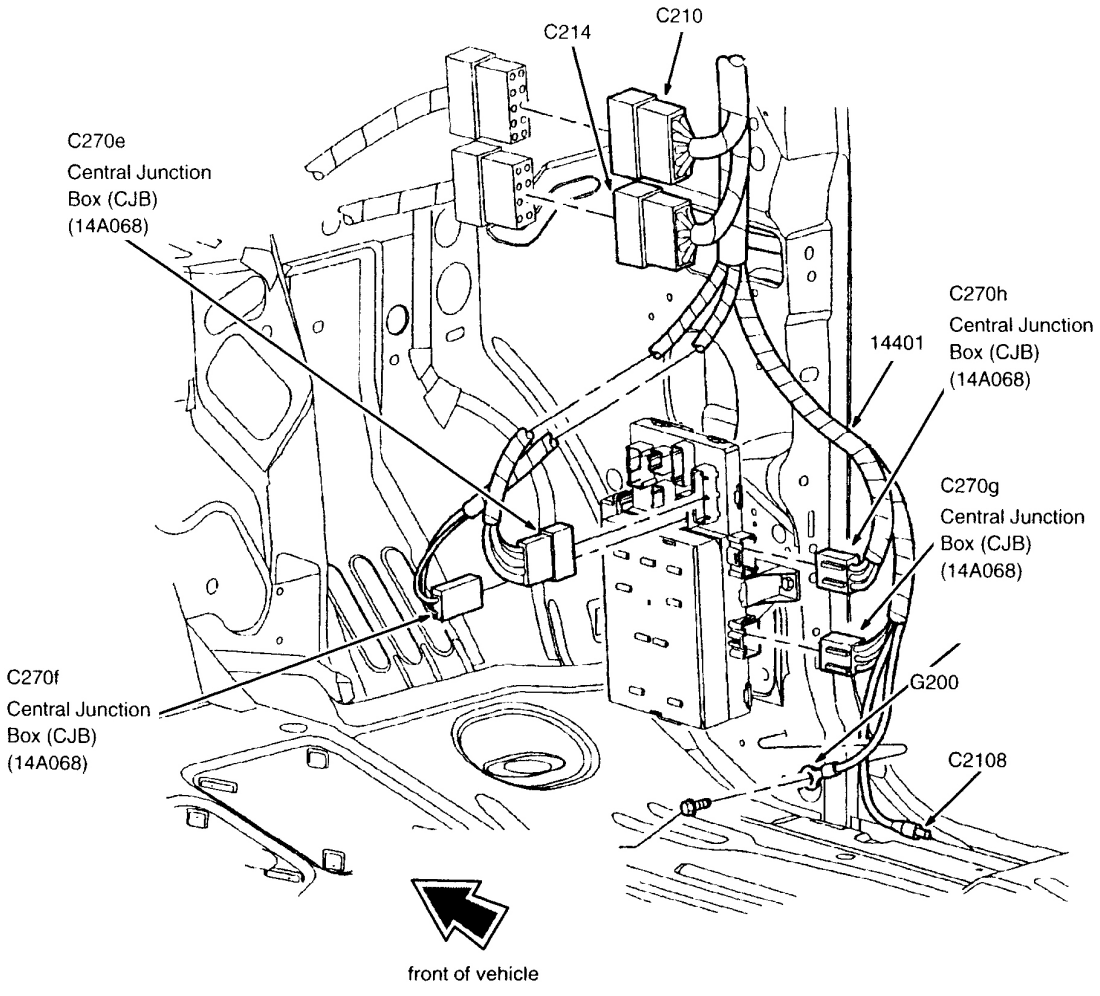


Fig. 1: Locating Central Junction Box
Courtesy of FORD MOTOR CO.

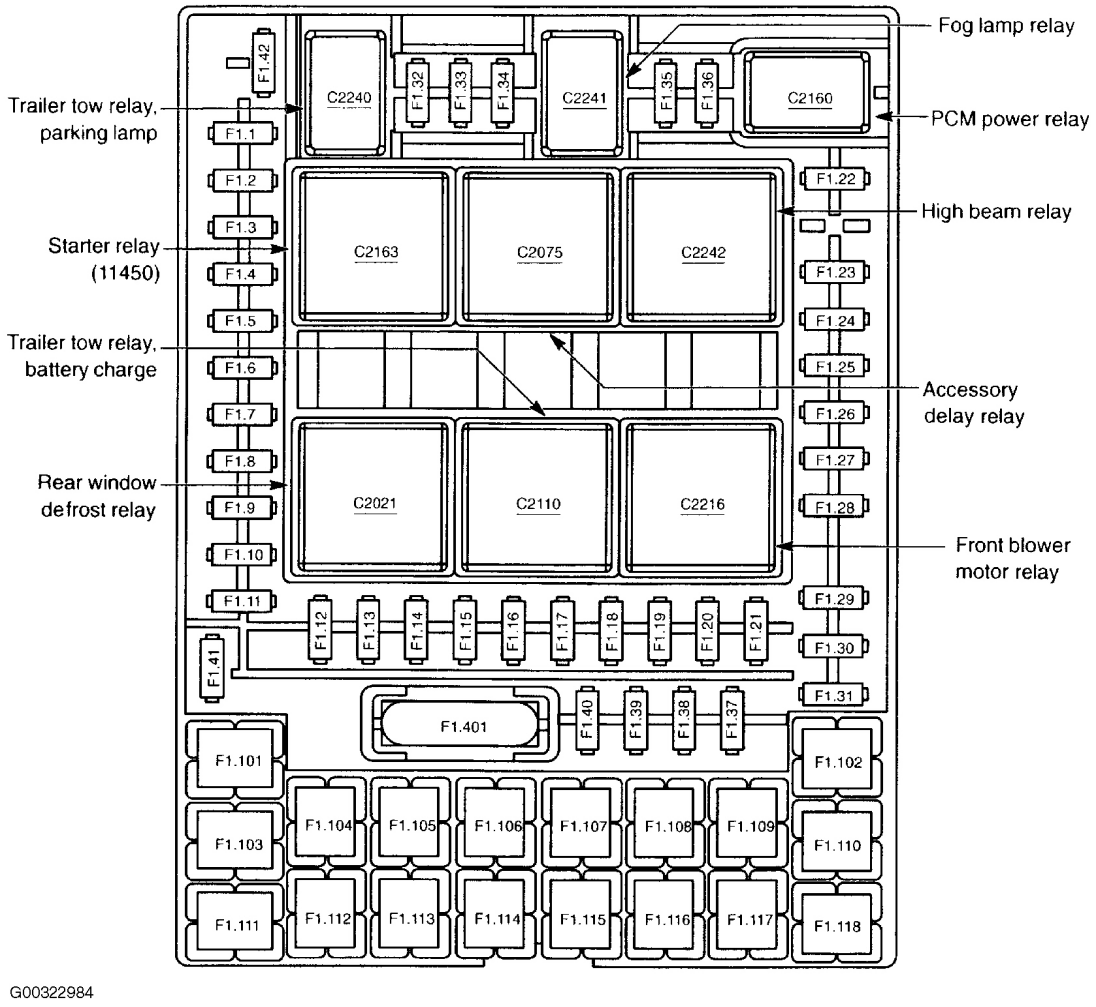


Fig. 2: Identifying Central Junction Box Components
Courtesy of FORD MOTOR CO.

Fuse	Amps	Circuits protected
F1.1	10	Instrument cluster, Low tire pressure module, Windshield wiper motor (17508), Rear wiper motor assembly
F1.2	20	IVD stop lamp relay, Brake pedal position switch (13480), Indicator flasher relay (13350)
F1.3	7.5	Exterior rear view mirror switch (17B676), Power seat switch, left, Driver seat module (14C718)
F1.4	15	CD changer (18D806), Rear Integrated Control Panel (RICP) (19980), DVD player
F1.5	7.5	Powertrain Control Module (PCM) (12A650), Deactivator switch, Third row folding seat relay, left, Third row folding seat relay, right, Power liftgate module, Brake pedal position switch (13480), Sunload sensor (19E663), Clock (15000), Function selector switch assembly, front, Electronic Auto matic Temperature Control (EATC) module (19980)
F1.6	15	Vehicle Security Module (VSM), Main light switch (11654), Floor shifter
F1.7	7.5	Radio (18806), Exterior rear view mirror, left, Exterior rear view mirror, right
F1.8	10	Electronic Automatic Temperature Control (EATC) module (19980), Exteri or rear view mirror, left, Exterior rear view mirror, right
F1.9	10	Generator
F1.10	20	Trailer tow relay, parking lamp, Trailer tow relay, reversing lamp
F1.11	10	A/C clutch relay, Integrated wheel ends solenoid
F1.12	10	Speed control fan clutch relay
F1.13	10	Electronic Automatic Temperature Control (EATC) module (19980), Rear window defrost relay, Trailer tow relay, battery charge, A/C high pressure switch (19D594), Function selector switch assembly
F1.14	10	Digital Transmission Range (DTR) sensor (7F293), Daytime Running Lamps (DRL) ignition relay, Daytime Running Lamps (DRL) park brake relay, Temperature blend door actuator (19E616)
F1.15	5	Instrument cluster, Traction control switch
F1.16	10	ABS control module (2C219)
F1.17	15	Fog lamp relay
F1.18	10	Electrochromatic inside mirror unit (17700), Climate controlled seat module, passenger side, Climate controlled seat module, driver side, Indicator flasher relay (13350), Electronic park brake release relay, Electronic park brake reset relay, Blend door actuator, rear (19E616), Auxiliary function selector switch assembly, front
F1.19	10	Restraints control module (14B321)
F1.20	30	Four–wheel drive control module, Air suspension module (3C142)
F1.21	15	Instrument cluster, Low tire pressure module, Electronic park brake re lease relay, Electronic park brake reset relay
F1.22	10	Radio (18806), Electronic Hidden Antenna Module (EHAM), Quarter win dow open relay, Quarter window close relay, Power window motor, left front, Door lock switch, driver side (14028), Roof opening panel switch (15B691), Power quarter window switch
F1.23	10	Low beam lamp, right front
F1.24	15	Battery saver relay
F1.25	10	Low beam lamp, left front
F1.26	20	Horn relay
F1.27	5	Parking Aid Module (PAM) (15T850), Electronic Compass (19A548), Air suspension module (3C142), Overdrive cancel switch (7G550), Floor shifter, Brake shift interlock
F1.28	5	Passive anti–theft transceiver, PCM power relay, Speed control fan clutch relay, PCM power diode
F1.29	30	Trailer electronic brake control connector
F1.30	30	Vehicle Security Module (VSM), Power window motor, left front
F1.31	25	Radio (18806), Subwoofer amplifier (18C804)
F1.32	15	4R70W transmission, Heated Oxygen Sensor (HO2S) #22 (9G444), Heated Oxygen Sensor (HO2S) #12 (9G444)
F1.33	20	EVAP canister vent control solenoid, Vapor management valve, EGR vacuum regulator solenoid (9J459), Heated Oxygen Sensor (HO2S) #21 (9F472), Heated Oxygen Sensor (HO2S) #11 (9F472)
F1.34	20	Mass Air Flow (MAF) sensor (12B579), Powertrain Control Module (PCM) (12A650), Fuel injectors, Idle Air Control (IAC) valve (9F715), Fuel pump relay
F1.35	10	Fog lamp relay, Main light switch (11654), Daytime Running Lamps (DRL) ignition relay, High beam lamp, left front, High beam lamp, right front
F1.36	10	Trailer tow connector, 4–pin, Trailer tow connector, 7–pin
F1.37	20	Power point, rear (19G247)
F1.38	25	Rear wiper motor assembly
F1.39	20	Power point, instrument panel (19N236), Power point, console 1, Power point, console 2
F1.40	20	Daytime Running Lamps (DRL) ignition relay
F1.41	20	Data Link Connector (DLC) (14489), Cigar lighter, front (15055)
F1.42	10	Trailer tow connector, 4–pin, Trailer tow connector, 7–pin
F1.101	30	Starter relay (11450)

G00322985

Fig. 3: Central Junction box Legend (1 Of 2)
Courtesy of FORD MOTOR CO.

Fuse	Amps	Circuits protected
F1.102	30	Ignition switch (11572)
F1.103	30	ABS control module (2C219)
F1.104	30	Third row folding seat relay, left
F1.105	30	Power liftgate module
F1.106	30	Trailer tow relay, battery charge
F1.107	30	Rear blower motor relay
F1.108	30	Power seat switch, right, Lumbar adjust switch, right front
F1.109	30	Driver seat module (14C718), Power seat switch, left, Lumbar adjust switch, left front (14B691), Adjustable pedal switch
F1.110	30	Running board motor, left, Running board motor, right
F1.111	50	Air suspension solid state relay (2C013)
F1.112	30	ABS control module (2C219)
F1.113	30	Windshield wiper motor (17508)
F1.114	40	Rear window defrost relay
F1.115	30	Four–wheel drive control module
F1.116	40	Front blower motor relay
F1.117	30	Third row folding seat relay, right
F1.118	30	Climate controlled seat module, passenger side, Climate controlled seat module, driver side
F1.401	30 c.b.	Roof opening panel motor assembly (15790), Master window adjust switch (14529)

G00322986

Fig. 4: Central Junction Box Legend (2 Of 2)
Courtesy of FORD MOTOR CO.

FUSIBLE LINKS

There are two fusible links, A & B, located on the engine, near the battery. Both consisting of 12 GA. Gray wire. See **Fig. 5**.

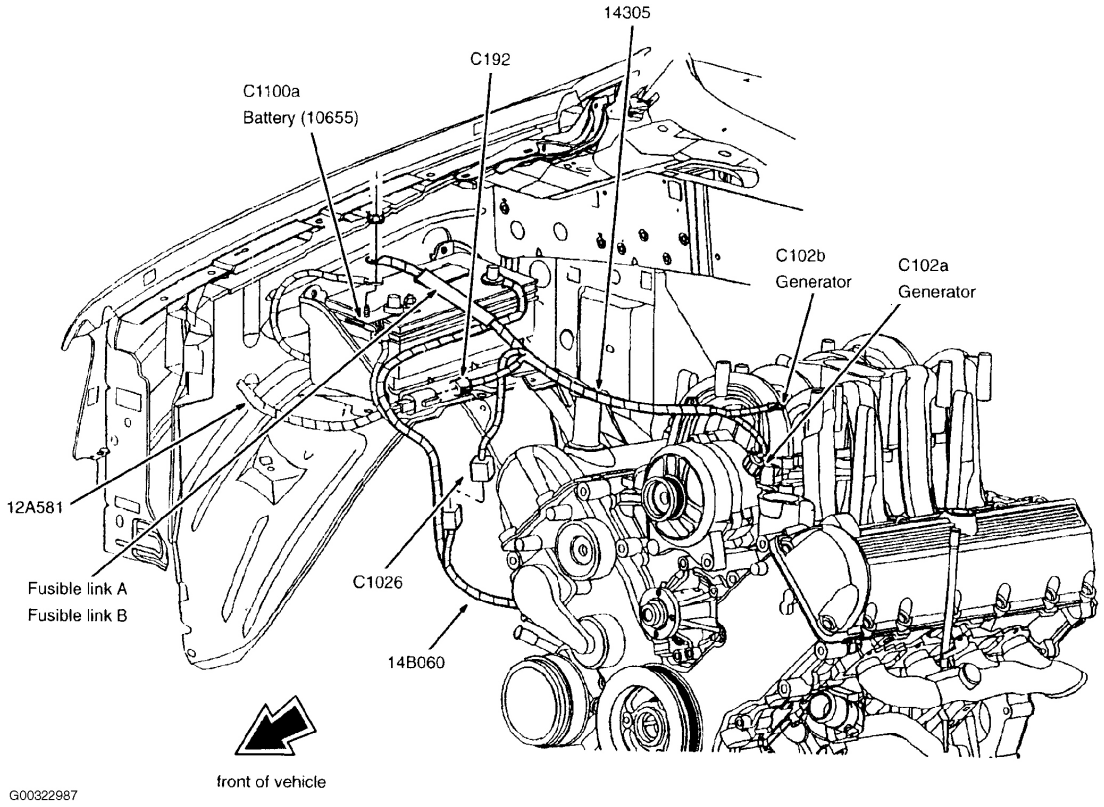


Fig. 5: Locating Fusible Links
Courtesy of FORD MOTOR CO.

AUXILIARY RELAY BOX 1

NOTE: **Auxiliary relay box 1 is located in the left front corner of engine compartment. See Fig. 6.**

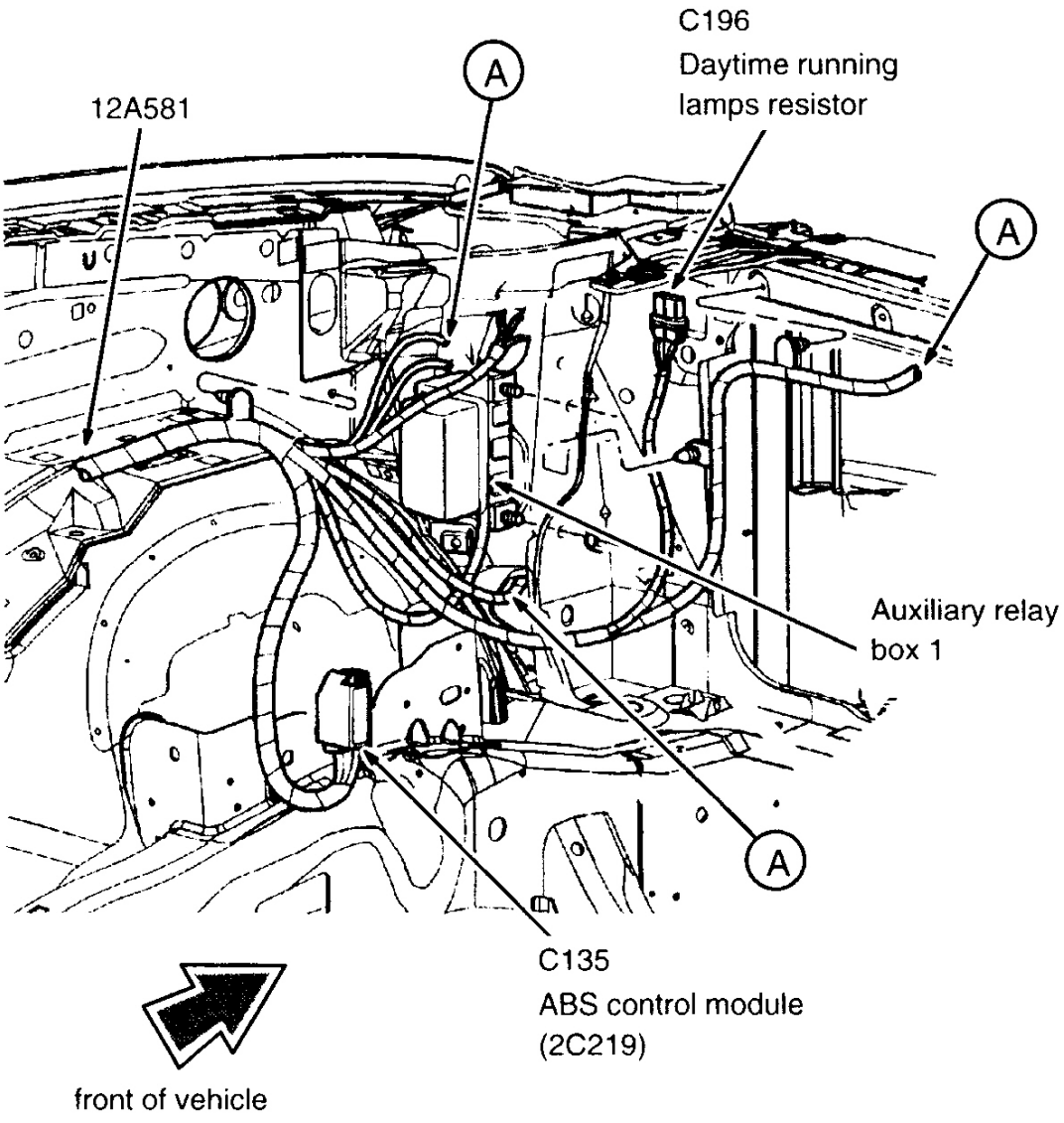


Fig. 6: Locating Auxiliary Relay Box 1
Courtesy of FORD MOTOR CO.

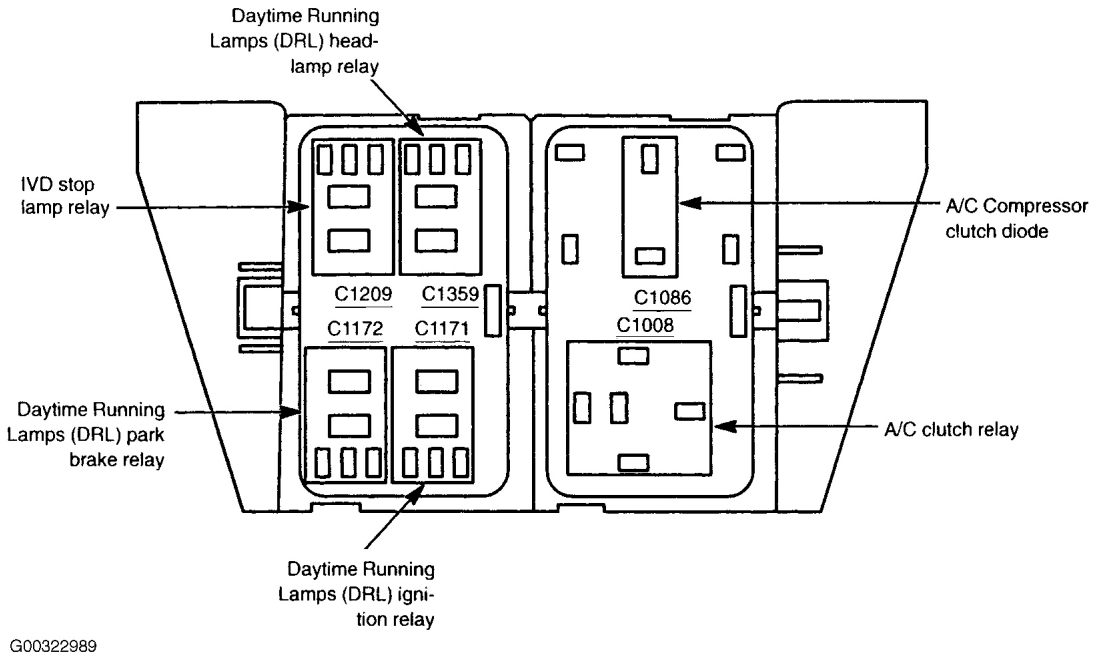


Fig. 7: Identifying Auxiliary Relay Box 1 Components
Courtesy of FORD MOTOR CO.

AUXILIARY RELAY BOX 2

NOTE: Auxiliary relay box 2 is located behind right rear quarter trim panel. See Fig. 8.

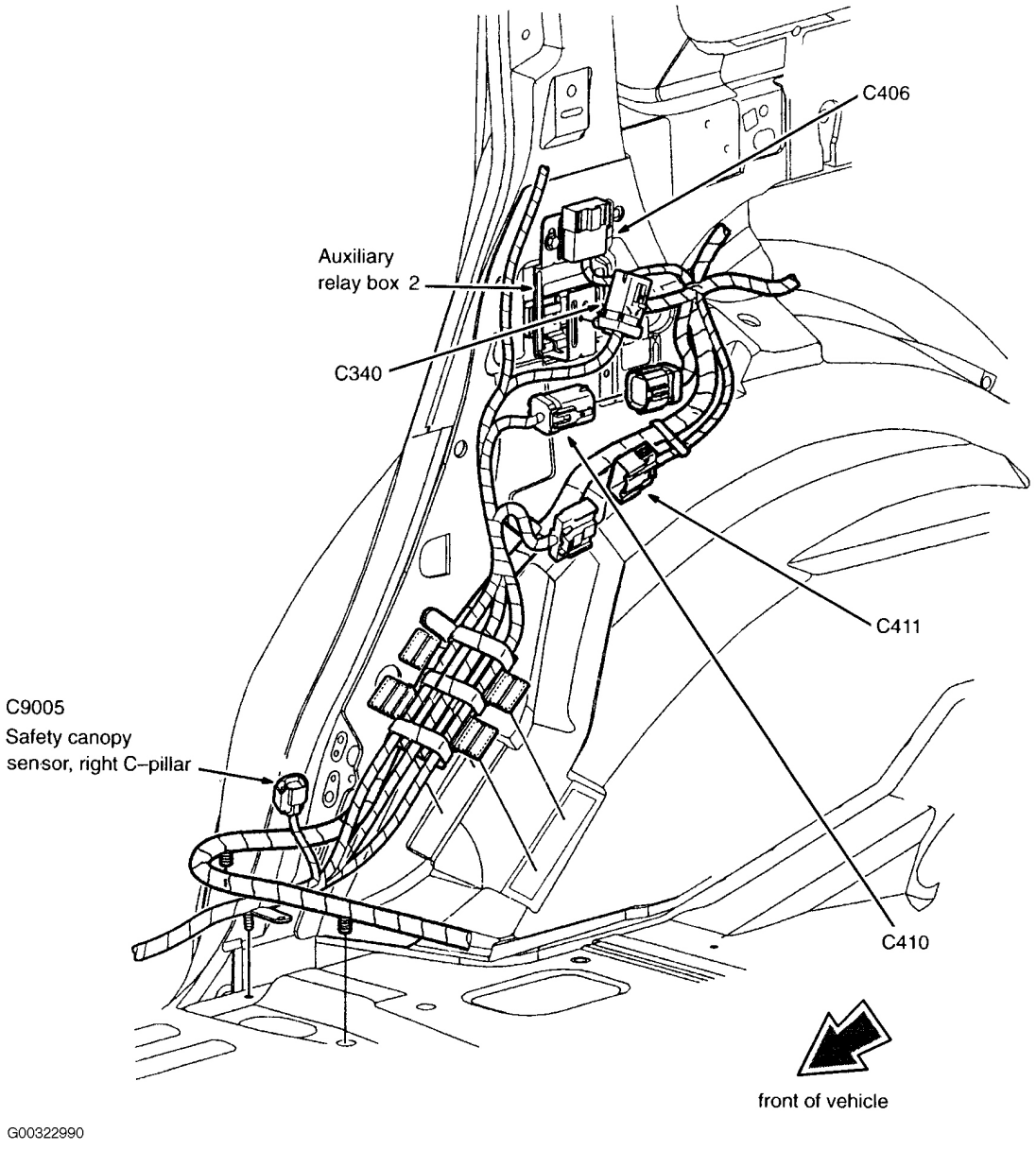


Fig. 8: Locating Auxiliary relay box 2
Courtesy of FORD MOTOR CO.

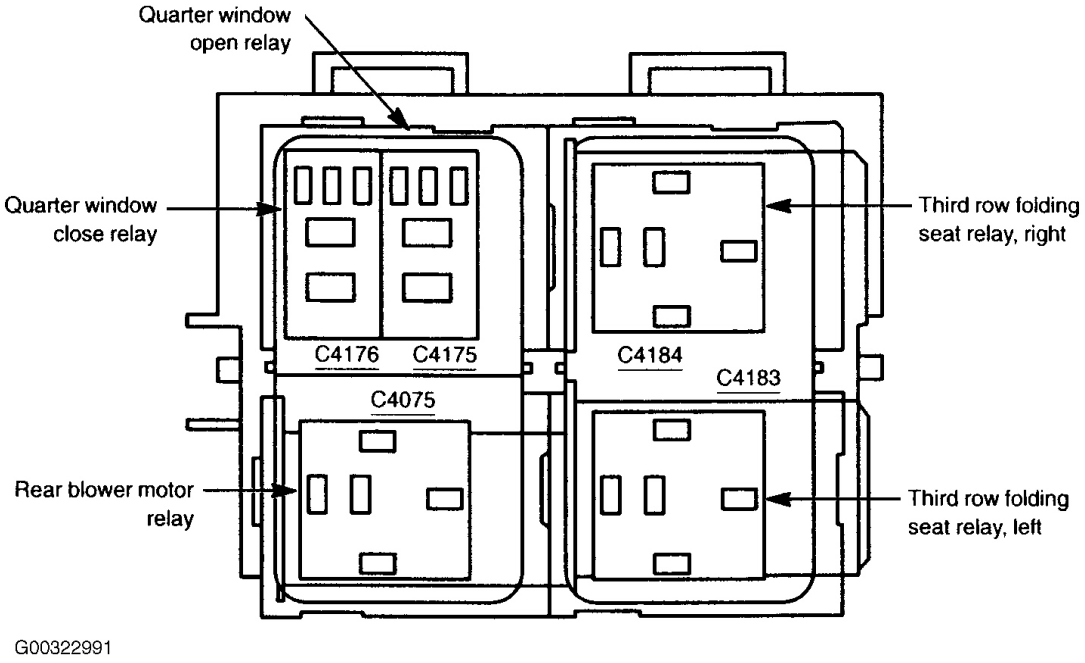


Fig. 9: Identifying Auxiliary Relay Box 2 Components
Courtesy of FORD MOTOR CO.

AUXILIARY RELAY BOX 3

NOTE: **Auxiliary relay box 3 is located behind left side of instrument panel. See Fig. 10.**

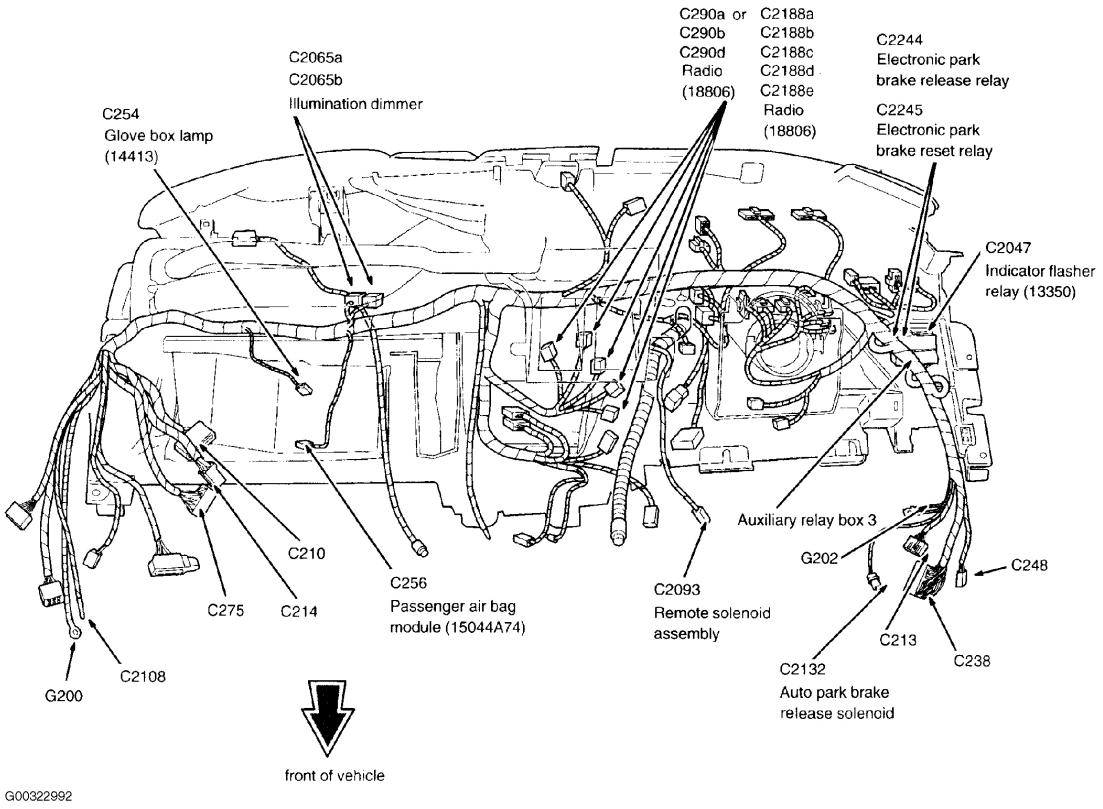


Fig. 10: Locating Auxiliary Relay Box 3
Courtesy of FORD MOTOR CO.

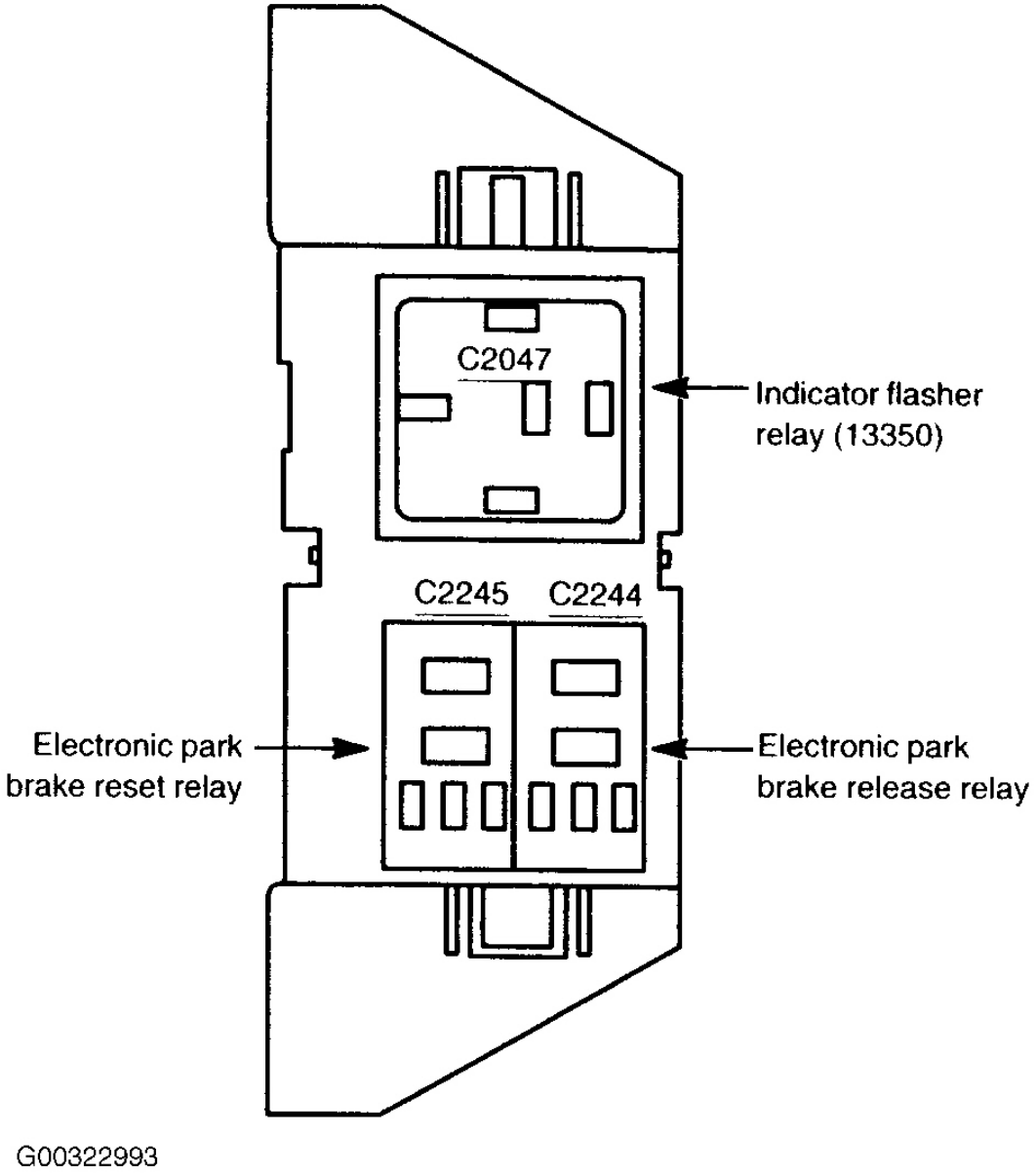


Fig. 11: Identifying Auxiliary Relay Box 3 Components
Courtesy of FORD MOTOR CO.

2003 FORD MOTOR CO.

Expedition & Navigator

BUZZERS, RELAYS & TIMERS

BUZZERS, RELAYS & TIMERS LOCATION

Component	Location
Accessory Delay Relay	In central junction box.
A/C Clutch Relay	At left front of engine compartment.
Air Suspension Solid State Relay	At right front of engine compartment.
Battery Charge Trailer Tow Relay	In central junction box.
Daytime Running Lamps Headlamp Relay	At left front of engine compartment.
Daytime Running Lamps Ignition Relay	At left front of engine compartment.
Electronic Park Brake Release Relay	Behind left kick panel.
Electronic Park Brake Reset Relay	Behind left kick panel.
Foglamp Relay	In central junction box.
Front Blower Motor Relay	In central junction box.
High Beam Relay	In central junction box.
Indicator Flasher Relay	Behind left side of dash. See **Fig. 5**.
IVD Stoplamp Relay	At left front of engine compartment.
Parking Lamp Trailer Tow Relay	In central junction box.
PCM Power Relay	In central junction box.
Quarter Window Close Relay	At right side of cargo area, behind trim.
Quarter Window Open Relay	At right side of cargo area, behind trim.
Rear Blower Motor Relay	At right side of cargo area, behind trim.
Rear Window Defrost Relay	In central junction box.
Starter Relay	In central junction box.
Third Row Folding Seat Relay (Left)	At right "C" pillar.
Third Row Folding Seat Relay (Right)	At right "C" pillar.

CIRCUIT PROTECTION DEVICES

CIRCUIT PROTECTION DEVICES LOCATION

Component	Location
A/C Compressor Clutch Diode	At left front of engine compartment.
Auxiliary Relay Box 1	At left front of engine compartment.
Auxiliary Relay Box 2	At right side of cargo area, behind trim.
Auxiliary Relay Box 3	Behind left side of dash. See **Fig. 5**.
Central Junction Box	Behind right kick panel. See **Fig. 7**.

CONTROL UNITS

CONTROL UNITS LOCATION

Component	Location

ABS Control Module	At left side of engine compartment.
Air Suspension Module	Under left side of dash.
Climate Controlled Seat Module (Driver's/Passenger's)	Under respective seat.
Driver Seat Module	Under driver's seat.
Electronic Automatic Temperature Control Module	In center of dash. See **Fig. 5**.
Electronic Hidden Antenna Module	At right "C" pillar.
Four Wheel Drive Control Module	At left "B" pillar.
Heater Blower Control Module	Behind dash.
Inlet Manifold Runner Control Module (5.4L 4V)	On top front of engine. See **Fig. 2**.
Liftgate Chime Module	In left side of liftgate.
Low Tire Pressure Module	At left "C" pillar.
Parking Aid Module	At left side of cargo area, behind trim.
Passive Anti-Theft Transceiver	Behind left side of dash, near steering column.
Power Liftgate Module	At left side of cargo area, behind trim. See **Fig. 8**.
Powertrain Control Module	On right side of firewall.
Restraints Control Module	Below center console or under seat.
Roof Opening Panel Module	In roof panel.
Vehicle Security Module	Under right side of dash.

MOTORS

MOTORS LOCATION

Component	Location
Adjustable Pedal Motor	On accelerator pedal support.
Air Suspension Compressor Assembly	At right front of engine compartment.
Auxiliary Blower Motor	At right side of cargo area, behind trim.
Blend Door Actuator (Rear)	At right side of cargo area, behind trim.
Fuel Tank Unit	In fuel tank.
Heater Blower Motor	Behind dash.
Liftgate Cinching Motor	In right side of liftgate.
Liftgate Drive Motor Assembly (Left/Right)	At rear of roof.
Liftgate Glass Actuator	In liftgate.
Liftgate Lock Actuator	In liftgate.
Liftgate Unlatch Motor	In right side of liftgate.
Mode Door Actuator (Rear)	At right side of cargo area, behind trim.
Rear Wiper Motor Assembly	In liftgate.
Roof Opening Panel Motor Assembly	In roof panel.
Running Board Motor (Left/Right)	Under respective side of vehicle.
Speed Control Servo	On left side of engine compartment. See **Fig. 4**.
Temperature Blend Door Actuator (Driver's/Passenger's) (Dual Zone A/C)	Behind dash.
Temperature Blend Door Actuator (Manual A/C)	Behind dash.
	On right side of engine compartment, on washer

Washer Pump Motor (Front & Rear)	fluid reservoir. See **Fig. 3**.
Windshield Wiper Motor	On left side of firewall. See **Fig. 4**.

SENDING UNITS & SENSORS

SENDING UNITS & SENSORS LOCATION

Component	Location
Adjustable Pedal Memory Potentiometer	On accelerator pedal support.
Ambient Air Temperature Sensor	Behind radiator grille.
Brake Booster Sensor	At left rear of engine compartment.
Camshaft Position Sensor (5.4L 2V)	On front of left cylinder head. See **Fig. 1**.
Camshaft Position Sensor (5.4L 4V)	On front of left cylinder head. See **Fig. 2**.
"C" Pillar Safety Canopy Sensor (Left/Right)	On respective "C" pillar, behind trim.
Crankshaft Position Sensor (5.4L 2V)	On lower front of engine. See **Fig. 1**.
Crankshaft Position Sensor (5.4L 4V)	On lower front of engine.
Cylinder Head Temperature Sensor (5.4L 2V)	On left front of engine.
Cylinder Head Temperature Sensor (5.4L 4V)	On left rear of engine.
Differential Pressure Feedback EGR Sensor (5.4L 2V)	On top left side of engine. See **Fig. 1**.
Differential Pressure Feedback EGR Sensor (5.4L 4V)	On top left side of engine. See **Fig. 2**.
Digital Transmission Range Sensor	On left side of transmission.
Door Safety Canopy Sensor (Left/Right)	At bottom rear of respective front door.
Driver Seat Position Sensor	Under driver's seat.
Engine Coolant Temperature Sensor (5.4L 2V)	On top front of engine.
Engine Coolant Temperature Sensor (5.4L 4V)	On top front of engine. See **Fig. 2**.
Forward Crash Sensor	On left front of vehicle.
Front Height Sensor (Left/Right)	At respective shock tower.
Fuel Tank Pressure Transducer Sensor	In fuel tank.
Heated Oxygen Sensor No. 11	On right exhaust downpipe.
Heated Oxygen Sensor No. 12	On rear of exhaust system.
Heated Oxygen Sensor No. 21	On left exhaust downpipe.
Heated Oxygen Sensor No. 22	On rear of exhaust system.
Intake Air Temperature Sensor (5.4L 2V)	In intake system, near left front of engine. See **Fig. 1**.
Intake Air Temperature Sensor (5.4L 4V)	In intake system, near front of engine. See **Fig. 2**.
In-Vehicle Temperature/Humidity Sensor (Navigator)	In center of dash.
In-Vehicle Temperature Sensor (Expedition)	In left side of dash.
Knock Sensor (5.4L 2V)	On rear of engine.
Knock Sensor (5.4L 4V)	On right rear of engine.

Liftgate Obstacle Detection Strip (Left)	At lower left side of cargo area. See **Fig. 8**.
Liftgate Obstacle Detection Strip (Right)	At lower right side of cargo area.
Mass Airflow Sensor	In intake system.
Output Shaft Speed Sensor	On rear of transmission.
Parking Aid Radar Sensor	At center rear of vehicle.
Parking Aid Ultrasonic Sensor (Left/Right)	On respective rear side of vehicle.
Primary Brake Pressure Sensor	At left rear of engine compartment, on brake master cylinder. See **Fig. 4**.
Rear Height Sensor	Under rear of vehicle, near axle.
Secondary Brake Pressure Sensor	At left rear of engine compartment, on brake master cylinder booster. See **Fig. 4**.
Steering Position Sensor	On steering column.
Sunload Sensor	On top center of dash, near windshield. See **Fig. 5**.
Throttle Position Sensor (5.4L 2V)	On throttle body. See **Fig. 1**.
Throttle Position Sensor (5.4L 4V)	On throttle body. See **Fig. 2**.
Yaw Velocity Sensor	Under center console.

SOLENOIDS & SOLENOID VALVES

SOLENOIDS & SOLENOID VALVES LOCATION

Component	Location
Auto Park Brake Release Solenoid	At driver's footwell. See **Fig. 6**.
Brake Shift Interlock	Near steering column.
EGR Vacuum Regulator Solenoid (5.4L 2V)	On left side of engine. See **Fig. 1**.
EGR Vacuum Regulator Solenoid (5.4L 4V)	On left side of engine. See **Fig. 2**.
EVAP Canister Vent Control Solenoid	Under rear of vehicle, above rear axle.
Front Shock Absorber Solenoid Valve (Left/Right)	On respective shock tower.
Idle Air Control Valve (5.4L 2V)	On throttle body. See **Fig. 1**.
Idle Air Control Valve (5.4L 4V)	On left front of engine. See **Fig. 2**.
Integrated Wheel Ends Solenoid	At right rear of engine compartment. See **Fig. 3**.
Power Steering Valve Solenoid	On front of engine.
Rear Shock Absorber Solenoid Valve (Left/Right)	Under respective rear side of vehicle, near shock mount.
Remote Solenoid Assembly	Behind center of dash.
Vapor Management Valve	At left rear of engine compartment. See **Fig. 4**.

SWITCHES

SWITCHES LOCATION

Component	Location
A/C High Pressure Switch	At right front of engine compartment.
Air Suspension Service Switch	Behind access panel, on left rear quarter trim panel, near the liftgate.
Brake Fluid Level Switch	In brake fluid reservoir, near firewall. See **Fig. 4**.

Brake Pedal Position Switch	On brake pedal support.
Deactivator Switch	On brake pedal support.
Inertia Fuel Shut-Off Switch	At left rear corner of cargo area, behind trim. See **Fig. 8**.
Liftgate Home Position Switch	In right side of liftgate.
Oil Pressure Switch (5.4L 2V)	On left front of engine. See **Fig. 1**.
Oil Pressure Switch (5.4L 4V)	On left front of engine. See **Fig. 2**.
Parking Brake Switch	Above left kick panel.
Power Steering Pressure Switch (5.4L 2V)	On left front of engine. See **Fig. 1**.
Safety Belt Buckle Switch (Driver's/Passenger's)	In respective safety belt buckle assembly.
Thermostatic Expansion Valve Switch Assembly	On right side of engine compartment. See **Fig. 3**.
Washer Fluid Level Switch	On right side of engine compartment, on washer fluid reservoir. See **Fig. 3**.

MISCELLANEOUS

MISCELLANEOUS LOCATION

Component	Location
Auxiliary Blower Motor Resistor Assembly	At right side of cargo area, behind trim.
Blower Motor Resistor	Behind dash.
Data Link Connector	Under left side of dash. See **Fig. 5**.
Electronic Fan Clutch	At right front of engine compartment.
Fuel Tank Unit	In fuel tank.
Ignition Transformer Capacitor 1 (5.4L 2V)	On top right front of engine. See **Fig. 1**.
Ignition Transformer Capacitor 1 (5.4L 4V)	On top rear of engine.
Ignition Transformer Capacitor 2 (5.4L 2V)	On top left front of engine. See **Fig. 1**.
Ignition Transformer Capacitor 2 (5.4L 4V)	On top rear of engine.
Safety Belt Buckle Pretensioner (Driver's/Passenger's)	In respective safety belt buckle assembly.
Safety Canopy Delete Resistor	On right side of roof.
Subwoofer Amplifier	At left side of cargo area, behind trim. See **Fig. 8**.
Trailer Electronic Brake Control Connector	Behind left center of dash. See **Fig. 5**.
Trailer Tow Connector (4 Pin)	Near rear bumper.
Trailer Tow Connector (7 Pin)	Near rear bumper.

CONNECTORS

CONNECTORS LOCATION

Component	Location
C110 (Black, 16 Pin)	At right front of engine compartment.
	At left front

C133 (Black, 7 Pin)	of vehicle.
C134 (Black, 7 Pin)	At right front of vehicle.
C139 (Black, 4 Pin)	At left side of engine compartment. See **Fig. 4**.
C144 (5.4L 2V) (Black, 4 Pin)	On left front side of engine. See **Fig. 1**.
C145 (Black, 12 Pin)	At right side of engine compartment.
C146 (Black, 8 Pin)	At right side of engine compartment.
C192 (Black, 4 Pin)	At right side of engine compartment. See **Fig. 3**.
C210 (White, 20 Pin)	Behind right kick panel. See **Fig. 7**.
C211 (Gray, 14 Pin)	Behind right kick panel.
C212 (Gray, 16 Pin)	Behind left kick panel.
C213 (Green, 20 Pin)	Behind left kick panel.
C214 (Green, 20 Pin)	Behind right kick panel. See **Fig. 7**.
C215 (Gray, 4 Pin)	Behind right side of dash.
C219 (Gray, 6 Pin)	Behind left side of dash.
C237 (Black/Gray, 8 Pin)	Behind right side of dash.
C238 (Gray, 66 Pin)	Behind left kick panel. See **Fig. 6**.
C248 (Black, 12 Pin)	Behind left kick panel. See **Fig. 6**.
C260 (Green, 20 Pin)	Behind center of dash.
	Behind

C263 (Gray, 10 Pin)	center of dash.
C264 (Green, 20 Pin)	Under center of dash. See **Fig. 5**.
C265 (Gray, 10 Pin)	Under center of dash.
C268 (Black, 12 Pin)	Under center of dash.
C275 (Gray, 12 Pin)	Behind right side of dash.
C291 (Gray, 13 Pin)	Behind right side of dash.
C311 (Green, 20 Pin)	Under driver's seat.
C312 (White, 20 Pin)	Under driver's seat.
C313 (Black, 14 Pin)	Under driver's seat.
C314 (Gray, 66 Pin)	Below center console.
C315 (Black, 4 Pin)	Below center console.
C316 (Black, 14 Pin)	Under passenger's seat.
C327 (Gray, 16 Pin)	Below rear seats, under left rear of vehicle.
C328 (Black, 12 Pin)	Below rear seats, under left rear of vehicle.
C339 (Black, 12 Pin)	At left "C" pillar.
C340 (Gray, 16 Pin)	At right "C" pillar.
C405 (Gray, 12 Pin)	At left "C" pillar.
C406 (Gray, 12 Pin)	At right "C" pillar.
C410 (Black, 12 Pin)	At right side of cargo area, behind trim.
C411 (Black, 12 Pin)	At right side of cargo area, behind trim.

C422 (Black, 2 Pin)	In right side of liftgate.
C465 (Gray, 16 Pin)	At left "C" pillar.
C494 (Black, 8 Pin)	At left rear of vehicle. See **Fig. 8**.
C495 (Black, 4 Pin)	In liftgate.
C510 (Gray, 12 Pin)	In left front door.
C610 (Gray, 8 Pin)	In right front door.
C700 (Black, 12 Pin)	In left rear door.
C800 (Black, 12 Pin)	In right rear door.
C913 (Gray, 6 Pin)	In roof panel.
C919 (Black, 3 Pin)	At right "C" pillar.
C922 (Gray, 6 Pin)	In roof panel.
C934 (Gray, 10 Pin)	At left rear of roof.
C935 (Black, 8 Pin)	At left rear of roof.
C991 (Gray, 8 Pin)	At rear of roof.
C1026 (Black, 1 Pin)	At right side of engine compartment.
C2108 (1 Pin)	Behind right kick panel. See **Fig. 7**.

GROUNDS

GROUNDS LOCATION

Component	Location
G100	Near left side of radiator.
G101	Near right side of radiator.
G102	On right rear of engine compartment. See **Fig. 3**.
G103	On right side of engine compartment, on fender.
G104	On right side of engine compartment, on frame rail.
G105	On right side of engine.
G200	Behind right kick panel. See **Fig. 7**.
G201	Behind right kick panel.
G202	Behind left kick panel. See **Fig. 6**.
G300	On left "B" pillar, behind trim.

G301	Behind left kick panel.
G400	Under rear of vehicle.
G401	On left side of luggage compartment, behind trim. See **Fig. 8**.
G402	On left side of luggage compartment, behind trim. See **Fig. 8**.
G404	On right side of luggage compartment, behind trim.
G500	On bottom of left front door, behind trim.
G600	On bottom of right front door, behind trim.

SPLICES

SPLICES LOCATION

Component	Location
S100	In engine control sensor harness, near breakout to C133.
S101	In engine control sensor harness, in breakout to ABS control module.
S102	In engine control sensor harness, near breakout to speed control servo.
S103	In engine control sensor harness, near breakout to left front wheel speed sensor.
S104	In engine control sensor harness, near breakout to deactivator switch.
S105	In engine control sensor harness, near breakout to brake fluid level switch.
S106	In engine control sensor harness, near breakout to vapor management valve.
S107	In engine control sensor harness, near breakout to vapor management valve.
S108	In engine control sensor harness, in breakout to powertrain control module.
S109	In engine control sensor harness, near breakout to thermostatic expansion valve switch assembly.
S110	In engine control sensor harness, near breakout to thermostatic expansion valve switch assembly.
S111	In engine control sensor harness, near breakout to thermostatic expansion valve switch assembly.
S112	In engine control sensor harness, near breakout to thermostatic expansion valve switch assembly.
S113	In engine control sensor harness, near breakout to right front wheel speed sensor.
S114	In engine control sensor harness, near breakout to right front wheel speed sensor.
S115	In engine control sensor harness, near breakout to right front wheel speed sensor.
S116	In engine control sensor harness, near breakout to G101.
S117	In engine control sensor harness, near breakout to deactivator switch.
S118	In engine control sensor harness, near breakout to G101.
S119	In air spring suspension pressure indicator switch harness, in breakout to C110.
S120	In air spring suspension pressure indicator switch harness, in breakout to C110.
S121	In air spring suspension pressure indicator switch harness, in breakout to C110.
S122	In engine control sensor harness, near breakout to vapor management valve.
S123	In engine control sensor harness, near breakout to auxiliary relay box 1.
S124	In engine control sensor & fuel charge harness, near breakout to heated oxygen sensor No. 21.
S125	In engine control sensor & fuel charge harness, near breakout to intake air temperature sensor.
S126	In engine control sensor & fuel charge harness, near breakout to idle air control

	valve.
S127	In engine control sensor & fuel charge harness, near breakout to fuel injector No. 7.
S128	In engine control sensor & fuel charge harness, near breakout to heated oxygen sensor No. 11.
S129	In engine control sensor & fuel charge harness, near breakout to coil on plug No. 4.
S131	In engine control sensor & fuel charge harness, near breakout to ignition transformer capacitor No. 2.
S132	In engine control sensor & fuel charge harness, near breakout to heated oxygen sensor No. 11.
S133	In engine control sensor harness, near breakout to thermostatic expansion valve switch assembly.
S135	In headlamps harness, in breakout to C133.
S136	In headlamps harness, in breakout to C134.
S138	In back-up lamp switch to rear lamp feed harness, near breakout to powertrain control module.
S140	In back-up lamp switch to rear lamp feed harness, near breakout to powertrain control module.
S200	In front heater blower motor harness, in breakout to C237.
S201	In main harness, near breakout to instrument cluster.
S202	In main harness, near breakout to instrument cluster.
S203	In main harness, near breakout to glove box lamp.
S205	In console panel harness, near breakout to power point, console 1.
S208 (Expedition)	In main harness, near breakout to data link connector.
S208 (Navigator)	In main harness, near breakout to G202.
S212 (Expedition)	In main harness, near breakout to central junction box.
S212 (Navigator)	In main harness, near breakout to instrument cluster.
S221	In main harness, near breakout to C210.
S224	In main harness, near breakout to instrument cluster.
S227	In main harness, near breakout to central junction box.
S228	In main harness, near breakout to C219.
S229	In main harness, in breakout to C213.
S230	In main harness, near breakout to C210.
S231	In main harness, near breakout to brake pedal position switch.
S232	In main harness, near breakout to C215.
S238	In main harness, near breakout to instrument cluster.
S241 (Expedition)	In main harness, near breakout to electronic automatic temperature control module.
S241 (Navigator)	In main harness, near breakout to central junction box.
S242	In main harness, near breakout to trailer electronic brake control connector.
S244	In main harness, near breakout to instrument cluster.
S246	In main harness, near breakout to P113.
S247	In main harness, near breakout to radio.
S262	In main harness, near breakout to front function selector switch assembly.
S264	In main harness, near breakout to instrument cluster.

S266	In main harness, in breakout to instrument cluster.
S277	In main harness, near breakout to instrument cluster.
S279	In body main harness, in breakout to C214.
S280	In main harness, in breakout to C214.
S281	In main harness, in breakout to C210.
S282	In main harness, near breakout to instrument cluster.
S283	In main harness, in breakout to radio.
S284	In main harness, near breakout to sunload sensor.
S285	In main harness, near breakout to sunload sensor.
S290 (Expedition)	In main harness, near breakout to G202.
S290 (Navigator)	In main harness, near breakout to CD changer.
S291	In front heater blower motor harness, in breakout to heater blower motor.
S293	In main harness, near breakout to instrument cluster.
S294	In body main harness, in breakout to C214.
S303	In console panel harness, near breakout to C314.
S306	In console panel harness, near breakout to power point, console 2.
S308	In body main harness, near breakout to restraints control module.
S309	In power seats harness, near breakout to C311.
S310	In power seats harness, in breakout to left front lumbar adjust switch.
S311	In power seats harness, near breakout to C316.
S312	In body main harness, near breakout to C465.
S313	In body main harness, near breakout to left "C" pillar safety canopy sensor.
S314	In body main harness, near breakout to C327.
S315	In body main harness, near breakout to right "C" pillar safety canopy sensor.
S316	In body main harness, near breakout to C327.
S317	In body main harness, near breakout to C700.
S318	In body main harness, near breakout to C316.
S319	In body main harness, near breakout to C800.
S320	In body main harness, near breakout to restraints control module.
S321	In body main harness, near breakout to restraints control module.
S323	In console panel harness, near breakout to C314.
S324	In body main harness, near breakout to C800.
S329	In power seats harness, near breakout to right front lumbar adjust switch.
S342	In body main harness, near breakout to C800.
S343	In body main harness, near breakout to G201.
S344	In body main harness, near breakout to G201.
S345	In body main harness, near breakout to G201.
S346	In body main harness, near breakout to G301.
S347	In body main harness, near breakout to G301.
S348	In body main harness, near breakout to G301.
S349	In body main harness, near breakout to G301.
S350	In console panel harness, near breakout to power point, console 2.
S355	In body main harness, near breakout to G301.

S356	In body main harness, near breakout to central junction box.
S357	In body main harness, near breakout to central junction box.
S358	In body main harness, near breakout to C214.
S359	In body main harness, near breakout to C214.
S361	In body main harness, near breakout to parking brake switch.
S362	In body main harness, near breakout to parking brake switch.
S369	In body main harness, near breakout to G301.
S370	In body main harness, near breakout to right "C" pillar safety canopy sensor.
S371	In power seats harness, near breakout to C800.
S372	In body main harness, near breakout to restraints control module.
S373	In body main harness, near breakout to C214.
S374	In body main harness, near breakout to C327.
S375	In body main harness, near breakout to C316.
S376	In body main harness, near breakout to C316.
S377	In body main harness, near breakout to C316.
S378	In body main harness, near breakout to transfer case assembly.
S379	In body main harness, near breakout to C800.
S380	In body main harness, near breakout to C316.
S381	In body main harness, near breakout to C316.
S382	In power seats harness, near breakout to driver's safety belt buckle switch.
S383	In power seats harness, near breakout to driver's side climate controlled seat fan.
S384	In power seats harness, near breakout to driver's side climate controlled seat fan.
S385	In power seats harness, near breakout to driver's seat module.
S386	In power seats harness, near breakout to driver's side climate controlled seat module.
S387	In console panel harness, in breakout to traction control switch.
S388	In console panel harness, in breakout to C314.
S389	In console panel harness, near breakout to power point, console 2.
S390	In console panel harness, in breakout to rear integrated control panel.
S391	In body main harness, near breakout to right running board motor.
S392	In body main harness, near breakout to central junction box.
S393	In body main harness, near breakout to transfer case assembly.
S394	In body main harness, near breakout to C700.
S395	In body main harness, near breakout to G301.
S396	In console panel harness, in breakout to power point, console 2.
S397	In console panel harness, near breakout to rear auxiliary function selector switch assembly.
S400	In right rear window regulator control switch & wiring assembly, in breakout to liftgate chime module.
S402	In right rear window regulator control switch & wiring assembly, near breakout to rear window defrost grid.
S403	In rear lamp connector harness, near breakout to subwoofer amplifier.
S412	In rear lamp connector harness, near breakout to rear blend door actuator.
S414	In rear lamp connector harness, near breakout to G401.
S415	In rear license plate lamp harness, near breakout to right license plate lamp.

S416	In rear license plate lamp harness, near breakout to right license plate lamp.
S423	In rear lamp connector harness, near breakout to auxiliary blower motor resistor assembly.
S424	In rear lamp connector harness, near breakout to C410.
S427	In right rear window regulator control switch & wiring assembly, near breakout to rear window defrost grid.
S431	In rear lamp connector harness, near breakout to rear blend door actuator.
S432	In rear lamp connector harness, near breakout to auxiliary blower motor resistor assembly.
S436	In rear lamp connector harness, near breakout to G404.
S440	In back-up alarm jumper harness, near breakout to left parking aid ultrasonic sensor.
S445	In back-up alarm jumper harness, near breakout to left parking aid ultrasonic sensor.
S446	In rear lamp connector harness, near breakout to C410.
S447	In rear lamp connector harness, near breakout to C410.
S448	In rear lamp connector harness, near breakout to C410.
S449	In rear lamp connector harness, near breakout to C410.
S450	In taillamp harness, near breakout to trailer tow connector.
S451	In taillamp harness, near breakout to trailer tow connector.
S452	In taillamp harness, near breakout to trailer tow connector.
S453	In taillamp harness, near breakout to trailer tow connector.
S454	In taillamp harness, near breakout to C327.
S455	In rear lamp connector harness, near breakout to C410.
S456	In rear lamp connector harness, near breakout to C410.
S457	In rear lamp connector harness, near breakout to C410.
S458	In rear lamp connector harness, near breakout to air suspension service switch.
S460	In rear lamp connector harness, near breakout to subwoofer amplifier.
S462	In right rear window regulator control switch & wiring assembly, near breakout to C422.
S463	In right rear window regulator control switch & wiring assembly, near breakout to liftgate glass actuator.
S464 (Expedition)	In rear lamp connector harness, near breakout to C405.
S464 (Navigator)	In right rear window regulator control switch & wiring assembly, near breakout to C422.
S465	In right rear window regulator control switch & wiring assembly, near breakout to liftgate glass actuator.
S468	In rear lamp connector harness, near breakout to C410.
S469	In rear lamp connector harness, near breakout to C410.
S501	In body main harness, near breakout to left exterior rearview mirror.
S502	In body main harness, near breakout to left exterior rearview mirror.
S505	In body main harness, near breakout to left exterior rearview mirror.
S506	In left front door harness, near breakout to driver's side front power window motor.
S600	In body main harness, near breakout to right exterior rearview mirror.
S700	In door lock feed harness, near breakout to left rear window adjust switch.

S800	In door lock feed harness, near breakout to right rear window adjust switch.
S900	In interior illumination harness, near breakout to left side rail lamp.
S901	In interior illumination harness, near breakout to right side rail lamp.
S902	In interior illumination harness, near breakout to right side rail lamp.
S903	In interior illumination harness, near breakout to front auxiliary function selector switch assembly.
S904	In interior illumination harness, near breakout to front auxiliary function selector switch assembly.
S905	In interior illumination harness, near breakout to right vanity mirror lamp.
S906	In interior illumination harness, near breakout to right front map reading lamp.
S907	In interior illumination harness, near breakout to right front map reading lamp.
S908	In interior illumination harness, near breakout to front auxiliary function selector switch assembly.
S910	In rear lamp connector harness, near breakout to left side rear quarter window motor.
S914	In rear lamp connector harness, near breakout to left side rear quarter window motor.
S1001	In generator rectifier system harness, in breakout to battery.
S1002	In generator rectifier system harness, in breakout to battery.
S2001 (Expedition)	In main harness, near breakout to brake pedal position switch.
S2001 (Navigator)	In main harness, near breakout to glove box lamp.
S2003	In main harness, near breakout to brake pedal position switch.
S2005	In main harness, near breakout to radio.
S2006	In main harness, near breakout to data link connector.
S2007	In main harness, near breakout to data link connector.
S2008	In main harness, near breakout to data link connector.
S2013	In main harness, near breakout to C210.
S2018	In cigar lighter lamp wiring & socket assembly, in breakout to front cigar lighter.
S2019	In main harness, near breakout to illumination dimmer.
S2023	In main harness, near breakout to radio.
S2024	In main harness, near breakout to instrument cluster.
S2025	In front heater blower motor harness, near breakout to passenger's temperature blend door actuator.
S2026	In front heater blower motor harness, near breakout to driver's temperature blend door actuator.

COMPONENT LOCATION GRAPHICS

NOTE: Figures may show multiple component locations. Refer to appropriate table for proper figure references.

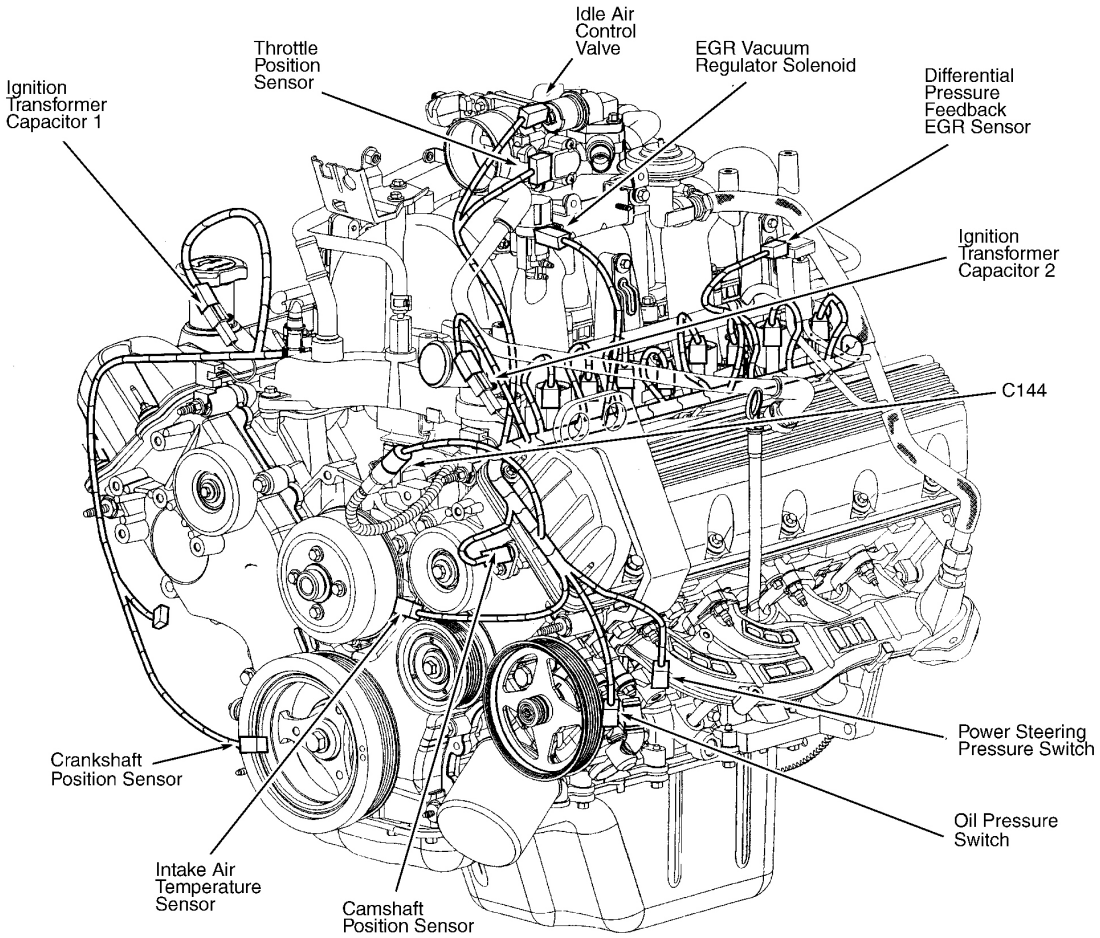


Fig. 1: Left Front Of Engine (5.4L 2V)
Courtesy of FORD MOTOR CO.

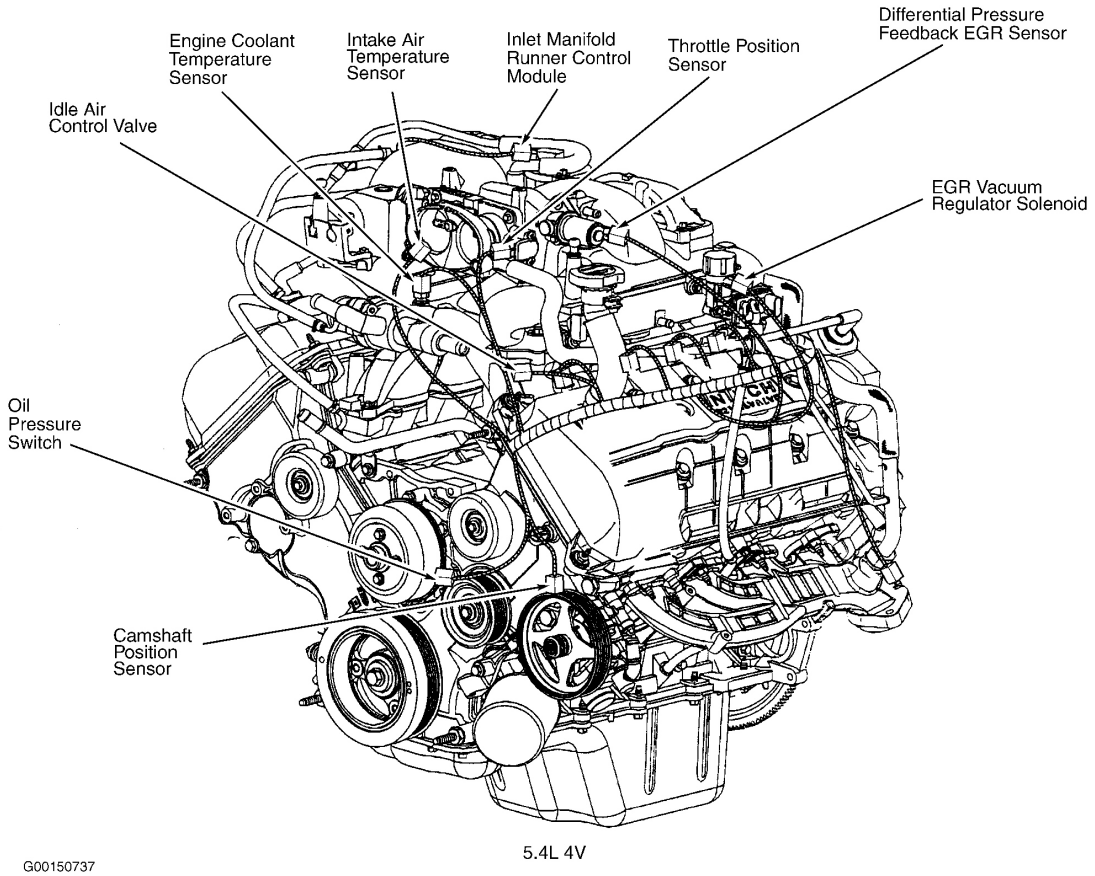


Fig. 2: Left Front Of Engine (5.4L 4V)
Courtesy of FORD MOTOR CO.

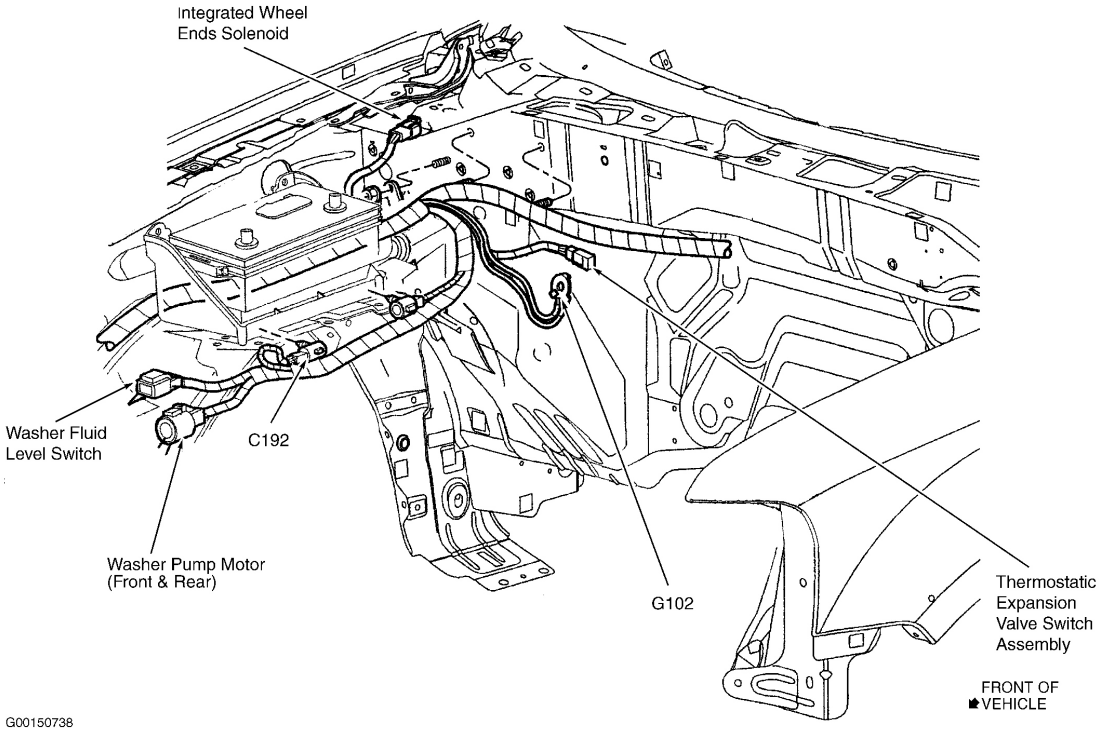


Fig. 3: Right Side Of Engine Compartment
Courtesy of FORD MOTOR CO.

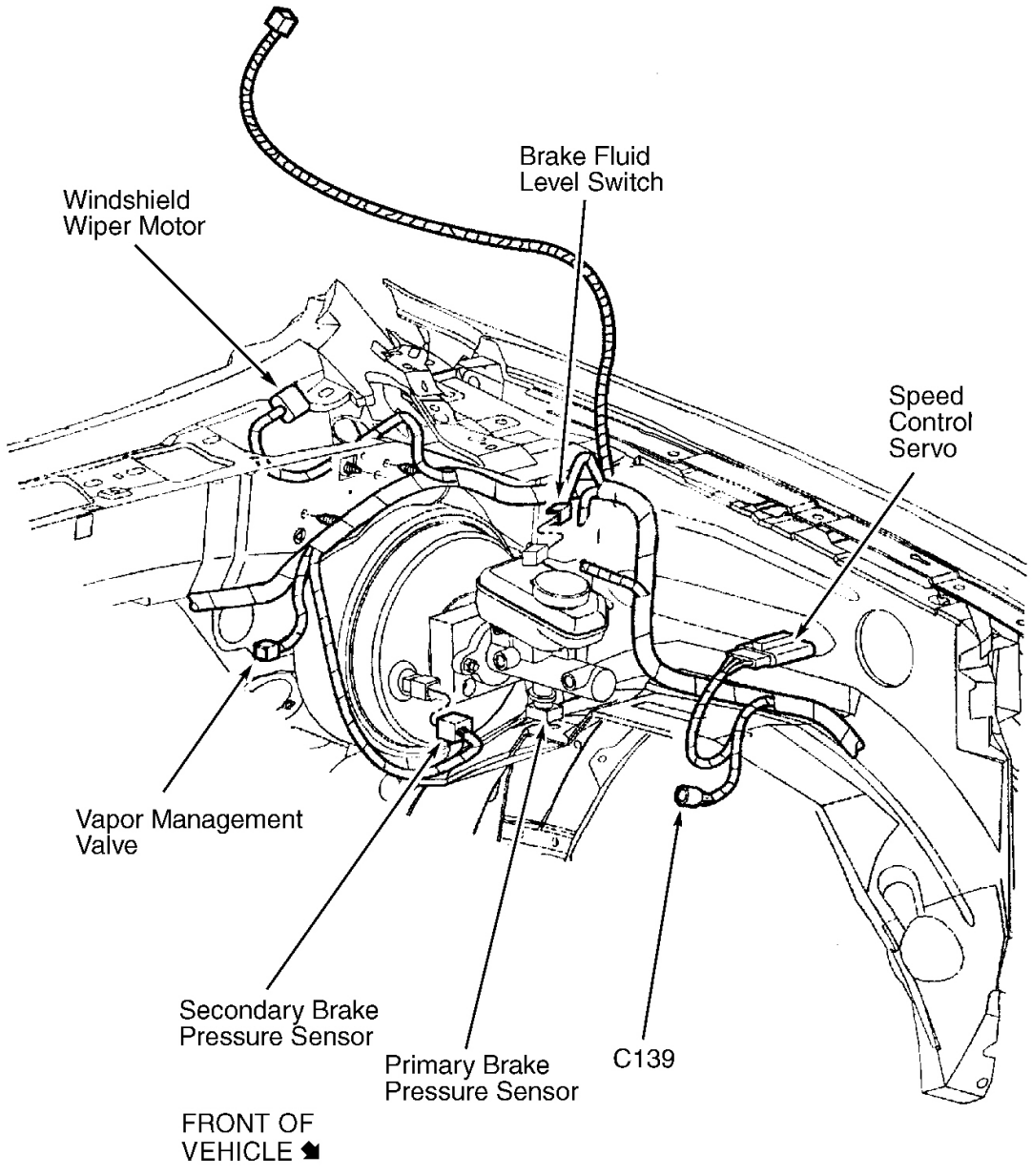


Fig. 4: Left Side Of Engine Compartment
Courtesy of FORD MOTOR CO.

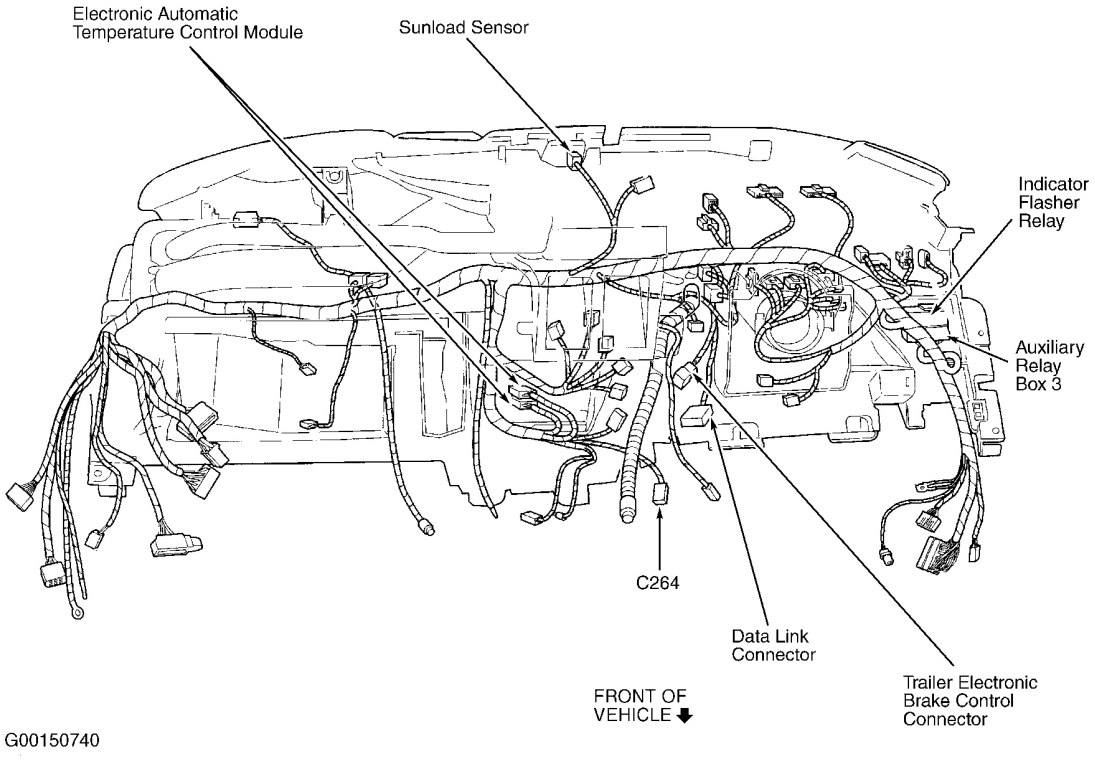


Fig. 5: Rear Of Dash
Courtesy of FORD MOTOR CO.

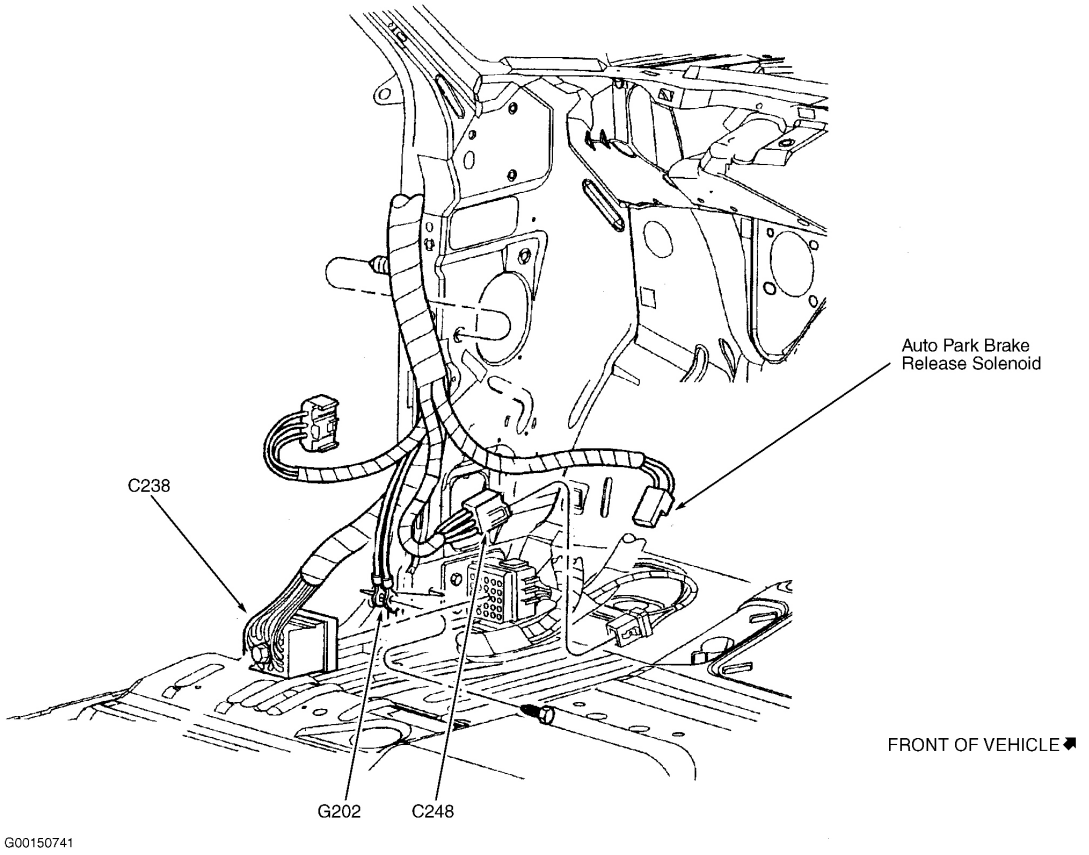


Fig. 6: Left Kick Panel Area
Courtesy of FORD MOTOR CO.

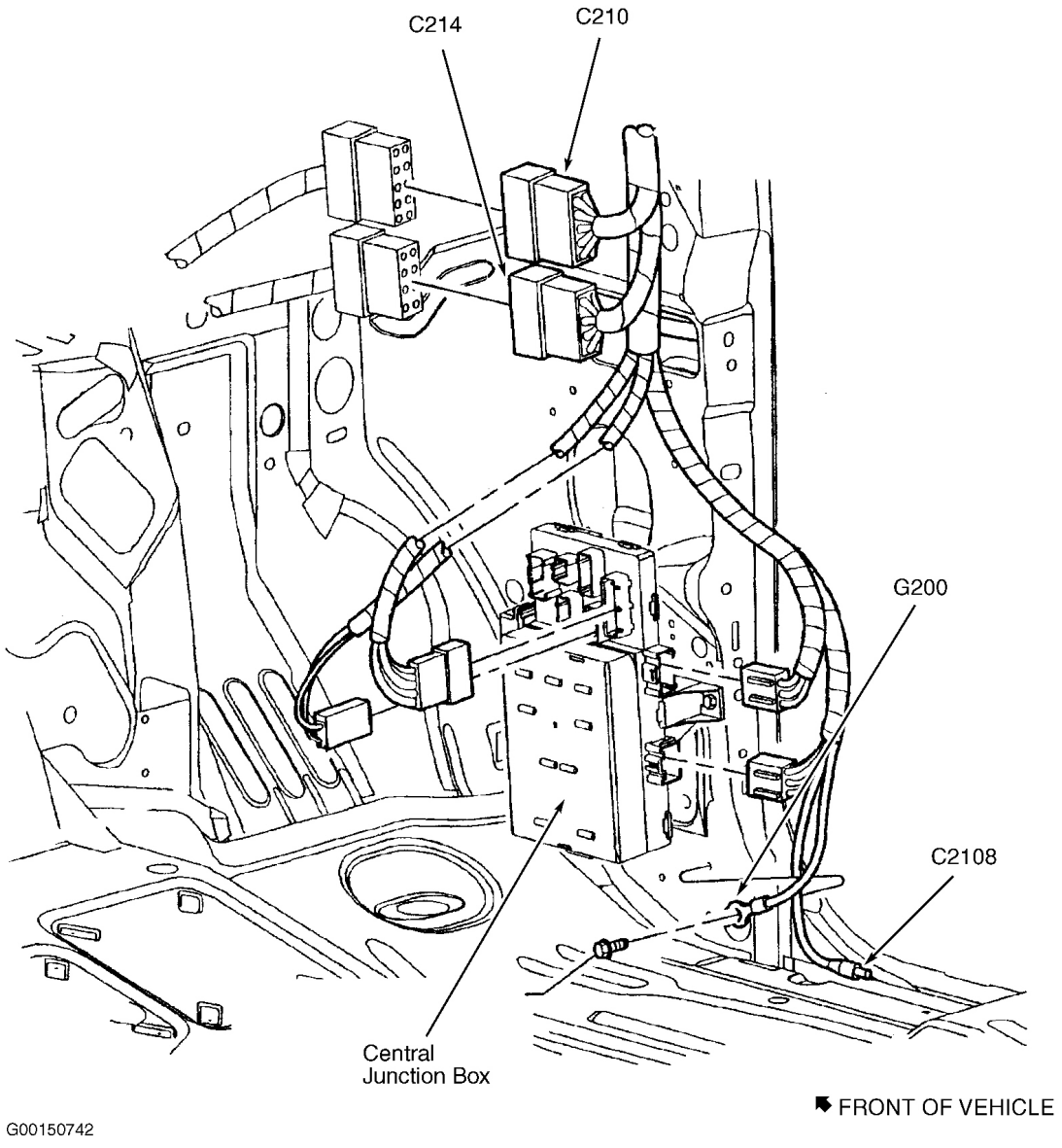


Fig. 7: Right Kick Panel Area
Courtesy of FORD MOTOR CO.

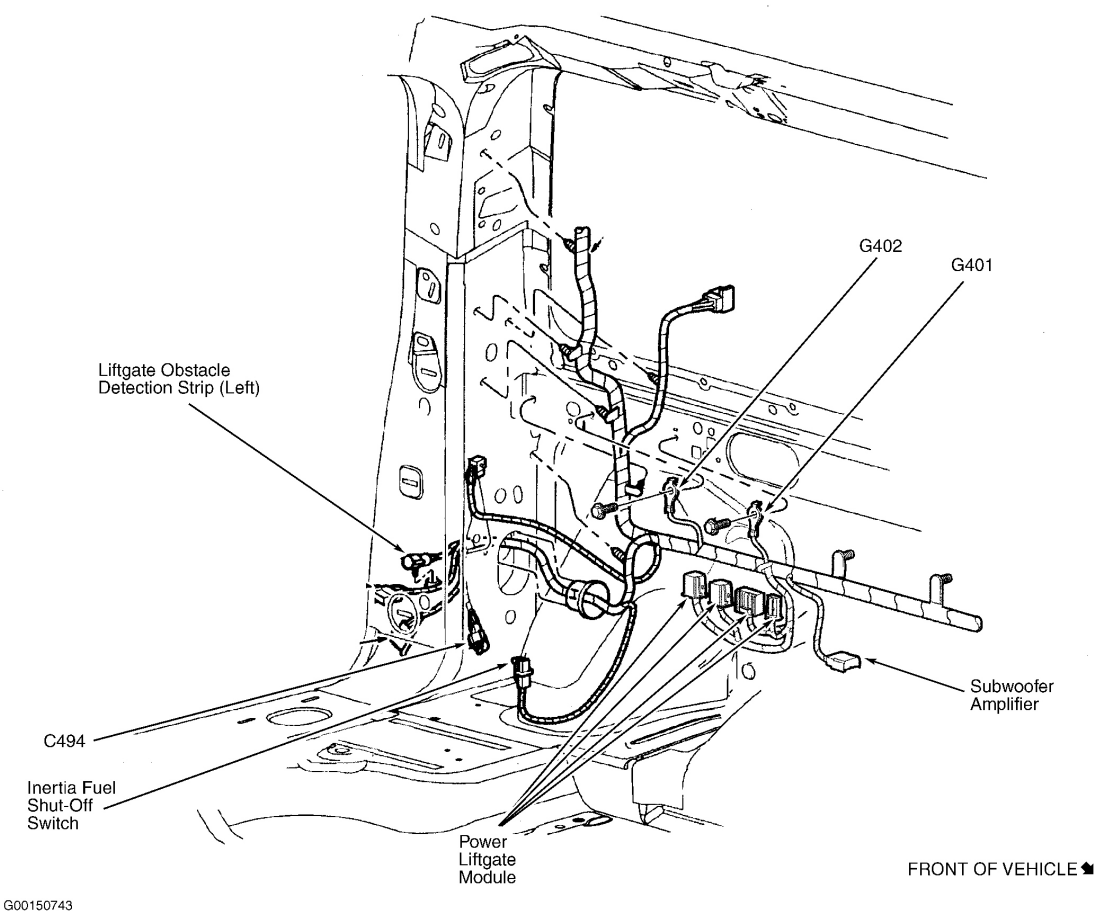


Fig. 8: Left Rear Of Vehicle
Courtesy of FORD MOTOR CO.